



Water Resources Management Plan 2015-40

Technical Report



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Glossary of acronyms

Term	Meaning
ADO	Average deployable output – <i>see para. 3.38 to 3.43 for explanation</i>
ADPW	Average day peak week – <i>see para. 3.42 for explanation</i>
AMP	Asset Management Plan period
AMP6	The next Asset Management Planning period, running from 2015/16 to 2019/20
AMP7	The Asset Management Planning period, running from 2020/21 to 2024/25
ASR	Aquifer Storage and Recovery
CC	Climate change
CC Water	Consumer Council for Water
Defra	Department for Environment, Food and Rural Affairs
DO	Deployable output
DYAA	Dry year annual average planning scenario – <i>see para. 3.38 to 3.43 for explanation</i>
DYCP	Dry year critical period planning scenario – <i>see para. 3.38 to 3.43 for explanation</i>
DYMDO	Dry year minimum deployable output planning scenario – <i>see para. 3.38 to 3.43 for explanation</i>
EA	Environment Agency
FWRMP	Final Water Resources Management Plan
HA	Hampshire Andover – one of Southern Water's 10 WRZ's – <i>see Figure 3.1</i>
HH	Household customers
HK	Hampshire Kingsclere – one of Southern Water's 10 WRZ's – <i>see Figure 3.1</i>
HRA	Habitats Regulation Assessment
HS	Hampshire South – one of Southern Water's 10 WRZ's – <i>see Figure 3.1</i>
IW	Isle of Wight – one of Southern Water's 10 WRZ's – <i>see Figure 3.1</i>
KM	Kent Medway – one of Southern Water's 10 WRZ's – <i>see Figure 3.1</i>
KT	Kent Thanet – one of Southern Water's 10 WRZ's – <i>see Figure 3.1</i>
l/h/d	Litres per head per day
LoS	Levels of Service
MDO	Minimum deployable output – <i>see para. 3.38 to 3.43 for explanation</i>
MI/d	Megalitres per day
NE	Natural England
NEP	National Environment Programme
NHH	Non-household – i.e. commercial and industrial customers
OJEU	Official Journal of the European Union
OR	Occupancy rate
PCC	Per capita consumption
PDO	Peak deployable output – <i>see para. 3.38 to 3.43 for explanation</i>
PET	Potential evapotranspiration
RSA	Restoring Sustainable Abstractions. EA programme – <i>see para. 3.95 to 3.98 for explanation</i>

Term	Meaning
SB	Sussex Brighton – one of Southern Water's 10 WRZ's – <i>see Figure 3.1</i>
SDB	Supply demand balance
SEA	Strategic Environmental Assessment
SH	Sussex Hastings – one of Southern Water's 10 WRZ's – <i>see Figure 3.1</i>
SN	Sussex North – one of Southern Water's 10 WRZ's – <i>see Figure 3.1</i>
SR	Sustainability Reduction – <i>see para. 3.95 to 3.98 for explanation</i>
STPR	Social Time Preference Rate – <i>see para 8.202 for explanation</i>
SW	Sussex Worthing – one of Southern Water's 10 WRZ's – <i>see Figure 3.1</i>
TUBS	Temporary Use Bans (replaces hosepipe bans)
WAFU	Water available for use
WE	Water efficiency
WFD	Water Framework Directive
WIA	Water Industry Act 1991
WRMP	Water Resources Management Plan
WRPG	Water Resource Planning Guidelines, produced and published by the EA
WRSE	Water Resources in the South East group
WRZ	Water Resource Zone – <i>see para. 3.5 to 3.10 for explanation</i>
WSW	Water Supply Works
WWTW	Waste Water Treatment Works

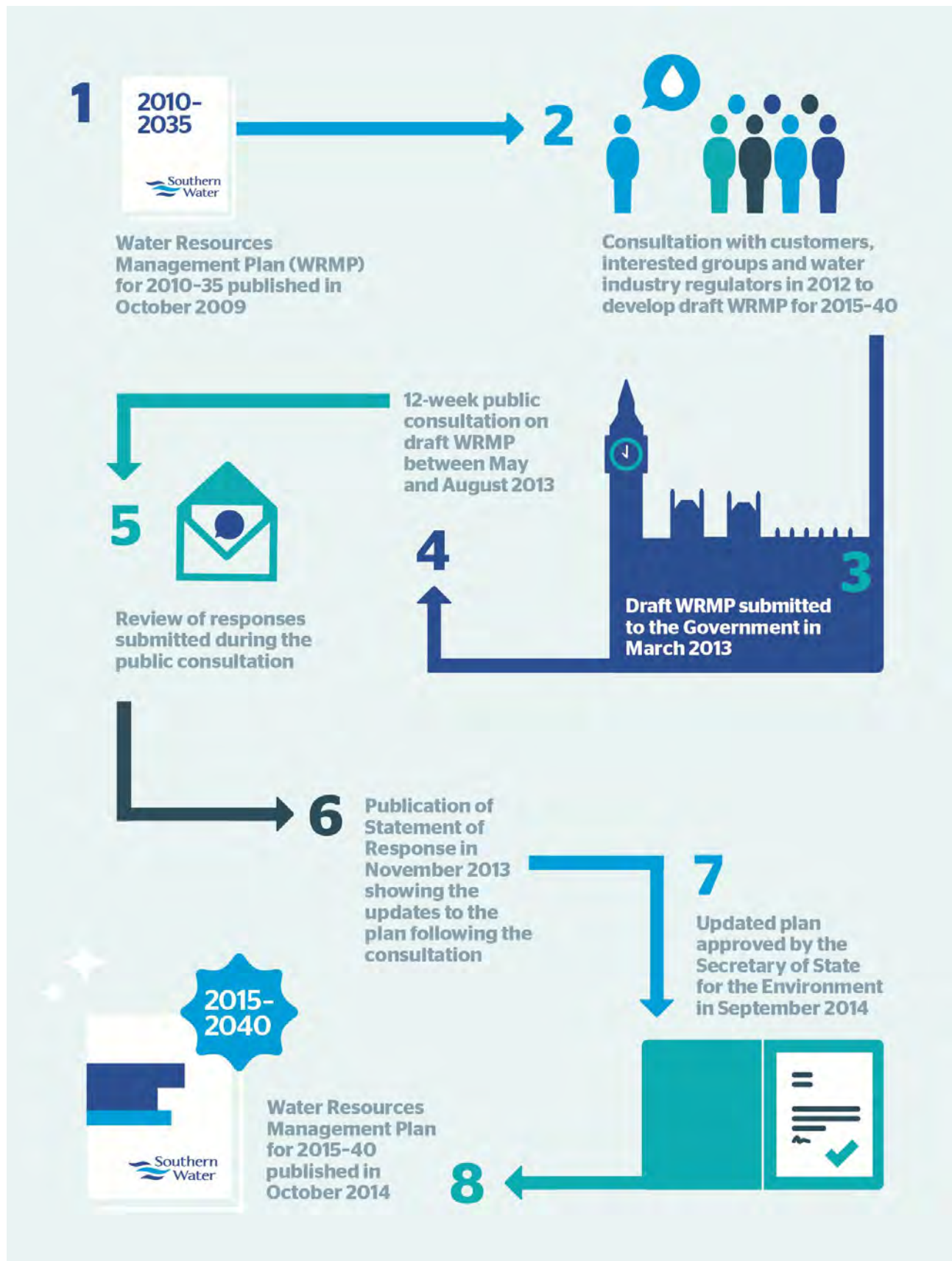
1. Summary

- 1.1. Southern Water is seeking the development of a sustainable, resilient supply system, which meets the expectations of customers with minimal impact on the environment.

A more resilient approach

- 1.2. The company has prepared a preferred plan using a new approach to assessing deployable outputs (DO). Rather than the 'conventional' approach, which is based on an analysis of a limited number of severe droughts within the historic records (just over 100 years of data), the new approach uses a statistical technique to provide a simulated set of 2000 years of weather data. This incorporates a much wider range of potential drought events. The purpose of this approach is to assist the development of greater resilience in the company's supply system and thus ensure that it is able to meet its target levels of service (LoS) in the future.
- 1.3. This more resilient approach does not necessarily mean that the deployable outputs will be markedly different from those determined using the more conventional approach; indeed this report shows that they are generally very similar. Rather, the major benefit is the level of confidence that the company now has in its deployable outputs and the nature of the risks that it needs to manage as it seeks to maintain its supply demand balance.
- 1.4. Given the similarity between the deployable outputs determined using the new and conventional approaches, it is not surprising that a comparison of the least cost plans arising from the two approaches also shows a high degree of similarity. Thus, in each of the supply Areas, the strategic schemes selected in the first 10-15 years of the 25 year planning period are very similar using both approaches, with only minor differences in the timing of their implementation. It follows that the level of investment required in AMP6, which covers the first 5 years of the planning period, is also very similar for both approaches.

Figure 1.1 The water resources journey – from the previous plan to the current plan



Summary of preferred plan

- 1.5. The critical period is the next five years (AMP6, 2015-20), because it is the one for which the company will need to obtain funding through the Business Plan process. The following five-year period (AMP7) is also important, as options which are required from 2020-25 are likely to require some form of investigation to be carried out during AMP6, to ensure that any required planning permissions are, or can be, obtained, and any environmental issues can be addressed and mitigated. The proposals identified in the final 15 years of the planning period are used to understand the strategic nature of the schemes which may be required. These are options planned for the long term, and so may be subject to greater uncertainty or risk. They will be reviewed in subsequent Water Resource Management Plans (WRMP) prior to their implementation.
- 1.6. The water resource strategy can therefore be summarised in terms of 3 key periods:
- | |
|--|
| • The next five years : from 2015/16 to 2019/20 – also known as AMP6; |
| • Years five to ten : from 2020/21 to 2024/25 – also known as AMP7; and |
| • The remainder of the planning period : from 2025/26 to 2039/40. |
- 1.7. Water efficiency schemes are introduced in AMP6 in all three supply areas, and leakage reduction schemes occur across all three supply areas over the planning period.
- 1.8. In the **Western Area**, full implementation of the Itchen Sustainability Reduction during AMP6, requires delivery of the following key resource options:
- T-HSO-3a 10Ml/d bulk supply from PWCo;
 - JO3a MDO groundwater scheme for river augmentation; and
 - HSL3+HST2 conjunctive use.
- 1.9. The analysis has demonstrated that these key options are a fundamental component of the least cost plan to enable the Itchen Sustainability Reduction to be implemented and that the use of these schemes will be infrequent. However, without them, the company would not have viable schemes in place to meet the deficit that would occur as a result of the proposed sustainability reduction in the required timeframe, as the company understands it must implement the Itchen sustainability reduction as soon as possible. It can only deliver the full reduction once sufficient alternative supplies become available. Therefore, Southern Water, in discussion with the Environment Agency, is seeking to adopt a phased implementation of the River Itchen Sustainability Reduction as soon as possible.
- 1.10. The chief difference between the least cost and preferred plan is due to the inclusion of an option that was not available to the least cost model. This provides an additional 5Ml/d from Portsmouth Water to the Hampshire South WRZ, but this is contingent on a 5Ml/d reduction of the existing baseline supply of 15Ml/d from Portsmouth to the Sussex North WRZ. The purpose of this option is to effectively spread the risk associated with the Itchen Sustainability Reduction across both the Western and Central Areas, and consequently optimise how the total bulk supplies available from Portsmouth Water (amounting to 25Ml/d) are utilised in these two Southern Water Areas.
- 1.11. Longer term additional schemes, which will require further investigation during AMP6 and in subsequent WRMPs, include the HTD4 and HTD2 desalination options and the HR9c non-potable water reuse option at an industrial site. All these options are in Hampshire and will need further detailed assessment to confirm their feasibility. Furthermore, the option IWL7 full capacity of existing Cross-Solent main will need to be developed, and investigations conducted on the feasibility of the IWR1 5Ml/d water reuse scheme on the Isle of Wight, or other Isle of Wight scheme, such as IWD1 8.5Ml/d coastal desalination (selected against the preferred programme where the IWL7 option is not available, in preference to a Hampshire desalination option).
- 1.12. Southern Water recognises that there are alternative strategies that might achieve the Sustainability Reductions over a longer timescale than its proposed strategy does. However current legislative drivers require implementation sooner making these alternative strategies unviable. The alternative strategies could involve a different phased implementation of

schemes, and even alternative schemes being promoted. Southern Water has explored alternative strategies that could be adopted to maintain the balance between supply and demand, and has presented the results of this analysis in section 10.

- 1.13. In the **Central Area**, the chief difference between the least cost and preferred plan is due to the inclusion of an option that was not available to the least cost model in Hampshire. This provides an additional 5MI/d from Portsmouth Water to the Hampshire South WRZ, but this is contingent on a 5MI/d reduction of the existing baseline supply of 15MI/d from Portsmouth to the Sussex North WRZ. The resultant effect is that the supply demand balance in Sussex North is reduced by 5MI/d from 2020/21.
- 1.14. The key strategic resource options selected in the preferred plan, which incorporates the above reduction of 5MI/d in the bulk import from Portsmouth Water, are:
 - Conventional and catchment management schemes in 2016/17 to recover lost DO from sources affected by nitrates;
 - N8a winter transfer stage 1 scheme in 2018/19;
 - N10 well field reconfiguration scheme in 2019/20;
 - The introduction of the CA1 4MI/d MDO aquifer storage and recovery (ASR) scheme in 2020/21;
 - Numerous catchment management schemes in all three WRZ in 2024/25. These schemes are required at sources which will be at risk of nitrate pollution by the mid-2020s (and hence would otherwise not be able to provide any output); and
 - NR2c 10MI/d water reuse scheme in 2026/27.
- 1.15. The alternative options which get selected where some elements of the preferred plan are not available are:
 - N1 irrigation licences management scheme in 2020/21 if either the N10 wellfield reconfiguration or the CA1 4MI/d MDO aquifer storage and recovery scheme are not available; and
 - The CD3 10MI/d tidal river desalination scheme in 2031/32 if the NR2c 10MI/d water reuse scheme is not available.
- 1.16. Therefore, apart from the immediate AMP6 schemes of the N10 wellfield reconfiguration and N8a winter transfer stage 1, along with the nitrate reduction conventional and catchment management schemes, the longer term scheme which will need investigation during AMP6 is the NR2c 10MI/d water reuse scheme. In addition the Aquifer Storage and Recovery scheme is currently under investigation during AMP5, and this investigation is likely to continue into AMP6 to ensure that it is available in early AMP7.
- 1.17. In the **Eastern Area**, the scenario testing process has demonstrated that:
 - Three AMP6 resource development schemes are always required – the MT10 asset enhancement scheme, the M10 River Medway licence variation and the M9 groundwater source licence variation;
 - The conventional with catchment management scheme and the two catchment management only schemes (KMC-a and KTC-a) at sources which will be at risk of nitrate pollution are always needed to recover the lost DO; and
 - The MR3 20MI/d water reuse scheme (or smaller variants) and the M21 licence trading scheme are required in most scenarios, but may be interchanged depending on the assumptions used.
- 1.18. Therefore, it will be critical for Southern Water to complete all enabling work for the AMP6 resource development schemes in early AMP6. In parallel during AMP6, Southern Water will also need to carry out technical investigations, a preliminary design and costing exercise, licence discussions, stakeholder engagement, and preparation of an environmental report including EIA Screening and Scoping, and supporting documentation for planning permissions for both the MR3 20MI/d water reuse scheme and the M21 licence trading scheme. Depending on the outcome of investigations it is intended that a complete application for just one of these schemes would be submitted before the end of AMP6.

- 1.19. There is some uncertainty about the viability of the M21 licence trading scheme, and if commercial agreement and technical feasibility cannot be resolved, then the company would also need to increase its leakage reduction activity over AMP6 and AMP7, as further leakage reduction options would then become economic.

Table 1.1 Summary of the water resources strategy for Southern Water

Period	Western	Central	Eastern
During AMP6 (2015-2020)	- Investigations (see Table 10.7) - Implementation of the sustainability reduction on the River Itchen - Leakage reduction to 0.4 MI/d below target level on IW in 2015 - T-HSO-3a 10 MI/d bulk supply from Portsmouth Water in 2017 - JO3a MDO groundwater scheme for river augmentation in 2018 - HSL3+HST2 conjunctive use in 2018 - HS-WE-A, B, C, D water efficiency schemes in 2019 - IW-WE-A, B, C, D water efficiency schemes in 2019	- Investigations (see Table 10.7) - SB & SW conventional & catchment management (to address nitrates) - Leakage reduction to 0.5 MI/d below target level in SW in 2016 - N8a winter transfer stage 1 in 2018 - N10 well field reconfiguration in 2019 - SW-WE-A, B, C, D water efficiency schemes in 2019 - SB-WE-A, B, C, D water efficiency schemes in 2019 - Further leakage reduction to 1 MI/d below target level in SW in 2019	- Investigations (see Table 10.7) - New export of 1.25 MI/d from M10 scheme to South East Water - M10 River Medway licence variation in 2015 - KM-WE-B, C, D water efficiency schemes in 2015 - SH-WE-B, C, D water efficiency schemes in 2015-1 - M9 groundwater source licence variation in 2016 - MT10 asset enhancement in 2017 - KMC-b conventional & catchment management (to address nitrates) - KT-WE-B, C, D water efficiency schemes in 2019 - Leakage reduction to 0.4 MI/d below target level in SH in 2019
During AMP7 (2020-2025)	- Leakage reduction to 2 MI/d below target level in HS in 2022 - Further leakage reduction to 0.8 MI/d below target on IW in 2022 - T-HSO-3d increase bulk supply from PWC to HS by 5 MI/d by 2024 - HSC-a & b catchment management of nitrate issues	- Reduction of bulk import from PWC to 10 MI/d in 2020 to provide HS - CA1 4 MI/d MDO aquifer storage & recovery in 2020 - SN-WE-A, B, C, D water efficiency schemes in 2020 - Leakage reduction to 1 MI/d below target level in SN in 2022 - Catchment management of nitrate issues in SB, SN & SW in 2024 - Further leakage reduction to 2 MI/d below target level in SN in 2024	- New WRSE export of additional 5 MI/d to South East Water in 2022 - MR3 20 MI/d water reuse in 2022 - New WRSE export of 12.5 MI/d to South East Water in 2023 - Catchment management of nitrate issues in KM and KT in 2024
Last 15 years of the plan (2025-2040)	- Further leakage reduction to 1.2 MI/d below target on IW in 2025 - Further leakage reduction to 3 MI/d below target level in HS in 2026 - IWL6 groundwater rehabilitation in 2027 - HTD2 20 MI/d coastal desalination in 2028 - Further leakage reduction to 1.6 MI/d below target on IW in 2029 - IWL7 utilise full capacity of existing cross-Solent main in 2032 - HK-WE-B, C, D water efficiency schemes in 2033-35 - Further leakage reduction to 4 MI/d below target level in HS in 2038 - Leakage reduction to 0.2 MI/d below current level in HK in 2038	- NR2c 10 MI/d water reuse in 2026 - N20 asset enhancement scheme in 2034 - N8b winter transfer stage 2 in 2036 - N8c winter transfer stage 3 in 2037	- M21 licence trading scheme in 2034 - KT-WE-A water efficiency scheme in 2035 - Leakage reduction to 0.75 MI/d below target level in KT in 2039
Total cost (NPV)	£102.7M	£92.3M	£57.1M
Company total (NPV)		£252.1M	

2. Introduction

Section summary

This Section outlines the purpose of a WRMP, the regulatory requirements that must be addressed, and sets it in the context of other strategic plans that the company produces. It also describes the consultation process associated with WRMPs

Aspect of the WRMP addressed in this section of the Technical Report	Reference
Involvement of statutory consultees in the development of the plan	Para.2.23, 2.27-2.28 (& Sect. 4)
Involvement of customers and other stakeholders in the development of the plan, and inclusion of their views in the Draft WRMP	Para.2.24-2.29, 2.34-2.35 (& Sect. 4)

Statutory requirements addressed in this section

The following table summarises the statutory requirements (legislation, regulations and directions) applied to the water resource planning process, and provides a cross reference to the relevant part of this section of the WRMP.

Legislation ref.	Description of matter to be addressed	Reference
WIA1991 S37A(8)	Before preparing its WRMP, the water undertaker shall consult: the Environment Agency; the Authority; the Secretary of State; and any licensed water supplier which supplies water to premises in the undertaker's area via the undertaker's supply system.	Para. 2.23-2.29 (& Sect. 4, Appendix A)
WIA1991 S37B(3)(a)	A water undertaker shall publish the Draft WRMP in the prescribed way, or if no way is prescribed, in a way calculated to bring it to the attention of persons likely to be affected by it	Para.2.30-2.31, 2.33
WIA1991 S37B(10)	The published version of the Draft WRMP shall exclude any information which the Secretary of State: has determined is commercially confidential; or directs the water undertaker to exclude on the ground that its publication would be contrary to the interests of national security	Para.2.8
Regs 2007 S2(1)	A Draft WRMP shall be published in paper form and on the website	Para.2.30-2.33
Regs 2007 S2(2)	List of the persons to whom a water undertaker shall send a copy of the published Draft WRMP in accordance with S37B(3)(c) WIA 1991	Para.2.33 (& Appendix A)
Regs 2007 S4(1)	A water undertaker shall, in relation to any representations received by the Secretary of State in relation to the Draft WRMP, prepare a statement detailing consideration that it has given to those representations and any changes that it has made to the Draft WRMP as a result	Para.2.38-2.43
Regs 2007 S4(2)	The water undertaker shall publish the statement in paper form and on its website and send a copy of the statement to any person who has made representations	Para.2.38-2.40
Dir 2012 S4	Send its Draft WRMP to the Secretary of State in accordance with S37B(1) WIA 1991 before 31 st March 2013	Para.2.30, & 2.41-2.43

Dir 2012 S5	Publish its Draft WRMP in accordance with S37B(3)(a) within 30 days of the later of the date on which the Secretary of State: makes a determination in respect of commercially confidential information; gives a direction to the water undertaker directing it to exclude certain information in the interests of national security; and notifies the water undertaker that it is not proposing to give any direction	Para.2.30
Dir 2012 S6	Publish the statement required under S4(2) Regs 2007 within 26 weeks of the date of publication of the Draft WRMP	Para.2.38

Purpose of the Water Resources Management Plan

- 2.1. This Revised Draft Water Resources Management Plan (also referred to as the Revised Draft WRMP) sets out in detail how Southern Water proposes to ensure that there is a sufficient supply of water to meet the anticipated demands of all its customers over the 25-year planning period from 2015/16 to 2039/40.

The primary objective of a Water Resources Management Plan is therefore to ensure that there are always enough supplies available to meet anticipated demands in all its areas of supply, even under the conditions of water supply stress, that is, under dry conditions where supplies are stretched and demand for water tends to be higher than normal. This is known as meeting the supply demand balance under design conditions.

- 2.2. All water companies must produce a WRMP. These plans are updated every five years. Southern Water published its last adopted WRMP in 2009, and so is now reviewing its plan in order to adopt a revised and updated version in 2014. The consultation process that led to this Revised Draft WRMP is explained in paras. 2.23 to 2.49.
- 2.3. In this document, the company sets out its proposals for developing new water resources, reducing demand and becoming more efficient with existing water resources in South East England.
- 2.4. Each plan builds on the last, updating and reviewing the proposals to reflect the latest information, technology and the views of customers and communities. This means that while options selected for the first five years of this plan will be implemented, it is possible that options for later years may change or the timing of their implementation be amended, as detailed investigations are carried out in future, and as the company revises and updates its plans in future years.
- 2.5. Last year, the Government published its White Paper '*Water for Life*', which sets out its vision for the future of the water industry. The Revised Draft WRMP follows the guidance of the *Water for Life* paper, which supports our work to create a more resilient, sustainable water network.

Overview of the regulatory process

- 2.6. This Revised Draft WRMP has been prepared according to the requirements of the statutory provisions, as set out in Table 2.1 below, which also provides cross-references to the relevant sections of the Revised Draft WRMP.
- 2.7. The WRMP has to be maintained, and is therefore a live document which Southern Water will keep under review. Southern Water is required to send to the Secretary of State a statement of its conclusions following each review, which is to be conducted on at least an annual basis. In accordance with the Water Industry Act 1991 (WIA1991), Section 37A(6), Southern Water will prepare a revised WRMP where:
- There is a material change of circumstances;
 - Directed to do so by the Secretary of State; or

- Not later than the end of the period of five years beginning with the date when the plan (or revised plan) was last published.

2.8. It should be noted that, in accordance with Section 37B(10) of the WIA1991, this WRMP does not include any information that is considered commercially sensitive, nor does it include any information that is adjudged to be contrary to the interests of national security

Figure 2.1 Overview of regulatory process and timeline for water resources planning for Southern Water

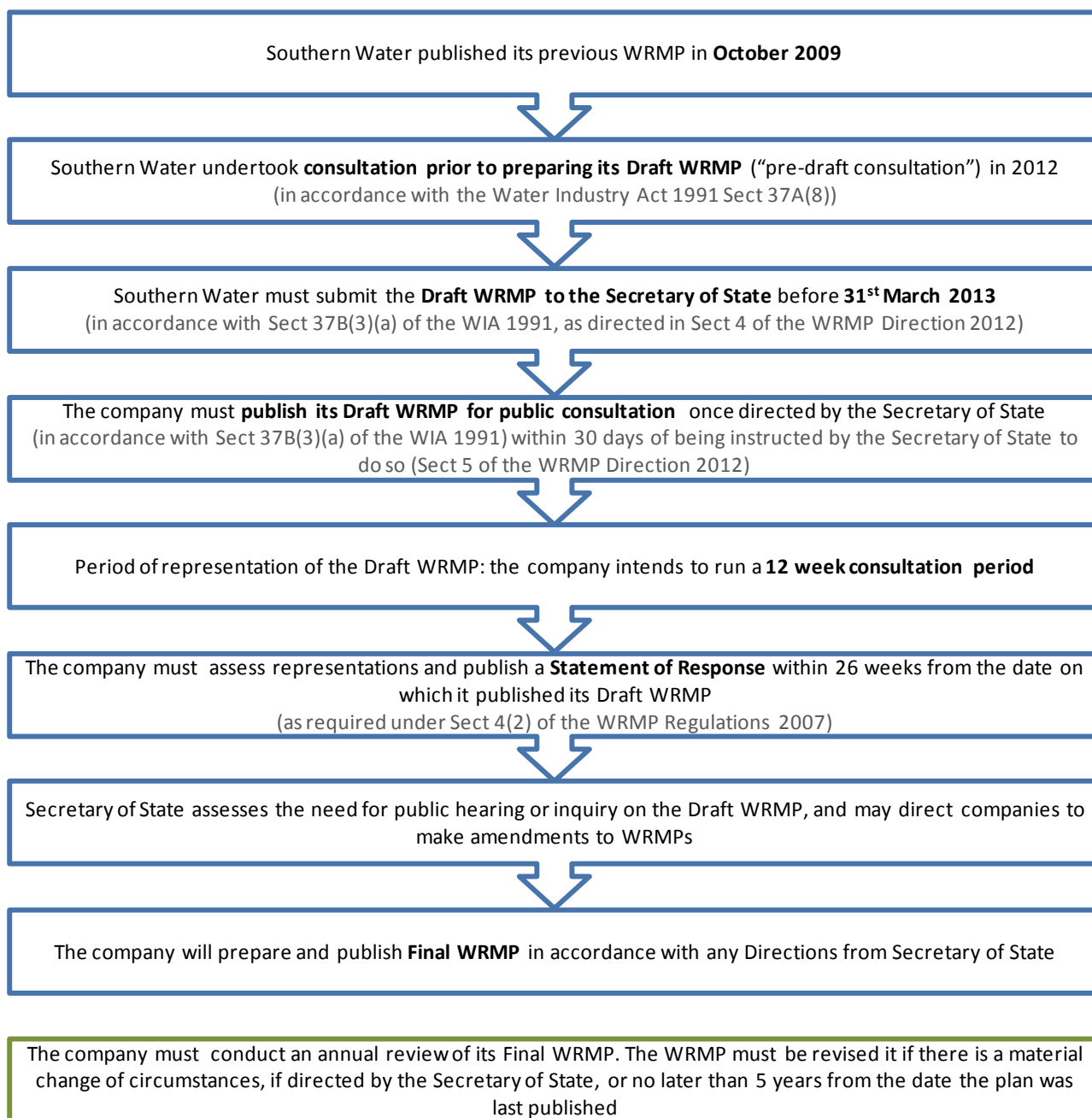


Table 2.1: References to statutory requirements for the WRMP

Statutory provision	Contents of WRMP specified by provision	WRMP ref.
WIA1991 S73A(3)(a)	The water undertaker's estimate of the quantities of water required to meet its obligations	Sect.10, Annex 1
WIA1991 S73A(3)(b)	The measures which the water undertaker intends to take or continue to take to meet its obligations	Sect.10, Table 10.1-Table 10.6, Table 1.1
WIA1991 S73A(3)(c)	The likely sequence and timing for implementing those measures	Table 10.1-Table 10.6, Table 1.1
WIA1991 S73A(8)	Before preparing its WRMP, the water undertaker shall consult: the Environment Agency; the Authority; the Secretary of State; and any licensed water supplier which supplies water to premises in the undertaker's area via the undertaker's supply system	Para. 2.23-2.29, 4.37-4.38 & 4.61-4.62 Appendix A
WIA1991 S37B(3)(a)	A water undertaker shall publish the Draft WRMP in the prescribed way, or if no way is prescribed, in a way calculated to bring it to the attention of persons likely to be affected by it	Para.2.30-2.31, 2.33
WIA1991 S37B(10)	The published version of the Draft WRMP shall exclude any information which the Secretary of State: has determined is commercially confidential; or directs the water undertaker to exclude on the ground that its publication would be contrary to the interests of national security	Para.2.8
Regs 2007 S2(1)	A Draft WRMP shall be published in paper form and on the website	Para.2.30-2.33
Regs 2007 S2(2)	List of the persons to whom a water undertaker shall send a copy of the published Draft WRMP in accordance with S37B(3)(c) WIA 1991	Para.2.33 Appendix A
Regs 2007 S4(1)	A water undertaker shall, in relation to any representations received by the Secretary of State [in relation to the Draft WRMP], prepare a statement detailing: consideration that it has given to those representations; any changes that it has made to the Draft WRMP as a result of consideration of those representations and its reasons for doing so; and where no change has been made to the Draft WRMP as a result of consideration of any representation the reason for this	Para.2.38-2.43
Regs 2007 S4(2)	The water undertaker shall publish the statement in paper form and on its website and send a copy of the statement to any person who has made representations	Para.2.38-2.40
Dir 2012 S2(1)	A water undertaker shall prepare a WRMP for a period of 25 years commencing on 1 st April 2015	Para.3.77-3.79
Dir 2012 S3(a)	How frequently it expects it may need to impose prohibitions or restrictions on its customers in relation to the use of water under S76 of the WIA 1991 and S74(2)(b) and S75 of the WRA 1991	Para.3.69-3.76, & 5.29-5.42
Dir 2012 S3(b)	The appraisal methodologies which it used in choosing the measures it intends to take or continue and its reasons for choosing those measures	Para.8.1-8.74, & 8.195-8.232
Dir 2012 S3(c)	The emissions of greenhouse gases which are likely to arise as a result of each measure which it has identified to meet its obligations	Para.10.126-10.127, & Figure 10.4
Dir 2012 S3(d)	How the supply and demand forecasts contained in the WRMP have taken into account the implications of climate change	Para.5.90-5.100, & 6.63-6.65 Appendix D & F

Statutory provision	Contents of WRMP specified by provision	WRMP ref.
Dir 2012 S3(e)	How it has estimated future household demand in its area over the planning period, including assumptions made in relation to population and housing numbers	Para. 6.25-6.26, 6.28-6.32, 6.36-6.39, 6.41-6.44, 6.46-6.48 & 6.69
Dir 2012 S3(f)	Its estimate of the increase in the number of domestic premises in its area over the planning period in respect of which it will be required to fix charges by reference to volume of water supplied under S144A WIA 1991	Para. 6.41-6.44 Appendix F
Dir 2012 S3(g)	Where the whole or part of its area has been designated as an area of serious water stress, its estimate of the number of domestic properties which are in the area of serious water stress and in respect of which it will fix charges by reference to volume of water supplied to those premises over the planning period	See above
Dir 2012 S3(h)	Its estimate of the increase in the number of domestic premises in its area (excluding those under S3(g)) over the planning period, in respect of which S144B(2) WIA 1991 will not apply because the conditions referred to in S144B(1)(c) WIA 1991 are not satisfied and in respect of which it will fix charges by reference to volume of water supplied to those premises	See above
Dir 2012 S3(i)	Full details of the likely effect of what is forecast pursuant to S3(f) to (h) on demand for water in its area	Sect.10, Annex 1
Dir 2012 S3(j)	The estimated cost to it in relation to the installation and operation of water meters to meet what is forecasted pursuant to S3(f) to (h) and a comparison of that cost with the other measures which it might take to manage demand for water, or increase supplies of water in its area to meet its obligations	Para. 8.102-8.105
Dir 2012 S3(k)	A programme for the implementation of what is forecasted pursuant to S3(g) and (h)	Para.6.44
Dir 2012 S4	Send its Draft WRMP to the Secretary of State in accordance with S37B(1) WIA 1991 before 31 st March 2013	Para.2.30, & 2.41-2.43
Dir 2012 S5	Publish its Draft WRMP in accordance with S37B(3)(a) within 30 days of the later of the date on which the Secretary of State: makes a determination in respect of commercially confidential information; gives a direction to the water undertaker directing it to exclude certain information in the interests of national security; notifies the water undertaker that it is not proposing to give any direction	Para.2.30
Dir 2012 S6	Publish the statement required under S4(2) Regs 2007 within 26 weeks of the date of publication of the Draft WRMP	Para.2.38

Notes:

WIA 1991 refers to the Water Industry Act 1991 (as amended by the Water Act 2003).

