Dŵr Cymru Welsh Water

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PR19: Cost adjustment claim: Cwm Taf Water Supply Strategy

September 2018

Pontsticill Water Treatment Works

Cwm Taf Water Supply Strategy

Dŵr Cymru Welsh Water

Contents

Executive summary

Driver for investment

Deteriorating raw water quality, population growth, ageing infrastructure, and climate change are all increasing stresses on our assets feeding Cardiff and the Valleys. This area includes 12 water treatment works (WTW) to supply water to over 1.43 million people. Without major investment over the next two AMP periods, the risk of our customers in the area receiving an unacceptable quality of water and increased level of supply interruptions will increase significantly. To ensure this does not happen, we need to invest in improving the reliability and resilience of our water supply to our customers.

The WTWs in this area were originally built early in the 20th Century and upgraded in the 1990s. Over the years it has proved difficult to maintain some of these assets due to the limited treated water storage available and maintaining performance is a challenge. While there is sufficient water resource in the area to meet future demands the current configuration of the assets is restrictive and is likely to cause problems in supplying increasing populations.

Alongside this, deteriorating raw water quality, has led to the formation of taste and odour forming compounds in raw water, where it has not been seen before, and the instances of landslips in the catchments has also increased, leading to high levels of turbidity that cannot be treated.

Over the years attempts have been made to mitigate these issues but with limited success. We have trialled two technologies to improve water quality but neither have been sufficiently effective. We have also worked in the catchment with landowners to stabilise river banks but this will only provide benefit in the long term when new vegetation establishes. We are also developing a wider programme of catchment management with landowners that will seek to stabilise raw water quality in the Brecon Beacons catchment area. The benefits of this programme will be realised in the medium to long-term and cannot be defined absolutely, but will not be able to reverse the current problems.

During this AMP period, we have released funding to install Powdered Activated Carbon dosing to three sites most at risk. The amount of carbon we can add is limited by what the downstream processes can remove - having not been designed for this increased load. This approach has led to reductions of approximately 50% of taste and odour forming compounds but has left the final water with levels that some people can still detect. We have also released funding to trial a granular activated carbon media to improve this position in the short to medium term.

Over the past five years, there have been a growing number of customer contacts due to the discolouration, taste and odour of the water provided. This averages about 200 customer contacts per year, which has resulted in the imposition of legal Notices by the DWI.

In summary, the principal reasons for investment include

- 10% population growth by 2035 in the area;
- Raw water quality deterioration;
- limited availability of land on existing sites for asset improvement;

- ageing assets with an increased rate of breakdown, a limited residual asset life, and insufficient water treatment capacity during major maintenance schemes; and
- tightening water quality standards;

The investment

We are proposing to resolve these issues and optimise water production in the area by providing a new 225Ml/d WTW, Merthyr WTW. We will also construct associated raw and treated water pipelines to connect the new WTW to our network and a new final water storage tank with 24 hours of storage, increasing the current volume of storage in the area by 68%. The proposed option would replace three existing WTW (Pontsticill, Llwynon and Cantref) in the zone. This option would also provide us with the opportunity to rationalise a further two works (Nantybwch and Carno), at a later date as part of our long-term strategy.

This investment will improve water quality to customers, improve reliability of supply with a new WTW with 24 hours of clean water storage and independent treatment streams, which will provide the minimum water production capacity in the event of individual stream shut down. It will also provide the capability to undertake future maintenance on the new WTW without an impact on customers. Once strategic network improvements are in place, it will also provide an alternative supply for key WTW supporting our long term aims of being able to move water around in South East and South West Wales, providing resilience of supply. This will contribute to the delivery of our strategy, Welsh Water 2050.

Need for a cost adjustment

This approach requires a short-term major investment to achieve a long-term sustainable future. The project will have a 40 year total pre-efficiency expenditure (totex) of £455 million. It will have at total 40 year pre-efficiency capital expenditure (capex) of £311 million, of which £91 million will be budgeted for delivery in AMP7 and £155 million budgeted for delivery in AMP8, as shown in Table 1.

We have included this investment as a cost adjustment in our PR19 business plan submission because it includes:

- £160 million of enhancement expenditure in AMP7 and AMP8,
- potential for Direct Procurement, and
- a large atypical capex investment with multi-AMP delivery.

	AMP7	AMP8
Enhancement	£91m	£66m
Base	£0m	£89m
Pre-Efficiency Total	£91m	£155m
Post Efficiency Total	£73m	£124m

Table 1: The investment values proposed, for AMP7 and AMP8

Cwm Taf Water Supply Strategy

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: Ensuring we have reliable and adaptive infrastructure in place which can respond to future shocks and stresses.

Fair bills: Provide cost savings which can be passed on to our customers through affordable bills.

Delivering for the future

In Welsh Water 2050, we identified future trends. The requirement for this investment is driven by the following trends:

Demographic change: Population is predicted to significantly increase in the area by 10%; from 1.43 to 1.59 million customers by 2035.

Climate change: More extreme weather events will affect raw water quality due to increased sediment and pollutant mobilisation within the catchment. The existing WTW sites are vulnerable to land slips, which may become more frequent due to extreme weather events.

Environmental change: New contaminants and changes in land use (such as deforestation and intensification of agriculture) will impact raw water quality.

Protecting essential infrastructure: The existing assets are ageing and in a poor condition with a limited residual asset life. In the 12 months to October 2017 there have been over 50 failures across the three works resulting in internal events. There have also been two DWI reportable events in the twelve months to end March 2018 which affected customers. Reactive maintenance work is at least twice the volume observed at other WTW of similar age.

