Dŵr Cymru
Welsh Water

Enhancement Investment Case: WSH58-RS02 – Reducing Drought Risks and Improving Customer Visibility of Usage for PCC Management

Contents

Executive Summary

This Enhancement Case covers the investment put forward in our published Water Resources Management Plan (WRMP). The WRMP has gone through a public consultation process with extensive input from our key regulators Natural Resources Wales and Ofwat. This case will not repeat material which is already publicly available but rather focus on key elements of the investment programme which will add value to the PR24 periodic review process.

Need:

The regulator has challenged Welsh Water to provide an ambitious WRMP which aligns with regulatory guidance to set ambitious targets to deliver a programme to achieve demand management and supply demand resilience targets. Their focus is achieving this through focussing on leakage reduction and by supporting customers to reduce their consumption.

The WRMP sets out its objectives in Section 2. The main areas of investment to support their delivery and meet the regulatory challenges in AMP8 are set out in the bullets below.

- Demand reductions through improvements to customer Metering in conjunction with household and non-household consumption interventions though Project Cartref
- Demand reductions from leakage savings
- Improvements to deployable output through network interconnector schemes

As part of the programme development for AMP8 a range of scenarios have been assessed as part of the WRMP including climate change and demand. The proposed AMP8 intervention programme would enable Welsh Water to achieve its 1 in 500-year drought resilience ambition.

The programme of work will also contribute to the delivery of Welsh Water 2050 outputs / WSH01 Long Term Delivery Strategy (LTDS).

Options:

A summary of the preferred set of options can be found in section 6.7 of the WRMP; note that the capital costs stated for the additional leakage options are just the “transition” costs i.e., the spend required to make the saving only. We have provided summary details of the network transfer options as a comparator against the available demand management options. In all cases these network schemes are a much lower cost and provide ‘Best Value’ given they deliver enhancement to our drought resilience and other business risks, such as interruptions to supply.

What We Will Deliver:

This Enhancement Case will deliver a range of interventions across our WRMP. The most material areas of delivery will be in meter installation ; 1) 40,000 meter optants(AMR), 2) 320,000 new meter installations (AMR), 3) 280,000 proactive meter replacements (basic to AMR conversion), 4) 29,000 reactive replacements (additional AMR infant mortality).

Efficient Costing:

Along with our overall costing strategy being reviewed and assured by Jacobs, we have also employed third party consultants to review single Enhancement Cases to provide confidence that the estimates within them are robust, efficient, and deliverable.

Customer Protection:

Welsh Water’s WRMP has identified the need for a range of interventions across our operating area to meet customer and regulatory expectations. Our planned investment programme and performance

commitments will be monitored by the Environment Agency and Natural Resources Wales (NRW) through the annual reporting process linked to the WRMP (the annual review and annual data return). The leakage and Per Capita Consumption (PCC) benefits will also be tracked by Ofwat via common performance commitments.

Benefits:

Our progressive metering strategy for AMP8 and beyond is underpinned by an appraisal of the economic, demand-related and business performance outcomes generated by a bespoke metering cost-benefit model. The model allows consideration of a wide range of metering options against a set of operational and retail performance metrics and examines the costs and benefits of each metering option relative to the company's current metering strategy. Projections of the number of meter installations, PCC and leakage forecasts are derived from our most recent baseline demand forecast for the long term planning period.

1. Introduction

This Enhancement Case covers the investment put forward in our published Revised Draft Water Resources Management Plan 2024 (WRMP24). The WRMP has gone through a public consultation process with extensive input from our regulators, notably Natural Resources Wales and Ofwat. This case will not repeat material which is already publicly available in the WRMP but focus on key elements of the plan which are relevant to the periodic review process.

The Enhancement Cases have been split into supply side and demand side initiatives, set out in the table below. Delivery of this activity will ensure that a supply demand balance is maintained as well as delivering on commitments to reduce per capita consumption, reduce leakage and deliver resilience to 1 in 500-year drought events.

Table 1- Overview of the Supply Demand Balance Improvement Programme

Supply side Interventions:		
Scheme		**CapEx Costs (£) In 2022/23 Prices with Efficiencies, Overheads, Cap Sals added**
Internal Interconnector Schemes TCUS		19.890M
Internal Interconnector Schemes Other Water Resource Zones		20.224M
Feasibility Studies		1.105M
Provide the Canal and Rivers Trust (CRT) with an alternative Water Supply from Grwyne Fawr Reservoir and by Improving Deployable output at Court Farm *		21.860M
Total Supply side interventions		**63.079M**
Demand-side interventions:		
Scheme		**CapEx Costs (£) In 2022/23 Prices with Efficiencies, Overheads, Cap Sals added**
Household (HH) Metering	New Meter Installations including meter optants	81.105M
	Proactive Meter Replacements	23.653M
	Reactive Replacements above BAU	7.939M
Non-Household (NHH) Metering	New Meter Installations including optants	3.481M
	Proactive Meter Replacements	7.751M
	Reactive Replacements above BAU	0.898M
Subtotal Metering Enhancement		**124.828M**
Demand-side leakage improvements (Cartref Programme) HH		4.273M

Supply side Interventions:	
Advanced Area Leakage Control (ALC) Transition	0.737M
Subtotal Leakage Reduction	**5.010M**
Demand-side demand reduction improvements (Cartref Programme) PCC HH and NHH	15.329M
Subtotal Demand Side consumption reduction	**15.329M**

* These schemes were not included in the WRMP programme are third party funded and no net cost for Welsh Water. The CapEx has been included in Table CW3b line CW3b.41 and funding has been added to the grants and contributions in Table DS1w.

In addition to the enhancement spend on metering there is a Base Maintenance programme of £9.898M for reactive meter replacement base on the forecast business as usual rate. This cost has not been included within the enhancement programme.

1.1 The Customer Metering Programme

The customer metering programme largest programme of enhancement investment within this case. This programme of work will both increase total meter penetration, from 59% at the end of AMP7 to 79% at the end of AMP8. It will start the process of moving our basic meter stock from basic to Automatic Meter Reading (AMR) with a pathway to Advanced Meter Infrastructure (AMI) currently planned during the 2040 to 2055 period.

The benefits of this will be to increase customer awareness of water usage and a more rapid way for significant changes in consumption at locations to be identified and targeted investigations undertaken. This will reduce customer consumption and enable demand side leakage external to properties to be identified more quickly.

For the metering programme the scope of work that has been defined as enhancement can be seen in the bullets below.

- Meter Optants
- Progressive Metering (the metering of unmeasured properties in line with Welsh Water's AMP8 Meter Strategy)
- Proactive Replacement (early replacement of visually read meters with AMR enhancement technology)
- Reactive Replacement existing visually read meters at end-of-life (the additional cost of an AMR over a visually read meter and increased AMR failure rate only)

Metering Terminology used in this document:

AMI (Advanced Metering Infrastructure) – A two-way communication system to collect detailed metering information throughout a utility's service industry. AMI is typically automated and allows real time, on-demand interrogations with metering endpoints.

AMR (Automatic Meter Reading) – AMR systems can be either walk-by or drive-by. An endpoint is connected to the meter's encoder register. The endpoint captures water flow and alarm data which is collected by utility personnel by walking or driving by with a data receiver in proximity to the device.

Basic or Dumb – Traditional 'Visual Read' meter which needs to be read manually. This will not transmit readings automatically to the water supplier.

Smart+ - These are AMR/AMI enabled meters.

1.2 Internal Interconnector Schemes

There are four internal interconnector schemes planned during AMP8. Two of which will be in the Tywi Conjunctive Use System (TCUS) and two within our South East Wales Conjunctive Use System (SEWCUS).

The aim of these schemes is to maximise our existing resources by increasing the capacity of our existing strategic network through a combination of additional pumping station capacity, pipelines, large diameter valve, washout, associated monitoring and control assets. A summary of the four schemes can be seen in Table 2 below.

Table 2 – Summary of the Supply Side Interconnector Schemes

Interconnector Scheme	Water Resource Zone Location	Capex £M	Scheme Summary
SEWCUS network upgrade	SEWCUS	£14.628M	Installation of additional pumping capacity to facilitate the delivery of additional volumes of water across our strategic network from Sluvad and Court Farm WTWs in the East to support the Llwynon and Pontsticill WTWs in the North of the zone.
Llwynon gravity	SEWCUS	£5.417M	Installation of new control valves and washouts to facilitate resource maximisation from the High Level Reservoirs in the Brecon Beacons when water is available and minimise resource use during drought periods.
Crai Distribution Options- Upsize Christopher Road WPS	TCUS	£15.616M	Installation of new water pumping stations and pipelines. This will enhance our ability to supply the lower parts the network normally supplied by Crai WTW by Felindre WTW instead helping to achieve resource maximisation during drought periods.
Ystradfellte- Reverse Flow through Tonna Control Valve	TCUS	£4.274M	Installation of new water pumping stations and pipelines. This will enhance our ability to supply the lower parts the network normally supplied by Cefn Dryscoed WTW by Felindre WTW instead helping to achieve resource maximisation during drought periods.

1.3 Project Cartref and Leakage

The aim of this investment is to deliver demand reductions through two intervention types:

1. **Consumption Reduction:** Demand-side per capital consumption (PCC) reductions for household (HH) and Non household (NHH) customers delivered through the Cartref Programme. This will be achieved in conjunction with our SMART metering programme to reduce consumption through providing support, communication and dedicated interventions for HH customers. Through inspections, information and advice programmes for NHH customers.
2. **Leakage Reduction:**
    a. Demand-side leakage improvements by locating and fixing external leakage on HH customer side through the Cartref Programme. Our proposed leakage strategy is closely aligned to metering policy whereby 'Smart' metering will not only support our

customers in reducing their demand for water but will also enable us to target customer supply pipe leakage which is becoming an increasingly large proportion of total leakage.

b. Advanced Area Leakage Control (ALC) Transition identifying leakage improvements across the supply side of our network.

1.4 Alternative Provide the CRT with an Alternative Water Supply

The programme of work consists of two projects, see Schemes 1 and 2 below which will enable us to maintain our level of service to customers should we reach agreement to provide the CRT with a bulk supply of water.

1) CRT water supply support Scheme 1 – use of Grwyne Fawr reservoir

2) CRT water supply support Scheme 2 – increase the deployable output of Court Farm WTW

These schemes were not included in the WRMP programme as they are third party funded and no net cost for Welsh Water. The CapEx has been included in Table CW3b line CW3b.41 and funding has been added to the grants and contributions in Table DS1w.

1.5 Structure of this Document

We have structured this investment case using the enhancement assessment criteria set out in Section A1.1 of Ofwat's final methodology for PR24, Appendix 9 - Setting Expenditure Allowances:

ID from Appendix 9		Abbreviated Assessment Criterion	Addressed in
A1.1.1 Need for enhancement investment	a	Is there evidence that the proposed investment is required?	Section 2.1
	b	Is the scale and timing of the investment fully justified?	Section 2.1
	c	Does the proposed investment overlap with base activities?	Section 2.2
	d	Does the need and/or proposed investment overlap/duplicate with previously funded activities or service levels?	Section 2.3
	e	Does the need clearly align to a robust long term delivery strategy within a defined core adaptive pathway?	Section 2.4
	f	Do customers support the need for investment?	Section 2.1
	g	Have steps been taken to control costs, including potential cost savings?	Section 2.5
A1.1.2 Best option for customers	a	Have a variety of options with a range of intervention types been explored?	Section 3.1
	b	Has a robust cost-benefit appraisal been undertaken to select the proposed option?	Section 3.1
	c	Has the carbon impact, natural capital and other benefits that the options can deliver been assessed?	Section 3.2
	d	Has the impact of the proposed option on the identified need been quantified?	Section 3.2
	e	Have the uncertainties relating to costs and benefit delivery been explored and mitigated?	Section 3.3
	f	Where required, has any forecast third party funding been shown to be reliable and appropriate?	Section 3.4
	g	Has Direct Procurement for Customers (DPC) delivery been considered?	Please refer to WSH50-IP00 Our Approach to Investment Planning (Section 3.4.1)
	h	Have customer views informed the selection of the proposed solution?	Our approach to customer engagement is set out in Stepping up to the Challenge: Business Plan 2025-30 (Section 2.2)
A1.1.3 Cost efficiency	a	Is it clear how the company has arrived at its option costs?	Section 4.1
	b	Is there evidence that the cost estimates are efficient?	Section 4.2
	c	Does the company provide third party assurance for the robustness of the cost estimates?	Section 4.1
A1.1.4 Customer protection	a	Are customers protected if the investment is cancelled, delayed or reduced in scope?	Section 5.1
	b	Does the protection cover all the benefits proposed to be delivered and funded?	Section 5.1
	c	Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments?	Section 5.2

2. Need for Enhancement Investment

This section sets out the drivers behind the Enhancement Case and describe the context within which it has arisen.

This Enhancement Case is required to deliver the improvements to the company's supply / demand balance and the enhanced drought resilience delivery of the WRMP and includes improved customer visibility of usage reducing per capital consumption (PCC). Emphasis is placed on the enhancement programme of 'smart' water meter deployment.

The objective of this plan is to ensure that we will always be able to provide sufficient water supply to meet our customers' demand for water over the next 25 years by making our water supply systems resilient to drought, considering climate change. The Plan uses best available evidence to formulate a set of actions through analysing future risks and identifying how we might need to adapt to different future circumstances. We have been guided by our regulators, interested parties and our customers in selecting the most appropriate solutions to the challenges we face.

The proposed investment aligns with our WSH01 Long Term Delivery Strategy– responding to the need for long term stewardship and improvement in service. The five sub sections below correspond to the seven criteria set out in Ofwat's PR24 Final Methodology, Appendix 9 (Setting Expenditure Allowances), Section A.1.1.1.

2.1 Evidence that Enhancement is Needed

Is there evidence that the proposed enhancement investment is required?
– Ofwat's final methodology for PR24, Appendix 9, A1.1.1a

The purpose of the WRMP is to ensure that we have sufficient water to meet our customer's needs. To do this robustly, the Plan draws on government and regulatory requirements, which affect the planning assumptions to be used. The basis for water resources planning is laid out in specific Welsh Government Guiding Principles and joint regulatory guidance. These documents are built upon and are directly linked to Government and regulatory authority legislation and policy.

The production of a WRMP is a statutory process with the legislative requirements for water companies to prepare and maintain a WRMP set out under sections 37A to 37D of the Water Industry Act 1991, (as amended by the Water Act of 2003 and the Water Act 2014).

Alongside this, other relevant legislation in the development of a WRMP includes the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 and the Conservation of Habitats and Species Regulations 2017.

