

Ref 5.8H

## PR19: Customer Minutes Lost Service Improvement

September 2018



@Arup

# Customer Minutes Lost Service Improvement

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## Executive summary

### Driver for investment

Our customers expect a high level of reliability in relation to their supply of water. Our challenge over the next AMPs is to improve our reliability of supply performance, measured as Customer Minutes Lost. This is a calculated value of supply interruptions greater than three hours (expressed in minutes per property). With our large rural network and dispersed population centres this represents a significant ongoing challenge to our business.

In previous investment cycles we have targeted hotspots of mains bursts activity but during AMP6 our approach has changed. This has included a review and improvement of our operational response to burst mains events resulting in a significant reduction in the time that customers are affected by events. We have also targeted the early identification of burst mains through improvements to bulk metering and pressure monitoring to move to a more proactive method of responding to burst events.

As this measure is prominent within the industry and we are not a strong performer we continue to look for ways to improve our performance. We are already seeing the benefits from our changes made in this AMP period and are forecasting a reduction in the customer minutes lost measure from 22 in 2015-16 to 12 in 2019-20. We will also focus on improving our strategic storage and interconnectivity of our trunk main system.

### The Investment

We propose to invest £104million during AMP7 to deliver customer minutes lost improvements across the company. Through reviewing our strategic objectives, key risks and the progress we have made during AMP6. Our holistic approach will use a combination of investments to improve our response to incidents and the resilience of our catchments, water resources, pipelines, clean water storage and studies/plans to reduce our risk in the short to medium term and inform our medium to long term interventions. A summary of our planned programme for delivery in AMP7 by the main investment types is shown in Table 1 below with the associated investment required.

AMP7 Whole CML Programme	Total by Investment Area
SMART and Metering Improvements	£15.81m
Emergency Planning and IS Systems Improvements	£14.85m
Strategic Network Resilience Schemes	£27.74m
Improvements to Service Reservoir Storage	£33.36m
Worst Served Customers (low pressure and interruptions)	£8.66m
Resilience Studies and Plans	£3.99m
<b>Total programme (pre-efficiency)</b>	<b>£104.41m</b>
<b>Total programme (post-efficiency challenge)</b>	<b>£95.80m</b>

Table 1: Integrated intervention programme with enhancement for AMP7

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## 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 through fewer interruptions to supply.



**Put things right when they go wrong:** Reduce the number and repair times for burst mains and leaks by improving our response times through improved monitoring and operational practice.



**A better future for all our communities:** Reduce the number of interruptions to supply for all our customers with customer minutes lost reduced to bring values in line with industry averages.

## Delivering for the future

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



**Climate change:** More extreme temperatures will increase the likelihood of burst pipes in the future.



**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 and cast-iron water mains present significant issues with reliability and water discolouration.

## Delivering our Strategic Responses

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



**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.



**Addressing our worst served customers:** Undertaking interventions to enable minimum service standards to be delivered to all customers.

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## 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:

Measure of Success	End of AMP6 Position	End of Investment Position
Supply interruptions greater than three hours (expressed in minutes per property)	12	8
Worst served customer for water service	1131	871
Asset Resilience (water network+ below ground assets)	47%	56%



## 1 Delivering our customer outcomes

### Need for investment

This investment is required to achieve our plans to deliver improvements to the reliability of supply to all customers - as outlined within our long-term strategy, Welsh Water 2050.

Our historic performance for Customer Minutes Lost (CML) has been consistently worse than the industry average across England and Wales, as illustrated in

below.

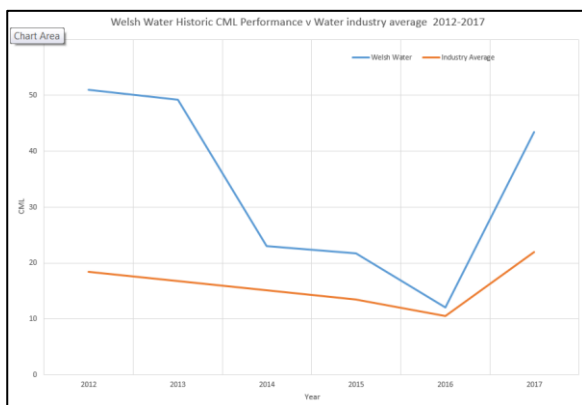


Figure 1: CML performance

Our comparatively poor CML performance is attributed to the topography and the large distribution network that we require to serve our widely dispersed customers. This limits the opportunity to provide alternative supplies and increases the length of time that it takes to identify, locate and mobilise to repair a burst main. In common with the UK water industry our pipeline system is steadily aging, which along with climate change is likely to result in a greater number of burst mains over time.

Approximately 11,000km of our water mains are made of cast iron, which amounts to 40% of our entire mains network. These pipes have reliability issues, and on average experience 30 bursts per 1,000km for cast iron pipes, compared to 6 bursts per 1,000km for plastic pipes.

The other pipeline material which results in a significant number of failures are asbestos cement (AC) mains. There is approximately 3,500km of AC mains in our area approximately 12% of our entire mains network. Over the last five years there have

been around 1,000 bursts and leaks per year for mains of this type of material, a rate of nearly 60 bursts per 1,000km.

Our water mains network consists of more than 5,000km of pipelines ranging from 200mm to greater than 1500mm. Although these trunk mains generally have a lower probability of failure, when compared with smaller diameter mains, when they do fail they affect large numbers of properties.

Due to the influx of tourism we attract in the summer months, our network can also experience large seasonal flow variations. These variations are in excess of 200MI/d for the company and result in localised wide variations of pressure and flow, which create a high risk of failure across our distribution network.

In 2017 we were the third worst performing company across the industry for interruptions to supply. The majority of long term interruptions were linked to the failure of trunk mains. These failures resulted from burst main events, transient flow and pressure variations during periods of high demand and extreme weather conditions.

The recent cold weather event and regular outages from our Pontsticill, Llwynon and Cantref WTWs has been monitored by the Drinking Water Inspectorate (DWI). The DWI have indicated that improvements to storage are required at our Pengarnddu service reservoir to reduce the likelihood of interruptions to supply and the associated water quality impact during AMP6.

Our Cwm Taf Water Supply Strategy will provide a greater level of storage, 160MI, which will provide 24 hours storage at average flows for the Northern part of SEWCUS. This separate investment case supports our strategy for improvements in the reliability of our supply.

### Views of our customers and stakeholders

We have undertaken extensive consultation with customers through our PR19 preparation programme, including our Welsh Water 2050

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strategy consultation held in the summer of 2017, which engaged with 19,980 of our customers.

During our consultation for Welsh Water 2050, providing enough water for all was amongst the most important aspects of our future plans, followed by providing reliability of supply and water quality<sup>1,2</sup>. Customers have stressed that they want stable water quality and reliability of supply, including resilience to extreme events.

We have consulted with our customers and stakeholders regarding their service expectations for reliability of their water supply. While many of our customers are generally happy with the current levels of service<sup>3</sup> customers have also told us that long term interruptions of greater than 8 hours have a big impact and are considered to affect health and wellbeing. However, interruptions of three to six hours, resulting from situations outside of our control, for example the weather, are not regarded as a big problem.

We have spoken with our customers to better understand their willingness to pay (WTP) for improvements to the reliability of water.

Customer feedback measure	WTP per property
Short-term interruptions to water supply (3 - 6 hours)	£636
Short-term interruptions to water supply (6 - 12 hours)	£702
Long-term interruptions to water supply (24 – 48 hours)	£4,009
Long-term interruptions to water supply (up to 7 days)	£6,743

Table 2 provides a summary of what our customers would be willing to pay per affected property, demonstrating that our customers consider reliability of water supply to be an important area of investment.

Customer feedback measure	WTP per property
Short-term interruptions to water supply (3 - 6 hours)	£636
Short-term interruptions to water supply (6 - 12 hours)	£702
Long-term interruptions to water supply (24 – 48 hours)	£4,009
Long-term interruptions to water supply (up to 7 days)	£6,743

Table 2: Summary of stakeholder feedback and proposed willingness to pay (WTP)

<sup>1</sup> WW2050 Qualitative Debrief, 2017- engaging with 108 customers

<sup>2</sup> Summer Consultation, Welsh Water 2050, 2017

<sup>3</sup> Performance targets qualitative, Welsh Water consultation, June 2017

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## Benefit for our customers

### Reliability of supply

Our proposals are expected to improve the reliability of our water supply to customers. For example, our proposed investment in additional trunk mains and clean water storage will reduce the risk of long term outages in our main population areas and increase the resilience of our strategic network.

Our plans also include resilience investment, which will give us greater flexibility in the long term to respond to events with minimal impact on customers.

