Dŵr Cymru
Welsh Water

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PR19: Water Treatment Maintenance

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Water Treatment Maintenance

Dŵr Cymru Welsh Water

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Executive summary

Driver for investment

Maintaining a high level of water quality, customer acceptability and reliability of supply remain three of our biggest challenges within the current and forthcoming AMPs. These are historical challenges in Wales and are driven by the age, condition and performance of our assets, deterioration of raw water quality, increased demand on our treatment works and distribution network as well as changes to regulatory standards.

We have developed an industry-leading, long-term strategy to enable us to overcome these challenges. The "source to tap" approach we have now adopted, including our water treatment maintenance programme, will tackle these root causes through catchments, water treatment works, service reservoirs, trunk mains and distribution systems. We have developed this approach alongside the DWI, accepting performance improvement notices for several of our water treatment works and distribution zones to improve the level of service we provide to customers.

We strive for upper quartile performance in each measure of success that ultimately governs water treatment maintenance and have made significant progress with targeted investment in recent years to improve these measures. However, it is important not to become complacent and, with significant changes to how water companies are regulated in terms of water quality as well as key changes to targets linked to reliability of supply and acceptability of drinking water planned prior to the start of AMP7, we must ensure that the level of investment is right to overcome these challenges.

The investment

We propose to invest £125.01 million during AMP7 to deliver improvements through a number of schemes that will contribute towards maintenance of our asset base of 62 water treatment works. Building on the progress we have made during AMP6, our approach will maintain final water quality, minimise water supply interruptions, minimise the number of contacts received for acceptability as well as maintaining resilience across our operational area. The water treatment maintenance programme to be delivered in AMP7 is shown in Table 1 with the associated investment required.

Programme of work	Proposed total budget
Safety of Drinking Water Management	£46.55 m
Acceptability of Drinking Water Management	£7.24 m
Reliability of Supply Management	£18.77 m
Other Maintenance	£28.22 m
Reactive Capital Maintenance	£24.32 m
Total programme (pre-efficiency)	**£125.10 m**
Total programme (post-efficiency challenge)	**£106.14 m**

Table 1 - WTW Maintenance programme for AMP7

Water Treatment Maintenance

Delivering for our customers

This work will meet the following of our customer promises:

Clean, safe water for all: Improve the quality of the water provided to our customers.

Put things right when they go wrong: By proactively planning for future deterioration of raw water quality, regulatory changes and external factors we reduce the need for costly reactive maintenance

A better future for all our communities: A more resilient water service, providing all of our customers with compliant water quality irrespective of regulatory drivers or climate change.

Delivering for the future

In Welsh Water 2050, we identified future trends. Our proposed investment will ensure that our critical wastewater assets are resilient to the following trends:

Climate change: Climate change will result in more extreme rainfall events and prolonged dry periods increasing the risk of water quality events

Changes in customer expectations: Changing customer and societal expectations may require us to ensure that all customers have a minimum universal service standard.

Protecting essential infrastructure: Our ageing assets present significant issues with reliability and resilience.

Changes to the structure of the economy: The growth of the digital, knowledge based economy will create opportunities to provide services in more efficient ways. However, it could also have an impact on the nature of society, and present a challenge to continuing to meet the needs and expectations of our customer

Protecting public health: We will have a role to play in promoting healthier and more sustainable lifestyles for our customers.

Delivering our Strategic Responses

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

Enough water for all: Improving water quality at our water treatment works and through our distribution network will ultimately increase resilience of supply for customers. By safeguarding water quality compliance it will ensure that there are fewer events and failures and therefore increasing resilience and security of supply for our customers.

Achieving acceptable water quality for all customers: Improving water quality for customers through a programme of source to tap interventions

Improving the reliability of drinking water supply systems: Providing more flexibility and capacity to deal with both short-term shocks and future trends.

Achieving our measures of success

In AMP7 we will continue to measure our performance against our Measures of Success (MoS). This investment will contribute to achieving the following MoS:

Measure of Success	End of AMP6	End of AMP7
Clean, safe water for all:		
Tap water quality Compliance Risk Index (Wt1) – A Drinking Water Inspectorate (DWI) measure designed to illustrate the risk arising from treated water compliance failures,	-	0
Tap water quality Event Risk Index (Wt6) - A Drinking Water Inspectorate (DWI) measure designed to illustrate the risk arising from water quality events.	-	Upper Quartile Position
Acceptability of drinking water (Wt3) - The number of contacts received from customers in the calendar year regarding the appearance, taste or odour of drinking water per 1,000 population served.	2.4	2.0
Water process unplanned outages (Wt5) - The company's total unplanned outage as a proportion of the company's total production capacity (%); where unplanned outage is a temporary loss of maximum production capacity.	-	0% change from 2019-20

1 Delivering our customer outcomes

Need for Investment

This investment is required to achieve our plans to deliver maintenance of our water treatment asset base to maintain a high level of water quality, reliability of supply and acceptability for all customers - as outlined within our long-term strategy, Welsh Water 2050. Our maintenance programme is designed around providing a stable level of service for enhancement investment to build on. The concept of completing maintenance at our water treatment works centres around returning assets to their design capacity to maintain service to customers.

By the end of AMP6 our water treatment asset base will be made up of 62 water treatment works which are all regulated to produce water in accordance with the Water Supply Regulations 2016. On a daily basis, we currently abstract and treat 850 million litres of water from rivers, reservoirs and ground water sources for supply to 3.1 million customers. In order to maintain this current level of service expected by our customers, we must maintain our assets to ensure their reliable and safe operation at the lowest long term cost.

Maintaining the achieved and expected level of service for drinking water supply is the most fundamental part of our water service provision. We are constantly reviewing risks that could challenge this notion and therefore adjusting the level of investment that will minimise the risk.

In AMP 7, investment is required to minimise the risk of water quality problems for customers and maintain chemical, bacteriological and cryptosporidium compliance at water treatment works at all times. Investment will also target minimising water treatment works being the source of water supply interruptions as well as contributing towards the number of customer contacts received for appearance, taste and odour. The programmes of work will enable a major step towards the achievement of our long term goal of achieving upper quartile performance for water quality and an improvement on our measures of success for water quality and asset resilience.

In developing this business case we have undertaken a comprehensive review of water quality results, recorded operational constraints, drinking water safety plans (DWSPs), customer contacts received for appearance, taste and odour as well as lessons learned following water supply outages and unplanned events. This approach has allowed us to identify a number of priority assets and challenges to focus on.

Our performance reported to Ofwat on an annual basis has been consistently stable for a number of years. Although performance for Water Quality will be reported using a different approach from 2020, we will aim for upper quartile performance in all measures with the planned level of investment outlined as part of this programme. Regular monitoring of water quality performance, water supply interruptions and acceptability of drinking water where our treatment works is a major contributor, allows us to target investigation and investment at poorly performing assets to prevent future failures and improve performance.

