Revised draft Water Resources Management Plan 2019

Addendum to Statement of Response

14 June 2019
Version 1

from Southern Water

Contents

1 Introduction

Our draft Water Resources Management Plan (draft WRMP), published in March 2018, sets out in detail our proposals to create a resilient water future for our customers by ensuring that there is sufficient water to meet the projected demand over the 50-year planning period from 2020-2070.

In doing so, we have taken account of the anticipated environmental and climate change impacts on both supply and demand over the 50-year period. Our plan also shows our contribution to the development of a more resilient water supply in the South East region as a whole; not just in our supply area.

We held public consultation on our draft WRMP over a 12-week period between 5 March and 28 May 2018. 130 representations were received during this period. We considered each one of these and responded to the issues raised in our Statement of Response (SOR) published on 3 September 2018. We submitted a revised draft WRMP and associated documents to the Secretary of State alongside our SOR.

1.1 This document

Defra has reviewed our SOR and revised draft WRMP, supported by the Environment Agency (EA). Before submitting our plan to the Secretary of State for a decision on next steps, Defra in its letter dated 19 March 2019 has asked us to:

1. Further consider the reliability and uncertainty of bulk supply from Portsmouth Water.
2. Provide better assurance of outage recovery plan to deliver reductions to outage.
3. Remove unconfirmed sustainability changes from the baseline plan and address the uncertainties through scenario analysis.
4. Further assess the environmental impacts and demonstrate the viability of the preferred plan.
5. Ensure WRMP Direction compliance.

This document, which forms an Addendum to our SOR, contains our response to each of the five points in the Defra letter and details the additional work we have undertaken in order to provide the required information. We were required to respond by 14 June 2019, in order for Defra to further review our plan and make its recommendation to the Secretary of State.

Upon receiving direction from the Secretary of State to publish our final WRMP, we will incorporate the additional information provided in this Addendum into our final plan, as appropriate.

1.1.1 Assurance

In keeping with the process we adopted for our draft and revised draft WRMPs, we have undertaken assurance on the information provided in this Addendum. This included:

- Internal technical review;
- Technical assurance by consultants, Jacobs;
- Legal review by our legal advisors, Addleshaw Goddard;
- Security and Emergency Measures Directive (SEMD) review by one of the Atkins SEMD Certification team; and
- Sign-off from our Director of Corporate Strategy and Regulatory Affairs.

1.2 Stakeholder engagement since our SOR

1.2.1 Engagement with the Environment Agency

Since publishing our SOR and revised draft WRMP in September 2018, we have liaised closely with the EA in order to understand and address any concerns they may have relating to our WRMP.

We met with the EA in November 2018 to discuss progress with outstanding issues and commitments made in the SOR. We held another meeting with the EA on 29 March 2019 to discuss and clarify the requirements for further information requested by Defra.

On 20 March 2019, the EA provided an annex of minor issues that it had identified from its review of our SOR but did not consider them to be material to our plan. We have nevertheless addressed them in this document wherever possible.

We met the EA, Ofwat and Defra on 11 April 2019 to discuss the WRMP and its deliverability, particularly in relation to the Western area strategy. This was followed by another meeting with the EA on 15 May 2019 to further clarify some of the points. Further meetings are planned to ensure all parties have a common understanding of the key drivers in the WRMP and confidence in the proposed solutions.

1.2.2 Our Business Plan and engagement with Ofwat

We also submitted our Business Plan to Ofwat in September 2018, which sets out what we intend to deliver for our customers and the environment during the period 2020-2025. Whilst mainly focused on our investment needs for the 2020-2025 period, our Business Plan also includes allowances for carrying out feasibility studies and detailed design work for some of the large schemes in our WRMP that will be needed after 2025 but require a long lead-in time to plan and build.

Since we submitted the revised draft WRMP19 in September 2018, Ofwat introduced a new regulatory approach in January 2019 as part of its Initial Assessment Plans (IAP) of the 2019 Price Review in relation to the delivery of various strategic water resource schemes (across the country), including for the Fawley desalination scheme. The regulatory approach includes a “gated” process for funding of key stages of scheme development and delivery which are linked to an Outcome Delivery Incentive (ODI).

We responded to Ofwat with our initial views on 1 April 2019 and provided more detailed proposals on 3 May 2019, in particular to reinforce the requirement for the supply scheme solutions to be delivered by 31 March 2027 and therefore the need to deliver earlier than the dates suggested by Ofwat in the IAP. Our 3 May response set out the actions we need to take to assess the different options and that, given the environmental and delivery risks associated with the options, we need to start these actions now to inform decisions on the options and use the gated process to identify a preferred option.

1.2.3 Western Area Stakeholder Group

We have continued to keep key stakeholders in our Western Area informed of the progress with the WRMP and the Drought Plan. This includes our investigations and technical work on WRMP schemes, and the work we are carrying out in partnership with the EA, Natural England and other stakeholders to deliver the commitments we made in the Section 20 Agreement signed as a result of the Abstraction Licence Inquiry in 2018. This has been done through briefings to all of the key stakeholders through the Western Area Water Resources Stakeholder Group in January and May 2019.

1.2.4 Natural England

Natural England (NE) have provided feedback on the schemes we have proposed in our WRMP. Following the SOR submission, NE attended a meeting that we held with the EA and South West Water (SWW) to discuss a bulk-supply option from SWW that is included in our WRMP. We will continue to engage with NE to discuss any potential impacts of our proposed schemes on designated sites.

1.2.5 Other water companies

We continue to actively support the Water Resources South East (WRSE) group as it moves towards building a regional plan for the South East that takes into consideration other sectors and wider resilience issues. Our WRMP has considered the latest WRSE modelling outcomes and many of the proposed solutions are consistent with our plan and provide building blocks for future resource sharing and trading opportunities. We also attend the West Country Water Resources Group to support the consideration and investigation of schemes from this region which could benefit Southern Water and other companies in the South East.

Following the submission on the SOR, we wrote to other water companies in the country to explore potential future transfer options that were not identified at the time of draft WRMP submission. In this regard, we held a meeting with Wessex Water on 13 May 2019 to discuss possibilities of future transfers from the Wessex region.

We have liaised closely with Portsmouth Water to ensure alignment around the points raised in Defra's letter that affect both companies (see sections 2 and 4). In addition to e-mail exchanges and phone calls, we met Portsmouth Water on 24 April 2019 to share information and agree a common position.

2 Reliability and uncertainty of the bulk supply from Portsmouth Water

2.1 Defra's comment

In response to representations raised, the company's revised draft WRMP now aligns transfers and schemes with South East Water and South West Water (Bournemouth supply area). However, we are concerned the company has not adequately considered the uncertainty and risks to the deliverability of its planned import from Portsmouth Water to its Western supply area.

There may be some uncertainty in the yield of water from Portsmouth Water's source at Source J, which may have a consequential impact to the volume of water it may be able to transfer to Southern Water. Portsmouth Water has highlighted this uncertainty in its revised plan through its scenario testing; however Southern Water has not acknowledged or taken account of this uncertainty in its preferred plan. If Portsmouth Water cannot deliver the volume of water that Southern Water are expecting, this is highly likely to pose a risk to the security of supplies.

Southern Water should undertake further scenario testing around the reliability of the Portsmouth Water bulk supply for the final plan. It must work with Portsmouth Water to better understand the potential uncertainty and manage risks of this transfer and ensure that its plan reflects risks identified within Portsmouth Water's scenario and sensitivity testing. If any uncertainty is identified that may impact the deliverability of this option, Southern Water should identify alternative options and/or outline mitigation actions it might take to resolve

the uncertainty and lessen any adverse impacts to the supply-demand balance. We expect the final plan to clearly describe and address any uncertainty in its preferred programme.

2.2 Our response and proposed changes to our plan

This request for further information relates to the 9Ml/d bulk supply from Portsmouth Water, which is implemented in our preferred plan in 2024, to supply the Hampshire Southampton East Water Resource Zone (WRZ) in our Western supply area. The bulk supply is reliant on the yield from one of Portsmouth Water's sources, on completion of a scheme to maximise its Deployable Output (DO), which the EA has identified as being uncertain. The bulk supply may also be partially delivered through demand management and leakage reduction activity by Portsmouth Water in AMP7.

Portsmouth Water's preferred plan selects the option to maximise the DO of this source in 2024-25 (Option R022a in the Portsmouth Water plan). Portsmouth Water have advised that although the existing boreholes at the source are currently being investigated for water quality (nickel) reasons, Option RO22a involves maximising the DO of the source within existing licence limits by constructing a satellite borehole. This option does not involve any increase in licensed quantity. Whilst a licence variation will be required for the satellite borehole, the average licence volume will remain the same. The source originally produced the full licence volumes by abstraction from two boreholes. The satellite borehole will replace one of the existing boreholes where yield has been proven. Portsmouth Water have advised that it believes it may face opposition to developing Source J further due to the potential impact on the sustainable flows in the area. However, Portsmouth Water have advised that investigations undertaken by them have confirmed that Source J was sustainable because it is on the confined chalk. Further, Portsmouth Water has advised that is has already reduced its licence at its Source I to protect the River Wallington and Portsmouth Harbour and therefore believes the proposal is appropriate. The option will require supportive work with the Environment Agency to progress, and we understand that informal discussions have begun.

Nevertheless, we have considered the risks associated with this bulk supply option through inclusion of a scenario whereby this option is not considered. This will help us to understand the sensitivity of the strategy to the 9Ml/d bulk supply from Portsmouth Water and whether alternative schemes need to be considered. The results of this scenario suggest the following impacts on the strategy which are described in detail, along with other scenarios, in Annex 9. In summary:

- The Test Estuary WTW industrial reuse scheme (with a capacity of 9Ml/d) in the Hampshire Southampton West WRZ would be selected in 2024-25 in place of the 9Ml/d bulk supply from Portsmouth Water. We expect that this could be delivered within AMP7 provided the decision on the viability of the Portsmouth Water transfer is made early in AMP7. However, if the investigation is not completed until later in AMP7, then delivery of the Test Estuary industrial reuse scheme would be delayed into AMP8. We commit to work closely with Portsmouth Water to ensure timely decisions are made to progress this alternative scheme if necessary.
- The Woodside transfer (Hampshire Southampton West WRZ to Hampshire Southampton East WRZ) would be needed in 2027 (in addition to the Southampton link main) to allow water from the Test Estuary industrial reuse scheme to be transferred across to Hampshire Southampton East WRZ, where the Portsmouth Water bulk supply would have entered the supply system.
- There would be no other major changes to the strategy; although there would be minor changes to the way supplies are balanced across the Hampshire grid.

A second alternative option to the introduction of the industrial reuse scheme could be to increase the size of the Fawley desalination scheme to compensate for the loss of the 9Ml/d bulk supply, with the associated Woodside transfer to allow the additional volume to be transferred to the Hampshire Southampton East

WRZ. Although there would be a programme delay to implementation of such a scheme, as the Fawley scheme would not be available until 2027.

It is also worth noting that, if the Portsmouth Water's R022a scheme cannot be progressed, there may still be scope for a bulk supply that is less than the 9Ml/d preferred scheme which would still provide some additional water into the Hampshire Southampton East WRZ.

Southern Water committed in the S20 Agreement to use "all best endeavours" to ensure the delivery of the Long Term Water Resources Scheme as set out in the Final WRMP. Southern Water is undertaking the investigation and promotion of its WRMP preferred schemes and strategic alternatives for the Western Area, to ensure that it meets this commitment and successfully delivers the necessary solutions. This will include the Test Estuary industrial reuse scheme (with associated Woodside transfer), and consideration of different capacities for Fawley desalination. It is important to note that various decisions do not lie entirely with Southern Water – many will require timely decision-making by regulators, including Ofwat, the Environment Agency, Natural England, DWI and Defra.

Whilst both of the alternative option sets are deliverable, we clearly need to understand the status of the 9Ml/d bulk supply option at the earliest possible stage so that we can modify our preferred strategy, if needed. We would therefore hope that the joint investigation being carried out by Portsmouth Water and the EA in this regard can be concluded early in AMP7. We will continue discussions with Portsmouth Water and the EA on the progress of their investigation so that we can take a view as early as possible as to whether we need a strategic alternative. We shall seek key investigation milestones from Portsmouth and the EA, so that we can incorporate these into our delivery programme for the Western area. If the investigation by Portsmouth Water and the EA cannot be concluded until later in AMP7, it will clearly affect the deliverability of the alternative scheme, although it should still be deliverable in AMP8.

It is also important to understand that bulk supply agreements cannot be completely reliable in all drought events, as the donor company has a duty to maintain supplies to its own customers. It is not possible to be prescriptive as to how volumes available for bulk transfers will vary during any specific drought as this depends on a number of factors. These factors will include such issues as: the relative status of available supplies, both at the time and expected in the future; and demand restrictions in place for each water company. We adopt the policy that the general principles of the provision of inter-company bulk supplies rely on mutual support and equitable 'pain share' with regards to the provision of supplies during a drought.

Portsmouth Water and Southern Water are committed to meeting on a regular basis to discuss ongoing investigations and the delivery of schemes in order to keep each other informed of emerging risks to each company's respective water resources strategies. This bilateral liaison will be in addition to discussions at a regional scale through the WRSE group of companies.

3 Outage

3.1 Defra's comment

Representations from the Environment Agency and Ofwat raised concern over the high outage experienced by the company. The company has provided some further information to describe its outage allowance calculation which is reliant on delivery of its outage recovery schemes, but it has not satisfactorily addressed the concerns raised.

The company continues to be significantly above the industry average for outage, with total observed outage for 2017-18 being five times higher than its planned outage allowance. Persistently high outage is causing an unacceptable and immediate risk to the security of supplies across the company's supply area, and it also exacerbates existing significant deficits in its Western supply area that are the result of recent reductions to its abstraction licences.

The company also continues to appear not to follow good practice guidance on calculating outage. We cannot be assured that the outage allowance presented in its plan is accurate, that the company is doing all it can to reduce outage and has minimised the potential impact of outage on the supply-demand balance.

The company should provide further information to:

- *demonstrate how it has used information and data from recent high outage events to inform its outage allowance in the plan;*
- *provide its outage recovery plan to regulators and better describe how outage recovery schemes have been appraised, selected and prioritised;*
- *provide better assurance that it can and will deliver tangible outage reductions through its outage recovery schemes;*
- *more clearly set out the schemes' benefit to outage reduction and its impact on the supply-demand balance over the planning period; and*
- *describe how it will continue to improve its outage data collection to inform its next plan.*

3.2 Our response and proposed changes to our plan

3.2.1 Historic actual outage

Historically (from 1993 to 2010), our actual outage levels[1] were around 25 Ml/d or under. This is based on data comprising **full** outage events i.e. only taking account of sources whose full deployable output is unavailable. During AMP5 (2010 to 2015), Southern Water introduced a new system of 'triple validation' for water quality monitoring at its water supply works (WSW), which increased the frequency of site shutdowns. Consequently, reported outage increased to just under 60 Ml/d for **full** outage events. Another factor which has contributed to higher outage levels is the company's successful customer metering programme which, in helping to reduce the average demand for water by 16%, has led to lower abstraction and source outputs. The lower utilisation of sources has led to more system failures when attempts to increase source outputs above these lower levels have been made. We are using the lessons from this to improve our asset management processes and preparedness for drought events.

In 2015-16 we improved our reporting methodology to provide a better picture of resource availability by including **partial** outage events, which is when a site is operational but cannot achieve its full deployable output. The new methodology for reporting outage was shared with the EA in December 2015 and we reported provisional figures for **partial** outage in the 2016 Annual Review of our WRMP. At this point the **partial** outage dataset was subject to further investigation to understand whether the causes were legitimate

[1] Measured outage as reported to the Environment Agency. This is calculated in relation to the minimum deployable output (MDO) for groundwater and run-of-river surface water sources and average deployable output (ADO) for reservoir sources, and differs from the outage figure reported to Ofwat which is based on peak week production capacity (PWPC) of water supply works.

outage events. A further meeting was held with the EA in November 2016 to discuss outage definitions and reporting and since the 2017 Annual Review of our WRMP we have formally reported **partial**, **full** and **total** outage figures to the EA.

The consideration of **partial** outage events has led to a large increase in our reported **total** outage (consisting of **full** outage plus **partial** outage events). Figure 1 shows the historic outage from 1993 to 2019 and the introduction of the reporting of **partial** and **total** outage in 2015-16.

By including **partial** outage in our assessment of actual outage Southern Water has gone further than most other water companies in attempting to fully quantify our ability to achieve deployable outputs during design drought events to maintain supplies. Our **total** outage levels should not be compared to other companies who have not included **partial** outage in their assessment and only based their assessments on **full** outage events.

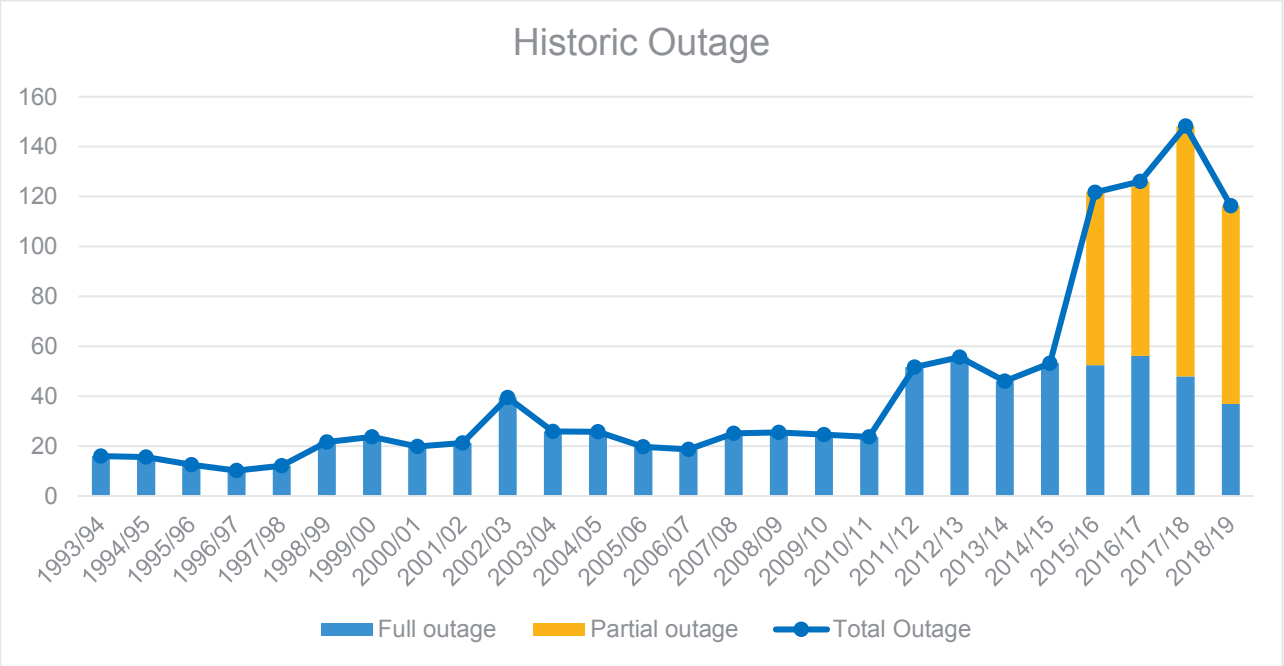

Figure 1 Historic actual outage

3.2.2 Outage allowance for the Water Resources Management Plan 2019

The methodology and assumptions we have used for the calculation of our outage allowance for the revised draft WRMP19 are set out in Appendix F of Annex 3 of the revised draft WRMP19.

In line with best practice our initial outage allowance assessment for the revised draft WRMP19 followed the UKWIR 1995 outage methodology[2]. The assessment was based on our **full** outage dataset recorded from

[2] UKWIR, 1995, WRP-0001/B Outage Allowances for Water Resource Planning

2015-16 to 2017-18 when sufficiently robust outage data was available. Whilst we have historic outage data prior to 2015-16 which includes the timing and location of outage events we do not have data on the causes of all these outage events which is needed to apply the methodology.

Monte Carlo analysis was used to develop a company level distribution of **full** outage events for the period from 2015-18 based on the nine water resources zones (WRZs) with **full** outage events in that data range. 10,000 simulations were run, across all the outage causes considered, to develop a distribution. This led to a **full** outage allowance of approximately 65 Ml/d, which is slightly higher than the May 2018 **full** actual outage figure of 58 Ml/d. This was the most up to date full outage figure available at the time of the analysis.

We considered that the results of the Monte Carlo simulation, referred to above, which followed the UKWIR methodology were not representative of an appropriate outage allowance in the long term due to the short dataset used in the analysis and the high actual outage experienced during the period when data was available. The assessed **full** outage allowance figure of 65 Ml/d is an overestimate of the actual outage we expect to be able to maintain throughout the course of our revised draft WRMP19. In addition, we needed a methodology that could take account of the more accurate actual outage data we were reporting (containing **partial** outage data) and the development and implementation of a focused outage reduction plan that was overseen by a new Operational Resilience group to manage water supply resilience risks.

Due to the need to base the outage allowance on a longer data set we then followed an adapted version of the Monte Carlo methodology that was previously adopted for Southern Water's final WRMP14 and our draft WRMP19. This is detailed in section 3 of Appendix F from Annex 3 and used a minimum period of five years of **full** outage data. An assessment of **partial** outage based on recent actual data was also made and added to the **full** outage allowance calculated using the Monte Carlo method. A **total** outage allowance of 79.6 Ml/d was derived by this approach but this was also considered to be too high as a long term outage allowance when compared to other water companies and Southern Water's previous WRMP outage allowances.

The Environment Agency's July 2016 technical note 'WRMP19 methods: Outage allowance' highlights that water companies should, where possible, use the UKWIR 1995 outage methodology, but if they decide not to they should discuss their alternative approach with the Environment Agency and clearly explain within their WRMP why they have chosen a different approach and the risks and benefits of doing so. The guidance note also urges companies to consider how the outage allowance could vary over the planning period and consider ways to reduce outage to manage supply-demand problems. As such we have developed a hybrid approach in line with this guidance which takes account of our current data availability and recent high **total** outage levels. We discussed aspects of our new approach with the Environment Agency in June 2018 as we considered what changes were necessary to our WRMP following the consultation on the draft WRMP19. This included the concept of having a different level of outage allowance for different severities of drought which we have adopted in the revised draft WRMP19 (see below).

The outage allowance we have used in the revised draft WRMP19 has been calculated based on our outage recovery plan (which is discussed further in the section below) and the historic **full** outage levels experienced during the 2005-06 drought event. The outage allowance is based on **total** outage (**full** plus **partial** outage) and on how we have forecast **total** outage to reduce in line with the outage recovery plan through the end of AMP6 to the end of AMP7.

The outage allowance profile follows a glide path, starting at 76 Ml/d at the beginning of AMP7 and reducing to 35 Ml/d by the end of AMP7 (see Figure 2). The outage allowance for the rest of the planning period from AMP8 (2025-26) to 2070 is set at 35 Ml/d in the normal and drought (1 in 20 year severity) planning scenarios in our revised draft WRMP19. In the severe drought (1 in 200 year severity) and extreme drought (1 in 500 year severity) planning scenarios the allowance for **total** outage is lower (29.5 Ml/d) to reflect the levels of outage that we expect to maintain during more severe drought events. This is based upon **full**

outage data from 2005-06 and includes an allowance for **partial** outage. Whilst the risk of some outage causes may increase in severe drought events (e.g. due to deteriorating raw water quality), we would do everything possible to fully utilise existing source of supply in order to maintain supplies to customers and avoid implementing drought permits and orders which have an environmental impact. The outage event of 2005-06 provides some evidence of the level of outage which could be maintained in such circumstances which is why we have used it as a best estimate of the outage allowance in severe and extreme droughts.

It is important to note that one of the key drivers to the approach we have followed in the revised draft WRMP19 is the fact that adopting higher outage allowances would result in larger supply-demand deficits, triggering a need for more or larger water resource schemes to manage the supply-demand balance. These would likely be more expensive than maintaining a lower outage level. However, there will be a point at which it becomes more expensive to maintain a low outage level than to implement a new demand management or supply scheme. We believe applying a similar concept as the economic level of leakage to outage could be explored further for the next round of plans.

- *provide its outage recovery plan to regulators and better describe how outage recovery schemes have been appraised, selected and prioritised;*

3.2.3 Outage recovery plan

Southern Water accepts that our actual outage levels in recent years have been too high, even when just considering **full** outage events. This poses a risk to customers' security of supply if droughts develop. The company Board is aware of the problem and an outage recovery profile has been derived and agreed with progress in delivery reported back to the Board on a regular basis. The company is committed to delivering the outage recovery plan set out below to enable it to reduce outage to acceptable levels in order to minimise customers' security of supply risk.

When the outage allowance for revised draft WRMP19 was derived, our **total** actual outage was 166 Ml/d (May 2018). By year end of 2018-19, **total** outage had reduced to 116 Ml/d because of outage recovery schemes delivered during the year. Further details of these are presented below. This reduction in **total** outage aligns with our outage recovery plan as discussed below.

The outage recovery profile which has been used to determine our outage allowance in the rdWMRP19 is shown in Figure 2. This is a plan for the reduction of **full** and **partial** outage at specific sources through to the end of AMP6 (March 2020) and then through to the end of AMP7 (March 2025). The plan is designed to tackle recent high levels of outage and reduce the risk of not achieving our planned customer levels of service. The profile assumes and incorporates the risk of an additional 10 Ml/d of new outage at the beginning of AMP7. This is approximately equivalent to having two average groundwater sources out of service and we consider that incidences of new outage can be maintained at this level through the asset maintenance programme moving forward.