Table 3 shows both our historic CML performance (as also illustrated in Figure 1) and our forecast performance for the remainder of AMP6 and through AMP7. The figures are based on our proposed level of CML investment and include the benefits of our proposed interventions.

Our forecast position by the end of AMP6 is 12 minutes per property for supply interruptions greater than three hours. This is forecast to fall to 8 minutes per property by the end of AMP7.



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AMP	Year	Source	Supply interruptions >3 hours (expressed as minutes/ property)
AMP5	2012-13	Actual	51.0
	2013-14	Actual	50.4
	2014-15	Actual	23.0
AMP6	2015-16	Actual	21.7
	2016-17	Actual	12.2
	2017-18	Actual	43.3
	2018-19	Forecast	12.0
	2019-20	Forecast	12.0
AMP7	2020-21	Forecast	11.2
	2021-22	Forecast	10.4
	2022-23	Forecast	9.6
	2023-24	Forecast	8.8
	2024-25	Forecast	8.0

Table 3: Actual and forecast CML performance per year

## Acceptable water

This investment proposal is linked to our plan to improve the appearance, taste and odour of our water. For example, our proposed investment in additional mains capacity to address interruptions to supply may also help to reduce the number of discolouration events across our network.

## 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.

## Wider benefits for Customers

The tools we have put in place and will continue to develop have a wider benefit to our customers. Having more of our network covered by mains hydraulic models means that we can respond quicker to questions on how the system works – this has brought benefits in two areas in particular. Firstly our Developer Services team are now able to respond much quicker to requests from developers to connect to our network and we are frequently top of the industry in customer satisfaction for this. Secondly our operational teams can assess both planned and emergency work more effectively, risk assessing the impacts to the network in real time and minimising or eliminating impacts to customers.

## 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 our customer minutes lost performance are set out below.

### Climate change

We expect climate change to have an influence on our distribution network. There will be increases in peak demands as well as larger variability of ground movement after freezing and dry weather periods. This will result in increased numbers of pipeline failures, resulting in low pressure and interruptions to supply for our customers.

The recent cold weather event in March and the current dry period in the summer of 2018 are examples of the impact of climate on our network and the knock on effect to our customers. A key issue was the ability to access burst locations and water treatment works when deep snow was on the ground resulting in higher than usual times to repair and interruptions to supply for our customers. This has not been experienced during the recent hot weather spell.

### Changes in customer expectations

Changing customer and societal expectations may result in less tolerance for even short term interruptions so we need to have a more resilient network. We should also ensure a minimum universal service standard. This will mean that the service we provide our worst served customers will need to improve.

### Protecting essential infrastructure

Industrialisation and urbanisation in parts of our region led to the rapid construction of water supply infrastructure in the late 19th and early 20th century. A growing number of physical assets constructed during this period are expected to reach or exceed their design life within the next 30 years.

Our ageing iron water mains for example are increasingly at risk of catastrophic failure. As well as their age and condition, climate change and

increasing volumes of traffic where pipelines cross roads, dual carriageways and motorways are all contributing to the increased likelihood of mains failure and long term outages.

### Land use change

Deindustrialisation in some of our supply areas means that our network is now oversized in places. When former industrial sites are developed contaminated land issues increase risk of corrosion and damage to our trunk mains and higher levels of failure at these locations.

### Legal duties

Our target to improve interruptions to supply (CML) performance is partly driven by the need to maintain and improve drinking water quality for our customers. Between 2015 and 2017 the DWI have issued notices to make improvements in 32 specific water supply zones. A greater level of resilience to our network resulting in fewer interruptions to supply will have a beneficial effect on the acceptability of water.

### Planning for the future

#### Long-term planning

This programme links with our Water Resources Management Plan (WRMP) and our long-term strategy, outlined within Welsh Water 2050, to improve the reliability of drinking water supply systems, protecting our critical water supply assets and achieving acceptable water quality for our customers.

#### Building on progress

Our proposals are not the start of our journey. We have made significant efforts in recent AMPs to improve the resilience of our drinking water supply. SEWCUS is an example of a conjunctive system which provides resilience of water supply to customers in South East Wales. Our programme of work will build on the existing system by increasing the levels of connectivity and providing clean water storage which will allow operational staff to react and re-zone the water distribution system to maintain supplies to our customers.

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## AMP6 Progress

We have developed and started implementation of a long term customer minutes lost strategy to guide our improvements in this area. Our strategy adopts a two-pronged approach to maximise the improvements that can be made.

The first aspect relates to improvements in operational practices. We have implemented a range of changes to how we manage the risk of interruptions to supply in our network, including:

Approach to planned maintenance, night work, improve risk assessment and project planning;

Extensive valve training for internal and third-party operators;

City & Guild training for Technicians to better understand hydraulic data and root cause analysis;

Low-velocity flushing;

Emergency planning review and improvements;

A new third-party partnership for standpipe management.

The second part of the strategy we will deliver is an in Zone Pressure Monitoring Programme. The programme includes the installation and data provision of up to 3,000 pressure points across the Network. We have installed 2,070 of these so far during AMP6. The data outputs of the programme will enhance our operational performance reducing the number of interruption events.

We have already commenced on our SMART journey with the establishment of the AMP6 programme of work which sets out to build and operate a SMART network of interconnected assets. This in conjunction with the use of existing and emerging technologies, will produce timely and accurate data in order to allow analysis and predictive processes to be carried out with the aim of supporting our customers. The capabilities that the AMP6 programme realises capitalises on technological advances, improving the service

performance and resilience of our assets via remote sensing, data analysis and automation in order to solve problems before they happen.

Our zonal studies programme combines hydraulic modelling, statistical analysis, and capture of the experience of local operations to identify the root cause of performance issues. The outputs from the studies are evidential, auditable and quantitative.

This allows for targeted investment within the zone to most appropriately improve long and short term performance for the benefit of our customers. Although the main focus of these studies are improvements to the acceptability of water there are also benefits to CML levels.

Our emergency planning and response has improved during AMP6 through an increased number of tankers, tanker base locations and other emergency equipment. This has allowed us to continue to offer a piped potable water supply to our customers in the event of critical distribution network failures.

Table 4 provides a summary of the network improvements we have made to date, largely driven by the zonal studies programme. It shows that we have cleansed more than 182km of our mains and replaced a further 143km of mains.

Intervention	2016-17	2017-18 to date	Cumulative Total
Total length cleansed (km)	18.49	164.26	182.75
Total length renewed (km)	80.25	62.65	142.90

Table 4: Summary of zonal studies outputs

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## 3 Options

### Background

Our historic performance for customer minutes lost has been consistently worse than the industry average across England and Wales. We are committed to improving our performance in this area, and have made significant efforts in AMP6 to develop our processes to allow us to do so.

To achieve this our customer minutes lost operational strategy has resulted in reductions to the response time and techniques used to maintain water supplies to our customers. We have developed a Strategic Asset Scorecard which assesses the risk associated with our key assets. We have also undertaken a number of high level feasibility assessments to enable us to more fully understand strategic pipeline schemes for strategic links between SEWCUS and the Tywi conjunctive use system.

In developing our AMP7 programme we have considered a range of options to support improvements in performance which include; robust water treatment, installation of strategic storage service reservoirs, enhancements to our trunk mains and further development of our SMART networks including the use of data analysis. These options have been grouped in the following programmes of work;

- Installation of strategic clean water storage
- Laying additional strategic pipelines
- Resilience investment in identified pinch point locations
- Improvements in service for our worst served customers
- Investment in SMART including data collection and analysis tools and equipment

### Installation of Strategic Clean Water Storage

Across our area the capacity of some of our Service Reservoirs (SRVs) severely limits our ability to respond to events without an impact on customers. During AMP7 we are planning to increase the level

of capacity at two sites, Llwynypia Quarry SRV, Broomy Hill WTW clean water storage and if required following assessment replace four SRVs in the Rhondda Valley because of structural risks associated with their tank design. The whole programme will enhance the resilience of our SEWCUS and Hereford distribution systems reducing the risk of interruptions to customers supply.

### Laying Additional Strategic Pipelines

Historically widespread mains replacement would have been the solution to reducing mains bursts, and therefore interruptions to supply but we now recognise that is not always a cost beneficial approach. Consequently we have targeted the pipelines which serve the majority of our customers. Our distribution network has a number of strategic pipelines for example SEWCUS and the Tywi Conjunctive Use System.

We have targeted improved connectivity between these two strategic systems. During AMP6 this has been assessed with a high level feasibility undertaken to improve the East–West and West–East connectivity. The installation of this pipeline will improve the resilience of our Tywi conjunctive use system which is heavily reliant on Felindre Water Treatment Works by connecting it to SEWCUS.

In North Wales we are planning to improve our Alwen Trunk main including the installation of a bypass around the Bwlch Tunnel. The tunnel bypass combined with other improvements along this main will facilitate reliable bidirectional flow and increase resilience for customers.