Regs 2007 refers to The Water Resources Management Plan Regulations 2007.

Dir 2012 refers to The Water Resources Management Plan Direction 2012.

WRA 1991 refers to the Water Resources Act 1991.

S144A WIA 1991 refers to the right of consumers to elect for charging by reference to volume.

S144B WIA 1991 refers to the restriction of undertakers' power to require fixing of charges by reference to volume.

Links to other plans

- 2.9. The Water Resources Management Plan is part of a package of plans presented by Southern Water as the company prepares for the future. The other plans are briefly described below.

Strategic Statement

- 2.10. The Strategic Statement sets out the company's ambitions on how it will deliver water and wastewater services in the next 25 years.
- 2.11. The Strategic Statement is available to be downloaded from the company's website at the address: southernwater.co.uk/about-us/about-southern-water/our-publications/our-reports/strategic-direction-statement.asp.

Business Plan 2015-2020

- 2.12. The Business Plan sets out how much the company needs to spend to maintain and improve its services over the five years from 2015 to 2020, and the impact that this will have on customer bills.
- 2.13. The Business Plan includes the first five years of the strategy developed in the WRMP, as well as any planning or investigation that may be required for schemes occurring in the longer term. A draft Business Plan was published for consultation in August and September 2013. The Business Plan was then submitted to Ofwat in December 2013, and subsequently updated following Ofwat's Interim Determination in April 2014. Ofwat published its Draft Determination in August 2014 with a 5 week consultation period. The Final Determination is expected in December 2014.

Drought Plan

- 2.14. The Drought Plan demonstrates how the company would manage the security of supplies in the event of impending or actual drought events, which are normally of short duration (typically affecting water supplies over a period of one to two years). The WRMP is a strategic plan of the investments required over a 25 year planning horizon to maintain the balance between water supplies and customer demand for water, whereas the Drought Plan describes how the company will operate during a drought event.
- 2.15. Southern Water published its Drought Plan in February 2013. The Drought Plan was subject to a process of statutory consultation prior to its finalisation.

Strategic Environmental Assessment

- 2.16. The requirement to undertake a Strategic Environmental Assessment (SEA) came about when the 'SEA Directive', came into force. The Directive and associated regulations make SEAs a mandatory requirement for certain plans and programmes which are likely to have significant effects on the environment. The WRMP, as a statutory plan with potential significant environmental effects, is considered to be subject to a SEA.
- 2.17. The SEA Environmental Report was published alongside the Draft WRMP for consultation. The findings of the SEA have been incorporated in the options appraisal process for the Draft WRMP, as described in Section 8.
- 2.18. A Revised SEA Environmental Report was produced to address comments received during the 12 week consultation period, which ended on 12th August 2013. An independent review of the approach to SEA undertaken for the Draft WRMP is included as Appendix M.
- 2.19. The SEA Statement is published alongside the Final WRMP. This Statement describes how the SEA and consultation on the Environmental Report were taken into account in formulating the final plan.

Habitats Regulations Assessment

- 2.20. If a plan or project is deemed likely to have a 'significant effect' on any site that is designated under the European Habitats or Birds Directives, an assessment is required under the

Conservation of Habitats and Species Regulations 2010 (the Habitats Regulations). This assessment is more commonly referred to as a Habitats Regulations Assessment (HRA).

- 2.21. An HRA Screening was undertaken to determine whether the Plan and its composite measures could be considered to have a likely significant effect on designated sites of European and international nature conservation importance. An Appropriate Assessment for those measures for which the screening was unable to conclude no likely significant effect was undertaken. These documents were published alongside the Draft WRMP for consultation.
- 2.22. A revised HRA was produced to address comments received during the 12 week consultation period, which ended on 12th August 2013, and an Appropriate Assessment was subsequently conducted for two schemes which the Stage 1 HRA Screening Assessment had not been able to conclude would have no likely significant effects. Both the Stage 1 Screening Assessment and the Stage 2 Appropriate Assessment are available in support of this Final WRMP.

Consultation

Pre-draft consultation

- 2.23. Under Section 37A(8) of the Water Industry Act 1991, prior to preparing its Draft WRMP, each water company must consult with the Environment Agency, the Authority [i.e. Ofwat], the Secretary of State [i.e. through Defra] and any licensed water supplier which supplies water to premises in the undertaker's area via the undertaker's supply system.
- 2.24. Southern Water took the opportunity to widen the scope of this consultation prior to the preparation of the Draft WRMP (the "pre-draft consultation" phase) to also include Natural England and neighbouring water companies.
- 2.25. Southern Water actively sought to develop potential water trading options through correspondence with neighbouring water companies, as well as through participation in the Water Resources in the South East (WRSE) group (more detail is provided in Section 8).
- 2.26. The company also invited bids for supplies of water through the publication of a notice in the Official Journal of the European Union (OJEU), and by correspondence with holders of large licence volumes within the company's supply area.
- 2.27. A series of workshops were held with a wide range of groups, from local authorities to environmental and consumer groups, to gain their views. Extensive research was also carried out with customers through focus groups, telephone interviews and online surveys. In addition, meetings were held with groups such as river trusts, horticultural organisations, MPs, environmental bodies and water-saving organisations. Thus, during the course of developing the Draft WRMP, the company consulted with thousands of customers and interested parties to ensure that the plan can deliver a water supply that will deliver best value to customers.
- 2.28. All water companies are required by the regulator, Ofwat, to set up a Customer Challenge Group (CCG) as they develop their business plans for 2015-2020. This is to ensure the views of customers are taken into account as we plan for the future. The CCG is made up of representatives of regulators and interested parties, including local councils and universities, the Environment Agency, Drinking Water Inspectorate, Consumer Council for Water, Natural England, Citizens Advice Bureau, Waterwise and WWF. Southern Water's CCG has scrutinised the approach the company has used to engage with customers and stakeholders and ensure that their views are properly represented in our plans.
- 2.29. Further detail on stakeholder engagement as part of the pre-draft consultation activity is available in Section 4 and Appendix A, while discussion of how customers' views have been incorporated into options appraisal and selection is provided in Section 8.

Consultation on the Draft WRMP

- 2.30. The Draft WRMP was issued to the Secretary of State on 28th March 2013. Southern Water was given permission to publish its Draft WRMP in May 2013. The plan was duly published on 20th May 2013.

- 2.31. Under the Water Industry Act 1991 37B(3), the Draft WRMP was published in both paper form and on the company website. The Draft WRMP was made available to be downloaded from the company's website at the address: www.southernwater.co.uk/wrmp.
- 2.32. The Strategic Environment Assessment (SEA), which outlines the environmental assessments that have been undertaken to support the plan, was also available to be downloaded from the company website at www.southernwater.co.uk/wrmp.
- 2.33. For the purposes of public consultation, the Draft WRMP was sent to those parties prescribed in Section 2 of the Water Resources Management Plan Regulations 2007.
- 2.34. Southern Water set a consultation period of 12 weeks, and hence the closing date for consultation responses was 12 August 2013.
- 2.35. During this time, the company talked to customers and stakeholders about the plans and held a further series of workshops, customer focus groups and surveys, following on from the pre-draft consultation activity described in para.2.27.
- 2.36. Southern Water published a questionnaire alongside its Draft WRMP to make it easier for customers to provide feedback. This questionnaire was available both in paper form and online at www.southernwater.co.uk/wrmp.
- 2.37. All feedback received by Southern Water was sent to the Secretary of State for the Department of Environment, Food and Rural Affairs, which considers all water company plans.

The Statement of Response and Final WRMP

- 2.38. In accordance with the requirements prescribed in Section 6 of the Water Resources Management Plan Direction 2012, Southern Water must publish a Statement of Response to any representations received within 26 weeks of the date of publication of this Draft WRMP. The Statement of Response was duly published on 18 November 2013.
- 2.39. As required under Section 4 of the Water Resources Management Plan Regulations 2007, the Statement of Response detailed:
- The consideration the company gave to representations;
 - Any changes that the company made to the Draft WRMP as a result of its consideration of those representations and its reasons for doing so; and
 - Where no change was made to the Draft WRMP as a result of its consideration of any representation, the reason for this.
- 2.40. The company sent a copy of the Statement of Response to all persons who had made representations in writing in relation to the Draft WRMP to the Secretary of State. The Statement of Response was made available in both paper form and on the company website. It was available to download from the company's website at www.southernwater.co.uk/wrmp.
- 2.41. The company decided to produce a Revised Draft WRMP and accompanying Revised Technical Appendices at the same time as producing its Statement of Response, to help customer and stakeholders understand the changes arising to the WRMP as a result of the representations received during the consultation period.
- 2.42. The Secretary of State conducts a review of the Statement of Response (and associated Revised Draft WRMP documentation) and decides whether to:
- Direct the company to make certain changes to its WRMP prior to preparing and publishing the Final Plan; or
 - Consider whether an inquiry or other hearing must be held in connection with the Draft WRMP.
- 2.43. Following the review of the Statement of Response, Southern Water published updated Sections 9 and 10 of the Revised Draft WRMP in May 2014, in response to a request from Defra to include more information on alternative options for Hampshire and the Isle of Wight.

- 2.44. The Final WRMP takes into account any Directions received by the Secretary of State, which might arise as a result of the representations received, and the company's proposed response to those representations as set out in the Statement of Response.
- 2.45. The Final WRMP is issued to the Secretary of State and the Environment Agency to check that it complies with any Directions. The company must then wait for Direction from the Secretary of State before it can publish its Final WRMP.
- 2.46. The Secretary of State gave Southern Water permission to publish its Final WRMP in a letter dated 17 September 2014.
- 2.47. All those who made representations on the Draft WRMP have been made aware of the publication of the Final WRMP, and copies sent to all statutory consultees.
- 2.48. Southern Water will carry out an annual review of its Final WRMP to identify whether there has been a material change that would trigger a revision of its plan. Southern Water will send its annual reviews to the Environment Agency.
- 2.49. After the Final WRMP is published it must be revised by the water company within 5 years of the date of publication and submitted to the Secretary of State. However, if there is a relevant material change in circumstances prior to this, then the water company must submit a revised WRMP, in accordance with the requirements prescribed under Section 37A(6) of the Water Industry Act 1991.

Structure of this Final WRMP

- 2.50. This technical report of the Final WRMP aims to take the reader through the WRMP process, from a general introduction to the company's supply area, through the technical sections describing how the forecasts of supply and demand are derived and combined to form supply demand balances that highlight where there may be a risk of deficits in future, through the process of appraisal of options that could address any deficits, and finally to the development of the company's preferred plan.
- 2.51. The Sections of this WRMP are therefore, as follows:
- **Section 1:** provides a summary of the preferred plan;
 - **Section 2:** outlines the purpose of a WRMP, the regulatory requirements that must be addressed, and sets it in the context of other strategic plans that the company produces. It also describes the consultation process associated with WRMPs;
 - **Section 3:** gives a brief introduction to Southern Water's supply area and sources, and describes the water resources planning process and some of the key concepts. The section also provides an outline of some of the main challenges the company could face over the 25 year planning period;
 - **Section 4:** summarises the consultation activity undertaken in preparation of the WRMP;
 - **Section 5:** provides the technical detail for the derivation of all aspects of the supply forecasts;
 - **Section 6:** provides a detailed technical explanation of how the demand forecast has been developed for the 25 year planning period;
 - **Section 7:** explains how risk and uncertainty are taken into account within the supply demand balance;
 - **Section 8:** describes the options appraisal process and the key types of options considered to meet any potential forecast supply shortfalls. It also explains how the least cost solution is derived and how the preferred programme of options is developed;
 - **Section 9:** describes the derivation of the preferred plan, including the scenario testing and sensitivity analysis undertaken to ensure that the preferred plan is robust; and

- **Section 10:** summarising the baseline supply demand balance situation for each Supply Area, and the preferred plan that the company believes will lead to a more resilient and flexible supply system. It summarised the investigations that are required over the next 5-10 years to ensure that the schemes comprising the preferred plan can be implemented in a timely and efficient manner.

2.52. Each Section has an introductory “section summary” which sets out the key aspects of the WRMP that are covered in that Section.

3. Overview of Southern Water and principles of water resources planning

Section summary

This Section gives a brief introduction to Southern Water's supply area and sources, the water resources planning process and some of the key concepts. The section also provides an outline of some of the main challenges the company could face over the 25 year planning period

Aspect of the WRMP addressed in this section of the Technical Report	Reference
Provision of high level schematics of the Water Resource Zone (WRZ) boundaries to allow users to understand how these are derived	Figure 3.1, (& Appendix B)
An overview of the evidence to show that the company's WRZs meet the EA's definition	Para.3.5-3.10, (& Appendix B)
Summary of the discussions the company has had with the EA, including any recommendations or issues that have arisen with regard to WRZ integrity	(Appendix B)
Detailed assessment of water resource zone boundaries in the Appendix to the Technical Report	(Appendix B)
Discussion of planning scenarios that the company uses for planning purposes	Para.3.38-3.54
Presentation of the planned Levels of Service that the company intends to offer its customers based on customers' preferences, environmental impacts and cost implications	Para.3.55-3.76 (& Sect 5)
Presentation of the actual Levels of Service experienced by customers and justification of significant differences between actual and planned Levels of Service for baseline and final planning scenarios	Para.3.74-3.76 (& Sect 5)
Discussion of the link to the Drought Plan Levels of Service	Para.3.69-3.76
Description of the key water resource planning problems and challenges	Para.3.29-3.37, 3.93-3.131

Statutory requirements addressed in this section

The following table summarises the statutory requirements (legislation, regulations and directions) applied to the water resource planning process, and provides a cross reference to the relevant part of this section of this WRMP.

Legislation ref.	Description of matter to be addressed	Reference
Dir 2012 S2(1)	A water undertaker shall prepare a WRMP for a period of 25 years commencing on 1 st April 2015	Para.3.77-3.79
Dir 2012 S3(a)	How frequently it expects it may need to impose prohibitions or restrictions on its customers in relation to the use of water under S76 of the WIA 1991 and S74(2)(b) and S75 of the WRA 1991	Para.3.69-3.76, (& 5.29-5.42)

The supply area

- 3.1. Southern Water's current water supply system is the result of the historic development and integration of a number of local systems over more than a century. Thus, the structure of its supply system is complex due to the fragmented geographical areas of its own supply system, and also due to the inter-connections between its own supply areas with those of a number of other water companies.
- 3.2. The area supplied by Southern Water covers a total of some 4,450 square kilometres and extends from east Kent, through parts of Sussex, to Hampshire and the Isle of Wight in the west, and serves just over 2.3 million customers.
- 3.3. Southern Water shares borders with eight other water companies:
- Thames Water;
 - Wessex Water;
 - Cholderton and District Water;
 - South East Water;
 - Affinity Water;
 - Sutton & East Surrey Water;
 - Sembcorp Bournemouth Water; and
 - Portsmouth Water.
- 3.4. There are a number of bulk supplies between the companies. Clearly, the number of boundaries and the existing and potential future inter-connections with so many water companies raises a number of opportunities for optimising the strategic use of resources across the region. However, it also adds significantly to the complexity of the planning process.

Figure 3.1 Schematic showing the Southern Water supply area



Planning area – the Water Resource Zone

- 3.5. Water Resource Management Plans (WRMPs) are built up from assessments of water supplies available and forecasts of demand at the level of the **Water Resource Zone (WRZ)**. This is a planning area which is defined as:

The largest possible zone in which all resources, including external transfers, can be shared and, hence, the zone in which all customers will experience the same risk of supply failure from a resource shortfall.

- 3.6. The company's WRZs are shown in Figure 3.1. There are ten WRZs in the Southern Water area; however, some of these WRZs are interconnected. For the purposes of planning, where actions in one WRZ can have an impact in an interconnected WRZ, it is possible to amalgamate these ten WRZs into three larger, sub-regional Areas:

- 3.7. Western Area – comprising the following four WRZs:

- Hampshire South (sometimes abbreviated in this Draft WRMP to “HS”);
- Hampshire Andover (sometimes abbreviated in this Draft WRMP to “HA”);
- Hampshire Kingsclere (sometimes abbreviated in this Draft WRMP to “HK”); and
- Isle of Wight (sometimes abbreviated in this Draft WRMP to “IW”).

- 3.8. Central Area – comprising the following three WRZs:

- Sussex North (sometimes abbreviated in this Draft WRMP to “SN”);
- Sussex Worthing (sometimes abbreviated in this Draft WRMP to “SW”); and
- Sussex Brighton (sometimes abbreviated in this Draft WRMP to “SB”).

- 3.9. Eastern Area – comprising the following three WRZs:

- Kent Medway (sometimes abbreviated in this Draft WRMP to “KM”);
- Kent Thanet (sometimes abbreviated in this Draft WRMP to “KT”); and
- Sussex Hastings (sometimes abbreviated in this Draft WRMP to “SH”).

- 3.10. In preparation of this WRMP, the company undertook a complete review of its WRZs to ensure they met the definition given in Paragraph 3.5. The WRZ integrity assessment is provided in the Appendix B to this Technical Report.

Sources of supply

- 3.11. The majority (around 70 per cent) of Southern Water's own supplies come from groundwater; predominantly from the Chalk aquifer which is widespread across the region. A further 23 per cent comes from river abstractions, most notably: the Eastern Yar on the Isle of Wight; the Test and Itchen in Hampshire; the Western Rother in West Sussex; the Eastern Rother in East Sussex; and the Tiese, Medway and Stour in Kent. The remaining 7 per cent of supplies come from four surface water impounding reservoirs, all of which are owned and operated by the company.

Rainfall and winter recharge

- 3.12. The water supply relies on rainfall, yet the South East is one of the driest regions in the country, with an average rainfall of 730 millimetres a year.

- 3.13. Most of this rain usually falls during the winter and this is critical to restock the underground aquifers, from where most of our water is sourced. It tends to be only during this period that rainfall infiltrates through the soil to recharge groundwater reserves, restore river baseflow for the following year and replenish surface water storage; this is known as the **winter recharge** period. Hence, it is winter rainfall that determines the ability to abstract water from sources.

- 3.14. Most of the rain that falls during the rest of the year is lost to the atmosphere through evaporation and transpiration from plants during the spring and summer periods, or runs off the land directly into rivers, and is thus of little value in replenishing groundwater resources.

Groundwater sources

- 3.15. The bulk of the groundwater sources are located in the Chalk aquifer, which extends throughout parts of Kent, Sussex, Hampshire and the Isle of Wight. The transmission and storage of groundwater in the Chalk aquifer is mainly a function of the distribution and continuity of fissures, which leads to uncertainty in how these sources may react in times of very low groundwater levels.
- 3.16. There is also the risk of saline intrusion in coastal aquifers, which can severely restrict yields at time of low groundwater levels. Faced with increasing chloride levels, the company may have to reduce abstraction in the short term in order to protect supplies in the future.
- 3.17. In addition to the Chalk aquifer, Southern Water has a number of borehole sources in the Lower Greensand aquifer that underlies the Chalk. The Lower Greensand consists of sands and sandstones. In the Sussex Hastings WRZ, the company operates sources that obtain their yields from the Ashdown Beds, a sequence of fine-grained sands, although these are generally low yielding.

Run-of-river sources

- 3.18. There are a number of river abstractions with no supporting storage to supplement the incidence of low flows. These are known as run-of-river sources and rely solely on the natural river flow available for their supplies.
- 3.19. These run-of-river sources are particularly vulnerable to drought, because abstraction licences may contain conditions that restrict abstractions during periods of low-flow to ensure that sufficient residual flows remain in the river to prevent the risk of environmental harm. The effect of a drought in reducing river flow is therefore absorbed entirely by the water abstraction in order to protect the environmental flow. Flows are also affected by licensed abstractions upstream (for instance for agricultural use). Abstractions for consumptive agricultural use tend to increase during hot dry periods, when demand for public water supply is higher than average, thus exacerbating the stress on run-of-river sources.
- 3.20. It is possible to make reasonable predictions of flows in the river from spring through to autumn once the river flow recession has become established (usually in April each year). Year-to-year predictions are more difficult as this will depend on winter recharge to groundwater storage that provides the baseflow to the river the following summer.
- 3.21. Runoff from summer storms provides limited benefit. Such storms can cause a rapid rise in flow that then declines quickly to typical baseflow conditions as soon as the rain stops. These events are usually too short to allow changes to operational abstraction regimes in order that the storm runoff can be captured. The water in storm events is also frequently polluted with silt or 'chemical runoff', which can give rise to treatment problems at the company's assets.

Raw water reservoirs

- 3.22. There are four surface water impounding reservoirs, all of which are owned and operated by the company. The largest of these is Bewl Water. Although the reservoir is owned and operated by Southern Water, South East Water has an entitlement to 25 per cent of the scheme.
- 3.23. The other three reservoirs in the Southern Water supply area are Darwell, Powdermill and Weir Wood.
- 3.24. Reservoirs offer the most potential for drought management, as any reductions in the water abstracted can be conserved for later use. They also have the advantage of greater flexibility to meet peak demands, as relatively large volumes of water can be abstracted for short periods without significant environmental impact. The only additional limitations are the abstraction licence or the treatment capacity at the Water Supply Works (WSW). It is the objective of the company to maximise the benefits that can be achieved in a drought by ensuring that winter refill is maximised to enable support for groundwater sources during the following summer.

Furthermore, abstraction from reservoirs may be maximised during the winter to rest groundwater sources and maximise the benefits of recharge.

Bulk supplies

- 3.25. Inter-company transfers are generally based on bulk supply agreements, which will tend to influence the amount of reliance the company can place on the availability of supplies from other companies. Where the company has a commitment to provide other companies with a bulk supply, this influences the assessment of its current and future resource position during drought events. These impacts are very specific to the terms of individual agreements.
- 3.26. The current bulk supplies affecting Southern Water are discussed in detail in Section 5 of this Technical Report. Options for additional bulk supplies have also been considered as part of this WRMP – these options are discussed in Section 8.
- 3.27. The availability of inter-zonal transfers will depend upon the water available within WRZs that can be used to support other WRZs during drought conditions.
- 3.28. The existing bulk supplies and internal WRZ transfers are presented in Figure 3.1.

The basis of a WRMP

- 3.29. The purpose of the Water Resources Management Plan (WRMP) is to set out how the company plans to ensure that for the next 25 years it will have sufficient resources in place to meet customer demand under a set of very specific water stressed (dry but not drought) conditions. Notwithstanding their title of “Management Plans”, they are not however a statement of how a company plans to regularly manage and operate its water resources. The WRMP is required to relate specifically to the conditions in a very dry year only. The conditions explored in the WRMP therefore bear no relation to water resources in more “normal” year to year operation, whether river abstractions, groundwater sources or reservoirs.
- 3.30. The WRMP is required to look ahead to each of the next 25 years and to assess what the balance between available supply and customer demand might be were that year to have the supply characteristics of the design condition year (that might be the driest year in the historic record) and the demand characteristics of a very warm, dry year (but without any demand restrictions in place).
- 3.31. In a normal or wet year, or succession of such years, water companies generally have plenty of water resource capacity to supply customer demand. This is because average or higher than average rainfall gives rise to correspondingly high river flows and groundwater levels, with plenty of water available for abstractions at river intakes or from groundwater sources. Under these conditions, source output is not constrained by hydrology or groundwater storage, but by abstraction licence conditions and/or infrastructure. Such conditions also allow reservoirs to be kept at or close to their optimum level. Customer demands for water also tend to be lower.
- 3.32. By contrast, in a dry year, the ability of sources to supply customer demand can be significantly reduced. Not only does customer demand for water tend to be higher, particularly in the summer months, but river flows and groundwater levels tend to be much lower. Abstraction licences, designed to protect the environment in such conditions, may start to constrain the volume of water available for abstraction from rivers to supply demands or to fill reservoirs. Groundwater abstractions may also be constrained by their licences or because the yields of particular groundwater sources start to reduce below licensed volumes as groundwater levels fall.
- 3.33. In these dry years, the spare water resource capacity starts to reduce and the risk of a shortfall in the volume of water available to supply demand starts to increase. In a succession of dry years (drought), when the risks of a shortfall become significant, measures to reduce demand (e.g. Temporary Use Bans (TUBs), formerly known as hosepipe bans) or to allow increased abstraction, outside that permitted by an abstraction licence, may be required. Such measures are known as drought interventions.
- 3.34. Drought interventions either have a direct effect on customers (e.g. TUBs) or the environment (e.g. drought permits for temporary changes to abstraction licences) and the companies need to strike an acceptable balance between the frequency with which such interventions are likely to

occur and the costs of having additional supply or demand measures in place to reduce the frequency of interventions. Water companies are therefore required to specify targets in their WRMPs, Drought Plans and Business Plans regarding the frequency with which such interventions will be permitted. These targets, which are known as “Levels of Service” (LoS) are agreed through a process of consultation with customers, the Environment Agency and Ofwat.

- 3.35. The LoS specified by Southern Water are that the average frequency with which customers experience a Temporary Use Ban (or hosepipe ban) will not exceed once every 10 years and the average frequency with which a drought permit is implemented will not exceed once every 20 years. These are the “benchmarks” against which the company must plan its future (25 year) investment in schemes that increase the water available for supply or that reduce customer demand for water in dry years. It is to address this specific planning requirement that companies are required to develop their WRMP.
- 3.36. The aim of the WRMP is thus to ensure that companies will be able to meet customer demands for water in these dry years without the need for drought interventions at a frequency that exceeds its stated LoS. The entire focus of a WRMP is therefore on the balance between supply and demand in dry or very dry years where the stress on the supply demand balance falls just short of that required to trigger one or more drought interventions.
- 3.37. With the requirement for the WRMP to have a narrow focus on dry or very dry years, the WRMP thus provides a somewhat extreme “snapshot” of the company’s water resource position. For example, regarding the stated volume of water available for supply, the WRMP guidelines provided by the EA require that the company must be confident that this volume of water would be available during the worst drought on record i.e. when river flows, groundwater levels and reservoir levels are all at an extreme historical low. The conditions required to be assessed in the WRMP, and the water available under those conditions, are therefore likely to be significantly lower than the water available for supply in wet or “normal” years. Most years in the 25 year period that companies must plan for must actually be, by definition, normal or wet, not dry or very dry.