Management of Risk

Water quality data collected through our statutory sampling programme, online telemetry monitoring system, review of operational costs together with audits of past events and reactive operational costs all contribute towards the continuous appraisal of DWSPs and management of risks to water quality that may present a risk to public health. DWSPs have been developed in the past few years to also record risks associated with interruptions and acceptability.

Risks associated with water quality are recorded in DWSPs which adopt a straightforward risk matrix approach of impact and probability contributing to an overall risk score. We report any significant risk changes to the DWI on an annual basis. Level 5 risks are the most significant with a high impact and probability of occurring compared with level 1 risks which are of negligible impact and low likelihood of occurrence. A summary of our current number of risks per business area is illustrated in Table 2.

Business Area	Residual Risk 1	2	3	4	5	Total
Catchments	371	625	227	49	0	**1272**
Treatment Works	2888	1960	300	34	2	**5184**
Service Reservoirs	2440	5352	447	4	0	**8243**
Network	2458	6621	563	28	0	**9670**
Total	**8157**	**14558**	**1537**	**115**	**2**	**24369**

Table 2 - Summary of water quality risks managed through DWSPs

DWSP risks are categorised according to their business area; catchments, treatment works, service reservoirs and network. We presently have two category 5 risks attached to water treatment works which will be resolved during AMP6 and a further 115 level 4 risks split across the four areas. We determine investment for level 5 risks as requiring remedial action immediately and level 4 risks as requiring remedial action within 5 years along with additional monitoring and investigation to monitor the risk in the interim.

We are also managing risk through detailed condition and performance reports completed in partnership with our Capital Alliance partners. We have produced a number of these reports since PR09, on a site by site basis which aim to build on risks already captured as part of DWSPs. We continually update these reports as part of each price review which target the highest priority sites in terms of investment. The reports validate the DWSP risks and develop solution options for the current and forthcoming investment periods.

Water Quality

Current water quality performance is monitored using Mean Zonal Compliance (MZC), which although it provides us with an overall performance figure, is reliant on the number of failed samples and does not provide an early warning system as to where failures are likely to occur in the future. The current MZC classification is also limited as each parameter is weighted equally and failures are disproportionally imbalanced towards zones with smaller populations.

From 2020, the existing Mean Zonal Compliance Index will be replaced by the Compliance Risk Index (CRI) which will offer a more risk based approach to compliance with parameters and types of event weighted individually. The end product will produce a clearer and better understood metric where it will be more straightforward to aim for upper quartile performance. In 2016, our CRI was calculated at 2.59 compared with the national CRI calculated at 4.78. CRI increased slightly for 2017 due to an increased number of additional zonal failures for last year. We are currently within the 50th percentile for performance with a target at the start of AMP7 to achieve an upper quartile position.

Compliance Risk Index	2015	2016	2017
Dŵr Cymru	-	2.59	2.85
England and Wales Average	5.55	4.78	3.56

Table 3 - Compliance Risk Index scores for previous 3 years

Investment in water quality is closely linked with other investment programmes including Network Maintenance, Improving the Customer Acceptability of Drinking Water and the Cwm Taf Water Supply Strategy project, to maintain our current level of performance as well as improve the experience for customers in terms of quality, appearance and taste and odour of water.

Acceptability of Water

The largest contribution towards our customer acceptability score is from planned and unplanned network events which cause discolouration of water in the network for our customers. Water treatment still has a role to play in this however, where manganese, iron and taste and odour performance of treatment works can make a significant contribution to the number of contacts we receive for acceptability by as much as 5% (approximately 500 calls per year).

Our progress in terms of acceptability in recent years has been positive following the implementation of distribution zonal studies in the network and major investment to deliver refurbishment of filtration processes and granular activated carbon treatment at all but one of our treatment works supplied by a river source. Our recent progress is highlighted in Table 4.

Year	Contacts per 1,000 customers served
2012	3.36
2013	3.53
2014	3.29
2015	2.91
2016	2.88
2017	2.79

Table 4 - Acceptability of Water progress since 2012

There is still work to be done to improve our score further. Maintenance, as part of this programme, together with our customer acceptability investment and Cwm Taf Water Supply project will aim to reduce water treatment's impact on acceptability even further.

Reliability of Supply

Although water treatment maintenance has little bearing on our primary measure for reliability, customer minutes lost, there will still be a benefit towards improving the number of unplanned outages, where we are targeting a 0% change from our position in 2019. Under normal operation, our reliability of supply measure is predominantly made up of distribution network events. However, if a major event was to occur at a treatment works, for example a rapid deterioration of raw water quality, or catastrophic failure of a treatment asset, the impact on the measure would be significant.

We are investing in conjunctive use systems in all parts of our business, which links to the Customer Minutes Lost investment case. The development of additional linkages between previously unconnected distribution zones will allow us to partially or wholly maintain supply to those areas should there be an unplanned outage at the treatment works.

Our recent results show that even though we have made good progress in certain years, events such as Storm Emma early in 2018, can have a significant impact on our progress within just a few days or weeks. Prolonged freezing conditions coupled with heavy snowfall and high wind speeds not only prevented our access to certain sites but also reduced our capacity to supply water in such challenging conditions. Consequently, the regulator has since investigated and reported on not only us, but all water companies' response to such challenging conditions, highlighting a number of recommendations to minimise the impact of such hazardous conditions on service in the future.

Asset Age

In general, as assets age then condition and performance deteriorates, which can impact on the level of service. Although we have been much more pragmatic in our maintenance approach in recent years, when the water industry was privatised in 1989 we were left with a legacy of significant numbers of old and failing assets that would require replacement.

Table 5 illustrates that recent analysis has identified that nearly 50% of our water treatment assets are older than 25 years, 25% are older than 30 years and 10% of our assets are older than 35 years. Considering that the average life expectancy of our current assets is 20 years we should be thinking about replacement of half of our entire asset base in AMP7 if age was the primary driver.

Age of Assets (years)	Cumulative % of Asset Base (older than)
10	90%
15	65%
20	58%
25	50%
30	29%
35	10%
40	7%
45	4%

Table 5 - Summary of cumulative asset age of our water treatment assets

To replace such a volume of assets would require investment greater than £600 million in AMP7 (based on our unit cost database), which is not possible. This has led us to develop our risk-based prioritisation techniques.

The proposed investment in this area will maintain the level of service currently provided to customers by meeting the following drivers:

- Maintaining water quality compliance and resilience of our water treatment assets in response to deterioration of raw water quality, asset deterioration and changes to legislation;
- Minimising water supply interruptions where our water treatment works have been a contributor;
- Targeting water quality parameters that, although may be compliant, have a wider consequence of contributing towards elevated volumes customer contacts for appearance, taste and odour;
- Meeting our customer's expectations and delivering our aim to maintain consistent water service across our supply area by targeting customers that experience below average service and quality.