The regulatory guidance provided for this round of planning has some different aspects and approaches with a key request that ambitious targets would be set around demand management and more specifically around leakage and support to customers in reducing their water usage. The objectives for our WRMP are:

- Leakage – 10% reduction (from 2024/25 position) during AMP8, 50% reduction (from 2017/18 position) by 2050
- Per Capita Consumption – reduced to an average of 110 l/h/d during a dry year
- Business demand – an 8% reduction by 2050 (Normal year demand from a 2019/20 position)
- Drought resilience – achieve 1 in 200 by 2029/30 and 1 in 500 by 2039/40

Our Revised Draft WRMP published on June 2023 incorporates the objectives set out in the regulatory guidance, see WSH01 Long Term Delivery Strategy Executive Summary and Section 2.1.1. The WRMP sets out the options considered, and investment required over the next 25 years to

maintain supply/demand balance. This Enhancement Case reflects the AMP8 requirements enshrined within the WRMP.

We continue to work with our stakeholders to update the WRMP to reflect the latest information and challenges. An example of this in support of the Dŵr Cymru Statement of Response on the revised Draft

WRMP24, this following the draft advice from Natural Resources Wales to Welsh Government on the Plan can be seen in Appendix B.

2.1.1 Evidence of Customer Support

> ***Where appropriate, is there evidence that customers support the need for investment?***
>
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.1f*

Regular engagement with stakeholders has been a key feature in the development of our WRMP, see Sections 2.6 and 4.5.2 for more detail, with early discussions helping to ensure that we reflect the priorities of Government and our regulators. The introduction of the regional water resources planning process has meant that through the Water Resources West group, of which we are a member, we have had regular weekly/monthly engagement with neighbouring water companies (United Utilities, Hafren Dyfrydwy, Severn Trent Water, South Staffs Water) and other key stakeholders such as EA, NRW, Ofwat/RAPID, the Canal & River Trust, the National Farmers Union, Natural England as well as representatives from the power sector. We have been guided by our regulators, interested parties and our customers in selecting the most appropriate solutions to the challenges we face.

Customer Engagement has included qualitative and quantitative preference survey work as well as in depth questioning of an online community over 4 weeks, to better understand customer rationale. We also held a series of online roadshows with the Water Resource West member companies and more recently consulted on our draft WRMP. This was a 14-week consultation including a dedicated stakeholder engagement event. We received over 200 comments and representations from 13 organisations on our draft WRMP which we have considered and accounted for with in our revised draft and in our Statement of Response. We have also written to each organisation regarding their individual comments. An example of the outputs of this for metering can be seen in Figures 1 & 2 below and Section 4.5.2 of the WRMP.

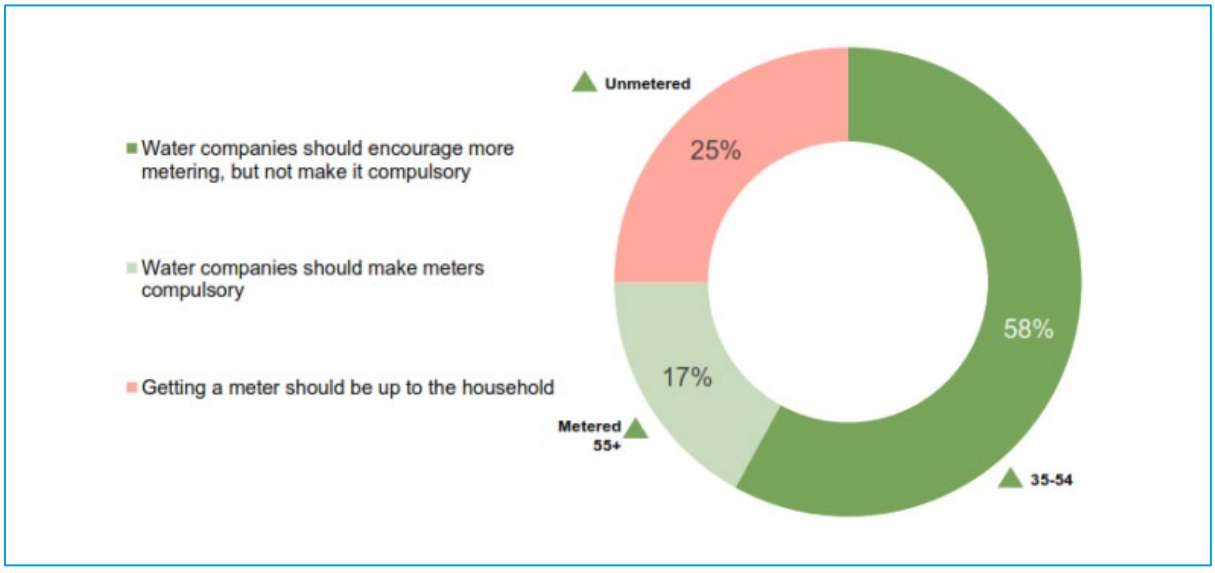

Figure 1 Customer views on metering.

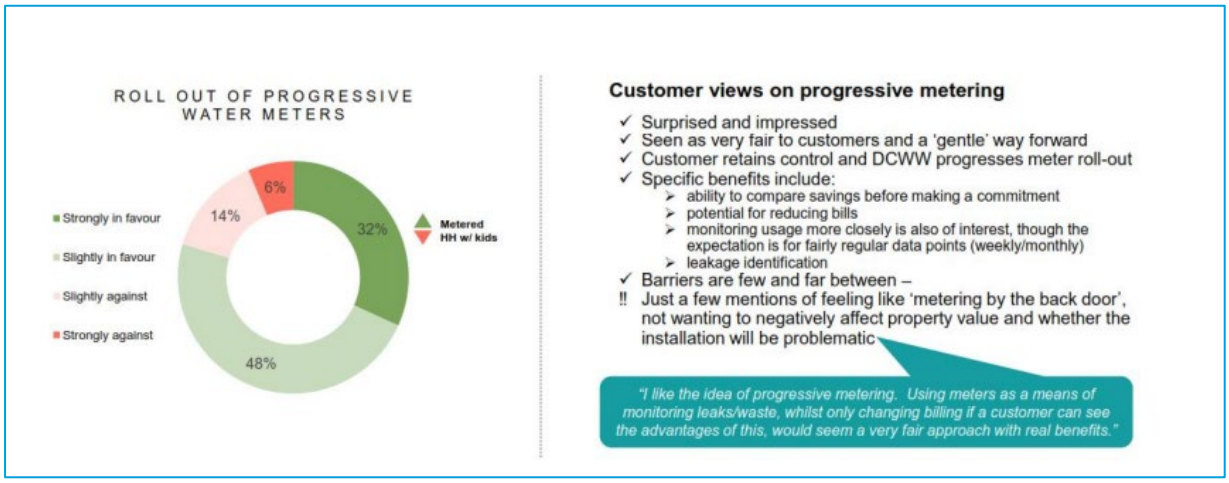

Figure 2 Customer views on progressive metering

Key insights from the WRMP customer engagement included customer preference for doing more with existing infrastructure, such as tackling leakage and helping them use less water, and that they support additional investment to meet supply/demand.

2.1.2 Scale and Timing of Investment

> ***Is the scale and timing of the investment justified?***
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.1b*

Within our WRMP, see Section 2.2 "Defining the Water Resource Problem", we have undertaken a thorough and detailed analysis of the potential risks to our water supply systems in terms of the availability of water resources to meet demand over the next 25 years. This assessment has shown that for the South East Wales Conjunctive Use System (SEWCUS) and Tywi Gower water resource zones there is a risk of not achieving target levels of water resource resilience.

Our proposal is to deliver a demand management programme which includes:

- Continuation of our 'find and fix' leakage programme to maintain and improved performance over time using new technology.
- A progressive customer metering programme delivered over the AMP8 and AMP9 periods. This supports a 10% saving in leakage over the AMP8 period and supports our domestic customers in reducing their usage to 110 l/p/d by 2050. This will increase the level of HH metering to 76% by the end of AMP8 with 67% billed on their consumption. The long term target is to meter 96% of households by 2050.
- Four network improvement schemes, two in the Tywi Gower and two in the SEWCUS water resource zones
- Delivery of the design for strategic inter zonal network transfer schemes, namely: Alwen Dee to Clwyd Coastal, North Eryri Ynys Môn to Lleyn Harlech-Barmouth, and Tywi Gower to Pembrokeshire. This could also enable future NHH demand to be met in the Pembrokeshire zone (see section 6.10).
- Commitment to undertake joint investigations with NRW in AMP8, to assess the future sustainability of our abstraction licences under a changing climate and to look further into Nature Based Solutions.

The outcome is that we will meet increased drought resilience targets for all the Dŵr Cymru water resource zones by 2031 or earlier for most zones. This is a robust programme of measures which secures water supplies under the future plausible pathways tested.

Delivery of our Plan will mean that the demand for water will on average be 205Ml/d lower by 2050. This will reduce the need for abstraction from the environment and deliver an overall net gain, supporting Welsh Government's SMNR aims to enhance the environment and biodiversity of Wales.

2.2 Overlap with Activities to be Delivered through Base

Does the proposed enhancement investment overlap with activities to be delivered through base?

– Ofwat's final methodology for PR24, Appendix 9, A1.1.1c

An overview of our enhancement investment and the overlap with our base intervention programme can be seen in Table 2 below.

Table 2 – Enhancement Schemes and an Assessment of the Overlap with Base Interventions

Type of Scheme	Overview of Investment Overlap
Internal Interconnector Schemes (Supply Side)	Where we are improving the capacity of our network through the four network interconnector schemes the improvements will not overlap with Base expenditure. These network improvements include the addition of new pumping station, pipelines, washouts, network ancillaries across our strategic mains network to facilitate the maximisation of our existing asset base.
Metering	Our split between Base and Enhancement for the customer metering programme is set out below. **Enhancement Interventions:** **Meter Optants:** Customers choosing to have a meter installed. **Progressive Metering:** the metering of unmeasured properties in line with Welsh Water's AMP8 Meter Strategy and WRMP **Proactive Replacements:** early replacement of dumb meters with AMR meters **Reactive Replacements above BAU:** the additional unit cost of an AMR meter when replacing an end-of-life or failed basic meter and addressing increased AMR meter infant asset mortality failure rate **Base Interventions:** **Reactive Replacement :** Like-for-like reactive meter replacements which is our Business As Usual ('BAU') approach **Current OpEx Costs** (Associated maintenance costs and Retail OpEx costs associated with meter reading). Our Metering Strategy will replace an additional 313,115 meters in AMP8 compared with the forecast run rate for meter replacement in AMP8.
Leakage Reduction	The additional investment for HH Demand side leakage improvement and for a programme of Active Leakage control on the demand side supported by our customer metering investment will deliver the improved leakage performance. Our base allowances will hold leakage at the end of AMP7 position. This reflects lower levels of leakage in 2025 and the increasing costs associated with maintaining those levels. Further enhancement related leakage detail can be found in Sections 4.5 and 4.6 of the WRMP.

Type of Scheme	Overview of Investment Overlap
Demand Side Demand Reductions	A combination of HH and NHH proactive communication, inspections and interventions on the Demand Side of the network, WRMP Section 4.5 Demand Reduction for more details. This is programme of work is all enhancement taking place on customer assets for which we are not responsible.

2.3 Overlap with Funding from Previous Price Reviews

Does the need and/or proposed enhancement investment overlap with activities or service levels already funded at previous price reviews?
– Ofwat's final methodology for PR24, Appendix 9, A1.1.1d

The AMP8 investment does not overlap with previously funded interventions which for the interventions covered by this case including leakage and water efficiency will be delivered by end of AMP7.

2.4 Alignment with the Long Term Delivery Strategy

Is the need clearly identified in the context of a robust long term delivery strategy within a defined core adaptive pathway?
– Ofwat's final methodology for PR24, Appendix 9, A1.1.1e

Our 'core' pathway includes all the options and associated investment within our 'most likely' future as these are required under all scenarios. In addition, we will progress with design work for 3 network schemes as low cost 'no regrets' interventions. These will then be 'dig ready' if future water resource pressures materialise including growth within these zones. Our 'core' investment pathway will, therefore, also include for:

1. Clwyd Coastal link main design work – high risk of abstraction licence reductions and so we will commence design work in AMP8
2. Pembrokeshire link main design work – zonal resilience is dependent on the delivery of demand management and vulnerable to environmental sustainability reductions as we abstract from two SAC designated rivers, loss of licence would cause supply concerns and so we will commence design work in AMP8
3. Lleyn Barmouth link main design work – zonal resilience is dependent on the delivery of demand management and so any under delivery would cause supply concerns and so we will commence design work in AMP8

2.5 Management Control of Costs

Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings been accounted for?
– Ofwat's final methodology for PR24, Appendix 9, A1.1.1g

A summary of the preferred options can be found in section 6.7 of the WRMP; note that the capital costs stated for the additional leakage options are just the "transition" costs i.e., the spend required to make the saving only. We have provided summary details of the network transfer options as a comparator against the available demand management options. In all cases the network interconnector schemes are a much lower cost and provide 'Best Value' given they deliver enhancement to our drought resilience and other business risks, such as interruptions to Supply.

3. Best Option for Customer

In this section we describe how we have developed options for addressing the need identified above. Our approach is set out in Sections 5 and 6 of our WRMP. The process of decision making for water resource planning has continued to evolve and for this iteration our Regulators now formally require companies to produce a 'Best Value' Plan, defined in guidance as "…one that considers factors alongside economic cost and seeks to achieve an outcome that increases the overall benefit to customers, the wider environment and overall society".

We need to demonstrate to our customers and regulators that our preferred solutions are appropriate to the scale and complexity of problem.

The five sub sections below correspond to the eight criteria set out in Ofwat's PR24 Final Methodology, Appendix 9 (Setting Expenditure Allowances), Section A.1.1.2.

3.1 Identification of Solution Options

> ***Has the company considered an appropriate number of options over a range of intervention types to meet the identified need?***
>
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.2a*

We appointed our framework partners Arup to develop a set of feasible supply-side options that would address the baseline supply-demand deficits identified in the SEWCUS and Tywi Gower zones. The optioneering followed a multi-stage, multi-criteria screening approach similar to that adopted for WRMP19.

However, newer guidance on screening criteria related to environmental considerations, regional supply benefits and national significance, was incorporated at the unconstrained options stage, in addition to operational feasibility and social and political acceptability criteria, see Figure 3 below. The expanded criteria provide an enhanced and more rigorous screening process that is consistent with best practice guidance and regulatory expectations, including the WRPG 2024 Supplementary Guidance: Environment and Society in Decision-making (Wales) and options guidance produced by the All Company Working Group. The resulting schemes developed from this process can be seen in Tables 4 to 7 below. The cost benefit of each of the schemes against the scenario performance requirements where then assessed and the most cost beneficial selected. The details of the prioritisation process can be found in Section 5.8 of the WRMP.