Planning scenarios

- 3.38. The supply demand balance will vary throughout the year, as available supplies and customer demands for water fluctuate. This “within year” variability highlights the need for assessment of a number of different periods or **planning scenarios** that must be considered for each year of the planning period.
- 3.39. These planning scenarios are all based on a design “**Dry Year**” condition, which is defined as a period of low rainfall but with unconstrained demand (i.e. no restrictions on demand such as Temporary Use Bans, formerly called hosepipe bans), since it is in such years that the supply demand balance will be under most stress.
- 3.40. Southern Water has identified three significant periods of “within year” variability for its supply area under the “dry year” conditions used for water resource planning. These are:
- Dry Year Annual Average (DYAA);
 - Dry Year Critical Period (DYCP); and
 - Dry Year Minimum Deployable Output (DYMDO).
- 3.41. All water companies in England and Wales must evaluate the dry year annual average daily demand planning scenario, known as the **Dry Year Annual Average**, or **DYAA** for short. It may also be referred to as the Average Deployable Output (ADO) scenario, particularly when talking about available supplies. This scenario compares the average daily demand over the year against the average daily supplies that are available over that same year. The Environment Agency uses the forecasts for this scenario to compare the plans of all water companies in England and Wales.
- 3.42. The **Dry Year Critical Period** planning scenario (**DYCP**) corresponds to the **period of peak water demand**, which normally occurs during the summer months of June, July and August. The peak period of demand is generally defined in terms of the average day peak week (ADPW) demand. The peak demand is compared to the supplies available during that same

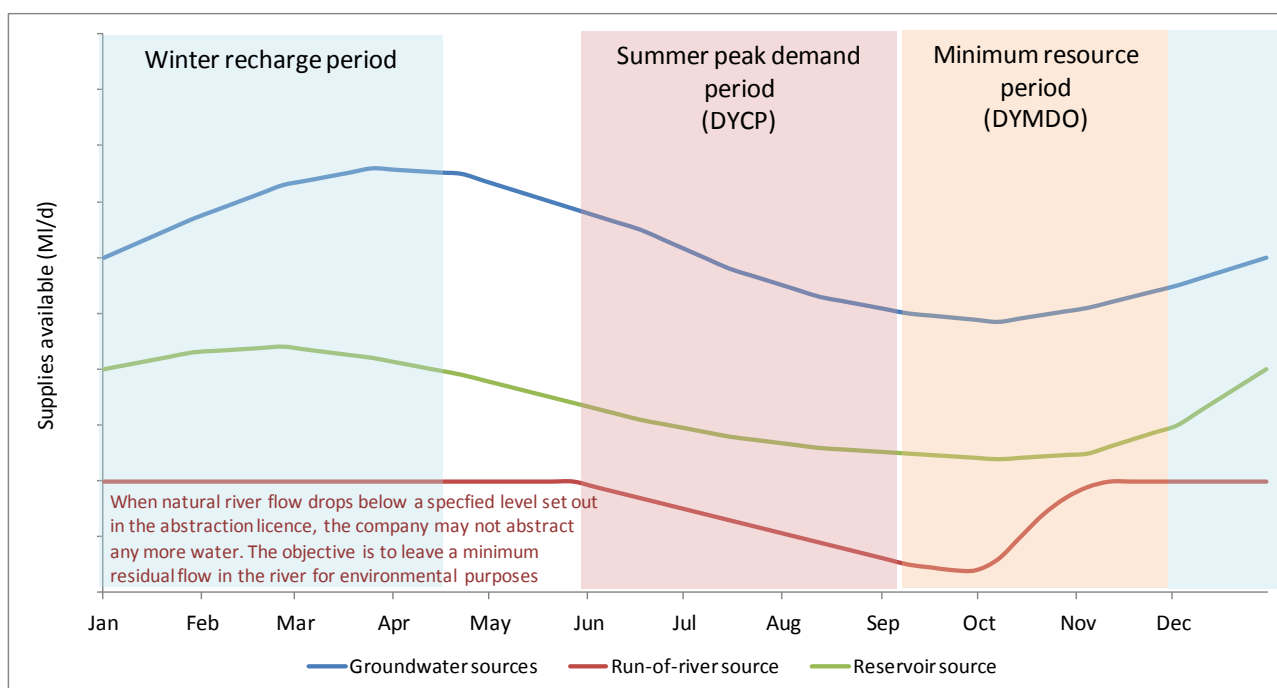
summer period. This may also be known as the Peak-period Deployable Output (PDO) scenario.

- 3.43. The “**minimum resource period**”, or **Dry Year Minimum Deployable Output** planning scenario (**DYMDO**), is used to assess the period where available supplies are expected to be at their lowest or most stressed. This normally occurs during late summer/early autumn when river flows are at their minimum following the summer, and groundwater levels are at their lowest prior to the onset of winter recharge. The demands under this scenario are based on the minimum rolling 30-day average daily demand over the same relevant period.

Planning scenarios and sources of supply

- 3.44. Each WRZ and supply area has a different composition of sources. It is important to understand that groundwater and the different types of surface water sources will react differently to differing hydrological conditions. This means that some sources are more susceptible to certain planning scenarios, or “within year” variability, than others. As a result, WRZs may be subject to differing degrees of stress under the same hydrological conditions due to their different mix of sources. This has been well illustrated during recent droughts, with different (often adjacent) WRZs and water companies experiencing markedly different levels of stress in their supply systems.

Figure 3.2 Summary of critical periods and simplified annual profiles for different types of sources



- 3.45. Surface water storage reservoirs, which can be seasonally managed most easily to cope with the average annual condition, account for only a small proportion of the supplies available to Southern Water.
- 3.46. Groundwater sources, which account for the majority of supplies available to Southern Water, can also, but to a more limited extent, be used to manage supplies over the year. However, groundwater sources are still prone to depletion of available output at times of peak demand, and at times of minimum groundwater levels late in the year due to limited antecedent rainfall.
- 3.47. Run-of-river abstractions with no associated storage facility are least able to be managed for the average annual condition. This is because they can only abstract from the flows available at the time and are governed by the minimum flow condition of the river, as set out in the abstraction licence. If flows are not sufficient, then abstraction could be severely curtailed, and may even be reduced to zero. In such cases, the average abstraction available throughout the year (defined as total annual abstraction divided by 365 days) may be meaningless when designing for the annual average condition.

- 3.48. The corollary of the above is that, for Southern Water and for the purposes of this WRMP, the Dry Year Annual Average period is not generally the most relevant in terms of the supply demand balance. It is only the driver for investment in the Eastern Area, where a significant proportion of supplies are from surface water storage reservoirs.

Summary of planning scenarios for each Supply Area

- 3.49. The **Western Area** is most susceptible to the “minimum resource period”, known as the Dry Year Minimum Deployable Output period, and to the Dry Year Critical Period (i.e. peak demand period), as the two largest resource zones have a significant proportion of supplies from run-of-river abstractions.
- 3.50. The two small WRZs in northern Hampshire are supplied solely from groundwater sources, however there is no supply demand balance deficit forecast in either of these zones over the 25 year planning period.
- 3.51. The **Central Area** is similar to the Western Area, as the Sussex North WRZ takes a significant proportion of its supply from a run-of-river source. The two coastal WRZ’s are supplied entirely by groundwater, although there is also a transfer from Sussex North to Sussex Worthing.
- 3.52. The **Eastern Area** differs from the other two supply areas, as the Bewl-Darwell reservoir system provides the ability to manage seasonal drought events. Hence the Eastern Area is most susceptible to the Dry Year Annual Average and Dry Year Critical Period planning conditions.
- 3.53. In light of the summaries above, the discussion and design of the supply demand balance for Southern Water in this WRMP will only address the peak period (DYCP) and minimum resource period (DYMDO) conditions for the Western and Central Areas, and the annual average (DYAA) and DYCP conditions for the Eastern Area, as summarised in the Table below.
- 3.54. Note that the assessment of DYAA for the Western and Central Area WRZs is not actually required as the zones are driven by the DYMDO and DYCP conditions; however, the DYAA assessments have nevertheless been undertaken to comply with the requirements of the EA’s Water Resources Planning Guidelines.

Table 3.1 Summary of planning scenarios which drive investment, by Supply Area

Area	WRZs	DYAA	DYCP	DYMDO
Western	Hants South, Hants Andover, Hants Kingsclere, Isle of Wight	No ^[note 1]	Yes	Yes
Central	Sussex North, Sussex Brighton, Sussex Worthing	No ^[note 1]	Yes	Yes
Eastern	Kent Medway, Kent Thanet, Sussex Hastings	Yes	Yes	No ^[note 2]

Notes:

[1] DYAA assessments have been undertaken and reported, to comply with the requirements of the EA’s Water Resources Planning Guidelines.

[2] DYMDO assessments have been undertaken and reported for the Eastern Area to allow company-level MDO figures to be presented.

Defining design conditions and Levels of Service (LoS)

- 3.55. The objective of a Water Resources Management Plan is to ensure that there are always enough supplies available to meet anticipated demands in all WRZs under every planning scenario, even under the conditions of greatest water supply stress.
- 3.56. Such design conditions, or drought events, normally occur when there has been a lack of rainfall during the previous autumn and winter recharge period, coupled with high demands as a result of hot and dry summer conditions. These conditions do not occur that often, and therefore the process of water resources planning usually has to consider simulating how the water supply system would have reacted during a drought event.
- 3.57. In order to develop a system that is as resilient as possible to different design droughts, due consideration must be given to the optimum balance of the type of sources in any given WRZ and how they are likely respond under a variety of planning scenarios. This should be an important factor in the choice of supply and demand management options. For instance, a forecast deficit at times of peak demand might be met through increased treatment capacity, whereas average or minimum resource period deficits may require the development of more storage or the provision of a drought resilient solution such as water re-use or desalination.
- 3.58. Previously, the assessment was based on droughts that had been observed in the historic record. There are a number of historic droughts which are normally used to represent design events, such as those which were experienced during 1900-03, 1920-22, 1930-33, and sometimes 1976.
- 3.59. The problem with this approach is that it is limited by the drought events that have actually been observed over a relatively short period of time (just over one hundred years) and so does not allow the system to be tested in earnest; nor does it take account of different types of drought that could occur in future, or could have occurred in the past.
- 3.60. All drought events are different, and so basing the WRMP on consideration of one drought event only (the worst in the historic record) may mean that the designed supply system is not as resilient as possible, i.e. a different type of drought, with different lead-in conditions and low rainfall duration and extent, may threaten supplies to an even greater extent.
- 3.61. Southern Water and some other companies in the South East of England are currently failing their stated levels of service, particularly in terms of customer restrictions and frequency of drought permits. The South East of England has experienced a number of droughts in recent years, notably 1989-1992, 1995 and more recently in 2004-2006 and 2011 to 2012. These droughts have placed great stress on the water resources in the region and have impacted on public confidence of the resilience of water supplies. Moreover, as the severity of the drought deepened at the start of 2012, the real prospect of water shortages later in the year triggered real concerns at the highest level of Government. Those concerns were allayed only when significant rainfall started in the spring. This concern was also demonstrated through the consultation before and for the Draft WRMP where customers' key concern was the resilience of the supply system.
- 3.62. In order to address this issue, Southern Water has developed an alternative approach which allows the company to consider a wider range of droughts for its water resource planning. This new approach is based on statistical generation of weather sequences, and is known as the 'stochastic approach'. Instead of a single historic record, this new approach allows the generation of multiple timeseries of weather data that are entirely consistent with the current climate within each WRZ, but allow many more drought events to be simulated and used to evaluate resilience and Level of Service issues. This moves us away from the worst historic drought approach that is traditionally used. The new approach is described in detail in Appendix C.
- 3.63. The company's analysis of the resilience of its sources to both climate change and different droughts has indicated that generally the groundwater sources are more resilient than the surface water storage systems in the Central and Eastern Areas. The sensitivity of deployable output to droughts of different characteristics is well illustrated by two key sources: the Western Rother and the River Medway Scheme. At the time of privatisation, estimates of the yield of the sources was based on a 1:50 year drought return period giving a yield of just over 103 MI/d for the River Medway Scheme and 30 MI/d for the Western Rother. Analysis based on the worst

historic drought resulted in significant reductions in estimated yields to 72 MI/d and 7.5 MI/d respectively and confirmed the sensitivity of these systems to drought. Analysis conducted during AMP4, which included the 1900 to 1904 drought, led to further reductions in the yield of the River Medway Scheme down to 55 MI/d.

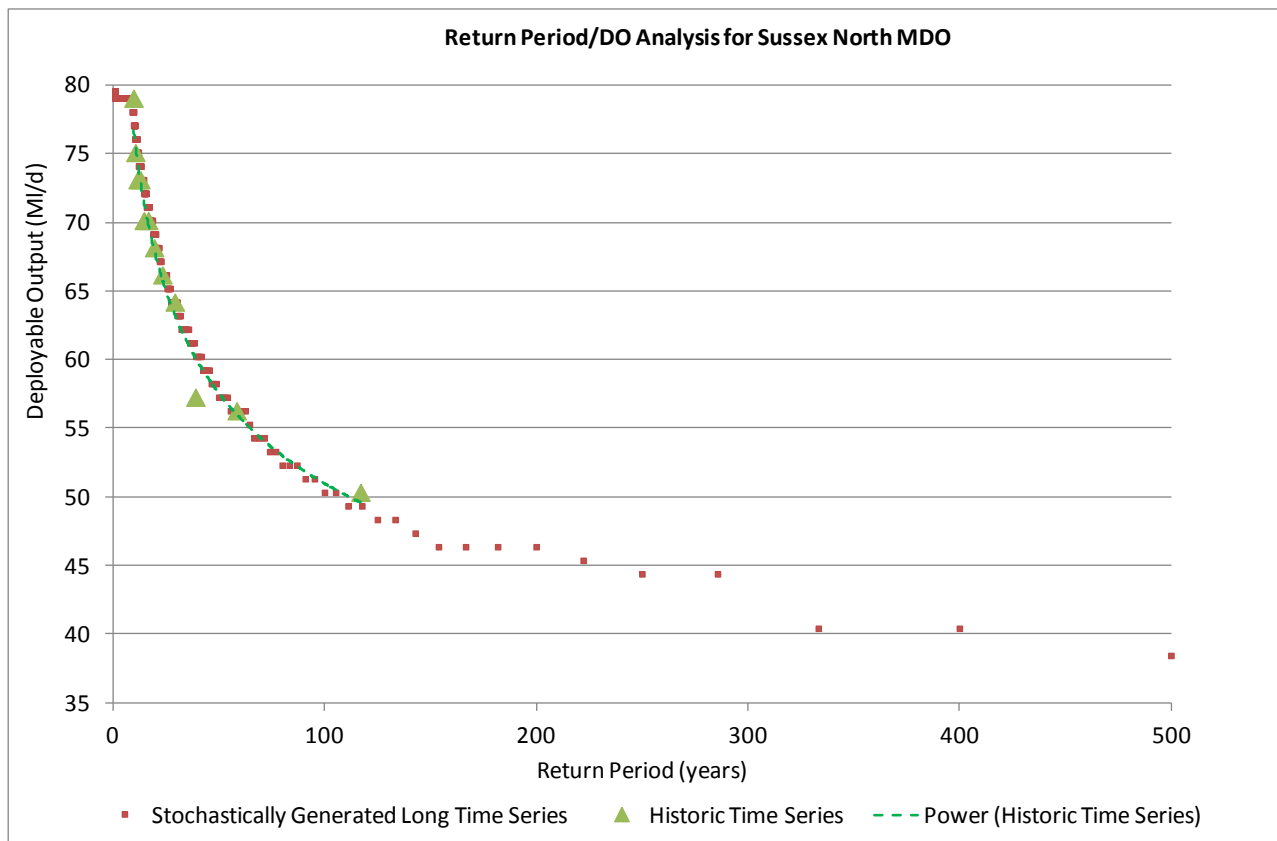
- 3.64. Therefore the key aspect of the stochastic work for the WRMP was to determine how sensitive our existing resources are to droughts of different characteristics. The stochastic work generated many different drought events to consider, some of which were significantly longer and more severe than had been observed in the historic sequence. A number of criteria used to separate the full range of stochastic generated drought events into two sub-sets, those that are considered for WRMP planning purposes and those that will be addressed in the next Drought Plan.
- 3.65. The drought events that have been used to calculate deployable output for the WRMP are those that:
- Would not be of any greater duration than had been observed historically;
 - Take account of the demand-side Drought Plan actions;
 - Would not trigger supply-side Drought Permits &/or Drought Orders; and
 - Are reflective of the levels of protection Defra has issued with regard to critical national infrastructure.

The 'stochastic' approach

- 3.66. One of the key issues that water resources managers face is that the drought conditions that can lead into a severe drought situation occur much more frequently than an actual severe drought, as the drought either breaks, or there is sufficient rainfall to prevent the worst from actually happening. This was well illustrated by the 2011/12 drought, which was actually worse for many sources in the March/April period than the historic 'design' droughts listed above. However, because the drought conditions did not continue through to the summer or autumn, it did not actually result in the resource stress that had been anticipated for Southern Water's supply systems.
- 3.67. Since there are few severe droughts within the historic sequence, it can be very difficult to evaluate both how resources may respond to severe droughts of different types (patterns, duration, etc.), and what type of 'lead in' conditions can result in different drought severities. This makes it difficult to understand drought risks and resilience of the supply systems, and relate assessments of drought return periods to Levels of Service interventions, as the only available information comes from a relatively small historic record (just over one hundred years). In other words, there is very little understanding of how likely it is that the 2011/12 drought might have continued through to the summer and autumn/winter period of 2012. If it had not rained and there had been another dry winter, this could have been one of the worst droughts ever experienced.
- 3.68. The 'stochastic' approach developed by Southern Water is conceptually relatively simple. It relies on using the existing rainfall record and analysing it using a combination of statistical sampling techniques to produce a very long time series of the meteorological events that could occur at a given site. For this Revised Draft WRMP, that means Southern Water has been able to statistically generate multiple iterations of rainfall and temperature data for each of its key resources based on the patterns in the large scale 'drivers' of weather (North Atlantic Oscillation, sea surface temperature) that have been observed in the historic sequence. This has provided multiple timeseries of weather data, which include around seventeen times as many 'potential' droughts as have been observed in the historic record, all of which are compatible with the current climatic conditions at the site. For ease of data processing, these multiple time series (17 sets of 120 years duration) have been collated into a single, Very Long Time Series (VLTS), which is equal to 2000 years worth of weather data. This approach is best described as a 'stochastically based, very long time series (VLTS) assessment', and was adopted instead of other types of probabilistic mathematical modelling methods because:
- It models droughts in a way that is comparable with the existing historically based time series methods, so it is more intuitive for Southern Water and its regulators, and allows all of the stochastically generated droughts to be described in terms of return periods and durations; and

- The retention of a time series component allows the provision of information on the conditions that 'lead-in' to severe droughts, which means that the frequency at which interventions are triggered during the lead-in period to droughts of different types and severities can be analysed more accurately.

Figure 3.3 Example of DO analysis with historic versus stochastically generated events



Target Levels of Service

- 3.69. Levels of Service set out the standard of service that customers receive or can expect to receive from their water company.
- 3.70. The **target Level of Service** sets out what the company aims to achieve. There are two target Levels of Service relevant to water resource planning:
- **Customer target Levels of Service** – which relate to the frequency and nature of restrictions that customers may experience (in the form of Temporary Use Bans (TUBs) restricting different categories of water use, and Drought Orders on non-essential water use during drought conditions); and
 - **Environmental target Levels of Service** – which relate to the frequency of Drought Permits and Orders allowing modified abstraction regimes at some of Southern Water's sources.
- 3.71. The company's current target Levels of Service are shown in Table 3.2 below.

Table 3.2 Target Levels of Service

Type of restriction or measure	Frequency (return period)
Customer target Levels of Service	
Advertising to influence water use	1 in 5 year
Temporary Use Ban on different categories of water use	1 in 10 year
Drought Order to restrict water use	1 in 20 year
Emergency Drought Order to restrict water use	Only in a civil emergency
Environmental target Levels of Service	
Drought Permit/Order to increase supplies through relaxation of licence conditions, increase in licensed quantities, or other measures	1 in 20 year

- 3.72. The company considers that the design standards it is proposing would reduce the likelihood of recourse to Emergency Drought Orders, which restrict water use to an absolute minimum. However, before any consideration of such emergency events, Southern Water considers that there would likely be prior government designation of some form of national or regional emergency.
- 3.73. Return periods represent the frequency at which measures are expected to be implemented. However, it is likely that measures such as Drought Permits and Orders may have to be applied for more frequently than shown in Table 3.2, because drought conditions may ease within the period between preparing and submitting an application to when it is actually granted. The conditions of a Drought Permit or Order would only be implemented if the water resource situation continued to deteriorate. Some Drought Permits may also be implemented as risk management measures on a more frequent basis.

Actual Levels of Service

- 3.74. The first key point to note is that return periods associated with Levels of Service are not the same as drought return periods. When assessing system capabilities for a given drought, the Deployable Output is calculated assuming that the system 'fails' on the last day of a drought. However, Levels of Service interventions are put in place based on forecasts of what might realistically occur as the drought develops, and are therefore not related to the actual 'point of failure' for any given drought (which is clearly never actually known in advance). This means that, to ensure security of supplies, interventions will need to be put in place far more frequently than the 'post event' drought return period (i.e. the return period for a drought can only be calculated after the event), as shown by Southern Water's recent experience with droughts. As a result, despite developing a system that is intended to be resilient to the worst historic drought on record, the frequency of the introduction of Temporary Use Bans (TUBs) and Drought Permits and Orders is significantly higher than the Levels of Service commitments described in Table 3.2. The 2011/12 drought continued to demonstrate the vulnerability of the current system, and also showed how interventions that affect actual Levels of Service often need to be planned and applied for, even though droughts may break before any potential significant resource stress is experienced.
- 3.75. For this Revised Draft WRMP, the stochastic water resource modelling approach has therefore been used to examine how the interventions and triggers described in the Drought Plan (which is published on Southern Water's website) interact with severe droughts and the lead into severe droughts in order to develop design scenarios that reflect the Levels of Service stated in Table 3.2. These design scenarios represent what Southern Water considers to be the appropriate level of resilience required to ensure that drought interventions are no longer triggered more frequently than required under the stated Levels of Service.
- 3.76. The detailed aspects of the stochastic approach are discussed further in Section 5 and Appendix C.

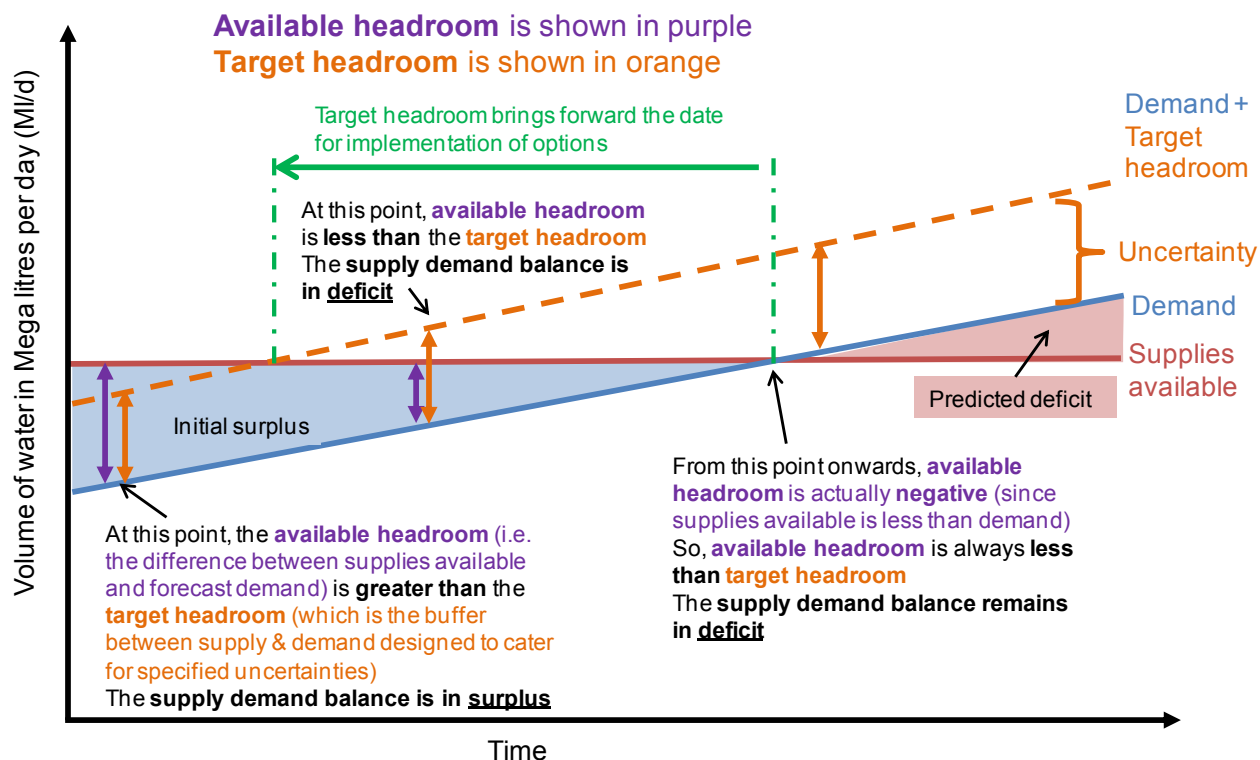
Planning period

- 3.77. Water companies are required to prepare plans covering a 25-year period. For the purposes of this WRMP, the **planning period** is from 2015/16 to 2039/40.
- 3.78. The **base year** is used as the starting point for forecasts and projections of future supplies and demands over the planning period. For the purposes of this WRMP the base year is 2011/12, as this was the most recent year for which there was complete annual data available when preparing the Draft WRMP.
- 3.79. The WRMP identifies the **strategic options** likely to be required over the 25-year planning horizon. However, funding will only be secured for the next 5 years from 2015-20 for options that are required during that period. In addition, some funding may be secured for potential investigations required for options identified in future periods. The WRMP will be updated in 5 years time, and this will provide the mechanism for reviewing strategic options for the 2020-2040 period in that plan.

The supply demand balance – a summary

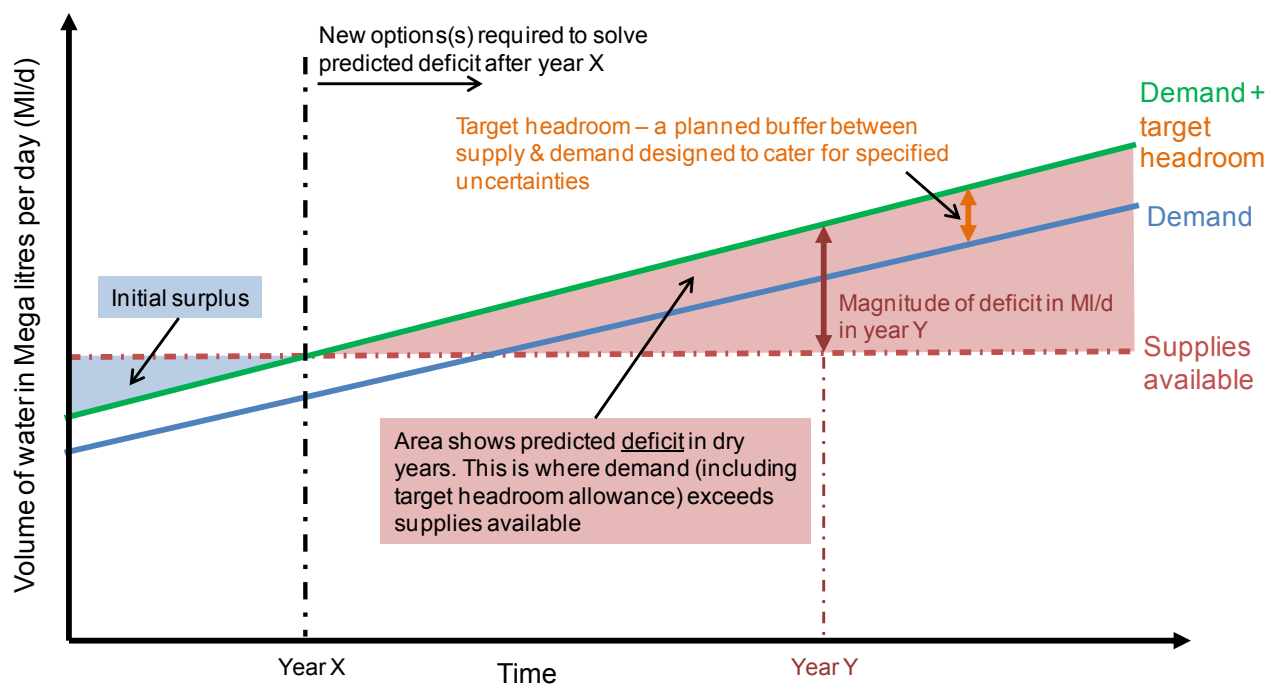
- 3.80. The **supply demand balance** (also referred to using the abbreviation “SDB”) is, quite simply, the difference between the supplies available (water sources) and anticipated demands (water use) over each year of the planning period for a given planning scenario. The forecast based on current estimates of the supply demand balance is called the **baseline supply demand balance** – this effectively demonstrates whether there is likely to be a surplus or deficit during the planning period for a specific planning scenario and, therefore, whether any further action may be required.
- 3.81. Behind this simple equation, there are more complicated calculations which work out how the need for water in the future is affected, for example:
- Housing and population growth;
 - Industrial and commercial demand for water;
 - The effects of climate change; and
 - The impact of new legislation.
- 3.82. The difference between the supply forecast and the demand forecast is known as the **available headroom**. However, as will be seen later, estimates of both supplies available and forecast demands are subject to sources of uncertainty. To account for this “**headroom uncertainty**”, a risk-based minimum or “**target**” **headroom** is determined in accordance with industry best practice and incorporated as a planning allowance in the supply demand balance.
- 3.83. The components of the supply demand balance are illustrated in Figure 3.4 below followed by further discussion of how the status of the supply demand balance affects the planning process.

