Draft Water Resources Management Plan 2024

Section 8 – Demand Options

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Background and Introduction

What's in this section?

Demand options reduce the total demand for water, and include actions to reduce both leakage and consumption. Our draft Water Resources Management Plan 2024 (dWRMP24) demand options have been developed in conjunction with the Water Resources South East (WRSE) Regional Plan.

The purpose of this section is to identify and describe our demand options and explain the development of our demand reduction programmes.

To reduce water demand, we need to identify demand reduction options and bring these together to create demand reduction programmes. In dWRMP24, we do this in five stages:

1. Governance and Strategy
2. Demand Options Screening
3. Feasible Demand Options
4. Creating Demand Programmes
5. Leakage, per capita consumption (PCC) and Non household reductions

In stage 1, we have developed our demand reduction strategy to align with the recommendations from the Department for Environment, Food and Rural Affairs (Defra), the Environment Agency (EA), the Water Services Regulation Authority (Ofwat) and the National Infrastructure Commission (NIC).

Our demand reduction strategy consists of eight ambitions. These are:

- Ambition 1 – reduce leakage by 50% (from 2017-18 levels) by 2050
- Ambition 2 – maximise feasible PCC reductions by 2050
- Ambition 3 – smart meter all practicable connections by 2035
- Ambition 4 – minimise unmeterable properties by 2040
- Ambition 5 – wipe out most wastage by 2050
- Ambition 6 – minimise impact on customer bills
- Ambition 7 – minimise carbon cost
- Ambition 8 – create a deliverable, resilient and ambitious programme

In stage 2, we have undertaken demand options screening to identify a list of feasible demand options that we can include in our demand reduction programmes to achieve our strategy for dWRMP24.

The outcome of the demand options screening process is a Feasible Options list that consists of 18 demand options.

The options are grouped into three categories:

- Metering – seven demand options
- Water Efficiency – eight demand options
- Leakage – three demand options

For metering, evidence shows that, on average, the installation of a new smart meter will result in a 13% consumption reduction per property. Ten per cent of this saving is due to changes in behaviour and 3% is due to repair of wastage. Using innovative metering methods, including in our WRMP programme for the first time in WRMP24, we expect to reduce the number of properties that previously could not have a meter installed from over 1.2 million to 308,000.

We have introduced several new water efficiency workstreams under household innovation and tariffs to reduce household consumption both in the short and long term. These include innovative solutions and ambitions such as targeting activity to remove wastage from most properties and Digital Engagement with customers to provide advice on reducing their consumption.

For leakage, we have considered new options, Advanced District Meter Area Innovation (DMAi) and Leakage Innovation, to approach leakage reduction with innovative methods to reduce overall cost and increase efficiency.

In stage 4, we bring the feasible options information together to create demand reduction programmes. Based on our strategy for leakage, PCC and Non household consumption reduction, we created three demand reduction programmes: Deliverable, High and High Plus.

Target	Deliverable	High	High Plus
50% Leakage Reduction	50% by 2050	50% by 2045	50% by 2040
AMP8 Leakage reduction	15% in AMP8	15% in AMP8	20% in AMP8
Household Consumption Reduction (PCC)	Deliverable delivery of options – innovation by 2035	Ambitious delivery of options – innovation by 2033	Very ambitious delivery of options – innovation by 2030
Non-Household Consumption Reduction	AMP8 and AMP9 activity	AMP8 and AMP9 activity	AMP8 and AMP9 activity

In the final stage, stage 5, the outcomes of the demand reduction programmes are detailed. We have used a bottom-up approach to forecast our 2050 PCC, meaning we have used our comprehensive data led evidence base to quantify the maximum savings from each demand option in our programme.

Our PCC forecast includes both traditional and innovation options. This means we are confident our plan strikes the right balance between deliverability and ambition for the future.

High Users have been investigated in an industry first through our smart meter high users study

This study showed that in our smart meter sample, most customers (mode) used around 100 l/p/d and 37% of customers in the sample were already using below the Government target of 110 l/p/d.

Customers in this study who voluntarily moved to a metered bill reduced their PCC below customers who were automatically moved to a metered bill. This supports our Digital Engagement and Household Innovation demand options to ensure greater reductions in PCC.

To ensure that we do not overestimate the savings we can achieve from customers, and ensure our overall plan remains robust and realistic, we have concluded that the volume of reductions included in our dWRMP24 is the maximum we should reasonably assume that we can deliver by 2050.

We will continue our 'high water use' study between our draft and revised draft WRMP with the next stage of the study due to commence in the autumn of 2022.

For leakage, our Deliverable demand reduction programme achieves a 50% reduction (of 2017-18) leakage by 2050. Our High and High Plus demand reduction programmes achieve a 50% reduction (of 2017-18) leakage by 2045 and 2040 respectively.

By 2100, all programmes achieve the same total volume of leakage reduction. The difference between the programmes is the programme of delivery of the leakage reduction options.

Our dWRMP24 scenarios include 31 Ml/d more leakage reduction that we included in WRMP19 by 2100.

In WRMP19 we concluded our leakage reduction activity in 2055. In dWRMP24, we continue leakage reduction activity beyond 2050. This is due to our new generic demand option, Leakage Innovation, which assumes that through future innovation approaches both costs and customer inconvenience will be reduced compared to our current assumptions.

The leakage reductions included in dWRMP24 strike the right balance between our desire to reduce leakage further and the financial impact of leakage reduction on customers' bills.

For non-household consumption reduction, a single profile has been included across all three scenarios, deliverable, high and high plus.

In comparison to WRMP19, we have include six times more non-household consumption reduction between 2025 and 2050 in dWRMP24, due to the results achieved since WRMP19.

Most of this reduction is planned between 2025 and 2030 where we will work with businesses to reduce their consumption by 24 Ml/d. In WRMP19, we planned to reduce non-household consumption by only 3 Ml/d in this same period.

The outcome of our demand reduction programmes aligns with our strategy and ambition for demand reduction into the immediate and long-term future.

Introduction

8.1 Demand options reduce the total demand for water, and include actions which lead to reductions in leakage and consumption. Our dWRMP24 demand options have been developed in conjunction with the WRSE Regional Plan.

8.2 The purpose of this section is to identify and describe our demand options and explain the development of our demand reduction programmes.

Why do we want to reduce demand?

8.3 Water demand consists of three main components:

- Leakage: water that leaks from our water mains and customer supply pipes
- Household Consumption: water consumed by household customers
- Non-Household Consumption: water consumed by businesses

8.4 Both Household and Non-Household consumption water demand can be further broken down into:

- Behavioural Use: water used by customers in the home or for business purposes. Examples of behavioural use include water used for bathing, clothes washing, drinking, or watering the garden (Figure 8 - 1)
- Wastage: water wasted in the home through leaking devices. Examples including a leaking toilet, tap or shower head

Figure 8 - 1 – Water Use in the home

8.5 Water that is wasted in homes or businesses (wastage) or that leaks from water mains or customer supply pipes (leakage) is water that could have remained untreated and in the environment.

8.6 Excess behavioural use of water such as running the tap while washing the dishes or running the washing machine for a single item also results in us extracting more water from the environment than is necessary.

8.7 The purpose of demand reduction is to protect our environment and ensure we can meet future demand for water.

Our Approach

8.8 We identify demand reduction options and bring these together to create demand reduction programmes. The approach we have used in dWRMP24 is outlined in Figure 8 - 2.

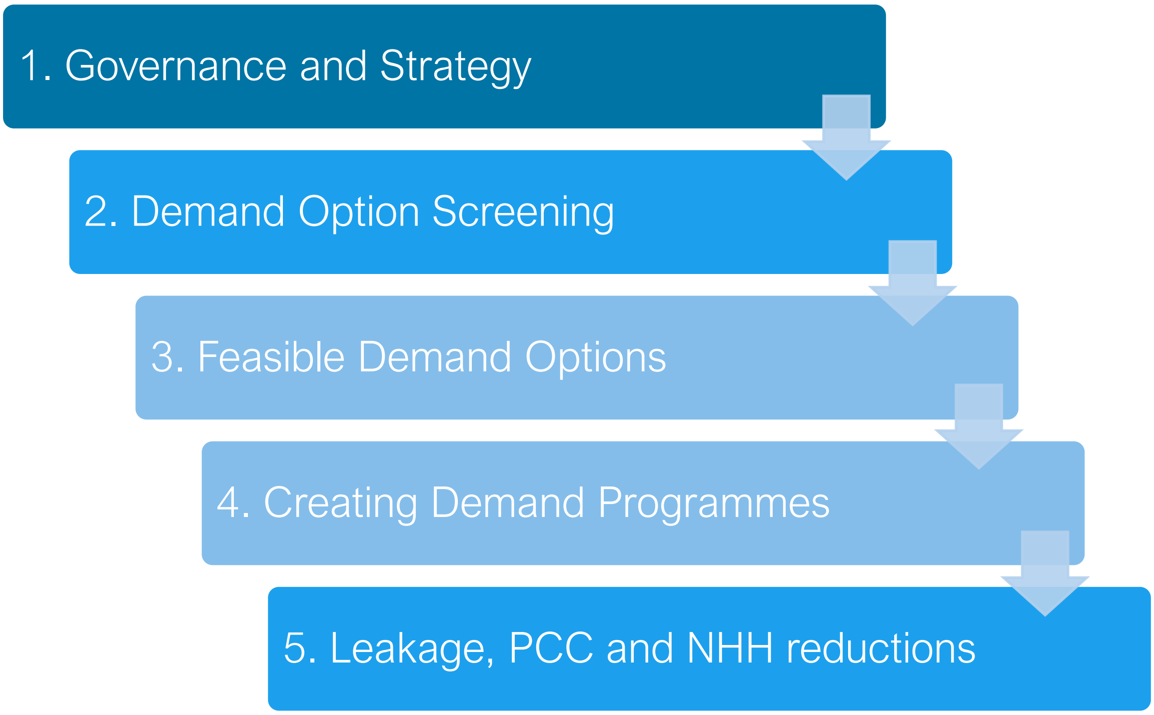

Figure 8 - 2: Our approach to Demand Reduction

8.9 This shows that we employ five stages to develop our dWRMP24 demand reduction plan.

8.10 The first stage is to define our strategy based on the recommendations from our regulators and associated organisations.

8.11 The next stage is to identify an unconstrained list of all possible demand options and screen these to a smaller list of feasible demand options.

8.12 The third stage is to identify the costs, benefits and volume of the feasible demand options.

8.13 The fourth stage is to bring the feasible options together to create demand reduction programmes. These demand reduction programmes are used in both our dWRMP24 and the WRSE Regional Plan.

8.14 The final stage is to ensure that the outcomes of these programmes lead to leakage, PCC and Non-household outcomes which align with the strategy identified in stage one.

Governance

8.15 To develop our Demand Reduction Plan, we have worked closely with our regulators and associated organisations.

- **Defra** is the UK government department that sets the overall water and sewerage policy framework in England including setting standards and drafting legislation.
- **The EA** is a non-departmental public body which is the principal adviser to the government. The EA seeks to maintain and improve the quality of raw water in England and Wales and is responsible for issuing water companies with abstraction licences. The EA published the Water Resources Planning Guidance (WRPG) which we utilise to develop our WRMP. The EA tracks our compliance with WRMP19 and the integrity of the information we include in dWRMP24.
- **Ofwat** is the economic regulator of the water and sewerage industry in England and Wales. Ofwat sets the limit on how much water companies can charge their customers to protect the interests of consumers and to secure the long term resilience of water supply and wastewater systems.
- **The NIC** carries out in-depth studies into the UK's major infrastructure needs and makes recommendations to the government.

8.16 Each of these organisations have published recommendations for leakage and PCC reduction. We have used these recommendations as the foundation of our demand reduction programmes.

8.17 The source and publication of these recommendations have been summarised in Table 8 - 1 and Table 8 - 2. From these recommendations we have generated 8 ambitions, these have helped us to form our strategy going forward (see Strategy section below).

Organisation	Document	Leakage Recommendation
Defra	Government expectations for water resources planning[1]	'The government expects both regional groups and water companies to reduce leakage by a minimum of 50% by 2050 from 2017-18 levels with ambitious milestones to achieve this.'
EA	National Framework[2]	'Regional groups should reduce the water lost from networks by 50% by 2050 from a baseline of 2017-18'.
EA, Ofwat, Natural Resources Wales	Water resources planning guideline (WRPG)[3]	'You should (as a minimum), plan to meet Water UK's commitment, on behalf of the industry, to reduce leakage by 50% by 2050 (from actual 2017 levels). In addition, you should plan to meet any leakage targets set out in Ofwat's price review methodology or by government. You may wish to consider setting more challenging targets for reducing leakage than these, if you can demonstrate you have support from your customers.' 'In the medium to longer term, it is recognised that reducing leakage by 50% will require innovation and you may not know how you are going to achieve these levels. You should demonstrate that you are actively investigating how

[1] Defra, 2022, 'Government expectations for water resources planning', page 5
[2] EA, 16th March 2020, 'Meeting our Future Water Needs: a National Framework for Water Resources – version 1', page 10
[3] EA, Ofwat, Natural Resources Wales, 4th April 2022, 'Water resources planning guideline, version 10', page 91 - 92

Organisation	Document	Leakage Recommendation
		to achieve your ambitions. Your leakage forecasts should be consistent with the data you include in the business plan you provide to Ofwat as part of its price review process’.
HM Government	25 Year Environment Plan[4]	‘We also want to see the amount of treated water lost through leakage continue to fall, year-on-year. All water companies will need to match the levels of leakage reduction achieved by the sector’s top performers.’
NIC	Preparing for a drier future[5]	‘DEFRA should set an objective for the water industry to halve leakage by 2050, with Ofwat agreeing 5 year commitments for each company (as part of the regulatory cycle) and reporting on progress.’
Defra	Governments strategic priorities for Ofwat[6]	‘We expect Ofwat to: • Challenge water companies to halve leakage across the industry by 2050. Water companies have committed to delivering a 50% reduction in leakage from 2018 levels by 2050. We expect Ofwat to monitor progress towards this target • Support and encourage water companies to develop a consistent approach to address leakage on customers’ own pipes’
Defra	Consultation on environmental targets[7]	‘There are a number of existing commitments and ambitions on water demand that are not statutory. These include commitments made by water companies to reduce leakage by 50% against 2017-18 levels by 2050’.

Table 8 - 1 – Governance documentation and leakage targets

Organisation	Document	Consumption Recommendation
Defra	Government expectations for water resources planning[8]	‘The government expects both regional groups and water companies to: • Take actions required to reduce PCC to 110 l/h/d by 2050, • Work with retailers to implement actions to assist non-household users to sustainably reduce their water use’
EA	National Framework[9]	‘Regional groups should: • Contribute to a national ambition on average PCC of 110 l/p/d by 2050 – this should be reviewed every five years. • Pursue ambitious reductions in non-household demand and contribute to the evidence available on the potential savings – as part of this regional groups should work with non-household water retailers and new appointments and variations

[4] HM Government, 2018, ‘A Green Future: Our 25 year Plan to Improve the Environment’, page 70.
[5] NIC, April 2018, ‘Preparing for a drier future, England’s water infrastructure needs’, page 15
[6] Defra, 28th March 2022, ‘Policy paper February 2022: The government’s strategic priorities for Ofwat’
[7] Defra, 6th May 2022, ‘Consultation on environmental targets’, page 24
[8] DEFRA, 2022, ‘Government expectations for water resources planning’, page 5 and 6
[9] EA, 16th March 2020, ‘Meeting our Future Water Needs: a National Framework for Water Resources – version 1’, page 10

Organisation	Document	Consumption Recommendation
		(NAVs) to align their approaches to planning, reducing demand, forecasting and monitoring non-household water use'[10]
EA, Ofwat, Natural Resources Wales	WRPG[11]	'Your preferred programme PCC should take into account any relevant future demand reduction planning assumptions set out in the national framework, regional plans and targets set by government or regulators. Your forecasts of PCC should be consistent with the data you include in the business plan (PR24) that you provide to Ofwat as part of its price review process.'
HM Government	25 Year Environment Plan[12]	'We want to see water use in England fall – the average person currently consumes 140 litres per day. With the average bath using around 80 litres and each flush of an old-fashioned toilet using up to 13 litres, there is action we can take to ensure we are using our water supply most efficiently. We will work with the industry to set an ambitious personal consumption target and agree cost-effective measures to meet it'.
NIC	Preparing for a drier future[13]	'Reduce demand from 141 litres per person per day to 118'.
Defra	Governments strategic priorities for Ofwat[14]	'We expect Ofwat to hold companies to account for their contribution towards reducing personal water consumption to 110 litres of water per head per day (l/h/d) by 2050'.
Defra	Consultation on environmental targets[15]	'There are a number of existing commitments and ambitions on water demand that are not statutory. These include planning assumptions based on reducing household water consumption to 110 litres per person per day by 2050'.
Defra*	Consultation on environmental targets – Water targets[16]	'Proposed target – To reduce Distribution Input (DI) over population by 20% from the 2019-20 reporting year figures by 2037-2038'. 'Three overall scenarios were modelled: the medium scenario including 9% reduction in NHH demand'.[17]

*these ambitions are still under consultation and so have not been directly incorporated into our dWRMP24. Following the outcome of this consultation we will revisit this in the rdWRMP24.

Table 8 - 2 – Governance documentation and consumption targets

8.18 In addition to the recommendations regarding leakage and consumption reductions, we have also considered Defra's recommendations for metering[18] and complied with The Water Resource Management Plan (England) Direction 2022 (Appendix Z – Defra Directions Checklist).

[10] The EA considered three scenarios which reduced non-household reduction ranging from 0% - 4%.
[11] EA, Ofwat, Natural Resources Wales, 4th April 2022, 'Water resources planning guideline, version 10', page 94
[12] HM Government, 2018, 'A Green Future: Our 25 year Plan to Improve the Environment', page 70.
[13] NIC, April 2018, 'Preparing for a drier future, England's water infrastructure needs', page 6
[14] Defra, 28th March 2022, 'Policy paper February 2022: The government's strategic priorities for Ofwat'.
[15] Defra, 6th May 2022, 'Consultation on environmental targets', page 24
[16] Defra, 6th May 2022, 'Water targets, Detailed evidence report', page 24 & 32
[17] The other scenarios ranged from a 6% - 20% reduction in non-household consumption
[18] Defra, 2022, 'Government expectations for water resources planning', page 5

Strategy

8.19 We have developed our demand reduction strategy to align with the recommendations from Defra, the EA, Ofwat and the NIC.

8.20 The key recommendations have been summarised in the Governance section above.

8.21 Our demand reduction strategy consists of eight ambitions. These are:

- Ambition 1 – reduce leakage by 50% (from 2017-18 levels) by 2050
- Ambition 2 – maximise feasible PCC reductions by 2050*
- Ambition 3 – smart meter all practicable connections by 2035
- Ambition 4 – minimise unmeterable properties by 2040
- Ambition 5 – wipe out most wastage by 2050
- Ambition 6 – minimise impact on customer bills
- Ambition 7 – minimise carbon cost
- Ambition 8 – create a deliverable, resilient and ambitious programme

* Please see later sections which describe why we have not assumed that reaching a nominal PCC target of 110 l/h/d

8.22 The nucleus of our demand reduction strategy is our metering programme.

8.23 The relationship between our ambitions is illustrated in Figure 8 - 3.

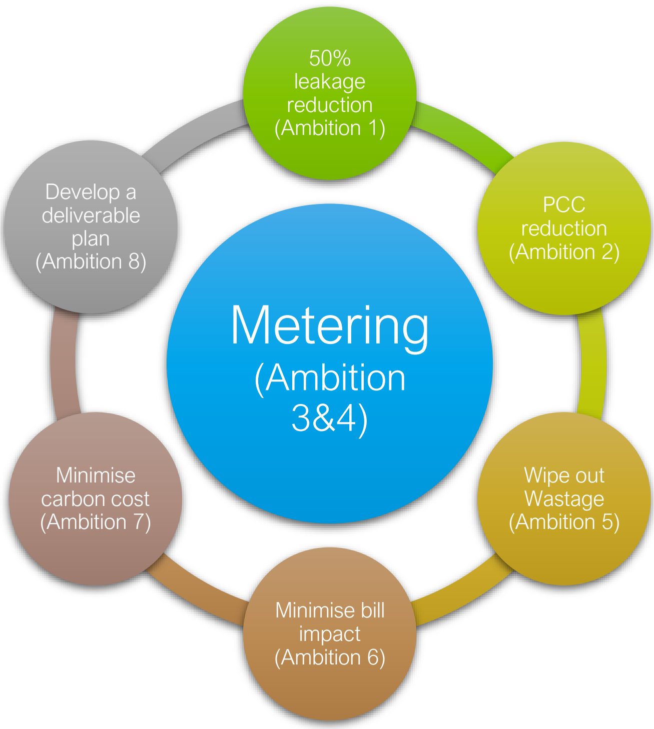

Figure 8 - 3 – Demand reduction ambitions

8.24 Smart metering is the foundation of our demand reduction strategy because it contributes to all eight ambitions.

8.25 It contributes to our leakage reduction through the detection of customer-side leakage (CSL, leakage which occurs on customer-owned pipes) and provides greater insight into asset performance, improving the speed and effectiveness of decision making and enabling investments to be made more informatively.

8.26 It contributes to PCC reduction directly, as evidence shows that, when metered, customers reduce their consumption through behavioural use changes and wastage repairs. It also enables further water efficiency activity to target greater volumes of wastage reduction.

8.27 Metering minimises bill impact for customers by ensuring they pay for what they use. It is also a more cost beneficial demand reduction option compared to more expensive options such as mains rehabilitation, therefore minimising overall bill impact for all customers.

8.28 Similarly, metering has a lower carbon cost than other more intensive solutions such as mains rehabilitation. And it is a proven deliverable and reliable solution to meet our ambition 8 to develop a deliverable, resilient and ambitious programme.

8.29 The eight ambitions which make up our demand reduction strategy have been used to develop the demand reduction programmes for dWRMP24.

Has our approach changed since WRMP19?

8.30 In WRMP19, we determined the Sustainable Economic Level of Leakage (SELL) and the Sustainable Economic Level of Demand Management (SELDM). This involved the creation of a range of demand reduction programmes to determine the most cost effective mix of activity to reduce leakage and total demand.

8.31 In dWRMP24, we have moved away from this approach and instead developed our programmes based on the government guidance (Governance section) and the eight ambitions in our demand reduction strategy. The change in approach is due to the change outlined in the WRPG, Section 9.3.1;

> *'Previously, companies have used the sustainable economic level of leakage method to determine levels of leakage. However, this is no longer acceptable for use in WRMPs and you should consider instead government's, regulators' and customers' views when deciding on your planned level of leakage'.*[19]

[19] EA, Ofwat, Natural Resources Wales, 4th April 2022, 'Water resources planning guideline, version 10', Section 9.3.1

Demand Options Screening

8.32 The purpose of demand options screening is to identify a list of feasible demand options that we can include in our demand reduction programmes for dWRMP24.

8.33 Demand options screening consists of two key stages:

- Stage 1 – Primary Screening of the Unconstrained Options List
- Stage 2 – Secondary Screening to create a Feasible Options List

8.34 The screening process is illustrated in Figure 8 - 4 – Demand Options Screening Process.

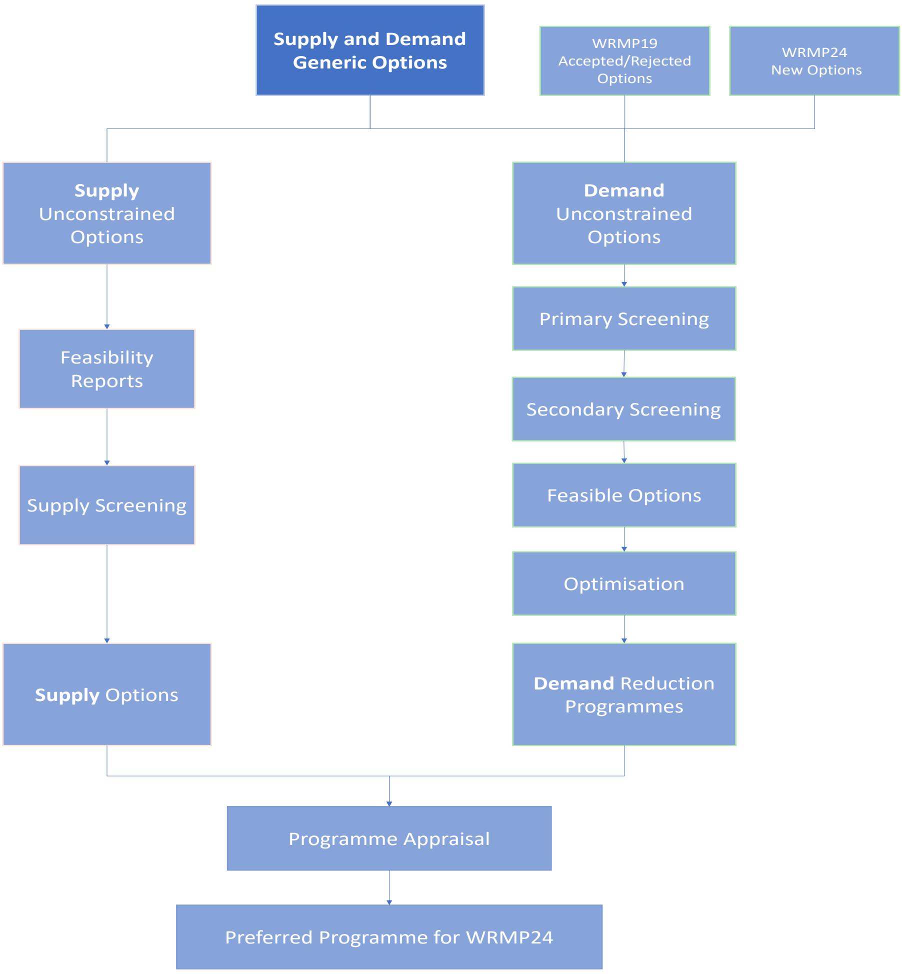

Figure 8 - 4 – Demand Options Screening Process

8.35 The purpose of Stage 1, Primary Screening, is to review and screen out those options that do not meet the key objectives. The resulting list of options represents a management set of options for further assessment.