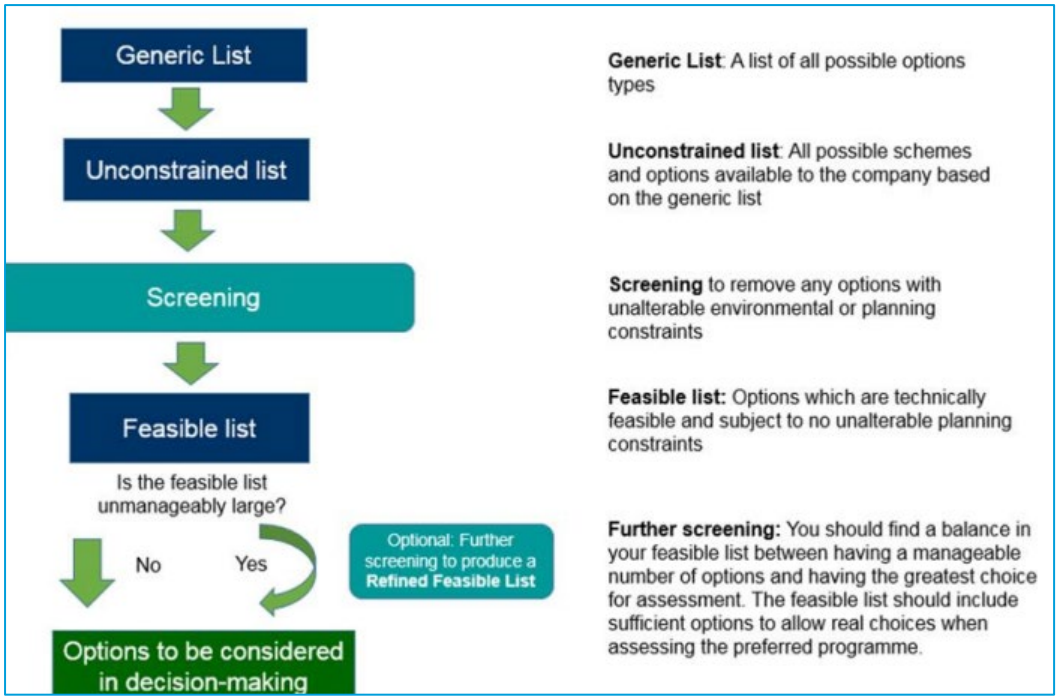

Figure 3 - Options Identification & Screening Process

Table 3 - Summary of SEWCUS feasible options costs

Option	CapEx	OpEx (assumed all year operation)	AIC (p/m3)
Great Spring to Court Farm	£70.707M	£1.736M	36.58
Great Spring to Llandegfedd	£63.442M	£1.448M	31.23
Dam raising at Talybont	£3.269M	£0.000M	30.42
Grwyne Reservoir for river regulation	£10.111M	£0.004M	8.7
Ponthir effluent reuse plus Wentwood	£51.370M	£2.367M	39.42
Pant yr Eos to Court Farm	£4.894M	£0.000M	19.7
Ynys y Fro to Court Farm	£3.998M	£0.108M	17.53
Ynys y Fro and Pant yr Eos to Court Farm	£7.923M	£0.108M	16.64
Reinstate Schwyll	£56.151M	£2.322M	39.29
Afon Lwyd to Court Farm	£1.680M	£0.119M	8.75
Afon Lwyd to Llandegfedd	£5.732M	£0.351M	23.68
Nantybwch washwater recovery	£5.348M	£0.139M	50.54
Wentwood reservoir to Court Farm	£17.253M	£0.300M	35.0
Effluent reuse Cardiff and Cog Moors VVWTW	£2.546M	£0.054M	56.41
Memorial/Cefn Mably WPSs enhancement	£14.778M	£1.388M	22.77
Llwynon Trunk mains upgrades	£5.480M	£0.000M	2.15

Table 4 - Summary of Tywi Gower Feasible Option costs

Option	CapEx	OpEx (assumed all year operation)	AIC (p/m3)
Bryngwyn washwater recovery	£0.651M	£0.013M	18.53
Upsize Llangyfelach WPS	£1.853M	£0.040M	8.47
Cwmdu Bridge enhancement	£8.184M	£0.000M	40.96
Tonna control valve enhancement	£4.325M	£0.064M	16.0
Llyn y Fan Fach Regulation	£24.828M	£0.000M	19.32
Christopher Road WPS enhancement	£15.777M	£0.568M	59.3
Carn Powell to Llanon upgrade	£2.350M	£0.119M	64.82
Enhanced Felindre supply to support Bryngwryn	£2.356M	£0.291M	25.17

Table 5 - Water efficiency options considered

Water Efficiency Intervention	Description	Average AIC p/m3
Online access to free issue water saving products	Online access to free issue products such as tap adapters, energy efficient shower heads, leak detection strips and toilet cistern bags.	78.69
Education	Expansion beyond our current education programme delivering to school assemblies and workshops.	8122.13
Leaky Loos	A more targeted and proactive approach using smart meter data and continuous flow or high consumption alerts to target properties that may not know they have a problem.	1420.38
Home audits	Home audits including home visits, including education and installing water saving devices.	103.73
Tariffs	High-level option to include benefits of tariffs, longer-term option as smart metering is a vital enabler for this. Our customers are not currently supportive of this currently and cost/benefit is uncertain	38.82
Greywater recycling	Longer-term option to consider retrofitting greywater recycling to existing properties with an assumption that the costs are borne by DCWW	N/A
Rainwater harvesting	Longer-term option to consider retrofitting rainwater harvesting to existing properties with an assumption that the costs are borne by DCWW	N/A
Behavioural Change	High level option, based on marketing team coupled with TV advertising campaign for the purposes of deriving a WRMP option. This option is to go beyond current activities relating to influencing behaviour such as the Get Water Fit application for customers.	290.94

For PR24, we have updated our leakage optimisation modelling to explore the costs and leakage savings associated with a broad range of innovative leakage reduction policy options, this to identify the best means of attaining leakage performance commitment for AMP8 and beyond. The analysis considers the numerous leakage control interventions shown in the Table 7 below.

Table 6 – Leakage Interventions and their Associated AIC Benefits

Leakage Intervention	Description	Average AIC p/m3
Active leakage control (ALC)	Our current ALC policy utilises technicians actively searching for leaks within an area, based on flow information that the leakage has risen. Detection and repair costs are found using a relationship between these values and leakage in a specific area. This includes lift and shift acoustic logging.	94
Permanent Acoustic Logging (PAL)	Permanent Acoustic Logging is the permanent deployment of loggers within the network for the long term monitoring of leakage. PAL deployment reduces routine manual surveying requirements and when a leak is suspected it helps to target ALC detection efforts.	58
Intensive active leakage control (I-ALC)	Intensive ALC can be defined as a systematic and concentrated leakage detection effort in DMAs. This has typically been undertaken in DMAs with historically high leakage that has proven difficult to pinpoint and reduce. Concerted effort is made to significantly reduce leakage within a DMA and this new leakage level is then maintained.	956
Pressure management	Pressure management is a method by which pressure is controlled in areas of the network, accomplished by monitoring flow rate throughout the area. Leakage is prevented through having a pressure-controlled network.	101,502
Distribution mains asset renewal	The replacement of deteriorating/leaking pipework within the distribution network, typically burst driven but can also be driven by target mains lengths.	7,368
Customer Metering (SPL)	The rollout of Smart metering will enable us to identify leakage on the customer supply pipe, compared to our current approach which focusses mainly on our distribution network.	
DMA Subdivision	DMA sub-division is the process of dividing existing DMAs into smaller geographical areas, allowing for greater granularity in data, more in depth analysis, and improved efficiency of leakage reduction.	5,107
Pressure Transients Management	Pressure Transients Management is the implementation of a network optimisation team dedicated to pressure transient repair, as well as the implementation of booster pumps, PRVs, ALC repair activities, and the engagement of high-consumer properties in order to understand and cater the network better to the relevant parties	10,019
Sahara surveying and fix	The Sahara system is a pipe surveyance tool that provides a feed of the internal structure and characteristics of the pipe, as well as an acoustic sensor used to detect pinhole leaks or trapped air pockets.	6,411
Trunk mains active leakage control	Additional ALC targeted at trunk mains. This option relies on the creation of a dedicated trunk main ALC team to identify leaks across the trunk main network, whilst calculating the benefit of installing new meters and/or loggers.	159
Trunk mains active asset renewal	With a similar premise as asset renewal, the renewal of materials in trunk mains was considered as an option. We have not included communication pipes in this option, meaning a mains only policy was considered.	2,284

A multi-criteria assessment was developed in collaboration with ARUP, drawing on the Water Resources West methodology, to produce the long listing of options for the unconstrained list. In addition, a qualitative high-level assessment of the following broad categories was carried out:

- Option benefit – including questions on contribution to national or regional needs and practicability of resource deployment.
- Deliverability and likely feasibility – including questions on technical feasibility and examples of use elsewhere.
- Potential environmental, planning, and other regulatory constraints - including questions on designations and avoidance of unmitigable damage to designated areas.
- Political and customer acceptability – including questions on planning and unmitigable socioeconomic impact.

Through our optioneering work we did not identify any feasible catchment based/nature-based solutions that could be developed further and taken through to options appraisal. We acknowledge this is a gap for WRMP given the contribution these types of schemes have the potential to make to achieving both more resilient water resources and ecosystems, aligning fully with the principles of SMNR. We are seeking funding in AMP8 to deliver investigations that will help provide information on the nature of our catchments and the associated water resources, with the aim to identify and design schemes that can support long term water and ecosystem resilience.

3.1.1 Assessment and Selection of Solution Options

> ***Is there evidence that the proposed solution represents best value for customers, communities, and the environment over the long term?***
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.2b*

Our Plan is based on long term forecasts of supply and demand needs and meets our objectives under the 'most likely' future environmental and social circumstances that we might encounter. The investment pathway for this scenario includes an allowance for uncertainty, but there are some key assumptions within our Plan that could change into the future which may require additional investment to address. Our regulators have asked that we explore the impacts of this through stress testing of our plans to a range of plausible future scenarios, including Ofwat's PR24 Common Reference Scenarios. The outputs from this testing have informed the makeup of our 'core' pathway of investment that would be required under all possible future scenarios. We have also identified alternative pathways due to potential significant deviations from our 'most likely' pathway. More detail of the approach can be seen Section 5 of the WRMP.

Using metering as an example our progressive metering strategy for AMP8 and beyond is underpinned by an appraisal of the economic, demand-related and business performance outcomes generated by a bespoke metering cost-benefit model. The model allows consideration of a wide range of metering options against a set of operational and retail performance metrics and examines the costs and benefits of each metering option relative to the company's current metering strategy. Projections of the number of meter installations, PCC and leakage forecasts are derived from our most recent baseline demand forecast for the long term planning period.

To provide a detailed understanding of each future potential metering strategy, our base year property numbers and meter estate have been categorised into cohorts for household/non-household, unmeasured/measured, meter manufacturer and technology, meter size, age, and location (internal/external). A metering model has been developed , see overview in Figure 4 below, which assesses the economic, demand-related, and business impacts of changes in the meter estate each year under different metering policies. Policy variables include the type of metering and charging/billing, the timing and speed of rollout, and meter replacement (including legacy meters). The model also allows for consideration of alternative AMR/AMI read frequencies and treatment of void properties and joint supplies. See further details in Section 5.4.1 of the WRMP.

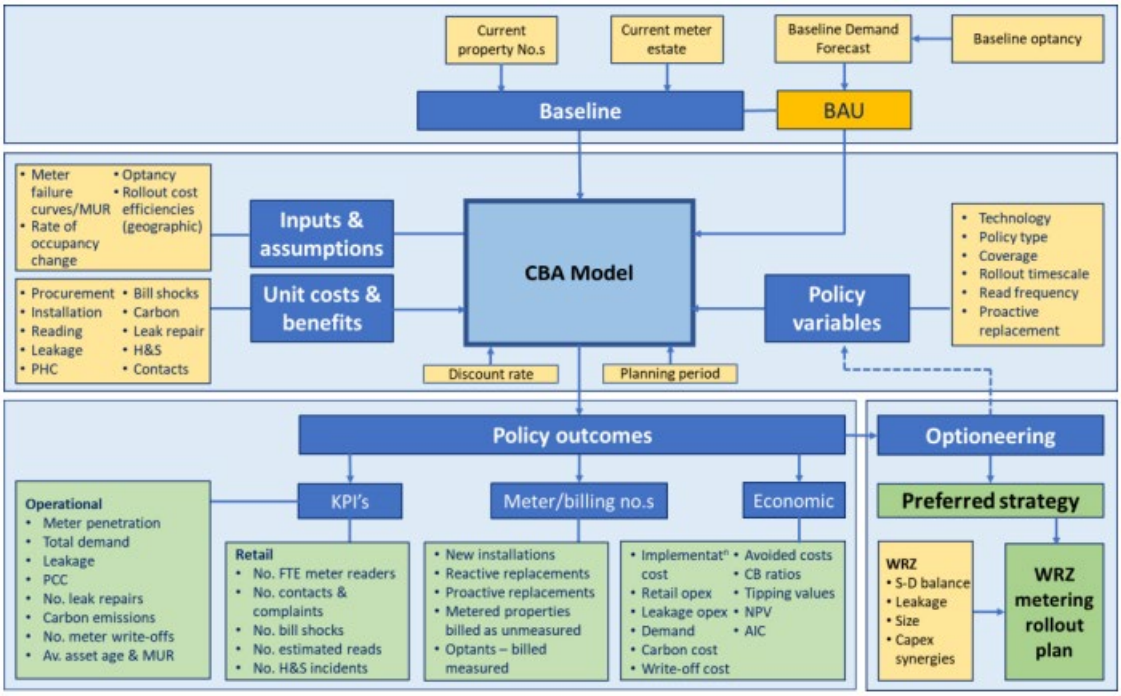

Figure 4 - Metering CBA Model Process Diagram

3.2 Quantification of Benefits

Has the company fully considered the carbon impact, natural capital and other benefits that the options can deliver?
Has the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?

– Ofwat's final methodology for PR24, Appendix 9, A1.1.2c and A1.1.2d

The WRMP should maintain and enhance Biodiversity, promote the resilience of ecosystems and accounting for carbon (Environment (Wales) Act 2016).

Understanding the impact of climate change is one of the key considerations for this Plan, something emphasised by both Welsh Government and Natural Resources Wales in their guidance for Welsh companies. Since the Welsh Government declared a climate emergency in April 2019, they are keen to see companies in Wales increase the pace at which they act to both reduce carbon emissions and implement climate adaptation.

Land within our catchments is subject to a variety of land use types and management practices and we own limited land within these areas. We understand the need to adopt catchment management approaches that will increase our ability to react, respond and recover from future events brought about by climate and land use change. Effective catchment management will help us control chemical and energy usage, and the associated carbon emissions associated with water treatment processes.