Views of our customers and stakeholders

We have undertaken extensive consultation with customers through our PR19 preparation programme, including our Welsh Water 2050 strategy consultation held in the summer of 2017, which engaged with 19,980 of our customers.

During our consultation for Welsh Water 2050, our customers ranked providing clean, safe water to all amongst the most important aspects of our future plans, followed by providing reliability of supply and acceptability. Customers have stressed that they want stable water quality, water that is acceptable in terms of appearance, taste and odour and a reliable service.

Benefit for our customers

Improvements to our MOS

We aim to improve our water quality compliance which from 2020 will be measured under the new Compliance Risk and Event Risk Indices. Our target position by the end of AMP7 is a score of zero for Compliance Risk Index and an upper quartile position for Event Risk Index.

For customer acceptability, although there isn't a specific water treatment works measure, treatment does contribute to the overall score. We are targeting a reduction in the number of contacts received per 1,000 population served from 2.4 to 2.0 which approximately translates as a reduction of 1,250 calls for appearance, taste and odour per year.

Finally, we are targeting consistency in the number of unplanned outages where the water treatment process can be attributed as the cause and planning to maintain a stable position throughout AMP7 from our end position in AMP6. A summary of our overall forecast performance is illustrated in the following table –

Measure of Success	End of AMP6 Position	End of Investment Position
Clean, safe water for all:		
Compliance Risk Index	-	0
Event Risk Index	-	Upper Quartile Position
Acceptability of drinking water	2.4	2.0
Water process unplanned outages	-	0% change from 2019-20

Table 6: Forecast MOS end of AMP6 and end of AMP7

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.

2 Investing for now and in the long-term

Future challenges

Our Welsh Water 2050 strategy identifies significant trends over the next 30 years and how these will impact on us and our customers. The most significant trends in terms of water quality, acceptability of water and reliability of supply are set out below.

Demographic change

An increasing population will inevitably increase demand for water and increase the pressure on our existing assets to supply potable and wholesome water as required by our customers.

Climate change

We expect climate change to have an influence on our catchments. This includes changes to the presence and development of algae and bacteria, and associated taste and odour compounds including Geosmin and 2-Methylisoborneol (MIB). It will be increasingly important to ensure strong catchment management to control taste and odour issues.

A warmer, drier climate will lead to increased water demand particularly during peak periods in summer months. Similarly an increased frequency of extreme and prolonged rainfall events particularly when following dry spells will lead to a deterioration in raw water quality, increases in sediment loadings, and pesticide concentrations increasing demand on our treatment works.

Environmental change

Pesticide and fertiliser use is increasing in Wales, which has led to increased nutrient loadings in reservoirs and rivers contributing towards the formation of and duration of algal blooms. There will be an increased need to install more advanced treatment processes to be able to remove these types of emerging contaminants

Changes in customer expectations

Increased demand for water as well as expectations regarding acceptability will put increasing pressure on assets to be able to achieve current and future water quality targets.

Changes to the structure of the economy

A projected increase in tourism in Wales could see an increase in pressure on rural and coastal water supply networks and treatment works at peak times to meet demand. This investment will contribute to achieving the outputs required from our existing assets.

Protecting essential infrastructure

A number of our assets are ageing and deteriorating and therefore have an increased risk of not being able to meet the standards of treatment required of them and being able to produce an uninterrupted level of service.

Policy and regulatory change

Uncertainty following the UK's decision to leave the European Union may lead to changes to water policy in many fields from abstraction to water quality. Our investment planning has considered this risk and its potential impact on customers.

Changes to water quality standards from 2020 onwards will contribute towards an ongoing challenge for our assets being able to meet these standards where they were not designed to do so.

Protecting public health

Evidence is emerging of the impact on people's health of additional contaminants not previously known about or monitored. These could lead to changes to the Water Supply (Water Quality) Regulations in the future.

Legal duties

Our target to improve water quality performance and to a similar degree, interruptions and acceptability, is partly driven by improvement notices issued by the DWI. Our two major schemes

to improve water quality in AMP6 were both driven by improvement notices generated following our PR14 submission for Water Quality. We have also been issued with a number of improvement notices to target appearance, taste and odour and resilience at water treatment assets by the regulator.

Planning for the future

Long-term planning

This programme links with our Water Resources Management Plan (WRMP) and our long-term strategy to improve the reliability of drinking water supply systems, protecting our critical water supply assets and achieving acceptable water quality for our customers.

The prediction of water quality is dependent upon a robust monitoring and sampling programme as well as collaboration with industry leading organisations in research and development. We are governed by existing regulations in terms of how we treat and manage water but we are aware of possible changes in raw water quality as well as changes to the regulations, which we need to take into account.

We are constantly broadening our water quality monitoring programme, which provides not only online real time data but also data from laboratory analytical methods. With more efficient analysis of this data we will be able to identify poor performing assets and areas that were previously not considered, as well as prioritising assets for investment where emerging water quality parameters and standards require additional treatment.

Working with academic and research based organisations including APEM, Bangor and Cardiff Universities as well as WRc, we are developing several models which can be used to gain an understanding of current and future problems. Examples of current projects include themes such as raw water quality deterioration, the dynamics and movement of taste and odour causing compounds and conditions for bacteria growth in service reservoirs.

Building on progress

Our proposals are not the start of our journey. We have made significant efforts in recent AMPs to improve our water quality compliance. Between AMP2 and AMP5 much of our investment has been targeted towards disinfection including bacteriological, cryptosporidium and turbidity compliance. Since the introduction of the Water Supply (Water Quality) Regulations in 2000 we have dramatically improved our performance for water quality, reducing the number of failures for turbidity and bacteria at treatment works from almost 100 per year in 1990 to 3 in 2017.

Figure 1 illustrates that even though we still have a small number of failures from water treatment works they do still have a significant bearing on our performance measures for water quality, including mean zonal compliance, disinfection index and process control index and therefore will have an equally large impact on the proposed Compliance Risk Index.

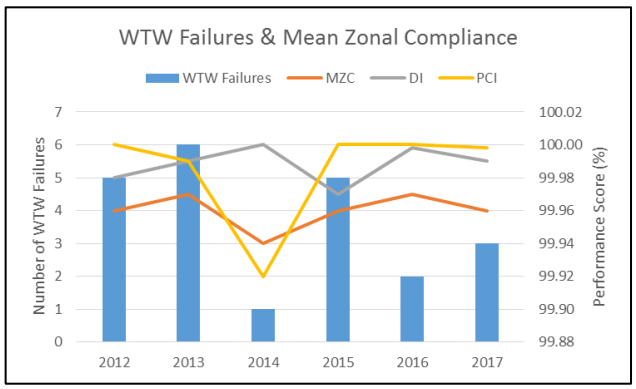

Figure 1 - Our water quality performance and WTW failures since 2012.