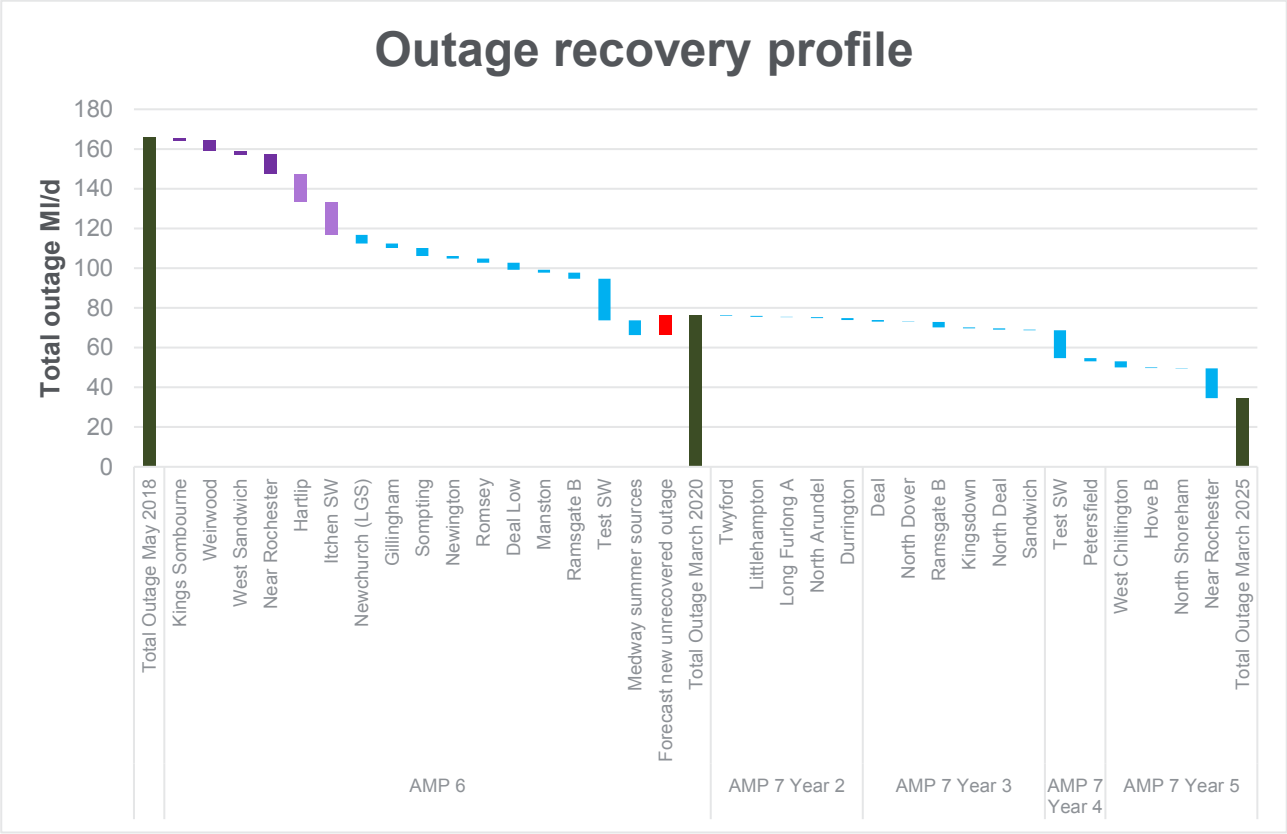

Figure 2 Outage recovery profile (Dark purple indicates sites fully recovered, light purple indicates sites with partially recovered and blue indicates schemes yet to be completed. Red indicates assumed new outage which may occur in AMP7)

The most notable planned reductions in total outage in AMP6 (2015-20) are due to schemes at our Hartlip, Itchen surface water and Test surface water sources. At the end of 2018-19 the Hartlip outage had been recovered, with schemes due to be completed for Test surface water and Itchen surface water sources by March 2020. Progress on the outage recovery plan towards achieving the outage allowance profile in the revised draft WRMP19 undergoes internal review and assurance on a monthly basis and we have committed to provide quarterly updates on progress to the Environment Agency.

The outage recovery plan used to inform the outage allowance in the revised draft WRMP19 was based on the outage situation at the time the allowance was calculated (May 2018). For the purposes of developing the outage recovery plan, Average and Minimum Deployable Outputs (ADO / MDO) stated in the WRMP14 were compared against maximum available source outputs to calculate outage as a temporary loss of deployable output. For the purpose of the outage recovery plan, **total** outage is used, which consists of **full** and **partial** outage.

The priority sites for outage recovery are dependent upon a number of factors. For the outage recovery plan, analysis was undertaken to better understand outage and where attention should be focused. This analysis considered the following:

1. Current outage against ADO / MDO
2. Current outage against previous historic maximum outputs
3. WRZ supply-demand deficits (against target headroom)

4. Cost of contingency water resource
5. Ability to recover deployable output
6. Site criticality in the WRZ

From these considerations a priority assessment of potential outage recovery options was made which ultimately formed the outage recovery plan.

The Test surface water and Itchen surface water improvement schemes are large capital investment projects which are due to be completed by March 2020. Following the recent (March 2019) abstraction licence changes on the Test and Itchen, we expect that the **partial** outage at Test surface water and Itchen surface water will be fully resolved via the work plan being completed in 2019-20. In assessing the new level of outage for the Test surface water and Itchen surface water sources we have taken account of the Section 20 Agreement between Southern Water and the Environment Agency which sets out a process for maintaining supplies to customers whilst a long term water resources solution is implemented. As such we will be measuring outage not against the new deployable output of these sources but against the maximum benefit that a drought permit or order will need to provide to maintain supplies until the long term solution is implemented.

The outage recovery plan was revised and extended in May 2018 due to the need to address rising levels of outage, as well as to produce an outage allowance profile for the revised draft WRMP19. This has led to a re-prioritisation of outage schemes and better governance around the delivery of the plan. Due to the nature of outage events, the recovery plan will be subject to continuous review and where necessary will be revised to address changing circumstances. We will continue to update the EA on a quarterly basis on any changes to the plan and on progress with its implementation.

The planned set of outage recovery schemes is set out in Table 1 with the resulting recovery profile in Figure 3. By the start of AMP7 **total** outage is forecast to have reduced by 90Ml/d to 76Ml/d. By 2024-25 **full** outage will have reduced from 58Ml/d down to 24Ml/d. In the same period **partial** outage will have reduced from 108Ml/d down to 10Ml/d bringing total outage down to 35 Ml/d.

The causes of outage for each site in the outage recovery plan are shown in Table 1. The majority of these are system failures or turbidity issues where work plans have been developed towards preventing or reducing the risk of future issues which could cause outage events. System failures include faulty monitors, mechanical shutdowns, and valves in need of repair and pump failures. They are often quite complex and require an investigation to determine what remedial action is necessary. The actions to resolve these would be the necessary repairs and system improvements to reduce or remove the risk of future outages.

Table 1 Outage recovery plan revised draft WRMP19

AMP/Year	State/SEMD Site Name	Total Ml/d	Outage cause	Full/Partial
	Total Outage May 2018	**165.7**		
AMP 6	Newchurch (LGS)	4.4	System failure	Full
	Kings Sombourne	1.4	Turbidity	Full
	Gillingham	2.2	System failure	Partial
	Sompting	4.0	System failure	Partial
	Weirwood	5.4	System failure	Full
	Newington	1.3	Turbidity	Full
	Hartlip	14.0	System failure	Full
	Romsey	2.2	System failure	Partial
	Deal Low	3.5	System failure	Full
	Manston	1.5	System failure	Full

AMP/Year	State/SEMD Site Name	Total Ml/d	Outage cause	Full/Partial
	Ramsgate B	3.0	System failure	Full
	West Sandwich	1.7	System failure	Partial
	Itchen SW	16.5	System failure	Partial
	Test SW	21.0	System failure	Partial
	Medway summer sources	7.4	System failure	Partial
	Near Rochester	10.0	System failure	Partial
	Forecast new unrecovered outage	-10.0		
	Total Outage March 2020	**76.3**		
AMP 7 Year 2	Twyford	0.3	System failure	Partial
	Littlehampton	0.5	System failure	
	Long Furlong A	0.15	Turbidity	Full
	North Arundel	0.5	System failure	
	Durrington	1	Turbidity	
AMP 7 Year 3	Deal	0.7	System failure	Full
	North Dover	0.21	Turbidity	Full
	Ramsgate B	2.8	System failure	Partial
	Kingsdown	0.44	System failure	Partial
	North Deal	0.6	System failure	Partial
	Sandwich	0.4	System failure	Full
AMP 7 Year 4	Test SW	14	System failure	Partial
				Full
	Petersfield	1.6	System failure	
AMP 7 Year 5	West Chiltington	3.12	System failure	Full
	Hove B	0.23	System failure	Full
	North Shoreham	0.14	System failure	Full
	Near Rochester	15	System failure	Partial
	Total Outage March 2025	**34.6**		

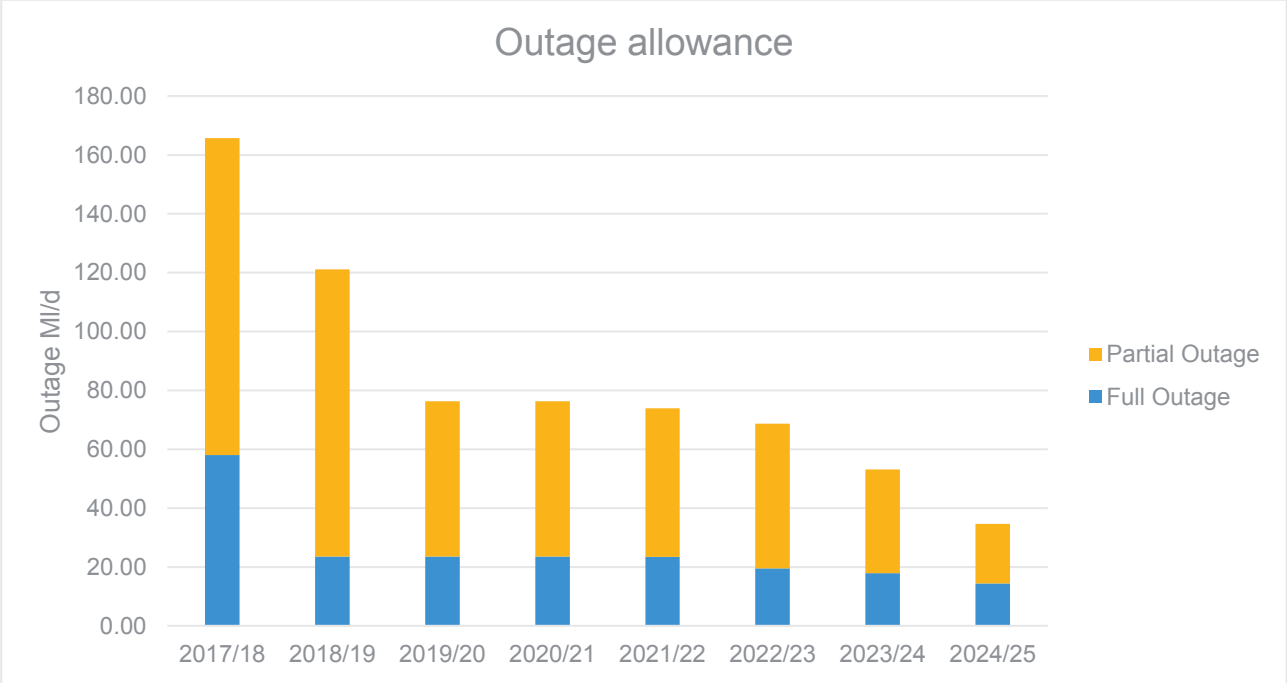

Figure 3 Outage recovery profile

- *provide better assurance that it can and will deliver tangible outage reductions through its outage recovery schemes;*

Our outage recovery to date (to year end 2018-19) against the AMP6 elements of the recovery plan has seen several schemes completed and outage reduced by approximately 50 Ml/d.

There has been a **partial** recovery at two sites:

- Hartlip 12.7 Ml/d
- Itchen surface water 4.5 Ml/d

There has been a **full** recovery of outage at four sites:

- Kings Sombourne 1.4 Ml/d
- Weir Wood reservoir 5.4 Ml/d
- West Sandwich 1.7 Ml/d
- Near Rochester 25 Ml/d

Our governance has been revised and improved for outage reporting. Overall outage reporting is owned by the Head of Planning and Resilience, with the Water Production Manager owning the process behind the data analysis and reporting. Monthly updates to the outage recovery plan are reviewed by the Operational Resilience group and we are implementing a new outage reporting system which will be internally assured on a monthly basis. This is, in part, to collect data for Ofwat's shadow outage metric and so the new reporting system will be fully compliant with Ofwat's revised reporting requirements as well as being consistent with our processes for reporting to all regulators.

As would be expected, while some sites are repaired and outage is recovered, other sites may go offline due to new outage events. Owing to the uncertain nature of these incidents the outage recovery plan will further adapt to these problems, but we expect it will still follow the overall glide path that forms the outage allowance in the revised draft WRMP19. Furthermore, we are working to improve our asset management and maintenance processes to better understand and reduce the root cause of outage events.

We will continue to provide quarterly updates on our outage recovery plan to the Environment Agency to demonstrate our recovery progress and to allow transparent reporting of our outage levels. Our most recent update was provided in May 2019.

- *more clearly set out the schemes' benefit to outage reduction and its impact on the supply-demand balance over the planning period*

Figure 4, Figure 5 and Figure 6 show the final planning supply demand balances in the Western, Central and Eastern supply areas respectively for the Dry Year Annual Average planning scenario in the severe drought (1 in 200 year severity) state of the world. The figures show the final supply demand balances with the planned outage recovery schemes implemented and the impact on the supply demand balances if they are not. The outage recovery plan assumes the profile in Figure 2 and much of the outage should already have been resolved by 2020-21.

In the Western area there is an immediate supply demand deficit due to the Test and Itchen licence changes which cannot be solved in the short term without the reliance on drought permits and orders to maintain supply to customers. Figure 4 incorporates the maximum benefit of drought permits and orders that are required to recover the supply demand deficit. If the Test surface water and Itchen surface water schemes are not delivered, then we would not be able to fully benefit from the Test and Itchen surface water sources with a drought permit or order in place. Although Figure 4 shows the supply-demand situation at the area level to be positive which assumes a full benefit from the drought permit and orders available, the situation is different at WRZ level. If the outage recovery plan is not delivered there would be a supply demand deficit in the Hampshire Southampton West (caused primarily by outage at Test surface water source) and Isle of Wight (caused primarily by outage at Newchurch (LGS)) WRZs even with drought permits and orders in place. Furthermore, any delay or failure to recover outage in the Western area could increase the frequency of needing to apply for and implement drought permits and orders.

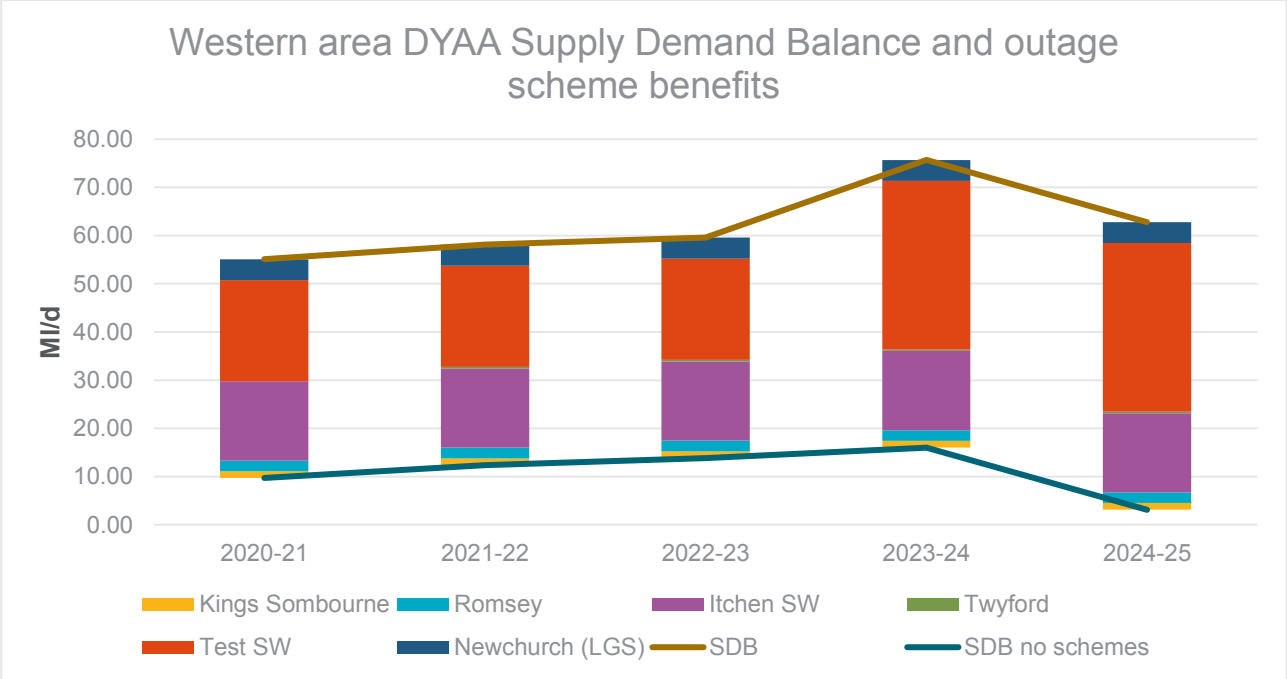

Figure 4 Western area supply demand balance (WAFU minus forecast demand) showing the benefits of the outage schemes in the outage recovery plan

In the Central area the supply demand balance is also positive at the area level with the outage recovery plan both implemented and not delivered. However, at the WRZ level, if outage schemes are not delivered, this would lead to a supply-demand deficit in the Sussex Brighton (caused primarily by outage at Sompting source) and Sussex North (caused primarily by outage at Weir Wood reservoir) WRZs.

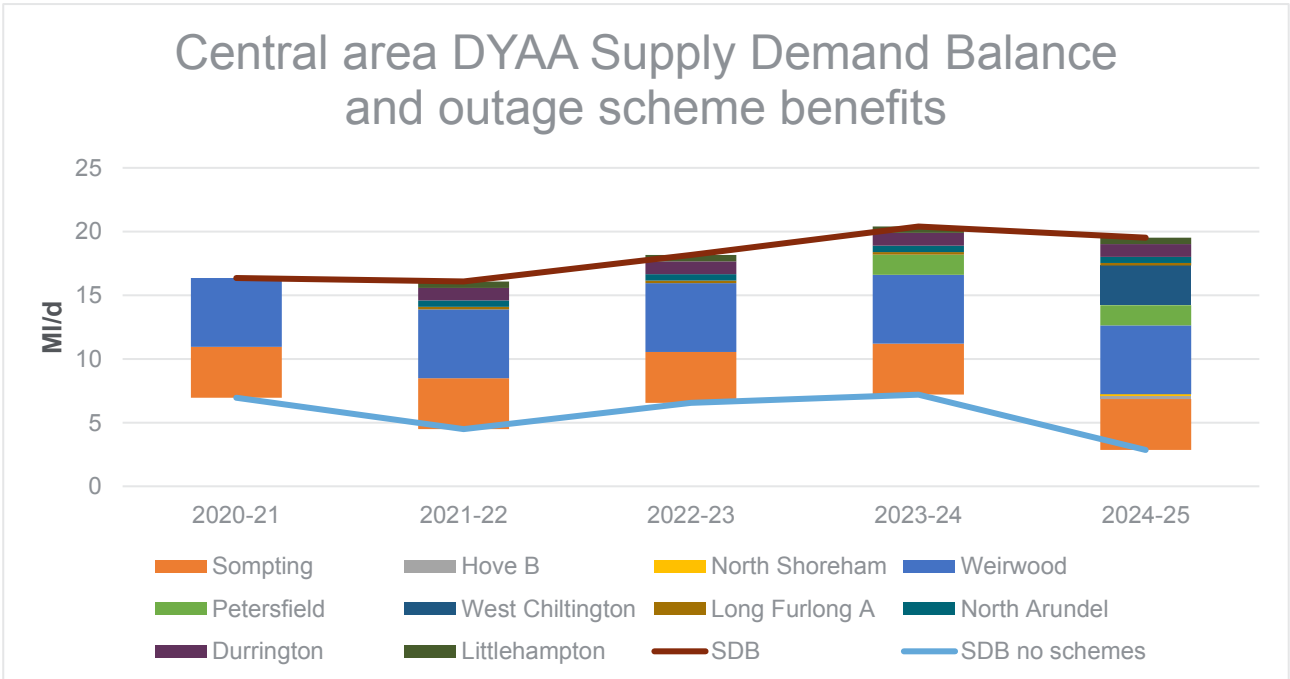

Figure 5 Central area supply demand balance (WAFU minus forecast demand) showing the benefits of the outage schemes in the outage recovery plan

In the Eastern area there is a surplus in the final planning supply demand balance, however, as can be seen in Figure 6, there would be a supply demand deficit at the area level if the outage recovery plan were not to be delivered. This highlights the importance of delivering the schemes in our outage recovery plan.

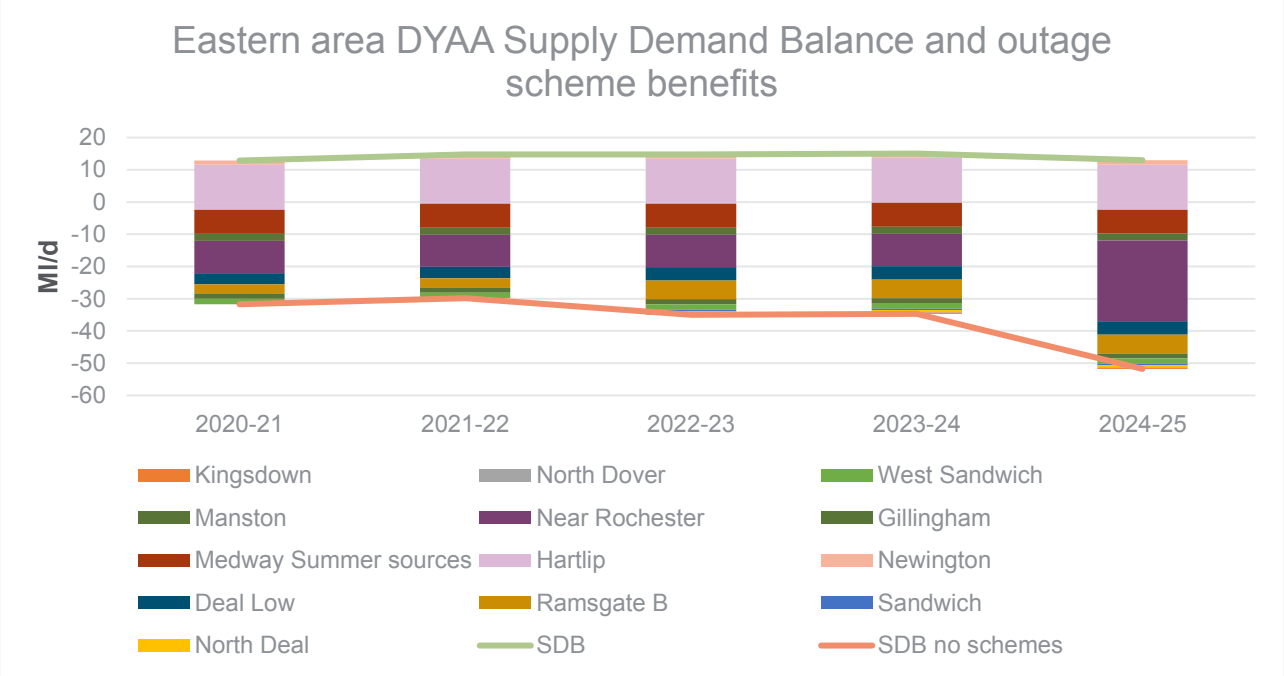

Figure 6 Eastern area supply demand balance (WAFU minus forecast demand) showing the benefits of the outage schemes in the outage recovery plan

- *Describe how it will continue to improve its outage data collection to inform its next plan.*

Since April 2019 our outage reporting has improved further to ensure we are fully compliant with the Ofwat AMP7 outage methodology[3]. This looks at the failure or deterioration of any asset in the water production process which impacts on the ability to achieve the peak week production capacity (PWPC). The PWPC is essentially the maximum sustained capacity output of a WSW and could be the constraint on deployable output. In other instances, it will be greater than the deployable output where there are other constraints such as, for example, the hydrological yield of a source in the design drought. The process of collecting data to report against the PWPC also allows us to compare failures against the ADO / MDO to provide data consistent with outage reporting to the EA. This provides fully assured data that is directly comparable across both methodologies.

We are concurrently running the old and new reporting methods until the new process is fully established as reliable and accurate. The Water Production Manager owns the process for reporting outage. Monthly updates to the outage recovery plan are reviewed by the Operational Resilience group and we are implementing a new outage reporting system which will be internally assured on a monthly basis.

[3] Ofwat, 2019, Reporting guidance - unplanned outage (updated)

Telemetry data is used to indicate asset faults or failures, with this being recorded as the start of the outage period. This telemetry data is then linked to SCADA (supervisory control and data acquisition) data, which provides flow volumes and work completion information. Once all required work is complete, the final completion date and time is used as the end of the outage period. This period of outage is then compared to internal records to separate planned outage. Flow data from the site is then used to determine the volume of water put into supply during the period of outage, ensuring that both **full** and **partial** outage are captured. This flow data is compared against PWPC and MDO to produce comparable figures for both Ofwat and the EA. Further validation is also carried out against exclusion criteria, and to ensure that if there has been a failure of the telemetry system, any reduction in flow is still captured and investigated to ensure no outages are excluded in error and similarly to ensure that no instances of low demand are incorrectly captured as outage. The reports will be assured on a monthly basis in terms of data accuracy and then again on a yearly basis against reporting requirements.

Quarterly updates will be provided to the Environment Agency to update them on outage recovery.

4 Unconfirmed sustainability changes

4.1 Defra's comment

In its revised draft plan, Southern Water has incorporated an unconfirmed sustainability change (River Itchen) into its baseline supply forecast from 2024/25 onwards. This is in contrast to guidance within the WRMP19 planning guidelines, although we recognise we will be considering how to improve the arrangements for incorporating environmental improvements within future WRMPs.

The future long term target flow regime for the River Itchen has not yet been determined and will be agreed as part of an AMP7 WINEP investigation so as such is still unconfirmed. Due to the uncertain impact of unconfirmed sustainability changes on the supply forecast, these investigations should be considered through scenario analysis. In addition, the company has not taken the same approach across its supply areas, this approach is only being taken in its Western supply area. The approach the company has taken to modelling and reporting this uncertainty in its revised WRMP is also not consistent with Portsmouth Water. The River Itchen source is used by both Portsmouth Water and Southern Water. A change in the target flow regime for this river will impact both companies and it is important that both companies model and report on this uncertainty consistently.

Given the current uncertainty around the target flow regime on the River Itchen, the company should demonstrate how this may affect its selection of options and provide assurance its plan can adapt to account for the range of possible future supply-demand deficits it faces. This should include ensuring that the desalination plant at Fawley has the flexibility to alter the output volume, following the outcome of the WINEP investigations. We understand that doing so should not delay you meeting the timetable for developing a solution for the area, as agreed with the Environment Agency (s20 agreement).