It encourages investment in the best value solutions that also support the natural capitals approach and promotes collaboration and joint working, allowing us to deliver the best possible service for our customers.

We are taking an integrated approach to the environmental appraisal of this Plan, aligned to that adopted for the Water Resources West regional plan. This approach ensures all the feasible options we have considered have been appraised in accordance with the legislative requirements, notably:

• Strategic Environmental Assessment (SEA)
• Habitats Regulations Assessment (HRA)
• Water Framework Directive (WFD) Assessment
• Biodiversity Net Gain (BNG) and Natural Capital Assessment (NCA)

Guidance from NRW and WG is clear that our WRMP needs to deliver for both our customers and the environment through adoption of the principles of SMNR. To ensure that our Best Value planning decision making accounts for this we have considered the areas within Figure 5 below.

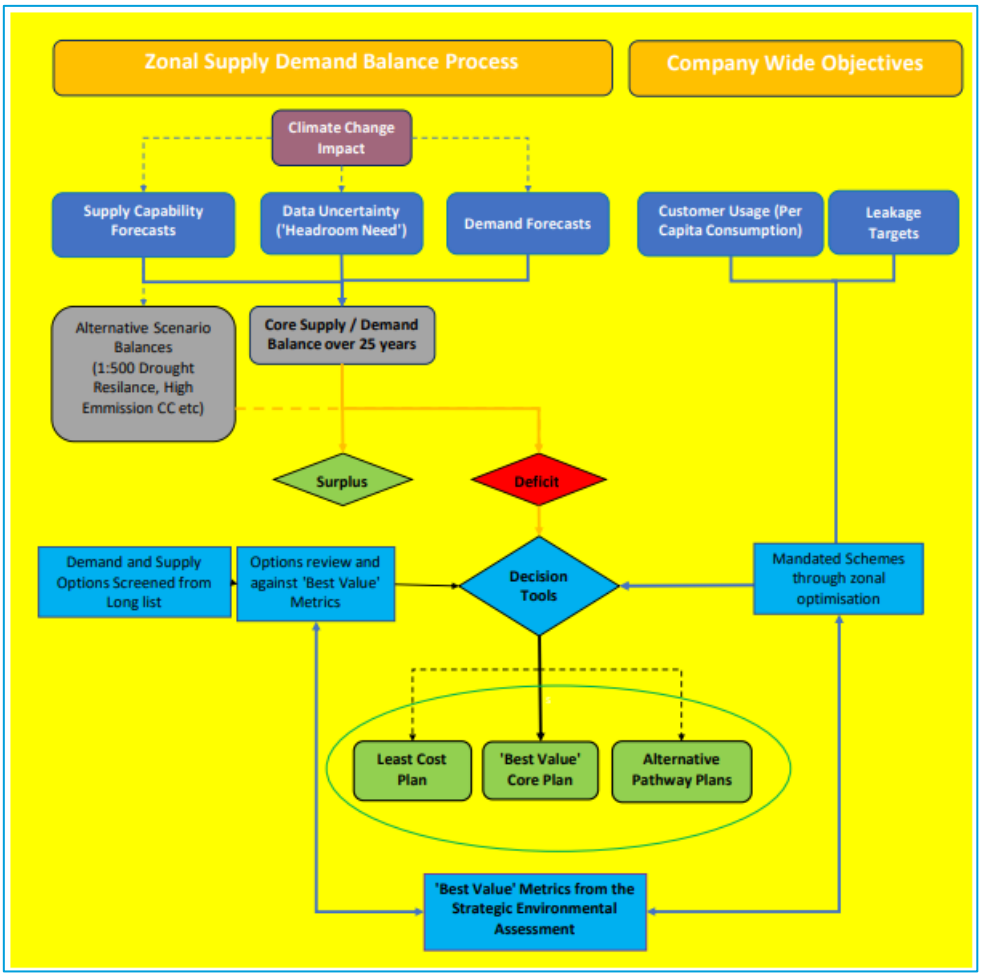

Figure 5 - Best Value decision making process.

Through the delivery of catchment management solutions, we have an opportunity to achieve multi-benefits such as:

- Carbon Strategy - Restoring peatlands and planting trees to sequester carbon and deliver a more resilient raw water supply reducing treatment energy costs.
- DWI - Supporting the delivery of our Compliance Risk Index (CRI)/ Events Risk Index (ERI) targets through a better understanding of both current and future raw water risks, their potential impacts on WTW and customers.
- Biodiversity Strategy and the Environment (Wales) Act - Contribute to improving terrestrial and aquatic habitats and the Welsh National Forest ambition through new woodland planting

There are clear benefits from the programme of work and WRMP. Using metering and demand side consumption projects as an example these projects will impact two of our performance's commitments – Leakage and Per Capita Consumption (PCC). The relative impact of these interventions can be seen for the years 2025/26 to 2034/35 in Figures 6 and 7 below shows the relative magnitude of PCC and demand management reductions. In AMP8 and AMP9 most demand management savings will come from the progressive meter policy and the demand side demand reduction interventions through project Cartref which will reduce both customer supply pipe leakage and customer usage. We have assumed that government led water labelling of household items which use water will support this.

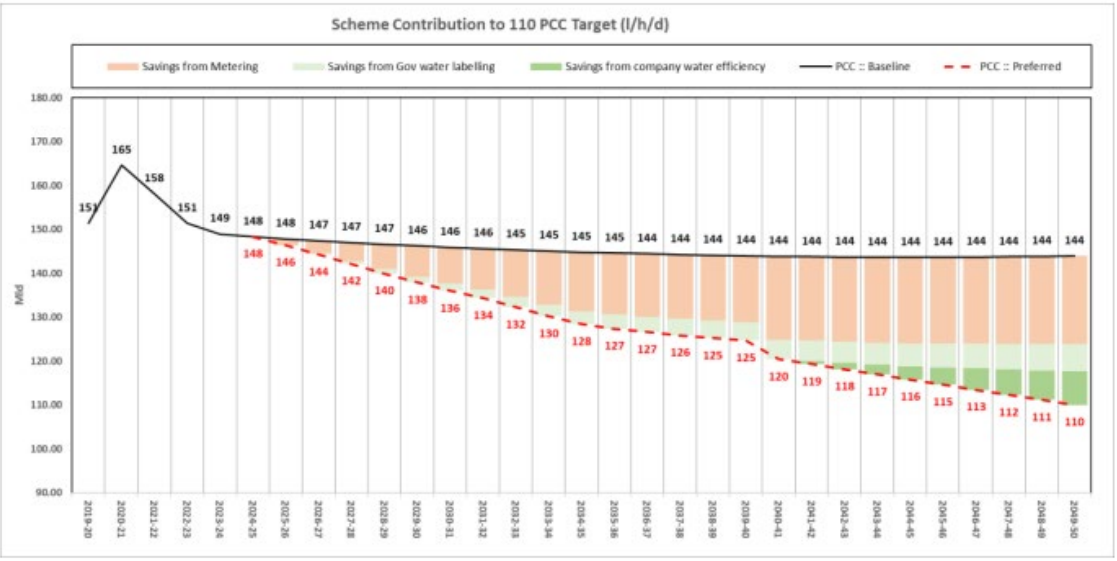

Figure 6 - Option benefits to achieve PCC target of 110 l/h/d (as detailed in the WRMP)

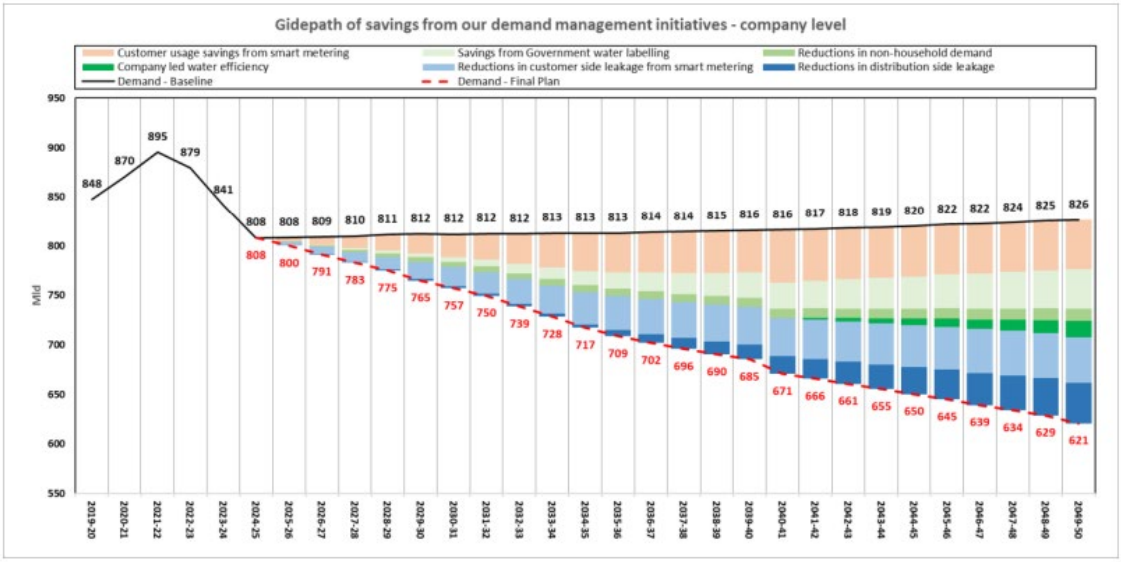

Figure 7 - Glidepath of savings from our demand management strategy (as detailed in the WRMP)

The assessment of options within the WRMP has considered the pace of change against both these measures as part of optimising the long term plan.

3.3 Uncertainties relating to cost and benefit delivery

Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where forecast option utilisation will be low?

– Ofwat's final methodology for PR24, Appendix 9, A1.1.2e

Where there is a supply/demand deficit, all feasible demand management and water supply enhancement options are developed with cost and benefit metrics calculated. A decision-making process is then followed to examine the trade-offs between performance metrics and generate a 'best value' societal and environmental plan. The preferred programme of solutions is then tested against potential futures to identify any need for an adaptive plan that would lead us to deliver an alternative programme. This is described in more detail within the Scenario Testing Section 6.6.1 of the WRMP.

We have aimed to balance efficiency in cost versus innovation and risk throughout the development of the programme. The options we have brought forward are a suitable mix of well established approaches that will deliver high likelihood benefits.

The overall benefit to WAFU of the network enhancement schemes is 65.5Ml/d at an AMP8 TotEx cost of £51M (22/23 prices). In support of the investment programme Table 7 shows how often the additional capacity of the solutions would need to be used during varying drought return periods. Schemes utilisation is high, even in less severe dry years. The schemes also provide additional resilience to the high-level system works outages which will be needed in delivering the Cwm Taf scheme.

Table 7 - Preferred supply side option utilisation

Return period (y)	Memorial/Cefn Mably WPSs enhancement – no. days operated/yr	Llwynon Trunk mains upgrades – no days operated/yr
500	140	95
200	126	83
100	113	75
50	96	68
10	41	38

Our preferred supply side schemes for Tywi Gower are detailed below, as shown in Table 8 below they have fairly high utilisation rates, even in less severe dry years.

Although the metering programme is targeted on the Tywi zone early within the Plan, this is insufficient to provide zonal resilience during the AMP8 period and the demand management schemes do not provide the additional resilience against outages at the Crai or Cefn Dryscoed water treatment works.

1) A scheme that increases the capacity of the Christopher Road pumping station and associated network to allow increased supplies from the Felindre WTW system to reduce the required outputs from Crai WTW, which in turn reduces the abstraction needed from Crai reservoir.
2) A scheme that allows us to safely reverse the flow through the Tonna control valve, which is the key asset for controlling the balance of supply between the Felindre and Cefn Dryscoed systems. Water quality issues mean that currently this is a difficult operation to achieve and so this scheme will significantly upgrade the asset to allow more frequent and greater operation of this flow reversal.

The benefit to WAFU of the Tywi Gower network enhancement schemes is 31Ml/d at an AMP8 CapEx cost of £20M (22/23 prices). The frequency of needing additional capacity from the two new solutions can be seen in Table 9 below across varying drought return periods. The utilisation of both schemes is relatively high, even in less severe dry years and as stated above add significant resilience to the customers served from the Crai and Ystradfellte reservoirs and associated works.

Table 8 - Tywi Gower option utilisation

Return period (y)	Christopher Road WPS enhancement– no. days operated/yr	Tonna enhancement – no days operated/yr
500	202	166
200	186	144
100	163	125
50	141	105
10	74	42

3.4 Third Party Funding

Has the scale of forecast third party funding to be secured (where appropriate) been shown to be reliable and appropriate to the activity and outcomes being proposed?

– Ofwat's final methodology for PR24, Appendix 9, A1.1.2f

No third-party funding is involved in any of the projects included in this Enhancement Case.

Through our involvement with Water Resources West and our pre-consultation exercise, we have not identified any feasible supply options from either neighbouring companies or other third parties. We are, however, working with the Canal and Rivers Trust on developing a joint solution to both organisation's water needs along the River Usk.

3.5 Involving Customers in option selection

Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views?

– Ofwat's final methodology for PR24, Appendix 9, A1.1.2h

Given our unique business model and the requirement of guidance, we have taken a collaborative approach to plan development through active engagement with regulators, stakeholders, and customers. To ensure acceptance of the WRMP, we have held regular monthly progress meetings with NRW and EA to review and agree processes and planning assumptions.

We have undertaken dedicated formal precomputations meetings with OFWAT, The Consumer Council for Water (CCW), NRW, EA and ran a full pre-consultation exercise contacting over 300 stakeholders including National and Regional environmental interest groups and all local authorities. Environmental engagement has also been completed through presentations to the Welsh Water Independent Environmental Advisory Panel.

Please refer to WSH56-RS00 - A Reliable Water Supply for the Short and Long Term (Section 1.2).

4. Costing Efficiency

In this section we give specific details on our approach to costing and benchmarking. Our overarching approach to developing efficient costs is set out in WSH50-IP00 Our Approach to Investment Planning (Section 7).

The two sub sections below correspond to the three criteria set out in Ofwat's PR24 Final Methodology, Appendix 9 (Setting Expenditure Allowances), Section A.1.1.3.

4.1 Developing a cost for Supply and demand

> ***Is it clear how the company has arrived at its option costs?***
> ***Is there supporting evidence on the calculations and key assumptions used and why these are appropriate?***
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.3a and A1.1.3c*

Leakage and Demand Side Consumption Reduction
The nature of the Cartref leakage programme does not lend itself to using our Unit Cost Database (UCD) Cost & Carbon Estimating Tool) C&CET, the preferred approach to costing. We have therefore used two of the other approaches detailed in our 'Overview: How we have developed our investment plan'.
This programme of work has been costed using a bottom-up approach, quantifying the interventions on an annual basis, and applying unit rates per intervention. The rates used came from company staff rates and framework rates.