8.36 Primary screening assesses option feasibility at a high level for acceptance or not, having regard to Technological, Financial, Environmental, Risk and Resilience and Legal constraints.

8.37 The purpose of Stage 2, Secondary Screening is to create a list of demand options which are considered to have a reasonable chance of implementation and of achieving a water demand saving.

8.38 Secondary screening further refines the options list that has emerged from the primary screening exercise by reference to qualitative criteria.

8.39 The outcome of sequential Primary and Secondary screening exercises is the drawing up of a Feasible Demand Options List. The options included in the Feasible Demand Options List are then optimised in the 'Demand Profile Calculator' and our Integrated Demand Management (IDM) model.

Screening process changes for dWRMP24

8.40 The Demand Options Screening Process shown in Table 8 - 4 is identical to the process undertaken in WRMP19. This approach has been reviewed for dWRMP24 to ensure that the criteria and process is aligned with the supply options screening approach and that recommendations from regional planning are considered.

8.41 The main changes to note are:

- Removal of the Combined Options from the Demand Options List

8.42 In WRMP19 all discrete water Demand Options and combinations of discrete options underwent Primary Screening and Secondary Screening before being declared a Feasible Demand Option.

8.43 For dWRMP24 to achieve consistency with the process outlined in the EA's WRPG, it was deemed more appropriate to first screen out discrete water Demand Options and then, through the modelling phase, develop the Demand Reduction Programmes. This alteration ensured that all feasible discrete options were considered and included in the modelling process used to create demand reduction programmes.

- Secondary Screening Questions – Additional question

8.44 Change, Question 11: Can cost and benefit of the demand option be modelled for comparison with alternative at DMA level or can the option be actively investigated in the 2025-30 period for future consideration within our long-term strategy?

8.45 For the details of the demand options screening process including the full list of unconstrained options and screening questions, please see the report titled, 'Demand Management Options Screening, September 2022', Thames Water.

Screening process outcome

8.46 The outcome of the demand options screening process is a Feasible Options list that consists of 18 demand options.

8.47 The options are grouped into three categories:

- Metering – 7 demand options (Table 8 - 4)
- Water Efficiency – 8 demand options (Table 8 - 5)
- Leakage – 3 demand options (Table 8 - 6)

8.48 The development of these feasible options into benefits, costs and deliverable volumes is detailed in the section covering Feasible Options - Metering, Feasible Options - Water Efficiency and Feasible Options - Leakage.

Feasible Options - Metering

8.49 Metering is the mainstay of our demand reduction strategy.

8.50 Metering is the only group of feasible demand options to deliver both a leakage and household and non-household consumption reduction.

8.51 There are seven feasible metering options. These are summarised in Table 8 - 3.

Option		CSL Reduction	Household Behavioural Use Reduction	Household Wastage Reduction	Non-Household Reduction	WRMP19 or New
1	Progressive Metering Programme (PMP)	Yes	Yes	Yes		WRMP19
2	Progressive Smart Upgrade Programme Household (HH PSUP)	Yes	(see Water Efficiency Digital Engagement)	(see Water Efficiency Digital Engagement)		WRMP19
3	Bulk Metered Area (BMA)	Yes				WRMP19
4	Mini Bulk Metered Area (mBMA)	Yes				WRMP19
5	Metering Innovation (PMP)	Yes	Yes	Yes		New
6	Metering Innovation (PSUP)	Yes				New
7	Progressive Smart Upgrade Programme Non Household (NHH PSUP)	Yes			Yes	New

Table 8 - 3 – Feasible Metering Options

Where do metering savings occur?

8.52 Our metering options can reduce customer side leakage (CSL), wastage, or behavioural usage of customers. This applies to both household and non-household customers. Figure 8 - 5 illustrates where these savings occur.

8.53 Change in water use behaviour and wastage repairs occur in the home downstream of the internal stop tap. This includes pipework that extends outdoors for customers with a garden.

8.54 Change in water use behaviour refers to the changes customers make to their discretionary water use in response to the move to a metered bill. Examples include running the washing machine on a full load and using a watering can in the garden.

8.55 Wastage repairs refer to the repair of wastage issues in the home, such as a leaking tap or toilet in response to the move to a metered bill.

8.56 CSL repairs occur on the pipework between the external and internal stop taps. This pipework is the responsibility of the customer but, we offer free CSL repairs to household customers to help us meet our commitment to reduce leakage.

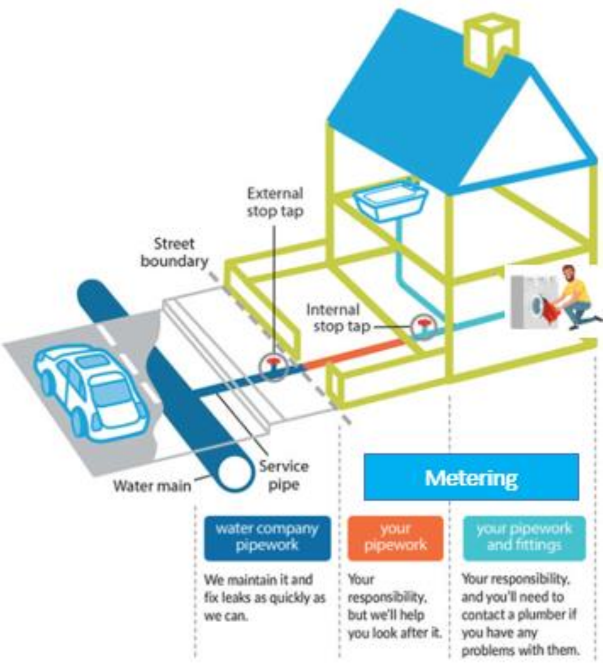

Figure 8 - 5 – Water pipes and ownership, Metering [20]

8.57 The following sections on Progressive Metering Programme, Progressive Smart Upgrade Programme (Household), Bulk and Mini Bulk Metered Areas, Metering Innovation and Progressive Smart Upgrade Programme (Non-household) detail the demand reduction volume, cost, and constraints for each feasible metering option. This information is used to calculate the volume of metering in each demand reduction programme (Creating Demand Reduction Programmes). Further technical detail is in Appendix N, Metering and Appendix R, Scheme Dossiers.

Progressive Metering Programme

Description

8.58 The Thames Water supply area is designated as an area of serious water stress[21] and, since 2012, the Secretary of State has granted us legal powers to compulsorily meter properties. In the Water Resources Management Plans 2014 (WRMP14) and 2019 (WRMP19), we responded with our compulsory meter installation programme called the Progressive Metering Programme (PMP).

8.59 Our PMP is a proactive workstream where we compulsorily meter our household unmeasured customers. It enables fairer customer billing because customers only pay for what they use, and facilitates a reduction in customer usage, internal wastage and CSL.

8.60 Our PMP applies to all property types; detached, semi-detached and terrace properties and individual dwellings in mini bulk and bulk properties.

[20] Sourced from Discover Water UK, www.discoverwater.co.uk/leaking-pipes
[21] Environment Agency and Natural Resources Wales, 'Water stressed areas – final classification', July 2013

'Smart' Technology

8.61 For dWRMP24, our PMP will install a digital meter which is either:

- **Advanced Metering Infrastructure (AMI):** commonly referred to as a 'smart meter', AMI meters send automatic reads through a secure wireless network to provide real time water consumption data. They can do this when our Local Communication Equipment (LCE)[22] and wide area network (WAN) communication system is available.

  Electronic readings are remotely passed from the meter to our Smart Meter Operations Centre (SMOC) which is responsible for the storage and analysis of our smart meter data.

- **Automatic Meter Reading (AMR):** provide a meter reading during a 'walk by' or 'drive by' reading. These meters are equipped with a short range radio that communicates with a meter reading device. In contrast to 'Basic meters' (Section Progressive Smart Upgrade Programme (Household) meter reads can be taken without physical access to the meter.

  AMR meters are referred to as 'smart enabled' as they have the capability to be switched into AMI mode when our WAN communication system becomes available in that location.

8.62 To enable complete AMI smart metering by 2025-26, we are currently extending our WAN in Thames Valley. This means we are working with existing telecommunication companies to use their masts to communicate with our AMI smart meters.

8.63 The current WAN covers 95% of London, and parts of the Thames Valley such as Reading and Guildford (Figure 8 - 6).

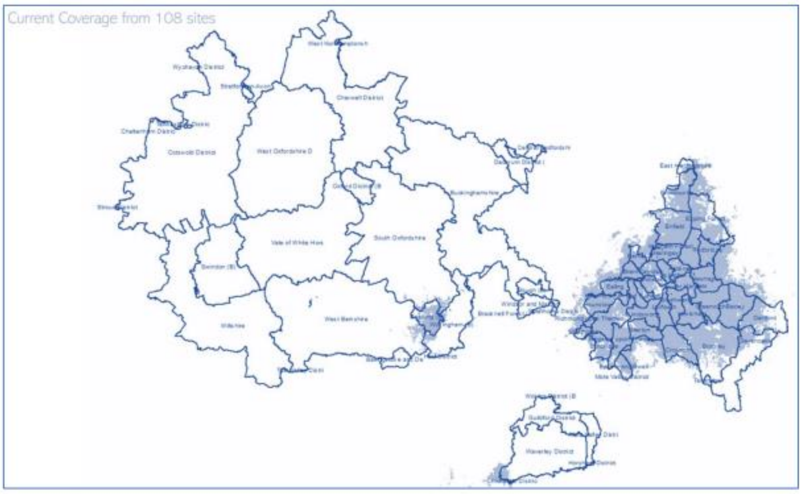

Figure 8 - 6 – Wide Area Network in 2022

8.64 By 2025-26, we will have WAN coverage across Thames Valley. This will enable all PMP meters to be AMI for our dWRMP24. AMR meters will be installed by exception such as in the accommodation of religious or personal customer circumstances. For example, some religious

[22] Local Communication Equipment (LCE): Two-way communication hardware also referred to as a communication smart-point. It is wirelessly installed adjacent to the meter and enables transfer of data from the meter to our systems utilising a wide area network infrastructure.

communities oppose the installation of smart technology and similarly, some individuals oppose the installation of smart technology in their homes.

8.65 Our PMP contributes to Ambition 2 – maximise feasible PCC reductions by 2050, Ambition 3 – smart meter all practicable connections by 2035, Ambition 4 – minimise unmeterable properties by 2040, Ambition 5 – wipe out most wastage by 2050, Ambition 6 – minimise impact on customer bills, Ambition 7 – minimise carbon cost and Ambition 8 – create a deliverable, resilient and ambitious programme. Installation of meters can also contribute to Ambition 1 – reduce leakage by 50% (from 2017-18 levels) by 2050, but our dWRMP programme does not include this because our remaining PMP installations will be internal (inside homes), meaning that they do not result in CSL savings which covers the pipework outside of the household.

Fair Billing and the customer One Year Journey

8.66 Our PMP is driven by our commitment to fairer and accurate billing as well as conserving water resources. We achieve this though:

- Proactive customer engagement
- Consistent high quality of meter installation
- Robust fixed asset data capture
- New metering technology
- Enhanced systems and processes for data management

8.67 To minimise the billing impact on customers, we currently implement a 'one year journey' from the time a customer has a meter installed and the time they begin paying on a metered tariff. Within this one year window, customers receive comparative bills which show the cost of water on an unmeasured and measured tariff. This incentivises customers to save water prior to being put on a metered tariff at the end of their one year journey.

8.68 This information is included in the optimisation stage of modelling so that the full savings expected from household metering do not occur at the same time as a meter install but rather one year after the meter install. We assume that 10% of the savings occur at the time of meter install and the remaining 90% occur one year after the meter install.

Benefits

8.69 Our PMP results in three types of water saving:

- Customer behavioural change
- Customer wastage repairs
- CSL repairs

8.70 Customer behavioural change results from customers changing their discretionary water use in response to moving to a metered bill. This means they may be aware of areas they could make water savings, such a ensuring a full load before using the washing machine or taking shorter showers. Customers are prompted to make these savings once they are charged for the water they use on a metered bill.

8.71 Customer wastage repairs refers to customer own repair of wastage issues in their home. Customers may be aware of low running wastage such as a leaking toilet or tap that they have been meaning to repair for some time, or customers may be unaware of an internal wastage issue until they receive their meter readings and are prompted to find and fix their internal wastage. In both cases, customers are prompted to repair their own wastage issues once they are charged for the water they use on a metered bill.

8.72 CSL repairs refer to leakage on the customer supply pipe that is detected following a smart meter reading. The repair of CSL is either undertaken by the customer or Thames Water through our free CSL repair programme. Historically, our PMP resulted in CSL savings, however, in dWRMP24 all new meter installs will be within properties. This is because we have completed our external meter installs in AMP6 and AMP7 and only internal installs remain. Internal meters measure the volume of water going into a customers' home and do not measure the volume of water going through or lost from the customer supply pipe. Therefore, CSL savings do not result from our PMP in dWRMP24 and will be detected through our normal find and fix leakage activities.

8.73 The sum of customer behaviour change and wastage repairs is referred to as total household consumption reduction. The total household consumption reduction is the benefit of PMP in dWRMP24.

8.74 In dWRMP24, our models have been updated to use smart meter data. In contrast, our WRMP19 models were based on basic meter data. The smart meter data used in dWRMP24 has given us the opportunity to reforecast the savings we expect from PMP and to split these savings between customer behavioural changes and wastage. This reforecast has been implemented in our Smart Meter Benefits Study[23].

Smart Meter Benefits Study – Smart Meter Data Sources

8.75 The Smart Meter Benefits Study has been undertaken to forecast the average savings from PMP. This study involves looking at smart meter data to determine both our unmeasured property consumption prior to metering and measured property consumption after a customer receives their metered bill.

8.76 In this study, smart meter data is analysed by property type. Property type is broken into six areas; detached, semi-detached, terrace, dwellings in bulks, dwellings in mini bulks and unknown.

8.77 To determine the benefits of smart metering, we analysed the data from 103,100 smart meters. The meters included in the study had to meet the following conditions:

- The data from the smart meter covered the whole meter journey. This includes from meter installation, to being activated on the PMP journey, through bill comparisons and then switching to a metered bill account, either voluntarily or compulsorily switched. Each meter in this study was analysed individually so all smart meters included required a full dataset throughout the metering journey
- The property had not received a Water Efficiency Smarter Home Visit (SHV) or Wastage repair. This was done to ensure we did not double count the benefits from smart metering with the benefits from Water Efficiency activity
- The property had completed its one year journey and moved to a metered bill prior to January 2020. This was done to ensure the impact of Covid-19 was not included in the results. Further work is required to robustly model the changing impact of Covid-19. At

[23] Artesia Consulting, May 2022, 'Smart Metering Benefits Template_2022-05-18'

the time of this analysis, we did not have a full year of data during Covid-19 and therefore it could not be reliably included in this study

8.78 The meters included in this study were all based in London because the roll out of smart metering is under development in our Thames Valley region.

8.79 The split of property type of the smart meters included in the study is summarised in Table 8 - 4.

Property Type	Total
Detached	4256
Semi-detached	21716
Terrace	60622
Dwelling (mBulk)	9644
Dwelling (bulk)	3766
Unknown	3096
Total	103,100

Table 8 - 4 – Smart Meter Benefits Study Sample Size

8.80 This shows that 59% of our sample were terrace properties, 21% semi-detached, 4% detached, 13% dwellings in blocks of flats and 3% unknown.

8.81 For the purposes of the smart meter benefits study, this mix of property type was deemed robust to draw conclusions about the benefits of smart metering. However, it is noted that this sample does include the following bias:

- Most smart meters are in terraced properties. Larger property types such as semi-detached and detached can make greater savings due to the number of bathrooms and garden size in these properties. A larger sample size of these properties may show average greater savings can be achieved from these property types. There is a risk we have underestimated the final benefits of smart metering as a result.
- All data was collected in London. For larger property types, we may have underestimated the savings based on customer affluence between London and Thames Valley. This also poses a risk that we have underestimated the final smart metering benefits. Results for this will be known in AMP8 for WRMP29.
- The smart meters installed to date were based on the rollout of our PMP in AMP6. We may have introduced a small bias and targeted easier to access areas and boroughs where external installs are more readily available.

8.82 As more properties within our area complete their smart meter journey, as we install more smart meters, and as we decide how to analyse data that includes the influence of Covid-19, our smart meter dataset will increase substantially. Analysis of our smart meter data is ongoing and will be reviewed again within the Smart Meter Benefits Study, and if timing allows will be included in our revised dWRMP24 in 2023.

Smart Meter Benefits Study – Methodology and Results

8.83 The approach[24] taken in this analysis has been to analyse the data of each smart meter. For each meter, the unmeasured consumption has been determined and compared to the measured

[24] Artesia Consulting, 2021, 'Quantifying the savings from PMP – Summary', Artesia Consulting Technical Note

consumption once the customer moves to a measured bill. The difference between the unmeasured and measured consumption is the benefit of smart metering for that property.

8.84 The unmeasured consumption is determined by looking at the first 11 days of data before the activation date of PMP. The activation date of PMP is when the customer is formally moved onto a metered bill. It is assumed that after the activation date a customer becomes more aware of their water consumption whereas prior to this date they are behaving as they historically have as an unmeasured customer.

8.85 We have checked this assumption by looking at the change in the components of consumption, the customer behavioural usage and wastage at the activation date. This found that the activation date is a key point in time when there is a change in the measured total flow which may be related to fixes of known wastage or CSL when the customer becomes aware that they have a meter.

8.86 The measured consumption is determined by looking at the first 30 days after a customer is moved to a measured bill. This is the period where a customer has completed their one-year journey and are billed for their measured water consumption.

8.87 The Smart Meter Benefits study analysed both the unmeasured and measured consumption by looking at the breakdown between customer behavioural usage, wastage and CSL. This analysis was done by first splitting the smart meter flow into continuous flow[25] and variable flow. The continuous flow was then split into wastage and CSL based on our historical analysis.

8.88 Since our historical analysis and assumptions favour a larger proportion towards CSL, this may introduce some bias into the smart meter study and underestimate the wastage savings we can achieve from smart metering. However, until we can prove this split is different with a larger dataset, we have retained our auditable split of wastage and CSL. This work will continue in Part 2 of the Smart Meter Benefits Study.

8.89 These results of this analysis are illustrated in Figure 8 - 7 and Figure 8 - 8.

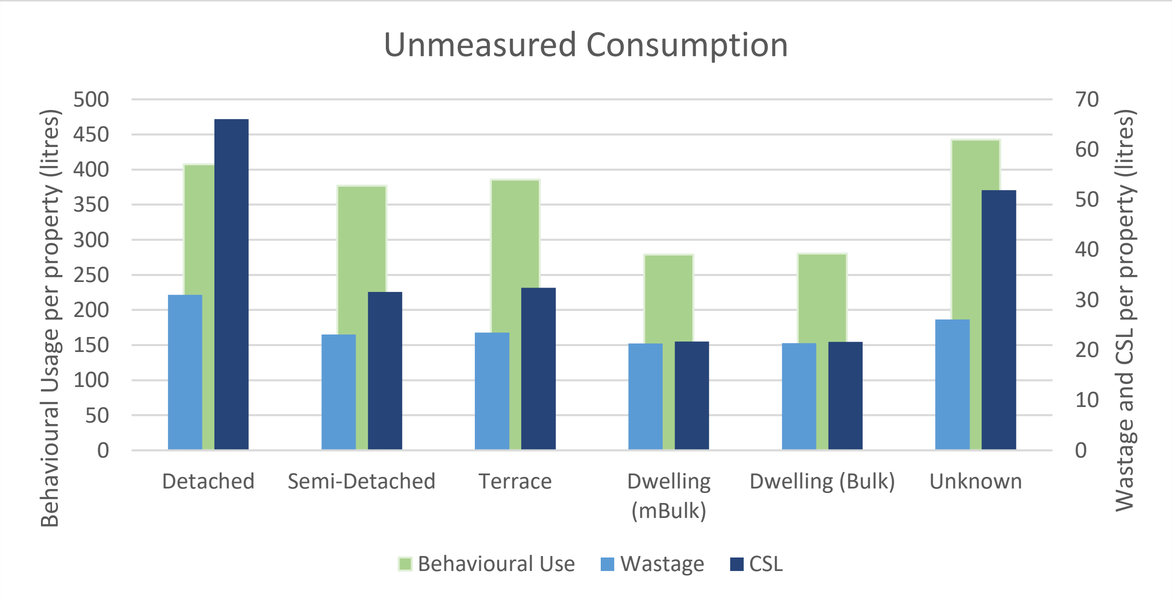

Figure 8 - 7 – Unmeasured Consumption (Smart Meter Benefits Study Results)

[25] Continuous flow is flow that does not drop below 0. It indicates either a CSL or wastage issue at the property.

8.90 Figure 8 - 7 shows that, on average, 85% of total unmeasured consumption is due to customer behavioural use, 6% is wastage and 9% is CSL[26].

8.91 In comparison, Figure 8 - 8 shows that on moving to a smart meter, customers eliminate almost all their CSL so that it represents 1% of total measured consumption. This is due to our free CSL repair programme that we have offered customers throughout AMP6 and 7.

8.92 Both behavioural usage and wastage also decrease so that wastage is only 3% of total consumption once customers move to a metered bill.

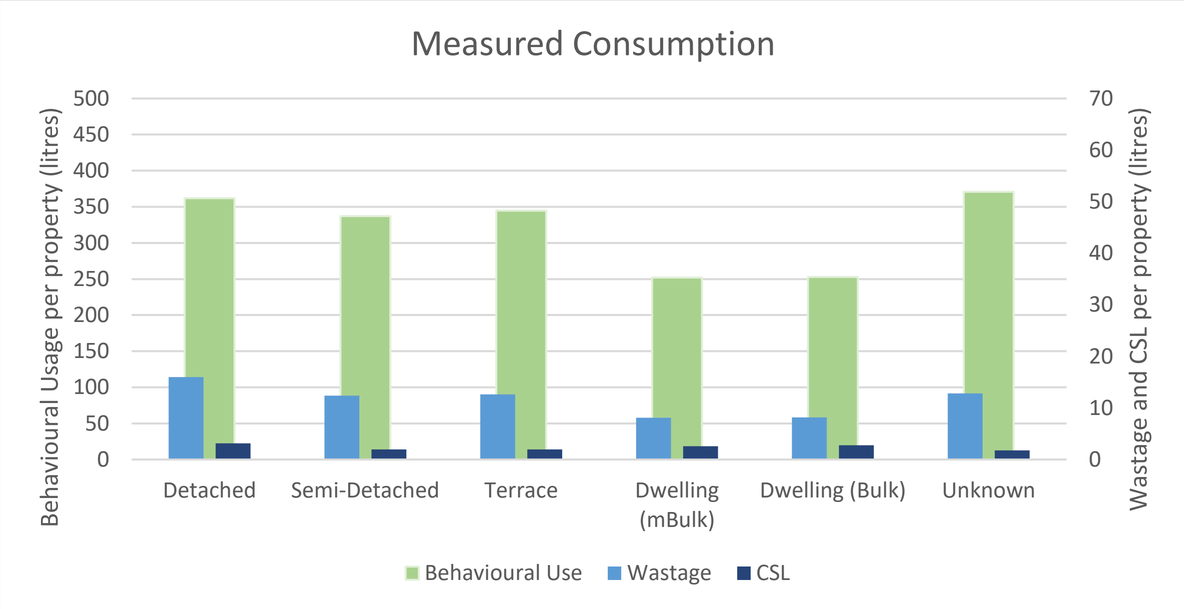

Figure 8 - 8 – Measured Consumption (Smart Meter Benefits Study Results)

8.93 For direct comparison with WRMP19, the remaining analysis will include the change in behavioural use and wastage only. WRMP19 split the total consumption from metering into activities that customers undertake in response to a metered bill (behavioural use change and wastage repair) compared with the repair of CSL by Thames Water.

8.94 The behavioural use and wastage reduction contribute to an overall reduction in household consumption and company PCC. The reduction in CSL contributes to a reduction in company Leakage. The dWRMP24 has retained the same definitions and defined household consumption reduction or PCC reduction achieved from smart metering as the change in customer behaviour and wastage reduction in response to the customer being moved to a metered bill.