Figure 3.4 Supply demand balance showing principles of available headroom and target headroom



- 3.84. From the point where available headroom becomes less than target headroom, the supply demand balance is said to be in **deficit**. A deficit could occur in any or all of the planning scenarios described previously (paras. 3.38 to 3.43).
- 3.85. Once a deficit is identified, some form of intervention option or options will be needed to redress the “baseline” supply demand balance to produce an acceptable **final planning supply demand balance**. The final plan shows the resultant supply demand balance including the option(s) which are introduced to meet baseline deficits. **A solution is necessary to meet the deficits in each planning scenario and for each year of the 25-year planning period simultaneously**. The series of figures below demonstrate how the process moves from the baseline supply demand balance, to selecting appropriate options to alleviate that deficit, and the impact these options have on the final planning supply demand balance.
- 3.86. To construct the baseline supply demand balance, the supplies available and the forecast demand for water are plotted over the planning period. The target headroom buffer for uncertainty, which may vary through the planning period, is added to the demand forecast line. This is presented in Figure 3.5. Where supplies available are greater than the demand plus target headroom line, the WRZ has a surplus of water available under the planning scenario. But where the supplies available are less than the demand plus target headroom line, the WRZ is in deficit.

Figure 3.5 Baseline supply demand balance



- 3.87. A key aspect in the water resources planning process involves **options appraisal**, which involves the identification of all feasible supply and demand options which could be used to reduce or close any supply demand balance deficit. There are a wide variety of potential options that could be utilised to solve a deficit. In simple terms, there could be supply-side schemes, or demand management schemes.
- 3.88. Demand management schemes seek to either reduce the likely customer demand for water, for example, through water efficiency activity, or to reduce leakage. Figure 3.6 demonstrates how a demand management scheme could solve or partially solve a supply demand balance deficit – in this case it delays the time at which a deficit may occur.
- 3.89. Supply-side schemes could involve the development of new resources to provide more water (such as desalination or reservoirs), creation of new imports from neighbouring companies, or making more use of the water the company already has (such as water re-use). Some of these schemes can be large-scale, and could therefore be sufficient to solve the entire deficit of the WRZ (Figure 3.7). Alternatively, a number of smaller schemes may be required, either because there are no large supply-side schemes that are feasible for the WRZ in question, or because a combination of smaller schemes is cheaper and more feasible to implement (Figure 3.8).
- 3.90. Ultimately, some combination of both supply-side and demand management schemes may be most economical and appropriate. This is known as the **twin-track approach**, and is presented in Figure 3.9.

Figure 3.6 Selection of demand management options to meet a deficit in the supply demand balance

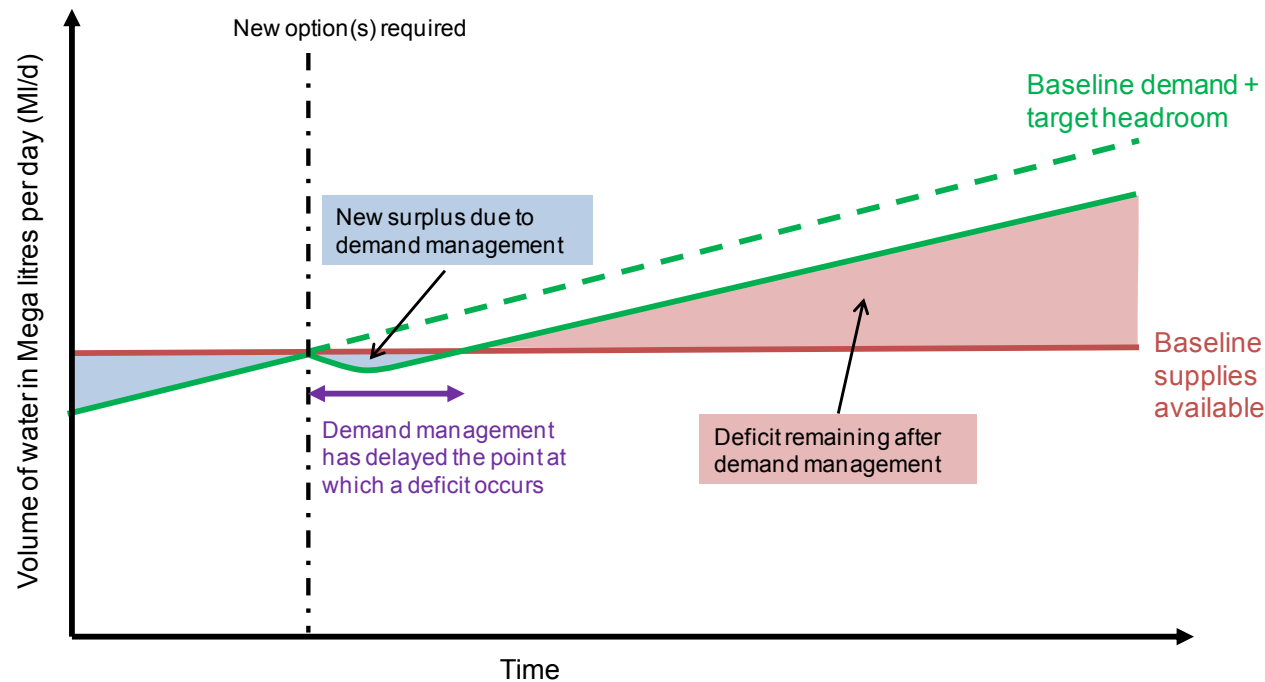


Figure 3.7 Selection of a large supply-side scheme to meet a deficit in the supply demand balance

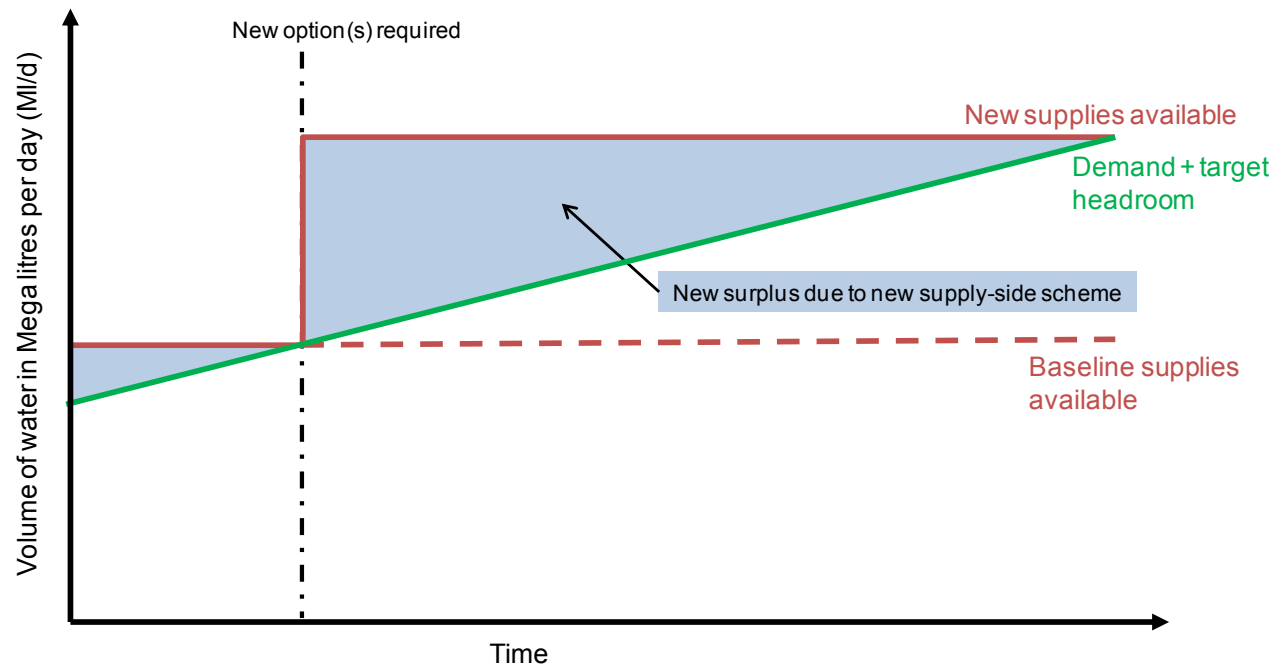


Figure 3.8 Selection of smaller supply-side options to meet a deficit in the supply demand balance

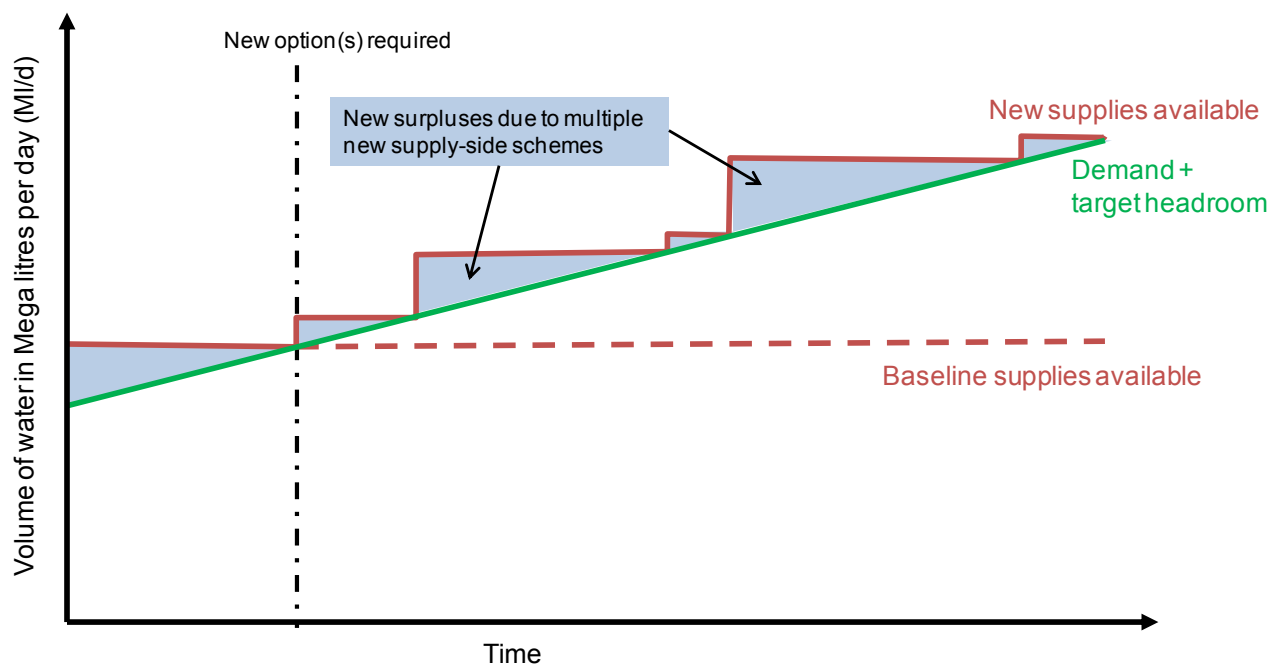
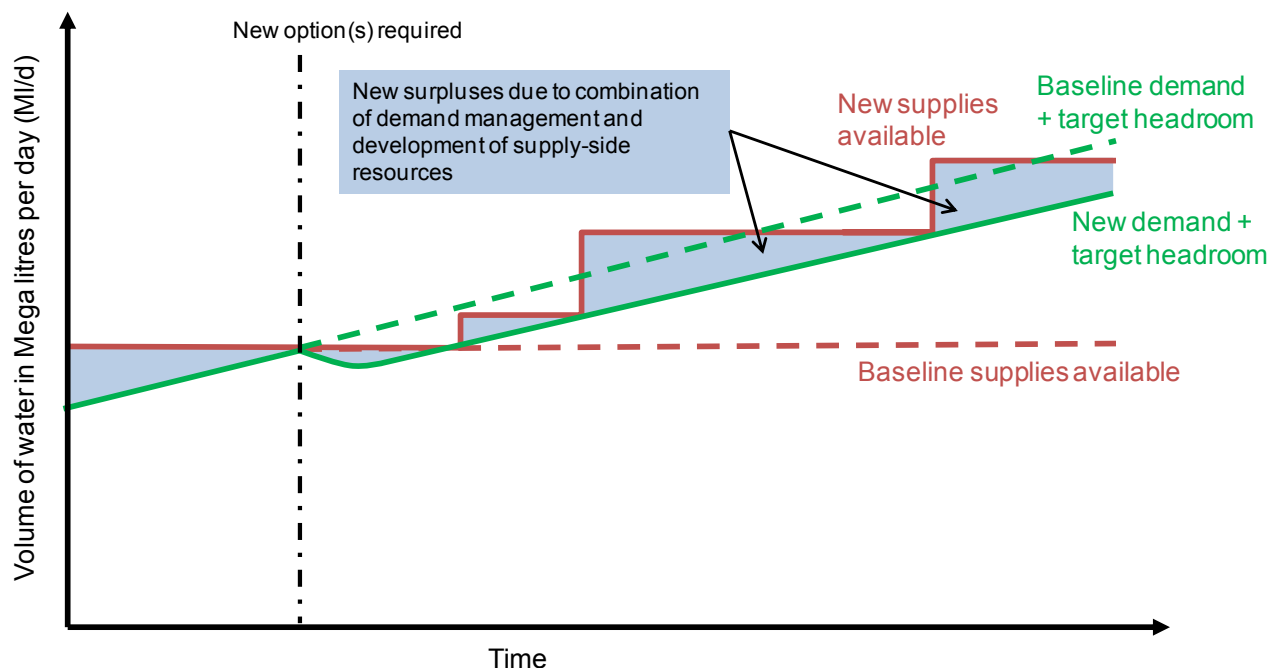


Figure 3.9 The twin track approach to meeting a deficit in the supply demand balance



- 3.91. There may be a range of different options that could be selected to address any given deficit. The optimum solution is derived using an investment model to derive the least cost solution. However, this solution must also be considered against criteria such as customer preferences, environmental considerations and whether the option will lead to a sustainable and resilient system that represents “best value” to customers. This is discussed further in Section 8.
- 3.92. The final solution, taking account of cost and these other considerations, is known as the **preferred programme of options**, or the **final planning solution**.

Key challenges for Southern Water

- 3.93. The company faces many challenges over the next 25 years to balance the need for water for customers while protecting our rivers and environment and providing water at an affordable price. These challenges may be “generic” ones which the water industry in general faces, or more specific challenges facing companies in the South East region.
- 3.94. Southern Water plans for these challenges, however, as the WRMP looks 25 years into the future, these challenges become increasingly uncertain, which is why the company is required to update its plan every five years. The challenges are summarised in the table below and then described briefly in the subsequent paragraphs.

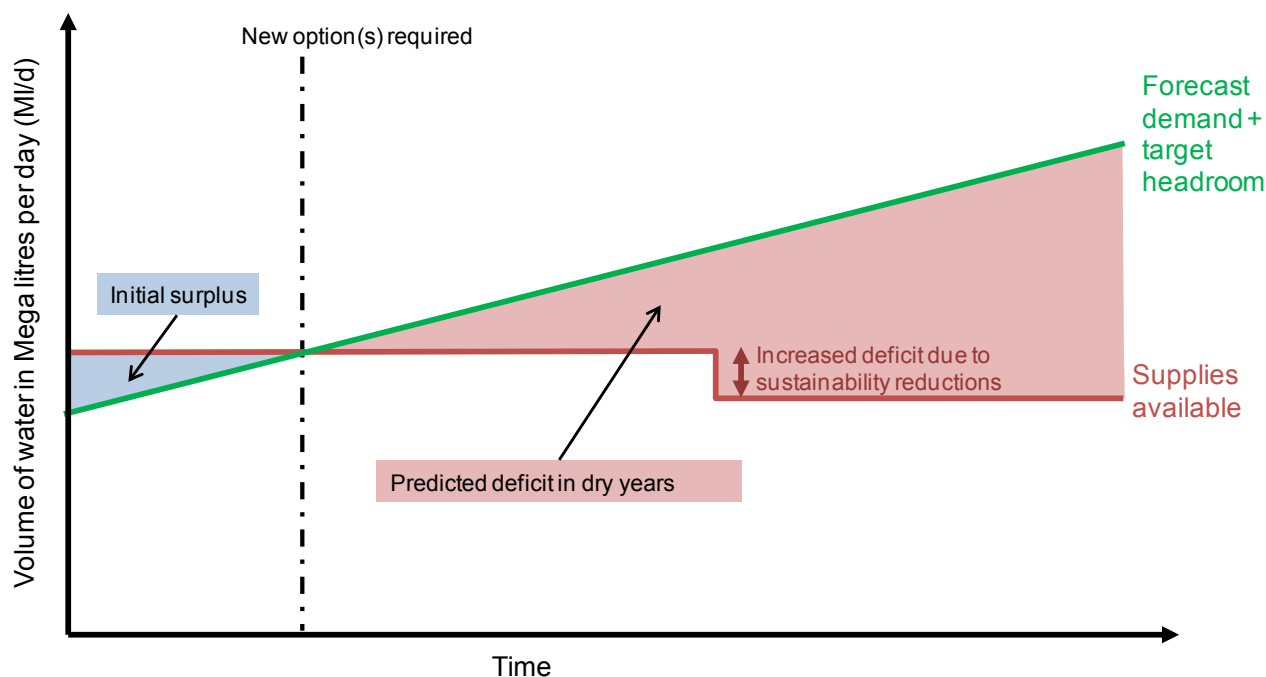
Table 3.3 Key challenges and timeline

Challenges	2015-20	2020-25	2025-40
Stricter laws on how much water we can take	Challenge	Challenge	Potentially a challenge
Catchment management solutions	Challenge	Challenge	
New houses being built		Challenge	Challenge
More people and people living on their own		Challenge	Challenge
The effects of climate change		Challenge	Challenge
How much energy we use		Challenge	Challenge
The state of the economy	Challenge	Potentially a challenge	Potentially a challenge
Resilient water supply system	Challenge	Challenge	Challenge
Resilient water sources	Challenge	Challenge	Challenge
Transfers of water and water trading	Challenge	Challenge	Challenge
Planning constraints	Challenge	Challenge	
Value of water	Challenge	Challenge	

Stricter laws on how much water can be abstracted

- 3.95. The greatest challenge facing water companies is new European legislation, which could reduce the amount of water the company is licensed to take for water supplies.
- 3.96. Recent and forthcoming decisions by the Environment Agency, as a result of its interpretation of European environmental legislation, including the Habitats Directive and the Water Framework Directive, are likely to affect the company’s abstraction licences. This means that in dry years much less water could be available for abstraction. The impact of these “**sustainability reductions**” is shown in Figure 3.10 below.
- 3.97. One example is the River Itchen Sustainability Reduction in Hampshire, required following the Habitats Directive Stage 4 Review of Consents, which will reduce the amount of water that can be abstracted from Lower Itchen surface water and groundwater sources. These reductions, which mainly occur when river flows are low, mean that the company needs to find other ways to continue to meet the demands of its customers in Hampshire.
- 3.98. There remains a great deal of uncertainty surrounding the outcome of many investigations under the Environment Agency’s Restoring Sustainable Abstractions (RSA) programme. To account for this uncertainty the company has run a number of scenarios to demonstrate the potential impact that these unknowns RSA schemes may have on the WRMP.

Figure 3.10 Impact of sustainability reductions on the baseline supply demand balance



Catchment management solutions

- 3.99. It is vital for everyone to work together to balance the needs of our customers, industry, agriculture and the environment in the South East.
- 3.100. During the next 25 years, Southern Water would like to develop more catchment management solutions to secure water resources where possible. This will involve working in partnership with landowners, farmers, River Trusts and fishermen to ensure our rivers are kept flowing and clear of chemicals which affect water supplies.
- 3.101. A number of pilot schemes for these solutions have been included within this plan and discussions are being held with organisations such as the Arun and Rother River Trust, the South Downs National Park Authority and the RSPB. It may take some years for the benefits of catchment management solutions on the supply demand balance to be quantified, however Southern Water is committed to increasing its work on catchment management from the start of AMP6.

New houses being built

- 3.102. The number of households that will need to be supplied with water is likely to grow over the planning period. This issue is especially acute in the South East. Growth in housing and the associated impact on demand are taken into account in the demand forecast described in Section 6. However, it is possible that the requirement for new houses will grow beyond current projections, which may have implications for plans to provide sufficient water supplies. This risk is managed through the process of undertaking a complete review of the WRMP every 5 years. However, it is also worth noting that the anticipated growth in households could turn out to be less than forecast.

More people and people living on their own

- 3.103. The population in England is forecast to grow by nearly 10 million by 2035, with most of the increase in areas which are already classified as being water stressed, such as the South East.
- 3.104. The Office for National Statistics believes the population on the Isle of Wight will be one of the fastest growing; with the Medway region and Brighton and Hove also set to grow by more than 10 per cent.
- 3.105. A growing trend for smaller households and more people living on their own is also adding to the pressure on the provision of water supplies. Although this could be offset by newer, more

water efficient appliances and changes to more conservative water using behaviour by customers.

The effects of climate change

- 3.106. Climate change is likely to make weather extremes more common in the future. The effects are likely to be a rise in temperature between 1.1°C and 6.4°C above 1990 levels by the end of this century and annual rainfall decreasing by up to a half in the South East.
- 3.107. Changing weather patterns could lead to more frequent and severe droughts and a change in the seasonal demand for water, all putting more pressure on the water supply system. It could also result in a pattern of warmer drier years that would not necessarily be classified as drought years, yet which put additional stresses on the water supply system, and may impact on the quality and availability of the company's water sources.
- 3.108. In the light of such changes, what remains unclear is the magnitude of the future climate change, and WRMPs must therefore address the probability that climate change will increase the frequency, duration and magnitude of future drought events.

How much energy the company uses

- 3.109. The water industry uses large amounts of energy to abstract, treat and pump water to customers' taps. Southern Water therefore needs to consider the rising cost of energy and its effect on the environment and climate change, in terms of associated greenhouse gas emissions.
- 3.110. This WRMP therefore considers not only the energy required to introduce a water option, such as to building a new reservoir, but also the on-going energy costs of running it.

The state of the economy

- 3.111. During the past few years, the UK has experienced one of the worst recessions on record, resulting in high levels of unemployment and reductions in wages, against a backdrop of an increased cost of living. The company is mindful that at this time customers expect better value services than ever before, at a price they can afford. The state of the economy can also affect industrial and service sector outputs, and hence can impact on elements of the demand forecast.

System resilience

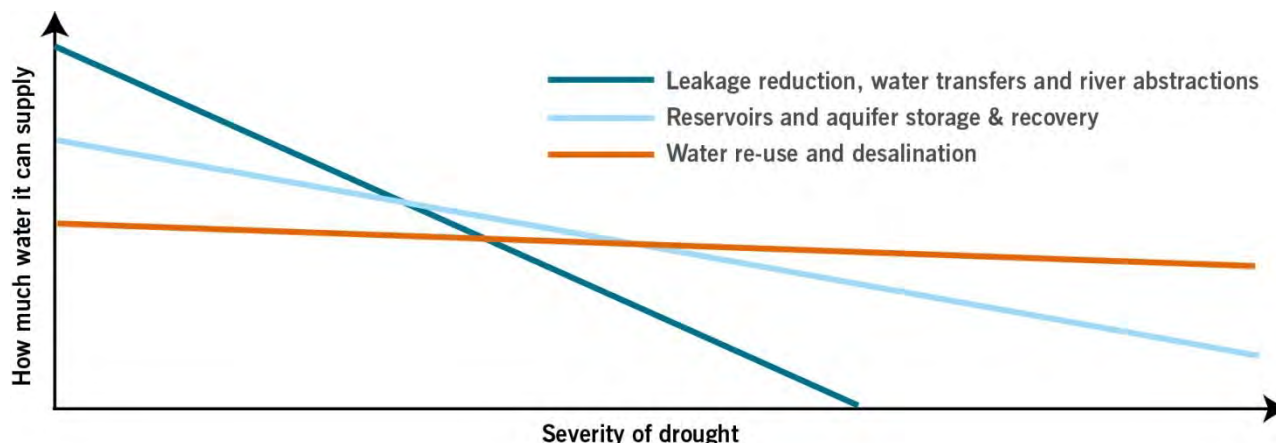
- 3.112. Customers and stakeholders have indicated that the introduction of standpipes and/or rota cuts would not be acceptable. The implication of this is that the company needs to develop a more resilient system. By starting to change the way we plan now, the company will create building blocks for a more sustainable and resilient water network in the long-term, which will be able to maintain the security of supplies under the most severe conditions.
- 3.113. In this WRMP a new approach has been taken to planning our future water resources in order to secure a more 'resilient' water supply. This 'resilient' system would be less vulnerable to weather patterns and consequently to the possible use of rota cuts and standpipes if the company faced water stress in severe droughts.
- 3.114. However, the company have also prepared a more conventional plan which uses historical planning approaches, so that Southern Water can elicit customers' views on the appropriateness of the more resilient system that the company feels is appropriate.

Resilient water sources

- 3.115. As has been discussed throughout this section, different types of water sources react differently to droughts and changing weather patterns.
- 3.116. Underground aquifers, rivers and reservoirs rely on rainfall in the winter to guarantee supplies. After one or two dry winters they can come under pressure.

- 3.117. Options which reduce the demand for water, such as fixing more leaks, water efficiency and metering tariffs, mean less water needs to be supplied on a daily basis on average. However, they do not improve the supplies available during severe droughts.
- 3.118. Water resource options which can provide a continuous and reliable source of water, even during prolonged droughts, include water re-use and desalination. Water re-use involves putting cleaned wastewater back into rivers, allowing it to be taken out downstream and treated to the highest drinking water standards. Desalination involves treating seawater to drinking water standards.

Figure 3.11 How different water resource options perform during droughts



- 3.119. In a very severe drought, schemes such as water re-use and desalination would provide a reliable water supply for customers, agriculture and businesses, although this increased source resilience would come at a cost, not only financially, but in terms of, for example, an increased carbon footprint.

Transfers of water and water trading

- 3.120. Over the years, the company has introduced a number of schemes to increase the security of supplies by increasing the connectivity between different WRZs in order to enhance its capacity to transfer water from areas of surplus to areas of deficit. Further options in this regard have been assessed in developing this WRMP.
- 3.121. There are also a number of transfers of water with neighbouring water companies, which take place under conditions stated in bulk supply agreements that have been developed over the last 50 years. These may be imports to Southern Water, or exports to other companies.
- 3.122. A number of the existing bulk supply agreements to provide exports of water from Southern Water to other companies will terminate during the planning period. Over that same period, several of the WRZs that provide these bulk supplies are forecast to develop a supply demand balance deficit. The company has taken the view that it will continue to renew all existing bulk supply agreements to other companies throughout the planning period, subject to the volumes that are applicable at the time of contract renewal. This could result in Southern Water having to develop additional resources and/or adopt further demand management measures, in order to maintain these bulk supplies to neighbouring companies as part of a regional strategy to increase the resilience for South East England as a whole.
- 3.123. In order to develop this regional strategy of inter-company transfers, Southern Water has again played an active role in the Water Resources in the South East (WRSE) group. This group comprises members from water companies, Defra, Ofwat, the Environment Agency, Natural England and the Consumer Council for Water. It meets at managing director, technical and specialist sub-group levels. The objective of the WRSE group is to consider the shared strategic development of water resources in South East England, which has to date led to the development of further bulk supplies between water companies, several of which have involved Southern Water.
- 3.124. However, whilst the work of the WRSE group helps to facilitate appropriately integrated solutions across the region, each company remains responsible for developing its own strategy

in line with the requirements of its own Board. Thus, whilst it may be quite reasonable for Southern Water's preferred strategy to differ from that which might have arisen from work undertaken by the WRSE group, some justification may be required for regulatory approval of the company's preferred strategy. The water resources strategy in this WRMP presents the "company preferred regional strategy" which is consistent with the latest available results from the WRSE group modelling work in terms of the additional regional bulk supplies required. This aspect is further discussed in Sections 8 to 10.

- 3.125. In 2011, the Government published *Water for Life*, the Water "White Paper". This emphasised the importance of companies considering all options to balance their supply and demand including water trading, cross-boundary solutions and third-party supplier options. In addition to working with neighbouring water companies to develop potential bulk supply agreements through the WRSE and bilateral discussions, the company has actively sought to obtain other water trading and third party supplier options. This is discussed further in Section 8.

Planning constraints

- 3.126. A major challenge facing future planning of water resources is the range of potential constraints in the South East of England on the development of new sources, as the whole region has been designated as being in an "area of serious water stress" by the Environment Agency. There has for many years been an Environment Agency policy of no increase in abstraction from groundwater for consumptive purposes. In addition, the high population density gives rise to a very high premium on space and this, combined with National Parks, large Areas of Outstanding Natural Beauty (AONB), and European and National nature conservation designations that are rightly afforded a high degree of environmental protection, significantly reduces the options available for new abstraction, storage, treatment and supply infrastructure. For example, there are very few remaining sites in the South East that might be appropriate locations for a new surface water reservoir.
- 3.127. The planning system itself also introduces additional uncertainty into the appraisal of new options, as the timescales for achieving planning permissions and other consents can be uncertain for different types of potential resource developments. This is particularly critical for options which need to be introduced in the next AMP period (from 2015 to 2020) in order to satisfy a projected supply demand balance deficit.
- 3.128. Southern Water believes that, given such constraints, all of the potential sites for the development of new resources identified in this WRMP during the planning period, provided they are socially and economically acceptable, and environmentally sustainable, should be identified and set aside for future development through Local Plans and other planning documents.