The company should:

- *remove the unconfirmed sustainability reduction from the baseline supply forecast and consider likely impacts through scenario testing.*
- *justify how any scenario testing has been used to inform its preferred plan and the selection of the size of Fawley desalination plant.*
- *work with Portsmouth Water to ensure a consistent modelling approach is adopted.*
- *provide assurance its plan can adapt to account for the range of possible future supply-demand deficits it faces.*

4.2 Our response and proposed changes to our plan

At the end of the Western Area Public Inquiry in March 2018, the EA's closing statement referred to the prospect of a further review of the proposed Hands off Flow (HoF) conditions on the River Itchen licences at the point of intended renewal in 2024.

Whilst these revisions still have to be investigated during AMP7 (2020-2025), the last independent review[4] of the HoF conditions proposed a flow condition of 224Ml/d, which is higher than the current conditions of the recently amended licences (198Ml/d).

We used this estimate of 224Ml/d as the potential new HoF condition on the River Itchen licence in order to assess the likely impact on the supply forecast post 2024. We included the impact of this additional sustainability reduction on the River Itchen from 2024 in the baseline supply forecast in our revised draft WRMP. It was deemed prudent to do so, given that it was raised in evidence during the Public Inquiry.

The rationale for including the unconfirmed additional River Itchen sustainability reduction in the baseline supply forecast, was to try to ensure that the solutions we are developing for the Western supply area are capable of accommodating this additional change to the licence over and above those which had been agreed at the Inquiry. This additional change could occur as soon as the next AMP and there may therefore be limited time to develop and implement an alternative source to address the licence change. We felt it was critical that this was included in the analysis and planned for as not including it could delay the programme for developing a solution for the area, because it may require a later revision to planning application documentation or trigger entirely different schemes. Southern Water committed in the Section 20 Agreement to use "all best endeavours" to ensure the delivery of the Long Term Water Resources Scheme as set out in the Final WRMP. Southern Water is therefore undertaking the investigation and promotion of its WRMP preferred schemes and strategic alternatives for the Western Area, to ensure that it meets this commitment and successfully delivers the necessary solutions.

As instructed by Defra, we have revised this assumption, and will instead include the uncertainty associated with this further sustainability reduction. This is consistent with the consideration of other uncertain and unconfirmed sustainability reductions in our plan, across all supply areas. However, as we describe below, the key issue with the additional SR on the Itchen is that, should it be confirmed, it is expected that it would then be implemented before the end on AMP7, as indicated by the Environment Agency in the evidence at the March 2018 Public Inquiry.

We have also assessed, in discussion with Portsmouth Water, the potential impact that this additional sustainability reduction on the River Itchen could have on Portsmouth Water's abstraction from the river.

[4] Wilby, R. 2010, An assessment of invertebrate-based target flows for the River Itchen, Hampshire, Technical Note prepared on behalf of WWF-UK Rivers on the Edge Technical Support (GB900135) http://www.hwa.uk.com/site/wp-content/uploads/2017/12/Doc-2-WWF-Professor-Wilby-2009.pdf

4.2.1 Revised approach to inclusion of the unconfirmed additional sustainability reduction on the River Itchen in our plan

As stated in the Defra response there are a number of proposed WINEP schemes in AMP7 which may lead to derivation of alternative flow targets, these include:

- Common Standards Monitoring Guidance (CSMG) for flow targets on the River Itchen. This will be carried out jointly with Portsmouth Water and South East Water.
- Investigations and Options Appraisal of abstraction impacts on the Candover Stream (a tributary of the Upper Itchen). This will be carried out jointly with South East Water.
- The Itchen Wetlands investigation on abstraction impacts on any Site of Special Scientific Interest (SSSI) and priority habitats (including the Southern Damselfly).

Until these investigations are complete, we felt it was prudent to use the 224Ml/d HoF condition to try to understand the impacts that this potential additional sustainability reduction could have in the Western supply area.

In order to comply with the instruction from Defra and the EA, we have changed our approach for the final WRMP, and allowed for the inclusion of the uncertainty in a way that is wholly consistent with the approach used for other “unconfirmed” sustainability reductions.

A Real Options approach has been used to inform the decision making for the WRMP strategy, as described in detail in Annex 8 of the WRMP. This approach solves the supply demand deficits simultaneously for seven different ‘states of the world’ across five different ‘futures’ or ‘branches’.

- ‘States of the world’: represent a snapshot of different climatic conditions and intra-annual pressures on water resources and demands, from normal year through to severe and extreme droughts, looking at periods when water supplies are at their minimum, and at periods of peak water demand during summer months.
- Different possible ‘futures’ modelled by different ‘branches’: represent a plausible set of future supply demand balances for which different solutions may be required.

The use of different futures in the Real Options approach effectively recognises that the future is not certain, and so the method tries to identify how solutions may change through time in the face of different possible future water resource pressures. The objective of our approach is therefore, to ensure that the plans cover a wide, yet appropriate, range of futures to ensure that all the key strategic options are identified. This is critical because there may not otherwise be sufficient time from when the sustainability reductions are confirmed for implementation to develop appropriate schemes. These uncertain futures are a key reason why we have adopted the Real Options approach – so that key schemes and alternatives which address these uncertainties can be investigated and progressed in parallel to the preferred plan. Should the magnitude of the future uncertainties be less severe, then some of the schemes would not need to proceed past feasible investigation and planning / promotion stages. However, the company has little choice but to conduct these investigations of alternative and preferred schemes through AMP7 (and AMP8), given the scale of uncertainties the company faces in the next 10 years.

It must be noted that, **until we reach the point at which the branches diverge (from 2027 onwards), there is a common supply-demand deficit based on the middle (50th percentile) branch**. This is described in detail in Annexes 8 and 9 of the WRMP. Therefore, **we are effectively including and planning for the additional Itchen sustainability reduction in 2024, even where we have allowed only for the uncertainty associated with the unconfirmed sustainability reduction on the Itchen in 2024** (as discussed below). The only difference is that there then may be a reduction in the deficit from 2027 onwards in some of the lower deficit branches (reflecting the potential that the additional Itchen sustainability

reduction may not materialise). As described below a similar strategy is selected in our scenario without the additional Itchen sustainability reduction, with only one difference – the size of the Fawley desalination plant.

Unconfirmed sustainability reductions are incorporated into our scenario generator model. The output from the scenario generator model is a range of plausible future supply-demand deficits at different levels of probability combining the various uncertainties. There are three scenarios or "cases" of sustainability reduction that are included within the uncertainty model, as described in detail in Annex 3. For each of these, we have assigned a distribution to allow the uncertainty to be combined with other uncertainties (demand growth, climate change) in our scenario generator model, as described in Annex 5.

The three cases and their associated probability are summarised as follows:

- A Lower case that includes only "green" sustainability changes; assumed to have a 25% probability;
- A Middle case that includes "green" and "amber" sustainability changes and a pragmatic estimate of the "red" sustainability changes; assumed to have a 25% probability; and
- An Upper case that includes "green", "amber" and "red" sustainability changes and a pragmatic estimate of any further sustainability changes that may be required following investigations and options appraisals or driven by future legislation or requirements; assumed to have a 50% probability.

Table 2 Summary of sustainability reductions by WRZ

WRZ	Lower case (25% probability)*	Middle case (25% probability)	Upper case (50% probability)
Hants Southampton East	Itchen, Twyford – included in baseline DO figures.	Additional Itchen sustainability reduction in 2024 – to HoF 224Ml/d	Additional Itchen sustainability reduction in 2024 – to HoF 224Ml/d
Hants Southampton West	Lower Test. Included in baseline DO figures.	As Lower	As Lower

*Additional Itchen sustainability reduction in 2024 - to HoF 224 was previously also included in the Lower case in the revised draft plan.

In order to remove the additional Itchen sustainability reduction from the baseline forecast and consider it like other unconfirmed sustainability reductions, we have made certain assumptions that are set out in Table 2 above.

The revised distribution reflects our experiences of the sustainability reductions process over the last few AMP cycles. For example, we were unable to include a sustainability reduction for the Test in our Draft WRMP14 (published in May 2013), yet by the time of the next draft plan for WRMP19, we faced the prospect of a licence change leading to the full loss of deployable output of this source, which was confirmed following a Public Inquiry held in March 2018. This had a significant impact on the supply demand balance for the Southampton WRZs within a short 5 year timeline. We believe our approach is therefore a reasonable and pragmatic attempt to account for the uncertainty around potentially very significant impacts of sustainability reductions on our supply-demand balance. The timing of most of the sustainability reductions is another critical factor. Except for the confirmed and the additional sustainability reduction on the Itchen, the other sustainability reductions are assumed to occur in 2027. This does not allow much time to plan for and develop new resources to address the deficits that would result. Through our real options modelling, we can assess how these and other uncertainties related to growth and climate change, may affect the plan, and select a preferred plan that can address whichever "future" we actually end up with.

To be consistent with inclusion of other unconfirmed sustainability reductions, we have assumed that the above approach will be used in the main planning scenario that is used to determine the preferred plan.

4.2.2 Impact on the preferred plan

There is little change from the revised draft plan in terms of the key strategic schemes that are required to address the significant deficits we face in our Western Area. Our plan has set out that the Fawley desalination scheme needs to consider a range of potential capacities, depending on how an whether some uncertainties occur, including with bulk supplies and further sustainability reductions. This is discussed further below, in comparison with our approach used for the revised draft WRMP.

A key part of our strategy, alongside bulk supplies from neighbouring water companies, significant leakage reduction and further demand management activity, is the need for a new large scale scheme – the desalination scheme. This can be modular in design, so the capacity of the scheme can be altered in response to changes in the supply-demand deficit to be addressed (both in the short and in the longer term). However, this adds to the risk on the delivery programme as different treatment capacities may have differing footprints, or may require different associated infrastructure, which may have an impact on the planning case that must get approved prior to construction of the scheme. As a result, the earlier we can agree with the EA whether there will be any further sustainability reductions, and then understand the consequent supply-demand deficit that we need to plan for, the lower will be the risk to the delivery programme for the Western area to address our Section 20 Agreement commitments.

Whilst the desalination scheme is modular, if the HoF on the Itchen is very different to what has been assumed to date (i.e. a new HoF of 224Ml/d), then this could affect the size of the desalination scheme. For example, if the desalination scheme needed to be larger than 75Ml/d as a result of the EA implementing a higher HoF on the Itchen, then additional infrastructure may be needed in order to move water from the west of the Solent to the eastern side. It may also affect the approach used for securing planning approval. We have made a pragmatic assumption of the possible HoF that could be imposed by the EA, based on best available evidence, but as Defra's letter states, this is not yet confirmed. Hence, we are planning in the face of uncertainty. Our approach aims to ensure we are as robust as possible in the face of that uncertainty. It is important to remember that many decisions do not lie entirely with Southern Water – many will require timely decision-making by regulators, including Ofwat, the Environment Agency, Natural England, DWI and Defra.

For comparative purposes, we also included two further scenarios to allow us to more fully understand the impact that this unconfirmed, yet probable, sustainability reduction could have on the plan:

- Inclusion of the additional Itchen sustainability reduction in the baseline supply forecast – which is equivalent to the run made in the revised draft WRMP.
- No additional Itchen Sustainability reduction nor allowance for the uncertainty associated with it.

Comparing the results of our new preferred plan, based on the inclusion of the uncertainty of the unconfirmed additional sustainability reduction on the Itchen (as set out above), with the **scenario where the additional Itchen sustainability reduction is forced into the baseline supply forecast (the revised draft WRMP approach)**, there is very little difference in the strategy. This is because, in accordance with our approach to including the unconfirmed sustainability reductions described previously, the additional Itchen sustainability reduction would be in place in 2024, and up until 2027 we use the middle (50th percentile) branch as the common branch to all futures until the branches split in 2027. The additional Itchen SR is included in the Middle and Upper sustainability reduction cases, and so effectively will account for the sustainability reduction being applied in 75% of the analysis. Therefore, the 50th percentile branch is likely to include the additional SR on the Itchen.

The sustainability reductions (and the impacts of the uncertain unconfirmed ones) are assumed to be implemented by 2027, and in 2024 for the additional Itchen sustainability reduction, and so solutions to the deficit need to be developed in AMP7 due to the planning and construction time required before a scheme is ready for implementation. The Real Options approach effectively identifies the set of schemes in the short term which are worth investing in, regardless of the future deficit the company ends up with. Timing is therefore a critical factor, and the short term nature for the implementation of sustainability reductions is, by necessity, a critical factor in the decision making process.

When we compare the results of our new preferred plan with the **scenario where there is no additional sustainability reduction (and no allowance for the uncertainty of that sustainability reduction)**, the size of the Fawley desalination scheme is reduced to 50Ml/d in 2027 (from 75Ml/d in the preferred plan), with the need to increase this from 50Ml/d to 75Ml/d in 2029, but only in 1 branch. This is shown in branch diagram in the Figure below for both the preferred plan and the “no additional Itchen SR” scenario.

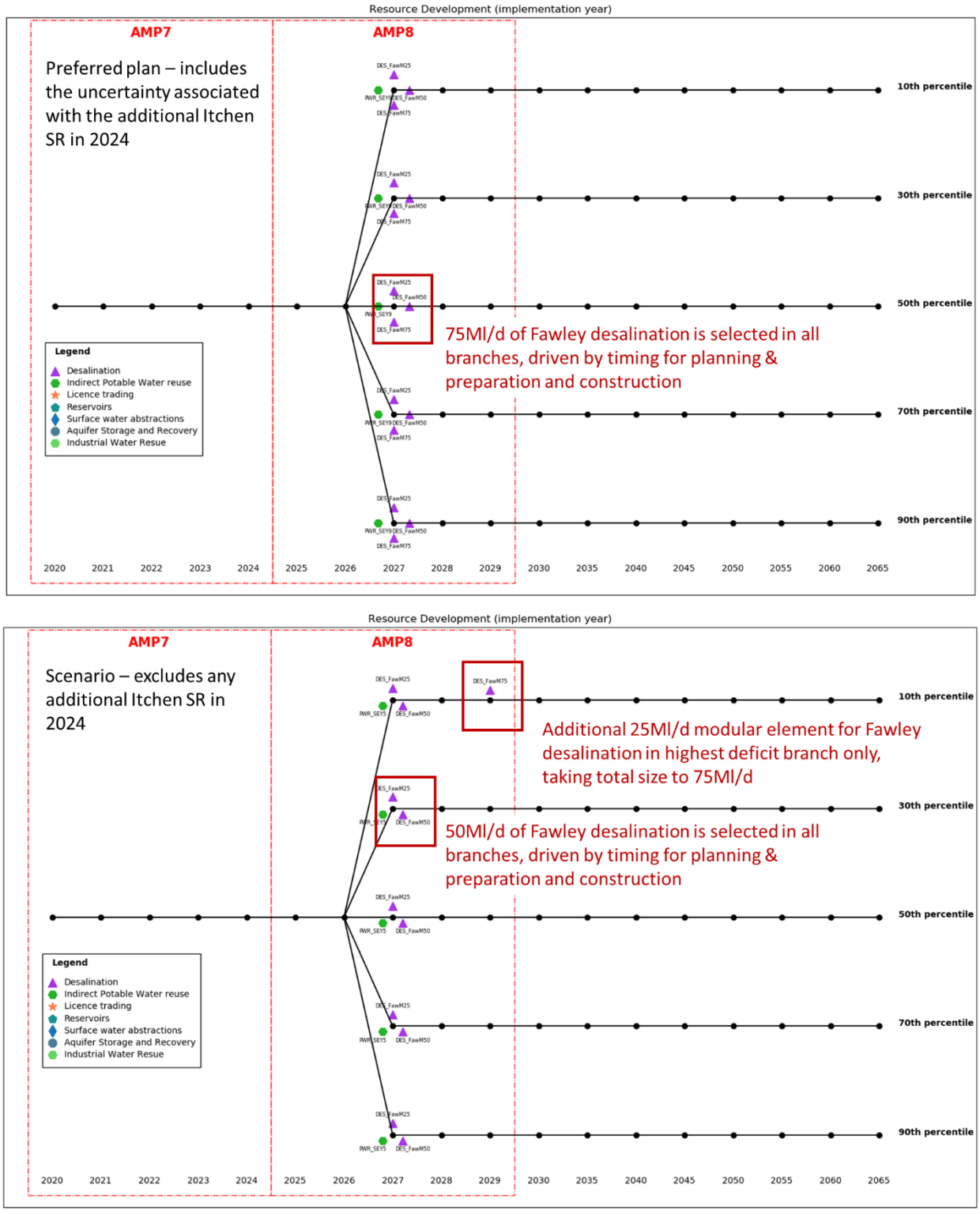

Figure 7 Branch diagram for the "no additional Itchen SR" scenario compared to the preferred plan

This suggests that the preferred plan is broadly stable – to address the other drivers of deficits in the Western supply area (e.g. the sustainability reductions already enacted on the rivers Test and Itchen) a large scale scheme is still required. Whilst the capacity of that scheme may be reduced if the additional Itchen

sustainability reduction does not occur, it does not otherwise fundamentally change the strategy. In order to ensure we are complying with the S20 Agreement to use “all best endeavours” to ensure the delivery of the Long Term Water Resources Scheme as set out in the Final WRMP, we must undertake the investigation and promotion of our preferred schemes (and strategic alternatives). And this must, on the basis of the above analysis include the 75Ml/d Fawley desalination scheme. And in the face of other uncertainties (around sustainability reductions and bulk supply options for example) we should also consider a larger desalination scheme as a strategic alternative to some of our preferred planning schemes, along with other strategic alternatives such as Itchen water reuse schemes.

4.2.3 Impact on the bulk supplies from Portsmouth Water

We have also reviewed our assumptions around future unconfirmed sustainability reductions and the reliability and alignment of our yield assessments for sources close to the River Itchen and with those carried out by Portsmouth Water for their surface water abstraction on the River Itchen.

The approach to assessing deployable output on the River Itchen will be reflected in an updated section of Annex 3 in the final WRMP.

An important consideration in Defra’s response is to align our assumptions on the sustainability reductions and potential sensitivity to DO on the Lower Itchen such that both companies are consistent in their approach. This may consequently have a bearing on assumptions around the resilience and reliability of bulk supply arrangements between Portsmouth Water and Southern Water.

We recognise that we have employed a different methodology to Portsmouth Water for our DO assessments in the Lower Itchen catchment. As our Lower Itchen DO assessment methodology is readily adaptable, we carried out an initial yield assessment for the Portsmouth Water source consistent with our modelling methodology, and have shared this assessment with Portsmouth Water, and both companies were in agreement over the conclusions of that analysis.

The results of the yield assessment indicate that the DO is resilient when tested using the same technique we have used to assess the DO of our Lower Itchen sources and that at least 20Ml/d is available in severe drought. The yield is essentially sustained by, and highly sensitive to the assumed discharge from Chickenhall WWTW. Consequently, even when a conservative severe drought discharge from Chickenhall WWTW of 20Ml/d is assumed, the stated 20Ml/d yield is likely to be maintained. This appears to be the case even if there are future licence changes or revised flow targets on the River Itchen. Yields could decline for more extreme droughts e.g. 1 in 500 year events under a revised flow regime.

We have therefore assumed that the DO from the Portsmouth Water bulk supply (dependent on them having developed Havant Thicket reservoir) can be maintained at 21Ml/d for our preferred planning model runs. Portsmouth Water and Southern Water are committed to meeting on a regular basis to discuss ongoing investigations and the delivery of schemes in order to keep each other informed of emerging risks to each company’s respective water resources strategies. This bilateral liaison will be in addition to discussions at a regional scale through the WRSE group of companies. We will continue to work towards a common assessment approach to resource assessment on the River Itchen.

However, we have also undertaken a scenario test of the preferred plan where the supply during a 1 in 500yr event is halved, alongside other bulk supplies into the Western supply area (the 9Ml/d bulk supply from Portsmouth also halved, while the 20Ml/d supply from South West Water is reduced even further to a “sweetening flow” only). This will test the sensitivity of the plan to the performance of the bulk supplies in the face of more extreme events. Such a scenario had been included in our revised draft WRMP.

The results of this modelling change suggest little difference in the strategy, as there is capacity within the desalination schemes in the extreme drought conditions to compensate for the reduced amount from Portsmouth Water in these extreme events. The main constraint is being able to move enough water from west to east in the branch with the largest deficit, and so the Woodside transfer is needed (in addition to the Southampton link main), but in the highest deficit, 10th percentile branch only.

We have therefore concluded that our plan can adapt to the uncertainty around this additional sustainability reduction, subject to **potential risks to the delivery programme that could arise if the associated investigation is not agreed early in AMP7, or the result of the investigation is a higher HoF than we have allowed for**.

5 Environmental assessment requirements

5.1 Defra's comment

Fawley Desalination Scheme:
The company has still not adequately addressed multiple concerns raised relating to the environmental impacts resulting from the building and operation of the proposed desalination plant. Until further modelling is undertaken on a wider range of environmental risks, there is uncertainty around the environmental feasibility of this option, and therefore the deliverability of the preferred plan to address supply deficits in the Western area by 2030.

The company should complete a full and thorough environmental assessment to determine all possible environmental impacts of this option, alone and in-combination. The company's environmental assessment contains several assumptions and statements that do not appear to be evidence based, and does not appropriately take account of or reflect the environmental risk of preferred options in the Western area. When undertaking the environmental assessment, the company should first present the impacts and then demonstrate how mitigation measures will reduce the risk to an acceptable level.

Whilst the company has provided a programme of works for the development of its desalination option; it is already significantly behind schedule. It has not finalised a site location, carried out the further modelling or started to collect baseline data. There is a significant risk to delivery of this option within the committed timescales if the company does not undertake the work needed to progress this option.

Alternative Schemes:
The company has further considered alternative schemes to desalination, and its preferred alternatives are effluent reuse on the rivers Test and Itchen. The company has made some assumptions about the environmental standards it will be required to meet, and these assumptions and uncertainty are not reflected in the company's revised WRMP. We are concerned that this may pose a risk to viability of these scheme as alternatives.

The company should:

- *present and commit to a detailed and appropriate timetable for undertaking further modelling on a wider range of environmental risks in relation to its desalination scheme to demonstrate the environmental feasibility of the desalination option at Fawley by 2030. The company should ensure it works with and consults its stakeholders including the Environment Agency and Natural England when undertaking this further work. This should include clarifying whether the Testwood pipeline would be required or not, and exactly how the pipeline has been re-routed to minimise impacts to designated sites;*

- *demonstrate that all risks have been appropriately considered and where needed, there are effective mitigation actions in place to minimise environmental impacts of the preferred plan;*
- *better consider a wider range of uncertainties and in-combination effects within its assessment of alternative schemes, to demonstrate they are viable and deliverable alternatives should it not be able to deliver its preferred plan; and*
- *after the environmental assessment has been completed, review and revise (if necessary) the programme to show that the preferred plan and simultaneous development of alternative options can be delivered within the timescales committed to as part of the public inquiry decision.*

5.2 Fawley desalination scheme and alternative water reuse options: revised draft WRMP19 strategic and regulatory context

In responding to the Defra request for further information in relation to the Fawley desalination scheme and the alternative water re-use options, we firstly set out below the revised draft WRMP19 strategic and regulatory context to our response.

5.2.1 Section 20 Agreement

The revised draft WRMP19 strategy for our Western Area is driven by the Water Resources Act 1991 Section 20 Agreement signed in March 2018 following the Public Inquiry, and the associated changes to our River Test and River Itchen abstraction licences, which were confirmed by Defra in March 2019. These licence changes have resulted in an immediate and significant supply-demand deficit affecting around 0.57 million customers in Hampshire and the Isle of Wight, including the large population centres of Southampton and Winchester. This supply-demand deficit drives the need to develop the Fawley desalination scheme (or the alternative water reuse options).

Southern Water committed in the Section 20 Agreement to use “all best endeavours” to ensure delivery of the long term Water Resources schemes for the Western Area as set out in the Final WRMP19. Southern Water is undertaking the investigations and promotion of its WRMP19 preferred schemes and strategic alternative options for the Western Area to ensure that it meets this commitment.

All parties have a responsibility in finding the right solution to address this supply reliability risk to 0.5 million customers in accordance with the Section 20 Agreement timescale, which reflect the commitments made as part of the Public Inquiry decision. All parties therefore need to work together to address the challenges involved with delivery of the Fawley desalination scheme and/or alternative water re-use schemes to meet the Section 20 Agreement timescales for delivery of the solution by March 2027. The Section 20 Agreement therefore drives the timetable to which we all need to work, requiring early actions before either the WRMP19 or the 2019 Price Review process have been completed.

5.2.2 Revised draft WRMP19

Annex 9 of the revised draft WRMP19 sets out the proposed approach to development of the Fawley desalination scheme (up to 75 Ml/d) and the parallel development of strategic alternative water reuse options involving the River Itchen to meet the Section 20 Agreement timescales:

- Portsmouth Harbour and Fareham potable water reuse scheme (up to 90 Ml/d) using the Lower River Itchen
- Woolston and Portswood indirect potable water reuse scheme (13.5Ml/d) using the Lower River Itchen to further increase supply if required.

We refer to these options collectively as the Itchen indirect water reuse options in this response.

The Defra letter refers to a "Test water reuse" option. The revised draft WRMP19 includes the Test Estuary direct industrial water reuse scheme (9 Ml/d) which is a direct water reuse option to supply industrial customers only and does not involve any discharges to the River Test for subsequent re-abstraction downstream from the River Test or the Test Estuary. This scheme is not a strategic alternative to the Fawley desalination scheme due to its small size and we will make this clearer in the final WRMP19 text of Annex 9. We have not provided further details in relation to this scheme as it is not part of the strategic considerations as to whether to develop the Fawley desalination scheme or the Itchen reuse strategic scheme. The Test Estuary direct water reuse scheme may be considered as a strategic alternative to other smaller water supply schemes in our preferred plan for the Western Area.

As set out in Annex 9, the Fawley desalination scheme has been considered as a modular option up to 75 Ml/d, with a likely capacity ranging between 50 Ml/d and 75 Ml/d. Additionally, a larger Fawley desalination scheme option at up to 100 Ml/d capacity is being considered as a strategic alternative option in case some of the water import schemes could not be delivered to the full volume assumed. Our engineering design and environmental investigations will use the 100 Ml/d capacity as the upper size constraint for the Fawley desalination scheme.

Our scenario and sensitivity testing presented in Annex 9 showed that the water reuse schemes on the River Itchen could be considered as a plausible strategic alternative to the Fawley desalination scheme. Annex 9 also demonstrated that the Fawley desalination option and the Itchen indirect water reuse options were both able to provide, either separately or in combination, the water needed to satisfy the large supply deficits in our Western Area.