Water Quality

The deterioration of raw water quality is an issue faced in every drinking water catchment and water treatment works and has the potential to impact our customers. Although there are robust treatment stages at our water treatment works to be able to produce compliant water, a small number of works are approaching the limit of their treatment capability for particular parameters.

Focus on water quality is going to remain relevant during the remainder of the current and next AMP period. As asset age increases and the condition deteriorates there will be an increasing drive to prioritise specific sites for increased attention and investment. At the same time, there is increased scrutiny on the regulations with the inclusion of emerging contaminants such haloacetic acids in 2020 and amendment of existing standards such as Lead, on the agenda of the regulator as well as interested 3rd party research organisations.

Acceptability of Water

Manganese deposits in our distribution network have been found to contribute to an increased number of customer contacts for appearance following planned and unplanned events. The source of the manganese is our catchments, of which we have little control. However, poor removal of this excess manganese at our treatment works and subsequent related customer contacts contributes towards one of our key measures of success for customer acceptability of drinking water. Although we are performing well in terms of manganese compliance, our strategy labelled "Journey to 2" currently targets treatment works where average final manganese above 2 µg/l is contributing towards the number of contacts we receive for acceptability.

We are continually developing our manganese strategy at water treatment works and have found that there is an almost linear relationship between manganese at low levels and the number of additional customer contacts that we receive for appearance. We currently have 35 treatment works where average final manganese is greater than 1 µg/l of which 14 works have an average final manganese greater than 2 µg/l.

Average Final Mn	Number of WTW	% increase in customer contacts
≥ 1 but < 2 µg/l	21	5%
≥ 2 but <3 µg/l	4	10%
≥ 3 but < 4 µg/l	6	15%
≥4 µg/l	4	20%

Table 7 - Relationship between WTW final manganese and customer contacts

Since the adoption of "Journey to 2" as an internal strategy we have made significant progress through treatment optimisation and targeted improvements in AMP6 to reduce average final manganese at treatment works. Figure 2 shows that even though we have made improvements towards final water manganese, the challenge will remain constant with average raw water concentrations actually increasing.

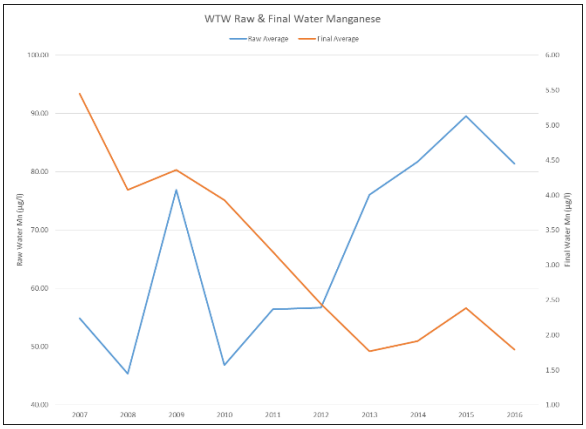

Figure 2 - Historical raw water and final water manganese concentrations since 2012

We will continue with this strategy into AMP7 to minimise the impact of treatment works on our customer acceptability measure of success.

Reliability of Supply

We have found that interruptions to supply where water treatment is the source are rare events. However such events do occur and can be challenging, particularly when they occur in distribution zones with only one treatment works as a source of supply. One example of such a situation occurring in recent years occurred at Broomy Hill treatment works in Hereford in August 2015. Following a rapid deterioration of raw water quality and treatment issues with the works, we came close to losing supply for up to 120,000 customers. Figiure 3 illustrates the water level of service reservoirs in the Hereford area throughout the duration of this event. Our major service reservoirs dropped to as low as 27% which with a minimum level of 25% required to maintain supply, we estimated that we were only 2 hours from losing supply completely to the whole network.

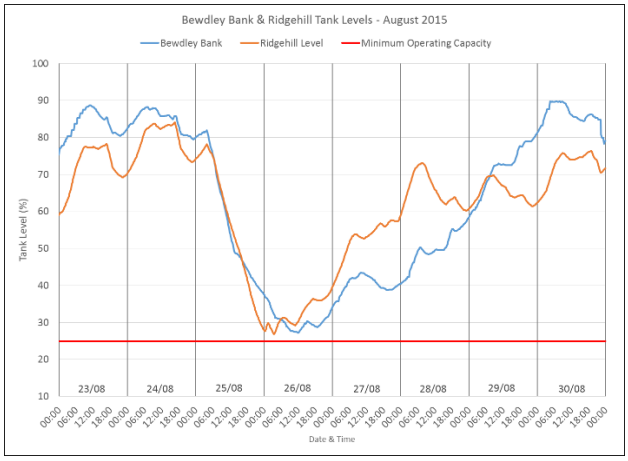

Figure 3 - Service reservoir levels following unplanned WTW event in August 2015

Following this event however we have improved the process at Broomy Hill, including the addition of a run to waste facility, optimisation of treatment processes and operation of tank levels. This event has led us to develop a strategy of implementing such measures at other treatment works, of which we have completed a number in AMP6.

AMP6 Progress

The current level of investment in AMP6 is approximately £122.8 million which can be seen in Table 8;

Scheme	Scheme Cost	Customers Benefitted	Customer Benefit
WTW Maintenance	£122.8 m	3.1 million	Completion of reactive and planned capital maintenance ensures a rational allocation of investment across all of our water treatment assets to safeguard water quality compliance, reliability of supply and satisfactory acceptability of water for all of our customers.

Table 8 - Summary of our AMP6 Investment

All projects within the PR14 submission are on target to complete by the end of AMP6.

During AMP6 we have spent £9 million implementing run to waste facilities at 15 treatment works that did not have such a facility prior to the start of the AMP. Run to waste facilities at these treatment works will allow us to continue to operate the treatment process should quality deteriorate because of a deterioration of raw water or failure of an asset. Run to waste facilities at these 15 sites will altogether benefit up to 1.4 million customers to ensure they continue to receive a compliant and uninterrupted supply.

The filter maintenance programme during AMP6 has consisted of spending £10.8 million investment at 10 sites which were identified as requiring refurbishment of filter media, floors, nozzles and structural issue. We have refurbished or are currently refurbishing 1st stage, 2nd stage and granular activated carbon filters. This maintenance programme will contribute to maintaining our measures of success for safety of drinking water and acceptability of water by minimising particle breakthrough, reducing the impact on disinfection and by removing taste and odour causing compounds. Our filter refurbishment programme will benefit up to 800,000 customers.

We have invested £2.6 million with the installation of Powdered Activated Carbon dosing treatment at 7 sites. With the deterioration of raw water quality coupled with the lack process capacity of our treatment assets we have experienced taste and odour issues at several treatment works in the previous 5 years. The installation of powdered carbon treatment allows us to maintain a stable level of service to customers by removing taste and odour causing compounds at the treatment works as a resilient but interim measure prior to further investigation and investment. Such investment has been essential to preserve our measure of success for customer acceptability.