Value of water

- 3.129. The Water White Paper, *Water for life*, made clear the importance that the UK Government attaches to the sustainable use of water resources. One of the policy priorities that Governments expect water companies to address in their plans was to take better account of the value of water by reflecting its scarcity and the environmental and social costs of abstraction in order to make the water sector's activities more sustainable.
- 3.130. The company aims to investigate the sensitivity of the WRMP to the value of water through the application of "scarcity charges" within the least-cost economic model. A scarcity charge would mean the price abstractors pay better reflects the environmental impact of water abstraction.
- 3.131. If introduced, a higher price would be paid for water which is abstracted from areas where there is less water available. This would provide an incentive for water companies to optimise the use of the water they have abstracted and consider other potential options.

4. Views of customers and stakeholders

Section summary

This Section gives a summary of the consultation activity undertaken in preparation of the Draft WRMP and during the public consultation on the Draft WRMP.

Aspect of the WRMP addressed in this section of the Technical Report	Reference
Involvement of statutory consultees in development of the plan	Para.4.1-4.62
Involvement of customers and other stakeholders in the development of the plan, and inclusion of their views in the Draft and Revised WRMP	Para.4.1-4.65
Provision of opportunity for water companies and other third parties to provide options to be considered in the development of the plan	Para.4.27-4.36, 4.61

Statutory requirements addressed in this section

The following table summarises the statutory requirements (legislation, regulations and directions) applied to the WRMP process, and provides a cross reference to the relevant part of this section of the WRMP.

Legislation ref.	Description of matter to be addressed	Reference
WIA1991 S37A(8)	Before preparing its Draft WRMP, the water undertaker shall consult: the Environment Agency; the Authority [Ofwat]; the Secretary of State; and any licensed water supplier which supplies water to premises in the undertaker's area via the undertaker's supply system.	Para. 4.37-4.38 & 4.61-4.62 (& 2.23-2.29, Appendix A)

- 4.1. As part of the process to prepare this WRMP, the company engaged with its customers and stakeholders about enhancements, Levels of Service and options. The findings of these activities was crucial to the development of the Draft WRMP, which was consulted on and subsequently revised in light of comments received from customers and stakeholders.
- 4.2. Southern Water also engaged with the regulators, who are statutory consultees: the Environment Agency, Ofwat and Natural England.

Customer engagement activity

- 4.3. The need for customer engagement is also prescribed in the EA's WRP (p.103):

Customers' views are very important in shaping the water resources management plan. Ofwat expects companies to use the full range of information at its disposal and to carry out robust new customer research where appropriate to establish its customers' priorities for services and their views on bills, which will be influenced by the proposals contained within the plan.

- 4.4. The consultation process was broken down into two distinct periods: pre-consultation and the main consultation. The pre-consultation was undertaken to facilitate the development and formulation of the Draft Water Resources Management Plan and took place between June and November 2012. The main consultation period took place between May and August 2013, and the results from this main consultation period have been incorporated into the WRMP.

Pre-draft consultation to facilitate development of the Draft WRMP

- 4.5. Appendix A provides a detailed timeline of research and engagement activity conducted in preparation of the Draft WRMP.

Stakeholder workshops

- 4.6. During July and August 2012, four workshops were held with key stakeholders across Kent, Sussex, Hampshire and the Isle of Wight, with a combined attendance of more than 100 delegates. The workshops included an overview of the water resources planning process, scenario modelling, resilience, water scarcity charges and catchment management.
- 4.7. The workshops provided a summary of the current options to secure water resources in each county and an exercise for delegates to put forward new options and 'design' a 25-year-plan themselves. At the conclusion of the exercise, delegates were asked to vote on a series of questions about their priorities for future water resource planning. The results of the workshop voting exercise are summarised below, with the detailed findings presented in Appendix A.
- 4.8. In addition, a workshop to discuss catchment management options was held in June 2012 to elicit potential catchment management options which could be included in the Draft WRMP.
- 4.9. Stakeholders ranged from councils, environmental bodies, elected members, economic forums and consumer groups, to specialist water bodies, the Consumer Council for Water (CC Water), and regulators.

Customer focus groups

- 4.10. Eight domestic customer focus groups were held in July and August 2012 to discuss the potential frequency of water restrictions, rota cuts and standpipes and water resource options. The customers were asked to rank their preferred options for drought planning and water resource options, having been given information about costs, environmental and social impact and time to deliver. The results of the customer focus groups are summarised below, with the detailed findings presented in Appendix A.

Customer online survey

- 4.11. To build on the results of the customer focus groups, an online survey of 1,000 customers was developed with YouGov around the selection of water resource options. The research took the form of a 'shopping basket' exercise, where customers were asked to 'shop' to meet a predicted deficit in water supplies – selecting from a list of generic water resource options. They made their choice in the context of price, resilience to weather patterns and environmental costs, and the price of their selection was reflected in an increase on their overall water bill. The results of the customer online survey are summarised below, with the detailed findings presented in Appendix A.

Water re-use study

- 4.12. A detailed research study was also conducted to explore and evaluate customer attitudes and perceptions towards developing and implementing water re-use schemes as a way of increasing the resilience of its water supply by making more water available to put into the water supply network.
- 4.13. The research study comprised two phases. The first element was qualitative, comprising a series of focus groups and face to face depth interviews. The second phase involved undertaking 1,000 telephone interviews with Southern Water customers to understand customers' views of water re-use and what their communications preferences would be for conveying the key messages associated with such schemes.

Other customer engagement conducted by Southern Water for other plans, but with findings relevant to this Draft WRMP

- 4.14. In addition, customer research and engagement that was carried out by Southern Water for the development of its Strategic Statement, Business Plan 2015-2020 and during "business as usual" was considered alongside consultation that was specific to the Draft WRMP.

Key findings from pre-draft consultation customer engagement

- 4.15. This sub-section provides a summary of the key findings from customer engagement as part of "pre-draft" consultation activity used in the development of the Draft WRMP. Appendix A provides further detail on the pre-draft consultation activity and findings.

Resilience

- 4.16. The company asked what importance customers put on 'resilience', which water options were preferred, how customers felt about water re-use and how much they will pay for improvements. Our customers told us:

A reliable water supply is a priority

- 4.17. A resilient network, which will not run out of water, is very important to customers and they do not find the use of rota cuts or standpipes acceptable in the 21st century. They are generally willing to pay a small amount extra on their future bill to secure this.

Water restrictions

- 4.18. While customers would like to see water restrictions such as Temporary Use Bans (previously known as hosepipe bans) introduced less often, they accept that such restrictions have a role to play during droughts. Customers feel restrictions put pressure on small businesses and tourism and want Southern Water to work closely with these industries.

Water restrictions are acceptable during droughts

Water re-use schemes

- 4.19. Customers think re-using water from wastewater treatment works makes sense and would like to see these schemes in use to secure reliable water supplies.

Water re-use makes sense

Demand management

- 4.20. Customers feel it is important for Southern Water to set an example by fixing more leaks and promoting water efficiency. However, they also recognise that the amount of water these options provide is limited and is more expensive than other options.

Leakage and water efficiency are important but limited

Preference of options to secure water for the future

- 4.21. The schemes that customers prefer to supply water are Aquifer Storage and Recovery and water re-use, where available. Desalination is popular for its resilience to drought, but only if it can be developed with a renewable energy source to offset the high energy use.
- 4.22. Overall, the research ranked schemes in the following order (from most preferred to least preferred):

1)	Aquifer Storage and Recovery;	(Most preferred)
2)	Water re-use;	
3)	Leakage reduction;	
4)	Desalination;	
5)	Water efficiency;	
6)	Storage reservoir; and	
7)	Seasonal and/or rising block tariffs.	(Least preferred)

Different views in different areas

- 4.23. Views of informed parties varied across the region, with water re-use popular in Kent, Sussex and the Isle of Wight, desalination and managing demand for water a priority in Hampshire and a water efficiency campaign a priority on the Isle of Wight.

Customers do not think that a single universal approach is necessarily appropriate

Willingness to pay

- 4.24. The company spoke to 1,538 households and 789 business customers about how much they were willing to pay for the services Southern Water provides, with options to pay more for better services or less for a reduced service and a lower bill.
- 4.25. These surveys showed customers would pay more to reduce the likelihood of introducing Temporary Use Bans (which include what were previously known as hosepipe bans) from one in six years to one in 10 years; and to reduce the likelihood of introducing emergency measures such as standpipes from one in 80 years to one in 200 years.

There is support to invest in reliable water

- 4.26. This enabled the company to derive a value that customers place on developing a more resilient water supply, which was about £3.40 on an average customer bill for the next 25 years.

Water trading and transfers

- 4.27. The company contacted neighbouring water companies and holders of large water abstraction licences to examine the possibility of trading water licences while developing the Draft WRMP. The company also investigated potential third party supply options and neighbouring water company transfers, as part of the pre-draft consultation stage of the WRMP.
- 4.28. Four specific approaches were used to identify potential options:
- 1) Publication of a notice in the Official Journal of the European Union (OJEU) to seek third party supplies;
 - 2) Publication of a “statement of need” on the company’s website to seek third party supplies, including from neighbouring companies;
 - 3) Direct contact with neighbouring water companies with a view to initiating water trading discussions; and
 - 4) Contacting large abstraction licence holders within the company supply area with a view to initiating water trading discussions.
- 4.29. As discussed in Section 3, it should also be noted that Southern Water is an active participant in the Water Resources in the South East (WRSE) group, which comprises water companies in South East England as well as Defra, Ofwat, the Environment Agency, Natural England and the Consumer Council for Water. The objective of the WRSE group is to consider the shared strategic development of water resources in South East England, which thus provides a forum for identifying potential bulk supplies as part of a wider regional strategy, allowing the companies involved to discuss and agree requirements, volumes and potential charges.

Official Journal of the European Union (OJEU) notice

- 4.30. Southern Water received two responses to the OJEU notice (2012/S 187-308209) for a bulk supply of raw or treated water, which are under investigation, but did not form feasible options within the Draft WRMP, as the volumes of water and feasibility of these third party supplies were not significant.

Statement of Need

- 4.31. In September 2012, Southern Water published a “Statement of Need” on its website. This provided a broad summary of indicative supply demand balances for each of the company’s ten Water Resource Zones, highlighting those which were at risk of deficit over the next 25 years (under “dry year” conditions).
- 4.32. Southern Water invited potential suppliers with the ability to provide water to the company’s supply network to submit proposals for options that could be included in the company’s options appraisal process. However, at the expiry of the deadline for the submission of the proposals at the end of October, Southern Water had not received any responses.

Contact with neighbouring water companies

- 4.33. In November 2012, letters were issued to all Southern Water’s neighbouring water companies highlighting the publication of the Statement of Need, and inviting them to contact Southern Water to discuss potential bulk supplies.
- 4.34. Although no formal responses to these letters were received, Southern Water and its neighbouring water companies have been liaising regarding bulk supplies as part of the WRSE group.

Water trading

- 4.35. Southern Water made a request to the Environment Agency for details of large (greater than 1 Ml/d¹) abstraction licence holders within Southern Water’s supply area. Anything less than this minimum 1 Ml/d potential licence trade was considered not to provide a strategic option for

¹ 1 Ml/d is equal to 1000m³ per day

Southern Water. The approach was discussed and agreed during pre-draft consultation with the Environment Agency.

- 4.36. A small number of potential candidates were identified as potential water trading partners. A letter was sent to these companies to enquire whether they would consider trading all or some of their licensed abstraction, dependent on the viability and cost effectiveness of the potential schemes. However, Southern Water did not receive any response to this correspondence.

Pre-draft consultation with regulators

- 4.37. During the pre-draft consultation phase, meetings were held with the Environment Agency, Natural England and Ofwat to report on the status of developments with the Draft WRMP, explain approaches and report results.
- 4.38. Details of the consultation activity are provided in Appendix A.

Public consultation on the Draft WRMP

- 4.39. The Draft WRMP was published for a 12-week public consultation between 20 May and 12 August 2013. The consultation was supported by a wide range of activities to engage as many customers and stakeholders as possible and to encourage feedback on the plan.
- 4.40. During the consultation a total of 962 responses were received with 771 of these via telephone-based customer research. All of the consultation responses were submitted to Defra.
- 4.41. Appendix A provides a detailed narrative of the research, engagement activity and results during the public consultation on the Draft WRMP.

Customer research

- 4.42. Qualitative and quantitative research was carried out with more than 700 customers during the public consultation, with participants recruited from a range of geographical areas, age groups and socio economic backgrounds in order to secure a fair representation of the company's one million water supply customers. This included 71 customers taking part in eight extended customer focus groups in and 600 domestic customers and 100 business customers taking part in telephone surveys. In all cases the customers studied material from the Draft Water Resources Management Plan Consultation Document (see para 4.49) and answered the 16 questions in the accompanying questionnaire. All the completed questionnaires and comments were submitted to Defra and formally accepted as part of the consultation responses.
- 4.43. The reports on the customer research can be found in Appendix A

Stakeholder engagement

- 4.44. At the launch of the consultation, more than 1,600 stakeholders were posted a copy of the Draft WRMP Consultation Document, a questionnaire and a pre-paid envelope to return the questionnaire directly to Defra. All stakeholders received an invitation to attend a workshop or request an individual briefing or more information. In addition, nearly 200 parish councils were sent a copy of a DVD with details of the public consultation and the Draft WRMP.
- 4.45. Between May and August 2013, four workshops were held with key stakeholders across Kent, Sussex, Hampshire and the Isle of Wight, with a combined attendance of 63 delegates. The workshops included an overview of the Draft WRMP, the development of the plan and an option to give feedback on the day or via the questionnaire. In addition, 13 stakeholders attended shorter two-hour workshops, 24 individuals and organisations had personal briefings and several MPs attended a reception in the House of Commons.
- 4.46. Stakeholders ranged from councils, environmental bodies, elected members, ministers, economic forums and consumer groups, to specialist water bodies, the Consumer Council for Water (CC Water), and regulators.
- 4.47. The company also actively engaged with Southern Water's Customer Challenge Group, a group set up under direction from Ofwat to advise and scrutinise water companies on their engagement with customers and how this is reflected in their future planning.

- 4.48. The detailed findings of the stakeholder engagement are presented in Appendix A.

Consultation Activities

- 4.49. In order to make the consultation accessible to as wide an audience as possible, the company published a Draft WRMP Consultation Document, in addition to the main technical documents. This 44-page document summarised the main points and used illustrations and maps to present the information in a simple format.
- 4.50. The company also produced a four-page A5 customer leaflet, a short DVD about the plan and the consultation, a questionnaire and a pre-paid envelope to return the questionnaire directly to Defra.
- 4.51. This was supported by a dedicated section on the company's *Have Your Say* website and on the company's main Southern Water website. The section included information on the plan and the consultation, downloadable documents and information on how to request the technical reports, an e-reader with the consultation document, the film, interactive maps showing the selected options, an online poll, blog and online version of the questionnaire, which was forwarded directly to Defra. About half of the responses received during the consultation were submitted via the online questionnaire.
- 4.52. Customers also had access to a dedicated *Have Your Say* email to submit feedback during the consultation.
- 4.53. During the consultation, there were 2,880 views and 1,847 visitors recorded on the WRMP landing page of the *Have Your Say* website and a further 979 views and 649 visitors to the main Southern Water website.
- 4.54. A number of activities were carried out during the public consultation to raise awareness of the Draft WRMP and the opportunity to comment. News releases were distributed to regional and national media at the launch of the consultation in May and also in July, with media briefings organised with local newspapers to provide more in-depth coverage and interviews for radio and television. The media focused on key themes such as water re-use, desalination and the frequency of water restrictions. This was supported by two newspaper advertising campaigns, estimated to have reached a total readership of more than 700,000.
- 4.55. Twitter was used to promote consultation activities and information was also placed on Southern Water's Facebook page.
- 4.56. Customer brochures were distributed at public events and outside shopping centres, copies of the consultation document were posted to all libraries in the region and members of staff included information in talks to schools and community groups during the consultation period.
- 4.57. A recorded message about the consultation was played to customers calling the Customer Contact Centre and customers were also able to lodge their feedback through the centre.
- 4.58. Several workshops were held for Southern Water staff, so they in turn were able to inform customers about the plan in their day to day liaison with them. This was supported by team briefings, articles in the company newsletter, staff announcements on the intranet and posters promoting the consultation and the *Have Your Say* website.
- 4.59. The consultation was supported by a campaign to donate £1 to international charity WaterAid for every response received, resulting in a donation of £962.
- 4.60. Full details of the consultation activity and examples of adverts and news releases can be found in Appendix A.

Contact with neighbouring water companies

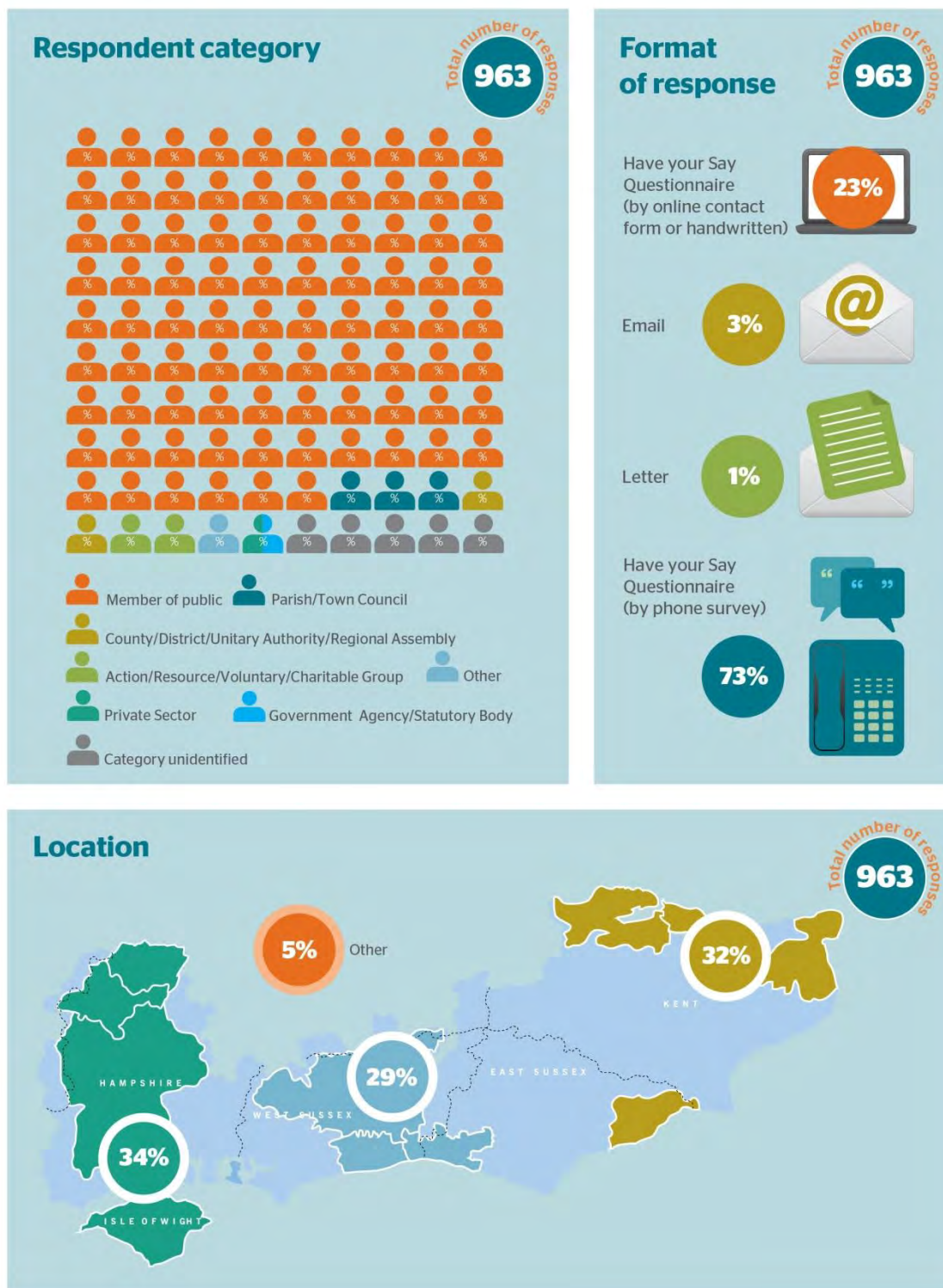
- 4.61. Further discussions were held with neighbouring water companies to agree and ensure consistency between the WRMPs of Southern Water, South East Water, Portsmouth Water and Affinity Water, in terms of assumptions around bulk supplies and joint sources. Southern Water continued its active participation in WRSE.

Regulators

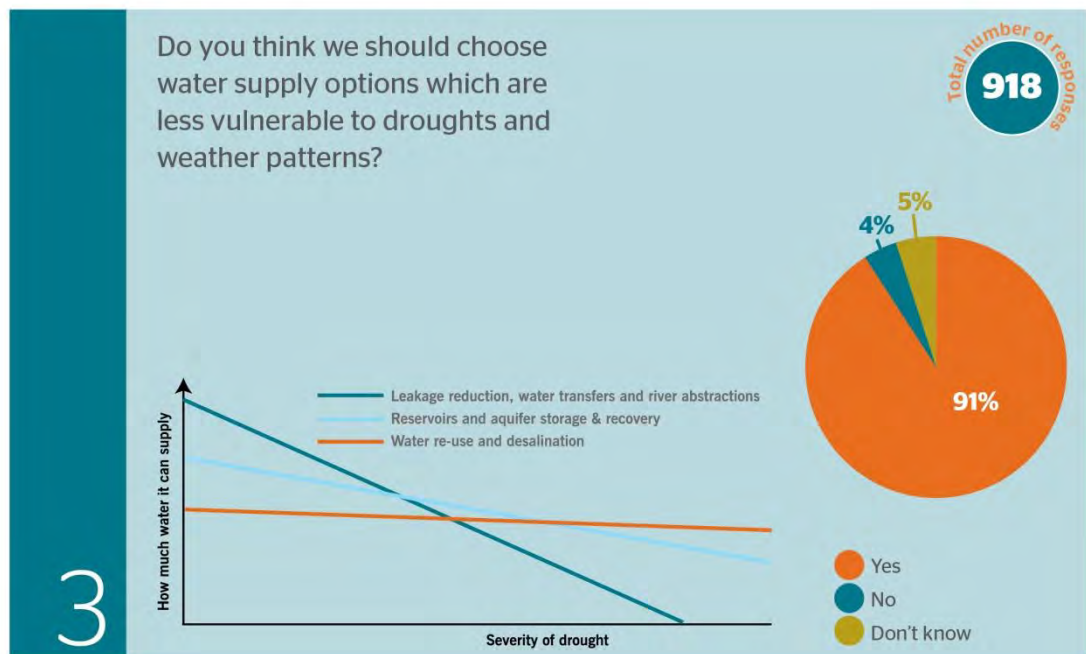
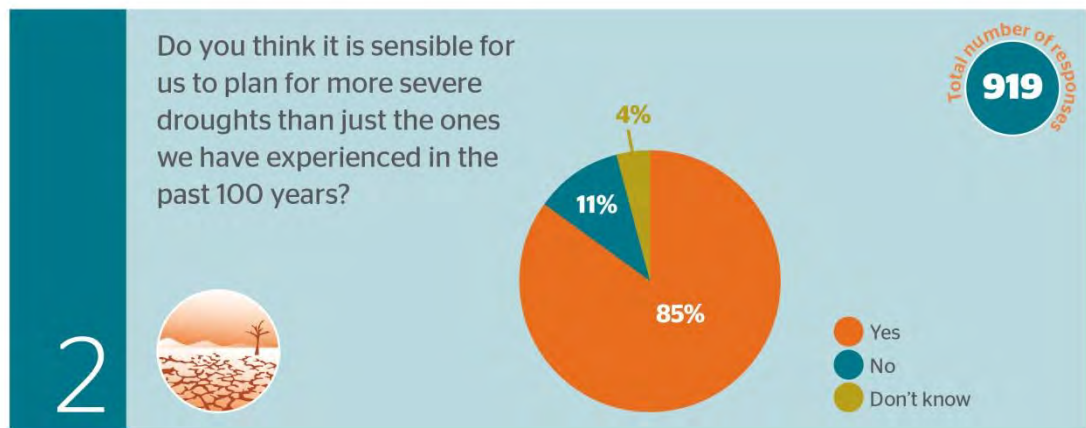
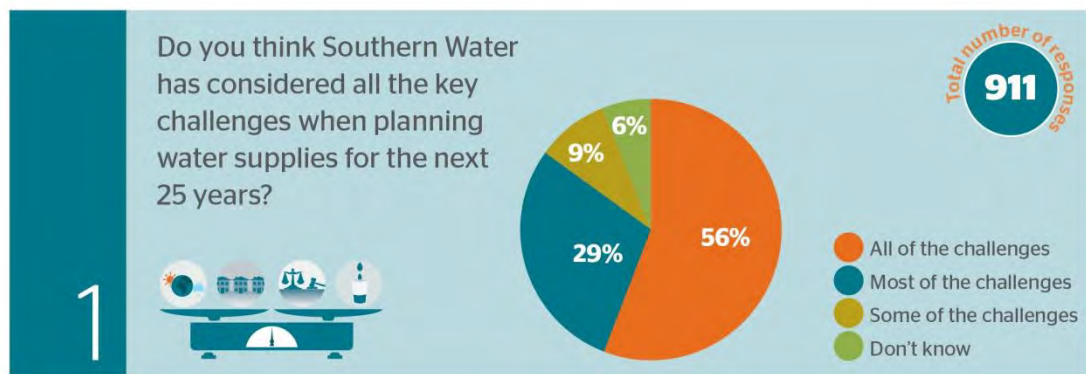
- 4.62. Following the pre-draft consultation, regular meetings continued with the Environment Agency, Natural England and Ofwat to report on the status of developments with the Draft WRMP, explain the approaches and report the results.