Annex 9 explains that by adopting this parallel supply strategy, there is a need to progress more detailed feasibility investigations, secure discharge consents, undertake planning and promotion of the water reuse schemes in parallel with the Fawley desalination options, as well as the need to progress discussions with the Environment Agency and Natural England to understand whether, or the extent to which issues surrounding the Itchen indirect water reuse options may affect their deliverability – for example, the revised Common Standards Monitoring Guidance (rCSMG), or effects on aquatic species such as migratory fish.

5.2.3 Regulatory developments since submission of the revised draft WRMP19

Since we submitted the revised draft WRMP19 in September 2018, Ofwat introduced a new regulatory approach in January 2019 as part of its Initial Assessment Plans (IAP) of the 2019 Price Review in relation to the delivery of various strategic water resource schemes, including for the Fawley desalination scheme. The regulatory approach includes a "gated" process for funding of key stages of scheme development and delivery which are linked to an Outcome Delivery Incentive (ODI).

We responded to Ofwat with our initial views on 1 April 2019 and provided more detailed proposals on 3 May 2019, in particular to reinforce the requirement for the supply scheme solutions to be delivered by 31 March 2027 and therefore the need to deliver earlier than the dates suggested by Ofwat in the IAP. Our 3 May response set out the actions we need to take to assess the different options and that, given the environmental and delivery risks associated with the options, we need to start these actions now to inform decisions on the options and use the gated process to identify a preferred option. We expand on this further in subsequent sections.

5.2.4 Water Resources South East (WRSE): strategic water resources planning in the South East

Since submission of our revised draft WRMP, WRSE has been carrying out further modelling of strategic water supply solutions at a regional level. The latest (spring 2019) modelling has explored a wide range of scenarios, including: different resilience standards; different per capita consumption levels; a range of sustainability reductions; and the use, or not, of drought management interventions. For each scenario, the WRSE investment model has been used to determine the optimum range of strategic supply solutions for the South East to meet the anticipated requirements of water customers in the region. Whilst there are common supply schemes that are selected in the model across a range of these scenarios, no scheme is selected as frequently as the Fawley desalination plant option. The Fawley scheme typically is selected across all of the scenarios considered in the WRSE model and therefore is considered by WRSE to be a core strategic supply scheme to help meet the region's future challenges. We will continue to work closely with the other water companies in the South East through WRSE as we further develop the Fawley and Itchen indirect water reuse options.

Defra's request for further information, and our response, focuses on the work and studies that need to be carried out early in the delivery programme, which are dominated by environmental concerns and identifying risks and appropriate mitigation plans. These activities are required to reach a final decision on the environmental feasibility of the Fawley desalination scheme option or otherwise the environmental feasibility of the alternative water reuse options.

5.3 Progress on early activities

Defra has stated: "*whilst the company has provided a programme of works for the development of its desalination option; it is already significantly behind schedule. It has not finalised a site location, carried out the further modelling or started to collect baseline data. There is a significant risk to delivery of this option within the committed timescales if the company does not undertake the work needed to progress this option.*"

We set out below the progress we have made to date on the early activities and our plans to progress the desalination option and investigate the alternative water reuse options.

We acknowledge the delivery risks to meet the Section 20 Agreement timescales and recognise there are a substantial range of early actions that are required to progress this option, and in parallel to carry out similar investigations into the alternative Itchen indirect water reuse options. We have made clear the need to undertake these actions in our regulatory dialogue with the Environment Agency, Natural England and Ofwat, as well as with our key stakeholders.

In developing our WRMP, we recognised that there were a range of uncertainties and risks that needed to be managed. This was a key reason for adopting the Real Options approach to programme appraisal that enabled us to develop a detailed but adaptive plan that provides supply resilience in severe drought to a wide range of potential futures, as well as taking account of the potential step change in supply availability due to future possible sustainability reductions. We have also tested the robustness of our final WRMP19 strategy against a range of assumptions, to help identify key alternative options that we may need to investigate in parallel with the preferred plan. As such we need to progress with investigating the Fawley desalination scheme and the Itchen indirect water reuse options at a variety of capacities while we work to reduce uncertainties and further assess the environmental risks of each option. The value of the Real Options approach, and the adaptive planning it supports, is that we can respond appropriately to changing circumstances whilst delivering improved supply reliability for our customers and minimising environmental impact. The Fawley desalination scheme and alternative Itchen indirect water reuse options are modular in

nature allowing different combinations of scheme capacities to be considered depending on any changes to the forecast supply deficit.

Whilst both the WRMP19 and 2019 Price Review processes are still continuing, we have nevertheless been working on how we intend to actively address these risks through our adaptive planning approach. We provide in this response our plan to deliver these important early actions, which particularly focus on the environmental risks and uncertainties.

We are committed to delivering to the Section 20 Agreement timescales and since we submitted the revised draft WRMP19 in September 2018, we have continued to:

- progress with the planning and investigations for the Fawley desalination scheme and the Itchen indirect water reuse options
- expand our delivery team to develop the detailed delivery programme and commence pre-feasibility studies for the Fawley and water reuse options
- scoped out the water resources and hydraulic modelling work required to support detailed option design
- keep our key stakeholders updated on our progress with the Fawley desalination and Itchen indirect water reuse options through our Western Area Water Resources Stakeholder Group, with meetings held in January and May 2019
- actively engage in dialogue with Ofwat on the economic regulatory aspects of our delivery plan, including responding to the IAP gated process for strategic water resource schemes.
- work with the other water companies involved in the IAP gated process, establishing a joint governance group.
- engage with WRSE on regional water resources planning and modelling of strategic water supplies
- engage with Portsmouth Water to discuss ongoing investigations and planning for delivery of the Portsmouth Water bulk supply schemes (see also Section 2.1.2 earlier)
- discuss regulatory and environmental aspects with the Environment Agency and Natural England, including work to agree the scope of the WINEP investigations for assessing the impact of the revised Common Standards Monitoring Guidance for flow and water quality in the river Itchen which will help to inform the water reuse scheme investigations
- take account of regulatory and policy developments, including Defra's consultations on the draft National Policy Statement for Water Resources Infrastructure and on environmental net gain, both of which may influence delivery of the strategic water resource schemes for Hampshire
- meet with relevant third parties to discuss land availability and future water supply arrangements in connection with the Fawley desalination scheme, including constructive progress in our dialogue with a third party on a potential site for the desalination treatment plant located outside of the New Forest National Park.

5.4 Planning approach and timetable

Defra has requested that: "*the company should present and commit to a detailed and appropriate timetable for undertaking further modelling on a wider range of environmental risks in relation to its desalination scheme to demonstrate the environmental feasibility of the desalination option at Fawley by 2030*".

We set out below our overall planning approach and timetable for delivery of the Fawley desalination scheme option by 2027 in line with the Section 20 Agreement, with a focus on the timescales for the further modelling (and monitoring and assessment) necessary to demonstrate the environmental feasibility of the desalination scheme option. We also set out the parallel timetable for investigating the alternative Itchen indirect water reuse options.

5.4.1 Strategic timeline

We are committed under the Section 20 agreement to use 'all best endeavours' to implement the WRMP19 supply schemes for Hampshire.

Figure 8 sets out the strategic timeline for the environmental investigations and assessments, planning processes and delivery of the Fawley desalination scheme and/or the alternative Itchen indirect water reuse options to meet the Section 20 Agreement timescales.

The strategic timeline reflects:

- the need to proceed rapidly as our abstraction licences on the Test and Itchen have already been reduced
- the need to investigate the different options in parallel due to the tight timescales and in the face of a number of ongoing external uncertainties
- the need to effectively plan for different sizes/ capacities of the options
- the need for early start activities, particularly in relation to the environmental uncertainties.

Figure 8 shows the Itchen indirect water reuse options being developed to the same level of detail as the Fawley desalination option until the environmental feasibility of the desalination option at Fawley has been demonstrated (or if not, that the Itchen indirect water re-use options can be delivered to the agreed timescales). The parallel nature of developing the alternative Itchen indirect water reuse options will require multiple project teams to be set up and managed to progress the programme for each option, although it should be noted that some activities will be common to all options.

We set out in our IAP response to Ofwat in May 2019 our proposals for the "gated" process to represent the key decision-making processes necessary to meet the Section 20 delivery timescales as shown in Figure 8:

- **Gate 1:** intended date of September 2020 – gate to review findings of the first phase of investigations and consider whether any options should cease to be progressed further (if it is possible to do so at this stage), although it is currently anticipated that work on all of the options will need to continue to Gate 2. Gate 1 review will also help determine the focus of the further environmental monitoring/surveys, modelling and assessments taking account of the findings from the first phase of investigation work.
- **Gate 2:** intended date of June 2022 – gate for a final decision on the preferred option and the submission of applications for planning approvals and environmental permits.
- **Gate 3:** intended date of April 2023 – gate for receiving final decisions from planning authorities on planning approvals and final decisions from regulators on environmental permits.

The dates shown in Figure 8 are indicative and represent our current best view of the timelines for key activities but are subject to further refinement. It should be noted that the dates shown for these "gates" are indicative of when we would expect key decision-making processes to be carried out. These "gates" are not a single date in time and are anticipated to extend over a period of up to several months of decision-making activities.

The gated timeline has been proposed to Ofwat through our 3 May 2019 IAP response and we anticipate a response from Ofwat in the 2019 Price Review Draft Determination in July 2019. However, while we await this response, we are continuing to instigate the early activities to support programme delivery.

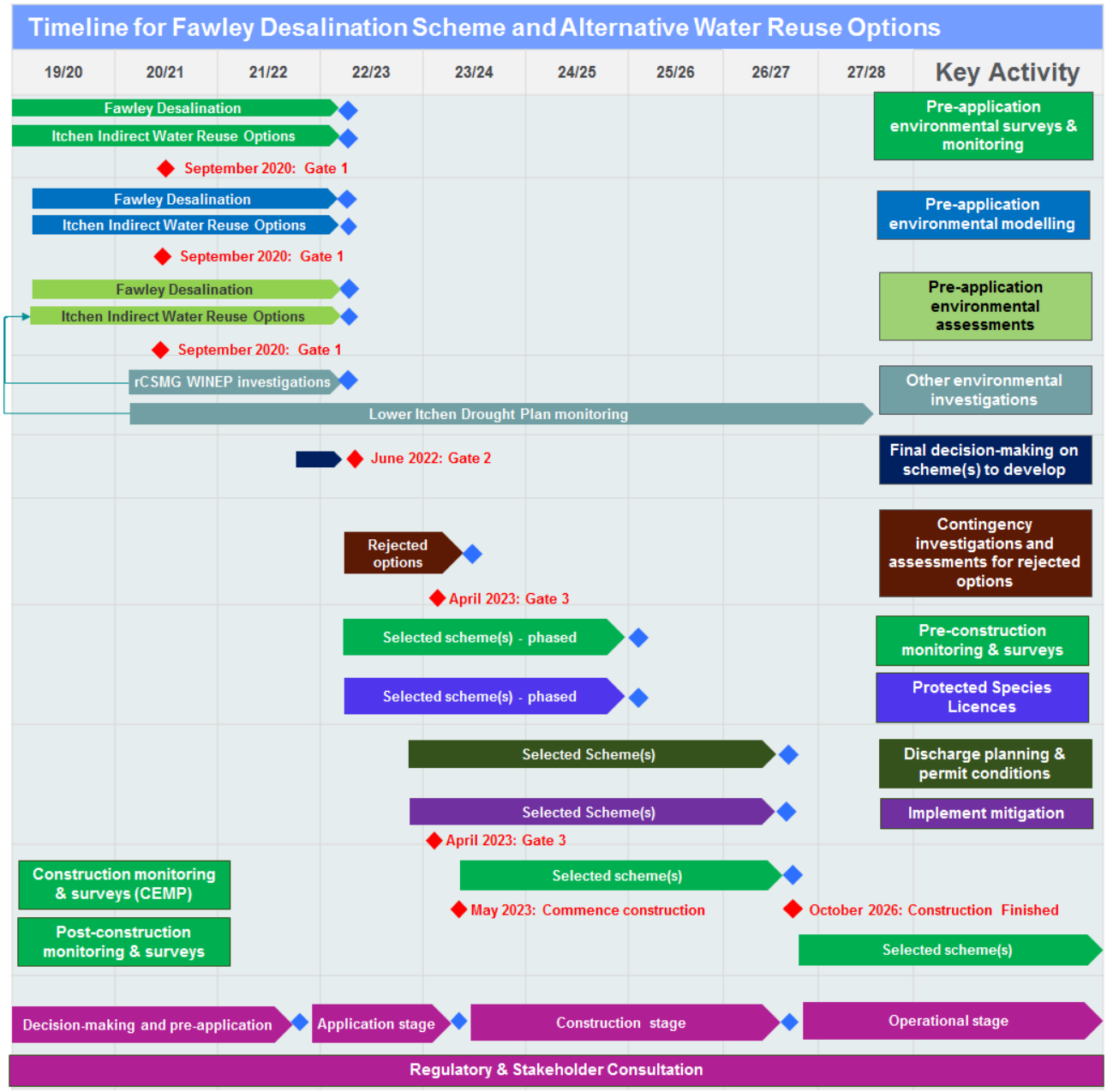

Figure 8 Indicative Timeline for Fawley desalination scheme and/or Itchen indirect water reuse schemes: key environmental activities linked to intended dates for key "gates"

There will be a number of critical decision points during the environmental investigations and planning period up to 2022 (i.e. Gate 2) at which we will need to decide on which size variants and which schemes should be pursued and which should be stopped (if considered appropriate to do so, taking account of the assessed risks relating to the remaining option or options). It is important to note that these decisions do not lie entirely with Southern Water – many will require timely decision-making by regulators, including Ofwat, the Environment Agency, Natural England, DWI and Defra. We have identified the following as some of the critical decision points:

- Confirmation of the required funding through the 2019 Price Review process
- A decision on the planning approval route (whether a Development Consent Order is required), will be needed at Gate 1 based on the best available information at the time. This is partly dependent on

further clarification from Defra following its consultation in late 2018 on the National Policy Statement for Water Resources Infrastructure.

- A decision on whether there will be a further Hands-off Flow (HoF) increase on the River Itchen, and the scale of any change as soon as possible, ideally by Gate 1. This will determine the scale of further sustainability reductions that we need to address and is a critical factor to identifying the scale of the supply / demand deficit that we will need to address.
- A decision from Defra, the Environment Agency and Natural England regarding whether the application of the revised Common Standards Monitoring Guidance (rCSMG) is to be implemented in this case as soon as possible, ideally by Gate 1, and to understand the full implications of this decision. This is critically important in determining whether the Itchen indirect water reuse options are viable or not. If rCSMG is made policy for abstraction licensing and environmental permitting, this could potentially make the Itchen indirect water reuse options infeasible, and therefore it is imperative that this policy decision is made in a timely manner. Timely review of the rCSMG WINEP investigation outcomes will also be important in this context.
- A decision on which options to develop, in close association with the next WRMP which will be closely linked to the development of a regional plan for the South East (through the WRSE group) and associated environmental assessments, and in light of any changes identified to the supply demand balance, including the potential for an additional sustainability reduction on the river Itchen.
- The results of the WRSE regional planning outputs supporting selection of the preferred delivery option and incorporating decisions on all elements of the supply demand balance could be available around April-June 2022 (although the plans will not be published as early as that). This decision point aligns with our Gate 2.

These decisions do not change the commitment given by Southern Water in the Section 20 Agreement to use “all best endeavours” to deliver the long term water resources schemes, but they are nonetheless critical to ultimately achieving this commitment. Southern Water will work to deliver the necessary evidence required to support these decisions in a timely manner.

Given the current uncertainties as to planning and environmental permitting approvals, we have also indicated in Figure 8 that we may need to carry on working on the alternative options investigations until planning approval has been granted for the selected scheme or schemes so that all alternative schemes are progressed to be “delivery ready” should they be necessary to meet the Section 20 Agreement timescales in an adaptive manner and address the supply deficit. The final solution could involve a combination of a smaller Fawley desalination plant and an appropriately sized Itchen indirect water reuse option if the investigations conclude this is the best overall solution to meeting the supply deficit.

The timescales for statutory environmental and planning activities recognise the regulatory complexity of the scheme delivery which will involve multiple statutory bodies and the consequent need for co-ordination from an early stage. We have established a regional strategic stakeholder group already and are in the process of setting up option-specific regulatory consultation groups (see Section 5.6 below) to ensure an integrated approach to these aspects of the delivery programme. Consultation has already commenced with key regulators and stakeholders and will continue throughout the delivery programme as indicated in Figure 8.

Subject to timely determination of planning approvals and environmental permits/consents (Gate 3 - intended date of April 2023), there is sufficient time allocated for the construction period to discharge any environmental conditions set by planners or regulators, obtain any necessary Protected Species licences, carry out pre-construction monitoring and deliver agreed mitigation measures. Environmental monitoring will also continue for the selected scheme or schemes pre-construction, during construction (linked to specific agreed Construction Environmental Management Plans - CEMPs) and post-construction. As set out in our IAP response to Ofwat, we currently anticipate an intended construction start date of May 2023 and construction finish at October 2026 (Figure 8).

5.4.2 Detailed timescales for environmental monitoring, modelling and assessment

As shown in Figure 8, the environmental monitoring, modelling and assessments have been prioritised for delivery early in the programme to reduce environmental uncertainties and risks by:

- ensuring that any currently uncertain environmental constraints (for example, presence of protected species at specific construction sites) are identified in dialogue with regulators, relevant planning authorities and key stakeholders as early as possible to proactively inform scheme design, with the aim of avoiding adverse environmental effects wherever possible.
- providing environmental evidence in sufficient time to develop agreed mitigation measures where adverse effects cannot be avoided and incorporating the mitigation measures into the detailed design prior to the application for planning / environmental permissions or consents.
- providing data for environmental modelling in a timely manner to ensure modelling work can be carried out in sufficient time to inform scheme design and the development of mitigation measures.
- providing information to inform pre-application dialogue with local planning authorities and with regulatory bodies on environmental permitting requirements
- enabling planning processes, notably EIA screening and scoping, to be implemented as early as possible.
- informing stakeholder dialogue so that any key environmental concerns from stakeholders are identified early and can be considered as part of the scheme design.

We have allowed sufficient time to carry out seasonally-dependent environmental surveys in advance of Gate 2 in June 2022 with contingency time available to cater for adverse weather or other external constraints on carrying out environmental surveys.

We will also take account of the Water Industry National Environmental Programme (WINEP), revised Common Standards Monitoring Guidance (rCSMG) investigations for flow and water quality for the River Itchen, as well as ongoing Drought Plan environmental monitoring for the lower River Itchen.

It will initially be necessary to carry out site surveys and investigations on a wider footprint to ensure we cover all potential receptors and locations that may be impacted by each potential option and for each capacity variants of both the Fawley desalination scheme and the Itchen indirect water reuse options. As the detailed scheme designs for each option are progressed, taking account of the environmental findings and external engagement activities, we will work with regulators and make decisions at Gate 1 as to whether we can narrow down the scope of the environmental investigations on a more focused footprint in preparation for environmental permitting and planning processes. However, for planning purposes, we currently assume that we will need to continue with the majority of the environmental investigation activities beyond Gate 1 and leading up to Gate 2.

Since submission of the revised draft WRMP19, we have further considered the sequencing of the early environmental monitoring, modelling and assessment activities that will be critical to decision-making, planning and environmental permitting applications and approvals. Figure 9 (Fawley desalination scheme) and Figure 10 (Itchen indirect water reuse options) provide the indicative timelines for carrying out the key environmental monitoring, modelling and assessment activities necessary to inform decision-making with detailed environmental evidence over the period to Gate 2 (June 2022).

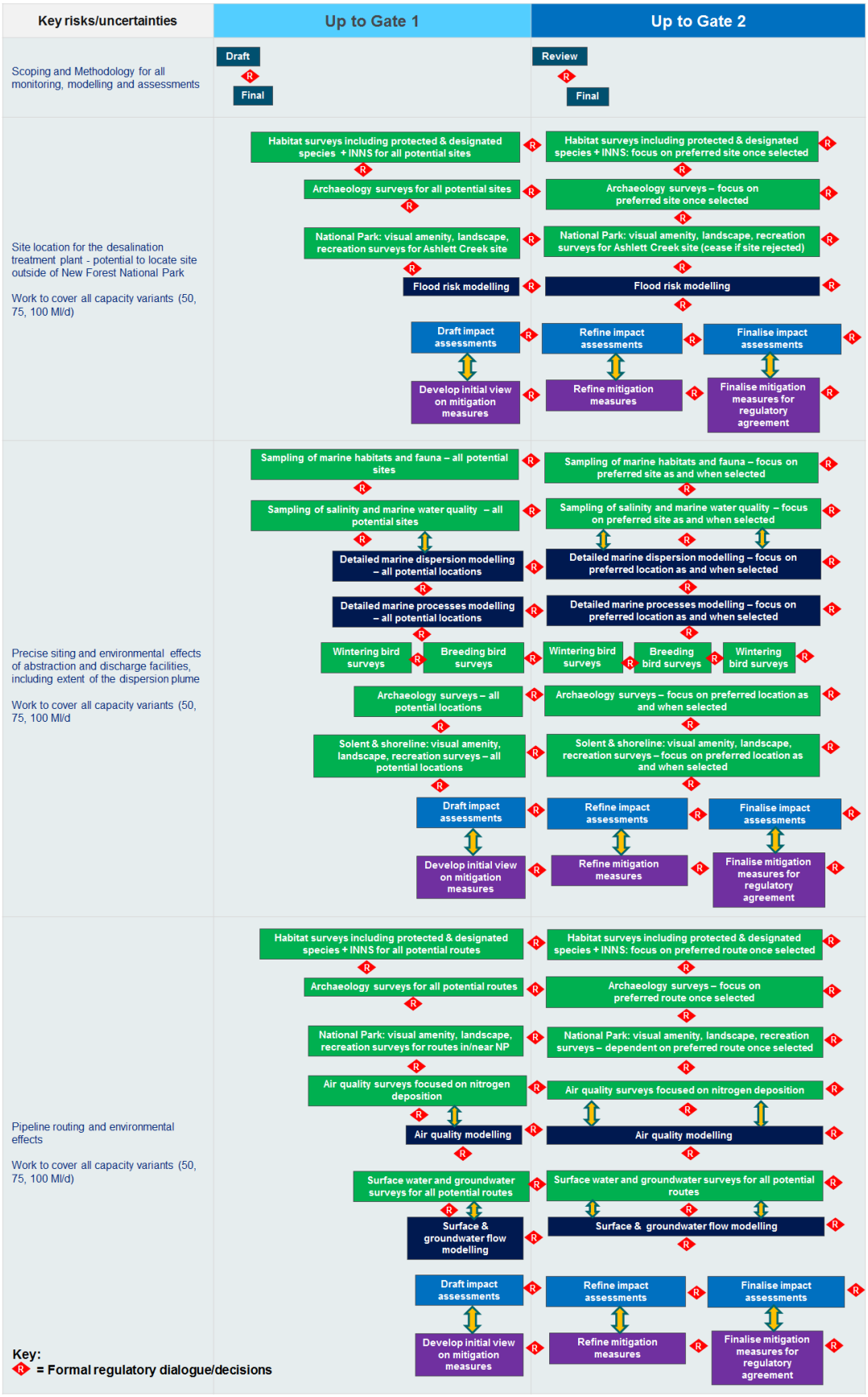

Figure 9 Fawley desalination scheme – indicative timeline to Gate 2 (June 2022)

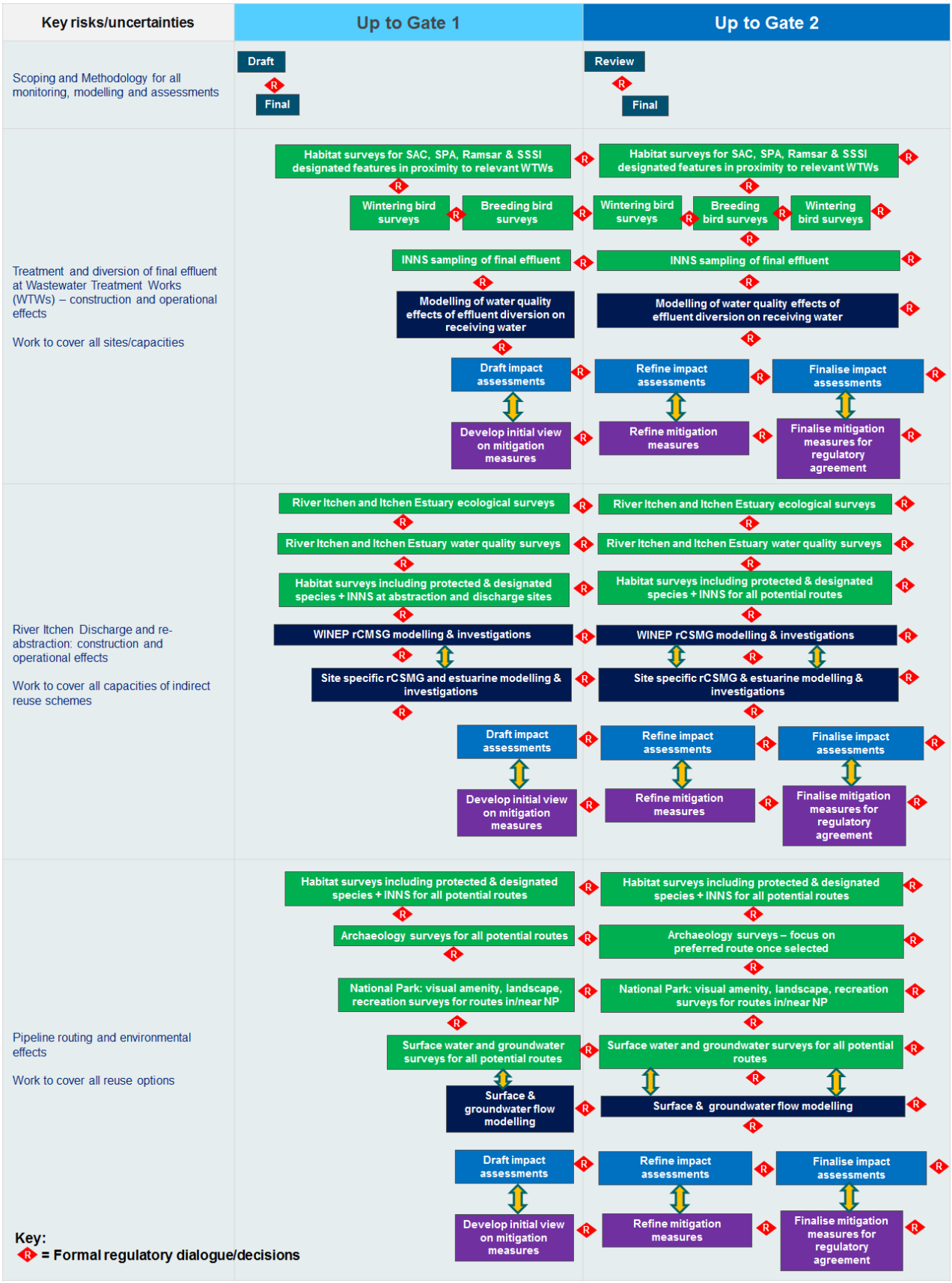

Figure 10 Itchen indirect water reuse – indicative timeline to Gate 2 (June 2022)

The timelines indicate (as marked by the red diamonds) that we are committed to regular and extensive formal dialogue with the environmental regulators at all stages of these early environmental activities, so that there can be ongoing two-way feedback on the emerging evidence, modelling findings, assessments and development of mitigation measures. In this way, we aim to minimise the risk of programme delays at a later stage during the planning and environmental permitting application processes.