### Resilience Investment in Identified Pinch Point Locations

Our strategic assets scorecard assesses the risk associated with our key assets including interruptions to supply. Stakeholders from across our area have reviewed the strategic assets including pipelines and identified key assets and sections of main. Our plan during AMP7 will be to assess critical crossings and define a scope of work to put in a permanent method to reduce the risk of a long term intervention for example cross connecting existing mains or installing a second

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pipeline where mains cross trunk roads, rivers and railways. In addition there will be emergency flow restoration plans developed to provide a short to medium term reduction in long term interruption risk.

## Improvements to Service for Worst served customers

We have analysed the geographical locations of our worst served customers for low pressure and interruptions to supply performance. This has helped to ensure that we also capture worst-served customers who are not located in our zonal studies or where the solutions have not been prioritised within the intervention programme.

We have reviewed customer complaint details and our DG2 (low pressure) and DG3 (interruptions to supply) worst served customers who receive consistently poor service. Our programme of work will target the largest clusters of poorly served customers and in exceptional cases single customers.

## Investment in SMART Including Data Collection and Analysis Tools

We have improved our distribution network knowledge through our zonal study programme. A zonal study is a holistic, Source to Tap investigation into the factors influencing performance at a Water Quality Zone level. Through the utilisation of all mains hydraulic modelling, statistical analysis and by capturing the experience and knowledge of local operations the Zonal Study is able to identify the root cause of poor performance within the Water Quality Zone in an integrated approach.

All the outputs from the Zonal Studies are evidential, auditable and quantitative. It therefore allows for targeted investment within the zone to the most appropriate long and short term solutions for the benefit of our customers and the business. Zonal Studies are a collaborative and integrated “business as usual” tool that acts as a streamlining tool through the capital gateway process and gives a joined up strategic approach to investment.

The methodology follows the four-step asset management process:

- **Plan** – target areas of poor performance;

- **Do** – full data and hydraulic model performance review to identify root cause;
- **Check** – operational review of options, select most cost beneficial; and
- **Act/Review** – deliver schemes and measure benefit

This process is cyclical and is part of our business-as-usual delivery. The process document is included as Supporting Document 5.8H.1.

As outlined earlier in this document, the level of performance for acceptability of water has been assessed across all of our 83 water distribution zones.

Of these, 38 distribution zones were selected for zonal studies to be undertaken. The worst performing 16 had the solution outputs selected for completion during AMP6 and the solution outputs will provide CML as well as AoW benefits.

During AMP7 of the remaining 22 zones, the worst performing 17 zones have been prioritised and recommended for further interventions to be undertaken based on the recommendations of the studies and prioritisation of the benefits based on AoW. There will be CML benefits but these, although defined have not been the primary driver for project selection.

In order to analyse future needs our zonal studies have been supported by hydraulic modelling, data analysis and operational intelligence from a range of teams across our business. We have also made use of deterioration models to predict the pipeline failures and to understand the network maintenance programme that might be needed in the future, for example pipeline replacement or cleansing.

This combination of deterioration modelling and detailed desktop network assessment has enabled us to build up a prediction of maintenance needs over the next five to ten years. And we are now beginning the investigations that will lead to investment identification for AMP8.

The investment in our SMART network will allow us to build on the improvements made during AMP6 and provide further improvements to our current Customer Minutes Lost Operational Strategic approaches. We will utilise the newly deployed



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2,070 permanent pressure sensors and the replacement bulk meters as well as targeting the bulk meter improvements to provide a proactive and early identification of mains failure increasing the speed of our response to failure.

We will continue to train our staff and contractors in the operation and issues associated with work on our network assets to minimise the risk of burst or discolouration events resulting from network asset use.

## High-level options appraisal

In order to improve CML performance options have been developed around the key areas for investment including water treatment, distribution and customers. Three high-level options were considered in the development of this investment case:

- **Option 1:** Do nothing;
- **Option 2:** Maintain the current level of service and meet legal obligations; and
- **Option 3:** Integrated intervention programme with enhancement

Further detail on these options is provided below:

**Option 1 - Do nothing:** do nothing in AMP7 and defer any interventions until AMP8 or later.

**Option 2 - Maintain the current level of service and meet legal obligations:** develop a programme of interventions to meet statutory obligations governed by Ofwat and maintain the current level of service in other areas. This option would include targeting the most cost beneficial clusters of worst served customers, limited improvement of our SMART network and improving our operational performance.

**Option 3 - Integrated intervention programme with enhancement:** develop an integrated programme of interventions with:

- review the zonal studies projects to assess and address the worst served customers for CML and low pressure;
- implementation of a programme of critical crossings assessment;

- deliver improvements to connectivity and operation of strategic mains to enhance resilience;
- addressing our worst served customers;
- These interventions will be in addition to the base maintenance required to maintain the current level of service.

We recognise that there are overlaps between the different intervention options and their impact on performance drivers. We have therefore developed this as an integrated investment case that considers all problems together to generate an optimal programme of work.

## Assessment

Our performance for CML is already well below the industry average and during the cold weather events in February/March 2018 our actual performance was hit. During the current hot weather despite the same levels of demand we have managed to avoid interruptions to our customers. This is because there has not been the same accessibility issues experienced as a result of deep snow during the cold weather.

Our worst served customers and worst performing water distribution zones are at risk of continual deterioration without further investment in AMP7. This means that “Option 1 – Do nothing” is not tenable.

The benefits of Option 2 will not achieve our required objectives and will only provide a limited improvement to the current level of CML performance rather than delivering further improvement to our target of interruptions to supply of 8 minutes per property by the end of AMP7.

Option 3 is the preferred option to take forward for implementation because it is the most effective way to deliver interruption to supply benefits and improve our service standards for our customers during AMP7. These improvements are supported by our customers and were captured during our customer consultation process.

Having significantly improved operational performance in AMP6 there is limited scope to improve performance further without significant investment in SMART. This will identify failures



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earlier, further improve our response times and to minimise the risk of interruptions to supply.

Option 3 will achieve improvements for each of our target investment areas at the lowest total expenditure (totex) to meet our performance

objectives for CML across the company and address low pressure and CML for our worst served customers.

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## 4 Preferred option

Option 3, 'Integrated intervention programme with enhancement' has been chosen to define the programmes of work to improve CML using lessons learnt from AMP6 particularly the recent extreme weather events. The whole CML enhancement programme can be seen in Table 5 below. The programmes of work are included within Lines A4, A14 and A27 within Table WS2 and WS2A.

Programme of work	Included within Table WS2 Line Number(s)	Proposed CML Enhancement Programme total budget
Improvements to Service Reservoir Storage	A14	£33.36m
Strategic Network Resilience Schemes	A14	£27.74m
Worst Served Customers (low pressure and interruptions)	A4 and A27	£8.66m
Resilience Studies and Plans	A14	£3.99m
SMART and Metering Improvements	A27	£15.81m
Emergency Planning and IS Systems Improvements	A14 and A16	£14.85m
<b>Total Pre-efficiency Challenge</b>		<b>£104.41m</b>

Table 5: Summary of proposed budget for CML programme

### SRV Storage Improvements

Across our area the capacity of some of our Service Reservoirs (SRVs) severely limits our ability to respond to events without an impact on customers. During AMP7 we are planning to increase the level of capacity at two sites, Quarryside and Broomy Hill

WTW and assess and if required replace four SRVs because of structural risks associated with that type of tank design. The whole programme will enhance the resilience of our SEWCUS and Hereford distribution systems reducing the risk of interruptions to customers supply.

Over following AMP periods we will need to target more areas of our network, but have selected these areas to start with due to the size of the population involved and the scale of risk identified.

### Strategic Network Resilience Schemes

Across our network we have identified several improvements to strategic mains. The schemes currently identified for development have been prioritised using a risk assessment identifying single source water supplies, areas which have a history of interruptions and the population affected following a main burst. We will incorporate the lessons learnt from the recent cold weather event as well as the dry weather event currently in progress to refresh our scope and priorities over the next 12 months.

The current programme of improvement includes schemes that were first identified during AMP6. For these larger schemes high level feasibility and a limited level of optioneering have been undertaken to identify an outline scope and costs, see Appendix 1.

The Network Resilience schemes currently selected will provide resilience through the duplication of existing pipelines at river crossing points at two locations Llangunnor and the Usk at Priory Wood. We are also improving the connectivity within SEWCUS by installing additional cross connections to the North of Cardiff within the Rhiwbina system. The additional connections will connect into the two 26" mains from Cefn Mably Service Reservoir (SRV) and improve the ability to transfer water from the West to the East, see more detail in the South Wales Strategic Pipeline Strategy Document.