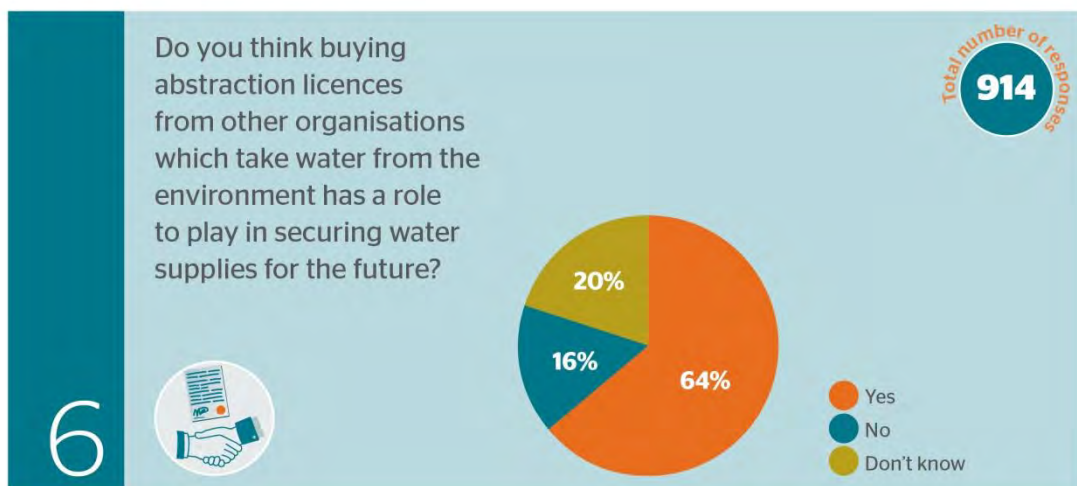
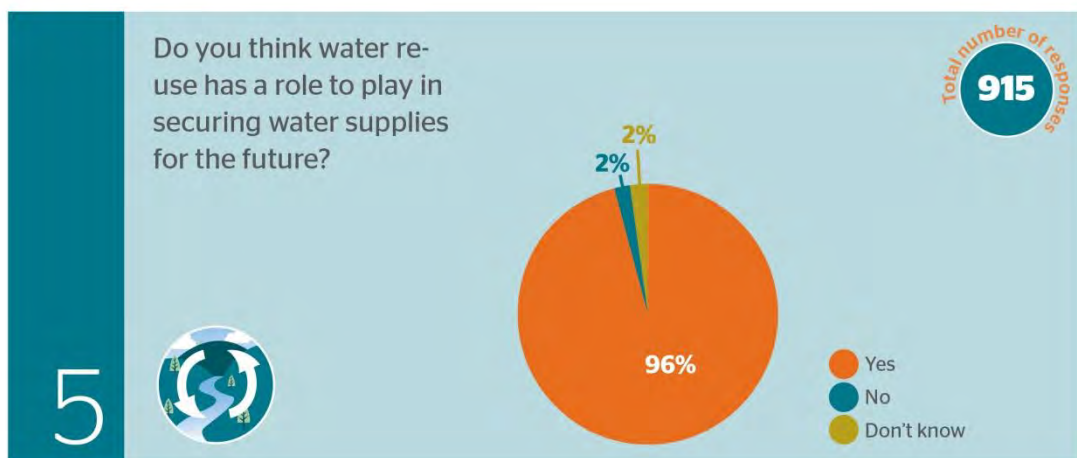
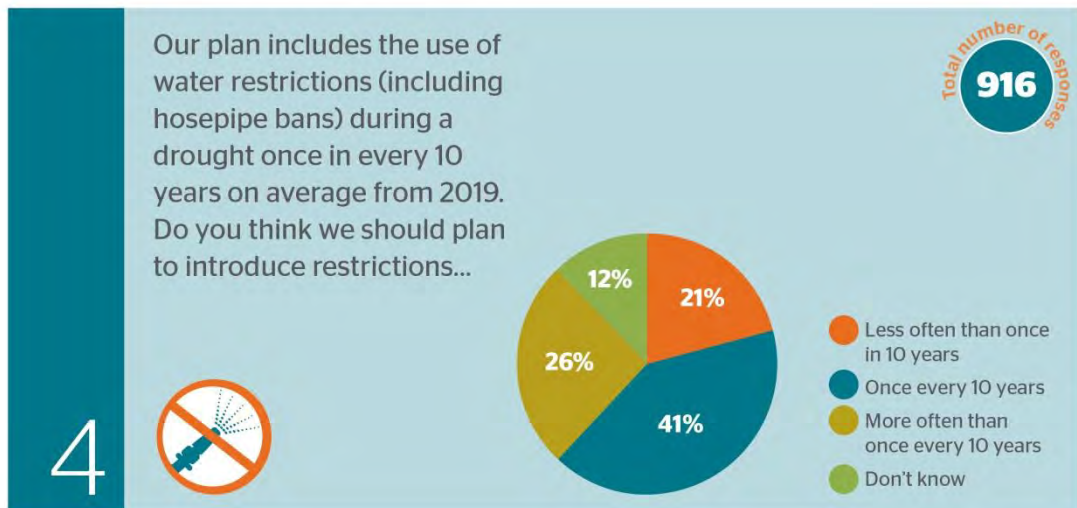
Key Findings from the Public Consultation

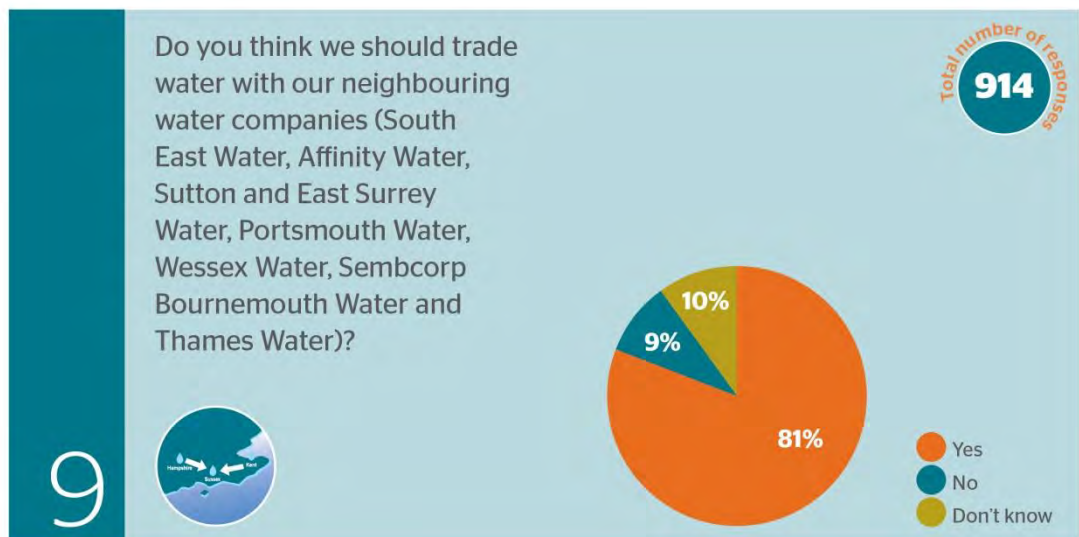
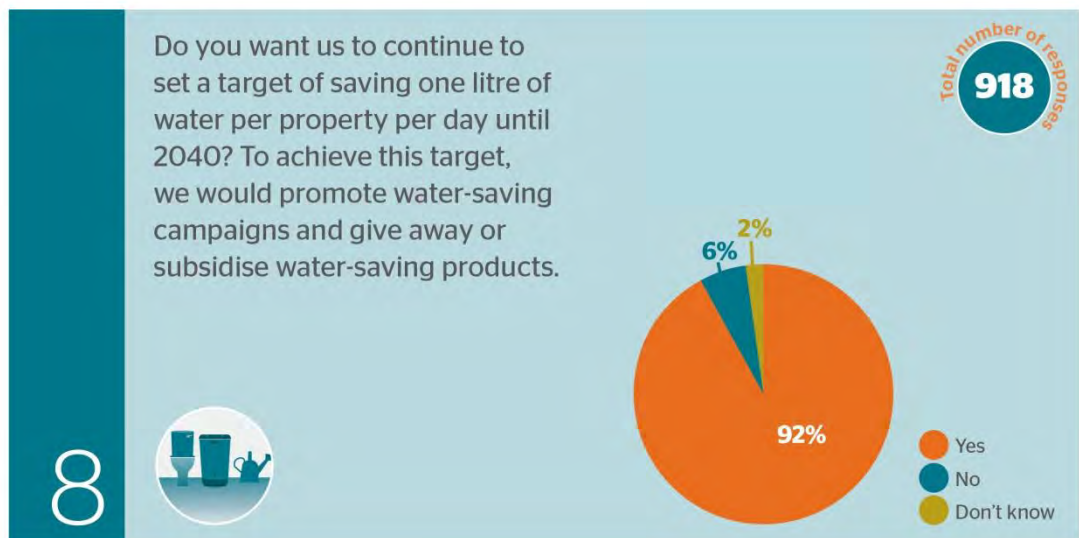
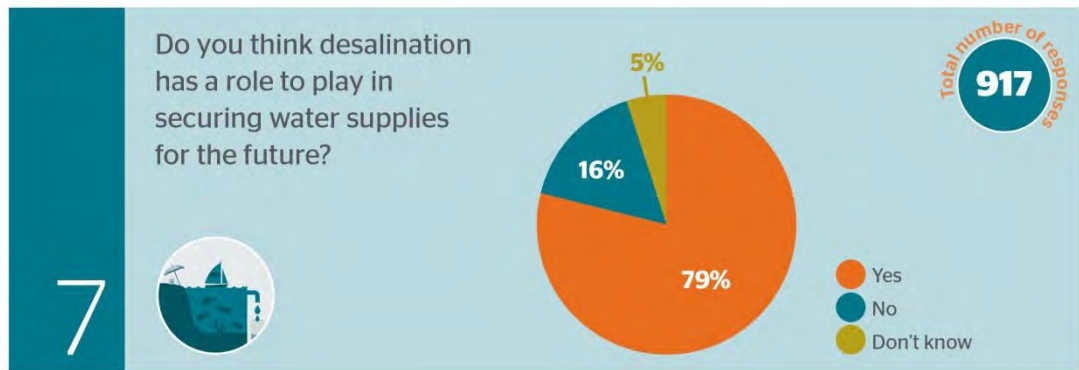
- 4.63. During the consultation 962 responses were recorded by Defra, with 771 of these via commissioned qualitative and quantitative customer research.



4.64. The majority of respondents submitted feedback using the online and paper questionnaire, with additional comments. The percentage of responses for these questions is recorded below:

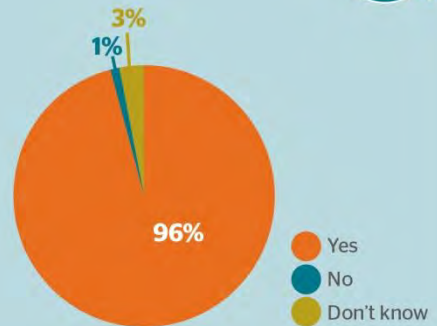






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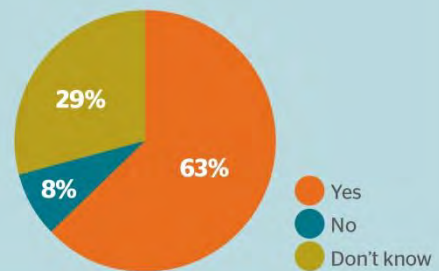
Do you support schemes to work in partnership with landowners, farmers and river trusts to improve the quality and flow of water in rivers and help keep them available for water supplies for longer?



11

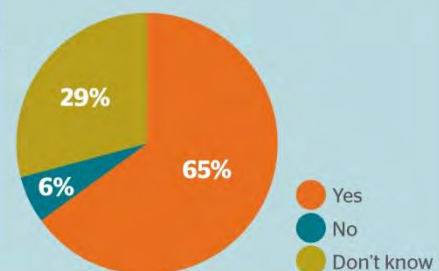


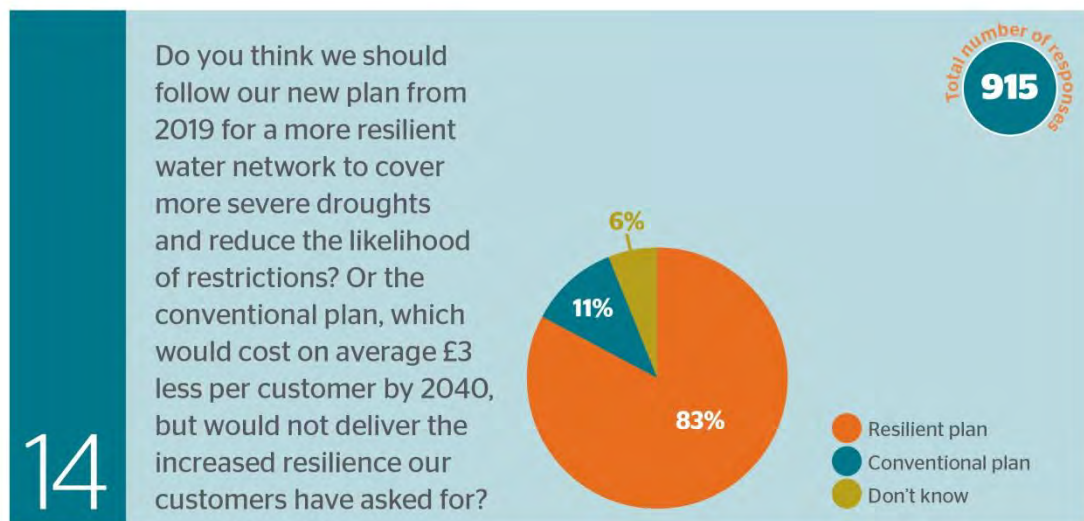
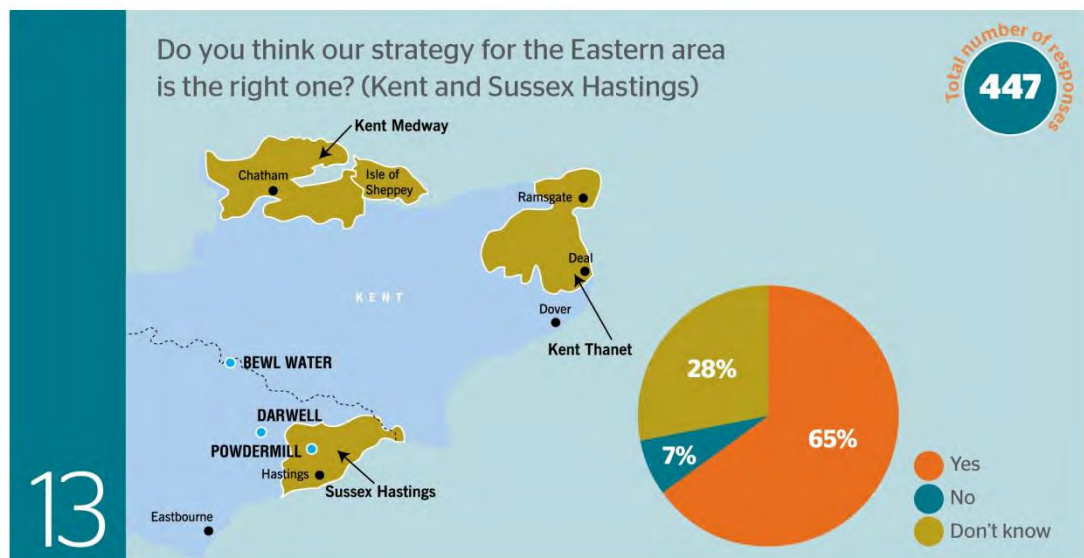
Do you think our strategy for the Western area is the right one? (Hampshire and Isle of Wight)



12

Do you think our strategy for the Central area is the right one? (Sussex North, Worthing and Brighton)





- 4.65. Following the publication of the Statement of Response on 18 November 2013, copies of the summary and full Statement of Response documents were published on the company's website, hard copies of the summary were posted to everyone who submitted comments during the consultation and stakeholder workshops, and a letter with a link to the summary document on the website was posted or emailed to all the customers who took part in the qualitative and quantitative research. A news release was also issued to the regional media and the publication of the Statement and Response and revisions to the Draft WRMP were promoted through social media.

5. Water available for supply

Section summary

This Section provides the technical detail for the derivation of all aspects of the supply forecasts.

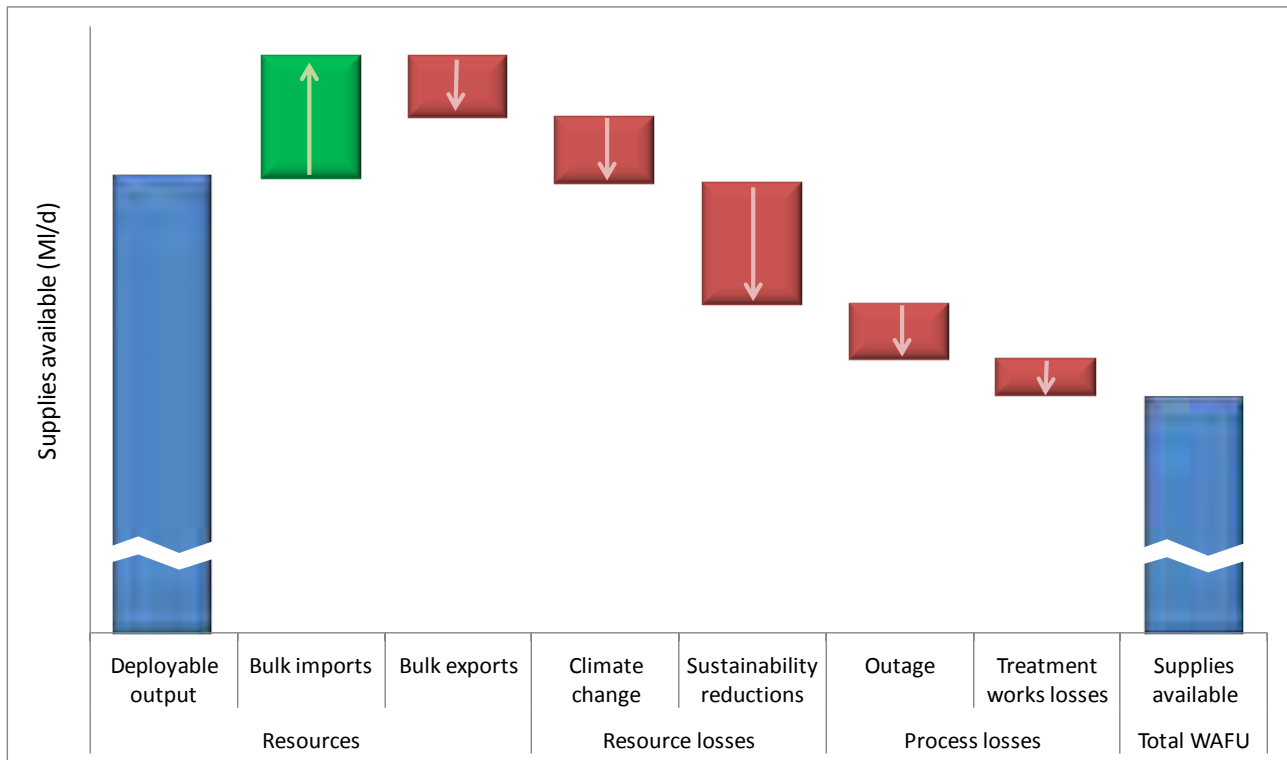
Aspect of the WRMP addressed in this section of the Technical Report	Reference
Quantification of the effects of the company's Levels of Service on deployable output (DO) through different Levels of Service scenarios.	Para.5.29-5.47
Presentation of the planned Levels of Service that the company intends to offer its customers based on customers' preferences, environmental impacts and cost implications	Para. 5.5-5.47
Presentation of the actual Levels of Service experienced by customers and justification of significant differences between actual and planned Levels of Service for baseline and final planning scenarios	Para.5.29-5.47
Discussion of potential changes of Levels of Service to help meet supply demand balance deficits	Para.5.29-5.47
Discussion of the link to the Drought Plan Levels of Service	Para. 5.22-5.42
Summary of the DO for each WRZ , including a description of the water resource modelling to estimate the "system" DO.	Para.5.20-5.21, Table 5.1 and Table 5.2
Presentation of the changes in DO since the previous WRMP was published in 2009.	Table 5.1 & Table 5.2, Figure 5.3- Figure 5.5
Discussion of the data sources used, including simulated data, and the length of data record used for the assessment of DO.	Para.5.9, 5.22-5.28
Provision of a full description of the methodology and assumptions the company has used to derive DO and comment on areas of significant uncertainty.	Para.5.5-5.43 (Appendix C)
Identification and comments on DO constraints, particularly non-hydrological constraints and potential options to investigate and remove these constraints.	Para.5.9-5.19, 5.81-5.89
Inclusion of confirmed and likely sustainability reductions in the baseline supply demand balance.	Para.5.57-5.80
For each sustainability reduction, presentation of licence changes assumed, impact on DO, assumed dates effective for both baseline and scenario testing, rationale and potential benefit.	Para.5.57-5.80, Table 5.3
Identification of further investigations required to increase certainty around future sustainability reductions.	(Table 10.7)
Identification of other potential reductions in DO , such as operational decline or loss of source due to long term pollution / water quality issues, and explanation of the need for reductions (with supporting information for clarity).	Para. 5.81-5.89
Provision of a basic assessment of the vulnerability of the company's supply system to climate change .	Para.5.90-5.91 (Appendix D)
Provision of details of how the climate change impacts in each WRZ have been assessed , and provide justification for the approach used. Detailing assumptions made and identify climate / flow / groundwater factors used.	Para.5.92-5.98 (Appendix D)
Provision of the confidence levels associated with these calculations.	Para.5.95

Presentation of the impacts of climate change on the supply demand balance , but ensure that these impacts are reported separately from the DO line	Table 5.5-Table 5.7	
Presentation of the outage allowances used, as assessed for each planning scenario and reflecting any significant changes to a supply system through the planning period.	Table 5.8	
Description and presentation of current outage data sources and data collection systems, including for perceived outage risks. Identification of measures to improve data collection.	Para.5.101-5.107	
Description and justification of outage analysis method used, with explanation in relation to the likelihood of events recurring, given the magnitude, duration and timing of actual outages; and provision of a clear audit trail for clarity.	Para.5.101-5.107	
Explanation of differences between outage allowances compared to previous estimates used in earlier WRMPs.	Para.5.101-5.107	
Provision of details of existing transfers between WRZs and with neighbouring parties . This includes details of the maximum capacity of each transfer and describes potential limiting factors. Consideration of whether a transfer could be reversed.	Para.5.108-5.114, Table 5.9 & Table 5.10, Figure 5.8 (Appendix E01)	
Explanation of the way transfers are managed under a dry year scenario.	Para.5.110-5.114 (Appendix E01)	
Explanation of assumptions about reliability of transfers, including for inter-company transfers the details of agreements between the companies. Comment on consistency of assumptions between neighbouring companies.	Para.5.110-5.114 (Appendix E01)	
Description of treatment works losses within each WRZ with description of how these are calculated, demonstrating consistency in approach across all WRZs.	Para.5.115-5.116, Table 5.11 (Appendix E02)	
Statutory requirements addressed in this section		
The following table summarises the statutory requirements (legislation, regulations and directions) applied to the water resource planning process, and provides a cross reference to the relevant part of this section of the WRMP.		
Legislation ref.	Description of matter to be addressed	Reference
Dir 2012 S3(a)	How frequently it expects it may need to impose prohibitions or restrictions on its customers in relation to the use of water under S76 of the WIA 1991 and S74(2)(b) and S75 of the WRA 1991	5.29-5.42 (& Para.3.69-3.76)
Dir 2012 S3(d)	How the supply and demand forecasts contained in this WRMP have taken into account the implications of climate change	Para. 5.90-5.100 (& 6.63-6.65, Appendix D & F)

Elements of the supply forecast

- 5.1. In order to plan effectively to ensure security of supplies, it is important to know what supplies will be available under the design conditions of the planning scenario. Southern Water has developed and refined its understanding of what supplies would be available in a variety of design events through the development of a number of advanced mathematical models. Previously, the assessment was based on droughts that had been observed in the historic record. The problem with this approach is that it is limited by the drought events that have actually been observed; it takes no account of different types of drought that could occur in future, or could have occurred in the past.
- 5.2. Southern Water has sought to develop a new approach based on statistics, to provide a simulated set of 2000 years of weather data (comprising 17 sequences each lasting 120 years), which therefore incorporates a very wide variety of potential drought events. This is discussed in detail in the paras 5.22 to 5.28.
- 5.3. The total supplies available are made up of a number of elements, as shown in Figure 5.1 below. The supply forecast thus refers to the estimation of the total supplies available to meet demands in the WRZ for each planning scenario, and for each year throughout the planning period.

Figure 5.1 How elements of the supply forecast derive the total supplies available for the WRZ

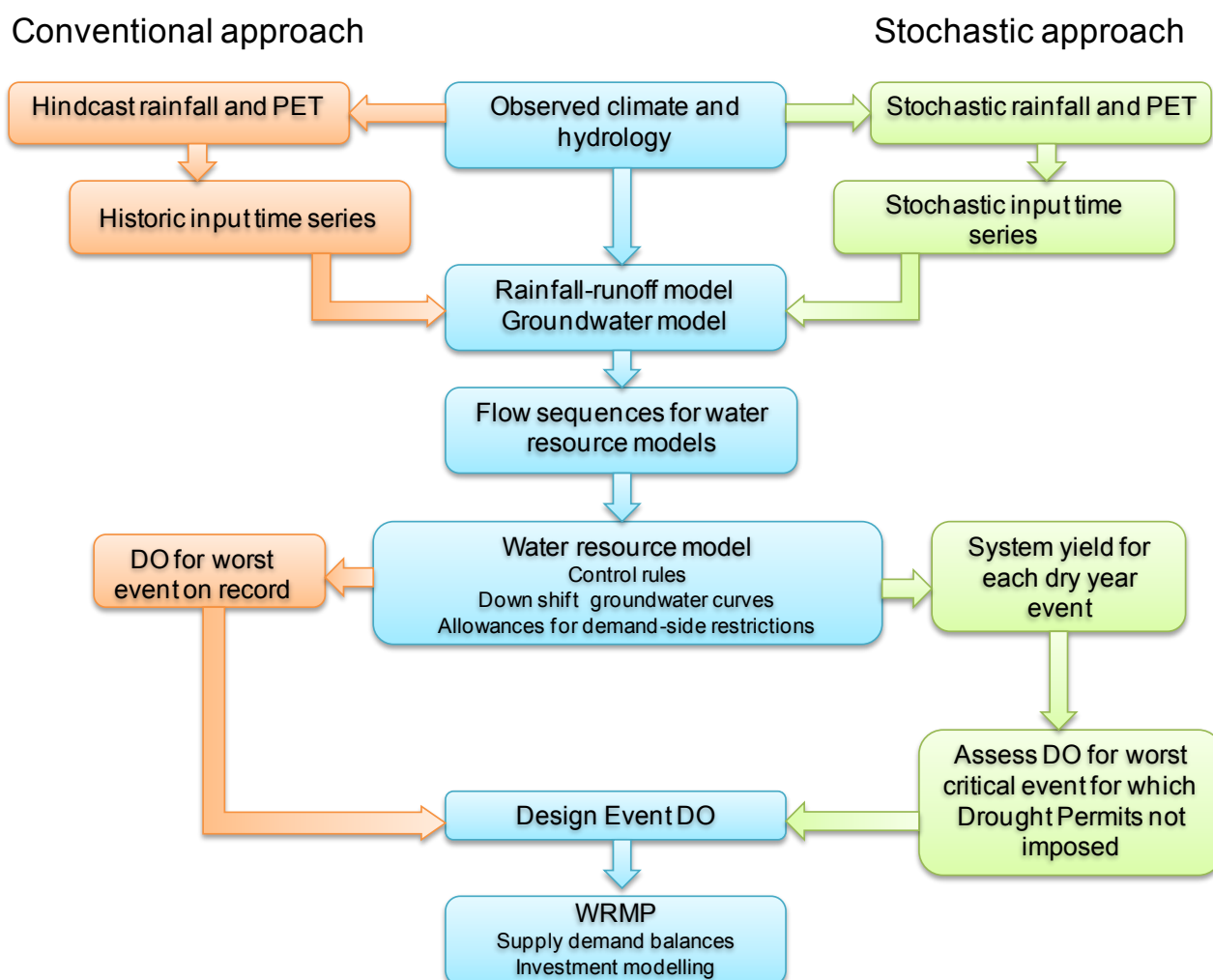


- 5.4. Each of these components is explained in turn in this section of the WRMP Technical Report. The overall supply forecast is presented in Annex 1, at the end of this Technical Report, for each WRZ, under each planning scenario, and as part of the overall baseline supply demand balance.

Deployable output

- 5.5. Deployable output (DO) is the volume of water that can be pumped into supply from the sources available (boreholes, river intakes and reservoirs) on a daily basis under different planning scenarios.
- 5.6. As described previously in para.3.55-3.68, Southern Water has developed a new “stochastic approach” to water resource modelling. One of the main reasons why this new approach was developed and adopted, and why a framework for the realistic interpretation of Level of Service (LoS) DOs was developed by Southern Water, was to address the current risks and high frequency of drought interventions that are having to be applied in the Central and Eastern Areas. The previous planning approach, whereby the worst historic drought sequence was taken as a simple design scenario, was not considered to be adequate, and experience from the recent 2012 drought suggests that it has not fully addressed the resilience issues within the system. The approach adopted for use in this WRMP therefore used stochastically generated drought sequences to understand how the design scenarios and drought intervention measures that are included within the WRMP link through to drought operations, and hence ensure that drought intervention measures are not applied more frequently than the stated LoS.
- 5.7. As illustrated below, the stochastic approach uses the same models as the conventional approach. The differences are in the data inputs to the rainfall-runoff and groundwater models from which the input timeseries for the water resource model are derived, and in the selection of the design condition for supply demand balances and investment modelling. This is discussed in more detail below and in Appendix C.

Figure 5.2 Steps in DO calculation under both the conventional and stochastic approaches



- 5.8. This sub-section describes the approach taken to deriving the DO's used in this WRMP. Southern Water has made significant improvements to its DO assessment since the previous WRMP was published in 2009 (referred to as "WRMP09"), but has carried these out in a step-by-step, transparent manner that ensures compatibility with previous WRMPs. Four key areas of change were adopted, which can be summarised as follows, and are described in the following sections:
- A review of all DOs based on the historic rainfall and potential evapotranspiration (PET) sequences that were developed for WRMP09. This included checks and updates on source constraints (particularly for DYCP), updates to groundwater source DO diagrams, checks on hydrological modelling of river flows, and the translation and updating of the WRMP09 conjunctive use water resource models from the Miser modelling platform to the Aquator platform, with associated improvements in the representation of operational practice in each WRZ;
 - Development of a new approach to water resource modelling that uses stochastic (i.e. statistically based) modelling of meteorological conditions to produce long time series of river flows and groundwater levels. This generated many more potential droughts than are available through the historic record, which provided a much greater understanding of drought variability and vulnerability within all WRZs;
 - Use of the stochastic sequences to calculate a 'preferred resilience' level of DO based on drought design return periods that are explicitly linked to the company's stated Levels of Service; and
 - Inclusion of WRZ level constraints and operational issues that result from drought vulnerability and risk, but that have not been adequately expressed before because the lack of significant drought events in the historic record meant that drought vulnerability could not be fully explored.
- 5.9. It should be noted that, other than the new constraints and the impacts from the review processes detailed below, all other assumptions, models and sensitivities remain the same as those detailed and signed off for the previous WRMP that was published in 2009.

Links to Stated Customer Preferences

- 5.10. The new approach that has been adopted for this WRMP has been designed to link specifically to customer preferences. The key stated preference by customers is that the water supply system should be 'resilient'. This has been reflected within the DO assessments by creating the 'preferred resilience' DOs, which are designed to ensure that there is no unacceptable risk that the supply system might fail to balance supply and demand given the drought intervention measures and Levels of Service (LoS) that are available in each of the Supply Areas.
- 5.11. Previous WRMPs were based on an untested assumption that meeting the worst historic drought with Temporary Use Bans (TUBs) in place would provide system resilience. The new method of evaluation used to develop the preferred resilience scenario within this WRMP quantifies the potential future risks that develop during ongoing drought situations, and examines how these are affected by the drought management options and stated Levels of Service that are available. Therefore, as well as providing a methodology that is designed to meet the LoS commitments for more frequent interventions (TUBs, Drought Permits), the new approach is also designed to ensure that extreme measures such as standpipes or rota cuts are not implemented as a result of perceptions of risk during ongoing drought situations. This is a key part of the expressed customer preference for a resilient system, and can only be achieved if the method links WRMP assumptions for DO to the drought management measures that are used to manage drought conditions.

Review and re-modelling of historically based DOs (conventional approach)

- 5.12. For the 'baseline' (conventional modelling approach) DO assessments, there were three areas of review and improvement that were carried out for this Draft WRMP:
- Review of groundwater DO constraints;
 - Review of surface water flow and treatment constraints; and

- Supply system re-modelling based on the Aquator water resources software platform, and associated re-evaluation of the conjunctive DO for each WRZ (including abstraction licence changes in the River Medway System).

5.13. The numerical impacts of all these changes are detailed in Appendix C, and are summarised below. All values are quoted to the nearest 0.5 MI/d.