We will continue to develop and refine this timeline, in dialogue with regulators, as appropriate, as regulatory processes continue (for example, the 2019 Price Review Draft Determination) and we are committed to keeping it updated as knowledge develops and additional evidence is acquired.

Further details on the environmental monitoring, modelling and assessment activities are provided in Section 5.5. Our proposed approach to regulatory consultation is set out in Section 5.6.

5.5 Environmental monitoring, modelling and assessments

Defra has stated that: "*The company has still not adequately addressed multiple concerns raised relating to the environmental impacts resulting from the building and operation of the proposed desalination plant. Until further modelling is undertaken on a wider range of environmental risks, there is uncertainty around the environmental feasibility of this option, and therefore the deliverability of the preferred plan to address supply deficits in the Western area by 2030.*

The company should complete a full and thorough environmental assessment to determine all possible environmental impacts of this option, alone and in-combination. The company's environmental assessment contains several assumptions and statements that do not appear to be evidence based, and does not appropriately take account of or reflect the environmental risk of preferred options in the Western area. When undertaking the environmental assessment, the company should first present the impacts and then demonstrate how mitigation measures will reduce the risk to an acceptable level.

The company has further considered alternative schemes to desalination, and its preferred alternatives are effluent reuse on the rivers Test and Itchen. The company has made some assumptions about the environmental standards it will be required to meet, and these assumptions and uncertainty are not reflected in the company's revised WRMP. We are concerned that this may pose a risk to viability of these scheme as alternatives.

Defra has requested that: "the company should demonstrate that all risks have been appropriately considered" and that the company should "better consider a wider range of uncertainties and in-combination effects within its assessment of alternative schemes, to demonstrate they are viable and deliverable alternatives should it not be able to deliver its preferred plan".

We set out below:

a) the environmental monitoring, modelling and assessment activities that we will be carrying out to address the risks, current assumptions and uncertainties around the environmental feasibility of the Fawley desalination scheme option and determine all possible environmental impacts of this option, alone and in combination, together with determining appropriate mitigation measures.
b) the environmental monitoring, modelling and assessment activities that we will be carrying out to address risks, uncertainties and current assumptions on environmental standards in relation to the alternative Itchen indirect water reuse options, both alone and in combination, together with determining appropriate mitigation measures.

5.5.1 Introduction

We fully recognise the need to carry out detailed environmental modelling, as well as environmental monitoring and assessment, to address concerns and uncertainties relating to the environmental impacts of the Fawley desalination plant to inform the environmental feasibility and deliverability of this option.

Environmental modelling, monitoring and assessments are therefore programmed early in the overall delivery process to address these concerns and uncertainties, as well as those relating to the Itchen indirect water reuse options. We will further assess the range of uncertainties and in-combination effects of the alternative schemes – beyond the detail provided to date in the strategic assessments in the revised draft WRMP19 - to demonstrate whether they are viable and deliverable alternatives should we conclude that the Fawley desalination scheme cannot be delivered. We are committed to working closely with regulators and stakeholders as we carry out this work.

The environmental monitoring and modelling will inform a detailed and thorough environmental assessment of each option to determine impacts, both alone and in-combination with other plans and projects (see below for more details on possible in-combination effects). The assessments will also consider any necessary mitigation measures to address identified impacts to reduce the risk to an acceptable level. We will continue to work in dialogue with the environmental regulators as we carry out this work to enhance the evidence base, agree the environmental standards to be met, and address and reduce the environmental uncertainties as far as possible.

Figure 11 outlines how the environmental surveys, modelling and assessment activities will interact to deliver the required evidence to support planning applications and applications for environmental permits and consents (e.g. European Protected Species (EPS) licences), marine licences, discharge and waste permits, ordinary watercourse consents), as well as inform scheme design and mitigation at an early stage.

The following sub-sections provide more detail on the key risks and uncertainties, and how these are to be addressed through environmental monitoring/surveys, modelling, and assessments.

As indicated in Figure 9 and Figure 10, scoping documents will be prepared providing details of the scope and methods for the proposed monitoring/surveys, modelling and assessments. These will be shared with regulators and key stakeholders for comment to minimise the risk of additional work or modifications at a later stage that could potentially lead to a delay to the delivery programme.

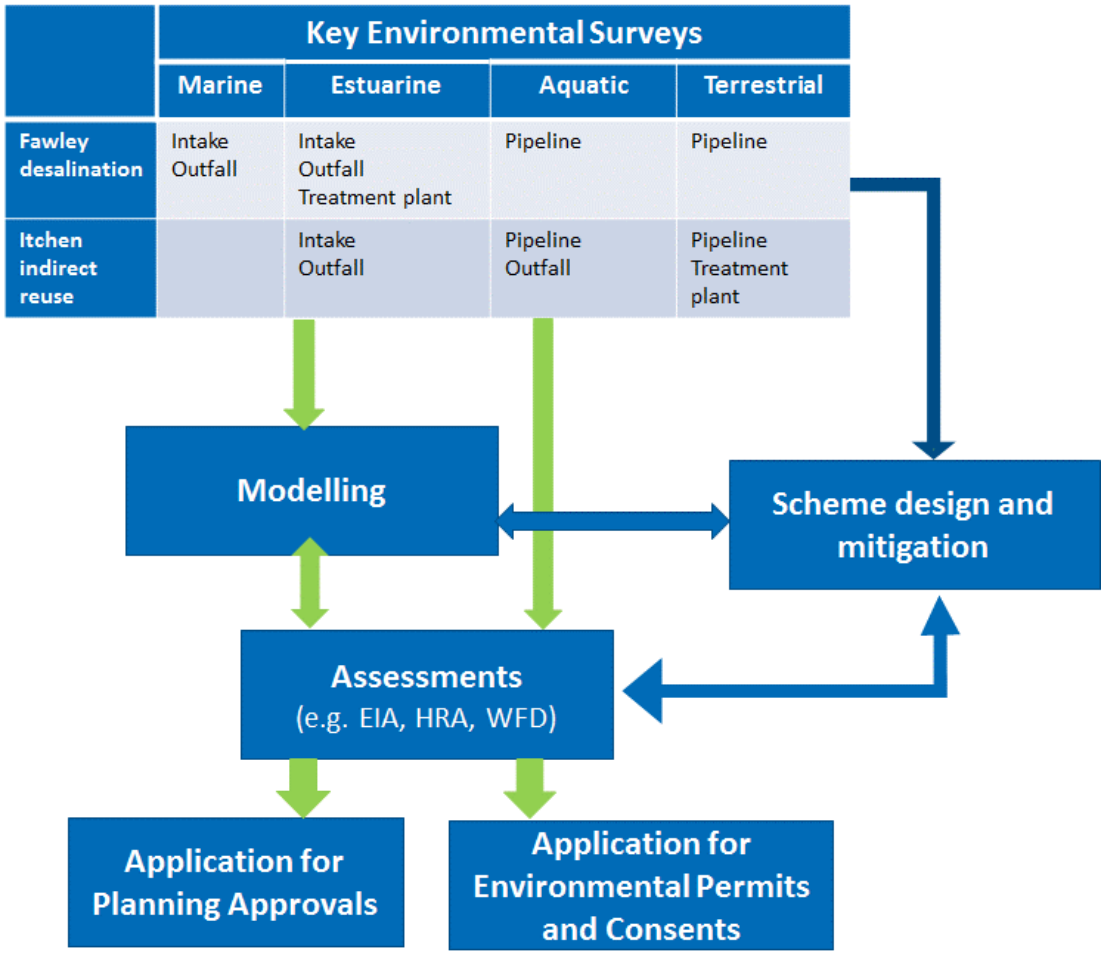

Figure 11 Overview of environmental surveys, modelling and assessment interactions

5.5.2 Fawley desalination scheme: monitoring, modelling and mitigation measures to address key environmental risks and uncertainties

Table 1 shows the key environmental risks and uncertainties relating to the Fawley desalination scheme and the environmental monitoring/surveys and modelling that we plan to carry out to address these risks and uncertainties and the key mitigation measures likely to be required.

These risks and uncertainties will be a key focus of the survey/monitoring, modelling and assessment effort to inform scheme design. However, the whole suite of Environmental Impact Assessment and environmental permitting issues will also be considered as part of our investigations, including but not limited to the following additional topics: transport (including marine); recreation (including boating/yachting); air quality; noise and vibration; lighting; waste and contaminated land.

Until the final capacity of the scheme is confirmed, we will continue to assume that the Fawley desalination scheme will need to be constructed up to a capacity of 100Ml/d. The scope of the survey/monitoring, modelling, assessment and mitigation development will therefore consider different capacities up to the maximum 100 Ml/d size (50, 75 and 100 Ml/d variants).

Key surveys and monitoring

The proposed surveys and monitoring will focus on each of the components of the option, including construction and operational aspects: treatment plant; intake/outfall assets to/from the coastline to the

treatment plant; pipeline route. The environmental features most at risk from the scheme will be prioritised in terms of survey/monitoring work necessary to inform scheme design, notably marine, estuarine and terrestrial ecology (particularly designated species and habitats), landscape and visual amenity, maritime transport and recreation. The key monitoring and modelling requirements to address the key risks and uncertainties are set out in Table 3, with further details on the environmental surveys provided in Table 4, but this is not intended to be an exhaustive list of all the environmental investigations that we will need to carry out.

The survey details provided in Table 4 have been derived using best available desk study information and will need to be informed and refined by:

- Specific desk based study, including review of local biodiversity record centre data and other available data (e.g. Webs data for breeding and over-wintering birds)
- Targeted site walkover surveys and/or similar reconnaissance surveys of the coastal environment
- Preliminary ecological appraisals
- Preliminary environmental appraisal for non-ecological features.

Additional features may be identified as needing survey following these activities to ensure all topic specific surveys required to inform statutory environmental assessment processes are identified and programmed for delivery.

Key modelling investigations

Findings from the key modelling activities set out in Table 3 will inform the environmental assessments and, in turn, inform the technology, design and siting of the intake and discharge structures, and any mitigation measures. This is likely to be an iterative modelling process as the design is optimised to minimise adverse effects and the final mitigation measures can be incorporated into the project-level HRA Appropriate Assessment, Environmental Statement of the EIA and other regulatory environmental assessments.

Mitigation measures

As part of the environmental investigations to Gate 2, we will specifically consider whether any identified adverse effects can be avoided by modifications to the scheme design or operating philosophy. By carrying out the environmental assessments early in the planning process (see Figure 8, Figure 9 and Figure 10 earlier), the findings will iterate with modifications to the scheme design to minimise adverse effects through design measures wherever feasible. Where residual adverse effects cannot be avoided, the monitoring, modelling and environmental assessments will inform the development of mitigation measures to be discussed with regulators and relevant stakeholders at an early stage: these will also iterate with changes to the scheme design so that they are integrated into the final scheme design to be submitted with the planning approval and environmental permitting applications. Table 3 sets out the likely key mitigation measures that will be required to address the key risks presented by the scheme construction and/or operation. The plan-level HRA Appropriate Assessment of the scheme in the revised draft WRMP19 provides further details on the mitigation measures to avoid effects on European sites and we will continue to discuss the development of these measures with Natural England as the scheme design is further developed.

We will aim to agree the mitigation measures with relevant statutory bodies prior to submission of the planning and permitting applications. Draft Construction Environmental Management Plans, Operational Mitigation and Monitoring Plans and Site Waste Management Plans will also be produced to accompany these applications.

In addition to developing any required mitigation measures, we will work with regulators and planning authorities to identify the opportunities for environmental enhancement to secure biodiversity net gain objectives.

Table 3 Fawley desalination scheme: key monitoring, modelling and mitigation measures to address the key environmental risks and uncertainties

Risk/Uncertainty	Environmental Monitoring	Environmental Modelling	Mitigation Measures
Location of the site for the desalination treatment plant. The revised draft WRMP19 site is within the New Forest National Park, and in close proximity to the Solent Maritime Special Area of Conservation (SAC) and Solent and Southampton Water Special Protection Area (SPA) and Ramsar site (and underlying SSSIs).	Habitat surveys, including protected and designated species. Breeding and wintering bird surveys of potentially affected areas to determine use of habitats by qualifying species close to areas likely to be affected by construction. Landscape, visual amenity and recreation appraisal of the desalination plant site in relation to the New Forest National Park.	Estuarine flood risk modelling	Mitigation measures will be required during construction to avoid adverse effects on the National Park, European sites and underlying SSSIs. These will particularly include measures to avoid adverse effects on designated bird species (such as noise and visual disturbance abatement) as informed by the bird surveys. Protected species mitigation measures will be informed by the habitat surveys. The agreed construction mitigation measures will be incorporated into the Construction Environmental Management Plan (CEMP). Landscape and visual amenity to be protected with screening during construction and sensitive landscaping of the operational site. Flood protection measures may be required to protect the site from future climate change impacts on estuarine flood risk.
Abstraction and discharge facilities: Partially located within the proposed Solent and Dorset Coast SPA, with construction sites in proximity to the Solent Maritime	Sampling and mapping of marine habitats and fauna (including designated and protected habitats and species) at the locations for the abstraction intake and discharge outfall (including along the construction corridor for the	Modelling of the abstraction intake and discharge outfall structures to understand: □ how they may interfere with, or be impacted by, coastal processes (such as currents and long-shore drift)	Modelling of the outfall and abstraction intake will be iterative with the engineering design to deliver an optimum design that minimises environmental impact. Mitigation measures may include ‘soft engineering’ to prevent

Risk/Uncertainty	Environmental Monitoring	Environmental Modelling	Mitigation Measures
SAC and Solent and Southampton Water SPA and Ramsar site.	proposed 500m extension to the existing outfall, and/or other locations that may also be considered for the discharge structure), to determine if highly sensitive ecological features could be affected. Breeding and wintering bird surveys of potentially affected areas to determine use of habitats by qualifying species close to areas likely to be affected by construction and/or operational activities. Landscape, visual amenity and recreation appraisals in relation to the Solent and shoreline.	whether their positioning might lead to increased localised erosion and/or sediment deposition in the vicinity of the structures. how the above potential changes to coastal processes may impact on marine habitats and fauna	localised erosion or sedimentation risks. Mitigation measures will be required to avoid adverse effects on European sites and underlying SSSIs. These will particularly include measures to avoid adverse effects on designated bird species (such as noise and visual disturbance abatement) during construction as informed by the bird surveys. Marine surveys and modelling will inform the development of mitigation measures necessary to protect habitats and species that may be affected by residual impacts on coastal processes. The agreed construction mitigation measures will be incorporated into the Construction Environmental Management Plan (CEMP). Landscape and visual amenity to be protected with screening during construction and sensitive landscaping of the operational site. Recreational mitigation to be determined from survey findings and assessment of potential effects.
Extent of the dispersion plume from the concentrated brine waste stream: Discharge (with treatment prior to discharge as necessary to protect the marine environment) into the	Sampling programme for salinity levels and other relevant water quality parameters within the spatial extent of the modelled dispersion plume, and to inform more detailed modelling of the dispersion plume.	Monitoring will inform detailed brine and chemical discharge dispersion modelling for the Solent. The model will be used to understand how the ambient salinity levels and marine water quality within the area of dispersion would be affected by either use of the existing disused	The monitoring and modelling will help determine the nature of any treatment required of the waste stream prior to discharge. This will also depend on the precise treatment process to be adopted and the nature of the waste stream

Risk/Uncertainty	Environmental Monitoring	Environmental Modelling	Mitigation Measures
proposed Solent and Dorset Coast SPA. There is a risk (depending on final location of outfall) for the plume to extend to part of the Solent Maritime SAC and Solent and Southampton Water SPA and Ramsar site.	Sampling of marine habitats and fauna within the waste stream dispersion plume: the sampling area will iterate with the more detailed plume dispersion modelling.	Fawley power station outfall (with 500m extension) or – if required- alternative new outfall structure.	it will produce. Dialogue with regulators on discharge permitting conditions will also inform the required treatment of the waste stream (chemical composition and temperature). Modelling will be iterative with the engineering design to deliver an optimum design of the outfall location, its orientation and dispersion methods to minimise impact on the marine environment and avoid adverse effects on European sites.
Pipeline routing: the pipeline to the Test Surface Water Supply Works to be installed within or in close proximity to the New Forest SAC, SPA, Ramsar site. There is uncertainty as to where the pipeline could be installed.	Mapping of habitats within the current electricity pylon wayleave of the New Forest SAC, SPA and Ramsar, in particular to check for any water-dependent habitat that could be adversely affected by changes to drainage, as well as checking for any habitats or species sensitive to air quality risks (notably nitrogen deposition) during construction.		Modelling will be iterative with the scheme design to ensure no adverse effects on European sites - if issues are identified, the pipeline routing will be further optimised to avoid any adverse effects.
	Surface water and groundwater surveys at sensitive locations along the pipeline route	Surface and groundwater flow modelling (informed by site-specific survey) will be required for sensitive locations along the pipeline route, notably within the New Forest SAC, SPA and Ramsar site, to assess whether the pipeline will alter the functionality of any water-dependent habitats by creating preferential drainage away from the features which cannot be adequately mitigated.	Develop appropriate design and construction techniques where risk of adverse effects on drainage may impact wetland habitat, by re-routing wherever feasible and sensitive design to mitigate adverse effects where this is not feasible.

Risk/Uncertainty	Environmental Monitoring	Environmental Modelling	Mitigation Measures
The majority of the pipeline connections will be required in the New Forest National Park.	Baseline air quality surveys, focusing on nitrogen deposition.	Nitrogen deposition is affecting the condition of some of the New Forest SAC habitats and therefore modelling work, informed by baseline air quality surveys, will be required to determine if the pipeline construction activities may present a risk of adverse effects.	Develop appropriate mitigation measures to avoid adverse effects on air quality during construction (such as dust suppression measures) that will be incorporated into the Construction Environmental Management Plan (CEMP).
	Landscape, visual amenity and recreation appraisal of the pipeline connections.		Landscape and visual amenity to be protected with screening during construction and sensitive reinstatement of ground cover and vegetation with biodiversity net gain principles applied. Recreational mitigation to be determined from survey findings and assessment of potential effects.
Risk of spread of invasive non-native species (INNS) associated with construction activities and possible changes to marine environment	Surveys and mapping to assess presence of any marine and terrestrial INNS.	Marine modelling (above) may be used to help assess the potential risks of spreading marine INNS.	Mitigation measures will be informed by the INNS surveys, marine modelling and INNS risk assessments, and will be designed in accordance with the latest INNS regulatory guidance and input from INNS specialists.
Effects on archaeological and heritage assets from construction and (for marine assets) operational activities	Baseline surveys of archaeology and heritage assets terrestrial and maritime within an agreed zone of influence of each of the scheme components and within the modelled dispersion plume area.	The marine modelling and groundwater/surface water modelling (above) may help to assess potential risks to marine or water-dependent archaeological and heritage assets.	Mitigation measures will be determined in dialogue with Historic England and other relevant stakeholders dependent on the findings of the baseline surveys and impact assessment work.

Table 4 Key environmental surveys to inform scheme design and planning and environmental permit applications*

	Physical Environment					Marine and Estuarine Environment							Freshwater Environment					Terrestrial Environment											Air, Heritage, Landscape & Recreation			
	Hydrology	Water Quality	Geomorphology	Coastal and	Subtidal features e.g.	Marine mammals e.g. seal	Species of nature conservation	Saltmarsh	Mudflat surveys	Rocky shores	Breeding and wintering	Fish (including eel)	Macrophytes (including	Macroinvertebrates	Fish (including	White clawed	Southern damselfl	Phase 1 habitat survey and NVC	Bats	Badger	Great crested newt	Reptiles	Water vole	Otter	Dormouse	Invertebrates e.g. stag	Breeding and	Hedgerows and TPOs (links	Maritime cultural heritage	Terrestrial	Air quality (nitrogen	Landscape, visual amenity
Fawley Desalination Option																																
Plant	✓	✓	✓	x	x	x	x	x	x	x	✓	x	x	x	x	x	x	✓	✓	✓	✓	✓	x	x	x	✓	✓	✓	x	✓	✓	✓
Intake/ outfall	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	✓	✓	✓	✓
Pipelines/ tunnels	✓	✓	✓	x	x	x	x	x	x	x	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓
Itchen Indirect Water Reuse Options																																
Pipeline	✓	✓	✓	x	x	x	x	x	x	x	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓
Abstraction/ discharge	✓	✓	✓	x	x	x	x	x	x	x	x	✓	✓	✓	✓	✓	✓	✓	x	x	x	x	✓	✓	x	x	x	x	x	✓	x	x
Effluent redirection	x	✓	x	✓	x	x	x	✓	✓	x	✓	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Treatment plant	x	✓	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	✓	✓	x	✓	x	x	x	x	x	x	x	x	x	✓	x

*please note that this table is not intended as an exhaustive list but identifies the key survey and monitoring requirements

Key: ✓ = survey / monitoring is required
x = survey / monitoring is NOT required

5.5.3 Itchen Indirect Water Reuse Options

We acknowledge that there are a range of environmental uncertainties and risks associated with the Itchen indirect water reuse options, and for this reason we are setting out early environmental monitoring, modelling and assessment actions to improve understanding of the risks and to examine how these can be avoided or mitigated to acceptable levels. By taking this early action in parallel to the work for the Fawley desalination scheme, we are aiming to ensure we can make better informed decisions as to which option is the best solution to delivering reliable and sustainable water supplies within the Section 20 Agreement timescales. Critical to assessing the deliverability of the Itchen indirect water resource options will be the decision from Defra, the Environment Agency and Natural England regarding whether the application of the revised Common Standards Monitoring Guidance (rCSMG) is to be implemented in this case.

Whilst the long-distance pipelines required for some of the options impact different areas, the common key environmental risk regarding all of these options is the discharge of water into the River Itchen SAC near the tidal limit and subsequent re-abstraction before the tidal limit. In particular, the River Itchen rCSMG targets for water quality and flow (in the short reach between abstraction and discharge) might be affected by these options. These issues require further dialogue with Natural England and the Environment Agency in particular and will also need to draw on the planned rCSMG WINEP investigations that Southern Water will be carrying out in partnership with Portsmouth Water in relation to the lower River Itchen.

Table 5 shows the key environmental risks and uncertainties relating to the Itchen indirect water reuse options and the environmental monitoring/surveys and modelling that we plan to carry out to address these risks and uncertainties and the key mitigation measures likely to be required.

These risks and uncertainties will be a key focus of the survey/monitoring, modelling and assessment effort to inform scheme design. However, the whole suite of Environmental Impact Assessment and environmental permitting issues will also be considered as part of our investigations, including but not limited to the following additional topics: transport, recreation; air quality; noise and vibration; lighting; waste and contaminated land.

The scope of the survey/monitoring, modelling, assessment and mitigation development will consider different capacities of the options until such time as a decision is reached on the capacity required.

Key surveys and monitoring

The proposed surveys and monitoring will focus on each of the components of the option, including construction and operational aspects: treatment activities at the wastewater treatment works (WTWs) and effects of reduced treated effluent discharge to the estuarine or marine environment; pipeline route; discharge to the River Itchen and subsequent re-abstraction. The environmental features most at risk from the scheme will be prioritised in terms of survey/monitoring work necessary to inform scheme design, notably terrestrial and aquatic ecology (particularly designated species and habitats). The key monitoring and modelling requirements to address the key risks and uncertainties are set out in Table 5 (with further details on the environmental surveys provided in Table 4 above), but this is not intended to be an exhaustive list of all the environmental investigations that we will need to carry out. We will also draw on monitoring of the lower River Itchen that is already being contracted as part of the Section 20 Agreement monitoring programme. Additional features may be identified as needing survey following these activities to ensure all topic specific surveys required to inform statutory environmental assessment processes are identified and programmed for delivery.

Key modelling investigations

Findings from the key modelling activities set out in Table 5 will inform the environmental assessments and, in turn, inform the technology and design of the treatment and discharge arrangements for the reuse options,

and development of necessary mitigation measures. This is likely to be an iterative modelling process as the design is optimised to minimise adverse effects.

Mitigation measures

As part of the environmental investigations to Gate 2, we will specifically consider whether any identified adverse effects can be avoided by modifications to the scheme design or operating philosophy. By carrying out the environmental assessments early in the planning process (see Figure 8, Figure 9 and Figure 10 earlier), the findings will iterate with modifications to the scheme design to minimise adverse effects through design measures wherever feasible. Where residual adverse effects cannot be avoided, the monitoring, modelling and environmental assessments will inform the development of mitigation measures to be discussed with regulators and relevant stakeholders at an early stage: these will also iterate with changes to the scheme design so that they are integrated into the final scheme design in the event that the Itchen indirect water reuse options are to be developed and submitted for planning approval and environmental permitting applications. Table 5 sets out the likely key mitigation measures that will be required to address the key risks presented by the scheme construction and/or operation. The plan-level HRA Appropriate Assessment of the scheme in the revised draft WRMP19 provides further details on the mitigation measures to avoid effects on European sites and we will continue to discuss the development of these measures with Natural England as the scheme design is further developed. Where appropriate, these may dovetail with proposed mitigation measures in the Lower Itchen being progressed as part of the Section 20 Agreement in respect of the Lower Itchen sources Drought Order to increase environmental resilience to abstraction during drought conditions.

In addition to developing any required mitigation measures, we will work with regulators and planning authorities to identify the opportunities for environmental enhancement to secure biodiversity net gain objectives.