Policy and regulatory change: Water quality standards for example, Water Supply (Water Quality) Regulations will continue to develop over the next 40 years as they have done over the last 25 years.

Delivering our Strategic Responses

In Welsh Water 2050, we set out to deliver the following Strategic Responses:

Enough water for all: Using the water resource management planning process to provide enough good quality drinking water.

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

Protecting our critical water supply assets: Provide greater reliability to water supply systems.

Achieving our measures of success

For PR19, we will measure our performance based on measures of success (MoS). This investment will contribute to achieving the following MoS as well as reducing the risk of a significant failure:

Measure of success	End of AMP6 position	Benefits at the end of investment
Water supply interruptions	12 minutes lost per customer	Reduction of 0.127 minutes lost per customer
Acceptability of water (odour, taste, appearance)	2.4 contacts per 1,000 customers	Reduction of 0.07 contacts per 1,000 customers

1 Delivering our customer outcomes

Need for investment for our customers

The Cwm Taf area is in the north-west of our SEWCUS zone, which supplies clean water to the South Wales area including the cities of Cardiff and Newport and the valley towns, serving a total population of 1.43 million people.

There are 12 WTW in total in the SEWCUS water supply zone, with eight WTW in the Cwm Taf area: Cantref, Llwynon, Pontsticill, Nantybwch, Carno, Hirwaun, Tynywaun and Maerdy. A schematic of the area is given in Figure 1.

Cardiff is predicted to be the fastest growing core city in the UK by 2035 and the population within this water supply zone is projected to increase by 10%, to 1.59 million by 2035. Although this zone has sufficient capacity to supply the increased population and is a conjunctive use zone, it relies on Pontsticill WTW and either Llwynon or Cantref WTW being fully operational. Pontsticill WTW can only be taken offline for 8 hours for maintenance or emergency outages and Llwynon WTW and Cantref WTW cannot be offline at the same time without affecting customers' supplies.

Over the past five years, there have been a growing number of customer contacts due to the discolouration, taste and odour of the water provided. This averages about 200 customer contacts per year. These issues are linked to a trend in deteriorating raw water quality with increased levels of taste and odour causing compounds, Geosmin and 2-Methylisoborneol (MIB) in the upstream impounding reservoirs. The traditional water treatment processes at Pontsticill, Llwynon and Cantref WTW were not designed to remove taste and odour causing compounds now present in the raw water.

As a result, Pontsticill and Llwynon WTW have Drinking Water Inspectorate (DWI) enforcement notices on them due to customer contacts about poor water quality see Appendices H and I, reflecting the fact that these assets are not providing the service our customers expect. Cantref WTW is likely to have enforcement notices in the next five to ten years.

To improve the service we provide to customers, we need to invest in improving water quality in this water supply zone.

In addition to water quality challenges, we have identified reliability issues at Pontsticill, Cantref and Llwynon WTW. The ability to undertaken major maintenance and refurbishment activities is constrained by the short shut down window available. This has resulted in asset deterioration with greater than 50 failures requiring reactive maintenance in the last 12 months across the three WTW. This is three times the rate of failures at other WTW. In 2017-2018, there have been two notifiable events at Pontsticill WTW: one resulted in loss of supply to customers and the other was a breech due to disinfection turbidity. Deterioration modelling has indicated that this trend will continue over the next 40 years with increasing numbers of reactive failures of assets resulting in works closure or a reduction in output.

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 enough clean water to all and, protecting our key assets from future impacts, as the most important aspects of our future plans, followed by providing reliability of supply and water quality[i,ii]. Our customers consider a continuous supply of water to be critically important, especially for vulnerable customers and business[iii]. Our customers have also told us that water with poor taste or smell is a key issue to address and that it would be concerning if it were a recurrent problem[iv].

We need investment in this area to ensure we provide clean, good quality water to our customers

in the Cwm Taf area and maintain reliability of supply.

Benefit for our customers

Water quality

We are proposing to provide a new 225Ml/d WTW, maintaining the existing capacity of the replaced three poorly performing WTW. The new Merthyr WTW will improve the water quality supplied to customers. It will provide the option to abstract flexibly from three impounding reservoirs based on raw water quality and use improved treatment processes to meet water quality standards.

Creating one new WTW will allow us to improve the quantity of acceptable quality water we provide to our customers. A single, combined site, with separate process treatment streams, would treat more variable quality raw water, allow blending, and include the additional processes required to meet the water quality standards.

Reliability of supply

The new WTW will also have improved reliability of supply to our customers. We will improve robustness and redundancy in the network by creating 24 hours of storage. This will also provide additional capacity to supply water in cold weather and other high demand high demand periods and support other WTW during periods of maintenance or failure.

The design of the new WTW will incorporate independent treatment process streams which will maintain the minimum water production capacity in the event of an individual stream shut down and facilitate planned maintenance. The new site will also have power generation facilities to enable its operation in the event of a mains power outage. It will be able to treat water from the three different existing impounding reservoirs, maximising raw water resources, helping balance drawdown during times when we may have raw water quality and availability challenges, providing system resilience.

In addition, moving to a new site will remove the risk of site stability issues at Pontsticill and Cantref WTW, the former experienced a landslips in 2016.

Cost savings

Building one combined new WTW will provide us with cost savings through reduced reactive maintenance costs, operational expenditure (opex) and ongoing maintenance costs. We can take advantage of an unconstrained site reducing construction costs and allowing for future site expansion. We plan to use the latest treatment technologies to create an efficient works and be able to treat more variable raw water. This will cost effectively utilise the water sources in the area for an increased duration throughout the year.