The proposed investment for AMP7 is crucial to ensure that we build on the progress made to date.

3 Options

To deliver maintenance investment we use a mix of reactive and proactive approaches. For many assets the impact of failure can be managed for a reasonable length of time due to the flexibility built into our network, so a reactive programme is the most cost effective approach. As we develop our analytical capability we will move to a more proactive approach but will always require some reliance on reactive investment.

We prioritise our proactive investment using a risk based methodology, taking into account the impact on customers. We have assessed the programme for AMP7 looking at individual investment classes separately then brought all the information together to take a balanced view of risk across the whole asset base. We will continue to review this through delivery of AMP7 and rebalance the programme to manage emerging risk.

Background

In the optioneering phase of our programme development we considered all of the problem areas that had been identified and proceeded to undertake feasibility work to build costed options for each one. These options were then reviewed with the operational teams to decide which ones became part of the programme.

In determining the best approach to allocate investment for water treatment maintenance we considered the following 5 overarching methods:

1. Maintenance on a reactive only basis;
2. Condition and performance of assets;
3. Age and life expectancy of assets;
4. Risk of assets to our measures of success
5. Holistic approach including all of the above

Each of these individual options to determine the correct allocation of investment is detailed below.

1. Maintenance on a reactive only basis

Prior to the privatisation of the water industry and preparation of the first Asset Management Plans in 1989, replacement of assets on a reactive basis was much a business as usual and sole method of managing asset stock and its condition/performance. Organisations responsible for water services prior to privatisation would focus their investment on the replacement of assets only after they had failed which had huge cost implications that led to huge debts as well as impacting on each organisation's ability to produce a reliable service. Although we have moved on from using this approach over the last 30 years with the development of planned capital maintenance, reactive maintenance still has its place today and will be considered as an option that will contribute towards the overall investment process for water treatment maintenance in AMP7. An element of reactive capital maintenance will always be required particularly when we are facing so much uncertainty in how our assets will respond to climate change and changes to regulatory standards.

2. Condition and performance

The known condition and performance of an asset is a useful tool in scheduling a maintenance strategy and is an approach that is used to validate any other method of maintenance. Maintenance should only usually be considered for an asset if condition and performance has deteriorated that it presents an imminent risk of failure or unacceptable risk to water quality, acceptability or interruption of supply. However, the condition and performance of an asset can change on an almost daily basis, particularly for assets are that run at high demand. Considering this, in recent years we have adopted a robust condition monitoring approach, initially to high priority assets such as critical supply pumps but this is now being rolled out to further assets. We have also adopted a Reliability Centred Maintenance approach through the use of Lean principles in recent years to not only attempt to improve the condition and performance of our assets but to gain a better understanding of these factors through the recording of performance indicators such as temperature, vibration, acoustics and operating ranges. This information is useful in the prioritisation of asset maintenance which ensures that we invest in the right areas.

From PR09 onwards we have produced detailed asset survey reports on a site by site basis outlining overall performance and condition of the asset.

These reports are appraised and continually updated on a prioritised basis and comprise completing a detailed site survey, desktop performance study and assessment of planned maintenance, all by water treatment experts. In AMP6 we produced updated surveys for 25 priority sites in collaboration with our Capital Alliance Partners. The sites chosen included 3 in the North region, 10 in the South East and all 12 sites in the South West on the premise of being able to produce a regional asset management strategy for this area. A regional survey will be particularly useful in future when developing conjunctive use systems where multiple sites all supply the same network. Each survey report then progresses further in detailing an assessment of asset maintenance required and estimated cost for the forthcoming and future AMP periods. An assessment of an assets performance and condition is widely seen as the most effective method of prioritising investment. However it is a time consuming process and if records are not continually reviewed, information can become quickly outdated and therefore inaccurate.

We continually monitor the performance of our assets through our water quality sampling programme and online telemetry reporting system. Our assets are now monitored more than ever and through the use of innovative technology as well as adoption in recent years of statistical process control we now have a much better, live understanding of how our assets are performing not only at a water treatment works level but down to pumps and valves as well.

3. Age and life expectancy

An assessment of our asset stock on an age basis is a useful tool in providing a general overall understanding of the number of assets we have and their estimated failure rate based on life expectancy. Although in the real world the life expectancy of an asset does not usually dictate when it is going to fail i.e. assets will often perform better or worse than expectation outside of this window, it is useful in determining and balancing the allocation of required maintenance across one or a series of investment periods according to the risk associated with asset failure. An age based model has been built to understand our risk profile. This used our asset register to build an understanding of the likelihood of failure and our unit cost database to assess the cost of asset replacement.

An impact assessment has been undertaken to illustrate which parameters that asset would impact on including water quality parameters such as cryptosporidium and turbidity, acceptability parameters including appearance and taste and odour and finally service parameters including interruptions to supply. For assets that do not impact on any of these measures then an avoidable cost only impact has been assumed.

The output of this analysis is now supporting prioritisation of maintenance to the most cost beneficial items.

4. Risk

The risk profile of every water treatment works is assessed through expert judgement in the DWSP process and all risks related to water quality are reported to the Drinking Water Inspectorate. This gives a useful cross-check against the other analytical approaches.

5. Holistic Approach

The final analysis for water treatment includes a holistic approach that includes all of the previous 4 options. The use of all these methods in producing a maintenance programme ensures that we make use of all the data and information available to us and therefore can prioritise maintenance on the greatest need and cost benefit outcome. Such an approach will not only allow us to maintain a stable level of service for the lowest cost but also minimise the need to maintain assets reactively which historically has been expensive for no additional net benefit.

Assessment

Chosen option: A holistic approach using elements of all of the above methods to ensure we prioritise investment in the right areas to safeguard our service to customers.

Following unplanned events at several of our treatment works, we have been issued with improvement notices by the regulator to improve on the minimum expected level of service.

Therefore considering these regulatory drivers, implementing maintenance on a reactive only basis is not an option.

Although each of the individual options of implementing maintenance using age, condition, performance or risk all have their advantages in producing a programme, the use of each strategy on their own would be short sighted and not sustainable in the long term. However we should retain flexibility for the unexpected when considering regulatory changes and the impact of climate change.

A holistic approach with an element of reactive maintenance, assessment of age, condition, performance and risk is the preferred option to take forward for more detailed definition. This is because it is the most effective way to deliver multiple benefits and improve our service standards for our customers during AMP6.

The main benefit of our chosen solution is that it achieves an improvement for each of the investment areas at the lowest total expenditure (totex) option to meet our measures of success.