Table 5 Itchen indirect water reuse options: key monitoring, modelling and mitigation measures to address the key environmental risks and uncertainties

Risk/Uncertainty	Environmental Monitoring	Environmental Modelling	Mitigation Measures
Additional treatment facilities and diversion of final effluent at two of the potential Wastewater Treatment Works (WTWs) – risk of construction and operational effects on European sites.	Habitat surveys, including protected and designated species: □ part of the Chichester and Langstone Harbours SPA and Ramsar site within the zone of influence of construction activities at Portsmouth Harbour WTW □ part of the Solent Maritime SAC and Solent and Southampton Water SPA and Ramsar site within the zone of influence of construction activities at Woolston WTW. Breeding and wintering bird surveys of potentially affected areas to determine use of habitats by qualifying species close to areas likely to be affected by construction and changes to treated effluent discharges.to the marine or estuarine environment, as applicable (Portsmouth Harbour and Woolston WTWs only).	Modelling of the effects of reduced treated effluent discharge on nutrient and salinity levels in the following European sites to confirm no adverse effects on designated features or species: □ part of the Chichester and Langstone Harbours SPA and Ramsar site (Portsmouth Harbour WTW) □ part of the Solent Maritime SAC and Solent and Southampton Water SPA and Ramsar site (Woolston WTW)	Mitigation measures will be required during construction to avoid adverse effects on the designated bird species (such as noise and visual disturbance abatement) as informed by the bird surveys. Modelling of the effects on nutrient and salinity levels is not expected to lead to any adverse effects on European sites but if modelling indicates a potential risk this will be discussed further with Natural England and Environment Agency. Protected species mitigation measures during construction will be informed by the habitat surveys. The agreed construction mitigation measures will be incorporated into the Construction Environmental Management Plan (CEMP).
Discharge of highly treated effluent to the lower River Itchen may have adverse effects on the River Itchen SAC (including in respect of rCSMG standards) and to the Itchen Estuary	Water quality, flow monitoring and habitat and species surveys of the lower River Itchen to the tidal limit (including migratory fish). Water quality and habitat and species surveys of the River Itchen Estuary (including migratory fish).	WINEP rCSMG water quality and flow modelling and investigations for the River Itchen SAC to inform the assessment of the impact of the Itchen indirect potable water reuse options. The WINEP modelling approach will be further developed to carry out option-specific modelling will be required to assess the effects on rCSMG standards. We will work closely with the Environment Agency and Natural	The surveys and modelling will help inform any specific requirements for the scheme design, in particular the specific water treatment requirements of the final effluent such that the discharge will meet the rCSMG water quality targets. These measures will be incorporated into the scheme design to meet the requirements of the Habitats Regulations.

Risk/Uncertainty	Environmental Monitoring	Environmental Modelling	Mitigation Measures
		England to ensure the approach adopted for the WINEP investigations can support the assessment of the reuse options as far as possible. Modelling of the impacts on water quality on the River Itchen estuary to assess the potential for any adverse environmental effects, including compliance with WFD transitional water body objectives, and in particular, any risk to migratory fish species.	Surveys and modelling will inform the need for any mitigation measures to comply with freshwater WFD objectives, in particular in respect of migratory fish not covered under the Habitats Regulations.
	Habitat mapping, including protected species surveys, and river channel surveys in the lower reach of the River Itchen in the area of the proposed discharge facilities. There may also be a need for a similar survey for a new abstraction facility, although existing abstraction assets may be used (subject to further study).		Habitat surveys and the water quality and flow modelling will inform the precise siting of the discharge (and if required, abstraction) facilities to avoid adverse effects on SAC features and minimise other environmental effects. The design will need to incorporate mitigation measures to avoid any entrainment of fish and avoid local scouring/erosion of the river channel.
Pipeline routing: risk of adverse effects on designated habitats and species from construction of long distance pipelines, in particular with some lengths of pipeline in close proximity to a number of designated sites: Portsdown SSSI; Botley Wood and Everett's and Mushes Copses SSSI; Solent and Southampton Water SAC, SPA and Ramsar site; River Itchen SAC.	Mapping of habitats (including designated and protected species) through walkover surveys of the pipeline routes. Walkover survey to include evaluation of options for reducing where feasible the number of crossings under/across the River Itchen SAC, such as utilising any existing crossing points of the lower River Itchen. Surface water and groundwater surveys at sensitive locations along	Surface and groundwater flow modelling (informed by site-specific survey) will be required for sensitive locations along the pipeline route to examine the impacts of the proposed pipeline crossings on the River Itchen SAC and wetland SSSIs. The modelling will assess whether the pipeline will alter the functionality of any water-dependent habitats by creating preferential drainage away from the features which cannot be adequately mitigated. .	Modelling will be iterative with the scheme design to ensure no adverse effects on European sites - if issues are identified, the pipeline routing will be further optimised to avoid any adverse effects. Develop appropriate pipeline design and construction techniques where risk of adverse effects on drainage may impact wetland habitat, by re-routing wherever feasible (such as using existing lower River Itchen crossing points), and adopting sensitive design to

Risk/Uncertainty	Environmental Monitoring	Environmental Modelling	Mitigation Measures
Construction of the section of pipeline to the Lower Itchen Water Supply Works is located in proximity to the South Downs National Park.	the pipeline route (notably designated wetland sites adjacent to the route and the River Itchen SAC crossings). Landscape, visual amenity and recreation appraisal of the pipeline connections.	None	mitigate adverse effects where this is not feasible. Landscape and visual amenity to be protected with screening during construction and sensitive reinstatement of ground cover and vegetation with biodiversity net gain principles applied. Recreational mitigation to be determined from survey findings and assessment of potential effects.
Risk of spread of invasive non-native species (INNS) associated with construction and operation.	Surveys and mapping to assess presence of any aquatic and terrestrial INNS. Sampling of wastewater treatment works final effluent for presence of any INNS larvae.	Water quality modelling (above) may be used to help assess the potential risks of spreading aquatic INNS.	Mitigation measures will be informed by the INNS surveys, marine modelling and INNS risk assessments, and will be designed in accordance with the latest INNS regulatory guidance and input from INNS specialists.
Effects on archaeological and heritage assets from construction activities.	Baseline surveys of archaeology and heritage assets within an agreed zone of influence of each of the scheme components.	Groundwater/surface water modelling (above) may help to assess potential risks to any water-dependent archaeological and heritage assets.	Mitigation measures will be determined in dialogue with Historic England and other relevant stakeholders dependent on the findings of the baseline surveys and impact assessment work.

5.5.4 Environmental Assessments

Environmental assessments of each option are required to be submitted in support of applications for planning approvals (including any Development Consent Order application) and environmental permit/consent applications (see Figure 4 above). These will draw on the surveys/monitoring and modelling activities, as well as published data and other relevant available evidence.

The assessments required for each of the schemes are broadly similar, although the Fawley desalination scheme has a greater number of marine issues that would need to be considered in consultation with the Marine Management Organisation, Natural England and other relevant marine stakeholders. A wide range of environmental assessments will be required, including (but not limited to):

- Environmental Impact Assessment
- Project-level Habitats Regulations Assessments (HRA)
- Project-level Water Framework Directive (WFD) assessments
- SSSI assessments
- Flood Risk Assessments (FRA)
- INNS risk assessments
- Marine Policy Assessment against the South Marine Plan
- Transport assessments (including air quality impacts)
- Energy Statements
- Sustainability Statements

The assessments will be carried out in accordance with regulatory requirements and best practice national guidance. We will consult on the scope of these assessments. Specific assessment methods (for example, the eDNA tool for Great Crested Newts or the WHPT and LIFE scores for macroinvertebrates) will also be set out in the scoping documents. In this way, we aim to agree the assessment approach and specific methods in advance of carrying out the work to avoid the risk of delay to the programme at a later stage in the planning process.

Cumulative, in-combination effects assessment

The assessments will consider cumulative environmental effects with other projects, including with other revised draft WRMP19 projects such as the Portsmouth Water Havant Thicket bulk supply scheme. We will also consider cumulative effects with other Southern Water projects, committed projects with existing planning permission (or permission being actively sought), with projects set out in land use plans (notably Local Plans), and with developments set out in other strategic plans, such as Shoreline Management Plans.

We set out in the Strategic Environmental Assessment, Habitats Regulations Assessment and Water Framework Directive assessment of the revised draft WRMP19 the potential for cumulative, in-combination effects with the Fawley desalination scheme and the Itchen indirect water reuse options.

There may be cumulative effects with the Bournemouth Water import option and the pipeline from Fawley desalination scheme if these were to be constructed concurrently and/or if part of the pipeline routes overlap. These will be investigated as both scheme designs are progressed further. There is also a potential for cumulative effects with the Test Estuary industrial direct water reuse scheme should this scheme be required to be constructed at the same time as an alternative option to one of the smaller supply schemes in our preferred plan. Cumulative effects with any developments at the Fawley power station site (Fawley Waterside development) and other local development projects will also be considered.

In relation to the Itchen indirect potable reuse options, there are several key concerns in respect of cumulative, in-combination effects that we identified in the revised draft WRMP19 environmental assessments and that we will be investigating in greater detail as part of the early environmental investigations, working closely with Portsmouth Water where relevant:

- Delivery of the Havant Thicket reservoir scheme pipeline: in particular, the same pipeline route for crossing of the River Itchen SAC is currently assumed for both options.
- Cumulative effects on the River Itchen SAC as a whole due to the potential for multiple river crossings by proposed new pipelines for various other WRMP19 schemes
- Cumulative effects on the South Downs National Park from multiple water company new pipeline schemes at the landscape scale where pipelines are to be constructed either within or in proximity to the National Park, requiring a cross-water company assessment of the landscape effects of these proposed pipelines.
- Cumulative effects during construction near to European sites for designated birds due to other infrastructure developments around Solent and Southampton Water SPA and Ramsar site and the Chichester and Langstone Harbours SPA and Ramsar site.

Portsmouth Water and Southern Water are committed to meeting on a regular basis to discuss ongoing investigations in relation to the delivery of water supply schemes in order to keep each other informed of emerging risks to each company's respective water resources strategies, including potential for cumulative environmental effects. This bilateral liaison will be in addition to discussions at a regional scale through the WRSE group of companies, which will consider the wider risks of cumulative landscape effects of multiple new pipelines.

In carrying out the early environmental investigations, we will work with the planning authorities, Natural England and Environment Agency to identify all other projects and proposals that may lead to cumulative, in-combination effects and ensure these are all considered as part of the environmental assessment of the Fawley desalination and the Itchen indirect water reuse schemes.

5.5.5 Planning and Permitting Activities

Figure 12 provides an overview of the planning and permitting requirements likely to be needed.

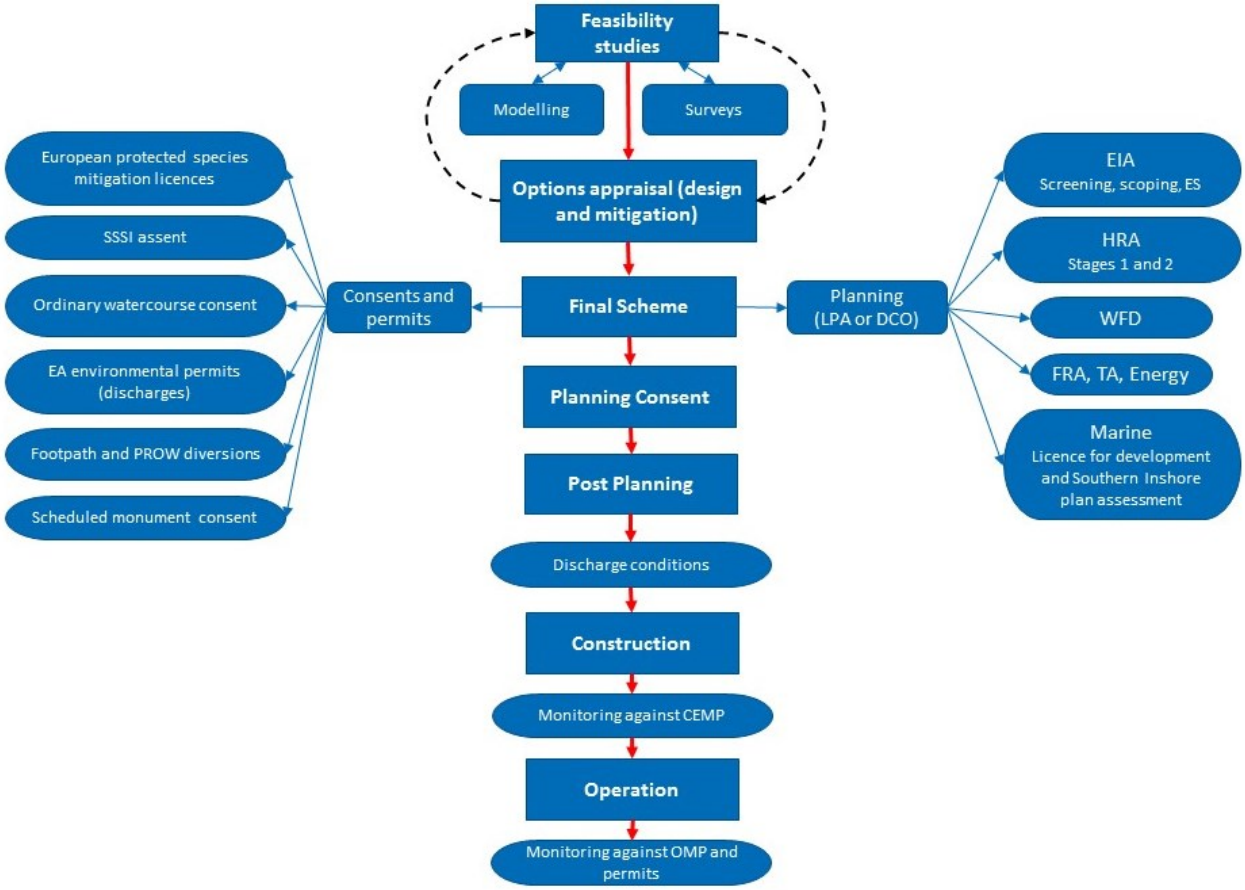

Figure 12 Overview of Planning and Permitting Requirements

Alongside the planning process, various permits/consents will be required to support the delivery of the selected scheme or schemes. We will develop the necessary evidence and assessments to support the application for planning approval and environmental permits/consents for each of the options so that once a final decision on the selected scheme or schemes is reached, there will be no delay in proceeding to make the statutory applications.

The permits/consents required will depend on the selected scheme or schemes, but will include:

- Marine licences for development (where relevant)
- Assent for works within a Site of Special Scientific Interest
- European protected species mitigation licences
- Ordinary watercourse consents for works in, on or near an ordinary water course
- Environmental permits for discharges to the aquatic environment and for waste arisings
- Public rights of way (PRoW) diversions

SSSI assent, marine licences and protected species survey licences may also be required for the survey work to be undertaken, along with land access agreements where necessary.

Post-Planning Approval

A number of the permits/consents identified above will not be authorised until planning permission has been granted, for example Protected Species mitigation licences, and therefore sufficient time has been allowed in the delivery programme (see Figure 8 earlier) to undertake habitat creation and species translocation or other similar activities. Given the different components of each scheme option and different construction durations, this work can be phased over a period of time in line with the construction programme: it will not all need to be carried out immediately following the start of the overall construction programme planned for May 2023.

Our delivery programme (see Figure 8 earlier) also allows time to discharge any relevant planning conditions ahead of the commencement of construction work: again, these can be phased according to the construction programme. Planning conditions could include, for example, finalising the Construction Environmental Management Plan with contractor input, finalising landscaping and planting schemes, achievement of relevant Protected Species mitigation licences, a confirmed scheme of investigation and timetable for cultural heritage mitigation measures, and land contamination remediation measures.

Monitoring during construction and once the scheme is operational (see Figure 8 earlier) will be crucial in confirming that the scheme is not impacting the environment. This is likely to include continuation of pre-application monitoring for the selected scheme or schemes where there is a risk of adverse effects and/or to monitor implementation of the success of defined mitigation measures (both during construction and during subsequent operation). The Construction Environmental Management Plan and any environmental permit/consent conditions will provide the formal mechanisms for monitoring during the construction phase, with thresholds and feedback mechanisms set to ensure any breaches can be addressed promptly. An Operational Mitigation and Monitoring Plan (OMP) may be used to secure longer term monitoring once the scheme is operational, and again identify thresholds, feedback mechanisms and additional mitigation should a breach be identified. There will also be regulatory monitoring set out in environmental permit/consent conditions. An Operational Mitigation and Monitoring Plan could also be used to secure a programme of longer-term maintenance for any habitat created to ensure it meets its full potential (e.g. removal of INNS, replacement of failed tree standards).

5.6 Regulatory and stakeholder consultation

Defra has requested that: "*the company should ensure it works with and consults its stakeholders including the Environment Agency and Natural England when undertaking this further work*".

We set out below our commitment to working and consulting with stakeholders, including the Environment Agency and Natural England, in undertaking the further work set out in above.

Southern Water is committed to working closely with regulators, local planning authorities and interested stakeholders in delivery of the Fawley desalination scheme and/or the alternative Itchen indirect water reuse options, including the additional environmental activities set out above.

We recognise that to deliver the scheme or schemes there are multiple regulators and stakeholders that we need to engage with (see below). We will continue to draw on our previous experience of managing multi-regulator and multi-stakeholder inputs to large capital projects on the land/marine interface, for example for the development of the large Brighton (Peacehaven) wastewater treatment works and sewerage improvements.

We have made progress in developing the necessary dialogue with many stakeholders already, building on existing relationships in many cases. As set out in earlier in this response (Section 5.2), since we submitted

the revised draft WRMP19 in September 2018, we have continued to consult with the regulators and stakeholders. In particular:

- we have liaised closely with the Environment Agency to understand and address any concerns they may have relating to our WRMP. In particular, we met with the Environment Agency in November 2018 to discuss progress with outstanding issues and commitments made in the SOR. We held another meeting on 29 March 2019 to discuss and clarify the requirements for responding to the further information request from Defra.
- we met the Environment Agency, Ofwat and Defra on 11 April 2019 to discuss the WRMP and its deliverability, particularly in relation to the Western area strategy. This was followed by another meeting with the Environment Agency on 15 May 2019 to further clarify some of the points.
- following Ofwat's publication of the IAP on 31 January 2019, we submitted further information to Ofwat as requested on its IAP on 1 April and 3 May 2019.
- we have continued to keep key stakeholders in our Western Area informed of the progress with the WRMP. This includes our investigations and technical work on WRMP schemes, and the work we are carrying out in partnership with the Environment Agency, Natural England and other stakeholders to deliver the commitments in the Section 20 Agreement. This has been communicated through briefings to all of the key stakeholders through the Western Area Water Resources Stakeholder Group in January and May 2019.
- we have taken account of the Natural England feedback on the schemes we have proposed in our WRMP and have discussed key points with technical staff.

As part of our commitment to collaborative working arrangements, our Western Area Water Resources Stakeholder Group, comprising both regulatory and non-regulatory representatives, meets on a regular basis, with the most recent meetings in January 2019 and May 2019. Table 6 details the membership of this Stakeholder Group. Figure 13 shows how our Western Area Water Resources Stakeholder Group forms the highest level consultation group in our overall engagement approach to regulatory and stakeholder consultation in respect of all water resources management issues in Hampshire and the Isle of Wight. This group will continue to be the strategic vehicle for engagement on the delivery of the Fawley desalination scheme and the alternative Itchen indirect water reuse options.

Table 6 Membership of the Western Area Water Resources Stakeholder Group

Western Area Water Resources Stakeholder Group Membership		
Environment Agency	Salmon and Trout Conservation	CPRE Hampshire
Natural England	Hampshire and Isle of Wight Wildlife Trust	RSPB
Consumer Council for Water	Wessex Chalk Stream and Rivers Trust	World Wildlife Fund
South Downs National Park Authority	Test and Itchen Association	Landowners
New Forest National Park Authority	Countryside Landowners Association	Fisheries
	Angling Trust	Portsmouth Water
	Hampshire Ornithological Society	

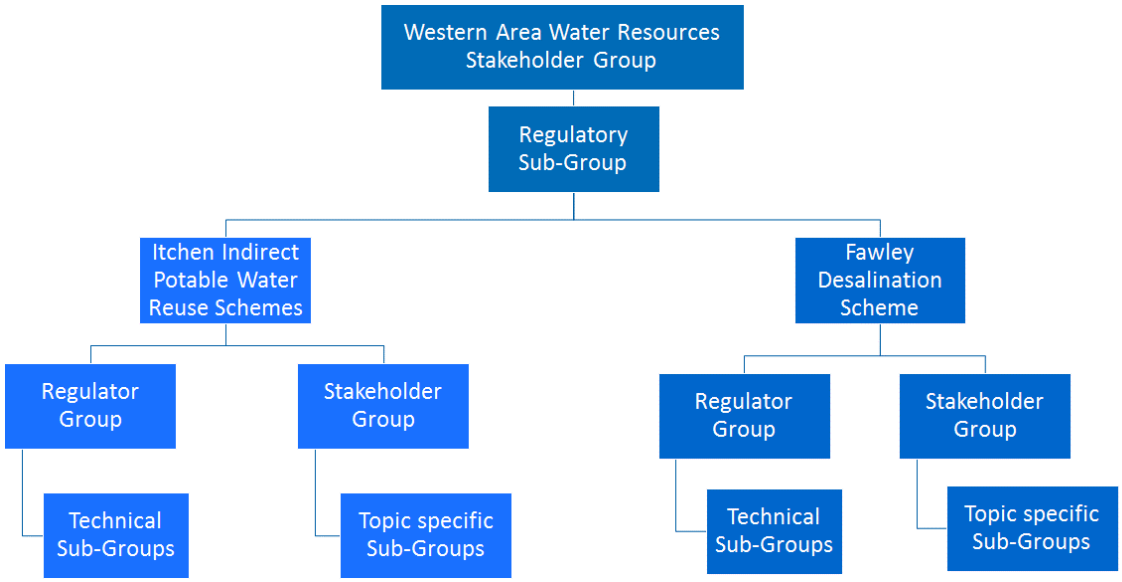

Figure 13 Overview of regulatory and stakeholder engagement approach for Fawley desalination scheme and the Itchen indirect alternative water reuse options

Below the strategic consultation group, Figure 13 shows that there is a regulatory strategic sub-group that provides a focus on regulatory matters. Additionally, we are in the process of establishing scheme-specific stakeholder and regulatory groups for each strategic scheme to enable dialogue on all aspects of the environmental and planning issues for each scheme. It is likely that there will also be a need for regulatory and stakeholder technical or topic-specific sub-groups (see Figure 13) for each scheme to enable greater focus on the details, for example on archaeology or marine environmental modelling. These sub-groups would meet as and when required according to the issues to be discussed and key milestones, including regulatory and planning submission dates. We currently consider it is appropriate to have one set of regulatory and stakeholder groups for all of the Itchen indirect water reuse options (i.e. Portsmouth Harbour, Fareham, Woolston and Portswood options) due to the overlap of many of the key environmental and planning issues.

Table 7 summarises the key regulatory and planning bodies that we expect to engage with as part of the regulatory groups, and Table 8 provides details of the key stakeholders that we will need to engage with on a regular basis.

Table 7 Key regulatory and planning bodies

Option	Key regulatory and planning bodies	
Fawley desalination	Environment Agency Marine Management Organisation (MMO) New Forest District Council Winchester City Council Historic England	Natural England New Forest National Park Authority Southampton City Council South Downs National Park Authority
Itchen Indirect Water Reuse Options	Environment Agency Portsmouth City Council Fareham Borough Council Eastleigh Borough Council Historic England	Natural England Southampton City Council South Downs National Park Authority Winchester City Council

Table 8 Key stakeholders

Option	Key stakeholders	
Fawley desalination	Hampshire & Isle of Wight Wildlife Trust New Forest Trust Inshore Fisheries/IFCA RSPB Forestry Commission RNLI MOD Boating/Yacht Clubs Key industrial land owners Key industrial customers English Heritage Local interest groups Local environmental groups	Western Area Water Resources Stakeholder Group members HM Coastguard Hampshire County Council Trinity House Harbour Authorities Ferry Operators Highways England National Grid Electricity distribution Suppliers Gas/fuel pipeline owners Fawley Waterside Ltd Landowners
Itchen Indirect Water Reuse Options	Portsmouth Water Hampshire & Isle of Wight Wildlife Trust Inshore Fisheries/IFCA RSPB Itchen fisheries owners Itchen angling groups Local environmental groups Network Rail Gas/fuel pipeline owners	Western Area Water Resources Stakeholder Group members Hampshire County Council Highways England Local interest groups Electricity distribution suppliers Harbour Authorities Friends of the South Downs

As well as the formal meetings of these groups, there will be ongoing dialogue with the representatives of regulators and stakeholders as required, including to gather information, seek advice or to consult on specific issues.

In addition to these collaborative consultation groups, we will continue to engage directly with our key regulators and with Defra on a regular basis on all regulatory aspects of the delivery of these water resource schemes. This includes joint meetings with several regulators and/or Defra as may be required.

Our regulatory dialogue with the Environment Agency and Natural England will include local teams, national permitting centres and other national teams/experts, as appropriate. We will continue to work with relevant experts within the Environment Agency and Natural England to discuss the detailed design of each scheme and the development of required mitigation measures, including through the Natural England Discretionary Advice Service (DAS).

We are committed to taking the views of the Environment Agency and Natural England, as well as the MMO where applicable, fully into account at all appropriate stages. As identified in the preceding section, during the early environmental activities up to Gate 2 (June 2022), there will be extensive dialogue with the environmental regulators to agree the options to be developed, the required mitigation measures and how any residual uncertainties and risks will be managed in advance of applications for planning approval and environmental permits/consents. Figure 9 and Figure 10 earlier indicate that that we will be actively engaging with the environmental regulators at regular intervals at each step of the monitoring, modelling and assessment processes.

We will also continue to engage with our neighbouring water companies through the Water Resources South East Group (WRSE) as the schemes are progressed. As referenced in Section 2.2, Portsmouth Water and Southern Water are committed to meeting on a regular basis to discuss ongoing investigations and the delivery of schemes in order to keep each other informed of emerging risks to each company's respective

water resources strategies. This will include working collaboratively to carefully consider the potential cumulative effects of the River Itchen indirect water reuse options with the Havant Thicket reservoir pipeline to the Southampton East Water Resource Zone, and where necessary identify appropriate detailed mitigation measures in dialogue with the environmental regulators.