8.95 In the Smart Meter Benefits study the total household consumption reduction from smart metering is calculated by subtracting the measured consumption (Figure 8 - 8) from the unmeasured consumption (Figure 8 - 7).

8.96 The total household consumption reduction from smart metering is shown in Figure 8 - 9. These results are split by property type.

[26] CSL associated with Dwellings in bulks and mini bulks is for external meter installations only.

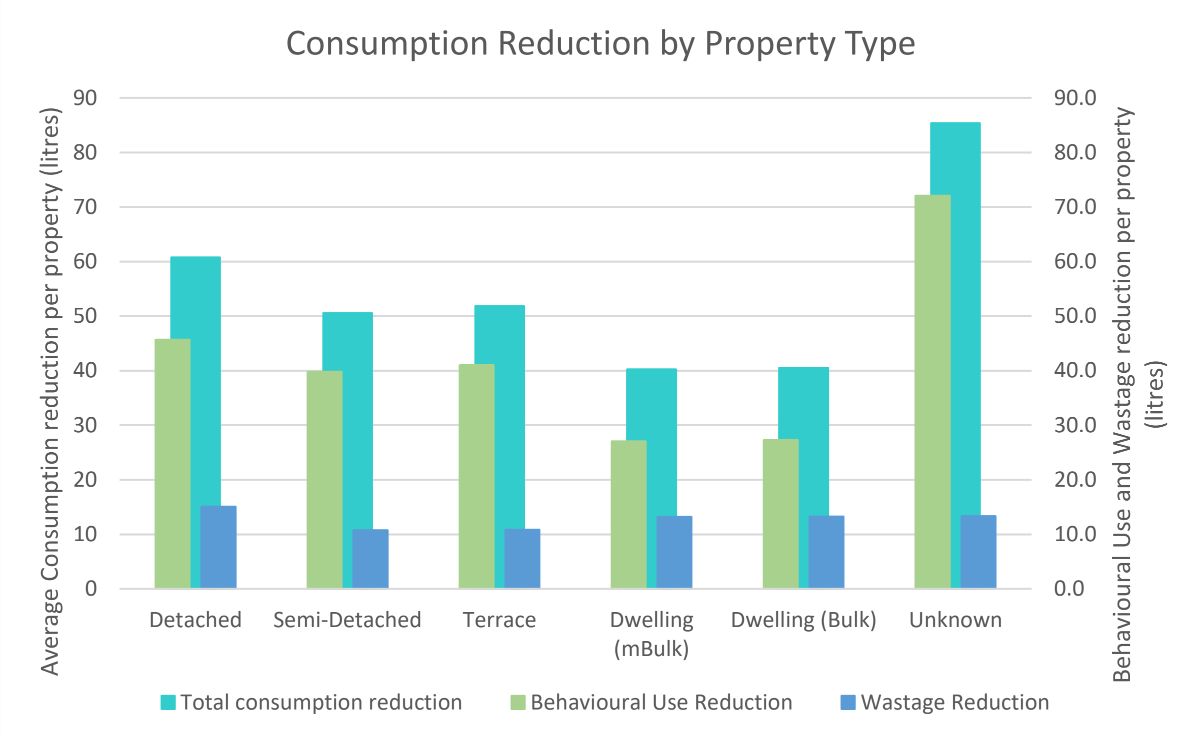

Figure 8 - 9 – Consumption Reduction by Property Type from Smart Metering

8.97 Figure 8 - 9 shows that the greatest savings can be achieved from smart metering houses with detached properties saving 61 litres per property, semi-detached saving 51 litres and terraces saving 52 litres per property on average.

8.98 The larger savings associated with detached properties is likely due to the higher number of bathrooms and larger gardens associated with these properties. This is reflected in the both the greater savings from wastage and behavioural use compared to other property types.

8.99 The largest savings in the sample are associated with Unknown property types. The savings from these properties indicate that the average savings from all property types may be higher once we factor in the unknowns. This does highlight that regardless of the property type being metered, there are substantial consumption savings to be made by smart metering all properties.

8.100 To provide a direct comparison between the dWRMP24 Smart Meter Study results and the results from WRMP19, the figures presented in Figure 8 - 7 must be converted to a percentage reduction from unmeasured to measured consumption.

8.101 Figure 8 - 10 shows the average percentage reduction in household consumption from smart metering.

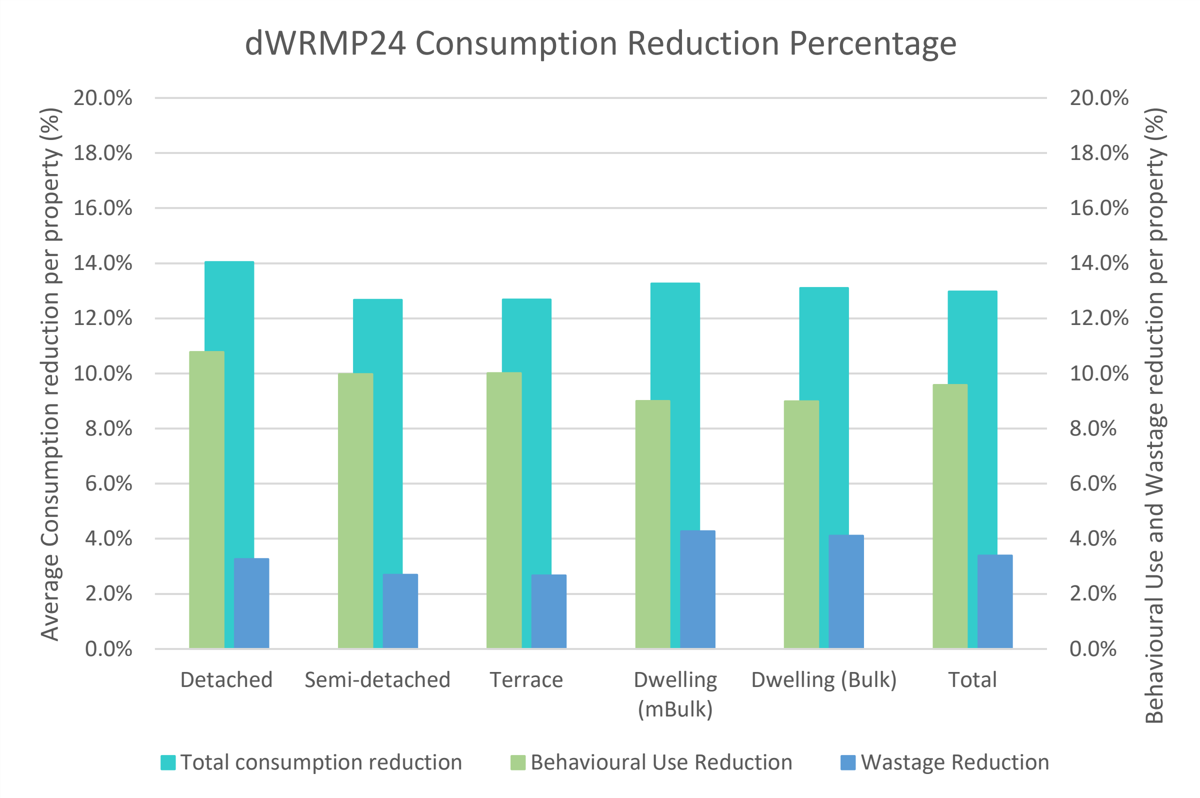

Figure 8 - 10 – Percentage reduction in household consumption from smart metering

8.102 This shows that, on average, the installation of a smart meter will result in a 13% consumption reduction per property. 10% of this saving is due to changes in behaviour and 3% is due to customer own repair of wastage.

8.103 Although the greatest percentage reduction remains for detached properties (14%), the percentage reduction for dwellings in bulks and mini bulks (13.3%) is higher than terrace and semi-detached houses (12.7%). This is largely due to the substantial wastage savings made by dwellings which save over 4% by repairing their wastage compared to houses of 2.7%. We hypothesise that this is because the occupants in these dwellings are aware of the wastage because they are in the smaller property. The smaller property may also indicate a more challenging socio-economic position, so these occupants are more likely to repair the wastage to save money on their metered bill.

How does this compare to WRMP19?

8.104 In WRMP19, we assessed the total customer consumption reduction from PMP using our Metered Consumption Model (MCM)[27]. This model compared basic meter readings to estimated unmeasured consumption per property to forecast savings from PMP.

8.105 Unmeasured consumption was calculated from our Domestic Water Use Study (DWUS) which consisted of approximately 1000 properties whose consumption was metered but the customer was not charged on a metered bill. We assumed these customers behaved as unmeasured customers. Measured consumption was calculated from 8,567 properties with a basic (non-smart) meter.

[27] Cocks, R, February 2017, ‘Using Household Consumption Models to Estimate the Impact of Metering’, Thames Water.

8.106 In WRMP19 our MCM was the best and most robust dataset available to assess the savings from PMP. Although the model could forecast total consumption reduction savings from PMP, it could not split these savings into customer behavioural use changes and wastage.

8.107 The results of our WRMP19 MCM compared with the dWRMP24 Smart Meter Benefit study are illustrated in Figure 8 - 11.

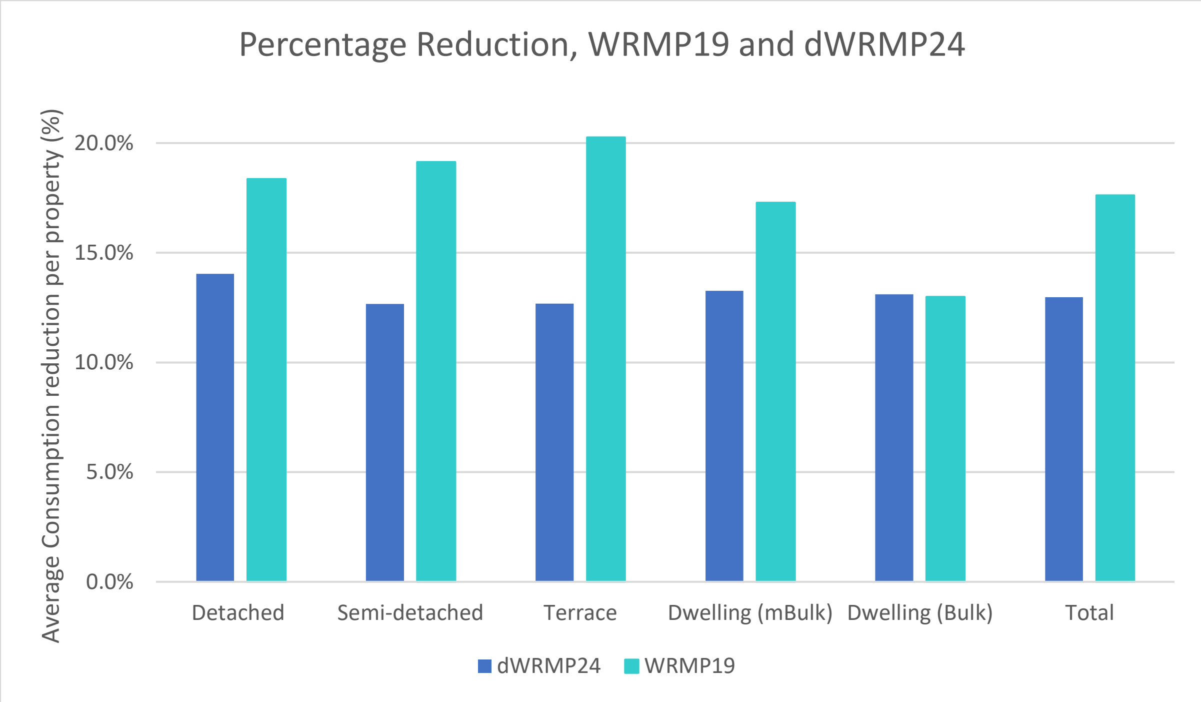

Figure 8 - 11 – Percentage reduction, WRMP19 and dWRMP24

8.108 This shows that, on average, in WRMP19 we found that the installation of a meter would result in a 17% consumption reduction per property. This result was based on basic meter data and so could not be reliably split into the savings from behaviour change and wastage.

8.109 In comparison with the Smart Meter Benefits Study conducted for dWRMP24 this initially indicates that the benefits from metering have decreased by 4% between our plans with the greatest difference occurring for terraced properties. However, further analysis of the information behind these percentage reductions shows that the reason for this change is largely due to the difference between WRMP19 and dWRMP24 figures for unmeasured consumption.

8.110 The difference in unmeasured consumption between dWRMP24 and WRMP19 is shown in Figure 8 - 12.

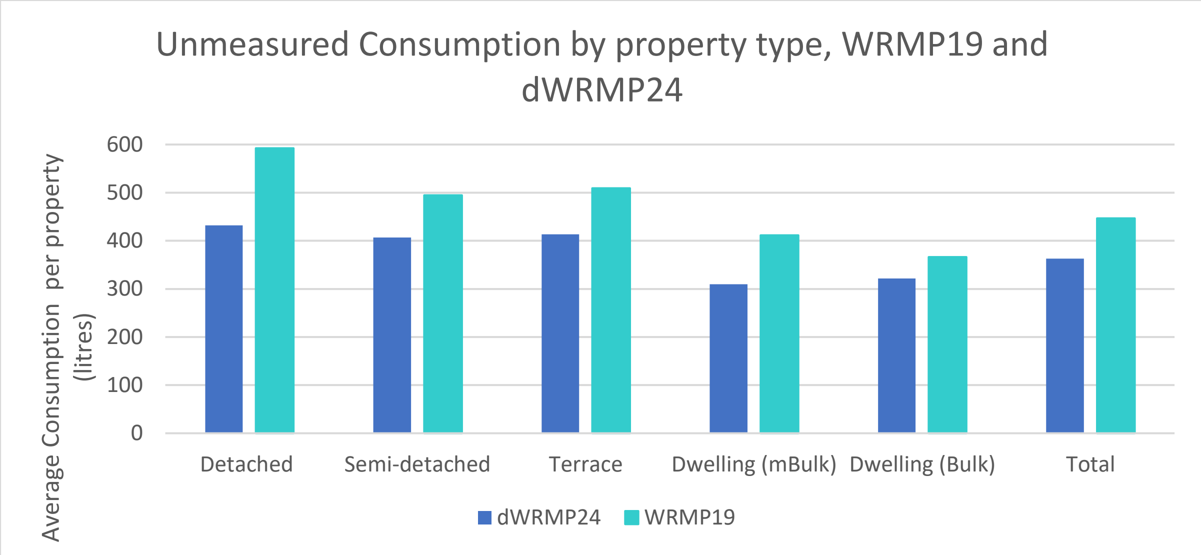

Figure 8 - 12 – Unmeasured consumption by property type, WRMP19 and dWRMP24

8.111 Figure 8 - 12 shows that WRMP19 unmeasured consumption was, on average, 23% higher than the unmeasured consumption in dWRMP24. The greatest differences were in detached properties with a 37% difference, dwellings (mBulk) with a 33% difference and terrace properties with a 23% difference.

8.112 The higher levels of unmeasured consumption in WRMP19 mean that we have calculated the savings from a higher starting point. The volume of savings from metering is heavily dependent on our view of unmeasured consumption.

8.113 The reason for the difference in unmeasured consumption is due to the difference in approach between WRMP19 and dWRMP24. Unmeasured consumption in WRMP19 was estimated from our DWUS panel of 1,000 basic meter properties whereas our dWRMP24 figures have been based on a much larger sample size, 103,100 properties and smart meter data.

8.114 We believe our unmeasured consumption from dWRMP24 represents the most accurate view, however as noted in the section 'Smart Meter Benefits Study – Smart Meter Data Sources', we may have included bias during the rollout of our smart meters. This means that there is uncertainty associated with our unmeasured consumption in dWRMP24. If unmeasured consumption was higher, the savings from metering in dWRMP24 would be higher than 13%.

8.115 We are continuing our analysis in Part 2 of the Smart Meter Benefits study. If we find that average unmeasured consumption is higher in Part 2 of the study, the average percentage reduction from smart metering is likely to be somewhere between the dWRMP24 figure of 13% and the WRMP19 figure of 17%, which could cause an improved benefit of household consumption in AMP8 of <2 Ml/d.

8.116 In contrast to unmeasured consumption, measured consumption between WRMP19 and dWRMP24 is more aligned.

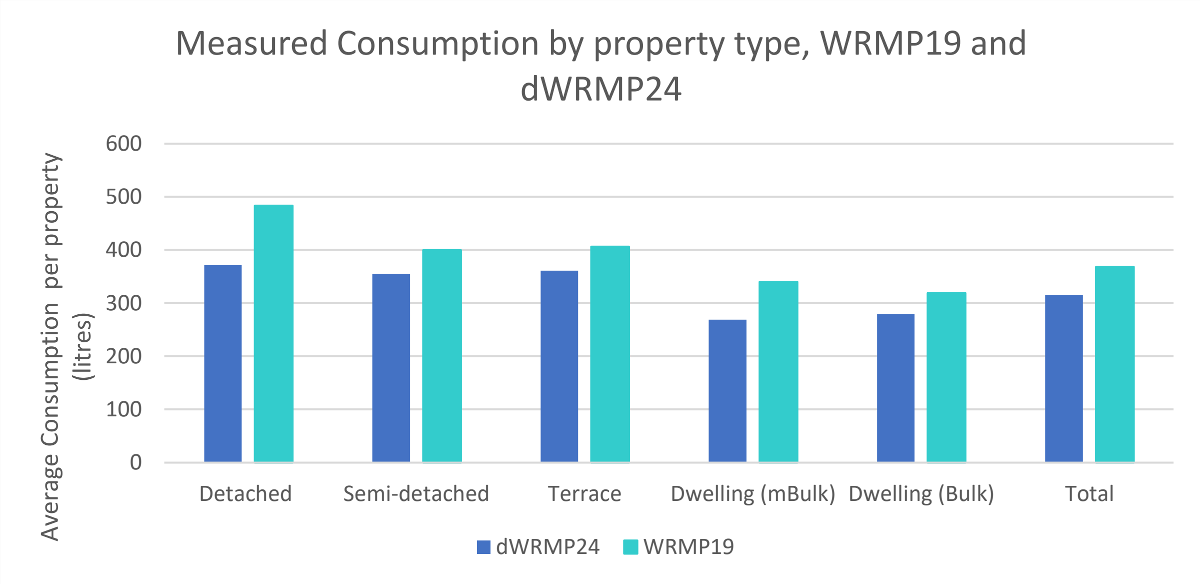

Figure 8 - 13 – Measured consumption, WRMP19 and dWRMP24

8.117 Figure 8 - 13 shows that the average difference between WRMP19 and dWRMP24 measured consumption is 16% (the average difference for unmeasured consumption was 23%). The difference is still most pronounced for detached properties with WRMP19 measured consumption being 30% higher than dWRMP24 (unmeasured was 37%), dwellings (mBulks) at 26% (unmeasured was 33%) and terraced properties at 12% (unmeasured at 23%).

8.118 Crucially, the measured consumption for dWRMP24 across all property types is lower than the measured consumption for WRMP19. This means that although the percentage reduction figures between our WRMP19 and dWRMP24 may imply the savings from metering have decreased since WRMP19, measured properties use less water in dWRMP24 than we forecast in WRMP19. The difference between the WRMP19 forecast of 17% reduction and dWRMP24 forecast of 13% reduction is predominantly due to the different unmeasured consumption values used in each plan.

8.119 To test this, we have compared our dWRMP24 measured consumption against our WRMP19 unmeasured consumption. If we were to calculate the usage reduction from metering using WRMP19 unmeasured consumption and our dWRMP24 measured consumption, then our dWRMP24 savings increase from 13% to 29%.

8.120 We have done this calculation to show the influence of the unmeasured consumption value on the results. Due to the larger sample size and availability of smart meter data we are confident our unmeasured consumption included in the dWRMP24 is the most accurate. For dWRMP24, we have used the 13% saving as this has been developed using our most up to date and accurate data set. As we analyse more data points in Part 2 of the Smart Meter Study, we will update our prediction of smart meter savings.

Costs

8.121 There are three types of cost associated with our PMP; to install the meter, to read the meter and to maintain the meter.

8.122 Meter installation costs consist of the cost to survey, consult with the customer about the meter installation, install the meter and the cost of the meter itself. There is also the cost to survey and consult the customer in properties that are then proven to not physically allow a meter installation. These properties are termed unmeterable.

8.123 The cost to survey and install depends on the size and position of the meter regarding whether it is in the pavement, the soft verge or within the property. The cost to install a meter internally is more expensive than an external install due to the additional time and resources required for the customer appointment facilitation. The cost of an external meter installation is broken down to the cost to dig and install a new boundary box with the meter or to screw in a new meter where a boundary box already exists from work conducted in AMP7.

8.124 The meter installation costs used in dWRMP24 are based on actual costs from AMP7 with a 6% uplift for inflation.

8.125 The cost to read an AMI meter is based on our SMOC[28], Meter Data Management System (MDMS) and Customer Experience costs. The cost to install our fixed network has been covered in AMP7. The cost to read our meters is based on the number of meters installed each AMP.

8.126 The cost to maintain our meters is based on the asset life of a smart meter. Based on the smart meter battery life, we assume smart meters installed up to 2040 need to be replaced every 15 years. Installs between 2040 – 2055 are assumed to have a 20 year life and installs after 2055 a 25 year life. We also assume that the cost of meter replacement and support costs decrease by 10% after 2040 and 20% after 2055 due to full smart meter penetration and technological advances.

Maximum Deliverable Volume and Constraints

8.127 The number of meters that can practically be installed in each water resource zone (WRZ) is referred to as the maximum deliverable volume.

8.128 The maximum deliverable volume is calculated based on three datasets:

- The number of unmeasured properties at a point in time split by property type
- The number of these properties that are likely to be internal or external installs
- The likelihood of successfully installing a meter at that property

8.129 For dWRMP24, we have taken the number of unmeasured properties at 2024-25. This assumes we will have undertaken our AMP7 metering programme which includes a volume of metering under our Green Economic Recovery (GER) programme. For details of our AMP7 programme see the section on Demand Forecast.

8.130 To calculate the maximum deliverable volume, we have then applied our Internal/External Split data and Survey to Fit Ratios.

8.131 The Internal/External split data identifies the number of unmeasured properties that will be an external installation or internal installation. An external installation is where a meter is fitted in the pavement at the stop tap position. An internal installation is where the meter is fitted at the first stop tap inside the property. In dWRMP24, our maximum deliverable volume applied to internal

[28] The SMOC centre monitors the performance data from smart meters. The team has been established to recognise potential leaks at a customers' property, identify disproportionate consumption and identify where a meter has gone missing resulting in a drop in communications. In response, the SMOC team will proactively dispatch technicians to investigate meters that are not performing as expected and refer cases of suspected leakage onto our CSL repair team to facilitate a timely repair.

installations only as we had targeted all our potential external installations throughout AMP6 and AMP7.

8.132 The Survey to Fit Ratio is based on data from AMP7. This represents the number of surveys we undertook compared with successful meter installations for each property type in AMP7. We use this information to predict the likely volume of meter installations we can achieve in the future to ensure we create a deliverable and realistic metering programme.

8.133 For the properties which cannot be metered under our PMP, we have included our Metering Innovation Solutions.

Maximum Deliverable Volume and Constraints

8.134 The maximum deliverable volume of bulks and mini bulks is calculated based on two datasets

- The number of potential bulks and mini bulks. This number is supplied by our field teams.
- The likelihood of successfully installing a bulk or mini bulk at that location

8.135 For dWRMP24, we have taken the number of potential bulks expected at 2024-25. This assumes we will have undertaken our AMP7 metering programme of bulks and mini bulks. For details of our AMP7 programme see Section 3 – Demand Forecast.

8.136 To calculate the maximum deliverable volume, we then apply our Survey to Fit Ratios to the possible bulks and mini bulks.

8.137 The Survey to Fit Ratio is based on data from AMP7. This represents the number of bulk and mini bulk visits we undertook compared with our successful installations. We use this information to predict the likely total volume of bulks and mini bulks. If the maximum deliverable volume is greater than 50,000 meters, we will consult with out delivery teams and contractors to determine a deliverable and an ambitious level of installations that can be achieved each AMP. This ensures we create a deliverable and realistic metering upgrade programme.

8.138 For the Survey to Fit ratio data and details of this calculation, see Appendix N – Metering.

8.139 The section on Metering Innovation describes our approach to target these properties and minimise the number of unmeterable properties in our area.

8.140 For the Internal/External Split, Fit to Install ratio data and details of this calculation, see Appendix N – Metering.

A note on Optants

8.141 Optants are meters that have been installed at the request of the customer. Customers who request a meter are typically lower water users or single occupancy dwellings who wish to minimise their bill. The volume of Optant customers is difficult to predict and reliably model. Consequently, Optant meters are not included in the demand reduction programmes but rather included as a fixed number removed from our baseline water demand forecast. Section 3 Demand details the volume of optant meters included in our dWRMP24.