In the North Wales area the Bwlch Tunnel is a bottleneck within the existing network and there is not currently a way to maintain this asset through a long term outage. During AMP7 we are planning to install a bypass around the tunnel that will enable

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at least 35 MI/d to be transferred providing resilience for the area, increasing the capacity of the system and allowing inspection to allow a decision regarding its maintenance or abandonment.

## Worst Served Customers

Our worst served customers programme will target those clusters of properties who have suffered the most interruptions to supply. The assessment to prioritise the locations for investment has reviewed the number of customers affected and the high level intervention scope and cost. A prioritised programme has been developed to target the largest clusters first. A similar process has been undertaken to identify those customers suffering from low pressure. A summary of our worst served customer at the end of AMP 6 and AMP 7 can be seen in Table 6 below.

The programmes of work will improve the reliability of mains by installing air valves, replacement pipeline sections and in the case of low pressure small pumping stations where required.

Worst Served Measure	Worst served Customers end AMP6	Number of customers end of AMP 7
DG2 Low pressure	131	121
DG3 interruptions of supply	1000	750

Table 6 – Worst Served Customer Targets

During AMP7 we will be reducing the number of worst served customers by replacing mains and additional pressure reducing valves and air valves to balance pressures within the network which would reduce the number of burst and leaks. Strata Florida is one of our worst affected zones which has 127 customers affected by repeated interruptions. These customers would not be addressed through our zonal studies programme but will now have their issues resolved within AMP 7. In this zone we are looking to replace 2.4km of main to improve performance.

We will also utilise operational solutions to reduce the frequency and impact of interruptions to supply

for our worst served customers whilst permanent solutions are planned and installed. We plan to use tankering into hydrants, the development and use of quiet pumps for our tankers to reduce noise complaints and further optimising tanker base locations to improve response times.

## Resilience Studies and Plans

This project is aimed at the 53 highest risk road, rail and river pipeline crossing sites across our area. There are two main parts to this project. The first are critical crossing desktop assessments to review options and scope out how to reduce the risk of failure of pipelines at critical crossing points and maintain supplies to customers.

The second part of this work is at critical crossing locations to develop emergency repair plans allowing a rapid repair in the event of a failure. The plans will define how to restore the supply, the location of isolation valves, the plant, specialist skills and spares required to do this.

## SMART and Metering Improvements

The improvement of monitoring and control across our strategic network will provide a number of benefits for our strategic and trunk mains networks. It will allow the early identification of leaks and burst improving our response times.

We will build on the improvements made during AMP6 as part of our SMART journey. By using advances in sensing and communication technologies we will increase the network monitoring, making use of more flow, pressure, quality and acoustic measurements which can wirelessly link to our operational intelligence data platforms via the Internet of Things (IoT) predicting and reacting to events before they happen or as soon as they happen. This will improve our service to customers by allowing us to react proactively to failure events.

We will further enhance our customer meters to ensure that not only water consumption is measured accurately but to also give us greater understanding of leakage, pressure and quality monitoring at the extremities of our network.

This increase in data and new asset flexibility will allow automatic management and optimisation of our networks. The use of machine learning, artificial

# Customer Minutes Lost Service Improvement

intelligence and robotic process automation will further enhance optimisation of the network. Making adjustments for demand, self-cleansing and interruptions of supply. The valuable data can be shared with key stakeholders like National Resources Wales (NRW) and public health Wales in a more open data forum to further increase collaboration and innovation.

## Emergency Planning and IS systems

The upgrade of our IS systems during AMP7 improves current functionality, ensures resilience and increases cyber security. This will make our water systems more resilient and maximise data from SCADA and other corporate systems to control and manage the network and identify mains failures at an early stage. We anticipate that developments in the IT marketplace and the shorter asset lives will see a more diverse and innovative range of asset-investment options where security, cost and agility variables can be balanced according to business needs.

The proposed emergency planning expenditure is linked to The Security and Emergency Measures (Water and Sewerage Undertakers) Direction 1998, which places requirements on water undertakers and sets out our duties to maintain water and sewerage services in the event of emergencies. Further to this, there are strict requirements for the provision of a minimum of 10 litres per person per day increasing to 20 litres after 5 days once a Major Incident is declared.

In order to allow us to improve our ability to continue to supply a piped potable water supply to our customers when critical distribution network failures occur. We will continue our zonal studies programme, including the installation of additional valves to reduce the number of customers affected by a burst main, and additional hydrant points to enable us to restore supply more effectively. We will also optimise tanker base locations and other emergency equipment and we will enable tankering into hydrants. We also plan to develop quiet pumps for our tankers to reduce noise complaints when we have to use them.

## 5 Cost efficiency and innovation

### Cost efficiency

We are proposing to deliver this programme with £8.61m of cost efficiencies as part of this investment programme, as shown in Table 7 below.

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

Programme of work	Proposed programme total budget
<b>Total programme (pre-efficiency)</b>	<b>£104.41 m</b>
<b>Total programme (post-efficiency)</b>	<b>£95.80 m</b>

Table 7: Proposed cost efficiency

Our Capital delivery governance process means that projects will be reviewed and the best value solution is chosen for implementation.

### Summary of innovation in this project

#### Worst Served Customers

A new method has been developed to identify the most effective solutions to mitigate supply interruptions for our worst served customers. We have built on the lessons learnt from our distribution zonal studies and developed a holistic method to assess our worst served customers by both post code, distribution zone and at a strategic level.

The method uses a desktop assessment to review the root cause of failures back to the source of the water. The desktop assessment includes a review of the zonal study reports where they exist prior to undertaking any work as well as an operational review including historic failures and customer complaints. The assessment includes; valves (including air valves), pumps, pipes and service reservoir level control as well as Water Treatment works.

The outputs of the desktop studies are then reviewed by the operational teams to highlight local issues including long term customer issues. The final project chosen will be a cost effective option which may be delivered in a modular fashion with the valves maintained and where appropriate new ones installed first, followed by pipeline replacement or re-lining where appropriate.

### Partnering and co-creation

Working closing 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 as well as the Drinking Water Inspectorate and Environment Agency/ Water Resources Wales.

## 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 projects within the CML investment case have been developed so that they are delivered in conjunction with other programmes of work. For

instance, the worst served customer programme has been developed in conjunction with the AoW and network and WTW maintenance programme to avoid duplication of schemes and to take advantage of any planned mains shutdowns.

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, the AoW Investment Case will provide CML benefits as a result of the mains replacements and other interventions undertaken to improve the acceptability of water.



# Customer Minutes Lost Service Improvement

## 7 Delivery

### Procurement

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. The programme of work has been based on delivering benefits across the five years of AMP7.

The programmes of work for worst served customers, trunk mains flow metering, critical trunk mains, Emergency Planning and SMART will be continually updated following further studies during AMP7.

The network resilience schemes, service reservoir improvements, additional interconnectivity in the South Wales area will be defined with detailed feasibility during year five of AMP6 and year 1 of AMP7. Currently our forecast for Llwynypia Quarry

SRV delivery is by the end of year 2 and Broomy Hill clean water storage and the post tensioned steel tanks during years 2 to 5.

We have currently only set out a five year AMP7 programme. Our plans and associated programmes of enhancements for further AMPs will be based on our continuous review of feasibility, the impact of SMART and Strategic Resilience scheme development 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.

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

## 8 Assurance

### Governance

Our current CML investment programme has been agreed with the Managing Director for Water Services and approved by the Dŵr Cymru Executive. This helps to ensure that the full focus of the business is directed at this investment.

CML performance is also targeted in the monthly Managing Director Water Service Meeting. These meetings are attended by key stakeholders including the Water Operations Distribution and Production teams and the 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 CML performance following the recent cold weather events and regular updates during our company-wide monthly team brief.

Our investments to reduce the customer minutes lost are 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 studies for the three SRV and larger pipeline schemes to enable the high-level scope of work and cost of the options to be assessed. However, further detailed feasibility will be required to define the final scope and cost of each project. We have utilised our unit

cost database to provide cost estimates of the schemes we have identified.

### Customer consultation assurance

Our customers have indicated that investments to reduce interruptions to water supply are key and would be concerned if interruptions greater than eight hours were a recurrent problem<sup>4,5</sup>.

### Measures of Success

We are continuing with our measure of success (MOS) to monitor the benefits that our CML interventions bring – the ‘Customer Minutes Lost’ MOS. Our target for improvement to this MOS over AMP7 as a result of our proposed investment is shown in Table 8.