5.6.1 Planning Co-ordination

We recognise that the Fawley desalination scheme and the Itchen indirect water reuse options will involve multiple planning authorities. In respect of the Fawley desalination scheme, depending on the final capacity of the scheme, it may be that the scheme is co-ordinated by the Planning Inspectorate through the Development Consent Order process as a Nationally Significant Infrastructure Project (under the Planning Act 2008).

If the Fawley desalination scheme is below the NSIP threshold capacity, we expect the scheme will be subject to the "Coastal Concordat" agreement to co-ordinate the dialogue on planning matters between the Marine Management Organisation (MMO), New Forest District Council, New Forest National Park Authority and Southampton City Council. This will include co-ordination with Natural England and the Environment Agency in respect of coastal development activities.

For the Itchen indirect water reuse options, the Coastal Concordat will not apply as the schemes do not involve coastal development. However, due to the multiple local planning authorities involved with these schemes due to long lengths of pipeline, we will discuss with the relevant planning authorities the use of voluntary Planning Performance Agreements to facilitate dialogue and agree timescales, actions and resources during the pre-application and application stages, and possibly extending through to the post-application stage.

5.7 Reviewing delivery timescales

Defra has requested that: "*after the environmental assessment has been completed, review and revise (if necessary) the programme to show that the preferred plan and simultaneous development of alternative options can be delivered within the timescales committed to as part of the public inquiry decision*".

We set out below our commitment to keeping the delivery timescales under regular review with the regulators.

Southern Water will continue to closely monitor its progress against delivery of the Fawley desalination scheme and the parallel investigations of the alternative water reuse options schemes, in dialogue with regulators and stakeholders, primarily through the Western Area Water Resources Stakeholder Group and project-specific consultation groups as set out earlier in Figure 13.

We will regularly review and update the delivery programme as we progress the early environmental actions, as well as following completion of the environmental assessments. The programme will evolve as more detailed information is acquired, decisions made by regulators and planning authorities, and through the ongoing dialogue with stakeholders.

Progress against the delivery plan will be reported formally at least annually through the WRMP Annual Review process, including setting out any changes to the risk and uncertainties, and also through the Ofwat reporting processes linked to the gated process and associated ODI.

5.8 Southampton Link Main

Defra has requested that we clarify: "*whether the Test Surface Water pipeline would be required or not, and exactly how the pipeline has been re-routed to minimise impacts to designated sites*".

We set out below the requirement for the Southampton Link Main pipeline and how it has been re-routed to minimise impacts to designated sites.

The Southampton Link Main (referred to as the "Test Surface Water Pipeline" in the Defra letter) is required to be developed as an integral part of the preferred strategy for the Western Area. It is a key part of the water supply resilience improvements for the Western Area and has been included in the revised draft WRMP19 to improve the inter-connectivity between the Hampshire Southampton West and Hampshire Southampton East water resource zones. This bi-directional pipeline is a key part of a wider resilience scheme for the Western Area that includes other pipelines linking other Hampshire water resource zones to form an integrated Hampshire Water Grid system. The pipeline would be used to help maintain supplies to customers during planned and unplanned outages, as well as helping to move water around the Southampton area from the various new water sources (for example, a proportion of the South West Water/Bournemouth Water bulk import and Portsmouth Water bulk imports, as well as a proportion of the water supplied by a Fawley desalination scheme (for the 100 Ml/d capacity option) and/or the River Itchen indirect potable water reuse options).

The Southampton Link Main is not the same scheme as the "Test Surface Water pipeline" scheme included at WRMP14 which would have involved abstraction from the River Test to supply water to Southampton East Water Resource Zone and was a single direction pipeline.

The proposed pipeline route has been designed to take account of all the potential future new water sources to be developed to both the east and the west of Southampton. It is a bi-directional pipeline (allowing east-west and west-east water flows) recognising that the new bulk imports will be from both the west and the east, and that a final decision on the Fawley desalination scheme and the alternative Itchen indirect water reuse options has yet to be made for the environmental reasons set out above.

The pipeline has been specifically routed to avoid the surface water catchment of the Emer Bog Special Area of Conservation (SAC) and to also avoid any crossing of the River Itchen SAC; the closest point to the River Itchen SAC boundary being the connection to the Lower Itchen WSW. Potential impacts to the River Itchen SAC during the construction phase were screened out through the Stage 1 Habitats Regulations Assessment process in the revised draft WRMP19, using a number of distance thresholds, for example for air quality (dust) emission effects.

Despite careful routing, the revised draft WRMP Habitats Regulations Assessment Report and Strategic Environmental Assessment (SEA) Report confirmed that it is not however possible to avoid all designated sites given the pipeline has to connect into existing Southern Water assets that are located very close to designated sites. The pipeline route extends under the River Test SSSI, the Solent and Southampton Water Special Protection Area (SPA) and Ramsar site, and the Lower Test Valley SSSI. The pipeline route is also located close to the boundary of the Solent Maritime SAC.

Given the proposed routing through the Solent and Southampton SPA and Ramsar, and underlying Lower Test Valley SSSI, a meeting was held with Natural England in December 2016 to discuss the pipeline route options in respect to these sites, and the mitigation measures required to maintain the integrity of these designated sites. Following the site meeting with Natural England, a suite of mitigation measures was developed to avoid or reduce adverse effects to the Solent and Southampton Water SPA and Ramsar.

Advice on the proposed mitigation plan was sought from Natural England in early 2017 and this advice was incorporated into the HRA Appropriate Assessment of this scheme in the revised draft WRMP19. This includes the measures to avoid compaction of the water meadow habitats and using the existing pipe bridge at the Little Test river crossing. Construction timing restrictions will be implemented to avoid disturbance of the qualifying bird species, and measures will be put in place to avoid preferential flow along the pipeline.

However, more detailed assessment of the scheme will be required in dialogue with Natural England and this may require further iteration of the final construction design and associated mitigation measures. Further detailed assessment, including a project-specific HRA, will be carried out in dialogue with Natural England at the detailed design stage to confirm the final agreed mitigation measures and demonstrate that there will no adverse effects on site integrity.

Work has also been undertaken to identify mitigation measures to avoid impacts to the River Test SSSI at one new river crossing where it is not possible to make use of an existing bridge to carry the pipeline. The pipeline route selected has also sought to minimise the overall length of pipeline required to be laid within water meadow habitat within or adjacent to designated sites (Lower Test Valley SSSI and Solent and Southampton Water SPA and Ramsar site). As mitigation, the proposed pipeline will therefore need to be constructed during the least sensitive periods (particularly for designated bird species), at sufficient depth to avoid adverse hydrological effects on the River Test and water meadow habitat, and with any construction activity set back sufficiently from watercourses to avoid adverse impacts to the designated features. We will continue to discuss the mitigation measures for the River Test SSSI with Natural England as we progress with the detailed design of the pipeline to agree the final route and final mitigation measures to protect the River Test and water meadow features.

6 Compliance with WRMP Directions

6.1 WRMP Direction 3(e)

6.1.1 Defra's comment

Southern Water must demonstrate compliance with the WRMP Direction 3(e) in its final plan.

3 (e) the assumptions it has made as part of the supply and demand forecasts contained in the water resources management plan in respect of— (i) the implications of climate change, including in relation to the impact on supply and demand of each measure which it has identified in accordance with section 37A(3)(b);

The company has undertaken climate change sensitivity assessments of its preferred plan and strategic alternatives and presented the qualitative outcome of these in its revised plan. Although the company has undertaken a sensitivity assessment, it has not explicitly stated a numerical estimate of the impact of climate change associated with its future operations for its demand and supply measures. The company must clearly state the impact of climate change on each preferred (final plan) supply and demand option individually, including the assumptions made in the assessment, to meet Direction 3(e).

6.1.2 Our response and proposed changes to our plan

In our statement of response for our revised draft WRMP we provided a response to issue R5.3 raised by the EA regarding our compliance with WRMP Direction 3(e). In our revised draft WRMP we provided three tables which set out our qualitative assumptions of the potential impacts of climate change for each of our identified measures in accordance with section 37A(3)(b) of the Water Industry Act, 1991:

- Revised draft WRMP Annex 9 – Section 4.3 - Table 5 for our Western area.
- Revised draft WRMP Annex 10 – Section 4.3 -Table 5 for our Central area.
- Revised draft WRMP Annex 11 – Section 4.3 - Table 5 for our Eastern area

Following Defra's request for further information (Section 6.1.1) we have undertaken a further review of our original qualitative assumptions. Where required, we have also undertaken some additional modelling and analysis in order to provide more robust quantitative estimate of the impacts of climate change for each of our identified measures in accordance with section 37A(3)(b) of the Water Industry Act, 1991.

Our quantitative assessment of the impacts of climate change for each measure are set out in Table 9 for our Western area strategy, Table 10 for our Central area strategy and Table 11 for our Eastern area strategy. We will include these updated tables in the area strategies of our final WRMP as direct replacements for those listed in Annexes 9, 10 and 11 above. These tables set out any specific assumptions we have made when assessing the climate change impact of each of our identified measures. We have also applied the following general assumptions to all estimated climate change impacts:

- We have excluded our "Strategic Alternative" options form this assessment after receiving clarification from the EA that only the preferred schemes needed to be included.
- We have based our assessment on our preferred strategy for the revised draft WRMP but acknowledge that this assessment may need to be updated if there are any further changes to our strategy in our final WRMP (for example bringing in a Strategic Alternative option). Based on the further modelling we have undertaken for this Addendum our main strategic scheme timings are unchanged, and the portfolio of options is also unchanged. The only option in the portfolio that has altered is that the Test Estuary WTW industrial water reuse scheme is now no longer required.
- We have assumed and stated the full impacts of climate change to 2085 consistent with our modelling assumptions in Annex 3.
- We have applied the same dry, medium and wet possible future climate change scenarios used in our Annex 3 modelling of climate change impacts for our baseline supply forecast.
- The climate change impacts on schemes are stated in a consistent manner with our baseline supply forecast for a severe drought (1:200) unless the option specifically states benefits under extreme droughts (1:500) or drought conditions (1:20).
- Unless otherwise stated, the climate change impacts are the same for both our critical period (PDO) and minimum or average period (MDO/ADO) states of the world. Generally, this means that where there are no forecast impacts, a single figure of 0.00Ml/d is reported and applies to all states of the world.

Table 9 Assessment of the impacts of climate change on the strategy for our Western area

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Demand management				
Target 100 water efficiency activity	0.00Ml/d	0.00Ml/d	0.00Ml/d	We have assumed that the benefits of demand management are not sensitive to impacts from climate change as they are dominantly controlled by behavioural or infrastructure change. The impacts of our water efficiency activities within our demand forecasts already reflect the impacts of hot, dry weather any additional effects of climate change are small. Therefore, in our WRMP we assume that climate change has no impact on water efficiency measures
Leakage reduction (15% reduction by 2025; 50% by 2050)	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Installation of automated meter reads (AMR) meters to take household meter penetration from 88% to 92%	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Temporary Use Ban (TUB) and Non Essential Use (NEU) ban	-1.30Ml/d at MDO -7.30Ml/d at PDO	0.00Ml/d	0.00Ml/d	We have quantified the DO benefits of TUBs and NEU bans as a percentage of baseline DO. To determine the impacts of climate change on these DO benefits for the Dry scenario we have assumed the same percentage factors and applied those to the total area DO. For the Mid and Wet Scenarios the impacts of climate change have minor water resource benefits and so we have assumed there would be no change in the DO benefit of demand restrictions.
Resource development and bulk supplies				
Hampshire grid (reversible link Hampshire Winchester-Hampshire Andover)	0.00Ml/d	0.00Ml/d	0.00Ml/d	This is an infrastructure scheme and the capacity of the transfer is insensitive to climate change. We have separately considered the impacts of climate change on the deployable output of contributing sources in our baseline assessment.

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Newbury WSW asset enhancement	-0.63Ml/d at MDO -0.57Ml/d at PDO	0.00Ml/d at MDO 0.00Ml/d at PDO	0.00Ml/d at MDO +0.04Ml/d at PDO	Source may become groundwater level constrained under dry climate change scenario. We have applied the same shift in baseline DO to the scheme but capped the impact at the forecast scheme yield.
Romsey Town and Broadlands valve (Hampshire Southampton West-Hampshire Rural reversible)	0.00Ml/d	0.00Ml/d	0.00Ml/d	This is an infrastructure scheme and the capacity of the transfer is insensitive to climate change. We have separately considered the impacts of climate change on the deployable output of contributing sources in our baseline assessment.
Additional import from Portsmouth Water (additional 9Ml/d)	0.00Ml/d	0.00Ml/d	0.00Ml/d	Impacts of climate change on the benefits of bulk supplies should be accounted for as part of the donor company's assessment. We have assumed the yield of this scheme is reliable under all climate change scenarios.
Additional import from Portsmouth Water (Havant Thicket Reservoir Development)	0.00Ml/d	0.00Ml/d	0.00Ml/d	Impacts of climate change on the benefits of bulk supplies should be accounted for as part of the donor company's assessment. We have assumed the yield of this scheme is reliable under all climate change scenarios.
Import from South West Water	0.00Ml/d	0.00Ml/d	0.00Ml/d	Impacts of climate change on the benefits of bulk supplies should be accounted for as part of the donor company's assessment. We have assumed the yield of this scheme is reliable under all climate change scenarios.
Fawley desalination - (modular to 75Ml/d)	0.00Ml/d	0.00Ml/d	0.00Ml/d	We have assumed that the DO benefits of desalination are not sensitive to climate change as dependency is on seawater availability. We have assumed there will be no change in water quality or environmental standards as a consequence of climate change that may affect our desalination options.
Southampton link main (reversible Hampshire Southampton West-Hampshire Southampton East)	0.00Ml/d	0.00Ml/d	0.00Ml/d	This is an infrastructure scheme and the capacity of the transfer is insensitive to climate change. We have separately considered the impacts of climate change on the deployable output of contributing sources in our baseline assessment.

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Hampshire grid (reversible link Hampshire Southampton East-Hampshire Winchester)	0.00Ml/d	0.00Ml/d	0.00Ml/d	This is an infrastructure scheme and the capacity of the transfer is insensitive to climate change. We have separately considered the impacts of climate change on the deployable output of contributing sources in our baseline assessment.
Sandown WwTW Indirect Potable Reuse (8.5Ml/d)	0.00Ml/d	0.00Ml/d	0.00Ml/d	We have assumed that the DO benefits of water reuse are not sensitive to climate change as dependency is on wastewater availability. We have assumed there will be no change in water quality or environmental standards as a consequence of climate change that may affect our water reuse options.
WSW near Cowes - reinstate & additional treatment	0.00Ml/d	0.00Ml/d	0.00Ml/d	The scheme draws upon a deep confined aquifer and hence is unlikely to be sensitive to drought or climate change.
Catchment management				
Nitrate Option – Chilbolton	0.00Ml/d	0.00Ml/d	0.00Ml/d	Our Catchment Management and Nitrate schemes provide an equal DO benefit to that lost as a consequence of Water Quality. The impacts of climate change on the DO from individual schemes has therefore been assessed as the same as the climate change impacts on baseline DO of each source. Some measures (e.g. Pesticide Options for the River Medway Scheme) do not have DO benefits and are for resilience purposes only. We have assumed there will be no climate change impacts on these measures. Agricultural practices may change in response to climate change and there could be shifts in the patterns of nitrates / pesticides usage. Catchment management schemes would still be required, and the schemes would need to dynamically respond to such changes in practices. For our in-stream catchment management options our modelling has shown that surface water flows may be significantly lower than present in both the River Test and River
Nitrate catchment management / treatment – Romsey	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Nitrate catchment management / treatment – Twyford	-19.60Ml/d at MDO -4.41Ml/d at PDO	+0.34Ml/d at MDO 0.00Ml/d at PDO	+0.84Ml/d at MDO 0.00Ml/d at PDO	
In-stream river restoration works on the Itchen	-1.12Ml/d at MDO -1.23Ml/d at PDO	0.00Ml/d	0.00Ml/d	
Pesticide catchment management / treatment – Test Surface Water	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Nitrate catchment management / treatment – Winchester	0.00Ml/d	0.00Ml/d	0.00Ml/d	

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Pesticide catchment management / treatment – Sandown	0.00Ml/d	0.00Ml/d	0.00Ml/d	Itchen. Consequently we have assumed that for a dry climate change future these schemes, which are assumed to partially offset future sustainability reductions, will not deliver any DO benefits.
Drought Permits/Orders in severe and extreme droughts				
Mitigation and monitoring activities on the Itchen (enabling option, no DO benefit)	0.00Ml/d	0.00Ml/d	0.00Ml/d	This scheme is an enabling option and has no DO benefit and hence is insensitive to climate change
Mitigation and monitoring activities for Candover (enabling option, no DO benefit)	0.00Ml/d	0.00Ml/d	0.00Ml/d	This scheme is an enabling option and has no DO benefit and hence is insensitive to climate change
Candover Drought Permit/Order (2020-27)	-9.09Ml/d at MDO -8.19Ml/d at PDO	5.25Ml/d at MDO 1.27Ml/d at PDO	7.24Ml/d at MDO -1.99Ml/d at PDO	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here.
Lower Itchen (g/w and s/w sources) Drought Permit/Order (2020-27)	-6.63Ml/d at MDO0 0.00Ml/d at PDO	-4.50Ml/d at MDO -5.32Ml/d at PDO	-13.75Ml/d at MDO -24.62Ml/d at PDO	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here. Note this scheme delivers less DO benefit under all climate change scenarios, either because flows are lower (dry scenario) or baseline flows are greater (mid and dry scenarios) hence the yield of the drought order up to the daily licence limit is reduced.
Test surface water Drought Permit/Order in drought conditions (interim measure only)	0.00Ml/d at MDO 0.00Ml/d at PDO	0.00Ml/d at MDO 0.00Ml/d at PDO	0.00Ml/d at MDO 0.00Ml/d at PDO	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here. Our analysis shows that the full yield of the drought permit or order would be available under all climate change scenarios.
Mitigation and monitoring activities on the Test (enabling option, no DO benefit)	0.00Ml/d	0.00Ml/d	0.00Ml/d	This scheme is an enabling option and has no DO benefit and hence is insensitive to climate change.

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Test surface water Drought Permit (2020-27)	-58.51Ml/d at MDO -28.87Ml/d at PDO	0.00Ml/d at MDO 0.00Ml/d at PDO	0.00Ml/d at MDO 0.00Ml/d at PDO	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here. This shows that under a dry climate change scenario yield would be substantially reduced but would be available under a mid or wet scenario.
Test surface water Drought Order (2020-27)	0.00Ml/d at MDO 0.00Ml/d at PDO	0.00Ml/d at MDO 0.00Ml/d at PDO	0.00Ml/d at MDO 0.00Ml/d at PDO	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here. Our analysis shows that the full yield of the drought order would be available under all climate change scenarios.
Drought Permits/Orders in extreme droughts only				
Candover Drought Permit/Order (from 2027 onwards)	-4.87Ml/d at MDO -7.01Ml/d at PDO	7.05Ml/d at MDO 5.81Ml/d at PDO	16.21Ml/d at MDO 8.18Ml/d at PDO	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here.
Test surface water Drought Permit and Order (from 2027 onwards)	-52.74Ml/d at MDO -54.09Ml/d at PDO	+24.07Ml/d at MDO +27.69Ml/d at PDO	+24.07Ml/d at MDO +27.69Ml/d at PDO	Our baseline DO assessment for this option has included an assessment of yield under different climate change scenarios and impacts are reported here.

Table 10 Assessment of the impacts of climate change on the strategy for our Central area

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Demand management				
Target 100 water efficiency activity	0.00Ml/d	0.00Ml/d	0.00Ml/d	We have assumed that the benefits of demand management are not sensitive to impacts from climate change as they are dominantly controlled by behavioural or infrastructure change. The impacts of our water efficiency activities within our demand forecasts already reflect the impacts of hot, dry weather any additional effects of climate change are small. Therefore, in our WRMP we assume that climate change has no impact on water efficiency measures
Leakage reduction (15% reduction by 2025; 50% by 2050)	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Installation of AMR meters to take HH meter penetration from 88% to 92%	0.00Ml/d	0.00Ml/d	0.00Ml/d	
TUBs and NEU ban	-2.80Ml/d at MDO -2.72Ml/d at PDO	0.00Ml/d	0.00Ml/d	We have quantified the DO benefits of TUBs and NEU bans as a percentage of baseline DO. To determine the impacts of climate change on these DO benefits for the Dry scenario we have assumed the same percentage factors and applied those to the total area DO. For the Mid and Wet Scenarios the impacts of climate change have minor water resource benefits and so we have assumed there would be no change in the DO benefit of demand restrictions.
Resource development and bulk supplies				
Coastal Desalination - Shoreham Harbour (10Ml/d)	0.00Ml/d	0.00Ml/d	0.00Ml/d	We have assumed that the DO benefits of desalination are not sensitive to climate change as dependency is on seawater availability. We have assumed there will be no change in water quality or environmental standards as a consequence of climate change that may affect our desalination options
Winter transfer Stage 2: New main Shoreham/North Shoreham and Brighton A	-3.00Ml/d at MDO -3.00Ml/d at PDO	0.00Ml/d	0.00Ml/d	This is dominantly an infrastructure scheme and consequently there is no climate change impacts under a medium or wet climate change scenario. Climate change sensitivity has been addressed in our baseline climate change assessments of contributing sources. This has indicated that under a dry climate change scenario flows in the Western Rother may be reduced and consequently we have assumed that the scheme will deliver no DO benefit in the winter.

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Littlehampton WTW Indirect Potable Water Reuse (20Ml/d)	0.00Ml/d	0.00Ml/d	0.00Ml/d	We have assumed that the DO benefits of water reuse are not sensitive to climate change as dependency is on wastewater availability. We have assumed there will be no change in water quality or environmental standards as a consequence of climate change that may affect our water reuse options.
Pulborough groundwater licence variation	0.00Ml/d	0.00Ml/d	0.00Ml/d	The DO of the Pulborough groundwater sources is dependent on long term recharge to a confined aquifer. By decoupling the groundwater licence from the River Hands off Flow condition we consider that this option and source become less sensitive to climate change under extreme droughts.
Transfer to Midhurst WSW & Petersfield BH rehabilitation	0.00Ml/d	0.00Ml/d	0.00Ml/d	We have assumed the rehabilitation and transfer scheme removes the existing demand, infrastructure and water quality constraints. We have assumed that the yield of rehabilitated boreholes can unlock licenced rates. Extrapolation of drought curve using Sussex Brighton Indicator borehole (as per AMP3 analysis) suggests yield will be constrained by the abstraction licence under all climate change scenarios
Scheme to bring West Chiltington back into service	-0.26Ml/d at MDO 0.00Ml/d at PDO	+0.34Ml/d at MDO0.00Ml/d at PDO	+0.84Ml/d at MDO0.00Ml/d at PDO	We have assumed the rehabilitation and transfer scheme restores DO to yield and removes treatment constraints. We have assumed that the yield of rehabilitated boreholes can unlock licenced rates. Extrapolation of drought curve using Sussex Brighton Indicator borehole (as per AMP3 analysis) suggests yield will be constrained by the abstraction licence under all climate change scenarios
ASR (Sussex Coast - Lower Greensand)	0.00Ml/d	0.00Ml/d	0.00Ml/d	The scheme utilises a deep confined aquifer as a storage reservoir. Recharge water will be sourced during wetter periods and stored for drought use. Consequently the scheme is not expected to be vulnerable to drought or climate change.
Catchment management				
Nitrate catchment management / treatment – North Falmer A	-0.03Ml/d at MDO -0.04Ml/d at PDO	0.05Ml/d at MDO 0.04Ml/d at PDO	0.10Ml/d at MDO 0.13Ml/d at PDO	Our Catchment Management and Nitrate schemes provide an equal DO benefit to that lost as a consequence of Water Quality. The impacts of climate change on the DO from individual schemes has therefore been assessed as the same as the climate change impacts on baseline DO of each source.
Nitrate catchment management /	-2.80Ml/d at MDO 0.00Ml/d at PDO	+1.40Ml/d at MDO +1.38Ml/d at PDO	+3.24Ml/d at MDO +3.08Ml/d at PDO	

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
treatment – North Falmer B				Some measures (e.g. Pesticide Options for the River Medway Scheme) do not have DO benefits and are for resilience purposes only. We have assumed there will be no climate change impacts on these measures. Agricultural practices may change in response to climate change and there could be shifts in the patterns of nitrates / pesticides usage. Catchment management schemes would still be required, and the schemes would need to dynamically respond to such changes in practices. For our in-stream catchment management options our modelling has shown that surface water flows may be significantly lower than present. Consequently we have assumed that for a dry climate change future these schemes, which will partially offset future sustainability reductions, will not deliver any DO benefits.
Nitrate catchment management / treatment – Brighton A	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Pesticide catchment management / treatment – River Arun	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Pesticide catchment management / treatment – Pulborough Surface	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Pesticide catchment management / treatment – Weir Wood Reservoir	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Nitrate catchment management – Steyning	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Arun/W Rother - instream catchment management options	-1.50Ml/d at MDO -1.80Ml/d at PDO	0.00Ml/d	0.00Ml/d	
Nitrate catchment management / treatment – North Arundel	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Nitrate catchment management / treatment – Long Furlong B	-0.18Ml/d at MDO -0.18Ml/d at PDO	+0.18Ml/d at MDO +0.18Ml/d at PDO	+0.49Ml/d at MDO +0.49Ml/d at PDO	

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Drought Permits/Orders in severe and extreme droughts				
Pulborough surface (Phases 1 to 3) Drought Permit/Order (2020-25)	-8.30Ml/d at MDO -16.80Ml/d at PDO	0.00Ml/d at MDO -16.80Ml/d at PDO	0.00Ml/d at MDO -16.80Ml/d at PDO	Our climate change modelling has shown that surface water flows in the River Rother may be lower than present under some climate change scenarios. Consequently we have assumed that where flows are reduced the scheme will not deliver any DO benefits.
Pulborough groundwater Drought Order (2020 onwards)	0.00Ml/d	0.00Ml/d	0.00Ml/d	The DO of the Pulborough groundwater sources is dependent on long term recharge to a confined aquifer. By decoupling the groundwater licence from the River Hands off Flow condition via a drought order we consider that this option and source become less sensitive to climate change under extreme droughts.
Weir Wood reservoir Drought Permit/Order (2020-25)	-3.60Ml/d at ADO -5.40Ml/d at PDO	0.00Ml/d at ADO -5.40Ml/d at PDO	0.00Ml/d at ADO -5.40Ml/d at PDO	Our climate change modelling has shown that surface water flows to the reservoir may be lower than present under some climate change scenarios. Consequently we have assumed that where flows are reduced the scheme will not deliver any DO benefits.
East Worthing Drought Permit/Order (2020-25)	0.00Ml/d	0.00Ml/d	0.00Ml/d	Yields from this source are licence constrained and will remain, licence/infrastructure constrained under all climate scenarios. We therefore consider that yield of this scheme will not be drought sensitive and there will be no impact from climate change.
North Arundel Drought Permit/Order (2020-25)	0.00Ml/d	0.00Ml/d	0.00Ml/d	Yields from this source are licence constrained and will remain, licence/infrastructure constrained under all climate scenarios. We therefore consider that yield of this scheme will not be drought sensitive and there will be no impact from climate change.
Drought Permits/Orders in extreme droughts only				
Pulborough surface (Phases 1 to 3) Drought Permit/Order (2025 onwards)	-5.60Ml/d at ADO -23.00Ml/d at PDO	0.00Ml/d at ADO -23.00Ml/d at PDO	0.00Ml/d at ADO -23.00Ml/d at PDO	Our modelling has shown that surface water flows may be lower than present climate change scenario. Consequently we have assumed that where flows are reduced the scheme will not deliver any DO benefits.
East Worthing Drought Permit/Order (2025 onwards)	0.00Ml/d	0.00Ml/d	0.00Ml/d	Yields from this source are licence constrained and will remain, licence/infrastructure constrained under all climate scenarios. We therefore consider that yield of this scheme will not be

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
				drought sensitive and there will be no impact from climate change.