Progressive Smart Upgrade Programme (Household)

Description

8.142 Our Progressive Smart Upgrade Programme for households (HH PSUP) refers to our proactive programme to upgrade 'basic' meters with 'smart' or AMI technology meters (Section Progressive Metering Programme

8.143 The definition of a basic meter is:

- **Basic Metering:** a conventional meter with a register dial. Meter reads are taken by a meter reader gaining physical access to the meter and visually recording the reading. Readings are manually entered into an electronic data capture device on site. Some data capture devices have bar code readers to check record and check the meter serial number.

8.144 HH PSUP reduces CSL directly. It also facilitates reductions in customer consumption through our Water Efficiency options of Section Digital Engagement and Section Smarter Home Visits

8.145 Prior to 2016, all meter installations were 'basic' meters. This included our PMP, new property and asset maintenance programmes.

8.146 Between 2016 and 2020 (WRMP14), we made the decision to phase out basic meters and install 'smart' meters on all PMP and new properties. Our asset maintenance programme continued to replace 'end of life' and faulty basic meters with new basic meters due to the minimal coverage of our WAN at the time, restricting smart meter roll out[29].

8.147 From 2021 (WRMP19), we have used 'smart' meters on all PMP, new property and asset maintenance installs. We also commenced our HH PSUP programme (previously called our proactive replacement programme) to proactively reduce the total volume of basic meters in our area.

Our dWRMP24 programme will continue to reduce the number of basic meters in our area to achieve our Ambition 1 – reduce leakage by 50% (from 2017-18 levels) by 2050, Ambition 3 – smart meter all practicable connections by 2035 and Ambition 8 – create a deliverable, resilient and ambitious programme. Together with our Water Efficiency options, PSUP will also contribute to Ambition 2 – maximise feasible PCC reductions by 2050, Ambition 5 – wipe out wastage by 2050 and Ambition 6 – minimise impact on customer bills.

Benefits

8.148 Household PSUP results in a CSL saving because smart meters provide real time information on water demand at each property.

8.149 When a meter is fitted through our PSUP, it will identify whether there is continuous flow of water on the property. Continuous flow is where the flow rate does not drop below a minimum consistently for several days. Continuous flow on an external meter indicates the customer either has a CSL or wastage within their property. For external properties, our leakage teams will visit properties with continuous flow over 5 l/hr to confirm whether it is CSL or wastage. Once it is proven as CSL, our repair team will either repair the CSL or relay the customer supply pipe.

[29] From 2018 in London, our asset maintenance programme began to replace basic meters with smart meters.

8.150 Continuous flow on an internal meter indicates the customer has wastage within their property. We have still included internal installations as part of our PSUP due to the reductions that can be made through Digital Engagement.

8.151 To calculate the CSL benefits of PSUP, we assume on average, that each install reduces CSL by 20 litres per day. This is based on the output of our Smart Meter Benefits Study[30]. This is a reduction on the volume of CSL we assumed in WRMP19 because we are finding in practice that our average savings from CSL are lower than we predicted in the previous plan. Since WRMP19 we have upgraded our understanding of the split between CSL and Wastage where we have found wastage makes up a higher proportion of continuous flow that we had assumed in WRMP19. This change in assumption is reflected in our lower assumptions about CSL and new ambition to wipe out wastage by 2050.

8.152 There is no direct additional household consumption (behaviour change and wastage) benefit associated with PSUP. This is because we assume basic meter customers have already reduced their consumption in response to being moved to a measured bill based on basic meter reads.

8.153 However, as they have previously only received basic meter reads at 6 to 12 month intervals, some customers may have outstanding wastage issues or changes in their behaviour that they could make to further reduce their consumption. Consequently, after a customer has gone through PSUP, we follow up with our Digital Engagement Programme. This programme is designed to assist customers to make further reductions in their household consumption by using their new smart meter data. The details of this option are in Digital Engagement.

Costs

8.154 There are four types of cost associated with our PSUP, the cost to install the meter, read the meter, fix any CSL and maintain the meter.

8.155 Meter installation costs consist of the cost to consult with the customer about the meter installation, install the meter and the cost of the meter itself. The cost to replace a basic meter with a smart meter does not require the additional cost to survey and is therefore cheaper than a PMP that requires a dig or internal installation with a survey.

8.156 The cost to repair any CSL detected from PSUP is based on whether the repair involves a repair of the existing pipe or full pipe relay. A full pipe relay is more expensive than a repair but has a longer asset life. We assume that 3% of installs will need funding for a CSL repair. We assume that 37% of CSL fixes are repairs to the supply pipe and 63% are replacements of the supply pipe. This is based on field data gathered throughout AMP6 and AMP7 while implementing our PMP and PSUP.

8.157 The meter installation and CSL repair costs for PSUP used in dWRMP24 are based on actual costs from AMP7 with a 6% uplift for inflation.

8.158 The cost to read an AMI meter is based on our SMOC[31], MDMS and Customer Experience recharge costs. The cost to install our fixed network has been covered in AMP7. The cost to read our meters is based on the number of meters installed each AMP.

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[30] Artesia Consulting, May 2022, 'Smart Metering Benefits Template_2022-05-18'

[31] The SMOC centre monitors the performance data from smart meters. The team has been established to recognise potential leaks at a customers' property, identify disproportionate consumption and identify where a meter has gone missing resulting in a drop in communications. In response, the SMOC team will proactively dispatch technicians to investigate meters that are not performing as expected and refer cases of suspected leakage onto our CSL repair team to facilitate a timely repair.

8.159 The cost to maintain our smart meters is based on the asset life of a smart meter. Based on the smart meter battery life, we assume smart meters installed up to 2040 need to be replaced every 15 years. Installs between 2040 – 2055 are assumed to have a 20 year life and installs after 2055 a 25 year life. We also assume that the cost of meter replacement and support costs decrease by 10% after 2040 and 20% after 2055 due to full smart meter penetration and technological advances.

8.160 The life of a CSL repair is assumed to be 20 years after which the customer supply pipe is relayed.

Maximum Deliverable Volume and Constraints

8.161 The maximum deliverable volume of PSUP is calculated based on two datasets:

- The number of basic measured properties at a point in time split by property type, and whether the meter has been installed internally or externally
- The likelihood of successfully upgrading the basic meter to a smart meter at that property

8.162 For dWRMP24, we have taken the number of measured properties at 2024-25. This assumes we will have undertaken our AMP7 metering programme of PSUP. For details of our AMP7 programme see Section 3 – Demand Forecast.

8.163 To calculate the maximum deliverable volume, we then apply our Survey to Fit Ratios to the basic meter properties at 2024-25.

8.164 The Survey to Fit Ratio is based on data from AMP7. This represents the number of PSUP visits we undertook compared with our successful meter upgrades for each property type. We use this information to predict the likely total volume of PSUP. If the maximum deliverable volume is greater than one million meters, we will consult with our delivery teams and contractors to determine a deliverable and an ambitious level of metering that can be achieved each AMP. This ensures we create a deliverable and realistic metering upgrade programme.

For the properties which cannot be upgraded under our PSUP, we have included our Metering Innovation Solutions.

Maximum Deliverable Volume and Constraints

8.165 The maximum deliverable volume of bulks and mini bulks is calculated based on two datasets:

- The number of potential bulks and mini bulks. This number is supplied by our field teams
- The likelihood of successfully installing a bulk or mini bulk at that location

8.166 For dWRMP24, we have taken the number of potential bulks expected at 2024-25. This assumes we will have undertaken our AMP7 metering programme of bulks and mini bulks. For details of our AMP7 programme see Section 3 – Demand Forecast.

8.167 To calculate the maximum deliverable volume, we then apply our Survey to Fit Ratios to the possible bulks and mini bulks.

8.168 The Survey to Fit Ratio is based on data from AMP7. This represents the number of bulk and mini bulk visits we undertook compared with our successful installations. We use this information to predict the likely total volume of bulks and mini bulks. If the maximum deliverable volume is greater than 50,000 meters, we will consult with out delivery teams and contractors to determine a deliverable and an ambitious level of installations that can be achieved each AMP. This ensures we create a deliverable and realistic metering upgrade programme.

8.169 For the Survey to Fit ratio data and details of this calculation, see Appendix N – Metering.

8.170 The section on Metering Innovation describes our approach to target these properties and minimise the number of unmeterable properties in our area.

8.171 For the Survey to Fit ratio data and details of this calculation, see Appendix N – Metering.

Bulk and Mini Bulk Metered Areas

Description

8.172 Bulk Metering refers to the installation of a large smart meter, usually fitted to a block of flats, to detect supply pipe leakage.

8.173 There are two types of bulk metering in dWRMP24, bulk metered areas and mini bulk metered areas:

Bulk Metered Area (BMA)

- Feeds **25 or more** properties
- Can supply multiple buildings
- Can have multiple supplies to the BMA
- Involves longer and/or more complex pipework (>20m of pipe in London, >50m of pipe in Thames Valley)
- Can included metered and unmeasured and household and non-household properties within the BMA

Mini Bulk Metered Area (mBMA)

- Feeds **up to 25** properties
- Supplies one building only[32]
- Single supply to the mBMA only
- Simple pipe work feeding multiple dwellings in one building (<20m of pipe in London, <50m of pipe in Thames Valley)
- Can included metered and unmeasured and household and non-household properties (particularly sites with flats over a business premises) within the mBMA

8.174 The meter fitted to a BMA or mBMA for leakage detection is non-revenue. This means it will measure the water supplied but the meter will not be used for billing. Individual premises within a BMA or mBMA may have individual meters on which they are billed.

8.175 A BMA or mBMA cannot be created if supplies into the area are already metered with meters used for billing or if the area is fed from more than one DMA.

8.176 Figure 8 - 14 shows the decision tree to define a BMA or mBMA.

[32] Exception – Terrace houses of up to 4 properties

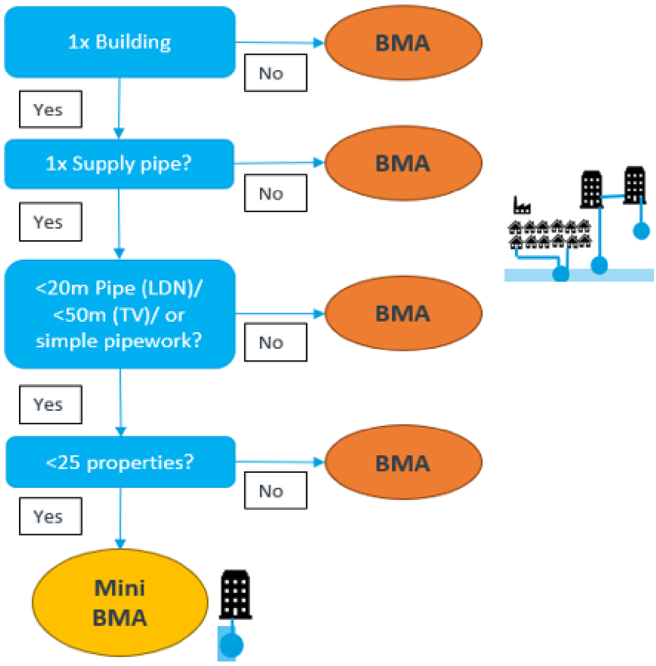

Figure 8 - 14 – Decision tree for a BMA or mBMA

8.177 There is a leakage reduction associated with bulk metering due to the increased ability to detect leakage on the shared supply pipe.

8.178 There is not a direct household consumption reduction because non-revenue bulk metered customers are not billed from the bulk meter, and BMAs and mBMAs can include a mix of household and non-household customers. Bulk metering does facilitate customer consumption reduction indirectly through our Water Efficiency option of Household Innovation and Tariffs (Section on Smarter Home Visits).

8.179 BMA and mBMAs will be deployed with two priorities, to reduce supply pipe leakage and to meter all meterable connections in our network.

8.180 In this way, our bulk meter programme contributes to Ambition 1 – reduce leakage by 50% (from 2017-18 levels) by 2050, Ambition 3 – smart meter all practicable connections by 2035, Ambition 7 – minimise carbon cost and Ambition 8 – create a deliverable, resilient and ambitious programme. Together with our Water Efficiency interventions, out bulk metering programme can also contribute towards Ambition 5 – wipe out wastage by 2050

Benefits

8.181 The volume of CSL that can be found from bulk installations is defined by two areas:

- Leakage led activity
- Normal activity

8.182 Leakage led activity is where we employ a specialist contractor to identify areas of high leakage and pin point BMAs which may have high levels of CSL. A bulk meter is installed, and the contractors finds and fixes the CSL.

8.183 Normal activity is where we aim to install a bulk on all practical bulk connections. We do not target leakage in that area first.

8.184 Leakage led activity achieves a higher CSL reduction per bulk meter install than normal activity. Based on our field data from AMP7, 43% of bulk meters installed due to leakage led activity have a CSL. The CSLs repaired are also substantial with the average size of leak being 36,501 litres/day.

8.185 In comparison, only 2.8% of bulk meters installed under normal activity have a CSL. The CSLs repaired are also much smaller with the average size of leak being 5,599 litres/day.

8.186 The volume of CSL found from mini bulk installations is also based on our field data from AMP7. This shows that 2.8% of mini bulk meters installed will have a CSL and that once that CSL is repaired it will save 1,306 litres/day.

Costs

8.187 There are six types of cost associated with our bulks, the cost to survey, install the meter chamber, install the meter, undertake the leakage led activity, fix any CSL and maintain the meter.

8.188 There are four types of cost associated with our mini bulks, the cost to survey, install the meter, fix any CSL and maintain the meter.

8.189 The cost to repair any CSL detected from bulks or mini bulks is based on whether the fix involves a repair of the existing pipe or full pipe relay. A full pipe relay is more expensive than a repair but has a longer asset life.

8.190 The meter installation and CSL repair costs for bulks used in dWRMP24 are based on actual costs from AMP7 with a 6% uplift for inflation.

8.191 The cost to maintain our meters is based on the asset life of a smart meter. Based on the smart meter battery life, we assume smart meters installed up to 2040 need to be replaced every 15 years. Installs between 2040 – 2055 are assumed to have a 20 year life and installs after 2055 a 25 year life. We also assume that the cost of meter replacement and support costs decrease by 10% after 2040 and 20% after 2055 due to full smart meter penetration and technological advances.

8.192 The life of a CSL repair is assumed to be 20 years after which the customer supply pipe is relayed.

Maximum Deliverable Volume and Constraints

8.193 The maximum deliverable volume of bulks and mini bulks is calculated based on two datasets:

- The number of potential bulks and mini bulks. This number is supplied by our field teams
- The likelihood of successfully installing a bulk or mini bulk at that location

8.194 For dWRMP24, we have taken the number of potential bulks expected at 2024-25. This assumes we will have undertaken our AMP7 metering programme of bulks and mini bulks. For details of our AMP7 programme see Section 3 – Demand Forecast.

8.195 To calculate the maximum deliverable volume, we then apply our Survey to Fit Ratios to the possible bulks and mini bulks.

8.196 The Survey to Fit Ratio is based on data from AMP7. This represents the number of bulk and mini bulk visits we undertook compared with our successful installations. We use this information to predict the likely total volume of bulks and mini bulks. If the maximum deliverable volume is greater than 50,000 meters, we will consult with out delivery teams and contractors to determine a deliverable and an ambitious level of installations that can be achieved each AMP. This ensures we create a deliverable and realistic metering upgrade programme.

8.197 For the Survey to Fit ratio data and details of this calculation, see Appendix N – Metering.

Metering Innovation

Description

8.198 Ofwat, Defra, the Greater London Authority (GLA) and CCW (previously the Consumer Council for Water) have all stated support for metering as the fairest way for customers to pay for water.

8.199 Metering also has broad customer support, recognising that it is fair to pay according to how much water is used.

8.200 The sections on Progressive Metering Programme and Progressive Smart Upgrade Programme (Household) demonstrated our maximum deliverable volume of household metering given the current deliverability and technological constraints.

8.201 However, to meet our ambition 3 – smart meter all practicable connections by 2035 and ambition 4 – minimise unmeterable properties by 2040 and, to ensure fairness in billing with the introduction of Tariffs (Household Innovation and Tariffs) we need to go beyond the current maximum deliverable volume of metering.

8.202 Metering Innovation has been introduced as a new option in dWRMP24 to quantify our path to achieve this long term metering ambition.

8.203 Metering Innovation has two workstreams; Metering Innovation (PMP), properties that haven't been metered following PMP and Metering Innovation (PSUP), properties that haven't been metered following PSUP.

8.204 The number of meter installations possible is currently constrained in two areas:

- No Access: properties where the customer is not available or will not provide permission for us to access their property and install a meter (either internally or externally)
- Unmeterable: properties where it is impractical or a health and safety risk to provide an installation. Examples of an unmeterable property include where:
  - More than two water meters per supply are required to calculate the consumption
  - There is a communal hot water supply
  - Substantial alterations to the pipework would be needed
  - It is unreasonably expensive to do so, defined as where the total cost exceeds a 50% uplift on the standard cost
  - The meter cannot be accessed or maintained after fitting
  - The installation would create an unacceptable health and safety risk for the technicians installing the meter or for the customer

8.205 Metering Innovation will reduce the number of No Access and Unmeterable properties in our area. We plan to do this by:

No Access Innovation

- Compulsorily metering properties when customers vacate or move into a property
- Extending our access to customer support to arrange a metering install appointment. This will include improving our call centre availability and reduction in waiting time to speak to a customer centre representative
- Extending our operating hours to offer customer metering installation appointments outside of normal working hours on weekdays and during weekends without additional charges
- Covering a portion of the cost of reinstatement works where an external meter installation impacts a customers' driveway or garden
- Investigating the introduction of a higher tariff for 'no access' customers

Unmeterable Innovation

- Employing innovative and emerging technological solutions to meter customers who are considered unmeterable. This may include the installation of new smaller meters for properties where there is limited space. Or, to employ new innovative ways to meter areas with shared hot water supplies or those which require multiple meters
- Seeking funding approval from our regulators to increase the limit of an unreasonably expensive install from the total cost exceeding a 50% uplift on the standard cost to the total cost exceeding an 80% uplift on the standard cost. This will substantially increase the average unit cost of metering for these installations but will enable a greater portion of unmeterable customers to become metered

AMP8 Investment in Innovation Trials

- The technology and approach to achieve our ambition for Metering Innovation is either emerging or is yet to be developed
- It is critical to understand the emerging technology and approaches to metering to ensure the deliverability of Metering innovation in our plan
- In AMP8, we will invest in trials of innovative technology and metering approaches. This will test and demonstrate the most cost effective innovative solutions available prior to their full implementation in later AMPs

8.206 At the conclusion of our Metering Innovation PMP, we expect to reduce the number of properties without a meter in our area from over 1.2 million to 308,000. Of these 308,000, 17,000 are No Access properties and 291,000 are physically unmeterable properties.

8.207 This means we expect our metering innovation PMP programme to install an **additional 900,000 meters**. This will achieve all eight of our ambitions, but especially, Ambition 6 - minimise impact on customer bills. This will ensure fairness in billing across our customer base.

Benefits

8.208 The benefits of Metering Innovation – PMP are broken down into No Access properties and Unmeterable properties.

8.209 No Access properties achieve a household consumption reduction only as they are all internal meter installs.

8.210 Unmeterable properties achieve a household consumption reduction and CSL benefit as they include internal and external installs.

8.211 The benefits applied for household consumption are those from our Smart Meter Benefits Study where the average saving from a new smart meter install is a 13% reduction in consumption (Progressive Metering Programme).

8.212 The benefit applied for a CSL saving is also sourced from our Smart Meter Benefits Study and assumes the same saving as PSUP, that on average each meter saves 20 litres per day in CSL.

8.213 The benefits of Metering Innovation - PSUP are also broken down into No Access properties and Unmeterable properties.

8.214 However, these are all internal installs and therefore include a benefit for household consumption reduction only. This benefit will not be realised until these customers go through Digital Engagement. The cost of Digital Engagement to realise these savings in addition to Metering Innovation PSUP installation costs has been included for this option.

Costs

8.215 The cost of Metering Innovation, PMP and Metering Innovation, PSUP are based on the costs of PMP and PSUP with an uplift of 1.5 times and 2 times respectively.

8.216 The uplift for Metering Innovation PMP and PSUP reflects the out of hours working and additional communication required to secure and appointment with the customer to gain access for a meter installation.

8.217 The higher uplift for Metering Innovation PSUP is due to the internal installation programme. These are high level assumptions which pose a conservative position for our plan. They do not include potential cost efficiencies from technological advances in the future which may reduce this cost.

8.218 The cost to maintain our smart meters is based on the asset life of a smart meter. Based on the smart meter battery life, we assume smart meters installed up to 2040 need to be replaced every 15 years. Installs between 2040 – 2055 are assumed to have a 20 year life and installs after 2055 a 25 year life. We also assume that the cost of meter replacement and support costs decrease by 10% after 2040 and 20% after 2055 due to full smart meter penetration and technological advances.

Maximum Deliverable Volume and Constraints

8.219 The maximum deliverable volume for Metering Innovation is calculated based on:

- PMP: The number of unmeterable properties remaining at the conclusion of the PMP. These unmeterable properties are broken down into ‘No Access’ and ‘Unmeterable’ (meaning physically unmeterable) and how many of these are internal or external installations
- PSUP: The number of unmeterable properties remaining at the conclusion of the PSUP. These unmeterable properties are broken down into ‘No Access’ and ‘Unmeterable’ (meaning physically unmeterable). These are all internal installs
- The likelihood of successfully installing a meter at the PMP or PSUP property

8.220 For dWRMP24, we have calculated the maximum deliverable volume using the following assumptions. These have been sourced from expert judgement from technical management and our delivery teams from their experience delivering PMP and PSUP in AMP6 and 7:

- Assume we can resolve 95% of No Access properties using innovative approaches to engage with customers and facilitate access for a PMP installation
- Assume we can install meters on 90% of PMP Unmeterable External properties and 58% of PMP Unmeterable Internal properties using innovative technology
- Assume we can install meters on 95% of PSUP Unmeterable Internal properties using innovative technology

8.221 For the Internal/External Split, Fit to Install ratio data and details of this calculation, see Appendix N – Metering.

Progressive Smart Upgrade Programme (Non-household)

8.222 Our Progressive Smart Upgrade Programme for non-households (NHH PSUP) refers to our proactive programme to upgrade 'basic' meters with 'smart' or AMI technology meters (Section Progressive Metering Programme

8.223 This is a new feasible option for dWRMP24.

Benefits

8.224 The benefits of NHH PSUP are based on the output of our NHH model[33].

8.225 This model first calculated the average consumption from NHH PSUP based on the size of the property meter. The volume saved was based on data from the Market Operator Services Ltd (MOSL) data from 2019.

8.226 The household consumption reduction was calculated assuming that 0.5% of the total consumption would be reduced following NHH PSUP.

8.227 The CSL benefit from NHH PSUP was calculated assuming that a certain percentage of the total consumption was leakage based on the size of the property meter and then assuming 50% of this volume could be reduced.

8.228 This gave both a household consumption reduction and CSL reduction associated with NHH PSUP.

Costs

8.229 There are four types of cost associated with our NHH PSUP, the cost to install the meter, read the meter, fix any CSL and maintain the meter.

8.230 Meter installation costs consist of the cost to consult with the customer about the meter installation, install the meter and the cost of the meter itself. The cost to replace a basic meter with a smart meter does not require the additional cost to survey and is therefore cheaper than a PMP that requires a dig or internal installation with a survey.

8.231 The cost to repair any CSL detected from NHH PSUP is based on whether the repair involves a repair of the existing pipe or full pipe relay. A full pipe relay is more expensive than a repair but has a longer asset life. We assume that 3% of installs will need funding for a CSL repair. We assume that 37% of CSL fixes are repairs to the supply pipe and 63% are replacements of the supply pipe. This is based on field data gathered throughout AMP6 and AMP7 while implementing our PMP and PSUP.

[33] Artesia consulting, 20th May 2022, 'NHH Meter Calculator_Artesia_Thames Numbers_10th May 22'

8.232 The meter installation and CSL repair costs for NHH PSUP used in dWRMP24 are based on actual costs from AMP7 with a 6% uplift for inflation.

Maximum Deliverable Volume and Constraints

8.233 The following assumptions have been applied to calculate the maximum deliverable volume of NHH PSUP:

- Assumed all externals are 100% successfully replaced
- Assume a Survey to Fit ration of 73.4% for internal installs. This number has been based on technical management expert judgement
- Assume that we will upgrade some basic meters before the end of their asset life (they will be less than 14 years old). This assumption was included by technical management expert judgement to enable a great volume of these upgrade to be prioritised earlier in the programme
- Assume that 10% of all external PSUP will be digs in the case where a boundary box has been buried

Feasible Options - Water Efficiency

8.234 Water Efficiency is critical to reduce household and non-household consumption. It has received strong support from our customers as a priority, second only to leakage. There are eight feasible Water Efficiency options. These are summarised in Table 8 - 5.

Option		CSL Reduction	Household Behavioural Use Reduction	Household Wastage Reduction	Non-Household Reduction	WRMP19 or New
8	Digital Engagement		Yes	Yes		New
9	Household Innovation and Tariffs		Yes	Yes		WRMP19
10	SHVs – PMP		Yes			WRMP19
11	SHVs – Optants		Yes			WRMP19
12	SHVs – PSUP		Yes			WRMP19
13	Wastage Fix			Yes		WRMP19
14	Green Redeem		Yes			WRMP19
15	Smarter Business Visits				Yes	WRMP19

Table 8 - 5 – Feasible Water Efficiency Options

Where do water efficiency savings occur?