We will pass these savings on to our customers through affordable bills and the customer dividend.

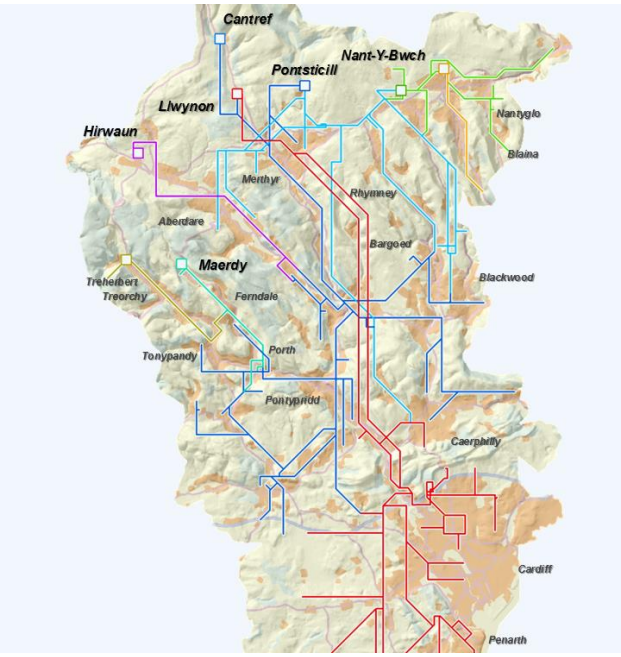

Figure 1: Cwm Taf supply area

2 Investing for now and in the long-term

Future challenges

Our strategy, Welsh Water 2050, identifies significant trends over the next 30 years, and how these will impact on us and our customers.

The trends that provide the most significant challenge for Cwm Taf are set out below.

Demographic change

Cardiff is predicted to be the fastest growing major city in the UK outside London to 2035. The population of this water quality zone is projected to be 1.59 million by 2035. This growth will place more stress on the system and the current flexibility of the network will be reduced. An example of this is that currently both Cantref and Llwynon WTW can shut down separately and water can be provided from alternative sources. This provides flexibility in the system as sites can be shut down for maintenance or if poor water quality is experienced. However, with the increased population and water demand, continuing to supply all customers during peak demand periods or in the event of an operational failure will no longer be possible.

Climate change

Climate change is predicted to cause more extreme weather events, such as high intensity storms and changes in precipitation levels. A 15% increase in precipitation is predicted in the winter by 2050[v].

These events will increase the likelihood of poor raw water quality with increased sediment, suspended solids, pesticide and nutrient loadings[vi,vii].

A 50% decrease in summer precipitation and increased temperatures are predicted[viii]. This decreases average raw water flows in summer, reducing the dilution of pollutants and increasing the incidence of blue-green algal blooms, and the incidence of taste and odour causing compounds in the raw water[ix]. This is shown in the forecast of Pontsticill raw water quality in Figure 2 below.

Environmental change

Environmental changes in the catchment affect raw water quality. Deforestation in the upstream catchment results in increased nutrient and soil run-off, increasing issues with colour, turbidity, taste and odour and a higher risk of landslips. This is reflected in the deterioration of raw water quality for the last ten years.

However, it is anticipated that with the planned programmes of catchment management, for example, the Brecon Beacons Mega Catchment, the

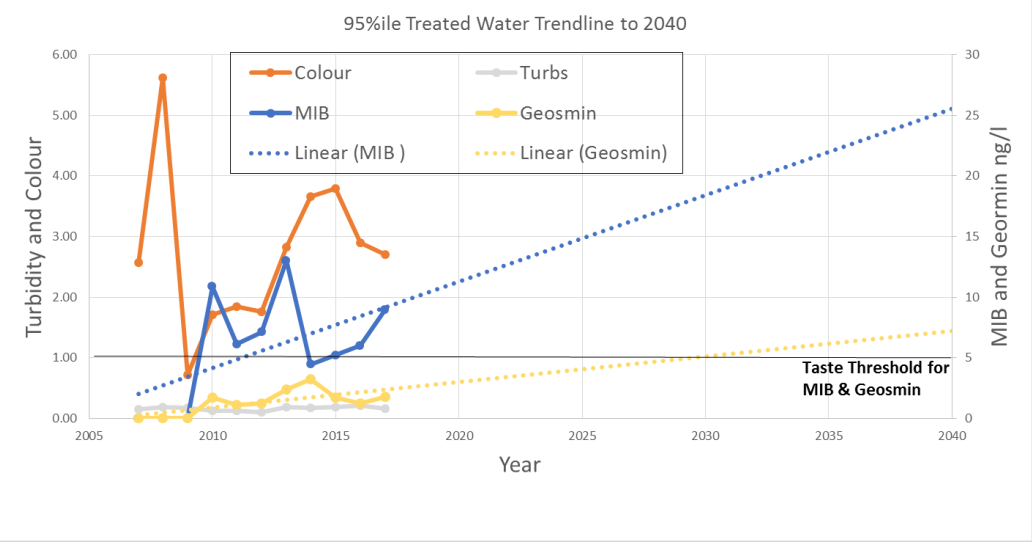

Figure 2: Forecast of water quality for Pontsticill WTW up to 2040

deterioration rate will stabilise within the next five to ten years.

Extreme rainfall events and deforestation are also affecting the vulnerability of our sites to landslips. Pontsticill WTW has site stability issues and suffered from a landslip in April 2016 which narrowly missed affecting the major plant. There have been two recent landslips in the Cantref catchment, in December 2015 and January 2016. These affected the raw water quality for Cantref WTW by increasing sediment, turbidity and caused the site to be shutdown. The most recent landslip was in the Llwynon catchment, in December 2017, which again affected raw water quality. The vulnerability of the WTW and their catchments is likely to increase as extreme rainfall events increase.