Measure of Success	End of AMP6 Position	End of Investment Position
Supply interruptions greater than three hours (expressed in minutes per property)	12	8

Table 8: CML MOS improvement predicted

### 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.

<sup>4</sup> WTP Qualitative research, Welsh Water consultation, August 2016

<sup>5</sup> WTP Qualitative research, Welsh Water consultation, August 2016

## Supporting Documents

5.8H.1 - Zonal Studies Methodology

5.8H.2 – South Wales Water Supply Strategy

## References

- <sup>1</sup> WW2050 Qualitative Debrief, 2017- engaging with 108 customers
- <sup>2</sup> Summer Consultation, Welsh Water 2050, 2017
- <sup>3</sup> Performance targets qualitative, Welsh Water consultation, June 2017
- <sup>4</sup> WTP Qualitative research, Welsh Water consultation, August 2016
- <sup>5</sup> WTP Qualitative research, Welsh Water consultation, August 2016

# Appendices

## Appendix 1 – CML project overview

### Strategic Pipeline and Storage Projects

Within our Welsh Water 2050 document we have outlined our strategic approach to improving service for our customers. The Customer Minutes Lost programme of work and the associated projects address four of our Strategic Responses, see bullets below and the Asset Resilience Framework target to implement effective asset management systems.

The Strategic Responses supported by these projects are;

Safe, clean water for all

Safeguard our environment for future generations

Put things right if they go wrong

Personal service that's right for you

We have prioritised those schemes which provide the greatest benefit in terms of reducing the risk of long term interruptions to supply customers using expert judgement. Our assessment has included learning from the extreme weather experienced across Wales during late February and March 2018

### Our Approach

We have targeted improved connectivity between strategic networks, improvements to existing systems to enable bi-directional operation and the addition of duplicate pipelines at river crossings to provide resilience. We will also develop a desk top study approach to assess the highest risk road, rail and river crossings and the associated emergency repair plans for these locations.

We have identified two key locations where additional clean water storage is required to enable operational changes to be made to the network allowing us to maintain the water supply for our customers. A further project is planned that will safeguard four existing service reservoir sites where the design and condition of the current structures means that a redesign and rebuild will be required.

## East West Link, linking the South East Wales Conjunctive Use System (SEWCUS) and Tywi conjunctive use system (TCUS)

### Need for the project;

The need for this project is to provide an additional connection between our two major conjunctive use systems, SEWCUS and TCUS. At present there is a risk to 54,283 properties of between 12 and 24 hours interruption to supply, as they are at the furthest extents of 2 network systems. When the overall network is experiencing periods of high demand these properties will be the ones worst affected.

### Project Budget;

The budget to undertake this project is £22m

### Project Benefits:

The benefits of this project will be to provide a bidirectional water supply from the SEWCUS to Tywi conjunctive use systems of at least 30 MI/day. This volume of water will provide for up to 60,000 properties or 25% of the total average demand from Felindre Water Treatment Works (TCUS) in the event of a catastrophic failure at the site or periods of extreme demand. It will also provide the opportunity for Felindre WTW to reduce outputs for maintenance activities. There is a restriction of 18MI/d on abstraction of the Wye and Usk rivers which puts strain on the SEWCUS system in times of drought. This new connection will alleviate the stress of this abstraction restriction on the west of Cardiff and in the Vale of Glamorgan.

### Overview of the Project;

This project has been identified within the range of schemes that make up our South Wales Water Supply Strategy, see Supporting Document 5.8H.2. Within the strategy we have identified a number of improvements that should be made to the East–West and West-East connectivity between the two strategic networks; SEWCUS and Tywi conjunctive use system.

The installation of an additional pipeline with a capacity of approximately 30 MI/d will significantly improve the resilience of our Tywi conjunctive use system (TCUS). TCUS is heavily reliant on Felindre Water Treatment Works, which is the largest treated water input into this system providing an average of 118 MI/d. In the event of a failure approximately 240,000 properties and business would be affected by an outage once the limited network treated water storage has been used.

This project is linked to the Cwm Taf project which will install a new Water Treatment Works due for completion at the end of AMP8 and will provide a treatment capacity of 225 MI/d which will provide the capacity to plan an outage or facilitate maintenance work. The installation of improved network connectivity between SEWCUS and TCUS, in addition to improvements to the Taff Trunk mains, will facilitate this.

A high level feasibility study has been undertaken for the project to assess the scope of work required to provide up to 30 MI/d between the two conjunctive use areas. The scope of this project is to install a new 900mm pipeline between the Cefn Hirgoed and Llantrisant Service Reservoirs and a second 900 mm pipeline between Port Talbot and Margam. An overview of the project elements as they currently stand and forecast budget can be seen in Table 1 below. These may change when detailed feasibility is undertaken to define the final solution.

Overview of the current main scheme elements;

Project Name	Scope	Budget
Cefn Hirgoed to Llantrisant	900mm pipeline between the Cefn Hirgoed and Llantrisant Service Reservoirs	£13m
Port Talbot to Margam	900mm pipeline between Port Talbot and Margam	£4m
Cefn Hirgoed Pumping Station	27 MI/d pumping station at Cefn Hirgoed	£1m
Network ancillaries and other associated improvements	Installation of new meters, valves and automation equipment to facilitate operation of the network	£4m
<b>Total</b>		<b>£22m</b>

Table 1 – Main scheme elements of the East West Link



## Bwlch Tunnel Bypass, Alwen Trunk Main

### Need for the project;

In North Wales we are planning to improve our Alwen Trunk main by building a bypass around the Bwlch Tunnel. The need for this is to facilitate an increase in the capacity of the tunnel up to 35 MI/d and to provide an alternative supply to the Bwlch Tunnel and remove the risk of a long term interruption to supply for up to 1600 properties.

The Bwlch tunnel is responsible for transporting water between the Alwen system and the Bretton system but currently supply is mono-directional, in the event of catastrophic tunnel failure repairs would take some considerable time, in this period it would not be possible to do any maintenance at either WTW as customers would wholly reliant on this for supply.

### Project Budget;

£3 million

### Project Benefits;

The tunnel bypass combined with other improvements along this main will facilitate reliable bidirectional flow and increase resilience for customers. It will also provide an ability to isolate the tunnel for maintenance purposes. Should an Alwen WTW catastrophic failure occur, 38,018 customers would experience a benefit from having water fed in two directions as a result of this project. An additional benefit will be to provide additional capacity at this location increasing the capacity of the tunnel up to 35 MI/day and allowing Alwen WTW to input increased volumes of lower cost water into the distribution network.

### Overview of the Project;

The Bwlch Tunnel is part of the Alwen Trunk main, which is the clean water network which runs from Alwen WTW in North Wales to Connah's Quay located to the North West of Chester. When there are failures at Alwen WTW or the other water treatment works in the area, Bretton Tre Castell and Glascoed the Alwen main is required to enable alternative supplies to be supplied to customers. Any resulting failures at Bretton or Alwen could be partly supplied and supplement the system to keep reservoir levels until the works is restored. An overview of the Alwen Trunk main, the area that it feeds and the location of Bwlch Tunnel can be seen in Figure 2 below.