8.235 Water Efficiency options can reduce customer behavioural usage and wastage. This applies to both household and non-household customers. Figure 8 - 15 illustrates where these savings occur. Water Efficiency savings occur in the home downstream of the internal stop tap. This includes pipework that extends outdoors for customers with a garden.

8.236 Change in water use behaviour refers to the changes customers' make to their discretionary water use in response to one of our water efficiency options. Wastage repairs refer to the repair of wastage issues in the home, either by the customer or through one of our free water efficiency wastage repairs for toilets and taps.

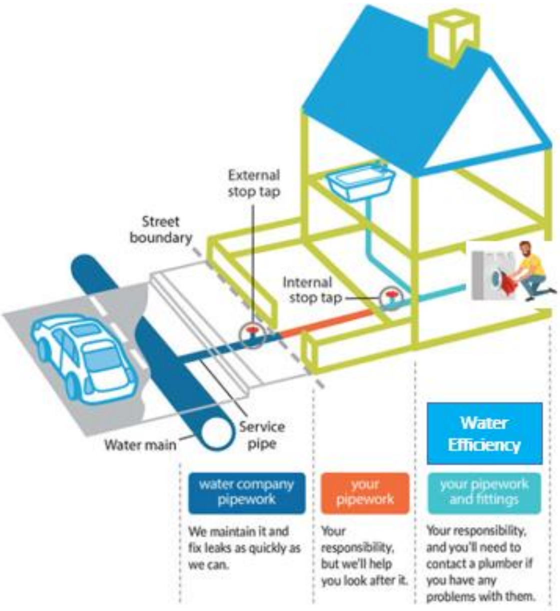

Figure 8 - 15 – Water pipes and ownership, Water Efficiency [34]

8.237 The remainder of this section (Feasible Options - Water Efficiency) details the demand reduction volume, cost, and constraints for each feasible water efficiency option.

8.238 This information is used to calculate the volume of water efficiency in each demand reduction programme (Creating Demand Reduction Programmes).

8.239 Further technical detail is in Appendix R, Scheme Dossiers.

Digital Engagement

Description

8.240 Digital Engagement is a new feasible option for dWRMP24.

8.241 Digital Engagement will provide smart metered customers with continuous access to their own water consumption data.

8.242 Presently, it is our policy to provide household consumption data to customers where available on request. Smart meter customers can request their historic and/or ongoing consumption data through our Providing Digital Media Data service. Basic meter customers can request to see their historic meter reads.

8.243 Digital Engagement will substantially improve on this system in two ways:

Digital Engagement Portal

8.244 We will create a digital engagement portal to enable customers to log on and access their smart meter data at their convenience. The portal will allow customers to track both their water consumption and cost throughout each day. This will allow customers to easily identify areas where they could save water or money on their bills.

[34] Sourced from Discover Water UK, www.discoverwater.co.uk/leaking-pipes

8.245 We envisage the digital portal will evolve into a system like the gas and electricity industry. Where, together with a smart meter, customers receive an in-home portal that quickly and easily displays consumption throughout the day.

Digital Engagement Advice

8.246 To assist customers with the interpretation of their smart meter data, Digital Engagement will also provide data assessment and advice. This will be an option which can be selected as part of the portal.

8.247 Digital engagement advice on the portal will:

- Identify which proportion of consumption may be a leak or internal wastage issue
- Identify peak periods of behavioural usage and recommend water saving tips
- Provide context of a customers' consumption impact on the environment. And provide context for the environmental benefits for water saved
- Provide advice to find and fix leakage or wastage issues within the home
- Encourage customers to maintain their previous water savings by highlighting any subsequent increase
- Alert customers when they are entering the 'high use' category of consumption

8.248 Digital Engagement is critical to engage a wider proportion of our customers in the long term in a cost efficient and effective manner.

Digital Engagement is a key option to meet ambition 2 – maximise feasible PCC reduction by 2050 and ambition 5 – wipe out most wastage by 2050.

Benefits

8.249 We have assumed that with Digital Engagement, customers will reduce their behavioural use and therefore their overall consumption following PSUP. We have based these savings on Anglian Water's smart meter study which showed PSUP result in 3% reduction in measured consumption. Without access to the detail of this study, we have been conservative and applied two thirds of this value, or 2% reduction to basic meter measured consumption. This assumes customers will still make the wastage savings but also greatly reduce their behaviour driven use in response to Digital Engagement.

8.250 Digital Engagement is critical to engage a wider proportion of our customers in the long term in a cost efficient and effective manner. It is a key option for meeting ambitions for PCC reduction and wastage reduction.

8.251 Digital Engagement will build upon the benefits provided by smart metering (Progressive Metering Programme, Progressive Smart Upgrade Programme and those customers who have opted to have a meter installed). The access to continuous water consumption data is an improvement on what is currently available for customers.

8.252 The consumption data and advice provided through the digital engagement portal will enable easier identification of the which parts of consumption may be from leakage or internal wastage. The advice will further enable customers to find and fix leakage and wastage issues which their usage data suggests may exist.

Costs

8.253 The cost of Digital Engagement is based on three costs:

- The original set up cost. This is £200,000 based on our Smart Meter Portal forecast[35]. This is a one off cost incurred in AMP8
- The annual IT contingency cost. This is £50,000 per annual based on our Smart Meter Portal forecast[36]. This is an annual cost
- Ongoing annual fee costs. These are calculated based on the number of expected participants engaged in Digital Engagement

8.254 Digital Engagement is one of our most cost beneficial solutions.

Household Innovation and Tariffs

8.255 Household Innovation and Tariffs encompasses our innovative household activity and future tariffs implementation.

Household Innovation Description

8.256 We have six potential solutions within this demand option, half of which are new for dWRMP24. The critical solution is the first one, AMP8 Water Efficiency Innovation Trials. The viability and practicality of the other innovation solutions relies on AMP8 investment in trials.

8.257 Household innovation is key to achieve our ambition 2 – maximise feasible PCC reductions by 2050, ambition 5 – wipe out most wastage by 2050.

AMP8 Water Efficiency Innovation Trials (new)

8.258 The technology and approach to reduce household consumption through innovation is either emerging or yet to be developed.

8.259 In AMP8, we will invest in trials of both emerging approaches and technology to test and demonstrate the most cost efficient and viable innovative solutions available to achieve long term, sustainable reductions in household consumption (PCC).

8.260 Due to its importance in our vision for the long term future of efficient use of water, we will specifically invest in a trial of non-potable solutions in AMP8 as a key milestone to achieve our 2050 vision.

Wipe out most Wastage (new)

8.261 Our smart meter data (Progressive Metering Programme) has shown that a greater proportion of consumption is wastage compared with the volume assumed in WRMP19.

8.262 This means that, even after we have completed our PMP, SHVs, Wastage Fixes and conducted Digital Engagement, some customers will still have internal wastage issues. This solution is to find innovative ways to understand and approach these customers to repair their wastage issues (Figure 8 - 16).

[35] Thames Water, March 2021, 'Smart Meter Portal Forecast'.
[36] Thames Water, March 2021, 'Smart Meter Portal Forecast'.

Figure 8 - 16 – Customer wastage fix campaign

8.263 This solution is key to reach ambition 5 – wipe out most wastage by 2050.

Non-Potable Water Supplies

8.264 Non-potable water is water that is not of drinking water quality, but that can be used for other purposes such as toilet flushing, laundry and garden watering to reduce the total demand on potable supply.

8.265 In dWRMP24, we have considered schemes which are a combination of rainwater harvesting, stormwater harvesting and greywater recycling.

Water Efficiency on Bulk Metered Areas (BMAs) and mini-Bulk Metered Areas (mBMAs, new)

8.266 BMAs and mBMAs may be non-revenue or revenue. Non-revenue BMAs are smart metered for leakage detection (see section - Bulk and Mini Bulk Metered Areas) and may include individually metered dwellings within the BMA.

8.267 Revenue BMAs meter the supply to a multi occupancy building for the purposes of billing the building landlord or managing agent. We do not have meters installed on individual premises within that building.

8.268 This solution involves conducting an SHV and, where required, a wastage repair on dwellings within revenue and non-revenue BMAs. This solution will specifically focus on those dwellings without a meter. This is a new option for dWRMP24 regarding revenue BMAs.

Media campaigns

8.269 Intensive area based media campaigns are designed to raise awareness about water resources and water efficiency solutions in specific locations throughout our supply area.

8.270 In WRMP19 these were designed with overarching messages that congratulated specific areas for saving water.

8.271 In dWRMP24, we revisit these campaigns to provide more focus to link water savings with environmental value and protection in the local area and include the promotion of local activities to help save water.

8.272 Media campaigns in the shorter term will raise awareness of all Water Efficiency activity and assist to increase the take up of our specific water saving initiatives.

New Water Efficiency Innovation

8.273 Although we have an indication of the types of future household innovation, there are solutions that are yet to be conceptualised.

8.274 Our new water efficiency innovation category includes these solutions and makes an allowance in our plan for solutions that will be discovered and developed in the future.

Tariffs Description

8.275 Tariff or pricing controls have potential to be an effective strategy for demand reduction if the water rate structures contain strong incentives to conserve water. This view is supported by behavioural economic theory which indicates consumers may respond to economic incentives by changing their behaviour to maximise their economic self-interest.

8.276 Tariff charging to encourage water conservation can be implemented by reforming water rates, introducing surcharges or establishing penalties to deter high water or wasteful water practices.

8.277 In WRMP24, we plan to introduce tariffs in 2035, once meter penetration is sufficient to ensure fairness in billing to customers.

Benefits and Costs

8.278 The benefit of household innovation and tariffs has been estimated based on technical expert assumption and the results of our Smart Meter Benefits study.

8.279 Our Smart Meter Benefits study showed that customers measured by a smart meter still consume a significant volume of water from their behavioural use. They also still have a volume of wastage in the home (Figure 8 - 17).

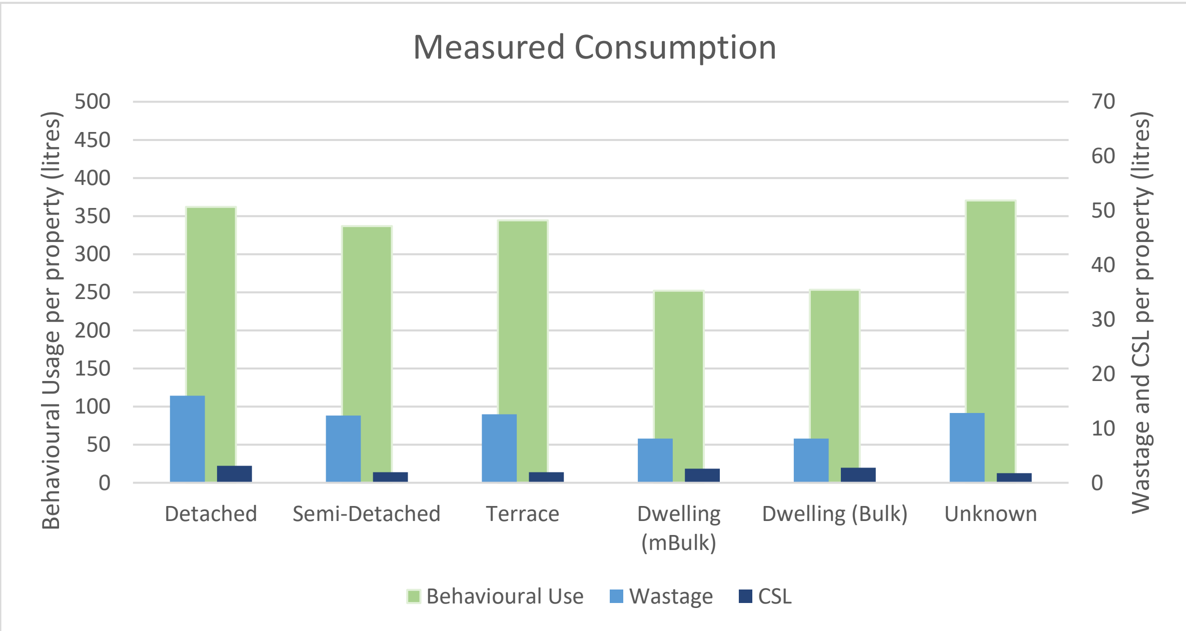

Figure 8 - 17 – Measured consumption from Smart Meter Benefits Study

8.280 Our assessment of the volume that can be saved from household innovation and tariffs assumes that customers can reduce their behavioural use, especially in response to tariffs. For example, a measured terraced property consumes 345 litres per day of water from behavioural use and 13 litres per day in wastage. This volume could be reduced by almost eliminating the wastage and making some more personal changes to save a further 10 – 30 litres per day per terraced property.

8.281 It must be noted that the figures quoted here assume these customers have had no other water efficiency activity applied. Once a measured customer receives an SHV or wastage repair their average behavioural use and wastage volumes will be less than is presented in Figure 8 - 17.

8.282 In forecasting our savings from household innovation and tariffs we have been careful to ensure we have not double counted our savings from metering and other water efficiency. This has allowed us to be ambitious in our PCC reductions, but we also have some idea how we are going to achieve these savings, are not wholly reliant on solutions which have not been developed yet and we have been diligent to ensure these savings do not overlap. This is critical to ensure we meet our ambition 8 – create a deliverable, reliable and ambitious programme.

Smarter Home Visits

Description

8.283 An SHV includes a free home visit by one of our qualified staff to install water saving devices and provide personalised water saving advice to households. It includes an App which our advisors use to produce a tailored water savings report for every customer. This report helps customers to quantify their potential water, energy, and money savings from changing their water use behaviour in the home. SHVs are the most intensive and face-to-face communication we have with our customers about water use.

8.284 SHVs are offered to customers' who are newly smart metered through our PMP, PSUP or Optant programmes.

8.285 In WRMP19, we also offered SHVs to unmeasured and basic metered properties. In dWRMP24 the volume of unmeasured properties has drastically reduced as we approach the conclusion of our PMP and complete the majority of our PSUP installs in AMP8. Water Efficiency activity on the unmeasured and basic metered properties that remain is covered by Digital Engagement.

8.286 An SHV contributes to our ambition 2 – maximise feasible PCC reduction by 2050 and ambition 6 – minimise impact on customer bills.

Benefits and Volume

8.287 SHVs are offered to both High Users and Normal uses. The proportion of high users is based on our AMP7 data analysis and includes:

- High users from PMP = 29.39%
- High users from Optants = 10.73%
- High users from PSUP = 20.40%

8.288 The remaining proportion of PMP and PSUP are assumed to be normal users. Optants only target high users for an SHV as Optants are traditionally lower water consumers prior to having a meter installed.

8.289 Not all metered customers will take up the offer of an SHV. Our uptake rates for an SHV have been applied based on the uptake rates seen through activity in AMP7. These are:

- High users and Normal users' uptake an SHV = 21.67%
- This is based on the average between our current AMP7 uptake rate of 13.33% and our future aspirational rate of 30%

8.290 The benefit of an SHV is the same for all three workstreams, PMP, Optants and PSUP. The benefit of an SHV is based on field data that we have collected throughout AMP7. The assumed saving in customer behavioural change from an SHV is:

- High Users = 70.5 litres per day
- Normal users = 37.94 litres per day

8.291 These figures are based on the analysis of 241,345 properties who received an SHV between 2019 and 2021.

8.292 In comparison with WRMP19, the benefits from SHVs have increased. In WRMP19, we assumed each SHV saved 37 litres per day. In WRMP19 we did not target high users', so this figure is comparable to our dWRMP24 normal users saving which is within the same range. The consistency of our WRMP19 and dWRMP24 assessment give us confidence that these savings are accurate and reliable.

Costs

8.293 The cost of an SHV is based on the unit rate per visit. This is based on contractor quotes for 2022-23.

Wastage Fixes

Description

8.294 Wastage Fixes are offered to customers following an SHV if they are found they have a leaking toilet or tap.

8.295 This demand option is critical to achieve our ambition 5 – wipe out most wastage by 2050.

Benefits and Volume

8.296 The volume of wastage fixes is based on figures achieved through our AMP7 programme.

8.297 The number of wastage fixes is based on the uptake rate. It is found that 10% of SHVs will identify the need for a wastage repair. Of these:

- 72% are leaking toilets
- 14% are leaking taps
- 14% are smaller leaks that are not claimed under our wastage fixes demand option

8.298 The average saving achieved from these wastage fixes is:

- Leaking toilet repair = 234 litres per day
- Leaking taps repair = 136 litres per day

8.299 These figures are based on the analysis of data from over 12,000 properties who received a water efficiency wastage fix over the latter six month period of 2021-22.

8.300 In comparison with WRMP19, the benefits assumed from a leaking toilet have slightly increased. In WRMP19, we assumed toilet repair saved 212 litres per day.

Costs

8.301 The cost of wastage repair is based on the unit rate per repair. This is based on contractor quotes for 2022-23 and assumes a rate increase in labour and materials.

Green Redeem

Description

8.302 Green Redeem is a scheme whereby customers are incentivised through non-financial offers to be more efficient with their water consumption.

8.303 It works by incentivising customers to use less water through awarding points that can be exchanged for money off vouchers, charity donations, prize draw entries and days out. We provide water reduction targets for customers based on their current usage and award points that may differ depending on whether they can reach their water saving target, whether they sustain the reduction in water usage and whether they exceed their target.

8.304 Green Redeem aims to influence customer behaviour through offering positive rewards.

8.305 This option achieves our ambition 2 – maximise feasible PCC reductions by 2050 and ambition 6 – minimise impact on customer bills

Benefits and Volume

8.306 It is assumed that 22% of SHVs will result in a Green Redeem sign up. This is based on our data from AMP7 experience.

8.307 Of those who sign up a 3% reduction is household consumption is assumed.

Costs

8.308 The cost of green redeem is based on the number of properties who sign up and a flat unit rate per year.

Smarter Business Visits

Description

8.309 A Smarter Business Visit (SBV) includes a free visit by one of our qualified staff to install water saving devices and provide personalised water saving advice to non-households.

8.310 Although we are no longer a retailer to business customers following the introduction of the non-household market in April 2017, non-household customers make up a significant proportion of demand in our supply area.

8.311 This demand option helps us achieve our ambition 5 – wipe out most wastage by 2050 and ambition 7 – minimise carbon cost.

Benefits and Volume

8.312 It is assumed that there will be a 10% uptake rate from businesses that are offered an SBV. These visits are offered both through lettering and groundwork contact with the businesses.

8.313 This figure is based on our lettering in AMP7 to 9,854 businesses.

8.314 The average saving from an SBV is 2,724 litres per day. This is based on the average savings achieved from over 10,000 SBVs up to July 2021.

8.315 In comparison with WRMP19, the benefits from SBVs have doubled. In WRMP19, we assumed each SBV saved 1,316 litres per day. This was based on the average savings from SBVs of 350 businesses up to 2017. In the five years since, we have increased our SBVs to over 10,000 and found that the average saving from business is significantly higher. Due to the substantial increase in the sample size used for this analysis we are confident in the reliability and deliverability of our dWRMP24 saving.

Costs

8.316 The cost of SBVs is calculated based on a unit rate per visit based on costs from 2021-22 and quotes for future programmes of work.

A note on our baseline options

8.317 In dWRMP24, we identify water efficiency options that realise a direct demand reduction. We also quantify the activity required to maintain those savings throughout the planning period.

8.318 Water Efficiency reductions achieved prior to dWRMP24 will also deteriorate into the current planning period. To offset this deterioration, we include baseline water efficiency options in our plan. Baseline water efficiency options both maintain our water efficiency reductions and deliver on our statutory duty to promote the efficient use of water.

8.319 The options that form our baseline water efficiency activity are included in Section 3 and Appendix O: Water Efficiency.

Feasible Options - Leakage

8.320 There are three feasible Leakage options. These are in addition to the CSL reduction achieved by Metering (Feasible Options - Metering).

8.321 The leakage options are summarised in Table 8 - 6.

Option		Leakage Reduction	Household Behavioural Use Reduction	Household Wastage Reduction	Non-Household Reduction	WRMP19 or New
16	Advanced District Meter Area Intervention (Advanced DMAi)	Yes				New
17	Leakage Innovation	Yes				New
18	Mains Rehabilitation	Yes				WRMP19

Table 8 - 6 – Feasible Leakage Options

Asset Maintenance

8.322 Leakage reduction is a long term sustainable option that is achieved through innovative solutions such as Advanced District Meter Area Intervention and Leakage Innovation, and traditional solutions such as Mains Rehabilitation.

8.323 Leakage reduction can only occur when we maintain our existing level of leakage. This means we need to continually maintain our asset base to prevent asset deterioration and leakage recurrence.

8.324 To maintain our existing levels of leakage we undertake activity to reduce bursts, visible and active leaks, and deterioration on our distribution and trunk mains network. This activity is referred to as Asset Maintenance and will be detailed in our Price Review 2024 plan.

8.325 In dWRMP24, we assume in our baseline that our existing levels of leakage are maintained through Asset Maintenance so that our leakage feasible options can achieve a leakage reduction.

Where do leakage savings occur?

8.326 Leakage reduction occurs in three areas, the water main, the service pipe and the customer supply pipe. In dWRMP24, leakage savings from the customer supply pipe are achieved through Metering (Feasible Options - Metering). Leakage reduction from the distribution water main and service pipe are achieved through Advanced DMAi, Leakage Innovation and Mains Rehabilitation. Figure 8 - 18 illustrates where these savings occur.

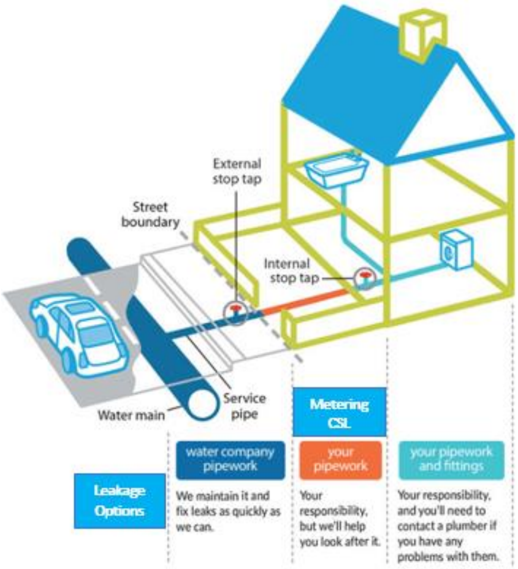

Figure 8 - 18 – Water pipes and ownership, Leakage [37]

8.327 Sections Advanced District Meter Area Intervention, Leakage Innovation and Mains Rehabilitation detail the demand reduction, cost, and constraints for each feasible leakage option. This information is used to calculate the volume of leakage in each demand reduction programme (Creating Demand Reduction Programmes). Further technical detail is in Appendix R, Scheme Dossiers.

Advanced District Meter Area Intervention

Description

8.328 Advanced District Meter Area Intervention (Advanced DMAi) is a new option for dWRMP24. It has evolved from our experience in implementing DMA Enhancement from WRMP19 and Enhanced Active Leakage Control from WRMP14. Advanced DMAi employs capital and operational activity to better understand water demand and pinpoint leaks within a DMA. The implementation of our Metering feasible options (Feasible Options - Metering) is critical to Advanced DMAi. The Advanced DMAi process is summarised in Figure 8 - 19.

[37] Sourced from Discover Water UK, www.discoverwater.co.uk/leaking-pipes

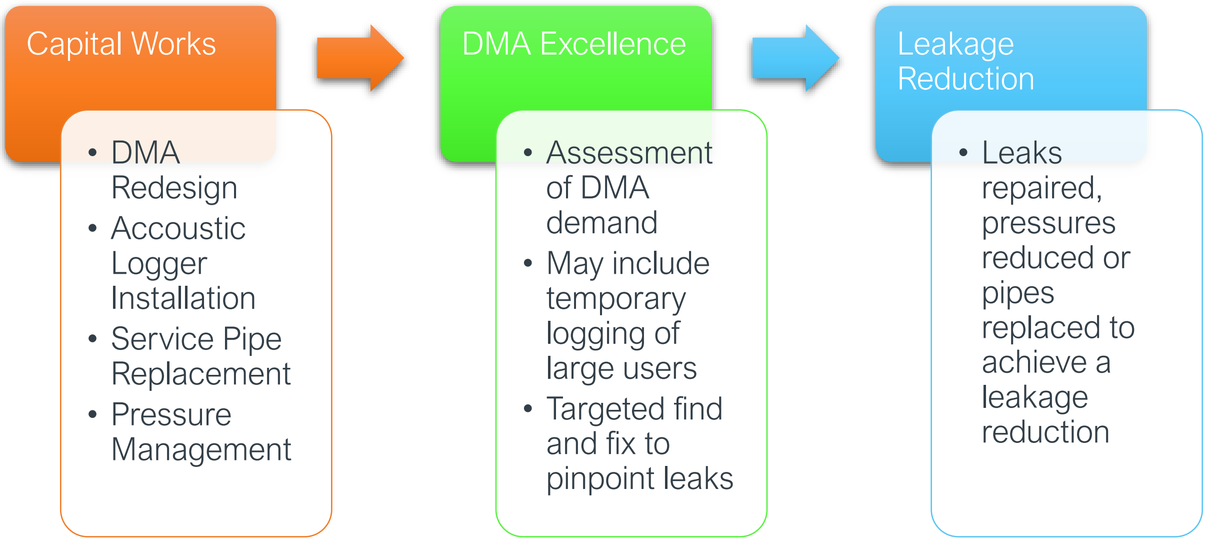

Figure 8 - 19 – Advanced DMAi Process Chart

8.329 The capital component of Advanced DMAi includes:

- DMA Redesign: capital work to redesign DMAs for leakage identification. This includes DMA splitting and reconfiguration via priority district meter relocation. In WRMP19, this was referred to as DMA Enhancement Plus.
- Acoustic logger installation
- Service pipe replacement
- Pressure Management: install new pressure management schemes within individual DMAs at sub-DMA level

8.330 The operational component of Advanced DMAi includes:

- DMA Excellence: operational component of the work following DMA Redesign
- This includes an assessment of demand in the DMA that looks at the assets, properties, and customer water demand. This may include temporary logging of large customers
- Traditional or innovative find and fix activity is then employed to pinpoint leaks. In WRMP19, this was referred to as DMA Enhancement activity

8.331 The final stage of Advanced DMAi is to fix the leaks identified to realise the leakage reduction.

DMA Redesign

8.332 DMA Redesign is a core component of Advanced DMAi and involves DMA splitting and reconfiguration.

8.333 DMA redesign is required because some DMAs are particularly large, making it inefficient to detect and pinpoint leaks.