The costing of this Enhancement Case is fully aligned with our previously submitted WRMP, which has been subject to the review governance process.
Along with our overall costing strategy being reviewed and assured by Jacobs, we have also employed third party consultants to review single Enhancement Cases to provide confidence that the estimates within them are robust, efficient and deliverable. Please refer to WSH50-IP00 Our Approach to Investment Planning (Section 6) for more information regarding the review and assurance undertaken.

Network Interconnectors & Improving Deployable output to supply third parties
The costs for this intervention programme follows the historic trend analysis using our UCD and its associated cost models set out in Section 5 Costing Methodology in WSH50-IP00 - Our Approach to Investment Planning. A scope was developed for the schemes which enables us to use our cost models contained in our Unit Cost Database (UCD) and the associated Cost & Carbon Estimating Tool.

A scope was developed with much of assets and items of work being constructed throughout previous AMPs, and therefore we have a rich source of historical cost data. For these items of work, we have developed cost models based on the dominant cost drivers, e.g. the most influential driver to cost for a tank is volume. This costing approach forms the direct works and site-specific costs. We apply construction indirect costs and project oncosts based on the work stream, in this instance this is Wastewater Non-Infrastructure, which applies modelled percentages to the cost of the direct works and site specifics.

The scope is aligned to our Work breakdown Structure (WBS), which was developed to support our data capture process of historical project cost against delivered assets, into a scope input sheet. Within this, sizing of the assets based on the relevant yardstick, which is dictated by the WBS, is provided following calculation in the previous engineering stages. Our costs models are developed in line with our WBS, and this allows us to input this information into the C&CET and generate a project estimate. WBS details the inclusions and exclusions of works under each cost model and the

limitations of the model, so we can ensure all project costs are captured and there is also no over costing.

A key assumption was that existing process assets are in acceptable condition and operating within their design envelope in terms of flow and load and existing process assets can be optimised without detrimental performance to downstream plant and processes. There is residual risk that utilisation/optimisation of the existing works may not provide the resilience and robustness to ensure the required works output to supply long term, without additional upgrade to processes.

Metering
This investment programme was developed and costed using a bottom-up approach, as described in 'Overview: How we have developed our investment plan', to costing the metering programme.

The approach was to develop a schedule of rates for the different interventions and work activities, which we can apply to the volume of meters we are looking to install.

Along with our overall costing strategy being reviewed and assured by Jacobs, we have also employed third party consultants to review single Enhancement Cases to provide confidence that the estimates within them are robust, efficient and deliverable. Please refer to WSH50-IP00 Our Approach to Investment Planning (Section 6) for more information regarding the review and assurance undertaken

4.2 Benchmarking our approach

> ***Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)?***
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.3b*

We have focused our benchmarking activities on the areas of the plan, which is most repeatable across companies, namely metering.

We engaged an independent consultant to undertake an industry benchmark review of our metering costs to understand our cost efficiency. The findings report identified that for the combined total for installation and procurement our pre-efficiency costing was within the industry benchmark range and 10% below the average.

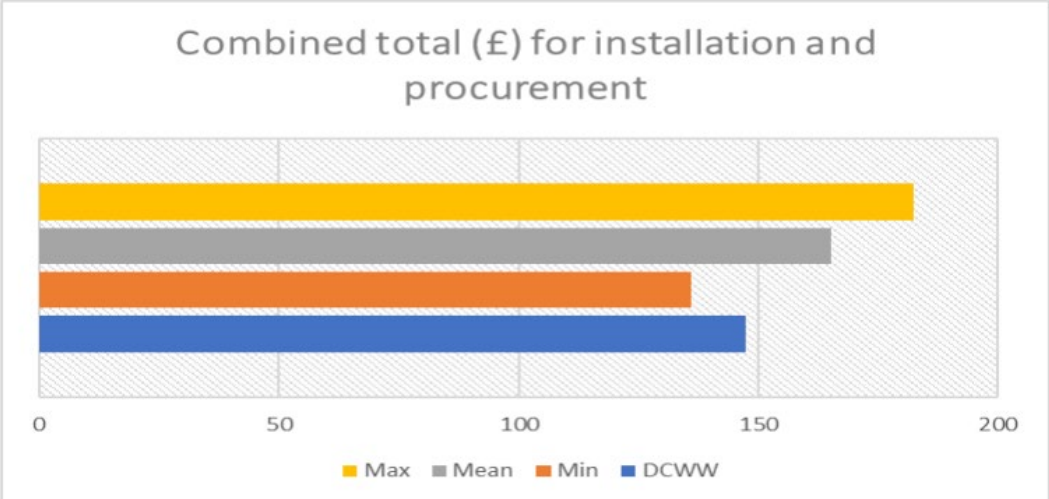

Figure 8 - Extract from benchmarking report

Metering
In this instance the benchmarking work which was undertaken by Aqua Consultants provided review and challenge of the costs put forward. All costing of AMP8 has been reviewed against PR19/AMP7 alongside cost and market pressures in this period as part of the internal assurance process that determines their accuracy and relative efficiency.

5. Providing Customer Protection

The delivery of our WRMP has strong oversight from Natural Resources Wales (NRW) and the Environment Agency (EA). Progress is reported annually through a formal reporting process to these regulators.

The work delivered through this programme also has a material impact on three of common performances commitments: Leakage, Per Capita Consumption (PCC) and Business Demand. The improvements in performances against these measures is set out in WRMP and in our performance commitment data tables.

In this section we set out the template for a proposed price control deliverable (PCD) to build on the existing regulatory mechanisms. This is designed to provide strong controls for the most material element of our planned enhancement programme – meter installation and upgrade (£124M 2022/23 prices). If the proposed volume of metering activity is not delivered, funding will be returned to customers on a proportional basis.

The two sub sections below correspond to the three criteria set out in Ofwat's PR24 Final Methodology, Appendix 9 (Setting Expenditure Allowances), Section A.1.1.4.

5.1 Proposed Price Control Deliverable (PCD)

> ***Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?***
> *– Ofwat's final methodology for PR24, Appendix 9, A1.1.4a*

The table below sets out the proposed structured for the PCD

Customer Facing Description of Enhancement Case	Reducing Drought Risks and Improving Customer Visibility of Usage for PCC Management
Short Description of Enhancement Case / PCD Area	WRMP : Metering
PCD Number	PCD2
Summary of deliverable	Count of meters delivered

<table>
<tr><td>Description</td><td>Our WRMP has identified the need for a range of interventions across our operating area to meet customer and regulatory expectations. Our planned investment programme and performance commitments will be monitored by the Environment Agency (EA) and Natural Resources Wales (NRW) through the annual reporting process linked to the WRMP (the annual review and annual data return). The Leakage, Per Capita Consumption (PCC) and Business Demand benefits will also be tracked by Ofwat via common performance commitments.

In addition, we are proposing a PCD around the largest area of investment: Installation of new revenue meters at household and non-household properties (this investment accounts for around 70% of the enhancement investment).

We will upgrade traditional 'dumb' (basic) meters to smarter AMR meters - meters which can be read via drive by technology and have the potential for future upgrade to remote read. The programme of work, see Table 10, will be delivered through people choosing to move to a meter (meter optants), selective (pro-active) metering of properties for the first time and by upgrading of existing meters.

Table 9 – Number of Meters Installed within the Enhancement Programme

<table>
<tr><th>Meter Intervention</th><th>Household</th><th>Non-household</th></tr>
<tr><td>Meter Optants (AMR)</td><td>40,179</td><td>503</td></tr>
<tr><td>New meter installations (AMR)</td><td>319,883</td><td>5,494</td></tr>
<tr><td>Proactive meter replacements (Basic to AMR conversion)</td><td>237,720</td><td>46,208</td></tr>
<tr><td>Reactive Replacements above BAU: (additional AMR infant mortality)</td><td>28,168</td><td>1,019</td></tr>
</table>

For reactive meter replacement maintenance activity, where basic meters will be replaced with an AMR meter, the installation cost and the cost of a basic meter is funded through our base activity. The additional cost of an enhanced meter c£40 each in 2022/23 prices will be funded through enhancement funding. The number of meters this includes has not been included in the Table 10 above but the cost of this work has been included in Table 11 below.</td></tr>
<tr><td>Measurement and Reporting</td><td>In line with Ofwat's guidance on PCDs (4th July 2023) the company propose the number of meters installed as the deliverable to be tracked.

Through the company’s meter Optant and selective household meter programmes, a total of 366,059 new AMR meters for household (HH) and non-household (NHH) customers metered for the first time are planned for installation during AMP8.

A total of 283,928 meters for household (HH) and non-household (NHH) customers are due to be replaced proactively moving from basic meters to AMR meters during AMP8.

A total of 155,339 meters for household (HH) and non-household (NHH) customers are also due to be replaced reactively moving from basic to AMR meters during AMP8. Of which 29,187 are enhancement above BAU reactive replacement and 126,151 are base BAU reactive replacement.</td></tr>
</table>

<table>
<tr><td></td><td>The volume of meters replaced will be reported annually to Ofwat as part of the annual performance report (APR).

Using the APR22-23 structure:

• new meter installs by type (basic, AMR and AMI) for HH optant, HH selective and New business customers can be found in data table 6D Lines references RAG6D.6, RAG6D.7 and RAG6D.8.
• The HH and NHH proactive and reactive replacements above BAU will be reported in lines RAG6D.8 for HH and RAG6D.9 for NHH.</td></tr>
<tr><td>Conditions on scheme</td><td>No additional conditions identified.</td></tr>
<tr><td>Assurance</td><td>The company will agree appropriate assurances with Ofwat as part of Final Determination.</td></tr>
<tr><td>Price control deliverable payment rate</td><td>The table below shows the calculated values for meter replacements used in the development of the company's business plan and WRMP.

If the company fails to deliver the total number of units, in any of the eight categories, the company will return money to customers at the rate shown in Table 11 below. This rate will be in direct proportion, on a pro rata basis (%), to the total number of meters due to be installed within the programme.

For example, in accordance with Table 10 above and Table 11 below, if 100% of the total number of meters are installed in relation to 'Household - New Meter Installations' then £0 (zero pounds) will be returned to customers. If 50% of the total number of meters are installed, then 50% of the programme cost value will be returned to the customers (£34,958,499).

Table 10 – Meter Enhancement Costs HH and NHH and Example Value to Return to Customers for incomplete scheme delivery

<table>
<tr><th>Intervention Type</th><th>Household Programme Cost & % Examples for return to customers</th><th>Non-household Programme Cost & % Examples for return to customers</th></tr>
<tr><td>Meter Optants (AMR)</td><td>Prog. Cost: £11.188M
Example returns:
50% = £5,594,095
10% = £1,188,191</td><td>Prog. Cost: £0.292M
Example returns:
50% = £145,857
10% = £29,171</td></tr>
<tr><td>New meter installations (AMR)</td><td>Prog. Cost: £69.917M
Example returns:
50% = £34,958,499
10% = £6,991,699</td><td>Prog. Cost £3.190M
Example returns:
50% = £1,594,784
10% = £318,956</td></tr>
<tr><td>Proactive meter replacements (Basic to AMR conversion)</td><td>Prog. Cost: £23.653M
Example returns:
50% = £11,826,268
10% = £2,365,253</td><td>Prog. Cost: £7.751M
Example returns:
50% = £3,875,554
10% = £775,110</td></tr>
</table>
</td></tr>
</table>

	Reactive Replacements above BAU: (additional AMR infant mortality + additional cost of AMR above basic meters)	Prog. Cost: £7.939M Example returns: 50% = £3,969,603 10% = £793,920	Prog. Cost: £0.898M Example returns: 50% = £449,163 10% = £89,832
Impact performance in relation to performance commitments	The interventions included within the WRMP will deliver demand savings through HH PCC and NHH consumption reductions as well as HH external leakage reductions. Leakage will reduce by a further 10% during AMP8 compared to the 2019/20 baseline. The target level of leakage reduction in 2029/30 is forecast to be 18.58 Mld. Most of this reduction is expected to be delivered through the identification and repair of leakage on the customer side because of our smart metering programme. PCC HH and NHH (Business Demand) consumption levels will reduce by 28.57 Ml/d compared to the end of AMP7 figure. This reduction will be achieved in part via the metering programme set out above, but also via response to our own water efficiency campaigns through project Cartref and initiatives delivered by Government.		

5.1.1 Extent of Protection

Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?
– Ofwat's final methodology for PR24, Appendix 9, A1.1.4b

The delivery of the metering programme is the most material element of the Enhancement Case.

Other areas such as leakage, PCC and Business demand will be covered by common performances commitments.

Delivery of new supply schemes will be overseen by the Environment Agency and NRW through the annual reporting process on the WRMP.

5.2 Third Party Funding

Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including how customers are protected against third-party funding risks?
– Ofwat's final methodology for PR24, Appendix 9, A1.1.4c

If the company enters into a commercial arrangement with the Canal & Rivers Trust to provide them with support water, two schemes may be required to be delivered in order to maintain our service to our customers. Such schemes would be 100% funded by third parties and any agreement(s) entered, would safeguard the parties in relation to the delivery of the output(s) and cost of such scheme(s).

Appendix A – Costs By Year For AMP8

The table below shows the total CapEx enhancement costs in Amp 8 for this Enhancement Case. The Ofwat drivers this Enhancement Case maps to are:

- Improvements to supply / demand balance reducing drought risks and Improved customer visibility of usage and PCC management. (CW3b.41)
- Demand-side improvements delivering benefits in 2025-2030 (excl leakage and metering); SDB CapEx. (CW3b.44)
- Leakage improvements delivering benefits in 2025-2030; SDB CapEx. (CW3b.47)
- Interconnectors delivering benefits in 2025-2030; SDB CapEx. (CW3b.50)
- New meters requested by existing customers (optants), metering CapEx. (CW3b.60)
- New meters introduced by companies for existing customers, metering CapEx. (CW3b.63)
- New meters for existing customers - business; metering CapEx. (CW3b.66)
- Replacement of existing basic meters with AMR meters for residential customers; metering CapEx. (CW3b.69)
- Replacement of existing basic meters with AMR meters for business customers; metering CapEx. (CW3b.78)

Table 11 - Total TotEx in AMP8 Plan in 2022/23 prices

	Year in AMP8					
Driver Ref	**1**	**2**	**3**	**4**	**5**	**Grand Total**
CW3b.41 CapEx	£0.000M	£6.451M	£6.451M	£6.451M	£2.507M	£21.860M
CW3b.44 CapEx	£3.091M	£3.045M	£3.041M	£3.056M	£3.095M	£15.329M
CW3b.47 CapEx	£1.007M	£0.993M	£0.994M	£1.001M	£1.015M	£5.010M
CW3b.50 CapEx	£7.837M	£17.452M	£15.930M	£0.000M	£0.000M	£41.219M
CW3b.60 CapEx	£3.045M	£2.619M	£2.223M	£1.851M	£1.450M	£11.188M
CW3b.63 CapEx	£17.614M	£13.889M	£13.735M	£13.556M	£11.122M	£69.917M
CW3b.66 CapEx	£0.571M	£1.449M	£0.291M	£0.053M	£1.117M	£3.481M
CW3b.69 CapEx	£4.646M	£5.915M	£6.237M	£6.379M	£8.416M	£31.592M
CW3b.78 CapEx	£1.334M	£1.745M	£1.740M	£1.699M	£2.132M	£8.649M
CW3b.51 OpEx	£0.008M	£0.008M	£3.209M	£3.209M	£3.209M	£9.643M
TotEx Total	**£39.153M**	**£53.567M**	**£53.851M**	**£37.255M**	**£34.064M**	**£217.890M**

What We Will Deliver: This Enhancement Case will deliver a range of interventions across our WRMP. The most material areas of delivery will be for the meter installation programme;
1) 40,000 meter optants (AMR),
2) 320,000 new meter installations (AMR),
3) 280,000 proactive meter replacements (basic to AMR conversion),
4) 29,000 reactive replacements (additional AMR infant mortality).