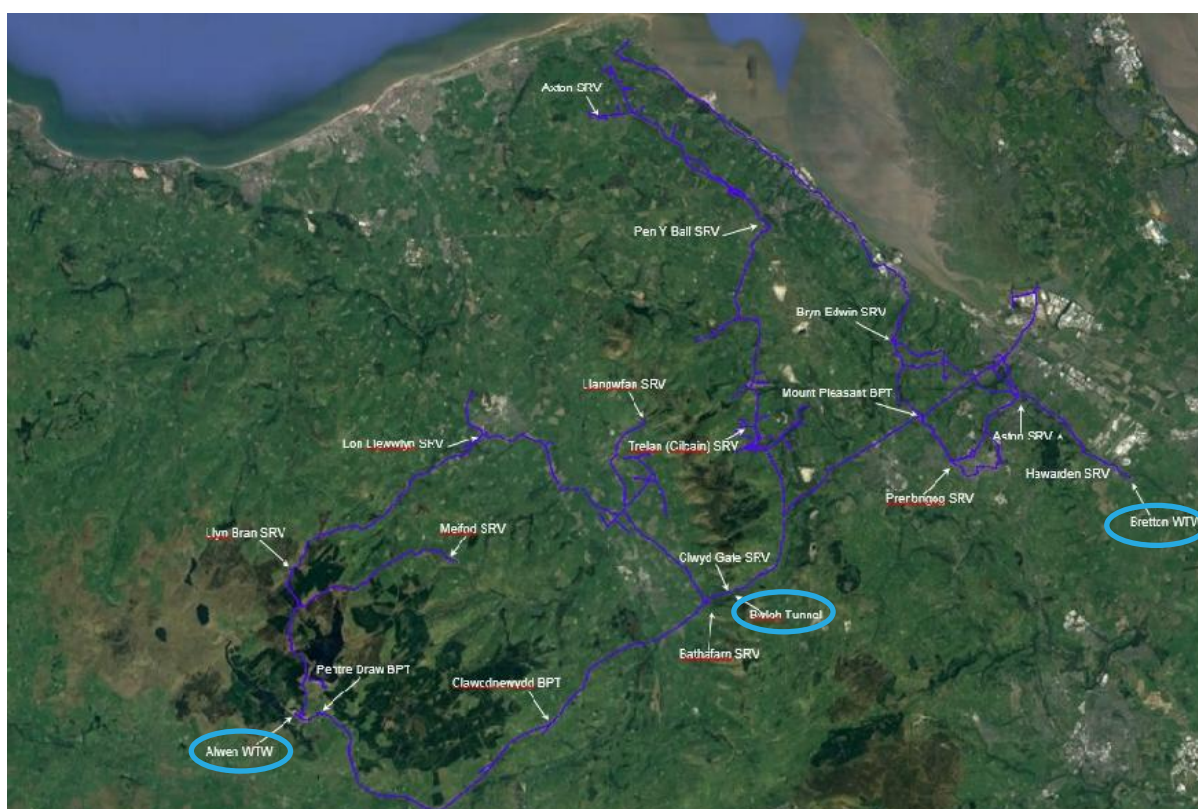


Figure 1 – Area Supplied by the Alwen Trunk Main

Currently the Bwlch Tunnel limits the ability to do this preventing the transfer of water towards Alwen WTW. This is for two reasons; 1) that the tunnel does not operate under pressure and is an open gravity system, 2) the capacity of the Bwlch Tunnel is currently limiting the transfer of water to approximately 23 MI/d. In order to maximise the raw water resources available and water treatment output capacity of Alwen water treatment works a capacity of 35 MI/d is required for the Bwlch Tunnel bypass.

The planned solution for the Bwlch Tunnel will be to provide a bypass around the existing tunnel of 450 to 500 metres in length with the associated valves and control to allow the tunnel to be isolated for maintenance and repair as required. It is anticipated that the bypass will consist of one or two pipelines to provide sufficient capacity but will also allow the system to remain under pressure through this section of the network. This will maximise the ability to move water bi-directionally during a failure event at Alwen WTW or Bretton Trecastell and Glascoed WTWs or the network, see Table 2 below. The planned maintenance programme will support this scheme by targeting maintenance activities along the Alwen trunk main and the Prenbrigog pumping station.

Project Name	Scope	Budget
Bwlch Tunnel Bypass	Installation of a pipeline or dual pipelines and the associated valves, monitoring and control equipment to act as a bypass for the Bwlch Tunnel. The bypass will have a capacity of at least 35MI/d	£3m
Total		£3m

Table 2 – Overview of the Bwlch Tunnel project

## Improved Cross Connections within the Rhiwbina system

### Need for the project;

The South Wales Conjunctive Use System (SEWCUS) provides the water supply to the Cardiff and Newport areas in South East Wales. This conjunctive use system distributes water from 12 Water Treatment Works. Capacity limitations of the current conjunctive use system mean 200,000 properties are at risk of up to three hours interruption to supply within the next 20 years. This reservoir is a 'pinch point' for the network system around Cardiff and the ability to inter connect with other reservoirs (Cefn Mably) would allow for greater resilience for 200,000 at risk customers.

### Project Budget;

£1 million

### Project Benefits;

The planned cross connections will increase the ability to transfer water from the East to the West and vice versa within SEWCUS and increase resilience for customers. It will allow the new Merthyr WTW to be maximised when water resources are available to optimise the costs associated with supplying water to our customers. This will allow us to maximise the use of our gravity sources treating water at our new Merthyr water treatment works to supply more water into the Cardiff area. This will minimise the amount of pumping from our sources in the East of the SEWCUS area. The cross connection will also provide improved resilience to SEWCUS and 350,000 customers in the Cardiff area by facilitating a greater level of bidirectional flow to maintain supplies when failures occur or maintenance is required.

### Overview of the Project;

The project will improve the connectivity of SEWCUS to the North of Cardiff within the Rhiwbina system (20" main) by installing two cross connections and a flow meter, PRV and valves. The additional connections will connect into the two trunk mains, 33 inch and 800mm from Cefn Mably Service Reservoir (SRV) that feed the Llanishen area of Cardiff and improve the ability to transfer water from the West to the East, see Figure 2 below. A summary of the programme budget can be seen in in Table 3 below.

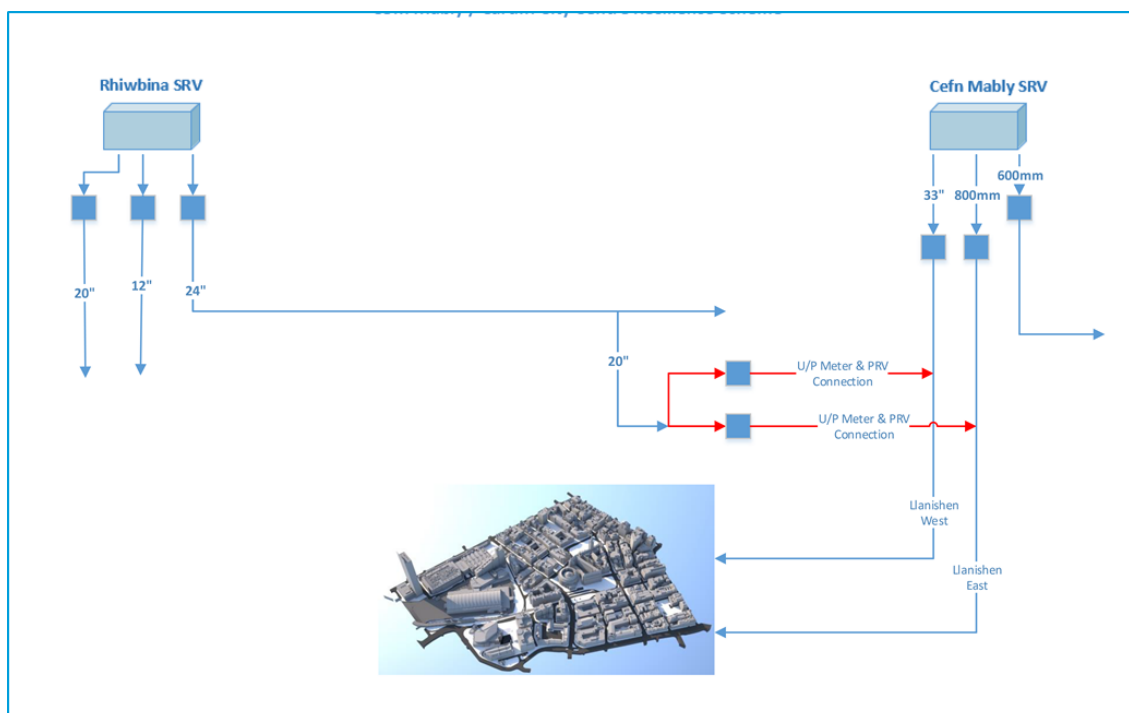


Figure 2 – Overview of the proposed cross connection in the Rhiwbina System

Project Name	Scope	Budget
Bypass pipelines	Installation of two pipelines to connect the 20 inch main between Rhiwbina and Cefn Mably	£600k
Valves and Meters	Installation of valves and meters to monitor and control the two new connections.	£400k
<b>Total</b>		<b>£1m</b>

Table 3 – Overview of the Rhiwbina Cross Connection project

## Additional Main at the River Usk Crossing at Priory Wood

### Need for the project;

The Usk river crossing is a dual purpose pipe crossing with 2 mains crossing the river, a dual pipeline for raw water carrying resource to Court Farm WTW and a potable supply carrying water from Priory Wood WPS to Catsash SRV (single main). Failure of the potable main at the this point would mean that 20,000 properties would loss water for greater than 6 hours as repairs would be difficult due to the environment.

The need for the project is to provide additional resilience to the network. By duplicating the Usk River crossing of a strategic pipeline the project will reduce the risk of a long term interruption to supply for 20,000 properties in the event of a burst main beneath the river.

### Project Budget;

£0.76 million

### Project Benefits;

The planned duplicate river crossing will improve the resilience of the water supply from Court Farm into the East of Newport. The proposed will also remove a bottleneck into the supply area enabling a greater flow of water to reach the Cats Ash Service Reservoir which serves 8715 properties and downstream reservoirs totalling 20,000 properties. Currently if the main was to fail at this critical point all those properties would go without water as this is the only main connecting Priory Wood to Catsash SRV.

### Overview of the Project;

The project will provide a duplicate pipeline to run in parallel for approximately 50 metres across the river Usk. The existing pipeline is 610mm. The current scope of work will install a pipeline of the same diameter with the associated valves, monitors and controls. A feasibility project was undertaken to review the issue of flow in the area, the Court Farm to Cats Ash Feasibility report and this project has been developed from that scope of work. Further assessment and feasibility specifically for this project will be undertaken early in AMP7 to define the final solution. A summary of the project costs can be seen in Table 4 below.