Protecting essential infrastructure

Due to the combined challenges of maintaining the water supply to customers and limited space at the existing sites, it is increasingly difficult and costly to carry out major capital schemes at these works. The new WTW will be designed to allow asset maintain removing the risk of and outages in the future.

Policy and regulatory change

The changes in drinking water quality standards have already required our WTW to adapt. Pontsticill, Cantref and Llwynon WTW were originally built with a relatively small footprint, and have been frequently modified to meet emerging water quality standards. This has led to the incorporation of new technology into the treatment process.

Water standards, for example, The Water Supply (Water Quality) Regulations 2016, will continue to develop over the next 40 years to reflect the emerging risk and improved understanding of microbiological and chemical issues and we need to be ready to adapt to meet these requirements. The predicted improvements are partly based on a continuation of the trend of tightening standards, seen over the last 25 years, and partly more specific trends like the tightening regulation on disinfection by-products such as trihalomethanes and haloacetic acids (HAA). A new WTW site would provide the footprint to build improved chemical dosing, clarification and filtration processes, should they be required, compared to the current WTW. We undertook significant investment in this area in AMP1 and AMP2 to improve treatment processes on site. This left little room for further expansion.

We do not think that our current sites have the flexibility and available space to deal with these changes.

Legal duties

Two Notices have been issued for Pontsticill WTW – DWR 3253v2 for risks associated with taste and odour and DWR3717 (draft) for risks associated with turbidity and microbiology. One notice has been issued for Llwynon WTW – DWR3682v2 for risks associated with taste and odour, microbiology, colour and turbidity. Investigations and short to medium term mitigations are identified in these notices but this investment proposal addresses the longer term solution. These are provided in Supporting document 5.8E.4.

Planning for the future

Long-term planning

The new works is the first stage of our long-term water supply strategy outlined in our Welsh Water 2050 vision, published in 2017.

This project links with our Water Resources Management Plan (WRMP) and our long-term strategy to improve the reliability of drinking water supply systems, protect our critical water supply assets and achieve acceptable water quality for our customers in this zone.

The WRMP has determined that no new abstraction licences are required over the next 25 years, despite the predicted increase in population. However, there is a need to maximise the use of existing licences which have gradually declined at the three sites over the last ten years.

3 Options

Background to the Cwm Taf

The trunk mains within the SEWCUS zone provide the flexibility to supply water from a combination of sources and feed 12 WTW. Of these WTW, ten treat water from reservoirs in the Brecon Beacons and two treat water from the rivers Wye and Usk.

While this system provides some flexibility most of the works have areas that only they can supply limiting the time that they can be out of service. At some works this situation has limited the ability to carry out major maintenance. We have assessed these works and have found that the frequency of maintenance at these works is twice the volume observed at other similar works, see Figure 3 below.

Due to major upgrades in the 1990s of sites originally constructed in the 1920s there is limited space on existing sites to carry out further upgrades, especially where additional treatment stages are required. In particular three of the eight sites, Pontsticill, Llwynon and Cantref WTW, are unable to physically expand further.

In response to sample failures and the level of customer complaints the DWI issued improvement notices for two of our works – Pontsticill and Llwynon. In response to this investments were made during AMP 6 to tackle the emerging water quality issues, in particular around Taste and Odour. Our catchment team has supported trails of an innovative ultrasound system to minimize algal growth and a destratification unit (ResMix) in one of our catchments. With the exception of improving manganese oxidation and removal these trials have not reduced the levels of compounds of concern and further research is ongoing with Cardiff University to understand the causes.

Alongside the catchment investigations we have installed Powdered Carbon dosing at three of our sites. Despite these sites not being designed for this they have achieved reductions of circa 50% but as a result output has to be restricted so as not to overload downstream processes. We are also undertaking a trail at Pontsticill to install carbon media in our filters to further enhance removal but this, even if successful is not a long term solution. This option is not available at Llwynon due to the type of filters present.

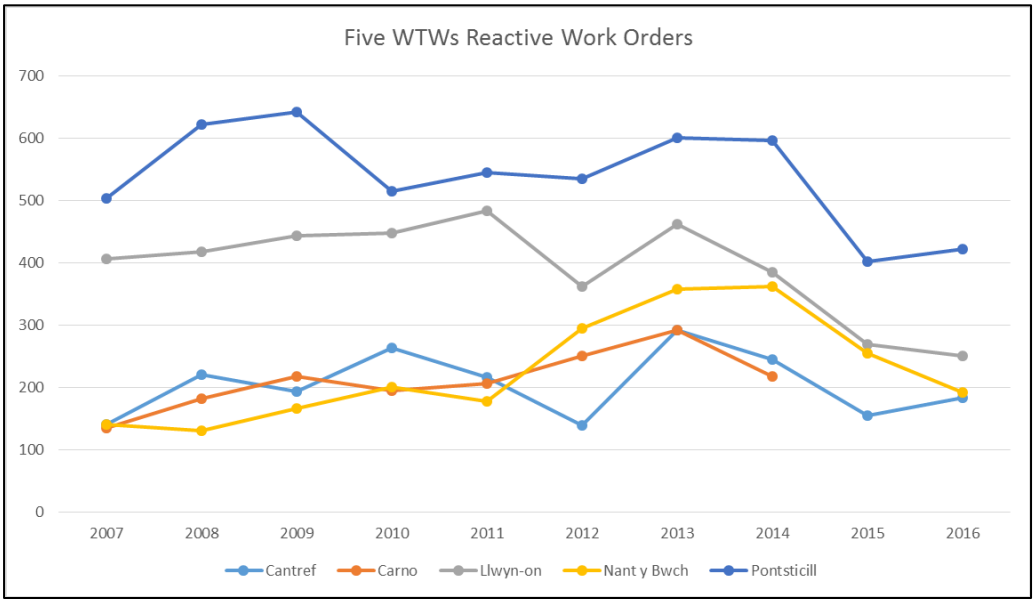

Figure 3: Reactive work orders at five WTW in the Cwm Taf area in the last ten years