Table 11 Assessment of the impacts of climate change on the strategy for our Eastern area

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Demand management				
Target 100 water efficiency activity	0.00Ml/d	0.00Ml/d	0.00Ml/d	We have assumed that the benefits of demand management are not sensitive to impacts from climate change as they are dominantly controlled by behavioural or infrastructure change. The impacts of our water efficiency activities within our demand forecasts already reflect the impacts of hot, dry weather any additional effects of climate change are small. Therefore, in our WRMP we assume that climate change has no impact on water efficiency measures
Leakage reduction (15% reduction by 2025; 50% by 2050)	0.00Ml/d	0.00Ml/d	0.00Ml/d	
TUBS and NEU Ban	-0.70Ml/d at MDO -2.50Ml/d at PDO	0.00Ml/d	0.00Ml/d	We have quantified the DO benefits of TUBs and NEU bans as a percentage of baseline DO. To determine the impacts of climate change on these DO benefits for the Dry scenario we have assumed the same percentage factors and applied those to the total area DO. For the Mid and Wet Scenarios the impacts of climate change have minor water resource benefits and so we have assumed there would be no change in the DO benefit of demand restrictions.
Resource development and bulk supplies				
Medway WTW Indirect Potable Water Reuse (18 Ml/d)	0.00Ml/d	0.00Ml/d	0.00Ml/d	We have assumed that the DO benefits of water reuse are not sensitive to climate change as dependency is on wastewater availability. We have assumed there will be no change in water quality or environmental standards as a consequence of climate change that may affect our water reuse options. Abstraction from Eccles lake currently has no environmental designations or licence constraints and we have assumed that treated effluent discharge and indirect reuse at this source will not be sensitive to climate change.
Recommission Meopham Greensand groundwater source	0.00Ml/d	0.00Ml/d	0.00Ml/d	The scheme draws upon a deep confined aquifer and yield will be constrained by our infrastructure and abstraction licence. We

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
				consider that abstraction will not be sensitive to drought or climate change.
SEW bulk supply near Canterbury	0.00Ml/d	0.00Ml/d	0.00Ml/d	Impacts of climate change on the benefits of bulk supplies should be accounted for as part of the donor company's supply assessment. We have assumed the bulk transfer will be resilient to climate change.
Utilise full existing transfer capacity (from Faversham4)	0.00Ml/d	0.00Ml/d	0.00Ml/d	This is an infrastructure scheme and the capacity of transfer is insensitive to climate change. We have reviewed climate change impacts based on our assessment of impacts on DO from the donor sources (Faversham3 and Faversham4). Both sources are considered insensitive to climate change as their DO presently is, and will remain, licence/infrastructure constrained under all climate scenarios.
West Sandwich & Sandwich WSW Licence Variation	-0.11Ml/d at ADO -0.19Ml/d at PDO	-0.01Ml/d at ADO 0.00Ml/d at PDO	+0.16Ml/d at ADO -0.01Ml/d at PDO	Yield at West Sandwich and Sandwich exhibits some sensitivity to groundwater levels and drought. A climate change assessment for the baseline deployable output at both sources has already been carried out and the total impact of this measures has been assumed as the total climate change impact on both sources.
Stourmouth WSW (10Ml/d with 20Ml covered storage)	0.00Ml/d	0.00Ml/d	0.00Ml/d	Yield of the scheme is dependent on discharges from a STW upstream of the abstraction point and is therefore independent of hydrology. We have assumed the scheme yield is therefore independent of climate change impacts.
Catchment management				
Pesticide catchment management / treatment – River Medway Scheme	0.00Ml/d	0.00Ml/d	0.00Ml/d	Our Catchment Management and Nitrate schemes provide an equal DO benefit to that lost as a consequence of Water Quality. The impacts the of climate change on the DO from individual schemes has therefore been assessed as the same as the climate change impacts on baseline DO of each source. Some measures (e.g. Pesticide Options for the River Medway Scheme) do not have DO benefits and are for resilience purposes only. We have assumed there will be no climate
Nitrate catchment management / treatment – Gravesend	0.00Ml/d at ADO -0.04Ml/d at PDO	0.00Ml/d at ADO -0.04Ml/d at PDO	0.00Ml/d at ADO 0.12Ml/d at PDO	
Nitrate catchment management / treatment – Strood	0.00Ml/d	0.00Ml/d	0.00Ml/d	

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Nitrate catchment management / treatment – Deal	-0.74Ml/d at ADO -0.98Ml/d at PDO	0.00Ml/d at ADO 0.00Ml/d at PDO	+0.16Ml/d at ADO +0.16Ml/d at PDO	change impacts on these measures. Agricultural practices may change in response to climate change and there could be shifts in the patterns of nitrates / pesticides usage. Catchment management schemes would still be required, and the schemes would need to dynamically respond to such changes in practices.
Nitrate catchment management / treatment – West Sandwich	-0.11Ml/d at ADO -0.19Ml/d at PDO	-0.01Ml/d at ADO 0.00Ml/d at PDO	+0.16Ml/d at ADO -0.01Ml/d at PDO	
Nitrate catchment management / treatment – Manston	-0.81Ml/d at ADO -1.70Ml/d at PDO	-0.13Ml/d at ADO -0.26Ml/d at PDO	+0.42Ml/d at ADO +0.01Ml/d at PDO	
Nitrate catchment management / treatment – Ramsgate B	-0.31Ml/d at ADO -0.34Ml/d at PDO	-0.03Ml/d at ADO -0.03Ml/d at PDO	+0.03Ml/d at ADO -0.08Ml/d at PDO	
Nitrate catchment management / treatment – Birchington	-0.44Ml/d at ADO -0.44Ml/d at PDO	-0.12Ml/d at ADO -0.14Ml/d at PDO	+0.53Ml/d at ADO +0.53Ml/d at PDO	
Nitrate catchment management / treatment – North Deal	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Nitrate catchment management / treatment – near Canterbury	-4.29Ml/d at ADO -6.29Ml/d at PDO	-0.01Ml/d at ADO +0.18Ml/d at PDO	+2.32Ml/d at ADO +0.65Ml/d at PDO	
Nitrate catchment management / treatment – Sandwich	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Nitrate catchment management – North Dover	-0.14Ml/d at ADO -0.13Ml/d at PDO	0.00Ml/d at ADO +0.01Ml/d at PDO	+0.08Ml/d at ADO +0.07Ml/d at PDO	
Pesticide catchment management / treatment – Darwell Reservoir	0.00Ml/d	0.00Ml/d	0.00Ml/d	
Pesticide catchment management / treatment – Powdermill Reservoir	0.00Ml/d	0.00Ml/d	0.00Ml/d	

Strategic Schemes	Climate Change Impact (Ml/d)			
	Dry Scenario	Mid Scenario	Wet Scenario	Climate change impact assessment assumptions
Drought Permits/Orders in severe and extreme droughts				
Faversham sources Drought Permit/Order (2020-2024)	0.00Ml/d	0.00Ml/d	0.00Ml/d	Our DO assessment for these sources indicates that they are licence constrained and are not drought sensitive. We therefore consider that drought permit yields are unlikely to be impacted by climate change.
River Medway Scheme (stages 1 to 4) Drought Permit/Order (2020-2024)	0.00Ml/d	0.00Ml/d	0.00Ml/d	Our modelling has shown that drought permit and order yield from the River Medway Scheme and associated reservoirs (Powdermill and Darwell) is insensitive to climate change
Sandwich Drought Permit/Order (2020-2024)	0.00Ml/d	0.00Ml/d	0.00Ml/d	Yields from this source are licence constrained and will remain, licence/infrastructure constrained under all climate scenarios. We therefore consider that yield of this scheme will not be drought sensitive and there will be no impact from climate change.
Powdermill Reservoir Drought Permit/Order (2020-2024)	0.00Ml/d	0.00Ml/d	0.00Ml/d	Our resource modelling has shown that drought permit and order yield from the River Medway Scheme and associated reservoirs (Powdermill and Darwell) is insensitive to climate change
Drought Permits/Orders in extreme droughts only				
Faversham sources Drought Permit/Order (2025 onwards)	0.00Ml/d	0.00Ml/d	0.00Ml/d	Our DO assessment for these sources indicates that they are licence constrained and are not drought sensitive. We therefore consider that drought permit yields are unlikely to be impacted by climate change.
Stourmouth Drought Permit/Order	0.00Ml/d	0.00Ml/d	0.00Ml/d	Yield of this source is dependent on discharges from a STW upstream of the abstraction point and is independent of hydrology. Scheme yield is therefore independent of climate change impacts.
Powdermill Reservoir Drought Permit/Order (2025 onwards)	0.00Ml/d	0.00Ml/d	0.00Ml/d	Our modelling has shown that drought permit and order yield from the River Medway Scheme and associated reservoirs (Powdermill and Darwell) is insensitive to climate change

6.2 WRMP Direction 3(f)

6.2.1 Defra's comment

Southern Water must demonstrate compliance with the WRMP Direction 3(f) in its final plan.

3. (f) its intended programme for the implementation of domestic metering and its estimate of the cost of that programme, including the costs of installation and operation of meters;

The company has considered options to increase metering further through a continuation of its compulsory metering programme. However, it is unclear how the company intend to implement this metering programme across the planning period. The company must describe its approach to implementing its metering programme (for example, which areas will be prioritised for meter installation), together with installation and operational costs, to meet Direction 3(f).

6.2.2 Our response and proposed changes to our plan

We have in recent years been a frontrunner in the field of demand management among UK water companies, having successfully implemented a Universal Metering Programme (UMP), compulsorily installing around 450,000 Automated Meter Reading (AMR) meters between 2010 and 2015, taking household metering levels across its supply area to around 88%. Subject to technical feasibility in each case, metering the remaining 12% of households may be possible, although investigations as part of the UMP have indicated that the costs are likely to be significantly higher and potential demand saving benefits uncertain and/or limited.

In our revised draft WRMP we have considered all the options which could feasibly increase our levels of household meter penetration. The programme of metering which has been selected as part of our strategy for each of our three supply areas is set out below. This information will supplement the summary information already contained in Annexes 9, 10 and 11 of our revised draft WRMP, and in doing so will meet WRMP Direction 3(f).

Option MAMR1 (increasing meter penetration to at least 92% in each WRZ) forms part of our strategy for the Western and Central areas, and "Target 100" will be implemented across all three areas. These two options are described in more detail below, with the full option descriptions provided in Annex 6. The full justification for this metering programme is provided in Annexes 9, 10 and 11 of our revised draft WRMP.

Option MAMR1 - compulsory metering
Option MAMR1, selected in the Western and Central areas, is an extension of our UMP that involves installation of AMR meters at unmetered properties and moving them over to a metered charging regime. This option will take domestic meter penetration from current levels (88%) up to a minimum of 92% in each WRZ by the end of AMP7.

Consistent with our findings from implementing the UMP, we have made an assumption that extending our metering campaign will generate a small (insignificant) number of optant requests, which have been incorporated in the overall meter penetration target of option MAMR1 (92%). This is in recognition of our statutory obligation to continue to provide optant meters to customers when requested.

The total numbers of meters to be installed in each WRZ as part of this option are summarised in Table 12. At this strategic stage of the planning process, for the purposes of estimating costs and benefits of the option (as detailed in Annex 6 of our revised draft WRMP), a linear installation programme has been assumed across AMP7, with an equal number of meters being installed in each of the 5 years of AMP7 across each of the WRZs in the relevant areas. There are currently no priority areas to be targeted first. As we move

towards more detailed planning of the scheme, it is likely we will draw upon our experiences in designing and implementing our UMP. However, because there relatively few meters being installed compared to our UMP, we will undertake geospatial analysis of where these customers are located, and design the implementation strategy accordingly, initiating customer contact in a systematic way.

Table 12 New meter installations under the preferred plan

Area	WRZ	Total number of meters to be installed during AMP7	Total installation cost (£k)*	Total cost of operation of meters (£k/yr)
Western Area	Hampshire Kingsclere	857	316	6
	Hampshire Andover	999	369	7
	Hampshire Rural	307	113	2
	Hampshire Winchester	731	270	5
	Hampshire Southampton East	3,632	1,340	25
	Hampshire Southampton West	0	0	0
	Isle of Wight	0	0	0
Western Area total		*6,527*	*2,409*	*46*
Central Area	Sussex Brighton	19,542	7,212	137
	Sussex Worthing	1,000	369	7
	Sussex North	6,795	2,508	48
Central Area total		*27,337*	*10,089*	*191*
Eastern Area	Kent Medway East	0	0	0
	Kent Medway West	0	0	0
	Kent Thanet	0	0	0
	Sussex Hastings	0	0	0
Eastern Area total		*0*	*0*	*0*
Company total		**33,864**	**12,497**	**237**

** Note that these costs are all classified as operational for consistency with Business Plan classifications.*

Target 100

As well as additional metering in our Western and Central areas, our preferred plan also includes implementation of our Target 100 option. Whilst this option does not include installation of new meters at previously unmetered households, it does include, but may not be limited to, the following metering-related enhancement activities (full details are provided in Annex 6 of our revised draft WRMP):

- During AMP7: Increasing the meter reading frequency from six-monthly to monthly in all supply areas (including replacing the 45,500 visual meter reading (VMR) meters that are expected to remain after the end of AMP6) (detailed in Table 13).
- During AMP8: Company-wide smart metering roll-out, involving replacing 780,000 existing meters (those already in place at the start of AMP7) with smart meters and installation of the associated technology (detailed in Table 14).
- During AMP9: Completion of company-wide smart metering roll-out, installing 320,000 smart meters at existing metered households by 2032 (detailed in Table 14).

These activities, and the numbers of households that will be included in each activity, are summarised in the tables below.

Table 13 Number and cost of VMR meters that will be replaced with AMR meters during AMP7, and cost of increasing meter reading frequency, both part of Target 100

Area	WRZ	VMR meter replacements during AMP7*	Total installation cost of VMR meters (£k)	Total operational cost of increasing meter reading frequency from 6-monthly to monthly over 25-year planning period (£k)
Western Area	Hampshire Kingsclere	342	25	25
	Hampshire Andover	1,647	122	126
	Hampshire Rural	606	45	54
	Hampshire Winchester	1,295	96	142
	Hampshire Southampton East	6,419	475	794
	Hampshire Southampton West	1,892	140	374
	Isle of Wight	6,042	447	84
Western Area total		*18,243*	*1,351*	*1,598*
Central Area	Sussex Brighton	5,816	431	576
	Sussex Worthing	3,415	253	382
	Sussex North	4,501	333	486
Central Area total		*13,732*	*1,017*	*1,443*
Eastern Area	Kent Medway East	4,746	351	741
	Kent Medway West	2,203	163	394
	Kent Thanet	4,283	317	413
	Sussex Hastings	2,126	157	157
Eastern Area total		*13,358*	*989*	*1,705*
Company total		**45,333**	**3,357**	**4,746**

** An equal number of replacements has been assumed in each year of AMP7 within each WRZ.*

Table 14 Number of smart meters that will be installed over AMP8 and AMP9 as part of Target 100

Area	WRZ	Number of smart meters installed **each year** of AMP8 (2025/26-2029/30)	Number of smart meters installed **each year** for the first 3 years of AMP9 (2030/31-2032/33)	Total installation cost of smart meters (£k)
Western Area	Hampshire Kingsclere	943	645	1,081
	Hampshire Andover	4,497	3,075	5,155
	Hampshire Rural	1,667	1,140	1,911
	Hampshire Winchester	4,453	3,045	5,105
	Hampshire Southampton East	23,735	16,229	27,207

Area	WRZ	Number of smart meters installed **each year** of AMP8 (2025/26-2029/30)	Number of smart meters installed **each year** for the first 3 years of AMP9 (2030/31-2032/33)	Total installation cost of smart meters (£k)
	Hampshire Southampton West	9,565	6,540	10,965
	Isle of Wight	9,686	6,623	11,102
Western Area total		*54,547*	*37,297*	*62,527*
Central Area	Sussex Brighton	22,660	15,494	25,975
	Sussex Worthing	12,307	8,415	14,108
	Sussex North	16,081	10,996	18,434
Central Area total		*51,048*	*34,905*	*58,516*
Eastern Area	Kent Medway East	19,274	13,179	22,093
	Kent Medway West	10,131	6,927	11,613
	Kent Thanet	13,638	9,325	15,634
	Sussex Hastings	7,361	5,033	8,438
Eastern Area total		*50,405*	*34,465*	*57,778*
Company total		**156,000**	**106,667**	**178,821**

Meters installed at new properties

It is important to recognise that new household properties will also contribute to the levels of household meter penetration achieved as part of our WRMP strategies, because all new properties are metered. Table 15 below summarises the number of new properties in each WRZ across each 5-year period (AMP) over the planning period, estimated as part of our WRMP demand forecast (details of which are provided in Annex 2).

Table 15 New household meters installed over the 25-year planning period

Area	WRZ	Total number of new properties				
		AMP7	AMP8	AMP9	AMP10	AMP11
Western Area	Hampshire Kingsclere	486	329	300	299	297
	Hampshire Andover	1,779	1,742	1,760	1,772	1,779
	Hampshire Rural	574	564	533	512	511
	Hampshire Winchester	2,864	896	482	507	512
	Hampshire Southampton East	9,597	7,449	5,545	6,288	6,194
	Hampshire Southampton West	3,598	3,257	2,805	3,028	2,968
	Isle of Wight	2,505	2,494	2,500	2,500	2,504
Western Area total		*21,402*	*21,402*	*21,402*	*21,402*	*21,402*
Central Area	6,009	6,009	5,109	5,288	5,282	5,262
	4,249	4,249	2,684	2,045	2,056	2,086
	6,422	6,422	3,336	3,656	3,410	3,425
Central Area total		*16,680*	*16,680*	*16,680*	*16,680*	*16,680*
	10,151	10,151	10,183	9,673	10,304	10,293

Area	WRZ	Total number of new properties				
		AMP7	AMP8	AMP9	AMP10	AMP11
Eastern Area	4,015	4,015	3,949	3,734	3,730	3,742
	7,662	7,662	6,563	5,096	5,458	5,465
	1,679	1,679	1,219	1,163	1,201	1,193
Eastern Area total		*23,507*	*23,507*	*21,914*	*19,666*	*20,693*
Company total		**61,589**	**61,589**	**59,997**	**57,748**	**58,775**

Cost information
The cost of installing meters at new properties forms part of our base expenditure, rather than enhancement, so these costs are not presented in the WRMP. All meter installations and ongoing operation of these meters are classified in our Business Plan as operational (opex) costs, therefore are treated as such in our revised draft WRMP (i.e. total costs are included in WRP Table 5 as variable opex).

6.3 WRMP Direction 3(h)

6.3.1 Defra's comment

Southern Water must demonstrate compliance with the WRMP Direction 3(h) in its final plan.

3. (h) its assessment of the cost-effectiveness of domestic metering as a mechanism for reducing demand for water by comparison with other measures which it might take to meet its obligations under Part III of the Act;

The company has assessed the cost-effectiveness of metering through the investment modelling process, however the outputs of this are not presented clearly in the revised plan. The company must provide an assessment of the cost-effectiveness of the following types of metering to meet Direction 3(h): Compulsory, Selective, Change of occupancy and Optant.

An assessment of cost-effectiveness should include an estimate of the costs for the above types of metering together with the associated reductions in demand, to enable comparison between options.

6.3.2 Our response and proposed changes to our plan

Our baseline position at WRMP19
Prior to implementing our UMP in AMP5, we undertook a cost effectiveness analysis which demonstrated that compulsory metering was the most cost-effective way of significantly increasing meter penetration and achieving the demand reductions required to meet our supply-demand balance deficit in the most cost effective way. The analysis that formed the basis for the justification for our UMP in our WRMP09 is presented in Table 16 and will be included in Annex 6 of our final WRMP. As part of this analysis, it was assessed that optant metering and change of occupier metering did not have the potential to reach the high levels of household meter penetration that could be achieved through compulsory metering during the WRMP09 25-year planning period, because they take longer to implement. Furthermore, optant and change of occupier metering were, as can be seen from Table 16, less cost effective than compulsory metering when both costs and benefits were taken into account.

Table 16 Relative costs and benefits of different types of metering (from WRMP09, 2007/08 prices)

Scenario	Difference in present value relative to optant-only baseline (£m)	Increase in total annual average demand saving (from the baseline) over WRMP09 25-year planning period (Ml/d)
Baseline - optant only (including selective metering of high water-using properties) reaching 87% overall household meter penetration	n/a (baseline)	n/a (baseline)
Change of Occupier metering reaching 93% overall household meter penetration	£25.3	120.9
Universal (compulsory) metering reaching 100% overall household meter penetration	-£3.7	400.8
Universal (compulsory) metering reaching 93% overall household meter penetration	-£37.9	322.4

Reasons for the greater cost effectiveness of compulsory metering included the following:

- Efficiencies could be gained from the geographically targeted (i.e. street-by-street) installation programme. It was considered unlikely for any geographical pattern to be present in optant meter requests or changes of occupier metering, meaning the travel time between properties would likely be greater, adding to labour and vehicle costs.
- The timing of when the meters would need to be purchased and installed would be known in advance with a compulsory metering programme, enabling economies of scale in the purchasing of the assets, and greater cost certainty.
- Optant and change of occupier metering would take longer than compulsory metering to achieve a certain level of meter penetration, as they rely on customers either opting for a meter or moving house, respectively. The benefits are therefore not gained as quickly.
- Change of occupier metering is the most expensive because it requires proactive customer contact initiated by the company which adds another cost element, as opposed to optants whereby the customer contacts the company in the first instance.

Our UMP has resulted in sustained demand reductions of approximately 13% (including supply pipe leakage savings). The scale of the metering programme that we have already implemented means that there is a relatively small residual number of unmeasured properties (approximately 140,000, 12% of our domestic customer base) across our three supply areas.

Options to increase household metering in our WRMP19

Subject to technical feasibility in each case, metering these remaining unmetered households may be possible, although investigations as part of the UMP have indicated that the costs are likely to be significant and potential demand saving benefits uncertain and/or limited. Whilst we recognise the importance of complying with our statutory duties as a water undertaker, including compliance with the WRMP Directions, we consider that our already high level of household meter penetration reduces the practicality of relying on certain types of metering (e.g. optant or change of occupier) to achieve further meaningful increases in meter penetration above our already high levels, in a timely manner.

That notwithstanding, our professional judgement is that the relative cost effectiveness of the different metering types that we assessed as part of our WRMP09 remains valid for our WRMP19. In discussions during preparation of this addendum, the approach of using WRMP09 information for this assessment was agreed in principle with the Environment Agency. In fact, we consider that the following points that are now

relevant to our WRMP19 baseline situation further strengthen the case for compulsory metering being more cost effective than other types of metering:

- In terms of *water saving benefits*, when starting out on a metering programme from initially low levels of meter penetration (as was the case when doing the calculations for our WRMP09), it is likely that optants would have shown greater water savings than those who were metered compulsorily, because they chose to opt for a meter - either because they expected to be able to save money, or they were driven by environmental considerations. Therefore, while the costs may have been higher than compulsory metering, so might the benefits - although the aggregate result overall (once both costs and benefits were taken into account) still showed compulsory metering to be more cost effective. However, as we are starting from a much higher baseline level of meter penetration for our WRMP19 (88%), it is likely that most of those potential optant customers from WRMP09 who had the potential to save the most water will have already been metered. Therefore, the future potential demand savings from optant metering are likely to be lower overall than they were at WRMP09. This means the relative cost-benefit ratio is likely to be lower for optants than that shown in Table 9 above, increasing the relative benefit of compulsory metering.
- Optant metering relies on *uptake*, i.e. customers proactively opting for a meter. Given the extensive publicity that surrounded our UMP while it was being implemented, and the fact we targeted 93% of our customer base, it is expected that most customers who would otherwise have opted for a meter will have already had a meter installed, where it was technically feasible to do so. Therefore, the uptake of optants is likely to be lower than it was in 2009, further reducing the relative cost-benefit ratio of optant metering.
- The *time taken* to achieve higher levels of meter penetration and their associated demand reduction benefits becomes an issue as the baseline unmetered population decreases. Even if the same proportion of unmetered customers opt for a meter or move house in any one year as was assumed in our WRMP09 cost effectiveness analysis (which, as discussed above is unlikely), it would take a much longer period of time for the demand reduction benefits to be achieved from optant and change of occupier metering when compared to compulsory metering. It is also far more uncertain because people opting for a meter and moving house are both outside the control of the company.

In conclusion, this analysis demonstrates that compulsory metering remains the most cost effective way that we can meter our remaining unmeasured customers in a timely manner, achieving the associated demand reductions as soon as possible in the planning period. As such, we have progressed the following options in our final WRMP19:

- MAMR1: Installing AMR metering equipment to take household meter penetration from current levels up to a minimum of 92% in each WRZ by the end of AMP7.
- MAMR2: Extending this programme to install AMR metering equipment for all remaining unmeasured households, also by the end of AMP7.

Through our investment modelling process, detailed in Annex 8, we assess the cost effectiveness of these options against other options, as part of the development of our preferred plan. Annexes 9-11 of our WRMP19 set out how these options have been taken forward as part of the strategy for each of our supply areas.