Appendix B – NRW Advice Notice

Please see attached Dŵr Cymru Response to the Natural Resources Wales Advice Note: 'Advice report on Dŵr Cymru Welsh Water's Statement of Response – 7th September 2023

Dŵr Cymru
Welsh Water

Dŵr Cymru Response to the Natural Resources Wales Advice Note:

'Advice report on Dŵr Cymru Welsh Water's Statement of Response – 7th September 2023'

dwrcymru.com

Version control and authorisation

Revision	Author	Checker	Approver	Date	Change
V 0.1	IB	CR	IC/MD	20.09.2023	

Executive Summary

This document provides additional information in support of the Dŵr Cymru Statement of Response on the revised Draft WRMP24, this following the draft advice from Natural Resources Wales to Welsh Government on the Plan.

It re-confirms our long-term ambition to make significant reductions in the volume of water we need to supply each day, bringing benefits to our customers in terms of a more resilient system during drought conditions, and to the environment through reduced levels of abstraction from our rivers and reservoirs.

We have re-stated the components of our water balance and are reporting differing levels of leakage and per capita consumption in our revised WRMP24 compared to that presented in our draft WRMP24. This has impacted the accounting of AMP7 performance commitments but in absolute terms we plan to make greater leakage savings over this period than targeted within our WRMP19 Plan.

The re-statement is intrinsic in formulating our demand forecast to 2050 and our demand management ambition has not changed. Our target remains to reduce leakage by 10% during AMP8 and by 50% by 2050 and to help our household customers reduce their average use to 110 l/h/d. On top of this we have now included a commitment to help our non-household customers reduce their usage by 11% by 2050. Taken together, our revised WRMP24 now forecasts that the overall demand for water by 2050 will be 30% lower than 2019/20 levels, with the absolute volume 5% lower than that presented in our draft WRMP24.

Our demand management ambition already takes us beyond our drought resilience targets so that any further reductions are both costly and arguably of limited benefit against regulatory targets or customer preferences.

1. Overview

We presented the Statement of Response and a revised draft Water Resource Management Plan to Welsh Government on the 23rd June. We have now received a draft of the 'Advice report on Dŵr Cymru Welsh Water's Statement of Response' from NRW and following our review, we would like to offer comment on this advice as part of ongoing dialog aimed at finalising our Plan with regulators and Welsh Government.

The advice acknowledges improvements made to the Plan following the many responses received to consultation, however, some key issues remain, most specifically in relation to meeting AMP7 demand management commitments and in setting further ambition in AMP8. This review note aims to provide further clarity, beyond that in our Statement of Response in these areas, and if needed we will add this information to our Final Plan for further transparency.

2. AMP7 Commitments

For WRMP19 we presented a demand forecast to meet a 15% leakage reduction over the AMP7 period based upon our then understanding of the company water balance between distribution input (DI) and the components of demand. Overall, we estimated that dry year demand (DI) would fall by 35Ml/d within AMP7 with a reduction in leakage of 25Ml/d from 173Ml/d to 148Ml/d. In addition, we forecast that PCC would reduce from 149l/p/d to 142l/p/d over the period.

Aligned to these estimates, we committed within PR19 to:

- A three-year rolling average reduction in leakage of 13.3% from a 2019/20 baseline of 174Ml/d
- A three-year rolling average reduction in PCC of just over 6% from a 2019/20 baseline of 155l/p/d

We subsequently reported against these targets using the AMP7 water balance methodology and base assumptions until this year's annual performance review.

As described in section 4.2 of our WRMP24, over the past year or so, we have undertaken a comprehensive review of our water balance. This led to improvements in the data and methodologies used and to the re-basing of DI and the components of demand from which future forecasts are estimated. We now have a far better understanding of our true performance and have back cast the AMP7 reported data using the same improved understanding.

This process has re-set our estimates of DI, Leakage and PCC for the remainder of AMP7 and has necessitated the amendment of our demand forecasts for the plan to 2050. As a result, we have re-optimised our leakage programme using new evidence from the industry leading SoLow model and a new bespoke domestic metering model. As such, comparisons between demand management outcomes presented in PR19 are not like for like with those presented in the revised draft WRMP24. The analysis below provides a direct comparison between % and absolute changes in leakage and PCC pre and post restatement and we have also hindcast the impact from the re-statement and to add clarity to performance against targets. The table below provides the reported values alongside the forecast changes in DI, leakage and PCC.

DI	2019/20 Ml/d	2024/25 Ml/d	% Reduction	Absolute reduction Ml/d
WRMP19 Estimates (Pre re-statement)	813	778	4.3%	35
Revised Draft WRMP24	866	808	6.7%	58

AMP7 DI comparison

Leakage	2019/20 Ml/d	2024/25 Ml/d	% reduction	Absolute reduction Ml/d
WRMP19 Estimates (Pre re-statement)	173	148	14.4	25
Revised Draft WRMP24	226	191	15.3	34

AMP7 Leakage estimate comparison

PCC	2019/20 l/p/d	2024/25 l/p/d	% reduction	Absolute reduction l/p/d
WRMP19 Estimates (Pre re-statement)	149	142	5.1	7.7
Revised Draft WRMP24	151	148	2.0	3.0

AMP7 PCC estimate comparison

Although both DI and Leakage values have risen, there is a greater proposed AMP7 reduction in dry year DI and leakage in both percentage and absolute terms from our estimates in the WRMP19/PR19 and our current revised draft WRMP24. In both cases, we achieve a c15% saving in leakage during the AMP7 period. Our estimate of PCC is similar but the proposed reduction to the end of AMP7 has reduced.

The following two tables provide a comparison between the 3-year rolling average performance commitments between PR19 and the current proposed Plan. The commitments were set as a percentage reduction from the 2019/20 base year. This shows a significant increase in leakage pre to post re-statement driven by the change in water balance methodology which has exposed a deterioration in leakage, particularly on the trunk main network since the impact of the freeze/thaw event in March 2018. The tables below show that the methodological changes represent around 34Ml/d of the leakage increase, the remainder due to performance. We now have far greater confidence in our water balance which has reduced the reconciliation gap and therefore the demand forecasts derived from these. We will continue to collect information that supports the calculation of the water balance to ensure it remains accurate, such as the introduction of an individual household monitor.

In terms of leakage, the proposed PR19 3-year average leakage reduction commitment is c23Ml/d. Following the water balance re-statement, the equivalent saving is c29Ml/d, however, we accept that this is from a far higher starting point. This being achieved through our leakage recovery plan which targets c60 of leakage saving by the end of the period. We have seen a step change in performance through our Leakage Recovery Programme with a reduction of 24Ml/d as at the end of August 2023 from the March 2023 position.

PR19	2017/ 18	2018/ 19	2019/ 20	2020/ 21	2021/ 22	2022/ 23	2023/ 24	2024/ 25
Annual Actuals	175.4	172.9	173.1	163.6	157.4			
3yr average actuals			173.8	169.9	164.7			
3yr average Baseline			**173.8**					
PR19 Perf. Com. %reduction				**-1.8**	**-4.2**	**-7.3**	**-10.3**	**-13.3**
PR19 Perf. Com Ml/d (3yr average absolute)				170.7	166.5	161.1	155.9	150.7
Saving from Baseline				3.1	7.3	12.7	17.9	23.1
DWRMP19 Forecast (3yr average)						158.6	153.41	148.21

Leakage Performance commitment (Pre re-statement)

PR19 restated	2017/ 18	2018/ 19	2019/ 20	2020/ 21	2021/ 22	2022/ 23	2023/ 24	2024/ 25
Annual Actuals	208.9	216.6	225.8	232.7	240.3	253.2		
3yr average actuals			217.1	225	232.9	242		
3yr average for PC			**217.1**					
PR19 PC target %				**-1.8**	**-4.2**	**-7.3**	**-10.3**	**-13.3**
PR19 PC target Ml/d (3yr average)				213.2	207.9	201.2	194.7	188.2
Saving from Baseline				3.9	9.2	15.9	22.4	28.9
RDWRMP19 Forecast (3yr average)							237.9	221.6

Equivalent Leakage targets post-restatement

In terms of PCC, AMP7 commitments were also set as a 3-year rolling average percentage of 2019/20 values. The re-calculated PCC reduction targets would be marginally less than those committed to in PR19 but we do not anticipate meeting these for AMP7 and understand that this may incur penalty.

PR19	2017/ 18	2018/ 19	2019/ 20	2020/ 21	2021/ 22	2022/ 23	2023/ 24	2024/ 25
Annual Actuals	151.7	157.5	156.5	176.0	174.7			
3yr average actuals			155.2	163.3	169.0			
3yr average for PC			**155.2**					
PR19 PC target %				**-1.00**	**-2.00**	**-3.00**	**-4.60**	**-6.30**
PR19 Perf.Com target l/h/d (3yr average)				153.69	152.14	150.59	148.11	145.47
Reduction from Baseline				1.5	3.1	4.6	7.1	9.7
DWRMP19 Forecast (3yr average)						163.8	157.5	150.6

PCC targets pre-restatement ('normal' year)

PR19 restated	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
Annual Actuals	143.7	147.6	145.8	160.9	154.8	148.7		
3yr average actuals			145.7	151.5	153.9	154.8		
3yr average for PC			**145.7**					
PR19 PC target %				**-1.00**	**-2.00**	**-3.00**	**-4.60**	**-6.30**
PR19 PC target l/h/d (3yr average)				144.3	142.8	141.3	139.0	136.5
Reduction from Baseline				1.4	2.9	4.4	6.7	9.2
RDWRMP19 Forecast (3yr average)							149.2	146.1

PCC targets post-restatement ('normal' year)

3. AMP8 Demand Management Ambition

3.1. AMP8 Ambition

Although we have undertaken significant work to improve and restate our water balance position, our Revised Draft WRMP24 retains the same level of ambition as our Draft WRMP24 to reduce leakage during AMP8 by 10% and by 50% by 2050 against a 2017/18 baseline. Within the Advice Note received from NRW on our SoR, it states an AMP8 ambition for leakage of an 8.2% reduction, which is incorrect. The table below provides the key leakage data for the revised draft Plan.

Leakage	2017/18 Ml/d	2024/25 Ml/d	2029/30 Ml/d	2049/50 Ml/d	Reduction in AMP8 %	Reduction in AMP8 Ml/d	Reduction 2017/18 to 2050 %
Revised Draft WRMP24 (Ml/d)	209	191	173	104	10	19	50

Given the level of drought risk identified across our supply area, we believe that our demand management programme provides the right balance of ambition against the costs to our customers, whilst achieving our target levels of resilience to drought. The identified supply demand deficits in our region are primarily caused by imbalances across our supply networks in the SEWCUS and Tywi Gower zones and so the proposed network schemes are the 'Best Value' schemes to address this.

The schemes will deliver a combined c65 Ml/d of benefit to our Water Available For Use (WAFU) across the two zones for a TOTEX of c£45m –further demand management schemes, even if targeted, are far beyond the cost benefit ratio of our preferred network enhancement schemes and would not present good value. Our modelling indicates that a further increase beyond that proposed in AMP8 leakage would incur significant further transition and maintenance cost.

Any further investment to reduce leakage would move the level of drought resilience beyond proposed targets and so does not present good value for money against either regulatory or customer expectations.

Retaining our ambition on leakage places our performance in line with other water companies. For the few companies that have now published revised draft WRMP24 planning data, the tables below show how we compare. In this first table the percentage reductions are set against 2019/20 leakage level as this is the earliest data reported in the WRMP tables.

Through the Environmental Improvement Plan 2023, Defra has set companies in England formal targets to cut leakage by 50% by 2050 with interim targets of a 16% reduction by 2025, a 20% reduction by March 2027 and a 30% reduction by March 2032. Although these targets do not apply to our Welsh supply area, the table below shows that our leakage reduction profile is in line with them.

	2024/25	2029/30	2034/35	2039/40	2044/45	2049/50
Dwr Cymru	15%	24%	31%	39%	46%	54%
United Utilities	14%	25%	33%	41%	46%	49%
Northumbrian Water	16%	23%	30%	37%	46%	55%

Our revised Plan has notably increased its ambitions on demand management in two key areas; namely PCC and Business Demand. For PCC we have quantified how we proposed to meet our long-term ambition to achieve an average household customer usage of 110 l/p/d in a 'dry' year. In the draft Plan we proposed to achieve this in a 'normal' year meaning that our forecast 'dry' year usage was 113 l/p/d which put us behind the ambition of companies in England.

The table below shows that our relative ambition on PCC will be at least in line with other water companies and potentially ahead of many (note % reductions are against a 2021/22 baseline).

	2024/25	2029/30	2034/35	2039/40	2044/45	2049/50
Dwr Cymru	6%	13%	20%	23%	28%	30%
United Utilities	5%	9%	13%	18%	22%	23%
Northumbrian Water	6%	15%	22%	27%	31%	31%

In the draft Plan we did not include any specific interventions to reduce non-household demand but in our revised Plan we set out how we will achieve a 9% reduction by 2037/38 and an 11% reduction by 2049/50. This is slightly less than the Defra 2023 EIP mandated target of a 15% reduction by 2049/50, noting that this is not applicable to Wales, however our target is a balance of delivering an ambitious reduction against the need to reduce demand further and the costs for doing so.

The key enabler for our ambitious demand management programme is the delivery of our SMART metering strategy which by 2034/35 will deliver customer meter penetration of c95%. Given the size and scale of this programme we have commenced work on our delivery programme to ensure that the scope is well understood and that we have procured the required contractor resource to deliver it in the most efficient way possible. One of the most complex elements is the customer facing process and associated IT systems that will be needed to manage the additional meter data that we will be collecting and communicating. Work to date indicates that this programme is challenging with little scope to accelerate outcomes, particularly as savings in water usage are dependent upon rate of change in household occupier. As part of this initial process, we will continue to evaluate the benefits of an earlier move from AMR to AMI technology, as described in our revised Plan.