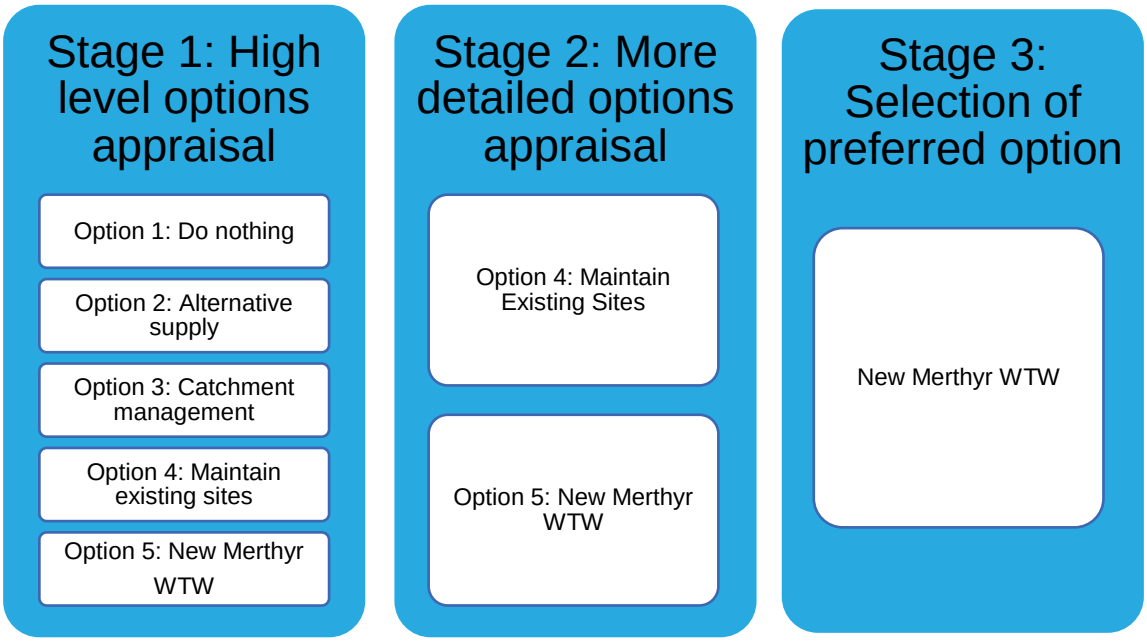

Figure 4: Option assessment process

Options

Over the last five years we have considered a range of diverse options to deliver our aim of providing our customers with high quality drinking water and address the problems discussed. As shown in Figure 4, the options considered include:

- Option 1: Do nothing
- Option 2: Alternative supply
- Option 3: Catchment management
- Option 4: Maintain existing sites
- Option 5: New Merthyr WTW

Stage 1: High level options appraisal

Option 1: Do nothing

This solution proposes to do nothing in AMP7 and to postpone any programmes of work until AMP8 or later.

With DWI notices already in place and customers noticing changes in taste and odour, it was considered that it is not feasible to do nothing in AMP7. We need to improve our service provision as our customers are already experiencing poor service.

Option 2: Alternative supply

We have assessed the potential to supply the Cwm Taf area with raw water resources which are treated elsewhere or are from an alternative location. This was assessed in association with our long-term WRMPs and within the Strategic Area Investment Plans.

The raw water resources are key to service provision in this area and account for roughly 25% of our total output, over 200Ml/d. Therefore, it is not feasible to underutilise this raw water resource. The costs associated with treating the raw water from elsewhere are high.

Option 3: Catchment management

This solution is to increase the catchment management programme in the area to address the deterioration of raw water quality in the medium-term to long-term.

Our assessments have indicated that catchment management alone will not achieve the required water quality for customers. As part of our PR19 investment plans we have a programme of catchment interventions that will seek to stabilise raw water quality in the Brecon Beacons catchment area. This will not prevent the need to provide improved water treatment capability. This is because the benefits of such a programme will be realised in the medium-term to long-term and cannot be defined absolutely.

Option 4: Maintain existing sites

This solution includes the maintenance and upgrade of the existing sites over the next 40 years. This includes three scenarios for maintaining the three, five or eight WTW described in Table 2.

This solution includes a programme of maintenance to replace existing assets, including buildings, tanks, pumps, instrumentation and control equipment, and providing new process streams to treat taste and odour compounds. Upgrade work to the process streams would need to be located at an alternative site due to the space limitations, and the listed buildings on the existing sites.

There are risks associated with rebuilding and refurbishing significant parts of existing WTW whilst maintaining continuous water production.

We took this solution forward to more detailed optioneering, described in the following section.

Option 5: New Merthyr WTW

This solution includes the development of a new multi-stream WTW to replace the existing sites for the three, five and eight WTW described in Table 2.

This will provide a larger, more flexible site which uses the local topography to utilise raw water from multiple sources and optimises raw water, water treatment and distribution pumping.