Project Name	Scope	Budget
Bypass pipelines	Installation of two pipelines to connect the priory wood and Catsash at a critical river crossing	£500k
Valves and Meters	Installation of valves and meters to monitor and control the two new connections.	£276k
<b>Total</b>		<b>£0.76m</b>

Table 4 – Overview of the River Usk Duplicate Crossing project



## Duplicate Crossing of the Llangunnor Main

### Need for the project;

The need for the project is to provide additional resilience to the network to an area currently experiencing frequent DG 3 events in periods of peak demand, with a loss of supply for up to 12 hours for 7,500 properties.

### Project Budget;

£0.8 million

### Project Benefits;

The planned duplicate crossing cross connections will improve the resilience of the water supply for the Llangunnor and Carmarthen trunk main by duplicating the main through the River Towey and its flood plain, see Figure 3 below. During times of peak demand the area is at a high risk of interruptions to supply. The new pipeline would allow water to feed from Llangunnor SRV rather than Penlanffos SRV, reduce the risk of interruptions to supply and alleviate the stress on the system.



Figure 3 – River Towey Crossing Point

### Overview of the Project;

The project will provide a duplicate pipeline of 225 mm in diameter to run in parallel to the existing pipeline for approximately 2km with the associated valves, monitors and controls. A feasibility project was undertaken to review the project and a scope of work developed, Llangunnor-Carmarthen Link Feasibility Report, which provides more detail regarding the scope of work. Further assessment and feasibility



specifically for this project will be undertaken early in AMP7 to define the final solution. A summary of the costs can be seen in Table 5 below.

Project Name	Scope	Budget
Bypass pipelines	Installation of two pipelines to connect the Llangunnor SRV to Carmarthen link main	£650k
Valves and Meters	Installation of valves and meters to monitor and control the two new connections.	£150k
<b>Total</b>		<b>£0.80m</b>

Table 5 – Overview of the River Llangunnor Main Duplicate Crossing project

## Post Tensioned Steel Service Reservoir Replacement

### Need for the project;

The existing Service Reservoirs at four locations need to be replaced due to a structural engineers report highlighting that they are at risk of catastrophic failure over the next 10 to 15 years. This system is in series and only feed from one treatment works so any failure would cause the system below it to not be able to feed customers, see Figure 4 below. Failure at the top of the System would result in 24,000 properties losing a supply for greater than 3 hours. As these reservoirs were built at the same time they are likely to fail in a close period of time to each other, if this were to occur we would not be able to supply this area from alternative mains.

### Project Budget;

£15 million

### Project Benefits;

Removal of four structural risks across the our network and improved resilience of the our network in the Rhondda Valley. The worst case would be that a total of 24000 properties would go without water if the upmost reservoirs were to fail. There is no other way to feed these properties and as a result customers would be without water for a long period.

### Overview of the project;

A structural problem is affecting service reservoirs (SRV) at four sites throughout the Rhondda network at Maerdy, Porth, Ferndale and Trebanog, see the schematic of the network in Figure 4 below. They are all currently functioning but complete structural failure of these above ground assets is possible. At each SRV a high level feasibility report has been undertaken regarding the replacement and repair of these tanks. Using the outputs from the Maerdy report as an example the new tanks would be built on the same footprint as the existing reservoirs.

The next phase of work will be to undertake principal and detailed condition inspections to define the scope of work required to refurbish or replace the existing SRV. A summary of the costs from the high level feasibility assessments undertaken during AMP6 can be seen in Table 6 below.

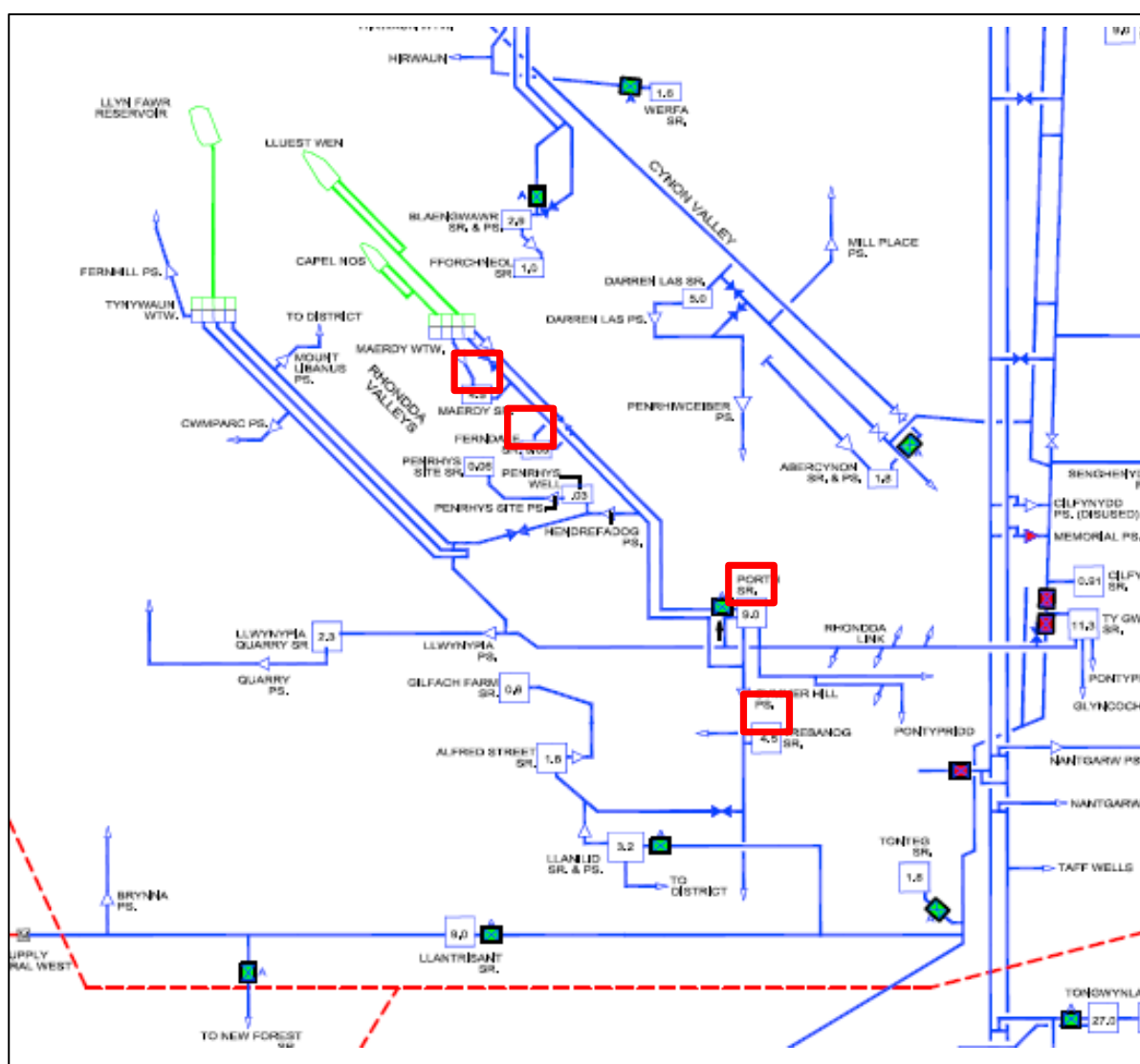


Figure 4 – Overview of the Post Tensioned Steel SRVs, highlighted in red boxes

Project Name	Scope	Budget
Trebanog SRV	Assess the condition and options to replace the SRV and rebuild either at the current site or suitable alternative location	£3m
Porth SRV	As above	£4m
Maerdy SRV	As above	£3m
Ferndale SRV	As above	£5m
<b>Total</b>		<b>£15m</b>

Table 6 – Overview of the Post Tension Steel SRV Replacement Programme

## Llwynypia Quarry Tanks

### Need for the project;

Llwynypia Quarry tanks directly supply 5,078 properties and two of the tanks have already been decommissioned due to structural condition. The two remaining tanks have a residual asset life of 10 to 15 years. These reservoirs are critical for the water supply to the Vale of Glamorgan. If we had additional storage at this strategic point in the network we would improve our ability to respond to issues that occurred within the SEWCUS system and minimise the potential effect on our customer.

### Project Budget;

£3.85 Million

### Project Benefits;

This project would remove two structural risks for the company and would bring supply resilience for the area in the long term. Once the two new reservoirs have been constructed, the capacity of the four reservoirs located at the Llwynypia Quarry site would provide the storage to enable the network to be supplied from an alternative source in the event of a trunk main or water treatment failure. The storage would provide the time to respond events without any loss of supply impact on our customers.