8.334 Other DMAs are 'unavailable' for leakage detection due to inherent network configuration issues. For example, a broken district meter located on a major London bus lane may not be accessed for a long period of time due to the requirement for substantial traffic management. As a result, the affected DMAs would not be available for leakage detection and leaks may run undetected.

8.335 The health of a DMA is determined by four factors, the number of district meters, the throughflow of the DMA, the DMA property count and the km of pipe network. An example of a 'Good' compared to 'Poor' DMA design is shows in Figure 8 - 20.

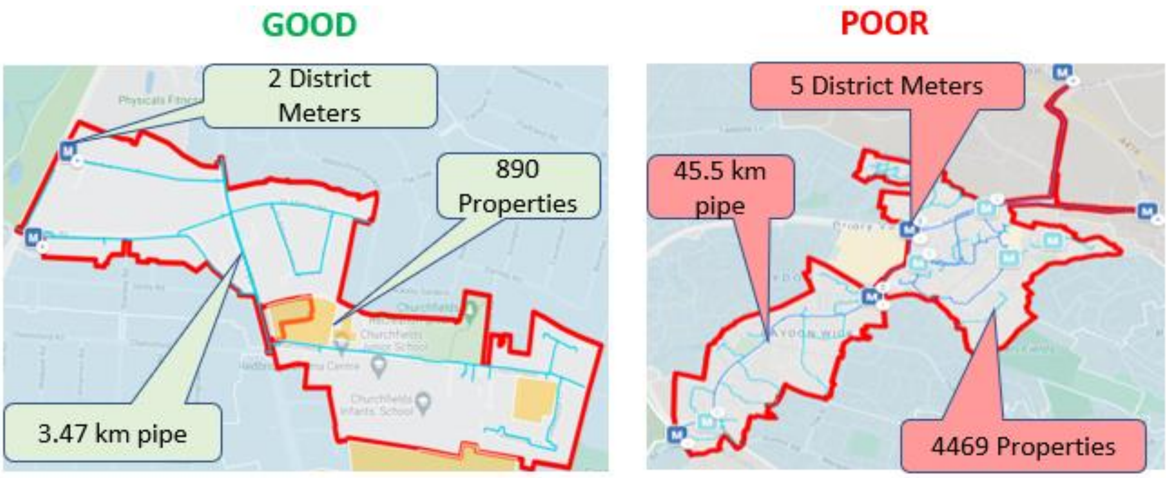

Figure 8 - 20 – DMA Redesign

8.336 The purpose of DMA redesign is to resolve and enhance long standing network issues and ensure key assets are more readily accessible. This will ensure DMAs will remain available and operable for leakage detection and repair.

8.337 Advanced DMAi helps to achieve ambition 1 – reduce leakage by 50% (from 2017-18 levels) by 2050, ambition 7 – minimise carbon cost and ambition 8 – create a deliverable, resilient and ambitious programme.

8.338 It also links with ambition 2 – maximise feasible PCC reductions by 2050 and ambition 5 – wipe out wastage by 2050 as it will allow us to identify higher than average water use in an area and ambition 6 – minimise impact on customer bills (in comparison to Mains Rehabilitation).

Benefits, Costs and Volume

8.339 Advanced DMAi volume and benefits have been based on technical expert assumptions from our Asset Management specialists. To do this, they have utilised their experience of AMP7 activity in DMA Excellence to forecast the benefits of our new option, Advanced DMAi.

8.340 The Advanced DMAi volume each AMP has been assessed on the volume we would like to achieve to meet our ambitious reductions for leakage into the future. These targets are based on our group assessment of potential opportunities across our area based on our experiencing implementing similar solutions in AMP7.

8.341 Based on the assumptions made, Advance DMAi is the most cost efficient of the Leakage only solutions, being cheaper than both Leakage Innovation and Mains Rehabilitation.

8.342 To maintain the savings from Advanced DMAi, it is assumed that one third of the leakage reduction achieve each AMP will reoccur within 15 years of the Advanced DMAi leakage fixes.

Further investment will then be needed within 40 years. This assumption is consistent with that of supply pipe leakage repairs.

8.343 The future cost of resolution of leakage reoccurrence is assumed to be 25% of the original cost of Advanced DMAi. This is included to ensure we are not under-estimating the costs of such a solution.

Leakage Innovation

Description

8.344 Leakage Innovation includes activities that provide a new and cost-efficient way to reduce leakage on our distribution mains network. Leakage Innovation is designed to be more cost efficient than Mains Rehabilitation.

8.345 Leakage Innovation includes activities that we are currently aware of and those that will be developed in the future.

8.346 Some of the activities included in Leakage Innovation are:

- Adoption of keyhole repair techniques
- Advancement of technologies for precise and accurate leak location – acoustics
- Advancement of technologies for precise and accurate leakage location – tracer gases
- New quality or design of joints so they are leak free – product development
- Advancement of technologies to repair pipes from the inside
- Enhanced detection equipment or innovation in detection
- Enhanced repair methods or innovation in repair methods

AMP8 Investment in Innovation Trials

8.347 The technology and approach to achieve our long-term leakage reduction ambition is either emerging or is yet to be developed. It is critical to understand the emerging technology and approaches to ensure the deliverability of Leakage Innovation in our plan.

8.348 In AMP8, we will invest in trials of innovative technology and leakage reduction and repair approaches. This investment is crucial to test and demonstrate the most cost effective innovative solutions available prior to their full implementation in later AMPs.

8.349 Leakage Innovation is key to achieve our ambition 1 – reduce leakage by 50% (from 2017-18 levels) by 2050 and ambition 8 – create a deliverable, resilient and ambitious programme and ambition 6 – minimise impact on customer bills (in comparison to Mains Rehabilitation).

Benefits, Costs and Volume

8.350 Leakage innovation volume and benefits have been based on technical expert assumptions from our Asset Management specialists. The Leakage innovation volume each AMP has been assessed on the volume we would like to achieve to meet our ambitious reductions for leakage into the future. This means we will investigate and trial innovative methods of leakage reduction from 2025 to develop and refine innovative methods of leakage reduction so they can be used in significantly greater volumes by 2035.

8.351 Leakage innovation is assumed to be more cost efficient than Mains Rehabilitation. However, we still expect it to reflect the increasing cost profile over time like that of mains rehabilitation. Therefore, we have assumed the cost of Leakage Innovation is 50% of the unit cost of Mains Rehabilitation. This assumes that leakage innovation will be able to achieve the same leakage reduction as mains rehabilitation using innovative methods to reduce overall cost. For example, repairing leaks from within a pipe to avoid the costs of traffic management and digging in a road or spray lining.

Mains Rehabilitation

Description

8.352 Water mains rehabilitation is a traditional and long-term sustainable option to reduce leakage from our distribution mains network. It refers to the replacement of water mains and service pipes that are our responsibility.

8.353 We are responsible for over 31,000km of water mains across London and Thames Valley.

8.354 Some of our original cast iron mains were installed well over 100 years ago. Although these water mains have served customers well, the increase in road traffic, corrosive soil conditions and ground movement mean they are more likely to leak.

8.355 In dWRMP24, we include mains rehabilitation to repair or replace old or damaged water mains to reduce leakage and prevent further leaks into the future.

8.356 Mains rehabilitation is the basis of our long-term sustainable commitment described in Ambition 1 – reduce leakage by 50% (from 2017-18 levels) by 2050 and Ambition 8 – create a deliverable, resilient and ambitious programme.

Benefits, Costs and Volume

8.357 To date, the approach to mains rehabilitation has been based on results combining national research, our experience over the last 20 years, experience gathered from other water companies and discussions with manufacturers.

8.358 However, since 2011, an approach to target pipe condition as well as performance has been investigated to ensure mains replacement is targeted to deliver sustainable benefits. This means mains replacement targeting is being done at street and 'superstring' level. Superstrings are pipes connected to each other of the same age, material and diameter. By analysing the performance of each pipe, those pipes within a DMA that are performing the worst can be targeted.

8.359 The distribution of mains replacement at pipe level is first modelled in the Distribution Mains Model. The output of this model is input into our IDM model to provide us with the volume, leakage reduction and costs for mains rehabilitation.

8.360 The cost of mains rehabilitation is input into the Distribution Mains Model based on information from our internal cost models.

8.361 In dWRMP24 the average cost of Mains Rehabilitation is £1,400 per meter of pipe. This is based on:

- Two DMAs in London from our AMP7 Conditional Allowance programme. They represent the most up to date costs in mains rehabilitation
- The price supplied by two of our contractors

- Whole DMA pricing
- They do not include some London DMAs that are expected to be a higher cost, potentially up to £2,000 per meter of pipe

8.362 The split of costs between London and Thames Valley DMAs is detailed in Table 8 - 7

WRZ	Cost (£ per meter)
Total Company	£1,400
London	£1,421
SWOX	£1,283
Guildford	£1,354
SWA	£1,303
Kennet Valley	£1,230
Henley	£1,230

Table 8 - 7 – Mains rehabilitation costs

8.363 The mains rehabilitation costs originally forecast for inclusion in the WRSE Regional Plan were lower than the dWRMP24 final costs. These were based on our costs assessment from November 2021, and were the latest cost estimates we had at the time of the Regional Plan modelling.

8.364 However, since then, in June 2022, we have updated our cost assessment of mains rehabilitation using the AMP7 Conditional Allowance project. These new costs have been utilised on our dWRMP24, and initial feedback from the regional modelling suggests that this has had no significant impact on the timing or benefit required from the strategic options.

8.365 The increase in price between the Regional Plan and dWRMP24 mains rehabilitation costs is due to:

- A substantial increase in council's charging for lane rentals, and restrictions meaning we are needing to stay on site for longer
- Cost of labour increase due to specialist labour shortages
- Recent economic inflation: Cost of labour and materials

We assume the dominant factors of council behaviour and labour costs are unlikely to change. Therefore, this higher rate of Mains Rehabilitation is a more accurate reflection of future costs. We are confident with the costs used from our Conditional Allowance, but will review for the revised dWRMP24 the future unit costs as a strategic programme of mains rehab, which is likely to provide a more efficient cost.

The merits of the Conditional Allowance programme are being considered for future AMPs, where the focus will be on improving the resilience of the distribution and trunk mains, especially to weather shocks from cold winters, dry summers and freeze-thaw effects. At this stage no formal decision has been made as to whether to progress with a multi-AMP programme of resilience-focussed mains rehabilitation. When it is our WRMP will take account of the leakage benefit that this achieves.

In later AMPs Mains Rehab has no existing competition from other known options, so will be the dominant solution. Finding more efficient approaches is critical to the success in achieving our

50% leakage reduction, especially in London and rural towns. The Leakage Innovation will also play a part in assisting with this, alongside any development in Conditional Allowance programme.

Creating Demand Reduction Programmes

8.366 This purpose of this section is to describe step 4, bringing this information together to create demand reduction programmes.

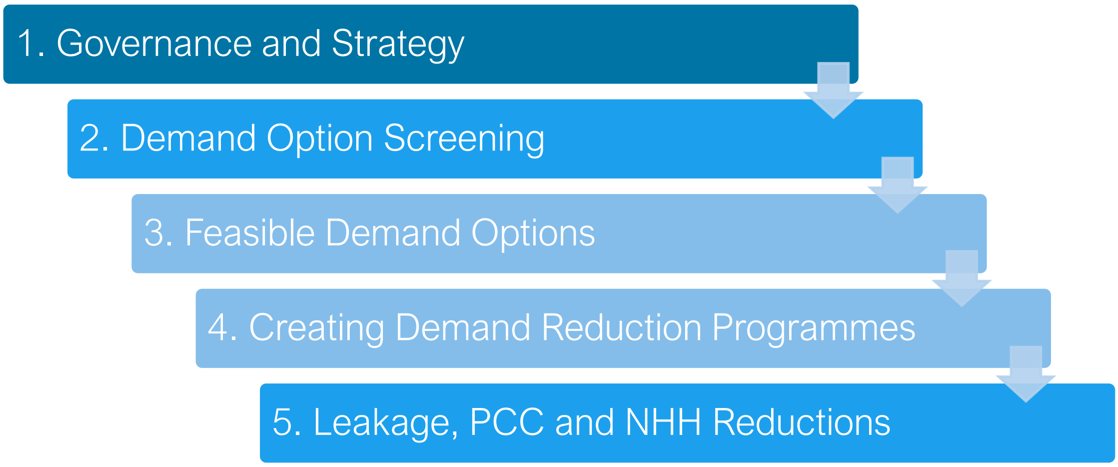

Figure 8 - 21– Our Approach to Demand Reduction

8.367 The purpose of creating demand reduction programmes is to provide a total demand reduction and cost for a 'basket' of demand options. This means that we appraise and optimise each of our demand options and combine them to create several different demand reduction programmes.

8.368 This avoids an assessment where each demand option is appraised against each supply option individually, and allows us to develop deliverable and reliable plans.

8.369 There are three primary steps to create demand reduction programmes for our dWRMP24:

- Definition of programme scenarios
- Cost benefit ratio of each demand option
- Optimisation of demand options

Step 1 - Definition of programme scenarios

8.370 Based on our strategy set out in Section Strategy we have developed:

- Three leakage reduction glide paths
- Three PCC reduction glide paths
- One Non-household demand reduction glide path

8.371 For leakage, the glide paths set out the leakage reductions required in each AMP to achieve our strategy leakage targets.

8.372 For PCC, these glide paths are determined by the deliverability of our Household consumption reduction demand options.

8.373 For Non-household, these glide paths include a technical expert assessment of a reliable volume of non-household reduction that can be achieved in our programmes.

8.374 Table 8 - 8 summarises the definition of each demand reduction programme scenario. We have identified three scenarios called Deliverable, High and High Plus.

Target	Deliverable	High	High Plus
50% Leakage Reduction	50% by 2050	50% by 2045	50% by 2040
AMP8 Leakage reduction	15% in AMP8	15% in AMP8	20% in AMP8
Household Consumption Reduction (PCC)	Deliverable delivery of options – innovation by 2035	Ambitious delivery of options – innovation by 2033	Very ambitious delivery of options – innovation by 2030
Non-Household Consumption Reduction	AMP8 and AMP9 activity	AMP8 and AMP9 activity	AMP8 and AMP9 activity

Table 8 - 8 – Definition of programme scenarios

8.378 These definitions are used in Step 3 – Optimisation of demand options to create three demand reduction programmes, a Deliverable, High and High Plus programme.

Step 2 - Demand option cost benefit ratio

8.379 Prior to programme optimisation, we calculate the cost for benefit achieved for each demand option. This is done using our tool, 'Options Data Calculator'.

8.380 Figure 8 - 22 illustrates the process we use to determine the cost benefit for each demand option.

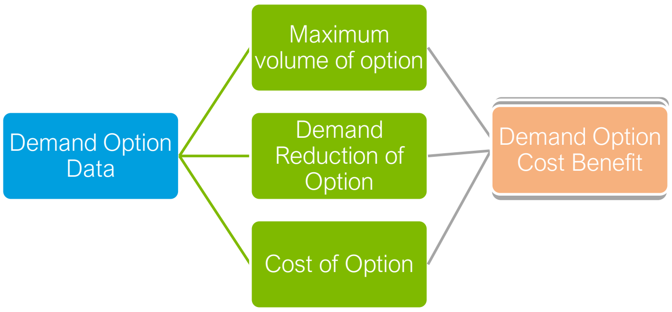

Figure 8 - 22 – Process to calculate Cost Benefit

8.381 The Demand Options Data (section on Feasible Options) is used to calculate the maximum deliverable volume of each option and subsequent demand reduction and cost. Together these produce the cost benefit ratio for each option.

8.382 The output of this process provides us with data to show the least to most cost beneficial demand options to include in our demand reduction programmes.

8.383 The demand option cost benefit is used to inform the next stage of the process, the Optimisation of demand options.

Step 3 - Optimisation of demand options

8.384 Demand reduction programmes consist of a suite of demand options that achieve a certain level of demand reduction in each year. There is a wide range of demand options that could be combined into programmes. For example, if we wanted to create the most cost efficient demand reduction programme, we would predominantly include lower 'cost benefit ratio' options such as water efficiency rather than more expensive options such as mains rehabilitation.

8.385 However, simply selecting for the cheapest demand option does not account for limitations to deliverability, and reliability. As an example, selecting for least cost alone would provide a programme of water efficiency activity only because it is our most cost beneficial solution. Although this would satisfy the condition to minimise cost, it wouldn't satisfy the Government ambition or our strategy to reduce leakage. It also wouldn't be a deliverable or reliable programme or consider the changing cost of schemes as they become more difficult to implement.

8.386 To ensure we consider the lowest cost and the deliverability and reliability of our plan, we must develop demand reduction programmes that have been optimised.

8.387 To achieve this, we have used two tools: our 'Demand Profile Calculator', and our IDM model. Both tools use the same methodology to optimise our demand options to create demand programmes. The former does this at WRZ level for all demand options. IDM is used to optimise mains rehabilitation at DMA level prior to being assessed at WRZ level due to the complexity of the costs and benefits associated with mains rehabilitation at pipe level.

8.388 The 'Demand Profile Calculator' considers the:

- Demand Reduction Strategy targets each AMP (defined in Step 1)
- The cost and benefit of each option (calculated in Step 2)
- The deliverability of each demand option
- The reliability of each demand option

8.389 The deliverability and reliability of each demand option is captured in the sections describing Feasible Options - Metering, Feasible Options - Water Efficiency and Feasible Options - Leakage.

8.390 Figure 8 - 23 illustrates the optimisation process used create our demand reduction programmes. Each of our programmes is created for the period 2024-25 to 2100.

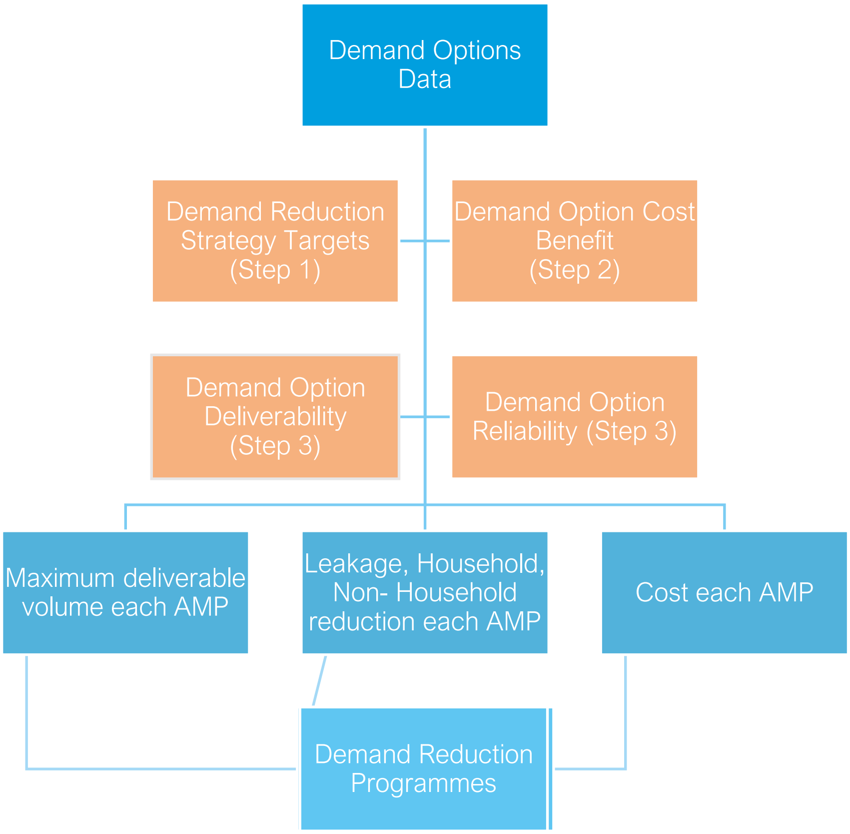

Figure 8 - 23 – Demand reduction programme optimisation

Demand Reduction Programme Outputs

8.391 We have developed three demand reduction programmes for inclusion in programme appraisal for dWRMP24. These programmes provide an annual profile of total demand, total Capex and total Opex from 2024-25 to 2100. Each programme is created at WRZ level.

8.392 These programmes are called, Deliverable, High and High Plus. These programmes provide an annual profile of total demand, total Capex and total Opex from 2024-25 to 2100.

8.393 They are defined as:

- **Deliverable** is an ambitious programme we can deliver. This programme has approved profiles of delivery for each option. For example, the number of meters we can install each AMP are based on current practices and experience. The Deliverable programme achieves the targets set out by our strategy

- **High** is the programme that is more ambitious in the speed with which we conduct the demand option activity. For example, this programme is designed to complete the metering programme faster and achieves a greater reduction in leakage by 2050 than the Deliverable Programme

- **High Plus** is our most ambitious programme. This programme requires significant and rapid innovation in both leakage and PCC reduction activity in the near future. The high plus programme assumes our most cost beneficial programmes from metering and water efficiency can be complete within AMP8. This is done to increase the volume of leakage we can reduce in AMP8. It also assumes innovation activities will be available by 2030 to continue to reduce leakage by 2050 by a volume that is greater than both the deliverable and high plus programmes

8.394 Each programme is created at WRZ level so in total we have created 18 programmes. We have assumed that we will have a coherent demand reduction strategy going forward, by which we mean that we will assume either a 'Deliverable', 'High', or 'High Plus' strategy is adopted across the whole company area, rather than considering the possibility of having a 'Deliverable' programme in one WRZ and a 'High Plus' in another zone.

8.395 The suite of metrics (environmental, resilience, and customer preference) defined for supply-side options have also been defined for each demand reduction programme. For further detail on environmental assessments carried out please refer to Section 9, and for a description of the process followed to derive resilience metrics please see Section 7. Customer preference metrics were defined by WRSE and assigned to generic option types.

8.396 An additional scenario, the Low scenario was created to enable scenario testing. The Low scenario included the assumption that we would achieve a 30% leakage reduction by 2050 and a slow roll out of our Metering programme. This scenario was included to test the impact on the whole programme if we didn't achieve the demand option activity set out in the plan, to ensure that we have a secure supply of water even if our demand management efforts are not as effective as we anticipate. The scenario has not been used in dWRMP24 as it does not meet the required target for leakage.

8.397 The detail of the output of the Deliverable scenario is provided in Section 11 Preferred Plan. An analysis of the Deliverable, High and High Plus scenarios at total company level is provided in the sections on Per Capita Consumption PCC and Leakage.

Government Scenarios

8.398 Government led interventions are a category of demand savings where potential Government policies would result in changes to the volume of water being used through initiative such as water labelling and minimum standards.

8.399 WRSE have set out a range of possible Government led scenarios along with timings in their government demand savings document[38]. This sets out a range of possible policies and the timing of their introductions. The policies are designed to introduce water labelling; water standards for water fittings; building regulations; and further government water efficient campaigns to promote water efficiency.

8.400 The approach set out by WRSE groups these activities into three levels of interventions by the government resulting in either a low, medium, or high level of water efficiency reductions at a per person level.

8.401 As our supply area is an area of serious water stress it was appropriate to understand how the combination of government interventions and our own demand management programmes could drive PCC down within the region and support the ambition of achieving an average 110 l/p/d across all five regions by 2050 as set out in the WRMP directions.

8.402 The table below sets out the different government interventions that have been modelled and summarises the impact each of the policies have on PCC.