In conclusion, the demand management ambition put forward within the revised Plan has not changed from the draft position and meets regulatory guidance with the programme developed using industry leading optimisation tools. Further demand management reductions beyond AMP8 are included within adaptive planning scenarios if these arise.

Appendix C - Leakage Strategy

Dŵr Cymru
Welsh Water

AMP8
Leakage Strategy

September 2023

dwrcymru.com

The loss of water from our supply systems is an unfortunate consequence of supplying large volumes of water across a vast network of pipes. On a typical day we supply around 850 million litres of water from our 64 water treatment works, through approximately 27,500 km of water main to our customers. Leakage is a high priority and emotive issue for our customers and failing to be seen to play our part in reducing levels of water lost can damage the trust our customers have in us.

Leakage is the escape of water from both our own pipework and that which is owned by customers as well as our service reservoirs, and in the context of regulatory reporting is referred to as total leakage. The key factors that influence how much water escapes from the network each day are how many leaks there are in the network, the physical size of each point of leakage and the pressure of water inside the pipe. Total leakage is also impacted by the number of days a leak is allowed to run. Water networks leak for a variety of reasons:

- Corrosion or deterioration of pipes, fittings or seals. This can be accelerated in aggressive soil conditions as an external factor, or internally due to corrosive water quality.
- Poor installation quality or practices, leading to weak joints or other points of weakness.
- Thermal expansion and contraction of pipes, leading to opening of joints or cracks in the pipes.
- Water networks are pressurised, higher pressures and pressure surges can contribute to leakage over time.
- Ground movement and stresses placed on underground pipes due to weather or climatic factors, or due to traffic loading.
- 3rd party damage.
- Structural failure of pipes and fittings. Often due to a combination of the above factors.

Once a leak occurs it does not self-heal. It may grow over time or remain constant, but it will continue to leak. A lot of the leakage reduction in the late 1990s was due to efforts to fix a backlog of leaks that potentially could have been running for many years. However, leaks continue to break out and to grow, leading to an increase in leakage, and this has become known as the ‘natural rate of rise’. A key consequence of this is that every day leaks need to be found and fixed to hold leakage at a steady level.

Within the water distribution system there are a large variety of leaks, from small weeps and seeps to very large leaks, some of which appear as bursts on the ground surface, but others can remain undetected for a long time. An implication of this is that there is likely to be many very small leaks in the system, which will be challenging to find and fix; these contribute to what has become known as the background or base level of leakage. This is the leakage level that might be very difficult to reduce using current detection technologies and techniques, without replacing or relining pipes.

The amount of water escaping from leaks can be minimized by reducing the pressure inside the pipes, but in areas with hills and mountains the water needs to be pumped over these, leading to higher pressures in some locations. However, managing the water pressure in the system is a key part of managing leakage. A pressure transient is a large and rapid pressure variation and is like water hammer in a domestic plumbing system. This can be caused where changes to the network are made, for example, by the actions of large commercial customers where water is taken rapidly

from the system. This can also cause leaks to break out, so maintaining calm networks is seen as increasingly important.

While leakage targets and performance commitments have historically been set on the basis of companies' sustainable economic level of leakage (SELL) assessments, there has been a growing regulatory concern over past Price Reviews that SELL does not incentivise companies to become more efficient in how they tackle leakage. This is because SELL is typically derived using cost relationships that are based on current policies and associated costs, and these may reflect neither innovative approaches to active leakage control (ALC) nor greater levels of cost efficiency. Accordingly, the regulatory guidance for PR19 and PR24 places less emphasis on the SELL calculation as a basis for leakage target-setting. Instead, it calls for water companies to establish leakage targets through the customer engagement process, and to demonstrate how they will meet their more stretching performance commitments through innovation, thus to deliver outcomes for consumers that are both cost efficient and affordable.

In 2019 the water companies in England, through WaterUK, all signed up to a Public Interest Commitment[1] which included amongst other things, a goal to triple the rate of sector wide leakage reduction by 2030 thereby matching the same level of improvement achieved over the past thirty years (1990- 2020). This is set within a longer-term ambition to halve leakage levels by 2050. Our updated leakage strategy follows a similar profile in-line with the goal set for the English companies, whereby we will deliver the 15% leakage reduction commitment in the 2020-25 period with a further 10% reduction (of our 2024-25 position) across the 2025-2030 period. Thereafter our leakage strategy will follow a profile to achieve a 50% reduction in leakage levels, set against a 2017/18 baseline, by 2050. This long-term target reconfirms our Water 2050 commitment and delivers the requirement from Welsh Government, as set out in their Guiding Principles for WRMP24.

Customer engagement has shown strong support for reducing leakage, seeing this as a key element in forming a 'social contract' between us and our customers whereby they will respond to the requirement to reduce demand if we are seen to be playing our part, demonstrated most explicitly through a commitment to continue driving down levels of leakage. When customers were asked for their views on what we should do to reduce demand through our Water Resource Management Plan (WRMP) engagement, reducing leakage on our distribution network was their first choice, closely followed by reducing leakage on customers' supply pipes. Leakage reduction options are based upon our current and forecast data in terms of costs and benefits, which is to be supported by a recently awarded Ofwat Innovation Fund project to understand background leakage, that Welsh Water are leading. For AMP8 we have looked at the options available to manage leakage and developed a strategy that meets our stakeholders' expectations in a cost-effective way.

[1] https://www.water.org.uk/publication/public-interest-commitment/

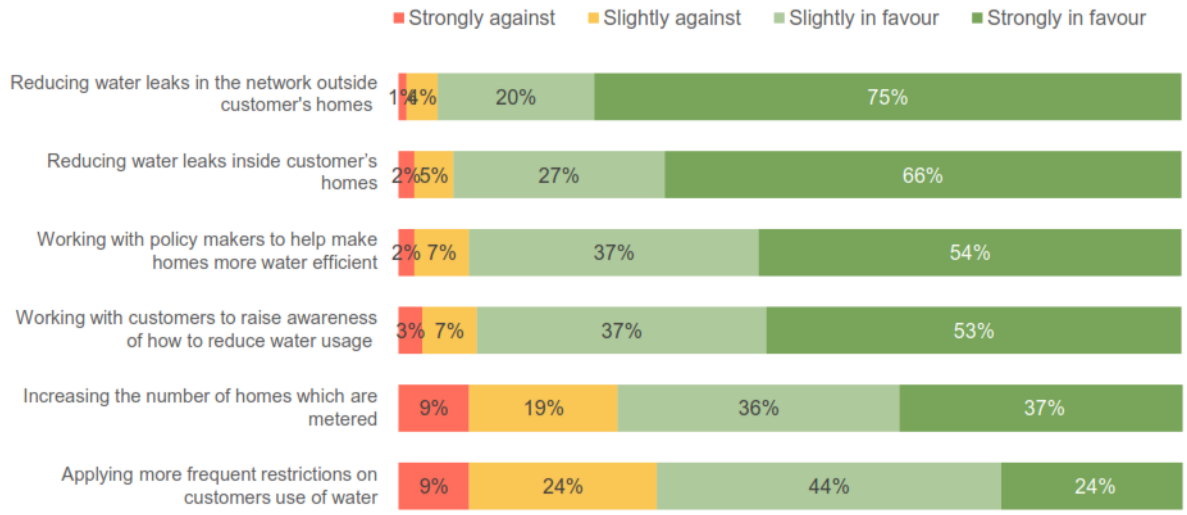

Figure 1 - Customer attitudes to demand-side solutions

For PR24, we have updated our leakage optimisation modelling to explore the costs and leakage savings associated with a broad range of innovative leakage reduction policy options, this to identify the best means of attaining leakage performance commitment for AMP8 and beyond. The analysis considers the numerous leakage control interventions shown in Table 1. Our understanding of leakage and the available techniques/technology to resolve it has moved forward considerably. Many of the leakage activities can now be undertaken in combination to enhance our detection and resolution efforts. As an example of this we can reduce the size of our DMAs whilst installing acoustic loggers and at the same time pressure manage on our distribution system, all supporting leakage reduction.

In order to develop an effective leakage strategy, we are now using the industry tested SoLow model to better understand our leakage options and the cost relationships at a water resource zone (WRZ) level. The SoLow model is able to assess a least cost programme across all WRZs or can be formulated to optimise leakage options within a WRZ. The model takes WRZ-level network characteristics and policies, as well as company-level leakage targets, and optimises which options need to be selected and when. It allows for a large number of flexible policy options and leakage management techniques to be assessed, see Table 1 below. Relationships between policies, leakage, and network characteristics have been considered.

Leakage Intervention	Description
Active leakage control (ALC)	Our current ALC policy utilises technicians actively searching for leaks within an area, based on flow information that the leakage has risen. Detection and repair costs are found using a relationship between these values and leakage in a specific area. This includes lift and shift acoustic logging.
Permanent Acoustic Logging (PAL)	Permanent Acoustic Logging is the permanent deployment of loggers within the network for the long-term monitoring of leakage. PAL deployment reduces routine manual surveying requirements and when a leak is suspected it helps to target ALC detection efforts.

Intensive active leakage control (I-ALC)	Intensive ALC can be defined as a systematic and concentrated leakage detection effort in DMAs. This has typically been undertaken in DMAs with historically high leakage that has proven difficult to pinpoint and reduce. Concerted effort is made to significantly reduce leakage within a DMA and this new leakage level is then maintained.
Pressure management	Pressure management is a method by which pressure is controlled in areas of the network, accomplished by monitoring flow rate throughout the area. Leakage is prevented through having a pressure-controlled network.
Distribution mains asset renewal	The replacement of deteriorating/leaking pipework within the distribution network, typically burst driven but can also be driven by target mains lengths.
Customer Metering (SPL)	The rollout of Smart metering will enable us to identify leakage on the customer supply pipe, compared to our current approach which focusses mainly on our distribution network.
DMA Subdivision	DMA sub-division is the process of dividing existing DMAs into smaller geographical areas, allowing for greater granularity in data, more in depth analysis, and improved efficiency of leakage reduction.
Pressure Transients Management	Pressure Transients Management is the implementation of a network optimisation team dedicated to pressure transient repair, as well as the implementation of booster pumps, PRVs, ALC repair activities, and the engagement of high-consumer properties in order to understand and cater the network better to the relevant parties
Sahara surveying and fix	The Sahara system is a pipe surveyance tool that provides a feed of the internal structure and characteristics of the pipe, as well as an acoustic sensor used to detect pinhole leaks or trapped air pockets.
Trunk mains active leakage control	Additional ALC targeted at trunk mains. This option relies on the creation of a dedicated trunk main ALC team to identify leaks across the trunk main network, whilst calculating the benefit of installing new meters and/or loggers.
Trunk mains active asset renewal	With a similar premise as asset renewal, the renewal of materials in trunk mains was considered as an option. We have not included communication pipes in this option, meaning a mains only policy was considered.

Table 11 – Description of the Leakage Options considered

Our metering strategy is designed to achieve good PCC delivery performance during the AMP8/9 periods so that we can achieve our long-term objectives. The metering strategy also enables the delivery of significant leakage benefit as through smart metering we are able to understand whether there are continuous flows into properties even during the night. This gives a good indication that there is a wastage issue within a property or that there is supply pipe leakage.

We estimate that up to 30% of our leakage takes place beyond the customer property line and we need to help our customers to understand if they have a leak and if so help them to fix this. Once we have identified a potential customer side leak, we will fund both leak detection and repair. In addition to these leaks identified on customer premises, we can also gain additional information on leakage within our own networks. With additional network monitoring through customer metering, new leaks will be found and fixed more quickly.

We have processes in place, through data science, to use customer and DMA meter data to undertake volumetric balances within each DMA and identify leakage hot spots. In line with meter delivery, we will scale up the identification of distribution leakage geographically for maximum efficiency. The use of this technology will enable us to better maintain leakage into the future. Our bespoke metering model has been used to understand the benefits gained from the metering strategy described above. We have then used the SoLow model to understand whether this is sufficient, company-wide, to meet our leakage objectives and if not to investigate the most cost effective and best value means of achieving our objectives.

The strategy to tackle leakage within our distribution system is structured around the Predict, Awareness, Locate, Mend (PALM) principles adopted by Water UK's Public Interest Commitment on leakage and UKWIR through the Zero Leakage project and consists of the following components:

- ***Prevention*** *of Leakage Breakout* – prevention of leakage occurrence through efficient optimisation of the renewal programme to tackle high leakage areas. Effective pressure management will lead to networking calming and help to avoid catastrophic pipe failures.
- ***Prediction*** *of likely causes and location of Leakage* – Detailed analytics of our network sensor data, repair data and mains material data to inform us of high-risk areas and deteriorating assets. This will ensure that detection staff are supported with intelligent data so that informed resource planning can take place.
- ***Responding*** *to Leakage* – The response to leakage events will be quicker and more efficient, allowing for greater coverage of areas with less resource and mitigating the cumulative impact of natural rate of rise leakage. The integration of technological developments will ensure staff are equipped with state-of-the-art detection devices and techniques.
- ***Project Cartref*** - Project Cartref is about gathering water use/leakage data, working with customers and using innovation to reduce wastage of water, either through customer-side leakage or inefficient use. This includes the provision of household water use surveys, house visits by specially trained staff, supply pipe replacement and meter installations.
- **Innovation** – Leakage will continue to push the boundaries of smart network sensing and metering equipment through the framework of specialist research and design companies. Collaboration both internally with the Welsh Water Innovation Team and externally with UKWIR, will allow for an agile, low cost and fail fast approach to innovation.

Prevention of Leakage Breakout

Prevention of leakage across the 27,500Km of the water distribution network is critical to the achievement of the 10% leakage reduction target set for AMP8 and is an essential theme in our journey to 50% leakage saving by 2050. Each year, leakage detection efforts are required to offset the breakout of leaks which account for a volume of approximately 230Ml/d (Natural Rate of Rise), less than half of which being triggered by a customer contact. The location and repair of these leaks requires a large team and with it, significant expenditure, so prevention presents an efficient solution. In addition to extending the life of the assets and preventing leakage, effective network calming and pressure management have significant benefits to other performance commitments including interruptions to supply, CMEX, mains bursts and customer acceptability.

We will build upon our AMP7 work to create a pressure hydraulic hierarchy, which has been created in GIS. The hierarchy will be managed through industry leading leakage analysis and reporting software, where our estate of over 5,000 dedicated network pressure monitors will communicate every 30 minutes. Algorithmic analysis will determine the performance of each

pressure zone and will highlight anomalies for investigation by a team of analysts. This will help prioritise the pressure management programme, enhance the delivery of maintenance and optimisation activity each year as well as feed into the investment cases for the installation and replacement of assets. In addition, collaboration with our supply chain will be undertaken to trial new technology and equipment to extend remote network control capabilities.