Review of groundwater DO constraints

- 5.14. For groundwater sources, the AMP5 Source Investigation and Optimisation Strategy (SIOS) assessment has resulted in further improvements to source DOs that have been accounted for in this WRMP assessment. At the same time, operational experience with recent changes in monitoring, treatment or infrastructure has revealed new constraints or source improvements that also needed to be accounted for in the DO assessments.
- 5.15. All groundwater sources were therefore reviewed to determine the level of change that has occurred in the asset base since WRMP09 (either due to physical works, or better information). This resulted in general increases in DO for the Hampshire South, Kent Medway and Sussex Brighton WRZs. A series of treatment and operational issues lowered MDO and PDO in Sussex Worthing WRZ, and the loss of the Haslingbourne source resulted in a minor adjustment for Sussex North WRZ. There was also a minor downward adjustment for the Isle of Wight WRZ. For Kent Thanet WRZ, there was no change to the MDO/PDO assessment for each source, but a re-calculation of the resulting ADO resulted in a minor (0.7 MI/d) downward adjustment.
- 5.16. Overall, this element of re-assessment resulted in an increase of 3.0 MI/d MDO and 1.5 MI/d PDO for the Western Area, a minor change in MDO and a reduction of 4.5 MI/d PDO in the Central Area, and an increase of 6.5 MI/d ADO and 6.0 MI/d PDO for the Eastern Area.

Review of surface water flows and constraints

- 5.17. Some adjustments were made to flow and de-naturalisation approaches in three of the main river systems (Itchen, Western Rother and Medway), but only to ensure stability across a range of drought conditions, and none of these had a significant impact on DO. It should be noted that the construction of the River Arun scheme resulted in an increase of 10 MI/d at MDO and 15 MI/d at PDO for the Sussex North WRZ (Central Area).
- 5.18. For the Western Area, the main impacts on surface water flows related to the sustainability reduction and associated imposition of the Minimum Residual Flow condition on certain sources in the Hampshire South WRZ, as detailed under the sustainability reductions sub-section below (paras.5.57 to 5.79). For the Isle of Wight WRZ, a review of the treatment constraint at a WSW showed that cold weather capability was worse than had been previously assumed, and was limited to 8 MI/d. This resulted in an overall reduction of 2 MI/d to MDO on the Isle of Wight.
- 5.19. For the Eastern Area, the PDO condition was revised to be equal to the treatment constraints that exist for each of the three reservoirs (Bewl, Darwell and Powdermill). Previously, the PDO for these three sources had been quoted as being equal to the Miser (water resource model) modelled outputs during the design drought event (1901-03). However, the PDO is only based on a peak week capability, and there is no reason why reservoir outputs could not be increased to the treatment capacity for that short period of time without significantly compromising the ADO of the reservoirs. The only infrastructure constraints that might affect this output relate to the constraints that exist between WRZs, which are better modelled through the investment model for short duration events such as the PDO condition. The only adjustment to ADO was for a WSW in East Kent, which was reduced by 1 MI/d to be in line with the PDO and MDO assessment for that source. This re-assessment resulted in a significant increase in PDO of 23 MI/d across the Eastern Area, and a minor decrease of 1 MI/d at ADO.

Water resource re-modelling (including River Medway Scheme licence changes)

- 5.20. The water resource models that were adopted for this Draft WRMP were optimised for the conjunctive use of all sources in each model area, with the same functionality as the Miser models that were used for WRMP09. These were applied to all WRZs where there was some form of surface water storage, which included the Isle of Wight (due to the augmentation of the River Eastern Yar), Sussex North, Kent Medway and Sussex Hastings WRZs. The impact of Temporary Use Bans (TUBs) on DO was specifically included within these models based on the

trigger curves detailed within the Southern Water Drought Plan (updated for Bewl). Aquator models were constructed for the other WRZs to confirm whether there were any significant infrastructure or operational constraints.

- 5.21. The change to the modelling resulted in only very minor differences in most WRZs (less than 0.5 MI/d). For the Eastern Area, the River Medway Scheme and associated refill curves were re-modelled to better reflect where abstraction is taken (which affects DO because of the requirement to release 20% more from Bewl than is abstracted), more accurately model the release delays contained within the licence, and reflect operational practice prior to drought events (as described within the LoS and DO Technical Notes in Appendix C). This reduced the DO of the combined Bewl-Darwell-Powdermill system, but was offset by the changes in licence operations that were agreed with the Environment Agency in 2012. The overall impact was therefore less than 0.5 MI/d. Overall the changes in other Supply Areas due to the re-modelling were also less than 0.5 MI/d.

Stochastically based water resource assessments

- 5.22. The overall objective of the stochastically based water resource modelling was to provide an understanding of how DO varies according to risk and return periods within Southern Water's supply system. There are very few severe droughts within the historic sequence, and so the approach is instead based on a technique that considers what droughts could occur. This analysis allows the company to determine the resilience of its sources in the each of the WRZs.
- 5.23. The approach has been developed by Southern Water for AMP5, and it uses risk-based techniques to improve resilience, which are used in other industries already. It is likely that other companies will adopt similar stochastically-generated approaches to assessing their deployable outputs for the next set of WRMPs in AMP6, in light of recent best practice guidance for the water industry (UKWIR WR27).
- 5.24. The risk to the water supply network, particularly when the resources are modelled conjunctively, has a multi-dimensional relationship with climate, which depends on the severity, timing and duration of drought periods. Very long historic time series would therefore be required before the relationship between resources and drought could be fully established, and the methods that are available for extrapolating from limited historic time series can introduce significant errors in assessing the variability of DO against drought severity. They also do not provide an understanding of the variability in the system in response to differing drought characteristics (e.g. timing and duration) because there are only a limited number of severe droughts in the historic sequence.
- 5.25. Finally, it should be noted that back-casting methods that seek to extend the historic time series (generally beyond the reliable data range that starts in the 1930s) are subject to assumptions and errors that can also significantly affect DO assessments.
- 5.26. Stochastic rainfall generation was therefore used to provide multiple generations of the weather patterns that might have occurred over the historic period given the patterns in the large scale climatic drivers (the North Atlantic Oscillation and sea surface temperatures) that occurred during that period. This was carefully designed and calibrated to ensure that each generation very closely matched the weather statistics that occurred within the historic pattern, but it allowed different patterns of weather and hence drought to be generated (i.e. it allowed a 'what if' analysis of historic weather patterns). These multiple (17) runs of the historic sequence were combined to create a 2000 year very long time series (VLTS) of potential weather patterns that could occur given the current climate in each WRZ. **The methodology that was used and the calibration that was achieved is fully described within Appendix C –Water Resources Modelling. This shows that the VLTS calibrates very well against the historic record for rainfall, river flows, groundwater levels and Deployable Output (DO). The calibration against DO is particularly important as it shows that the VLTS generated droughts were statistically consistent with the historic record, in terms of duration, magnitude and severity across multiple years.**
- 5.27. The multiple severe drought events that are generated in the stochastic sequences provide a much greater understanding of variability in drought patterns and duration, as there is no longer a need to rely on the limited number of severe droughts that occur within the recent historic sequence. This is very important when links to Levels of Service are being considered, as these depend on drought patterns, timing and the operational conditions that are encountered during

the period when droughts are developing. It also means that historically based and stochastically based time series can be combined to provide a wide range of drought types and severities when the impacts of new sources or climate change are being assessed.

- 5.28. To ensure that the process used for the stochastic generation of droughts was transparent and suitable for planning purposes, three over-riding principles were used in the modelling:
- The rainfall generation was subject to rigorous academic analysis, and the most simple, but adequate and supportable monthly-based models were used to prevent over-complication and lack of clarity in the statistical relationships;
 - The rainfall models were translated into water resource predictions using existing, accepted groundwater, surface water and water resource models that were developed for AMP4; and
 - At all stages the modelling was calibrated against the historic data set, as described above. This demonstrates the robustness of the stochastic models, and lends confidence to the Level of Service assessment described below.

Derivation of Level of Service compatible DOs from the stochastically generated data

- 5.29. Southern Water has recent experience of what drought management and Levels of Service actually mean during drought conditions on stressed water supply systems. Despite adopting back-casting methods and planning for worst historic droughts, problems over the frequency of the introduction of Temporary Use Bans (TUBs) and Drought Permits and Orders remain, and the 2011/12 drought continued to demonstrate the potential vulnerability of the supply system. Southern Water considers that the current supply system within the Central and Eastern Areas cannot therefore be considered to be 'resilient' and hence does not provide a service that is in line with customer preferences. Such considerations will also apply to Western Area once the Itchen Sustainability Reductions are implemented.
- 5.30. One of the key lessons learned from the 2011/12 drought was that droughts can break at any time, even in the summer, and from a water resource planning perspective the severity of a drought is largely irrelevant until it actually impacts on water resources (normally during the summer or autumn/early winter periods). Thus, although the 2011/12 drought was developing into the worst drought in recent memory, its timing and the fact that it broke so early in the year (April) means that it would hardly feature in any future assessment of historic water resources droughts. Nonetheless, because of the potential severity of the drought, in March 2012 (i.e. before the drought broke) the company, along with all other companies in the South East, began to implement a range of drought intervention measures (TUBs and Drought Permits/Orders) to protect the environment and water supplies.
- 5.31. The experience of the 2011/12 drought was that none of the interventions such as TUBs and Drought Permits/Orders that were implemented in early 2012 were actually required. The problem is that **no one actually knew this until after the drought had broken** (i.e. with the benefit of hindsight). The company had therefore implemented a range of planned interventions that directly impact on its Levels of Service for an event that, if simply viewed as part of a historic time series, would not suggest that any such interventions were warranted. **It is the risks and unknowns that are faced during the operational management of droughts, which result from relying on the worst historic drought as a planning scenario, that are causing the current difficulties with achieving stated Levels of Service within the Central and Eastern Areas.**
- 5.32. The key point to note from this is that Levels of Service do not equate to the frequency of severe droughts that actually occur (i.e. the drought return period). The implication of this is that if applications for Drought Permits (for example) are to occur no more than once every twenty years, the return periods of the droughts for which the company will need to have sufficient resources to meet demand without applying for a Drought Permit will need to be considerably more extreme than this.
- 5.33. The key to deriving a Level of Service DO for a WRZ is therefore to carry out an analysis that shows what drought return periods need to be planned for to ensure that the relevant interventions are not triggered more frequently than the Level of Service commitments (which are detailed in Table 3.2). **This has not been properly attempted before because there are**

too few droughts within the historic sequence to provide sufficient understanding of the interaction between Level of Service trigger frequency and drought risk. The availability of the stochastic VLTS means that Southern Water has now been able to explore this relationship and provide much better linkages between the LoS within this WRMP, and the drought interventions contained within the Drought Plan.

- 5.34. In order to achieve this, Southern Water developed a framework assessment approach that allowed a direct link to be made between Level of Service interventions, resource management as described within its Drought Plan, and the drought return periods that had to be used for the purposes of DO assessment in order to meet the Level of Service. This framework is fully described in Appendix C.
- 5.35. It should be noted that the approach that was used in developing a Level of Service DO was conservative (that is, it ensures no more investment than is necessary while ensuring security of supplies and improved system resilience). Critically it contains specific uplifts to DO to account for the impact of TUBs on WRZs where there is no surface water storage (i.e. for exclusively run-of-river and groundwater fed WRZs). The 'conventional' methods described within the EA (1997) and UKWIR (2002) assessment documents do not account for this, and only include for TUBs impacts on surface water storage systems. The approach to 'behavioural' analysis and the inclusion of demand side restrictions within the DO allowances is fully described in Appendix C of this report.
- 5.36. In the Central and Eastern Supply Areas it was found that, in order to only have to implement TUBs once every 10 years and Drought Permits and Orders once every 20 years, which represent the company's target Levels of Service, it is necessary to plan for a system that would be able to supply something like a 1 in 200 year drought event with just TUBs in place (i.e. without having to rely on Drought Permits or Orders). This compares to the conventional 'worst historic drought' planning condition, as presented in the previous WRMP published in 2009, which assumed that droughts with a return period of between 1 in 75 years and 1 in 150 years should be met with just TUBs in place (for WRZs with surface water storage). For the Western Supply Area, and assuming implementation of the Itchen Sustainability Reductions, the high baseflow of the River Itchen means that drought development is more predictable, and hence a lower return period drought can be planned for whilst maintaining system resilience. This critical drought type that was identified for the Western Area therefore equated to something like a 1 in 125 year drought event, which needs to be met with just TUBs in place. This is very similar to the worst historic drought for MDO conditions, but slightly more severe than the worst historic drought for PDO conditions.
- 5.37. For the Central and Western Areas, the key Level of Service constraint that dictated the severity of the critical drought type was the requirement that Drought Permits or Orders on the Western Rother and the River Itchen respectively should not be implemented more than once every 20 years. For the Central Area (Sussex North WRZ), it was found that a 1 in 20 year flow-based trigger curve could only be relied on to have a Drought Permit or Order in place and be operational in time for the summer/autumn critical stress period for those droughts that end up having a severity that is greater than a 1 in 200 year event. This was based on a requirement to undertake certain activities between the triggering of the need for the Permit and the Permit actually being operationally in place, which experience has shown takes at least 5 months. An explanation of this is given in Appendix C, but it should be noted that this period represents the total length of time from initial indications that Permit interventions might be required, to when the Permit is granted; the actual determination period is much shorter. The nature of drought recessions within the Rother means that there is a real risk that a Permit will not be in place in time for the critical point of a drought that is less severe than a 1 in 200 year event if the trigger level for the Permit application process is set at the LoS interval of once every 20 years. **The reasons for this, and a figure that explains why the design drought needs to have such a high return period, are provided in Appendix C.**
- 5.38. The same analysis applied to the Western Rother was used for the River Itchen, but, as described previously the more predictable nature of flows in the River Itchen means that the planned drought severity does not have to be as high, and has been evaluated at around 1 in 125 years.
- 5.39. For the Eastern Area, the decision over drought severity was dominated by the risks and vulnerabilities of the complex reservoir system. It was found that the benefits of Drought Permits on the River Medway Scheme became highly variable once revised triggers had been

developed that ensured LoS (1 in 20 years, only after two dry winters) would be met. Whilst there is a tendency for the Permit at Bewl to become more beneficial as drought duration increases, it is not necessarily the case that all severe droughts are of a long duration (many result from just two very dry winters). This variability means that a pragmatic view had to be adopted, whereby the critical drought type was taken to represent the average resource conditions that could reasonably occur during severe droughts, but the severity of the droughts that were allowed for was capped at a lower reasonable lower limit based on the resilience that is offered by the Drought Permit. .

5.40. Design scenarios for the other WRZs in each Supply Area were evaluated to complement these key defining criteria, and care was taken to ensure that the conjunctive risk of drought occurrence across all resources was taken into account when the return periods and associated DOs were being calculated.

5.41. A summary of the impact that the change from the historically based conventional assessment to the 'preferred resilience scenario' that is compatible with Levels of Service, is provided in Table 5.1 and Table 5.2. These impacts can be summarised as follows:

- Overall, it was found that the conventional historically based DO assessment for the **Central Area** was already reasonably close to its required design Level of Service once the impact of TUBs was specifically included, with an overall difference of only 2.2% on MDO and 0.3% on PDO between the conventional (historic approach) and preferred resilience scenarios. The MDO impact was almost entirely related to a slight lowering of DO within the Sussex North WRZ under the preferred resilience scenario;
- The **Eastern Area** was more sensitive to the ADO condition, with a difference between the conventional historically based and preferred resilience scenario of approximately 4%. This was almost all associated with the reservoir system (7.5 MI/d), but it should be noted that only two thirds of this difference (5 MI/d) related to drought severity. The rest was associated with the more realistic modelling of the Bewl-Darwell system outside of drought periods, as described in the next section. PDO impacts were limited to less than 2%, which were all associated with the Kent Thanet WRZ; and
- The **Western Area** demonstrated a similar sensitivity to the Eastern Area, with a difference between the conventional (historic approach) and preferred resilience scenarios of 3.8% on PDO and no significant change on MDO. The PDO impact was caused by reductions in flows above the Minimum Residual Flow (MRF) on the River Itchen once sustainability reductions have been implemented.

5.42. In terms of 'alternative' Level of Service scenarios, the conventional historically based assessment provides a good indication of the investment that would be required for a scenario that involved the imposition of TUBs and Drought Permits and Orders in accordance with current system capabilities. This represents a TUBs implementation rate of approximately 1 in 7 years, and a Drought Permit / Order implementation rate of approximately 1 in 10 to 1 in 15 years.

Comparison of the preferred resilience DOs and the conventional historically-based assessment

5.43. Table 5.1 and Table 5.2, and Figure 5.3 to Figure 5.5, below, provide a summary of the DO values developed under the preferred resilience scenario and a comparison to those DO values derived from an historically based assessment (referred to as the 'conventional' approach).

Table 5.1 Comparison of MDO/ADO for each WRZ using historic record (conventional) and preferred resilience (stochastic) approaches

WRZ	DO (worst historic drought approach) (MI/d)	DO (preferred resilience approach) (MI/d)	DO reduction due to stochastic approach (MI/d)
Western Area	MDO	MDO	MDO
Isle of Wight	28.1	28.4	-0.3*
Hampshire South	155.5	155.6	-0.1
Hampshire Andover	22.7	22.7	0.0
Hampshire Kingsclere	8.7	8.7	0.0
Central Area	MDO	MDO	MDO
Sussex Brighton	93.4	92.4	0.9
Sussex Worthing	54.8	54.8	0.0
Sussex North	50.3	46.4	3.9
Eastern Area	ADO	ADO	ADO
Kent Medway	162.4	160.8	1.6
Kent Thanet	59.1	55.9	3.1**
Sussex Hastings	26.0	20.2	5.8
Total for the company	660.8	645.9	15.0

Notes:

- * Some of the Level of Service related resilience scenarios are higher than assessments using the previous conventional historic methodology due to the explicit inclusion of TUBs in groundwater dominated WRZs
- ** Actual difference is less once Kent Thanet system constraints are taken into account – see paragraph 5.83.

Table 5.2 Comparison of PDO for each WRZ using historic record (conventional) and preferred resilience (stochastic) approaches

WRZ	DO (worst historic drought approach) (MI/d)	DO (preferred resilience approach) (MI/d)	DO reduction due to stochastic approach (MI/d)
Western Area			
Isle Of Wight	36.3	36.5	-0.3*
Hampshire South	203.7	195.2	8.5
Hampshire Andover	28.4	28.4	0.0
Hampshire Kingsclere	9.5	9.5	0.0
Central Area			
Sussex Brighton	109.3	111.3	-2.0*
Sussex Worthing	64.5	64.8	-0.3*
Sussex North	78.2	75.0	3.2
Eastern Area			
Kent Medway	206.6	206.6	0.0
Kent Thanet	65.7	61.0	4.7**
Sussex Hastings	51.5	51.5	0.0
Total for the company	853.6	839.8	13.8

Notes:

- * Some of the Level of Service related resilience scenarios are higher than assessments using the previous conventional historic methodology due to the explicit inclusion of TUBs in groundwater dominated WRZs
- ** Actual difference is less once Kent Thanet system constraints are taken into account – see paragraph 5.83.

Figure 5.3 Changes in deployable output from WRMP09 following reassessment for the Western Area

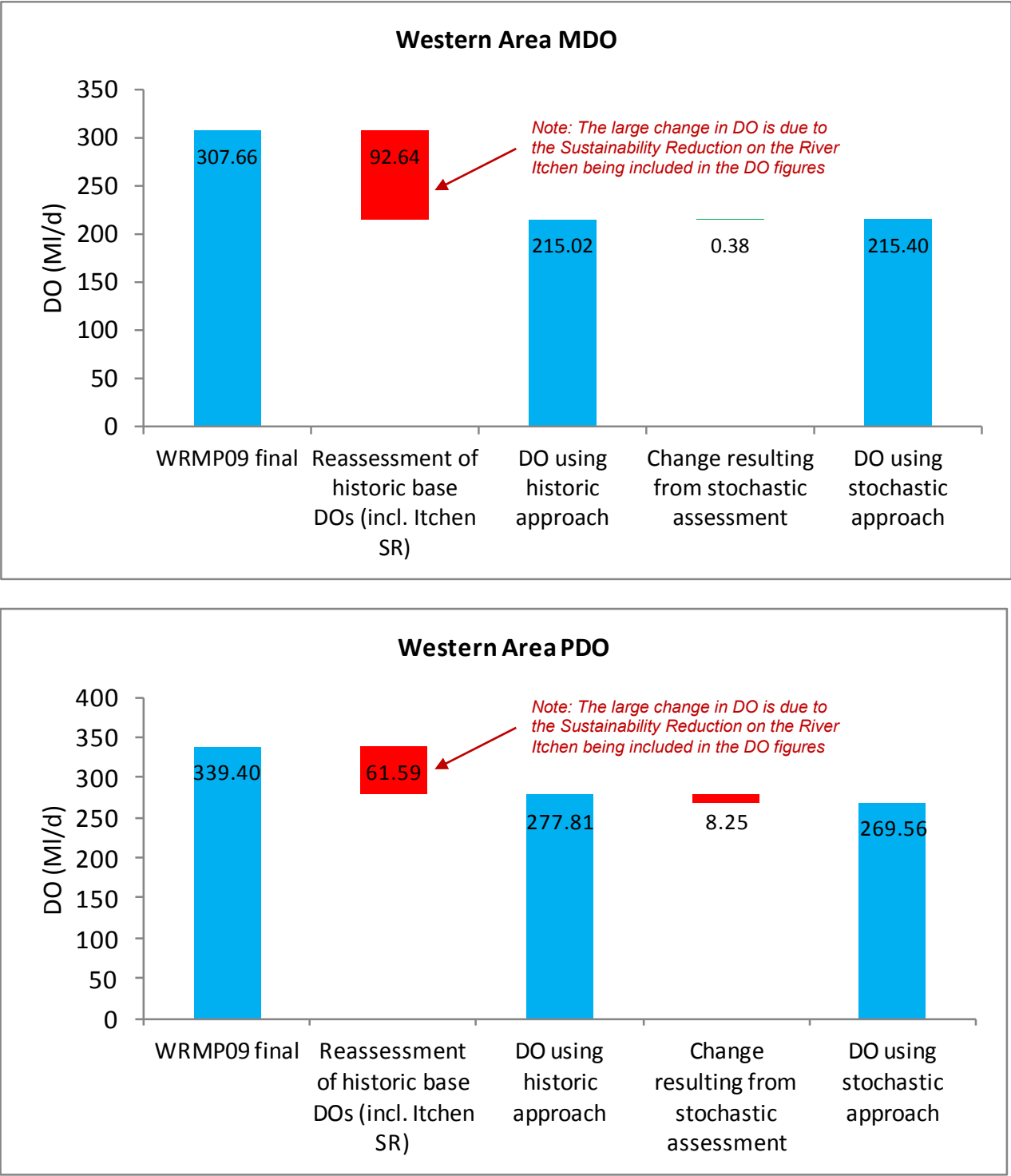


Figure 5.4 Changes in deployable output from WRMP09 following reassessment for the Central Area

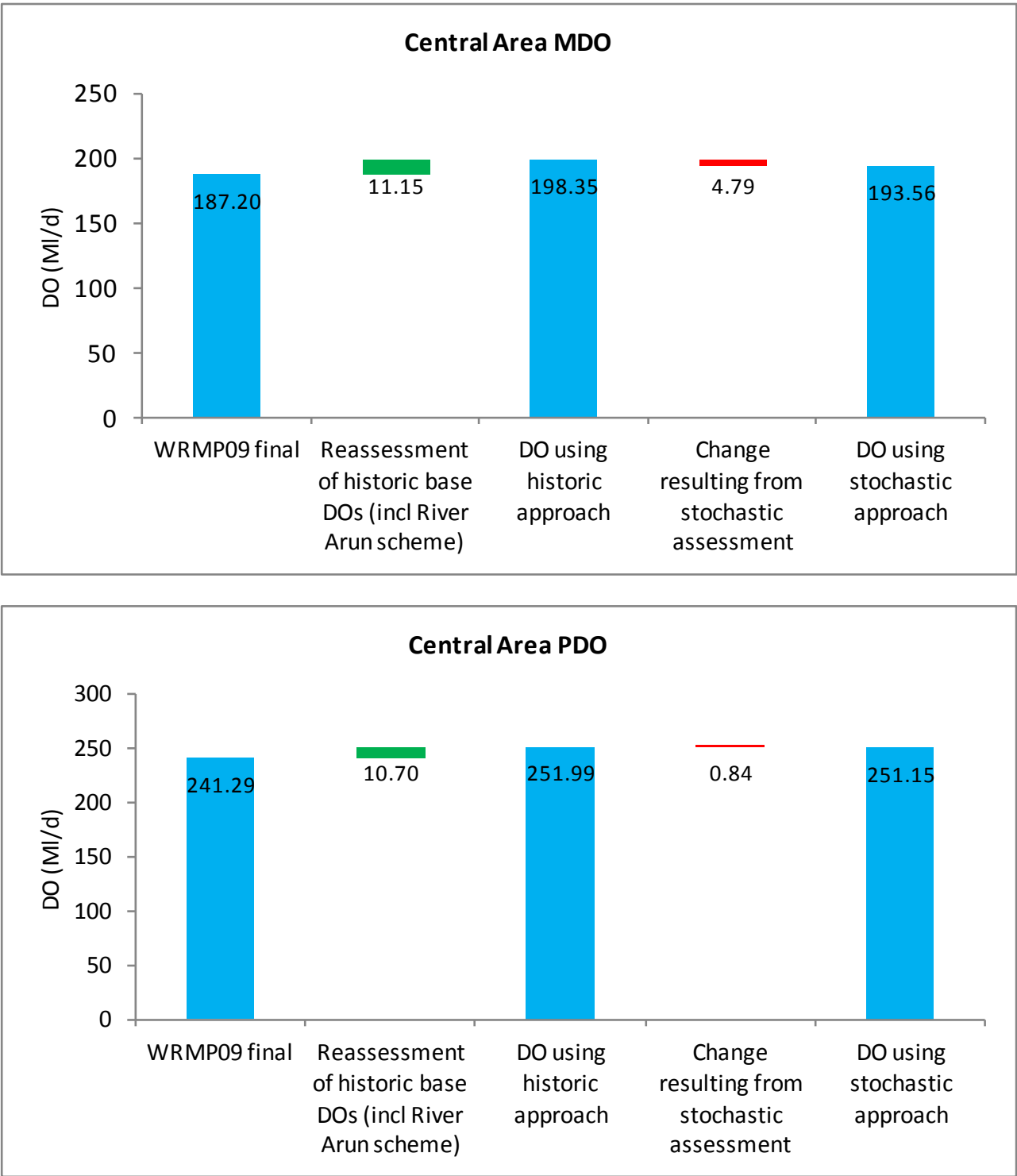
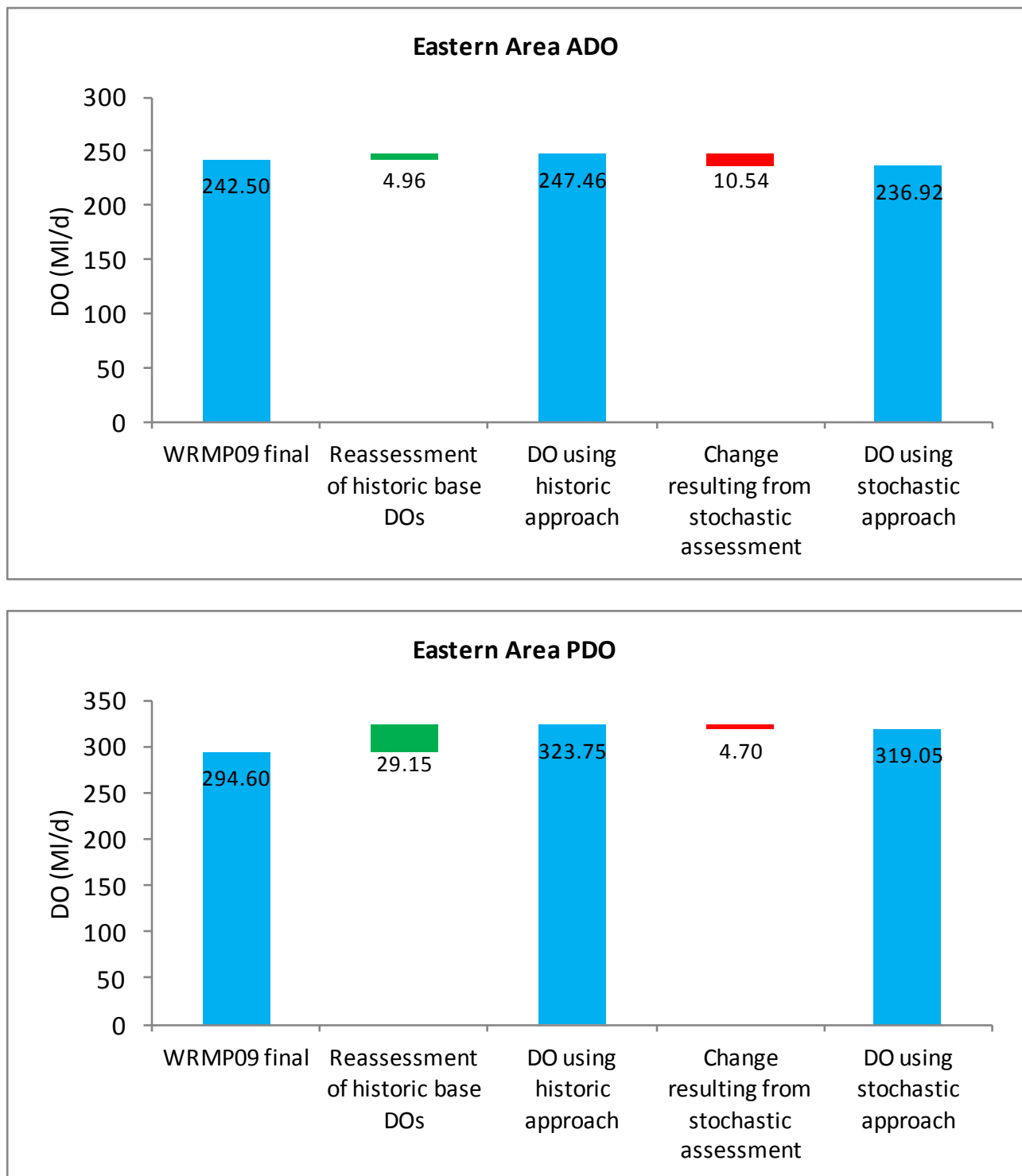


Figure 5.5 Changes in deployable output from WRMP09 following reassessment for the Eastern Area



Alternative Levels of Service

- 5.44. The Water Resources Planning Guidelines require that Levels of Service should be further investigated through the examination of both a 'no restrictions' scenario, and the reference levels of service provided within the Guidelines.
- 5.45. In terms of a 'no restrictions' scenario, this is somewhat meaningless for the preferred resilience scenario (derived from the stochastic approach), as the chosen drought return period has deliberately been selected to reflect the imposition of drought permits and non-essential use bans at a frequency no greater than 1 in 20 years. If this restriction is not counted, then there is no realistic constraint on the return period of the drought that is selected. Nevertheless, the impact that TUBs has had on the DOs quoted for the design event can be examined to demonstrate the sensitivity. As discussed previously, for the preferred resilience scenarios, the impact of TUBs on the supply demand balance has been included within the DO for reservoir, run-of-river and groundwater sources. Impacts are therefore relatively high, and the quoted DOs would decrease by the following amounts if the benefits of TUBs were not allowed for:
- Western Area: 4 M/d MDO, 10 MI/d PDO;
 - Central Area: 4 MI/d MDO, 8 MI/d PDO; and
 - Eastern Area: 4 MI/d MDO, 3 MI/d PDO.
- 5.46. For the conventional (historical DO) based scenario, the only TUBs impacts that have been included relate to the Sussex North, Kent Medway, and Sussex Hastings WRZs, as these are the only zones that contain reservoir storage (and hence 'conventional' Level of Service allowances within the water resource models). The impacts of TUBs are therefore limited to the MDO and ADO conditions for those WRZs, resulting in the following reductions in DO in a 'no restrictions' scenario:
- Central Area: -1.7 MI/d; and
 - Eastern Area: -1 MI/d (the value is low because the trigger level for Bewl is relatively low to ensure breaches no more than 1 in 10 years; the impact on DO is therefore correspondingly small).
- 5.47. The EA reference Levels of Service are the same as the preferred scenario in terms of TUBs (1 in 10 years), and more lenient in terms of non-essential use bans (1 in 20 years for the Southern Water preferred scenario, 1 in 40 years for the reference condition). Because a non-essential use (NEU) ban is not contained within the conventional scenario, then there is effectively no impact from this change. For the stochastically based approach, it is not certain what return period would have to be planned for in order to only have to implement NEU/Drought Permits once every 40 years, but it is likely to be in the order of a 1 in 400 year. Based on the analysis carried out on the 2000 year sequence, the effect would therefore be in the order of 5% reduction in DO, depending on the relative sensitivity of the WRZ.