We took this solution forward to more detailed optioneering, described in the following section.

Stage 2: More detailed options appraisal

This stage of assessment considered options 4 and 5 in more detail. This was considered by developing three scenarios, which compared maintaining three, five or eight existing sites with providing a single new WTW. The details of which WTW were considered for each scenario is shown in Table 2.

The assessment included on-site condition assessments, asset deterioration modelling, analysis of existing water quality results and desktop obsolescence assessments for Information Controls and Automation (ICA) equipment.

WTW	Three WTW scenario (new 225Ml/d WTW)	Five WTW scenario (new 264Ml/d WTW)	Eight WTW scenario (new 297Ml/d WTW)
Cantref	✓	✓	✓
Llwynon	✓	✓	✓
Pontsticill	✓	✓	✓
Nantybwch		✓	✓
Carno		✓	✓
Hirwaun			✓
Tynywaun			✓
Maerdy			✓

Table 2: WTW considered in scenarios for options 4 and 5

We found early on in this assessment that replacing eight works would not provide appropriate benefits for the investment required, due to high associated pumping costs. This option was abandoned and a more detailed analysis of replacing five and three WTW only was undertaken. We originally planned to replace the five WTW with a new works of 264Ml/d the combined capacity of the existing sites. But our assessments found that the most effective size of the replacement WTW should be a 225Ml/d site for both the three and five WTW scenarios. This is because building a 225Ml/d WTW provides the capacity to meet existing and future demand for both the three and five WTW scenarios, as well as providing the capability to maintain the site without affecting supply to customers. The improved reliability and flexibility of the multi streamed site design will reduce the required capacity of the five WTW option from 264Ml/d to 225Ml/d.

The costs associated with each option were also assessed. This included 40 year totex, capex and opex to enable the long-term asset whole life costs including maintenance needs. Costs are shown in Tables 3 and 4. From this work, our preferred option is option 5, a new Merthyr WTW. This is because it is more financially beneficial to build a new works than to maintain the existing sites and this new site will also be more flexible and robust. The comparative costs are shown in Table 3.

Stage 3: Assessment of preferred option

We have determined option 5, a new Merthyr WTW, to be the most appropriate solution, both commercially and practically, to resolve the issue of poor water quality and to meet future demand.

Over a 40 year period, we found that when considering totex, using net present value (NPV), the whole life costs were lower to create a new works than maintaining the existing sites. The majority of this investment is required over the next 20 years, see Table 3. The new site option allows the WTW to be developed offline, on a new site, and includes the necessary raw water and network connectivity.

Opex is lower on new sites compared to existing sites due to lower on-site pumping requirements and the inclusion of power generation and more efficient mechanical and electrical equipment at the new sites. There are also lower fixed costs associated with operating a single new site compared with three or five smaller sites.

	40 year opex (NPV)	40 year capex (NPV)	40 year totex (NPV)
Three WTW scenario			
One new works	£96.4m	£228.8m	£325.2m
Maintenance of three works	£127.0m	£240.0m	£367.0m
Five WTW scenario			
One new works	£113.6m	£263.2m	£376.8m
Maintenance of five works	£165.1m	£289.8m	£454.9m

Table 3: Pre-efficiency NPV cost estimates for each scenario over 40 years

The main difference in costs between the new three and five WTW options is the cost of laying connecting pipework from the new works to Nantybwch and Carno WTW and the associated pumping station capex and pumping opex.

Currently, the cost benefit of rationalising the five works is unclear, with uncertainty over the timing of upgrades required at the additional two sites. We have decided to implement the programme in a phased approach, concentrating on the rationalisation of the three works during the first phase in AMP7 and AMP8. We will continue to evaluate the costs associated with including the additional two works. We expect that the case will be proven for rationalisation of the further two works (Nantybwch and Carno) in AMP9 or AMP10.

These opex and capex estimates are shown in Table 3 and Table 4.

	AMP7 capex pre-efficiency	AMP8 capex pre-efficiency	Solution opex post completion (annual)
Three WTW scenario			
One new works	£91.5m	£154.6m	£3.2m
Maintenance of three works	£63.4m	£81.4m	£4.8m
Five WTW scenario			
One new works	£91.5m	£189.3m	£3.9m
Maintenance of five works	£88.4m	£94.5m	£6.2m

Table 4: Pre-efficiency costs in AMP7 and AMP8

4 Preferred option

Description

Our preferred option is to create one new Merthyr WTW to replace three existing WTW which are currently running ineffectively (Pontsticill, Cantref and Llwynon WTW). This provides us with the opportunity to resolve the maintenance and raw water quality issues over the next 40 years in the most cost effective way.

This scheme will provide the following benefits:

- Integrates into a single site all the additional processes required to provide good water quality;
- Improves robustness and redundancy in the network by creating 24 hours of storage;
- Allows improvements to be made without risk of impacting the water supplied to customers;
- Maximises the use of available raw water in the area by updating the water treatment processes;
- Provides ability to adapt and expand the WTW as required in the future;
- Provides the opportunity to close two further WTW at Carno and Nantybwch when the additional investment becomes cost beneficial; and
- Increases the power resilience of the site.

The new works and its associated storage will have the operational flexibility to provide a peak output of 225Ml/d. This will also include an additional 24 hours of storage of the average demand of 160Ml/day, increasing the current storage in the Cwm Taf area by 68%. The new Merthyr WTW will contribute to meeting demand for this area over the next 30 years to 2050, as defined within the WRMP. It will also enable maintenance to be undertaken in the future at the new WTW and maximises the use of gravity raw water sources, reducing the amount of raw and treated water pumping at other WTW within SEWCUS.