### Overview of the project;

There are two tanks in operation at the site, two and four, both have a capacity of 1,136 m<sup>3</sup> with a combined total of 2,272 m<sup>3</sup>, providing a retention time of approximately 12 hours. There is a total of 5,078 properties supplied directly. Currently there is insufficient resilience for Clydach Vale, demonstrated by the Rhondda Link's inability to provide the required supply to the Llwynypia SRVs when Pontsticill low level system has an issue and resulting in interruptions to supply.

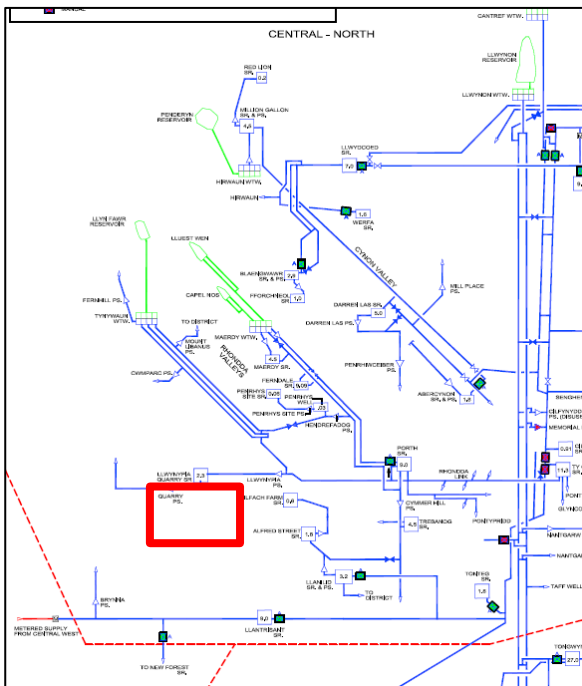


Figure 5 - Llwynypia Reservoir and local network schematic

Initially investigations including a structural survey were undertaken on the existing tanks to determine their condition, residual life and whether replacement was required. The survey report concluded that the two tanks in use have 10 -15 years of remaining asset life.

The solution proposed is the construction of four new SRV tanks on the existing site. The phased construction sequence will deliver two new tanks followed by demolition the existing tanks, followed by construction of two new replacement tanks. The solution provides 24 hour storage with a predicted asset life of 60 years.

Figure 5 provides an overview of the network in the Central area and the location of Llwynypia Quarry SRVs. By providing up to 48 hours storage at the Llwynypia Quarry SRVs, Western Cardiff and the Bridgend system will benefit from additional resilience in the event of failures on those systems. Figures 6 and 7 below provide a plan of the new site layout and a photograph of the existing SRVs at the site respectively.

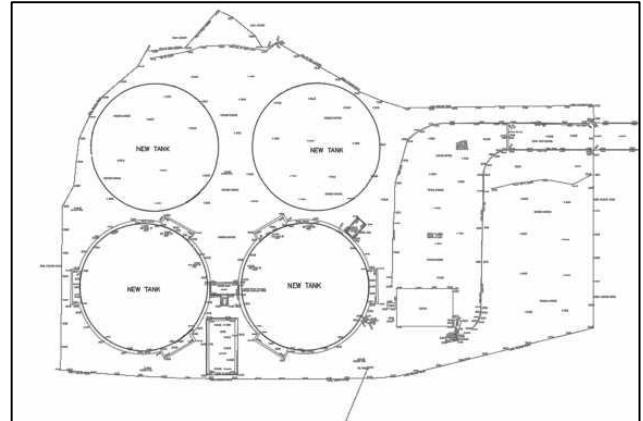


Figure 6 - Site layout including new reservoirs



Figure 7 - Image of the existing SRVs tanks

## Broomy Hill Reservoir Storage Increase

### Need for the project;

On 25th August 2015 we had a problem with raw water quality at Broomy Hill resulting in treatability issues and interruptions to supply were narrowly avoided to over 50,000 properties. This incident resulted in the loss of production at Broomy Hill for 24 hours. There is the potential for this type of event to occur again for a longer period and because there is no alternative supply of water for this area it would impact customers.

By having 48 hours storage at Broomy Hill WTW and/or the local network we would be able to minimise the risk of interruptions to supply supplied by this site should an incident of this kind occur again. The major service reservoir at Bewdley Bank, directly supplied from Broomy Hill WTW, will have its storage capacity improved to 26 hours during AMP6. The installation of a new trunk main in AMP6 will facilitate the ability to re-zone the network supplied by Ridge Hill service reservoir, also supplied directly by Broomy Hill, which will provide up to 35 hours storage. However, this will still leave customers supplied by Broomy Hill WTW at risk of future supply interruptions following a water treatment failure of up to 48 hours.

### Project Budget;

£14.6 Million

### Project Benefits;

The project would benefit over 50,000 properties and one large scale business customer and allow up to 48 hours of storage resilience if an incident similar to 2015 was to occur again at Broomy Hill WTW. In addition to raw water and treatability issues there are regular power dips in the area and can last up to 6 hours and so additional storage in the network would mean we could also maintain supplies to our customers during these events.

### Overview of the project;

The aim of this project is to increase the onsite storage at Broomy Hill WTW from its existing 13MI to 47MI of water, providing the works with 18 hours storage to meet local demand and increase resilience.

A high level feasibility report and model has been undertaken regarding the size and retention of Ridge Hill and Bewdley Bank SRVs within the network and clean water storage at Broomy Hill WTW, see Table 7 below. Although the study included options for both raw and treated water storage our preference is the installation of approximately 48 hours of treated water storage. The outputs from these reports including the proposed new tanks would be built on the surrounding farm land, see Figure 8 below.

The next phase of work will be to undertake detailed feasibility to finalise the scope of work for the solution including the most suitable location.



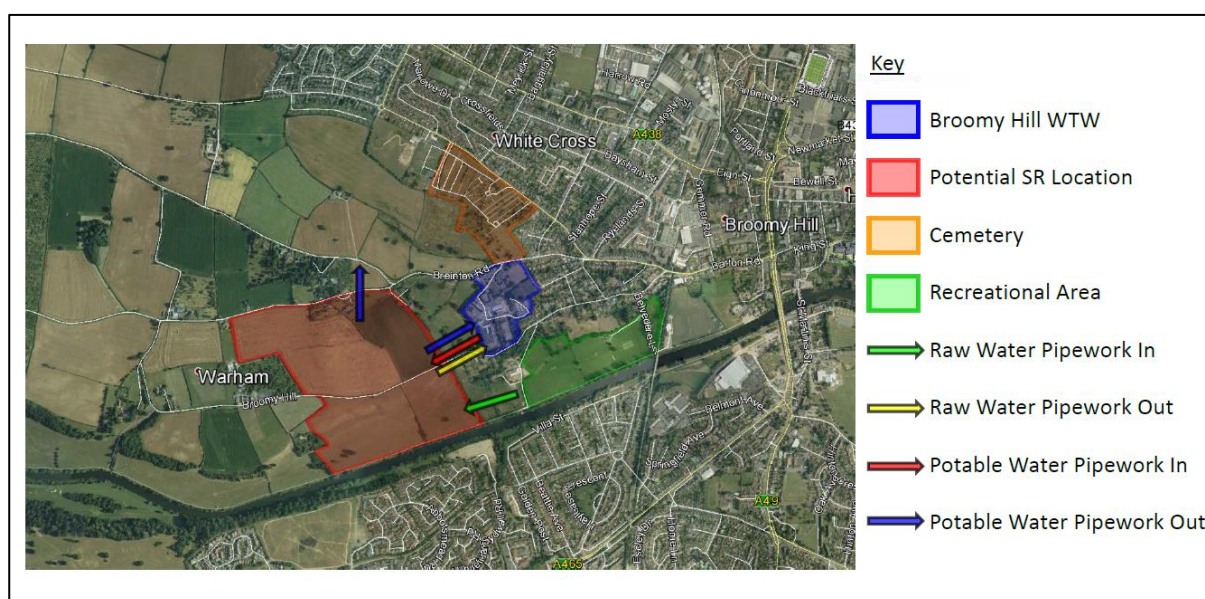


Figure 8 - Overview of Broomy Hill WTW and SRV

Reservoir name	24 - hour outage		36 - hour outage		48 - hour outage		72 - hour outage	
	Extra Storage (MI)	Total Retention Time (hrs)	Extra Storage (MI)	Total Retention Time (hrs)	Extra Storage (MI)	Total Retention Time (hrs)	Extra Storage (MI)	Total Retention Time (hrs)
Broomy Hill SR	14	10	20	13	34	18	58	29
Bewdley Bank SR	6.7	12	27	21	40	26	74	39
Ridge Hill SR	0	23	0	23	7	35	14	46

Table 7 – Storage assessment model outputs providing storage solutions by time