The next stage of work is to develop fully prioritised programmes of interventions so that the cost, scope of work and benefits are fully understood. The four programmes, which make up our measures of success, described in the next section, that form part of our preferred option are:

- Safety of drinking water management;
- Acceptability of drinking water management
- Reliability of supply management;
- Other site maintenance

4 Preferred option

Preferred option

Our preferred option sets a broadly similar level of investment as AMP6, prior to our efficiency challenge. Our plan will be developed using a holistic approach in determining the allocation of investment across our asset base of 62 water treatment works. We have used a combination of age, condition, performance and risk to determine the most appropriate split across 4 overarching strategies based on our measures of success. These 4 overarching strategies make up our 4 programmes of work that form the basis of the Water Treatment Maintenance investment and are as follows –

- Safety of Drinking Water
- Acceptability of Water Management
- Reliability of Supply
- Other Maintenance

Our prioritised interventions for each of the four programmes of work are outlined in Table 9. These programmes of work will be continually reviewed and updated taking into account operational performance, which may lead to reprioritisation of the interventions within or beyond the AMP7 period.

Programme of work	Proposed programme total budget
Safety of Drinking Water Management	£46.55 m
Acceptability of Drinking Water Management	£7.24 m
Reliability of Supply Management	£18.77 m
Other Maintenance	£28.22 m
Reactive Capital Maintenance	£24.32 m
Total programme (pre efficiency)	**£125.10 m**

Table 9 - Summary of proposed investment programme to address WTW maintenance in AMP7

Prioritisation of Treatment Works

Following a review of our risk database, Investment Manager, Drinking Water Safety Plans, asset performance surveys, collaboration with Asset teams and other investment areas to further assist in the allocation of investment in AMP7 we have initially prioritised water treatment works into 3 groups which include –

1. 6 priority treatment works based on number of risks, age and condition of assets and performance;
2. 3 treatment works covered by the Cwm Taf Water Supply Project investment case;
3. 53 treatment works that make up the remainder of our water treatment asset base

The top 6 sites were prioritised based on a review of risks to water quality, condition and performance assessments through asset surveys and collaboration with Operational and Water Assets teams. Given the level of risk to the business, approximately half of the overall planned capital maintenance investment has been allocated towards these 6 sites. Detail regarding investment allocation to these sites can be seen in Table 10.

WTW	Proposed Investment
Alaw	£1.81 m
Bretton	£4.11 m
Bryngwyn	£3.00 m
Court Farm	£14.85 m
Sluvad	£8.93 m
Trecastell	£1.27 m
Total	£33.97 m

Table 10 - Summary of proposed investment at our top 6 priority sites

The treatment works with by far the most investment in AMP7 is Court Farm which is a critical supply works for our conjunctive use system in South East Wales supplying 285,000 customers on a daily basis. In AMP7 we are proposing to replace filtration air blowers and backwash pumps which are now over 40 years old. We are also proposing to replace a number of chemical storage tanks including sodium hypochlorite, lime, polyelectrolyte

and orthophosphate which come to a combined total cost of £2.23 million. We have identified the onsite generator in need of replacement in AMP7 at a cost of £0.67 million which is critical for this site to ensure supply is maintained to our distribution network. We are also proposing the replacement of granular activated carbon media which by 2025 would have undergone 5 regeneration cycles and therefore be close to the end of its useful life. However the replacement of carbon media is currently under review due to improved functionality of the regeneration programme and the addition of virgin media each time it is regenerated. Finally we have identified £1.7 million to replace a number of ageing instruments at Court Farm. As part of a more general instrumentation strategy we are proposing to replace all instruments that are older than 30 years by the start of AMP7 which will be combined with a reactive replacement of other instruments that fail in the interim.

The allocation of investment towards the 3 sites covered by the Cwm Taf Water Supply Project investment case, involved gaining an understanding of the minimum level of investment and maintenance required to ensure that reliability and water quality is preserved until they are closed and abandoned in AMP8. We are proposing a total investment of £10.36 million in AMP7 in order to achieve this goal. Additionally the maintenance of particular assets including instrumentation and control will be made on a reactive only basis. A summary of investment allocated to these 3 sites is shown in Table 11.

WTW	Proposed Investment
Llwynon	£3.25 m
Pontsticill	£5.67 m
Cantref	£1.44 m
Total	£10.36 m

Table 11 - Summary of investment at 3 WTWs part of Cwm Taf Water Supply Strategy

We have undertaken a detailed site assessment of maintenance required at these 3 sites in AMP7 to identify the minimum to ensure that the sites remain compliant and continue to produce water without interruption until the replacement treatment works becomes operational. We are proposing to refurbish filters at all 3 sites which we believe is the most critical treatment process to safeguard quality and supply for the forthcoming AMP. We are also proposing to replace a number of chemical dosing pumps including coagulant, polyelectrolyte and chlorine which are also amongst the most critical treatment assets to prevent failure. Finally we have proposed the refurbishment or replacement of supply pumps where necessary to ensure supply is maintained in response to more challenging times such as we faced earlier in 2018 with extreme weather events. In terms of an instrumentation strategy, we are proposing to replace instruments on a reactive only basis at these 3 sites which will be funded from the larger reactive capital maintenance budget.

The remaining planned capital maintenance investment will be allocated towards the remaining 53 treatment works that make up our asset base. The level of investment at the remaining 53 treatment works is £35.69 million. Maintenance of assets at the 53 sites follows a similar methodology to the top 6 and Cwm Taf 3.

Prioritisation by process/strategy

To produce a prioritised level of investment across all water treatment works based on the 4 overarching strategies, we used a predominately age based approach, producing an age based model as detailed in Option 3. The outputs of the model were prioritised in terms of all assets that require replacement in AMP7 on a cost beneficial basis but also to ensure that every process received at least a small proportion of investment.

The proposed allocation of investment across each of the 4 strategies is as follows -

Safety of Drinking Water Management

We propose to spend £46.55 m on a programme that will contribute towards maintaining the safety of drinking water. We have allocated investment towards 4 common processes across all water treatment works which include;

- Chemical dosing;
- Coagulation and clarification;
- 1st stage filtration;
- Disinfection

These processes are critical in water treatment for minimising water quality parameters that may have an impact on customer's health including cryptosporidium, bacteria and disinfection by products.

Investment in this area will target assets that contribute predominately towards our safety of drinking water measures of success measured through the proposed Compliance and Event Risk Indices.

Costs have been calculated using our unit cost database included as part of the age based model.

As part of investment allocated towards the Safety of Drinking Water, we are also including the Clear Water Tank Cleansing Programme with a level of investment of £2.69 million. This programme is based on the average cost of a tank clean in AMP6 (~£25,000) and consists of 100 tanks that will require cleaning in AMP7 (based on a triennial cleaning frequency), including any associated remedial repairs.