[38] Government demand management savings and implementation profiles Version 2. WRSE, February 2022

WRSE Government policy intervention (Savings l/person/d)	2030	2040	2050
Government A	2	6.4	12
Government B	2	6	10.8
Government C	2	8.4	21.2
Government D	2.4	12	12.0
Government E	4	16.8	24
Government F	7.2	12	12
Government G	9.6	24	24

Table 8 - 9 - Summary of Government Led Interventions

8.403 The Government B scenario was chosen to be included within the investment modelling and has been discussed and agreed with Defra as a plausible scenario to explore in the WRSE regional plan. All water companies within WRSE have planned to use the Government B scenario. Since February 2022 WRSE have continued to consult on other potential scenarios and are aware that there are various alternative publications which set out potential ways forward. At this time Defra are working with Water UK on development of these options.

8.404 Within the Household Water Use chapter of Section 3, Future Water Demand, we explain our inclusion of a "Trend Adjustment Factor" which accounts for increasing efficiency of water using devices that has been observed over time. We first used this trend adjustment within our 2019 WRMP and carried it in to our dWRMP24 baseline forecasts, this was done prior to WRSE exploring Government led demand savings. As the water labelling component of government led interventions would also work by improving device efficiency it is important that we do not double-count potential water use savings. A comparison between the reduction in PCC from our Trend Adjustment Factor and the water labelling aspect of WRSE's Government B scenario is shown in Figure 8 - 24.

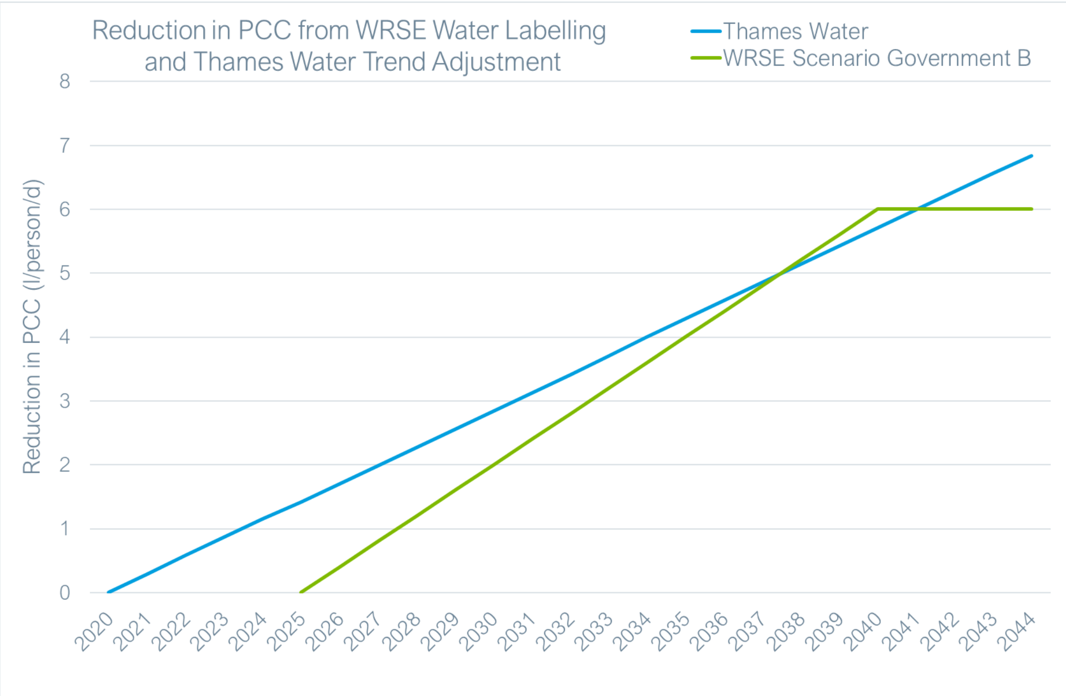

Figure 8 - 24 – Reduction in PCC from Water Labelling and Trend Adjustment

8.405 This shows the two profiles result in very similar savings with the Thames Water trend adjustment showing higher savings by 2045 but the Government B scenario setting a faster rate at which people transition to more efficient devices. As consultation is ongoing we have decided that we will not include the water labelling savings element of the WRSE Government B scenario as we believe this would double count the benefits we have already included. We will review this position for the revised dWRMP24. All other aspects of the Government B scenario (minimum standards and the full government support for demand savings) are included in their entirety.

8.406 Table 8 - 10 shows a comparison of savings used by Thames Water and WRSE for the government B scenario.

WRSE Government policy intervention (Savings l/person/d)	2030	2040	2050
Government B + Trend Adjustment – Thames Water	3.1	5.7	13.3
Government B - WRSE	2	6	10.8

Table 8 - 10 - Thames Water and WRSE PCC Reduction Government B Scenario

Per Capita Consumption

Comparison with WRMP19

8.407 Our demand reduction programmes demonstrate that, with company-led activities only, we can reduce household consumption to 125 litres per person per day by 2050.

8.408 This PCC figure is achieved with both traditional and innovative demand options. Our traditional options are based on our comprehensive dataset from on the ground experience in AMP7 and our innovation solutions have been developed to reflect our ambition for the future. Our evidence for these demand options has been summarised in the sections describing Feasible Options - Metering and Feasible Options - Water Efficiency.

- Our demand reduction programmes achieve a 2050 PCC of 125 l/p/d.
- This is 5 l/p/d higher than our WRMP19 PCC of 120 l/p/d. The difference is due to a higher PCC in 2020 (accounts for 3 l/p/d) and a reduction in savings achieved by PMP (accounts for 2 l/p/d).
- We have used a bottom up approach to forecast our 2050 PCC meaning we have used our comprehensive data led evidence base to quantify the maximum savings from each demand option in our programme
- Our PCC forecast includes both traditional and innovation options. This means we are confident our plan strikes the right balance between deliverability and ambition for the future.
- High Users have been investigated in an industry first in the smart meter high users' study. This study showed that in our smart meter sample, most customers (mode) used 100 l/p/d and 37% of customers in the sample were already below the national government target of 110 l/p/d.
- Customers in this study who voluntarily moved to a metered bill reduced their PCC below customers who were automatically moved to a metered bill. This supports our Digital Engagement and Household Innovation demand options to ensure greater reductions in PCC.
- To ensure we do not overestimate the savings we can achieve from customers, and ensure our overall plan remains robust and realistic, we have concluded that the volume included in our dWRMP24 is the maximum we should prudently assume that can achieve by 2050.
- We will continue our 'high water use' study with the next stage of the study due to commence in Autumn 2022.

8.409 Figure 8 - 25 illustrates the difference between total company PCC in WRMP19 and dWRMP24.

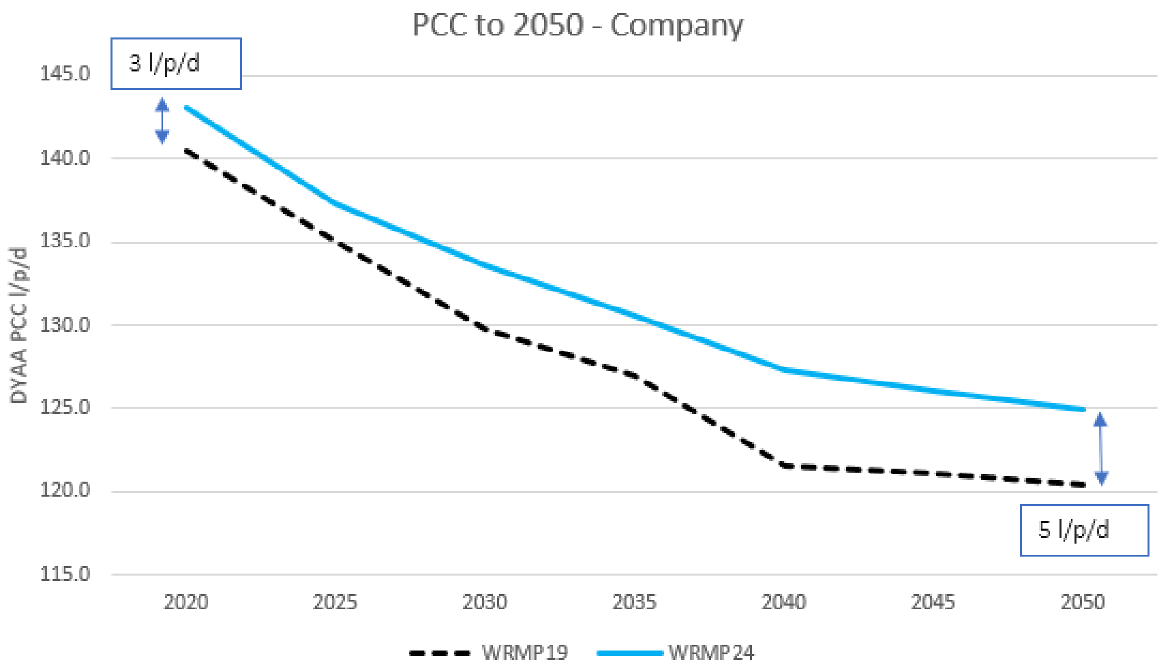

Figure 8 - 25 – DYAA PCC to 2050

8.410 This shows that, by 2050, our dWRMP24 PCC is 5 l/p/d higher than WRMP19. The reason for this difference is due to two factors; the difference in PCC at 2020 and the reduction in savings applied to PMP.

8.411 In dWRMP24, we have used our dry year annual average reported PCC for 2020 which is 143 l/p/d. This PCC is 3 l/p/d higher than forecast for 2020 in WRMP19 (140 l/p/d).

8.412 Since we started PCC in 2020 from a 3 l/p/d higher position compared to WRMP19, it follows that our PCC in 2050 will also be 3 l/p/d greater. This explains 3 l/p/d of the 5 l/p/d difference by 2050.

8.413 The remaining 2 l/p/d difference is explained by the difference in savings applied to PMP. In WRMP19, we assumed PMP would reduce customer consumption by 17% in response to moving to a metered bill. This was based on our consumption model from 2017 that used modelled figures for unmeasured consumption and basic meter data for measured consumption. This was the most accurate information we had available at this time.

8.414 In dWRMP24, we have been able to upgrade our consumption models to include smart meter data. This data has demonstrated that on average customers reduce their consumption by 13%. The section on our Progressive Metering Programme details the reasons behind this difference.

8.415 When we apply this change to the number of PMP meters[39] it results in a 23 Ml/d (or 2 l/p/d) reduction to the overall savings from PMP.

8.416 Together, the difference in PCC at 2020 and the reduction in savings applied to PMP explains the difference between our dWRMP24 and WRMP19 forecasts.

[39] 13% savings are applied to our dWRMP24 AMP8 PMP installs and GER PMP. In WRMP19, the meters for inclusion in GER were planned for installation in AMP8.

Confidence in Delivery

8.417 The previous section Creating Demand Reduction Programmes showed we have applied a bottom-up approach to forecast our 2050 PCC position. This means we have used our comprehensive evidence base to determine an achievable household consumption reduction for each demand option.

8.418 The achievable household consumption reduction from all demand options is 122 Ml/d[40]. This reduction gets us to our PCC of 125 l/p/d in 2050. We are confident we can deliver this volume due to the mix of traditional and innovative solutions incorporated in our plan. The traditional solutions are all based on data from our experience implementing these solutions in AMP6 and 7. Our innovative solutions are based on a mix between data led solutions and expert judgement assumptions applied to likely innovative ideas for the future.

8.419 Our demand options and their contribution to PCC reduction are broken down in Table 8 - 11.

Demand Option	Activity	Savings (Ml/d)	Savings (l/p/d at 2050)
Traditional – full data audit trail			
Metering - PMP	192 k new meters	8.6	0.8
Water Efficiency - SHV	320 k visits	10.6	1.0
Water Efficiency - Wastage	26 k wastage repairs	4.3	0.4
Water Efficiency - Incentives	70 k engagement	0.4	0.05
Metering – AMP7 Carry Over	144 k new meters	8.7	0.8
Total Traditional	750 k activities	32.6 Ml/d	3.05 l/p/d off PCC
PCC Innovation – mix of data and expert judgement			
Metering Innovation - PMP	740 k	35.1	3.0
Digital Engagement	625 k	10.2	0.9
HH Innovation and Tariffs – Wipe out Wastage	TBC (high users)	14	1.2
HH Innovation and Tariffs – tariffs	TBC (high users)	16	1.4
HH Innovation and Tariffs – future innovation	TBC (high users)	14	1.2
Trend base adjustment, water labelling (baseline reduction)	n/a	n/a	0.7
Total PCC Innovation	1.3 million + high users	89.3 Ml/d	8.6 l/p/d off PCC
TOTAL	2 million + high users	122 Ml/d	11.6

Table 8 - 11– Demand Option contribution to PCC

8.420 These volumes are supported by our on-the-ground evidence, experience, and smart meter data. A description and source of the evidence base for each option has been detailed in Sections Feasible Options - Metering and Feasible Options - Water Efficiency.

8.421 Defra has stated that the government expects the UK to reduce PCC to 110 l/p/d by 2050 (Governance). Our dWRMP24 demonstrates that as a water company, we can reduce PCC to

[40] This is the total savings between 2025 and 2050 included in our demand reduction programme for dWRMP24. AMP7 activity is included in our baseline forecasts.

125 l/p/d by 2050. With a prudent assumption for additional Government involvement beyond what is included in our baseline (Government), we can reduce PCC to 123 l/p/d by 2050.

8.422 We recognise our current PCC forecast is higher than the Government's expectation for the national UK average by 2050. To achieve an average PCC of 110 l/p/d, we would need to reduce household consumption by over 300 Ml/d between 2025 and 2050. This is 180 Ml/d greater than the volume of reduction currently included in our plan.

8.423 Our current plan exhausts our traditional activities to reduce household consumption. By 2040, we have concluded our metering and water efficiency programmes by targeting all possible properties for these solutions. At this stage, we are not able to increase the volume of any of our traditional activities above what is included in our plan.

8.424 Our innovative solutions include physical interventions, customer engagement and tariffs. Our physical interventions, metering innovation and Wipe out most Wastage are based on our current smart meter data. Wipe out most Wastage reduces the total wastage that we believe exists across our area based on our smart meter data. Both solutions reach their maximum possible reductions within the current plan.

8.425 Of our engagement areas, there are two based on technical expert judgement: tariffs and future innovation (assumed reduction volume). In theory, we could increase our assumptions around volumes of reduction that could be achieved by these means to satisfy the requirement to report that we will achieve a PCC of 110 l/p/d. To do this, we could adjust the technical expert's recommended volume and assume each of tariffs and future innovation achieve a reduction of an additional 90 Ml/d each. Although this would mean we could forecast a significantly lower PCC for 2050, it would compromise the deliverability, reliability, and credibility of our plan. Critically, it would introduce an unacceptable level of uncertainty that would undermine the integrity of our plan. This would directly undermine the direction from Defra that 'Regional plans and WRMPs must be deliverable, which includes managing the uncertainty faced'.[41] It is also worth noting that recent data from this summer's heatwave in August and ongoing drought conditions there was a notable increase in household use of water. Using our smart meter data, detached properties were seen using up to 50% more water per day. This recent information provides a concern in the ability to manage PCC in times of water stress, and an over estimation of the benefits would undermine our overall ability to maintain a supply demand balance.

8.426 Rather than assume we can achieve unrealistic household consumption savings across our entire customer base, we want to understand how we can most efficiently and reliably target our future innovation activity. We have done this by initiating the first smart meter study into a new area, high water use customers (High Water Use Study)

High Water Use Study

8.427 The High Water Use Study with smart meter data is the first of its kind in the UK. The results of this study will lead the water industry in our understanding of customer water use behaviour and opportunities to reduce PCC.

8.428 In dWRMP24, we initiated our 'High Water Use' study[42]. A first in the water industry, this study uses smart meter data to define, quantify and understand what it means to be a high water user.

[41] DEFRA, 2022, 'Government expectations for water resources planning', page 6.
[42] This study was done in conjunction with Artesia consulting who are experts in statistical analysis and specialists in understanding customer water demand.

The driver for this study is to understand the impact of high water use on our average PCC forecast.

8.429 In our PCC forecasts, we report average PCC, but we know some customers use more or less than the average. Historically, we have not been able to quantify the breadth of difference in water consumption across our population. With the introduction of smart meter data, we can now accurately quantify this magnitude.

8.430 The High Water Use Study has used 67,000[43] PMP smart metered households in the analysis. The study has used this data to quantify consumption prior to and following a customer's move to a metered bill. It has analysed this dataset according to two customer groups:

- Compulsory: customers who were automatically moved to a metered bill at the completion of their one year journey
- Voluntary: customers who volunteered to move to a metered bill before their end of their one year journey

8.431 Once we understand our high water use customers, we can more efficiently tailor demand reduction solutions, or account for water consumption more accurately to reduce average PCC.

How do high users impact PCC?

8.432 Industry experts propose that customer demand follows a log normal distribution with mean average PCC driven by a long right hand tail.

8.433 Customers whose water use falls within this tail, or the top 5%, are classified as high water users.

8.434 Figure 8 - 26 uses our smart meter data to validate this distribution. Both the compulsory and voluntary households follow the same profile; most households use less water than the mean average PCC but, a small proportion of households use significantly more water. These households are the high users in the right hand tail and their water use drives up the mean average PCC.

8.435 There are two key findings shown in Figure 8 - 26:

- Most customers use less water than the average PCC
- Customers who voluntary move to a metered bill save more than those who are compulsorily moved

[43] These customers had completed their one year journey prior to January 2020 and are based in London. We have not included smart meter data from customers who completed their one year journey after January 2020 due to the influence of Covid-19 and lockdowns on water consumption. We do not have any customers who have completed their journey in Thames Valley prior to January 2020.

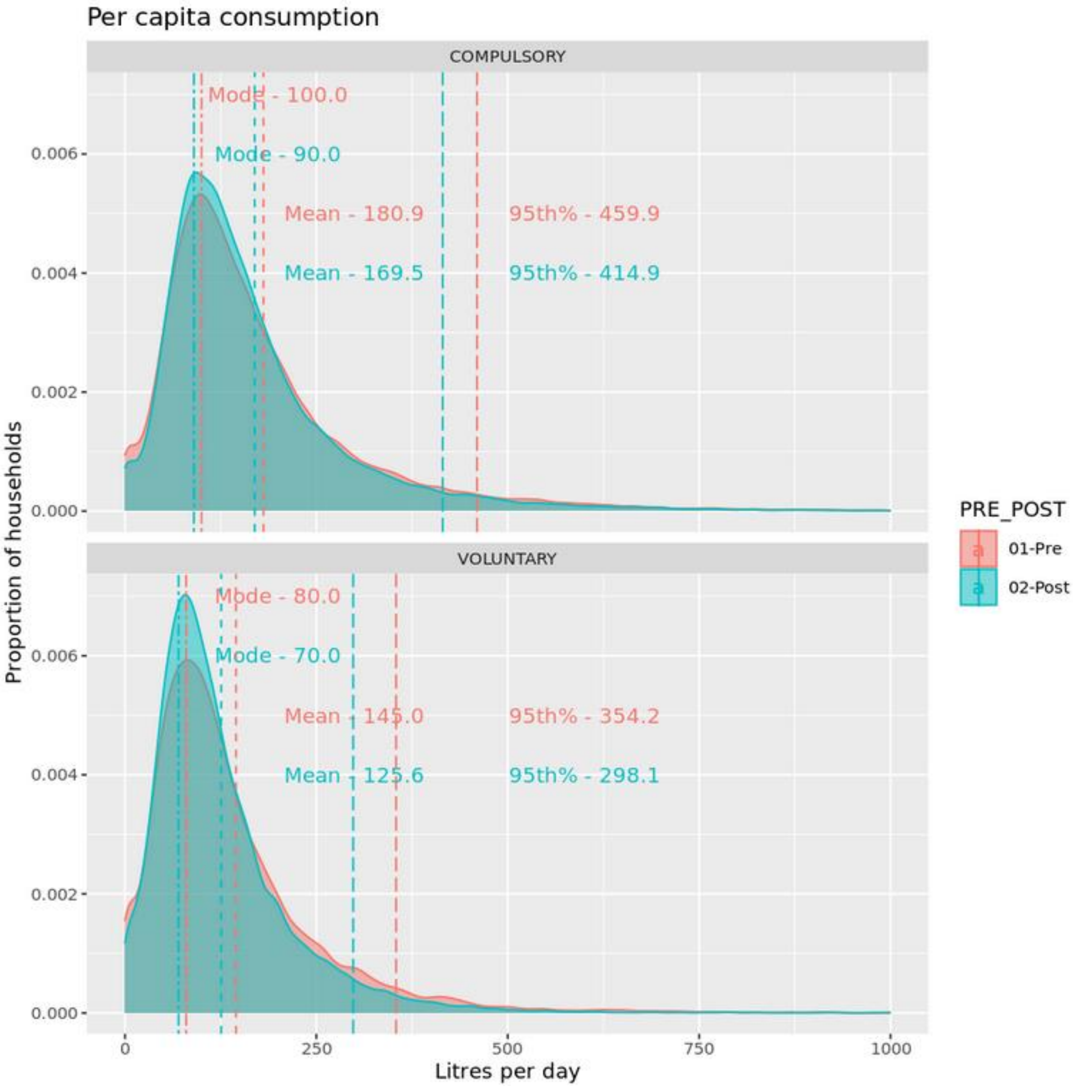

Figure 8 - 26 – PCC, Smart Meter Data from the High Water Use Study

Most customers use less water than the average PCC

8.436 The difference in PCC before (pre) and after (post) moving to a metered bill is shown by the pink and green curves respectively.

8.437 For compulsorily metered customers, most households (mode) use 100 l/p/d prior to moving to a metered bill. This is significantly less than the mean average, 180.9 l/p/d, and less than the Government's ambition of 110 l/p/d. Following their move to a metered bill, most compulsorily metered customers use less water again at 90 l/p/d.

8.438 However, a small proportion of households, the 95th percentile or higher users, use significantly more water. These customers use almost 460 l/p/d which is the same volume used by an unmeasured household each day. High use consumption is shown in the long tail that stretches to 1000 l/p/d. These high consumptions mean the mean average PCC before metering is 180.9 l/p/d.

8.439 Like most customers (the mode), high use customers save water and reduce their consumption following metering. However, their per person consumption of 415 l/p/d remains high and equates to the average volume of water used by a measured house. The high use increases the mean average so that after metering it is 169.6 l/p/d, even though the mode is 90 l/p/d.

8.440 This shows that the high use customers are having a significant impact on the total average PCC. Rather than targeting the whole population, a significant proportion of which are already at a low PCC, this result indicates that our greatest impact on PCC would be achieved by targeting high users with water efficiency options.

8.441 A note on these values: they are based on the PMP smart meter sample used in this study and therefore may contain some bias towards lower water users who have accepted a PMP meter. Although the conclusions drawn from this study are representative across our customer base further smart meter data points are required to confirm the mode of all our customers.

Voluntary customers save more than compulsory

8.442 Customers who move to a metered bill before the completion of their one year journey (voluntary) save more water than those automatically moved at the end of their journey (compulsory). Voluntary customers also use less water than compulsory customers prior to moving to a metered bill.

8.443 Based on average PCC, voluntary customers (19.4 l/p/d savings) save 8 litres more per person than compulsory (11.4 l/p/d savings). Most customers (mode) save 10 l/p/d for both voluntary and compulsory households. For high users, voluntary customers (56 l/p/d savings) save 11 litres more per person that compulsory (45 l/p/d savings).

8.444 This suggests that customers who want to save money on their bill prior to their meter installation are more likely to make greater savings with a meter.

8.445 This supports our Digital Engagement option that will engage a wider group of customers with practical tools to detect and repair their own wastage issues and change their water use behaviour. It also supports our Household Innovation and Tariffs option, specifically in relation to our programme to eliminate wastage and introduce tariffs.

8.446 Opportunities associated with compulsory customers are discussed in the section Confidence in Delivery.

Can we achieve 110 l/p/d average PCC?

8.447 The previous section quantified the impact of high users on average PCC. This section investigates how many of these high users we would need to target with water efficiency demand options to achieve an average PCC of 110 l/p/d.

8.448 To do this, we have looked at:

- The proportion of customers who use less than 110 l/p/d
- The volume of high users that must be removed to achieve an average PCC of 110 l/p/d

8.449 Table 8 - 12 details the proportion of customers within the smart meter dataset who use less than 110 l/p/d.

Type	Under 110 l/p/d (Post Metered Bill)	Average PCC (Post Metered Bill)
Compulsory	37%	169.5
Voluntary	54%	125.6

Table 8 - 12 – Percentage of households with PCC under 110 l/p/d

8.450 This shows that 37% of metered (compulsory) and 54% of metered (voluntary) properties have a PCC below the Government target of 110 l/p/d. The average PCC of a metered (voluntary) property is key because a metered (voluntary) property represents a household who has achieved several of our visions; paying on a metered bill, engaged with water efficiency advice and wiped out all their wastage. Their average PCC of 125.6 l/p/d is in line with our dWRMP24 which predicts our average customer PCC will be 125 l/p/d once they have undertaken these same demand options by 2050.

8.451 It also demonstrates the significant influence high users have on the average PCC. For example, when 54% of metered (voluntary) households are using less than 110 l/p/d, the average PCC remains at 125.6 l/p/d due to the remaining 47% of customers using higher volumes.