The new Merthyr WTW will rely on the Taf trunk mains. These mains need to be repaired, reinstated or replaced in the next 10 to 15 years to facilitate the full resilience and cost optimisation benefits of the new WTW.

The reinstatement of the Taff trunk mains in AMP6 and future improvements will provide the network capacity required to continue to supply this area.

The Merthyr WTW project will also include the following network improvements:

- Connectivity of the raw water mains;
- Additional potable water mains links to enable the new WTW to be connected to the existing distribution network; and
- Upsizing a 2.2 km section of the Taff trunk mains to increase the reliability and capacity of the existing mains.

Once the strategic network links have been improved during AMPs 9 and 10, the new WTW and network will have the ability to move water from East to West. This will enable it to provide a back-up supply to Swansea in the event of planned maintenance or catastrophic failure.

The Phase 1 solution proposed will address concerns that the available storage at Pengarnddu SRV is not sufficient to supply demand in the area during an outage at Pontsticill WTW. The proposed solution will address this issue either through reducing the supply area from Pengarnddu SRV or through providing additional storage. The proposed solution will be presented to the DWI on the 30th September and is likely to form the basis of a legal notice.

Cost

The project will have a 40 year pre-efficiency totex of £455 million. The scheme has pre-efficiency capex of £311 million. £91 million of the capex will be budgeted for delivery in AMP7, and £155 million will be budgeted for delivery in AMP8. This represents a step change in our WTW capital maintenance spend.

We are presenting this option as a special factor case due to the size and duration of the investment.

5 Cost efficiency and innovation

Innovation

As part of our high level options appraisal (Stage 1 shown in Figure 4), a range of innovative solutions have been considered. We constantly look for opportunities to undertake research and innovate to improve performance as outlined in our 2050 strategy.

We aim to involve customers at the outset of any scheme in order to enable them to help co-create solutions. We also have a strategic ambition to downsize the overall number of WTW across the business, from 63 to 39.

Innovative solutions considered in the high level options appraisal include non-standard water treatment processes emerging in the industry such as:

- The membrane filtration process used at Hall WTW by Anglian Water; and
- The ceramic micro filters at Mayflower WTW by South West Water

These processes could reduce construction costs. Whilst these processes are new to the UK, and their benefits have not yet been proven, they will remain an option to be assessed at the design stage. Further confidence in these processes will be gained when they have been commissioned and in operation for longer than 12 months.

Another innovative solution which has been explored is a method for improving the use of raw water resources through sampling, monitoring and control so that the optimal source and draw off can be utilised for the new WTW.

The integration of other innovative techniques will be delivered throughout the scheme, including but not limited to:

- Installation of multiple process streams to provide flexibility of operation and improved supply resilience, see Supporting Document 5.8E.2; and
- Development of a smart network system to give maximise raw water resources and optimise operational costs.

We will include new technology on site to improve efficiency. For example, the new WTW will provide an increased level of automation, monitoring and control. This will provide us with more real-time information on water quality enabling us to deal with customer contacts and ultimately improving the final water quality. It will enable us to optimise plant efficiency, reducing opex, providing savings that we can pass on to our customers.

We have also considered a number of hydroelectric power generation schemes within the options for the new WTW. This will reduce our pumping costs, improve our resilience to potential future power outages and mitigate against energy price rises.

Innovative solutions which have been identified will be further assessed through detailed feasibility to determine whether they will improve the efficiency of the system and therefore reduce scheme costs.

Further opportunities for innovation will also be explored further as the scheme progresses to detailed feasibility stages.

Partnering and co-creation

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

The new Merthyr WTW will work in conjunction with our Brecon Beacons Mega Catchment project. The aim of the Brecon Beacons Mega Catchment project is to work collaboratively with the Brecon Beacons National Park and other land users to develop new ways of working, including the tools and methods used by land managers to aid them in slowing and filtering raw water before it enters our impounding reservoirs. The benefits of this work will be a reduction in the level of fertilisers, pesticides and silt entering our catchment, which will result in a stabilisation of raw water quality within our impounding reservoirs, and reduced treatment requirements at our WTW.

This project is forecast to slow the deterioration of raw water quality into the reservoirs that will supply the new Merthyr WTW.

6 Value for money and affordability

Impact on customer bills

The replacement of three difficult to maintain WTW with one new WTW with 160Ml of storage has been identified as the preferred option. This will provide long term cost savings compared to the costs of continuing maintenance and upgrades of the existing WTW for a 40 year period. Due to our unique customer ownership model, the cost savings accrued will be passed on to our customers through affordable bills and customer dividends.

Value for money

Value for money was assessed using totex NPV over a 40-year period. This highlighted that it was more cost beneficial to replace three WTW with one new WTW. An assessment of the project payback has highlighted that the Merthyr WTW to replace three WTW will payback within 27 years and is the most cost beneficial option over a 40-year period.

The costs associated with the five WTW scenario were such that it was not progressed following a review of scope cost and benefits in December 2017. This was because the capex and opex costs associated with the additional raw and treated water mains and pumping stations required to connect the new works with the existing distribution network and raw water were not cost beneficial.

The Black & Veatch review of the solution options for the project has concluded has confirmed the cost benefit of building a new WTW to replace three existing WTW. For further information see supporting document 5.8E.1. We are still considering the case for including a further two works in the scope but have postponed this until a later date, when the benefit can be verified

7 Delivery

Procurement

Once the full scope of work has been defined and agreed we will undertake a procurement assessment to select the most cost-effective way for project delivery. One of the options being considered will be direct procurement because the project has a value of over £100 million totex.