Following the success of the calm networks training package delivered at our training centres in Sluvad and Glascoed, aimed at reducing network transients through the operation of the network, the focus will shift to assets and customers. A trial approach of liaison with large commercial customers in AMP7 resulted in significant reductions in transients caused through industrial usage patterns. Monitoring and analysis of network transients will allow this programme to be adopted into business-as-usual activity for all areas with large industrial users. There will be collaboration between other investments to ensure the opportunities presented through the delivery of large-scale capital projects including Zonal Studies and Lead Replacement are realised. Proactive replacement of assets which have deteriorated and affect leakage performance or are at a high risk of failing will help to mitigate leak occurrence.

Prediction of likely causes and location of leakage

Projects through AMP7 have led to a significant increase in both the quality and quantity of intelligent network data collected. This combined with the advancements in data science provide an opportunity to predict where leaks are likely to occur on the network, accounting for weather and climate, soil conditions, flow and pressure characteristics as well as pipe age and condition. This theory has been developed to form ‘Project Nemo’ which provides a dynamic assessment of the likelihood of leakage on each section of pipe, see example in Figure 3 below. From this, interventions can be designed so that they follow the most optimum sequence, proving resource efficiency and consistency of approach.

This analysis will also provide the opportunity to further understand the balance between leakage and consumption in seasonal high demand periods, so that leakage detection resources are managed and deployed to the right areas. An individual household monitor for measuring detailed consumption patterns will be delivered in the remainder of AMP7 as part of our Leakage Recovery Plan. This has helped refine the current small area monitor level fast logging analysis as well as provide a more accurate measurement for water efficiency projects and per capita consumption.

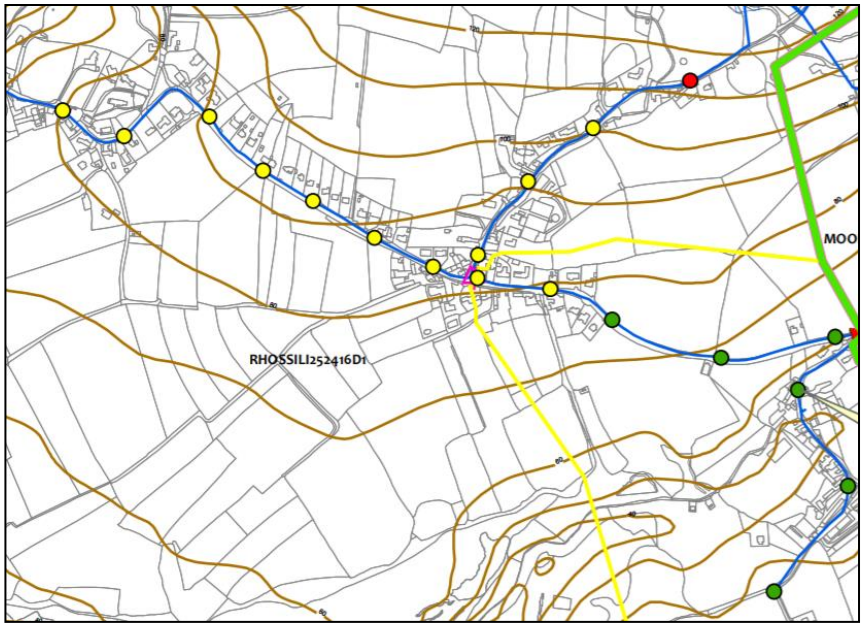

Figure 3 - Example conceptual output from Project Nemo, coloured symbols represent likely location of a leak

Responding to Leakage

Previous strategies have concentrated on improving the effectiveness of targeting and detection methods and have brought about success in achieving leakage reduction targets. However, further improvements are essential to meet the more challenging leakage reduction and cost efficiency targets through AMP8. The in-house developed performance and efficiency monitoring software will be used to drive a programme of improvement in workforce competency and placement. As well as tailoring training for each individual, the programme will provide a better understanding of each DMA's characteristics and how these impact on performance.

Areas can then be categorised providing an optimised and specific entry and exit level and planned work times. This will allow for the assignment of a specific resource to an area, matching the individual and techniques based on both their performance within that DMA type. Following extensive trials over AMP7, the selection of equipment and techniques available to the leakage delivery team has increased and the processes for their application have been refined. The technologically equipped inspector is now able to perform detection tasks in a consistent and repeatable manner with gains in efficiency being observed. This equipment will be rolled out more widely during AMP8. There has been significant investment throughout the industry in permanent acoustic network monitors and we will continue to invest in this technology where is provides efficiency over standard active leakage control. In addition, new and emerging technologies including high resolution pressure and temperature monitoring have also been trialled, to understand how they interact within the specific characterises of Welsh Water's network.

Innovation

Innovation is a constant thread throughout both the leakage strategy and operations. Our plan is to continue to push the boundaries of innovation though collaboration with our supply chain, other water companies and more widely with academia. The internal Leakage and Distribution Innovation team, comprised of innovation champions from around the business, meet monthly and will continue to deliver projects including the development of an ultrasonic smart meter with in-built acoustic leak sensing technology, smart control of pumping stations, adoption of narrow band internet of things (Nb-IOT) communications into network data loggers.

In addition, the team will work with Data Science to implement the machine learning capabilities to analyse big data to produce insight into leak likelihood and deterioration modelling. There will also be a continuation of the active participation in the UKWIR zero leakage club projects, which align with Water UK's public interest commitment to triple the rate of leakage reduction by 2030. Welsh Water have also been a founding member of the Wales and South West Leakage Hub, an innovation team involving representatives from Bristol Water, Wessex Water, South West Water and Portsmouth Water, with the goal of sharing innovation learning and challenging the market as a collective.

Revisions to the Water Balance in AMP7 has resulted in an increased level of unaccounted for water upstream of our DMAs. Over the remainder of AMP7 we will investigate and reduce leakage on the upstream network as part of our recovery plan in line with our revised methodology. Our trunk mains cover 3,500km and also include losses from our service reservoirs. We will continue our AMP7 strategy into AMP8 with a systematic approach of metering, verification of network configuration, data validation and triangulation across multiple balances in order to ensure a robust estimate of Trunk Main leakage before we can undertake any effective intrusive leak detection and repair.

Investigating Phase

Use of the UKWIR volumetric flow balance method for continual monitoring of trunk mains and service reservoir losses. The current meter coverage, age and condition means that meter accuracy needs to be improved to allow this to be effective due to the large volume of water across our trunk main network and this will be a continued focus for investment in AMP8. This programme of works will involve a combination of new meter installations, meter replacement and meter verification work programmes.

Site Based Interventions

Pinpointing and detection of real losses through leaking fittings, joints or pipe fractures due to the diameter of the pipelines, topography of where these pass through and also distance between fittings prevents traditional acoustic surveys from being effective. We will deploy in-pipe survey technologies as well as continue with exploring innovative solutions such as satellite and drone technologies and fibre optics.

Repairs

We will continue to undertake the repairs through a Capital Delivery led programme due to the engineering challenges and safety hazards as well as the potential customer impact. These will generally be through under pressure techniques such as encapsulation or isolating pipelines for cut outs through the use of flow stops and bypass sections. Some will require full shut down of the trunk main and a pipe length replaced which places risk on discolouration, loss of supply and provision of temporary supplies, by the nature of trunk mains this could be risk to large populations hence why they are delivered through our capital delivery team.

Through our water balance re-statement, reported leakage volumes have increased. However, we have retained our ambition to achieve a 10% saving in leakage during AMP8 (from the annual average in 2024/25) together with a 50% reduction by 2050, set against a 2017/18 baseline. We have amended our targets in line with the percentage savings, which means that we plan to deliver a 19 Ml/d reduction during the AMP8 period and an overall reduction of 87 Ml/d by 2050 (see Figure 4).

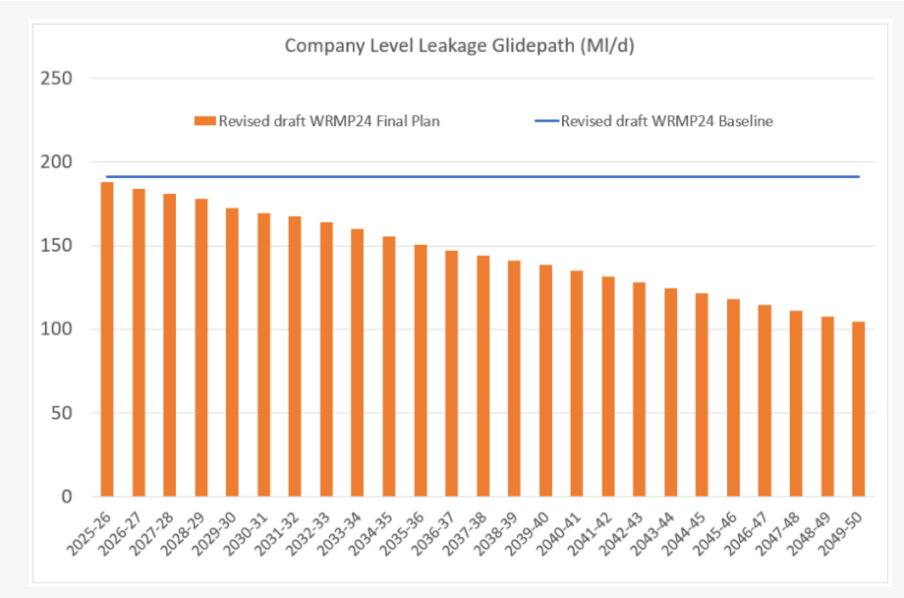

Figure 4 – Leakage reduction glidepath (%'s set against 2024-25 position)

Metering for solely leakage benefit is far more costly than many of the other techniques for leakage saving. However, to achieve an effective per capita consumption (PCC) reduction pathway also, we will implement our metering delivery programme. Once meters are installed to identify continuous flow and the potential for leakage, then the cost/benefit of fixing customer supply pipe leakage is cost effective against other leakage options. We will help the customer to resolve any leakage on the supply pipe and within the property and will ensure the supply is 'leak free' and in a 'good plumbing state'.

In addition, the installation of smart meters enables the discovery of distribution mains leaks previously undiscovered through conventional active leakage control or via customer reporting as we can undertake a full flow balance within DMAs. Any new leaks can be better targeted and repaired in a shorter duration due to enhanced awareness through more regular meter readings.
The proposed AMP8 leakage savings are achieved through both customer supply pipe savings and conventional find and fix activity. With the metering strategy in place, the SoLow model has been used to examine a least cost pathway to achieving our long term target. The planned 87Ml/d reduction in leakage across the next 25 years comes from three main components, the largest of which (c40%) being the savings we expect to achieve from repairing leakage on customer properties that has been identified from the installation of smart metering.
Traditional leakage repair (ALC) on our distribution network has a smaller role to play (c30%) and its delivery is set to later in the planning period to achieve our 2050 target once we have maximised the available leakage savings from our smart metering rollout.
The third component (c19%) is targeting leakage on our trunk mains network, an area recently identified as being a source of significant volumes of leakage. The costs to achieve our target

leakage reduction of 50% by 2050, rises sharply in the last 15 years of the planning period as the leakage saving becomes difficult to find with more expensive asset renewals required. However, by profiling the delivery in this way, it is anticipated that technological advances will allow us to deliver the required leakage reductions in the longer term for a lower cost than currently estimated.

Project Cartref is about working with customers and using innovation to reduce wastage of water, either through leakage or inefficient use, and to save them money, building on its success in AMP7. We think this is the right thing to do in view of the long-term challenges of conserving our water resources against the background of climate change and a growing population.

Free toilet repair service - We will continue to offer all our customers a free repair service on toilet cistern related leaks, estimates of 5 to 10% of WCs may be leaking (circumstances allowing, i.e. access, non-specialist).

Schools - The focus of the Cartref programme is domestic customers, however we have been supporting with some visits to schools in either Cartref areas, or areas of other interest (i.e. Water Resilient Community areas) – to promote the service to the wider school community.
Our target is to undertake water efficiency audits and fit outs at 200 schools per annum – 1000 over the AMP. Our education team currently undertake 400 but some schools will not be suitable or will not wish to take part in the workstream.

Water Home Audits - The Cartref programme currently looks to identify high users and engage with them to promote our virtual water audit and access to free products. Using the results of a pilot of 100 audits for the top 5% metered water users we will continue this programme of work over AMP8.

Metering Strategy Support - The Customer Metering Strategy and increased numbers of Smart meters will provide an increased ability to identify and react to leaks on customer supply pipes and internal leaks. The Cartref programme will support the meter installation programme by:

- **Leak identified at installation** Where a leak is identified at install (replacement or install) – we will proactively look to repair the leak through engagement with the customer
- **Metered Customers** we will promote a Water Efficiency through an Audit
- **Unmeasured Customers** they will be sent a “pack” of information around the potential benefits, outlining what has happened and why, as well as direction to free products.
- **Waste Notices** where an external supply pipe leak, or no engagement occurs for unmeasured customers would the customer be managed through the Waste Notice process.

Community - Community engagement will tap into key stakeholders and partners in the communities we are targeting. Whilst the costs are minimal for this, there is need for designated resource to support and co-ordinate the other elements of Cartref.

Free access to water saving products

Continue to provide a wide selection of water efficiency products free of charge to our customers. An estimate of 10,000 virtual audits (per annum) has been used to determine the resource requirement and the product costs used to provide the total cost of the service.

Effective management of the water network is essential to the management of leakage. Whilst direct benefits of other these other areas of activity are not included within the leakage strategy explicitly, the benefits are required to maintain a baseline of performance.

- **Acceptability of Water** – this programme of work is focussed on improving the acceptability of water across the network. One of the main interventions of this programme is the replacement of water mains which will reduce leakage as an additional benefit.
- **DMBC & Asbestos Cement (AC) Mains Replacement Distribution Investment** – this programme of work targets mains replacement, most of which is AC mains to reduce the number of bursts and interruptions to supply which also benefits leakage.
- **Worst Served CML** - this programme of work targets customers who meet a threshold for regular interruptions of supply. There will be a minor benefit to leakage through reduced burst frequency.
- **Customer Meters** – the customer meters programme will provide data that will support the identification of demand side leakage.
- **Bulk Meters** - this programme of work maintains the bulk meters across DCWW and instals loggers across the network and manages the associated data.
- **Pressure Reducing Valves (PRVs) Air Valves (AVs) and Sluice Valves (SVs)** – maintenance of these valves across the network reduces the frequency of mains bursts and benefiting leakage.

Figure 5 – Overview of IPCs Contributing to Achievement of the Leakage Targets