Programme	Top 6 Sites	Remaining 53	Cwm Taf 3	Total (£m)
Chemicals and Chemical Dosing	£8.50 m	£9.10 m	£2.77 m	**£20.37 m**
Coagulation and Clarification	£0.83 m	£2.89 m	£1.16 m	**£4.88 m**
1st Stage Filtration	£5.70 m	£4.64 m	£0.43 m	**£10.77 m**
Disinfection	£3.93 m	£3.16 m	£0.76 m	**£7.85 m**
Subtotal	**£18.96 m**	**£19.79 m**	**£5.12 m**	**£43.87 m**
Clear Water Tank Cleansing				**£2.68 m**
Total				**£46.55 m**

Table 12 - Summary of investment for Safety of Drinking Water Programme

Acceptability of Water Management

We propose to spend £7.24 million on a programme that will contribute towards maintaining customer acceptability of drinking water. We have allocated investment towards 3 common process across all water treatment works which include;

- 2nd stage filtration;
- Granular Activated Carbon (GAC) filtration;
- Inter-stage storage and pumping;

These processes are critical in water treatment for minimising the acceptability of water impact for customers by reducing manganese and iron which contribute towards appearance issues as well as granular activity carbon processes which control taste and odour causing compounds as well as certain pesticides. Investment in this area will target maintaining our customer acceptability score for the number of contacts received per 1,000 customer served.

Costs have been calculated using our unit cost database included as part of the age based model.

Programme	Top 6 Sites	Remaining 53	Cwm Taf 3	Total (£m)
2nd Stage Filtration	£0.05 m	£1.37 m	£0.57 m	£1.99 m
GAC Filtration	£2.11 m	£3.06 m	-	£5.17 m
Inter-stage storage and pumping	£0.06 m	£0.02 m	-	£0.08 m
Total	£2.22 m	£4.45 m	£0.57 m	£7.24 m

Table 13 - Summary of investment for Acceptability of Water Programme

Reliability of Supply Management

We propose £18.77 million on a programme that will contribute towards maintaining reliability of supply. We have allocated investment towards 5 common treatment processes across all water treatment works which include;

- Inlet works/ability to treat raw water;
- Clear water storage;
- Wastewater treatment;
- Highlift pumping;
- Site condition and location

These processes are critical in water treatment for minimising the reliability of supply impact by reducing the number of interruptions where the treatment works can be attributed as the source. Investment in this area will target maintaining our customer minutes lost measure.

Costs have been calculated using our unit cost database included as part of the age based model.

As part of investment allocated towards the reliability of supply, we are also including the building maintenance programme. This programme is based on the run rate of investment in AMP6. Buildings maintenance will target predominately treatment works structures and other civils that may contribute towards preventing interruptions of service including access roads and buildings.

Programme	Top 6 Sites	Remaining 53	Cwm Taf 3	Total (£m)
Inlet Works/Ability to Treat Raw Water	£0.18 m	£0.33 m	£0.14 m	**£0.65 m**
Clear Water Storage	£0.52 m	£1.36 m	£0.14 m	**£2.02 m**
Wastewater Treatment	£2.86 m	£3.25 m	£1.99 m	**£8.10 m**
Highlift Pumping	£0.57 m	£0.10 m	£0.29 m	**£0.96 m**
Site Condition and Location	£1.25 m	£1.56 m	£0.33 m	**£3.14 m**
Subtotal	**£5.38 m**	**£6.60 m**	**£2.89 m**	**£14.87 m**
Buildings Maintenance				**£3.9 m**
Total				**£18.77 m**

Table 14 - Summary of investment for the Reliability of Supply Programme

Other Maintenance

We propose to spend £52.54 million on a programme that will contribute towards other site condition maintenance that does not impact on the 3 previous measures including non-critical monitoring, health and safety and lifting equipment.

Costs have been calculated using our unit cost database included as part of the age based model.

As part of investment allocated towards other maintenance, we are including the following investment items;

Reactive Capital Maintenance (RCM)

A level of investment to allow the replacement of critical assets following unexpected failure. RCM has been costed based on a run rate from AMP6.

Asset Surveys

Further development of the asset surveys that were used to prioritise investment as part of water treatment maintenance. This will be completed in partnership with our Capital Alliance partners and has been costed on a run rate of AMP6.

Strategy Development

Development of key strategies including coagulation and 1st stage filtration. We have allocated a small investment programme to develop key strategies that will ultimately benefit our overall measures of success. Such strategies will involve detailed surveys of each treatment works performance as well as the use of monitoring equipment to develop future interventions.

Sludge Strategy

A programme designed to replace critical components of waste water systems at our water treatment works as well as optimisation to not only improve resilience of the treatment works but also to reduce operational cost. Interventions will include additional monitoring and control modifications to improve performance. This programme has been costed using run rate of AMP6.

Control Upgrade

This programme will target the automation of treatment works including the upgrade of SCADA systems. Many of our SCADA systems are old with redundant and outdated technology. Upgrading these systems at our highest priority sites will improve resilience of the site to be able to respond to more challenging circumstances in the future. This programme has been costed based on a study completed during AMP6 which has forecasted which treatment works require investment.

Programme	Top 6 Sites	Remaining 53	Cwm Taf 3	Total (£m)
Site Condition and Location	£7.42 m	£4.85 m	£1.76 m	**£14.03 m**
RCM				**£24.32 m**
Asset Surveys				**£0.53 m**
Strategy Development				**£0.14 m**
Sludge Strategy				**£3.89 m**
Control Upgrade				**£9.63 m**
Total				**£52.54 m**

Table 15 - Summary of investment for Other Site Maintenance programme

5 Cost efficiency and innovation

Cost efficiency

We are proposing to deliver £18.96 m of cost efficiencies as part of this investment programme, as shown in Table 16.

We will deliver these savings by challenging our Alliance partners to improve efficiency and by maximising opportunities to innovate.

Programme of work	Total Budget
Total programme (pre-efficiency)	**£125.10 m**
Total programme (post-efficiency challenge)	**£106.14 m**

Table 16 - Summary of proposed cost efficiency challenge

Summary of innovation in this project

The approach we are adopting to maintain our water treatment works is an example of how we like to think holistically to maximise the value of our investments. We are following a source-to-tap approach that looks beyond short-term reactive measures, to pursue investments that will benefit our customers for generations to come.

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.

An important part of this is exploiting opportunities to innovate. One of the areas we will seek to gain efficiencies is through the batching and timing of our investment programmes. We will work closely with our Alliance partners to optimise our delivery – for example by completing contact tank bypasses earlier in the AMP will allow inclusion into the cleaning programme to reduce their relative risk to bacteriological compliance.

We currently have **55** innovation projects delivering improvements across safety of drinking water, acceptability of water and reliability of supply that are either completed or currently still in progress.