An independent assessment of the applicability of direct procurement is being undertaken to initially assess the technical merits of direct procurement for customers (DPC), followed by a business case assessment where appropriate.

Programme

Before AMP7 commences, we intend to finalise the option to take forward. The ten year project delivery programme is outlined in Table 5. We will undertake detailed feasibility during year 1 of AMP7 (2020).

The environmental impact assessment, the public consultation and planning permissions are planned to be obtained in 2021.

The WTW is estimated to take five years to build, construction is scheduled between 2023 and 2028. Our current plan will be to deliver the 160 Ml storage reservoir and the pipework associated with the new tank first, to provided additional resilience, bringing this into service around the end of AMP7 / start of AMP8.

The whole project is planned for delivery by the end of AMP8 in March 2030 including full commissioning of the works and the associated water mains. A timeline is shown in Table 5.

Year	Activity	Planned spend (£ millions)
2020	Land purchase, detailed feasibility, preparation of the planning application and environmental impact assessment as well as ground, archaeology, utility search and public consultation	8.9
2021	Completion of detailed feasibility, planning application and environmental impact assessment. Procurement process (direct procurement/tender etc.) 6 months	8.6
2022	Complete the procurement process and start construction on WTW site and pipelines	20.2
2023	WTW construction and pipeline construction	21.3
2024	WTW construction and pipeline construction	32.4
2025	WTW construction and pipeline construction	46.4
2026	WTW construction and pipeline construction	47.3
2027	WTW construction and pipeline construction	36.4
2028	Completion of construction of WTW and pipelines	16.6
2029	Commissioning of the WTW and pipelines including beneficial use	8.0

Table 5: Programme of works for the next ten years

Risk mitigation and customer protection

As part of the detailed feasibility study we will produce a risk register to outline the key risks associated with the planning and delivery of the project. The risk register will outline potential risk mitigation measures. The risk register will be produced as part of the detailed feasibility study.

We recognise that the biggest uncertainties associated with the project are the following:

- Our ability to purchase the land for the site;
- Our ability to achieve planning permission;
- Our ability to meet the relatively short ten year timescale for delivery;
- The requirement to lay additional pipelines and the disruption to our customers during the build;
- The risk to water quality during the commissioning process for the WTW, storage reservoir, and pipes;

Objections from the local council or customers could cause delays to the outline programme or result in a less effective site being chosen. Until detailed feasibility has taken place, there remains considerable uncertainty in the project costs. Some mitigation measures include, but are not limited to:

- Winning the support of our regulators including DWI, Natural Resources Wales, The Welsh Government and Ofwat. The support of our regulators will allow us to progress to detailed feasibility and development of the project, which will reduce the uncertainties outlined above.
- The development of a detailed business case.
- Early purchase of land will reduce uncertainty in availability of the preferred site.
- The risk to water quality during the commissioning process will be mitigated by a detailed risk assessment and method statements for each stage of work.
- Disruption of additional pipeline installation will be mitigated by working with the local community to minimise disruption during the building process.
- Early consultation with the public and regular liaison with the council from the project manager and the designer for the site.

8 Assurance

Governance

Our board will review this project in detail before the business plan is submitted in September 2018. The outline has been shared with them and our stakeholders through the development of our Water 2050 strategy.

The project has also been shared with the DWI through submission of the Annex A reports in order to gain their support of our PR19 plans, DWI is due to feedback in May.

Cost assurance

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

Black and Veatch has reviewed the initial work undertaken by Arup and undertaken additional high-level feasibility work to develop costs, see supporting document 5.8E.1. The output of this work has been an agreed capacity for the new WTW of 225Ml/day with 160Ml/day clean water storage tank, see supporting document 5.8E.3, the treatment stages for the WTW. See supporting document 5.8E.2 and the agreed raw and treated water pipelines.

We calculated the 40-year totex using our UCD, a cost model which is annually updated and externally verified every five years, most recently by Mott MacDonald Bentley. The 40-year capex was modelled using UCD with a specific benchmarking process undertaken by Mott MacDonald Bentley. The 40 year opex for the new WTW was calculated using the cost data for existing sites; chemicals, power, sludge and operator costs from our Felindre WTW which has a capacity of 240Ml/d and an average output of 150Ml/d.

Customer consultation assurance

Our customers have indicated that they are supportive of investments to reduce interruptions to supply, improve resilience and remove regular water quality, taste and odour issues across our supply area[x].

Customers have also been consulted on bill acceptability, which indicated that currently customers are happy with the levels of current bills. This investment cases is not significant enough to materially impact bills. During summer 2018, we will be conducting additional research on the acceptability of our proposed bill changes.

The Customer Challenge Group have reviewed Welsh Water 2050, which includes this project. They will also be reviewing our PR19 business plan.

Monitoring and future assurance

Measures of success

The delivery of this project will impact on our performance, as monitored through our measures of success. In particular through:

- Water supply interruptions; and
- Acceptability of water (odour, taste, appearance)

Future assurance

The detailed feasibility stage is currently planned to be undertaken in AMP7. Additional assurance processes will take place at this stage.

Supporting documents

5.8E.1 - Cwm Taf Water Supply Strategy Review Sept 2017 to April 2018
5.8E.2 - Multiple stream example for Merthyr WTW
5.8E.3 - New Merthyr Works Capacity Assessment
5.8E.4 - DWI Notices
5.8E.5 – Cwm Taf Water Supply Strategy cost-adjustment summary form

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[x] From our consultations: “2017 Summer Consultation Report”, October 2017 and “PR19 Willingness to Pay Research Final Report”, December 2017