8.452 This insight proves that a proportion of our customers are already meeting the Government target for PCC. It also helps to direct us to tailor our water efficiency innovation activity to higher use customers to reduce the average PCC.

8.453 To understand how many of these customers we need to target with water efficiency advice, we have used smart meter data to quantify the number of high users that must be removed from a data sample to reach an average PCC of 110 l/p/d. When this is done, this shows that for metered (compulsory) properties, an average PCC of 110 l/p/d can be achieved by removing 27% of properties or all properties using greater than 196 l/p/d.

8.454 For metered (voluntary) properties, an average PCC of 110 l/p/d can be achieved by removing only 6% of properties or all properties greater than 283 l/p/d.

8.455 The metered (voluntary) properties require a lower volume of data to be removed at a higher PCC because this customer group includes 75% of households using less than 70 l/p/d. In contrast, metered (compulsory) properties include 50% of households using less than 70 l/p/d. These results highlight that our Digital Engagement, and Household Innovation and Tariff options are critical to reduce our average PCC.

8.456 In the smart meter sample used in this study, most customers (mode) used significantly less water than the average PCC. High use customers, some using as much per person as the average metered household, who increased the mean average.

8.457 Assuming we target high use customers only to achieve the additional 180 Ml/d required to reach a PCC of 110 l/p/d, this would equate to each high use customer reducing their consumption by approximately 300-350 l/p/d. To understand whether high use customers could feasibly make this reduction, we looked at our smart meter data to understand how and why high use customers used water. This showed that a significant proportion of high water use is likely to be genuine and persists even when meters are introduced. Therefore, targeting these customers for water efficiency reductions may not yield real reductions against PCC.

8.458 Table 8 - 11 showed that we have included a large proportion of innovation activity that will target higher water users in our plan. This equates to 30 Ml/d attributed to household innovation and tariffs. To ensure we do not overestimate the savings we can achieve from customers, and ensure our overall plan remains robust and realistic, we have concluded that this volume is the maximum we can reasonably assume to achieve by 2050.

8.459 To support our conclusion, we will continue to analyse our smart meter data, specifically in relation to high users to understand whether high use is due to genuine water use or whether there is further room for these customers to make sustainable reductions. We will continue our 'high water use' study with the next stage of the study due to commence in Autumn 2022.

Non-household Consumption

8.460 Our demand reduction programmes include a single profile of non-household consumption reduction across the three scenarios, deliverable, high and high plus.

8.461 In comparison to WRMP19 we have included six time more non-household consumption reduction between 2025 and 2050 in dWRMP24 (Figure 8 - 27).

8.462 Most of this reduction is planned between 2025 and 2030 where we will work with businesses to reduce their consumption by 24 Ml/d. In WRMP19, we planned to reduce non-household consumption by only 3 Ml/d in this same period.

8.463 This reduction is achieved by upgrading our basic non-household meters to smart (Progressive Smart Upgrade Programme (Non-household)) and working with businesses to improve their water efficiency through our SBV demand option (Smarter Business Visits).

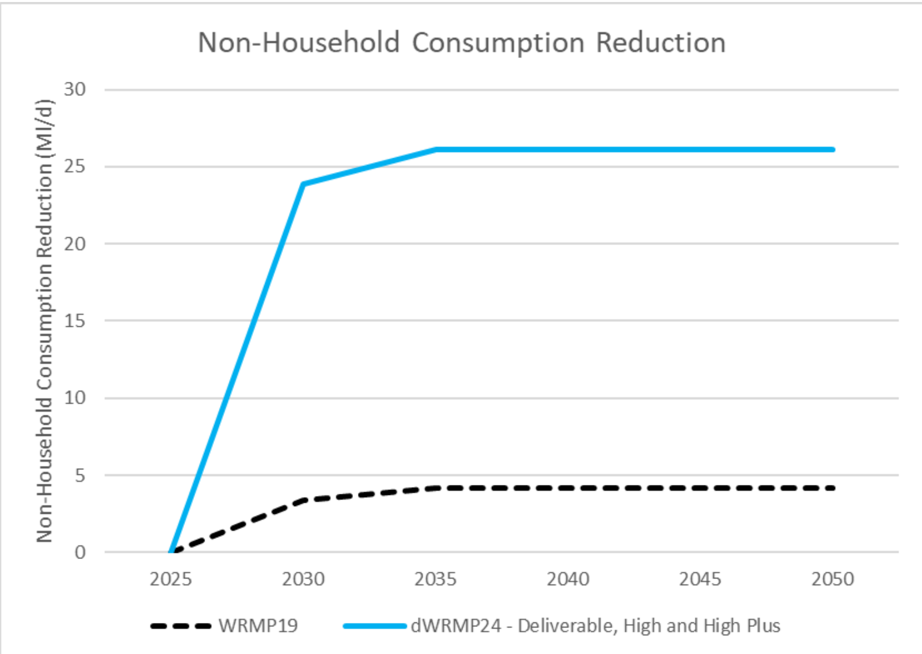

Figure 8 - 27 – Non-Household Consumption Reduction to 2050[44]

[44] The chart indicates non-household savings start at 0 at 2025 for a direct comparison between dWRMP24 and WRMP19. In AMP7 we are currently exceeding our target of 12 Ml/d by working closely with businesses through our water efficiency smart business visit programme.

8.464 In Defra's recent consultation on environmental targets[45], a target of 6% - 20% reduction has been proposed for non-households. Like PCC, baseline non-household consumption forecasts follow an increasing trend over time. Therefore, percentage reduction in this consumption is not reflected by the volume of work undertaken.

8.465 To avoid this issue, we have assumed that the non-household target will be the volume of activity compared to the 2024-25 non-household consumption. In this case, our current dWRMP24 activity represents a 6% reduction of 2024-25 non-household consumption. We will investigate opportunities to increase this volume in the rdWRMP24.

[45] Defra, 6th May 2022, 'Water targets, Detailed evidence report', page 24 & 32

Leakage

- Our Deliverable demand reduction programme achieves a 50% reduction (of 2017-18) leakage by 2050.
- Our High and High Plus demand reduction programmes achieve a 50% reduction (of 2017-18) leakage by 2045 and 2040 respectively.
- By 2100, all programmes achieve the same total volume of leakage reduction. The difference between the programmes is the programme of delivery of the leakage reduction activities.
- Our dWRMP24 scenarios include 31 Ml/d more leakage reduction than we included in WRMP19 by 2100.
- In WRMP19 we concluded our leakage reduction activity in 2055. In dWRMP24, we continue leakage reduction activity beyond 2050. This is due to our new demand option, Leakage Innovation, which assumes that, through future innovation, both costs and customer inconvenience will be reduced compared to our WRMP19.
- The leakage reductions included in dWRMP24 strike the right balance between our desire to reduce leakage further and the financial impact of leakage reduction on customers' bills.
- If we were to increase leakage reduction activity, this would impact customer bills.
- We are confident in the delivery of our leakage reduction programme due to the adaptive planning approach we have employed in 2021-22 and our decades-long history of meeting our leakage targets.

Comparison with WRMP19

8.466 Our demand reduction programmes include three leakage scenarios: Deliverable, High and High Plus. These programmes achieve a 50% reduction (of 2017-18 leakage) by 2050, 2045 and 2040 respectively.

8.467 By 2100, these programmes achieve the same total volume of leakage.

8.468 Figure 8 - 28 illustrates the difference between total company leakage in WRMP19 and dWRMP24. These leakage numbers are DYAA.

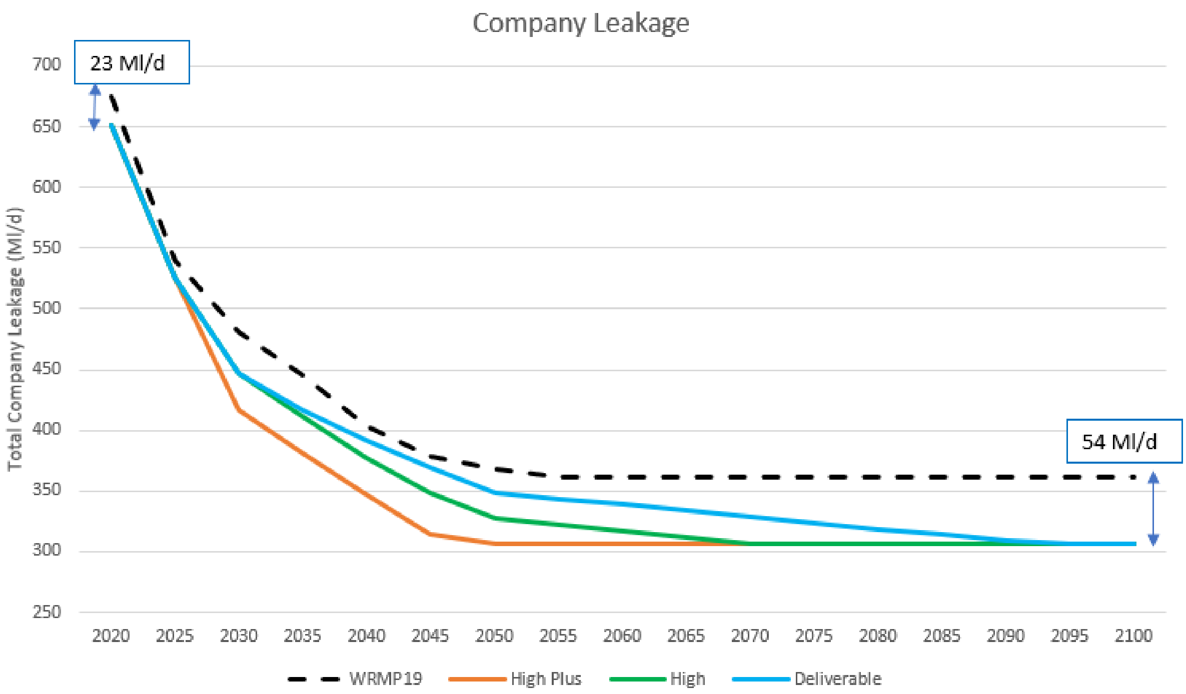

Figure 8 - 28 – Leakage to 2100

8.469 This shows that in WRMP19 we forecast that our 2019-20 leakage position would be 23 Ml/d higher than our reported leakage of 651.7 Ml/d. See Section 3 – Demand Forecast for the source of our 2019-20 leakage numbers.

8.470 By 2100 our Deliverable, High and High Plus leakage reduction scenarios result in a forecast of 54 Ml/d less leakage than we thought we would reach from our WRMP19 programme. This means our dWRMP24 plan includes 31 Ml/d more leakage reduction activity than our WRMP19 by 2100.

8.471 The reason for the increase in leakage reduction activity is our commitment in dWRMP24 to continue our leakage reduction programme beyond 2050.

8.472 In WRMP19, we concluded our leakage reduction activity by 2055 as a compromise between continuing to reduce leakage in line with customer preference and the impact on customer bills and day-to-day inconvenience that the activity will create. In WRMP19, our only solution to continue leakage reduction longer term was mains replacement which is very expensive and causes inconvenience to customers while the work is undertaken.

8.473 In dWRMP24, we have continued our leakage reduction programme well beyond 2050 due to our new demand option, Leakage Innovation. We have assumed that through future innovative approaches to leakage reduction, both costs and customer inconvenience will be reduced compared to our WRMP19. This enables us to continue with our leakage reduction programme and achieve a greater total reduction than that planned for in WRMP19. The details of Leakage Innovation are provided in the section on Leakage Innovation.

8.474 Table 8 - 13 provides a comparison of our total company WRMP19 and dWRMP24 scenarios at an AMP level and by 2050.

Programme	AMP Leakage Reduction (%)			50% reduction of 2017-18 leakage (year)	Leakage at 2050 (Ml/d)	Leakage as % DI by 2050[46]
	AMP8	AMP9	AMP10			
Deliverable	15%	9%	7%	2050	349.1	14.5%
High	15%	10%	9%	2045	326.8	13.7%
High Plus	20%	13%	9%	2040	306.8	12.9%
WRMP19	11%	7%	9%	2050	368.6	~15%

Table 8 - 13 – Leakage comparison, WRMP19 and dWRMP24

8.475 This shows that, by 2050, we forecast we will achieve a lower level of leakage in all dWRMP24 scenarios than we did in WRMP19.

8.476 Factoring in the 23 Ml/d difference between the dWRMP24 and WRMP19 2020 leakage level, this means that our high scenario delivers 19 Ml/d more and our high plus delivers 39 Ml/d more leakage reduction by 2050 compared with our WRMP19[47].

8.477 Our Deliverable scenario achieves slightly less reduction (-4 Ml/d) by 2050 compared to our WRMP19. Since we completed more reduction in AMP6 than forecast in WRMP19, we can achieve our 50% (of 2017-18 leakage) target with slightly less reduction between AMP8 – 12 in dWRMP24.

8.478 However, by 2100, our Deliverable scenario includes a further 45 Ml/d of leakage reduction compared with WRMP19 reduction after 2050 of 7.5 Ml/d.

8.479 The leakage reductions within AMP8 between our Deliverable, High and High Plus reflect the speed with which we achieve our leakage reductions between the three scenarios. Both Deliverable and High reduce leakage by 15% within AMP8. The High scenario delivers slightly more reduction in AMP9 and 10 to achieve our 50% (of 2017-18) target by 2045, 5 years earlier than the Deliverable scenario.

8.480 The High Plus scenario achieves the greatest percentage reduction within AMP8, 20% and continues to reduce leakage further in AMP9 and 10 to achieve the 50% (of 2017-18) target by 2040, 10 years earlier than the Deliverable scenario.

8.481 Table 8 - 13 refers to 2050 leakage as the percentage of Distribution Input (DI). These figures assume a household and non-household consumption reduction profile as detailed in this plan, dWRMP24. Leakage as a percentage of DI is significantly influenced by the volume of activity achieved in these metrics and the volume of growth forecast for the future. It is therefore not an accurate representation of our leakage performance but has been supplied to allow a comparison against our current performance.

8.482 As of 2021-22 we have reported that our leakage is 23% of DI. By 2050, our Deliverable and High scenarios reduce this by around 10% with leakage as a percentage of DI of 14.5% and 13.7%

[46] Assumes Household and Non-household consumption reduction from this plan, dWRMP24
[47] The High Plus programme concludes leakage reduction at 2050 whereas the WRMP19 programme included a further 8 Ml/d between 2050 and 2055. Therefore the net difference between the programmes by 2100 remains at 31 Ml/d.

respectively. The High plus reduces this by 11% with leakage as a percentage of DI of 12.9% by 2050.

Confidence in Delivery

8.483 Leakage reduction is an extremely important part of our plan to manage the balance between supply and demand. Our confidence in the delivery of our plan is key to ensure our demand reduction plan is robust and reliable.

8.484 We have developed our leakage reduction demand options based on traditional solutions and innovative solutions. Our traditional solutions include metering properties with new meters and bulk meters to detect and repair CSL and to undertake Mains Rehabilitation to reduce distribution main leakage.

8.485 Our innovative solutions include Advanced DMAi and Leakage Innovation. These options will implement innovative methods to detect and repair leakage and include an allowance for future development in mains rehabilitation technology.

8.486 Except for Leakage Innovation, all our leakage reduction options are being implemented in AMP7[48]. If follows that our confidence in delivery of future leakage reduction is consequent upon our ability to deliver leakage reduction in previous AMP's.

8.487 Figure 8 - 29 demonstrates our leakage reduction performance since 2005/06.

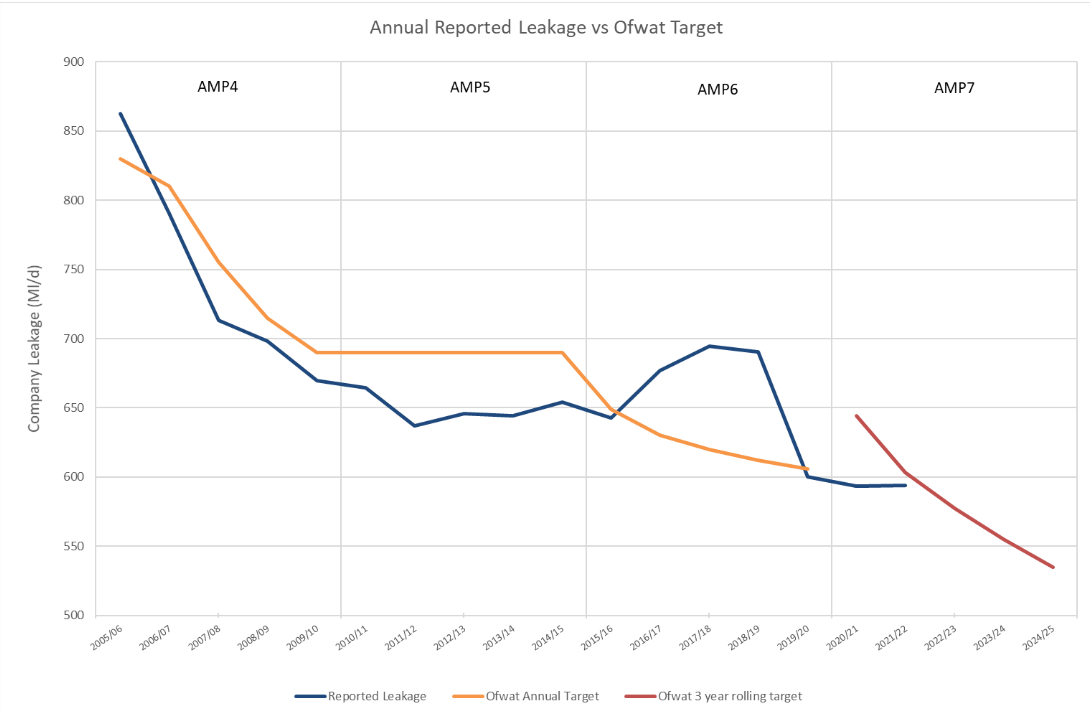

Figure 8 - 29 – Leakage reduction performance against target

8.488 Between 2005 – 2010 (AMP4) we achieved our leakage reduction target through the implementation of a large mains rehabilitation programme which delivered over 400km of mains replacement each year. This was supported by a programme of new pressure management

[48] Advanced DMAi has been trialled in AMP7 throughout DMA Enhancement and Excellence programme

schemes and a proactive plan to detect and repair leakage on both the distribution and trunk mains network. Large levels of find and fix activity continued to manage leakage recurrence.

8.489 Between 2010 – 2015 (AMP5), we maintained the low level of leakage achieved in AMP4. In this period, we focused on maintaining asset condition and delivery of smaller pressure management schemes to reduce company leakage by 2%.

8.490 Between 2015 – 2020 (AMP6) we committed to reduce leakage by 59 Ml/d through a combination of mains rehabilitation, pressure management and repair of CSLs from newly metered properties. Although we exceeded our leakage target in 2016/17 for the first time in 11 years, we recovered our leakage position to exceed our leakage target by 2019-20.

8.491 In the current planning period, 2020 – 2025 (AMP7), we have challenging targets to deliver a 20.4% reduction in our base level of leakage (as a 3-year rolling average) by 2024-25. This year (2021-22) we have met out 3-year average leakage performance target of 10.2% reduction against the baseline.

8.492 We faced several challenges during 2021-22 in part due to colder than average weather at the end of 2020-21 as well as resource challenges due to Covid-19 and market conditions.

8.493 The colder than average weather in early 2021 meant that our starting leakage position for 2021-22 was higher than we had initially planned for. For the first nine months of the year, we also had resource challenges which meant the delivery of our plan initially fell short. As a result, we reviewed our initial leakage delivery plan and created an enhanced plan to deliver additional leakage activity to recover the leakage position for the year.

8.494 Our 2021-22 enhanced leakage reduction plan focussed on a mix of innovation, increased productivity and data-driven decision making to support our ongoing leakage control activities. It included the deployment of an award-winning mobile application to improve leakage detection performance by targeting areas for leak location activity based on historical performance and the likelihood of a leak re-occurring due to network condition.

8.495 One of the key risks to delivery of the enhanced plan was the level of increase in leakage detection resource required. We mitigated this by purchasing additional leakage technology equipment to increase the acoustic logging capability and trialling new technology to provide insights into leak size to make sure that leak repairs could be prioritised more efficiently. Market conditions also had a considerable impact on repair resource. We worked with our partners through the year to review and increase team rates in line with industry benchmarks and supplemented resource by bringing in additional partners.

8.496 During 2021-22, we also created a Leakage Reporting and Insight Improvement Programme (LRIIP) which was designed to improve confidence in our data quality and processes, improve resilience, provide greater accuracy and consistency of reporting through assurance, and demonstrate how we will use insight to effectively deliver improved leakage performance expected by our customers and stakeholders.

8.497 The adaptive planning approach we have employed in 2021-22 demonstrates our ability to overcome both internal and external challenges to meet our leakage targets.

8.498 Appendix M - Leakage includes further detail about our leakage performance.

Can we reduce leakage further?

8.499 Customers and stakeholders have clearly indicated they wish to see leakage reduced (Appendix T: our customer priorities and preferences). Our ambition is to strike the right balance between our desire to reduce leakage further and the financial impact of leakage reduction on customers' bills. We also need to consider the need to maintain a robust and efficient water distribution network and the need to manage traffic congestion and household disruption that occur because of leakage reduction activity on our network.

Cost impact of further leakage reduction

8.500 Table 8 - 14 provides a summary of the activity required to achieve a leakage reduction of 40%, 50%, 60%, 70% and 80% by 2050. The leakage reduction volumes quoted in this table are the volume of leakage reduction we need to achieve between 2025 and 2050 to hit a given 2050 leakage target.

8.501 For context, our Deliverable scenario delivers 176 Ml/d of leakage reduction from 2024-25 to achieve a 50% reduction by 2050. The High scenario includes 198 Ml/d of activity from 2024-25 to achieve a 53% reduction by 2050. And the high plus scenario includes 218 Ml/d of activity from 2024-25 to achieve a 56% reduction by 2050.

8.502 To reduce leakage beyond our dWRMP24 scenarios, we would need to include more Leakage Innovation and Mains Rehabilitation activity. There are greater increases in Leakage Innovation to reflect the growing impact of technological advancements forecast for leakage detection and repair.

8.503 The installation of meters to detect and repair CSL is a key activity to reduce leakage, but we reach the maximum volume in our dWRMP24 scenarios because all meterable connections are metered. Therefore, the volume of metering cannot be increased to achieve greater volumes of leakage reduction.

Leakage Reduction by 2050[49]	What do we need to do?			Cost (£ billion)
	Metering	Leakage Innovation	Mains Rehabilitation	
40% = 108 Ml/d	Install 1.1 million meters, 47 Ml/d CSL reduction	46 Ml/d	634 km, 15 Ml/d	£1.4
50% = 176 Ml/d		77 Ml/d	3000 km, 52 Ml/d	£6.3
60% = 246 Ml/d		110 Ml/d	6600 km, 89 Ml/d	£13.9
70% = 316 Ml/d		174 Ml/d	7245 km, 95 Ml/d	£19.7
80% = 386 Ml/d		239 Ml/d	7765 km, 100 Ml/d	£25.3

Table 8 - 14 – Cost Impact of leakage reduction[50]

8.504 Table 8 - 14 shows that our Deliverable programme costs £6.3 billion to reduce leakage by 50% by 2050. To achieve a much greater reduction in leakage and achieve a 60% reduction by 2050,

[49] The Ml/d reduction volumes is the volume of leakage reduction between 2025 and 2050
[50] This includes the current unit cost of £1400 per meter, which will be reviewed for the Revised draft WRMP.

we double our Mains Rehabilitation activity to 6,600km and increase Leakage Innovation activity to 110 Ml/d. The programme to achieve a 60% leakage reduction would cost a total of £13.9 billion, £7.6 billion more than our Deliverable programme.

8.505 To go further and reduce leakage by 80% by 2050, we increase the mains rehab programme by 2.5 times the Deliverable programme to repair or replace 7,765km of mains and triple our Leakage Innovation programme to deliver 239 Ml/d of reduction. This programme would cost £25.3 billion, £19 billion more than the Deliverable programme.

8.506 If we wanted to achieve a leakage position that was 10% of DI by 2050, we would need to reduce leakage by 290 Ml/d between 2024-25 and 2050. This results in a 66% leakage reduction by 2050.

8.507 In deciding on our Deliverable, High and High Plus levels of leakage, we have balanced the impact on customer bills with the desire to significantly reduce leakage from 2017-18 leakage. Given the exponential impact on customer bills from greater reductions, we believe our dWRMP24 programme is the most cost efficient, deliverable, reliable and provides a lower impact on customer bills and disruption than including a programme with much greater leakage reduction.

8.508 All of the above assumes the cost of £1400 per meter, calculated through our current AMP7 Conditional Allowance programme. As stated earlier, we expect this cost to reduce due to the development of a strategic multi-AMP delivery programme which will include any length and benefit delivered by future Conditional Allowance programmes. We will review this the revised draft WRMP and include any changes.

8.509 Overall, this shows our reliance on mains rehabilitation and the need to innovate to achieve a sustainable, deliverable and cost-effective method to reduce leakage. Reductions in leakage also give other improvements in our overall network performance, such as interruptions to supply and resilience to weather shocks that are likely to become more frequent with climate change.

Thames Water