We will look to exploit the opportunities presented by these projects throughout our AMP7 delivery. Some of our most recent innovative projects include:

- Investigating the effect of phosphate dosing on water quality and in particular the growth of biofilms in different types of mains, using research information from Sheffield University;
- Implementation of flow cytometry analysis at our Glaslyn Laboratories to give us a greater understanding of the microbiological make-up of our water from source to tap and to support optimum chlorine residuals within our network, supported by spatial mapping of chlorine in our network;
- Understanding the mechanisms of Geosmin and 2-Methylisoborneol production in our raw water sources through work with Natural Environment Research Council (NERC) placement Dr Rupert Perkins from Cardiff University. We have started to ascertain the growth and stress factors associated with cyanobacteria which will in future enable us to better control nutrients in catchments to prevent or reduce the production of these compounds that affect the taste and odour of raw water;
- The Aquavalens project is a European Funded research project, whose aim is to develop new methods and technologies for monitoring the microbiological quality of drinking water and water used in food preparation. It is hoped that the knowledge gained from the work will allow water companies to assess the robustness of water treatment in terms of the microbiological quality of drinking water, and identify which catchments and activities pose the greatest risks. The project will work towards an increased understanding of the relationship between climate events and pathogen numbers in water supplies;
- Working in collaboration with our Hereford operational team to install an acoustic cleaner on to a lime silo to maintain consistent lime dosing and reduce operational call outs;

- Predictive modelling to highlight areas at risk of water quality failures by our in-house data scientists;
- Trialling of Resmix Vital at Betws yn Rhos service reservoir to ensure that chlorine levels are consistent leaving the tank; and
- Participation in a research programme to reduce dissolved organic carbon-DOC2C alongside partners in Belgium, the Netherlands, France and the UK.

Importantly, we will continue to share best practice across the industry through conference attendance and the Innovation Forum.

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, the Drinking Water Inspectorate. We have well-defined reporting points for each DWI notice – including completion milestones and setting of performance targets.

6 Value for money and affordability

Impact on customer bills

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.

Value for money

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

The programmes of work identified have been developed so that they are delivered in conjunction with other levels of investment. For example, planned investment that will target assets that impact on the acceptability of drinking water will be developed in conjunction with the Improving Customer Acceptability of Water investment case to ensure that the worst performing assets are prioritised to a degree greater than can be achieved through maintenance alone.

As outlined in the previous section of this document, we will also seek to ensure value for money by 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.

In addition to these investments, and funded separately our water resources, water quality, improving the customer acceptability of drinking water and network maintenance investment cases as well as the Cwm Taf Water Supply Strategy project will provide further contribution to our measures of success across the company to future challenges in terms of water quality, customer acceptability of water and reliability of supply.

7 Delivery

Procurement

We have undertaken an assessment of the applicability of direct procurement for these projects. The nature of these projects is such that we consider a direct procurement approach would not be in the best interests of customers.

The various projects will be managed by our Water 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.

Programme

A prioritised programme of work has been produced linked to the investments, costs and associated benefits of the assessment programme. Interventions to target water treatment maintenance will be balanced evenly over the course of the AMP with certain programmes prioritised for intervention earlier on to ensure we see the benefits towards the end of the AMP where we have set targets for Compliance and Event Risk Indices.

These programmes of work will be continually updated following review of water quality and compliance data as well as annual reviews of Drinking Water Safety Plans. This programme will be optimised early in year five of AMP6 based on this up-to-date performance data. This may lead to reprioritisation of the interventions undertaken during the AMP7 period. Currently we plan to frontload the 3 treatment works covered by the Cwm Taf Water Supply project investment as it will also help us to make these works more resilient for the short to medium term.

Our plan will be to continue with each of the investment programmes beyond March 2025 with the latest study, cost, performance and benefits data used to prioritise the interventions for each periodic review starting with PR24.

We have currently only set out a five year AMP7 programme. Our plans and associated programmes for further AMPs will be based on our continuous review of water quality during AMP7.

Risk mitigation and customer protection

We will deliver our programme in a modular fashion so that the benefits of lower cost assets, for example valves, can be seen in terms of their effect on reducing the number of burst mains before going ahead with the replacement of a main. This approach will be used for the worst- served customers in particular.

The largest uncertainty regarding improvements to acceptability is the level of service benefits in terms of contacts that will be achieved. A methodology has been used to calculate the benefits including factoring in where our performance levels will be at the end of AMP6. However, each zone is different and there is an inherent risk that the benefits achieved may be greater than or less than the calculated value. There is also uncertainty related to the occurrence of bursts and the impact this might have on performance.

We have developed an Outcome Delivery Incentive (ODIs) for water quality, which will provide protection for our customers in the event that we do not deliver our planned outcomes.

8 Assurance

Governance

Our current water treatment maintenance investment programme is supported by the Water Quality Steering Group and Treatment Works Investment Strategy Team. The teams meet on a monthly basis and are chaired by the Head of Water Quality and Head of Production respectively. This helps to ensure that the full focus of the business is directed at this investment.

Water treatment performance is also targeted in monthly meetings chaired by the Managing Director of Water Services. These meetings are attended by key stakeholders including, operational teams, the Water Services Science team and Water Assets team.

On a daily basis our current performance is shared internally to ensure that emerging trends and problem areas are targeted quickly. There is also strong awareness of our commitment to improve our water quality performance following company-wide stand-downs to ensure that quality issues are front of mind for all colleagues across our business.

Our investments to improve water quality is also reported to our Quality and Environment Committee (QEC) on a six-monthly basis. QEC checks the improvement progress against our Strategic Objectives and is provided with the key risks and mitigation measures.

We will continue to apply these effective governance systems for our proposed AMP7 investment programme. The board will carry out a final review of this investment in detail prior to the submission of the business plan in September.

Cost assurance

We have undertaken a high-level feasibility study to enable the high-level scope of work and cost benefit of the options to be assessed.

Costs of the water quality improvements are based on a similar level to the costs from AMP6 with 10% improvement on the delivered costs through efficiencies. These efficiencies are outlined in the 'Cost efficiency and innovation' section.

A number of our costs were developed using our in house Solution Target Pricing model and Unit Cost Database. The model is updated annually and externally benchmarked every five years to make sure that costs remain current.

Customer consultation assurance

Our customers have indicated that investments to reduce interruptions to improve the appearance, taste and odour of our water is key and would be concerned if poor water acceptability were a recurrent problem.

Measures of Success

We are continuing with our measure of success (MOS) to monitor the benefits that our water quality interventions bring – the 'Safety of Drinking Water' MOS. Our target for improvement to this MOS over AMP7 as a result of our proposed investment is shown in Table 17.

Measure of Success	End of AMP6 Position	End of Investment Position
Clean, safe water for all:		
Compliance Risk Index	-	0
Event Risk Index	-	Upper Quartile Position
Acceptability of drinking water	2.4	2.0
Water process unplanned interruptions	-	0% change from 2019-20

Table 17 - Summary of improvements to MOS

Future assurance

We have strong governance procedures for the planning and delivery of our capital investment. Our Board will continue to provide the high level overview and governance to ensure that we deliver these much-needed improvements in the interests of our customers.