Implications of the Water Framework Directive (WFD) on existing sources

- 5.48. The EA's pre-draft consultation letter (dated 21 Dec 2012) states that the company should review the use of existing surplus within licensed headroom. The EA's own assessment of water resource pressures and compliance is based on recent actual abstraction and an estimate of 'future predicted' abstraction, rather than licensed abstraction. This is why the EA requires companies to assess whether an option which uses the full licensed amount (the "headroom" over the average abstraction), as well as any changes to existing operations as part of the company's DO improvement programme, might result in deterioration of water body compliance.

WFD implications of WRMP options to utilise existing surplus within licensed headroom

- 5.49. The requirement for 'no deterioration' in water body status has been allowed for within the baseline assessment of DO by considering how the proposed WRMP might affect current levels of abstraction that occur at Southern Water sources. The DOs derived for this WRMP generally relate to abstraction rates that are at or below those that are routinely achieved. The risk to WFD status from those sources where DO is unchanged from WRMP09 is therefore negligible.

5.50. We have reviewed the map of the EA's river water body risk assessment risk of deterioration in status by 2027. The map indicates that there are no surface water bodies in our WRZ that are considered by the Agency to be 'at risk' or 'probably at risk' of deterioration from abstraction and flow pressures. The EA's risk assessment is consistent with our assessment of our existing abstraction licences.

5.51. At WRZ level, only the Hampshire South WRZ would have significant headroom during the planning period, although once the River Itchen Sustainability Reduction is implemented, this will remove any headroom.

WFD implications from the DO improvement programme

5.52. Resources are shared within WRZs, therefore increases in DO only become a likely risk of WFD deterioration if the aggregate DO within the WRZ increases as a result of enhancements to existing sources. The analysis provided earlier within this Section shows that this only applies to the Kent Medway WRZ.

5.53. For the Kent Medway WRZ, all of the sources where there are potential DO enhancements during AMP5 and AMP6 were therefore reviewed to confirm whether there might be a risk to water body status from the increased abstraction that could arise once infrastructure constraints are removed. One of the Sittingbourne Group groundwater sources is located within a relatively small headwater water body and hence any increase in actual abstraction could have a noticeable percentage impact on flows. Given the low natural flow rate of this water body (exact figures are not available, but it is likely to be less than 10 Ml/d) and the fact that at least half of the anticipated additional 2 Ml/d DO at the source that had been assumed in the DWRMP would come from the neighbouring catchment, it was concluded that there was a risk of >10% impact on flows. This indicates that, according to the EA standard classification approach, there could be a medium or high risk of deterioration from the additional abstraction if the water body is classified into Band 2 or Band 3 non-compliant. As a result of this, and the risks of non-achievement of the scheme improvements, the proposed source improvements at this source were removed from the baseline DO.

NEP investigations

5.54. A significant number of NEP projects into the impacts of the company's existing abstractions are also currently underway or have been identified by EA as requiring attention during AMP6; the status of these projects was summarised in a list the EA provided to the company in August 2012. An update was issued by the EA on 1 Feb 2013, and subsequent updates released in August and September 2013. The projects identified will be considered for the Final WRMP. The majority of the August 2012 list of investigations was classified as "unknown" – i.e. the EA has not been able to conclude whether or not there may be any risk to WFD objectives and whether any Sustainability Reduction may be necessary. The assumptions made for the Draft WRMP with regards to Sustainability Reductions are discussed in more detail in the section below.

Reductions in deployable output

5.55. Reductions in deployable output may occur for a number of reasons. Short term, temporary losses are known as outage, and these are discussed separately in paras. 5.101 to 5.107. However, medium to long term losses in DO are discussed here. The main reduction in DO arises from sustainability reductions.

5.56. Other losses include "locked in DO", where the water supplies available from individual sources cannot be distributed around the system as effectively as possible, and from long term pollution such as from nitrates. A number of these examples have been identified, so the options appraisal includes options to mitigate these losses, and hence restore DO to its original level.

Sustainability reductions

5.57. All abstractions are subject to the terms of the existing abstraction licences. Many of these licences were issued in 1965, when the provisions of the Water Resources Act (1963) came into force. The Environment Agency considers that the terms of some of these licences are such that the abstraction could cause environmental damage, or could have an impact on sites with environmental designations.

- 5.58. Sustainability reductions to some abstraction licences may be required by the EA where it considers that there is an unacceptable risk to the environment. The drivers for these investigations are related to European legislation, as discussed previously in Section 3 (para. 3.95 to 3.98). In order to manage the requirements of recent European and National environmental legislation and regulations, the EA set up the over-arching Restoring Sustainable Abstraction (RSA) Programme with funding for the investigations and (if shown to be required) implementation of mitigation options secured through the National Environment Programme (NEP).
- 5.59. If water company abstraction licences are confirmed as constituting an unacceptable risk to the environment, the EA requires that companies find and implement solutions to the problem, which may include additional abstraction licence conditions and/or constraints. The impacts that these changes might have on DO can be calculated or estimated.
- 5.60. There were 42 RSA and Water Framework Directive (WFD) investigations on the list the EA supplied to Southern Water in August 2012. Of these, only four cases were “confirmed” – i.e. with a decision on whether or not a sustainability change was actually required, while 7 were classified as “likely” and 31 were “unknown”. For this Final WRMP, the EA provided a revised list to Southern Water on 25 September 2013. This improves of the situation for the draft, although there are still a number of schemes classified as “unknown” The implications of this uncertainty are discussed below.

“Confirmed” sustainability changes

- 5.61. A “confirmed” sustainability change describes the actual licence change required to protect the environment following completion of an environmental investigation and options appraisal. The potential outcomes of these EA assessments include the “no change” option. In most of the “confirmed” cases no sustainability change was required; however, on the River Itchen, it was confirmed that a sustainability reduction was needed.

“Likely” sustainability changes

- 5.62. A status of “likely” should show the proposed change required to a licence under statutory drivers that the EA believes is necessary to protect the environment. These “likely” changes should be based on the best available information regarding environmental impacts, but they are only considered “likely” as the values have not been confirmed and agreed. It should be noted that a licence identified with a “likely” status could reflect that it is likely that no change to the licence would be required. In discussion with the EA, none of the “likely” investigations was included in the baseline sustainability reductions. However, even where no sustainability change is confirmed to be required, the EA may require “non-licence changes” to be made in AMP6.

“Unknown” sustainability changes

- 5.63. The remaining investigations were classified by the EA as “unknown”, which means that the sustainability change status is currently uncertain. This represents a significant component of uncertainty in this WRMP. However, the EA’s Water Resource Planning Guidelines do not allow companies to make any allowance for these uncertainties within the target headroom allowance.

The pragmatic inclusion of “unknowns” sustainability reduction scenario

- 5.64. In order to provide a pragmatic estimate of the potential impacts that these investigations that have been classified currently as unknown could have on supplies for Southern Water if they were later deemed to require a sustainability change, the company included a scenario to investigate the potential impacts. This scenario, known as the “pragmatic inclusion of unknowns”, assumes that 10% of the DO of the sources potentially affected by the “unknowns” will be lost as part of the sustainability changes. The scenario was updated following additional revision of NEP and WFD investigations provided by the EA in September 2013. It should be noted that this is a planning scenario only; it is an attempt to try to provide some indication of the potential magnitude of the impacts that sustainability changes could have on supplies to enable the company to investigate what other options or alternatives this might trigger.

The reasonable worst case sustainability reduction scenario

- 5.65. Clearly, there remains a great deal of uncertainty surrounding potential sustainability changes which could affect the company over the 25 year planning horizon. In order to investigate a possible upper scale of effect on the company's supplies, a second scenario was investigated, known as the "reasonable worst case sustainability reduction" scenario. This uses as its basis a paper the EA produced for the *Water Resources in the South East* group. The paper provides estimates of how much flow might need to be improved to support good ecological status under the Water Framework Directive (WFD) for each WRZ in the South East, using an approach based on Environmental Flow Indicators (EFI). The values used for our "reasonable worst case" scenario were based on improving the flow in all water bodies to achieve the EFI.
- 5.66. If sustainability reductions at these levels were to occur, a fundamental change to the company's supplies would be required, although some WRZs would be more significantly affected than others. Nevertheless, the scenario is instructive to inform the debate of what levels of investment could be required under a worst case, especially given the scale of sustainability reductions the company faces on the River Itchen in its Hampshire South WRZ.

Impact of sustainability reductions

- 5.67. It is important to stress that **the impact of the unknown sustainability reductions is potentially so large that it could easily outweigh the impact of other parts of the supply demand balance, such as the adoption of a new stochastics approach (rather than deriving DO using historical observations), population and housing growth, and climate change.** Therefore, it will be very important in the next AMP period to undertake and complete the investigations necessary to reduce the uncertainty of these unknown sustainability reductions.

Figure 5.6 Impact of sustainability reductions as a percentage of base year deployable output for company supply area

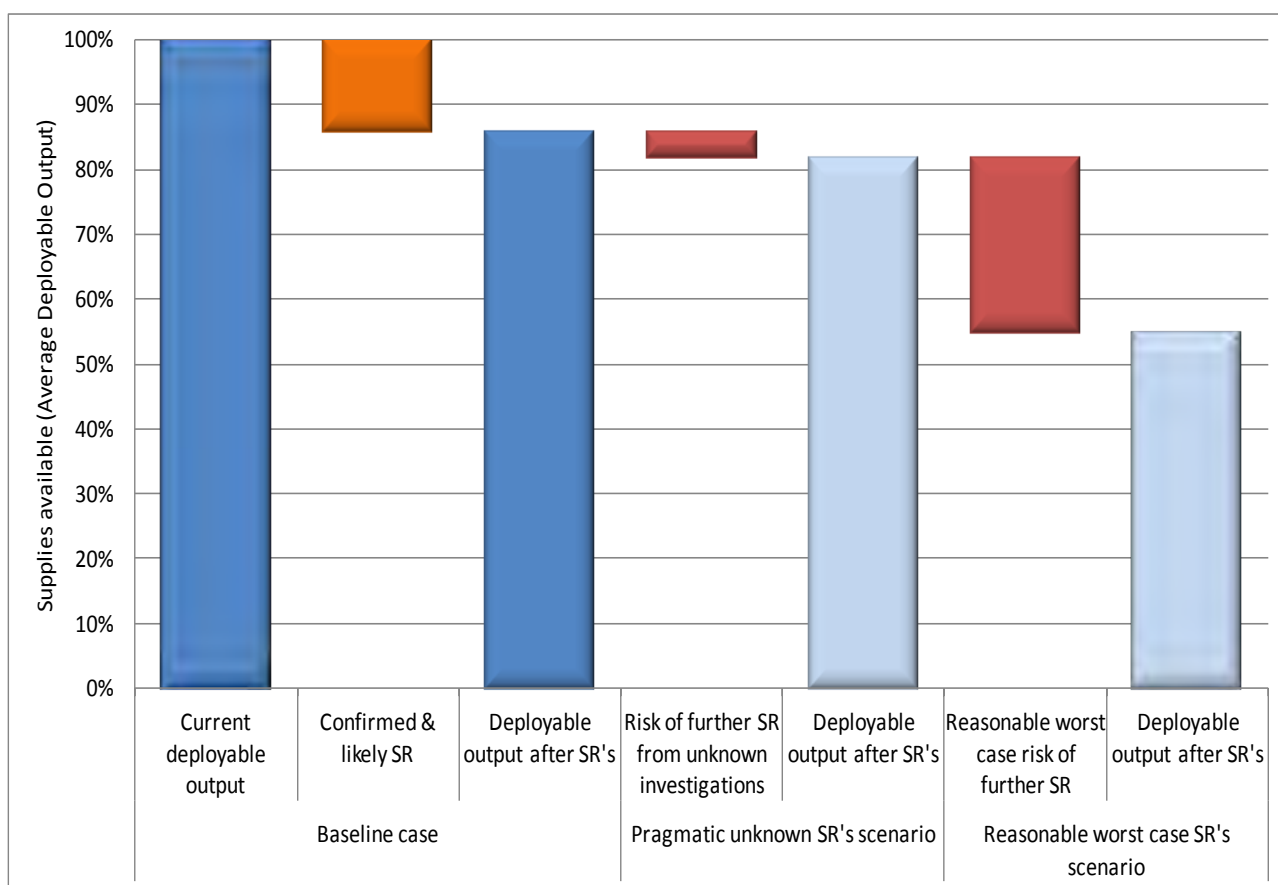


Table 5.3 Summary of sustainability reductions impacts under different scenarios

WRZ	Confirmed & likely SR (annual average) (MI/d)			Name of SR & assumed year of SR	Pragmatic inclusion of unknown SR impacts (in 2027) (MI/d)			Reasonable worst case SR impacts (in 2027) (MI/d)		
	ADO	MDO	PDO		ADO	MDO	PDO	ADO	MDO	PDO
Western										
HA	0	0	0	-	1.64	1.60	1.99	4.0	4.0	4.0
HK	0	0	0	-	0.00	0.00	0.00	2.0	2.0	2.0
HS ^[2]	93.66	93.66	71.87	Itchen, 2018 (with partial SR in 2015-2017)	94.78	94.51	75.08	109.7	109.7	87.9
IW	0	0	0	-	1.09	1.08	1.16	9.0	9.0	9.0
Central										
SN	0	0	0	-	1.82	4.80	3.26	31.0	31.0	31.0
SW	0	0	0	-	1.55	1.51	1.82	20.0	20.0	20.0
SB	0	0	0	-	8.21	8.03	9.63	49.0	49.0	49.0
Eastern										
KM	0	0	0	-	10.17	10.03	11.26	47.0	47.0	47.0
KT	0	0	0	-	1.66	1.65	1.74	26.0	26.0	26.0
SH	0	0	0	-	0.00	0.00	0.00	2.0	2.0	2.0
Western	93.66	93.66	71.87	-	97.51	97.19	78.23	124.7	124.7	102.9
Central	0	0	0	-	11.58	14.34	14.71	100.0	100.0	100.0
Eastern	0	0	0	-	11.83	11.68	13.00	75.0	75.0	75.0
Total	93.66	93.66	71.87	-	120.92	123.21	105.94	299.7	299.7	277.9

Note:

[1] Itchen sustainability reductions shown in this Table relate to the reductions required under stochastically based assessments.

[2] Additional scenarios have been run and presented in this Final WRMP to address uncertainties surrounding the Environment Agency's decision to further investigate the Lower Test under the Restoring Sustainable Abstraction programme. Further discussion on this is provided in paras. 5.75 to 5.78. Note that, were it deemed that a Sustainability Reduction is required on the Lower Test as well as the Itchen, the magnitude of the SR in the Hampshire South WRZ could easily exceed the "Reasonable Worst Case" values in the table above.

Timing of the Itchen Sustainability Reduction

- 5.68. Although the only confirmed sustainability reduction (SR) currently affecting Southern Water is on the River Itchen, the timing by which it can be fully implemented is dependent on the provision of alternative sources so that the security of public water supply is not put at any additional risk.
- 5.69. The approach adopted in the previous WRMP (WRMP09) was to assume that the current surplus, above target headroom, in the Hampshire South WRZ was reduced to zero from 2015 onwards, in order that part of the sustainability reduction would be implemented at the start of AMP6, but not implementing the full value of the sustainability reduction until 2019/20, when the final part of the solution was put in place. This gradual phasing was to allow sufficient time for implementation of the new schemes to replace the Deployable Output that will be lost under the Itchen Sustainability Reduction whilst maintaining target headroom.
- 5.70. Following extensive water resource investigations in AMP4, and as agreed with its regulators at that time, the company's key strategic scheme to address the River Itchen Sustainability

Reduction was identified as HSL3+HST2 Conjunctive use, a scheme which utilises the full abstraction licence volume during peak periods only, by improving the water treatment works, with an associated pipeline to another treatment works. This preferred scheme was identified in the previous WRMP, published in October 2009.

- 5.71. The Environment Agency has now notified Southern Water that measures to meet the Sustainability Reductions should be in place by 2015. Where this is not technically feasible then a detailed implementation plan needs to be agreed by 2015. This needs to include the intermediary actions that will be taken to protect the site from damage in the time up until the implementation of the final solution. In discussion with the Regulators, the company has agreed in principle to implement the River Itchen Sustainability Reduction as early as possible in AMP6. The size of the sustainability reduction means that large schemes, requiring long lead times for planning, design, construction and commissioning, need to be in place to deliver the full sustainability reductions. It should be possible to deliver the River Itchen Sustainability Reduction and maintain security of supplies to customers by 2018/19. **However, the only options available to achieve this are the HSL3+HST2 Conjunctive use, along with the T-HSO-3 10MI/d bulk supply from Portsmouth Water and the JO3a MDO groundwater scheme for river augmentation. These schemes will have to be in place by 2018/19. Without them, the company would not have viable schemes in place to meet the deficit that will occur as a result of the large proposed sustainability reduction.**
- 5.72. Therefore, in discussion with the Regulators, the company has agreed in principle to implement the River Itchen Sustainability Reduction as early as possible in AMP6. Southern Water will seek to agree with the EA that **the River Itchen Sustainability Reduction will be implemented through the gradual phasing of components of the Sustainability Reduction, aiming for full implementation by 2018/19** (or when viable scheme(s) are in place to meet the deficit that will occur). For example the following phasing of the licence amendments could be implemented as follows:
- **Phase 1:** The Lower Itchen **surface water and groundwater licence change for monthly totals (excluding September) in 2015**. Note that this licence change does not actually impact on the DO's, hence does not register in the supply demand balance;
 - **Phase 2:** The Lower Itchen **surface water Minimum Residual Flow (MRF) licence change in 2017**, which equates to loss of the full Lower Itchen surface water DO in that year; and
 - **Phase 3:** The Lower Itchen **groundwater licence change and the September monthly total in 2018**, and hence result in the full implementation of all the components of the Sustainability Reduction in this year..
- 5.73. However, Southern Water could only agree the implementation of the phased components of the River Itchen sustainability reduction once there were sufficient alternative supplies in place to ensure that customers were not at risk of a supply failure. The company understands it must implement the Itchen sustainability reduction as soon as possible; however it can only deliver the full reduction once sufficient alternative supplies become available. A phased implementation of the River Itchen Sustainability Reduction will be delivered as set out in the plan.
- 5.74. Therefore, although it will not now be possible for the full extent of the Sustainability Reductions to be implemented by 2015, Southern Water, in discussion with the Environment Agency, is seeking to adopt a phased implementation as soon as possible. The Environment Agency has made clear to Southern Water that if not by 2015, the Sustainability Reductions must be implemented in full as soon as possible.

Uncertainties in the Western Area

- 5.75. During AMP5, the Lower Test National Environment Programme (NEP) investigation was completed. This study, undertaken by Southern Water in close consultation with the EA and Natural England, concluded that an increase in abstraction from its current deployable output of 105 MI/d to its licensed amount of 136 MI/d would not have a detrimental effect on the environment.

- 5.76. Following the submission of the report on the investigation the EA and Natural England have advised that they consider that changes to the River Test abstraction licence combined with some catchment management measures are required. Discussions between Southern Water, EA and NE on the scope of work required to establish the nature and justification for changes to deliver the necessary environmental outcomes have continued since the Draft WRMP. Until such time as the structure of an amended licence has been agreed between Southern Water and the EA, the existing licence has been taken as the baseline for the WRMP. Note that the EA pre-consultation response dated 21st December 2012 stated in regard to the River Test WSW that:

“It is not appropriate to include a potential reduction of 40MI/d to the... source as a ‘likely’ sustainability reduction in the draft plan. The baseline deployable output... should remain as 105MI/d in the draft WRMP unless you have evidence to reassess the deployment output for this source.”

- 5.77. However, the Environment Agency has recently indicated that it wishes the Lower Test abstraction to be assessed under the Restoring Sustainable Abstraction (RSA) programme. This programme of work will include a review of existing and potentially new options that would be of benefit to the supply demand balance in the Western area. This work will be completed by December 2015, enabling the Environment Agency to determine whether any licence changes at the Lower Test abstraction need to be included as sustainability reductions within the next NEP programme, to be published in January 2016. Pending conclusion of that process, it is not known if there is any future potential sustainability reductions on the Lower River Test abstraction. **Any reduction could further significantly worsen the supply demand balance position for Hampshire South WRZ, with knock on effects for Isle of Wight WRZ and the Western Area as a whole.**

- 5.78. In order to address the current uncertainties which surround the implementation of the Itchen Sustainability Reduction and the forthcoming further investigation of the Lower Test under the RSA programme, Southern Water has, for the purposes of producing this WRMP, undertaken various modelling scenarios:

- The baseline case assumes that the River Itchen Sustainability Reduction is implemented in full in 2018/19, through development of sufficient water resource schemes to enable this to take place (but acknowledging the points made above regarding the need to have viable options available and in place to avoid putting Southern Water’s customers at risk of supply shortfall);
- Southern Water has then undertaken a scenario where the River Itchen Sustainability Reduction is implemented in full, but not until 2029/30. The purpose of this scenario is to identify whether a delay in the implementation date might lead to different water resource options being selected, and the costs of such an approach for Southern Water’s customers, and to demonstrate that the solution to meet a 2018/19 implementation date is robust. (See paras. 9.41-9.44 for discussion of output from this scenario);
- Three further scenarios were assessed to help understand the potential impact of future sustainability reductions in Hampshire. It was assumed that these could remove 45, 65 and 105 MI/d from the Hampshire South WRZ SDB in both MDO and PDO planning scenarios, over and above the River Itchen Sustainability Reduction volumes.

- 5.79. The company believes that presenting these scenarios to its customers and other key stakeholders in this WRMP will help inform debate on the pace at which the River Itchen Sustainability Reduction can be implemented in full whilst maintaining security of supplies.
- 5.80. If either or both of the HSL3+HST2 conjunctive use scheme and the JO3a groundwater scheme for river augmentation prove not to be deliverable, then the full implementation date for the River Itchen Sustainability Reductions will shift backwards accordingly whilst alternative options are promoted and delivered. In addition, should there be sustainability reductions notified for the Lower Test abstraction, this would add to the delay to the full implementation date for the River Itchen Sustainability Reductions. In order to provide some mitigation against any delays Southern Water will be investigating the alternative schemes outlined in Sections 9 and 10 in parallel with the preferred schemes. However, the alternative schemes will require design and environmental investigations to be undertaken before they can be progressed further.

Other reductions and adjustments

Drought operations and system level constraints

- 5.81. One of the findings that emerged from the stochastic water resource modelling exercise was the difference that exists between the modelled system that is assumed for water resource management plans, and the reality of operating complex, conjunctive use systems under drought conditions. In some cases it was found that operations and system constraints can limit WRZ level outputs under drought conditions, and this had to be reflected within this WRMP supply demand balance.
- 5.82. For the Western and Central Areas, it was found that the majority of the significant operational controls and issues could be addressed within the Aquator models and conjunctive use assessments described previously. However, there was one complication for the Central Area relating to Weir Wood reservoir, where it was found that the reservoir could not be relied upon to meet both the minimum compensation flow and the supply to South East Water (SEW) under droughts that are any worse than the historic record (roughly 1 in 100 years or worse). This created a localised problem that prevented conjunctive DOs being calculated for the WRZ as a whole. For water resource modelling purposes, this was addressed by assuming that the minimum output from Weir Wood should be kept at least as high as the 5.4 MI/d bulk supply to SEW, irrespective of drought severity. This was matched by the 5.4 MI/d bulk transfer to SEW that is included within the WRMP planning tables, and so there was no net impact on Southern Water's resource position. However, if SEW either wish to cease this transfer, or require that it is reliable below the 1 in 100 year event level, then this assumption would need to be re-visited and DO for the WRZ may have to be reduced accordingly.
- 5.83. For the Eastern Area, there were three design planning scenario related issues that affected system capability and hence required adjustments to reported DOs:
- The water supply works associated with the Bewl-Darwell system have significant excess capacity in relation to their ADO, which reflects the fact that the original system yield had been assumed to be higher than the more recent (AMP4 and AMP5) modelling has shown it to be. This means that there is both significant spare capacity in the works, and that the overall supply system is designed to move water from Bewl out towards the eastern and western parts of the Medway WRZ. This has significant practical implications, as both Southern Water and South East Water have to use Bewl at greater than its DO because of an uneven distribution of outage and demand within the WRZ. This can be managed during drought situations, but it is impractical to manage the system this way outside of drought periods. This means that demand tends to be higher during non-drought periods, and hence storage at Bewl tends to be lower than the theoretical levels suggested by conventional water resource modelling as the system enters into a drought.

A more sophisticated approach to resource modelling for Bewl was therefore adopted that reflected the Drought Plan, with a switch between 'normal' and 'drought' operation once every 5 years. This approach is fully described within Appendix C, and overall it was found that this effect reduced the drought DO capability of the Bewl-Darwell system by between 0.5 and 7.5 MI/d (with an average of 3 MI/d), depending on the nature of the drought. For the preferred resilience scenario, this meant that the DO was reduced by 3.0 MI/d in comparison to the 'conventional' England and Wales DO calculation, and DO was reduced by 0.5 MI/d for the conventional (historic) analysis. Because this impact relates specifically to the reservoir DOs, it has already been included in the quoted DO values shown in Table 5.1.
 - Under drought conditions when Bewl is stressed and output is reduced, there are two system constraints that limit the contribution that groundwater within the wider Kent Medway WRZ can actually make. The first of these, on the western side, is relatively minor, and has not been allowed for as part of the WRMP. The second constraint, which relates to the movement of water from the eastern part of the Medway WRZ to the middle area, is potentially significant and needed to be accounted for as part of the overall WRMP assessment. Full details are provided in Appendix C, but in summary, on a supply demand balance planning basis there is approximately 4.7 MI/d of DO that is 'locked in' to the Eastern Area (i.e. that cannot be realised due to the system constraints). The baseline DO has therefore been

revised downwards by this amount, but a relatively simple mains reversal scheme has been included in the WRMP options appraisal and least cost investment model to offset this reduction.

- For the Kent Thanet WRZ, both the Deal area groundwater and the Wingham area groundwater are limited by the amount of supply that they can deliver to the main Fleete demand areas. This issue was originally highlighted in the previous WRMP, and capital schemes (essentially trunk mains duplications) have now been developed as part of the options for this Draft WRMP to address these constraints. However, it was found that the benefit is marginal under severe drought conditions, as the aggregate DOs fall to around, or below, these constraint values. Impacts on the preferred resilience scenario were limited to -1 MI/d on MDO and -1.4 MI/d on PDO, and were not significant once climate change was taken into account. The main impact from the constraints is therefore to limit the relative impact that the move from conventional historically-based DOs to the preferred resilience scenario has on supply capacity.

Nitrate reductions

- 5.84. Southern Water completed a review of its sources in terms of their vulnerability to rising concentrations of nitrate in groundwater. Through the company's Drinking Water Safety Plan, a number of sources were identified as being at risk of breaching nitrate threshold levels in the future. Some of these identified sources did breach nitrate levels as a result of higher rainfall experienced during the winter of 2012/13.
- 5.85. Southern Water took a modelling approach taken that the DO for a source would be set to zero from the year in which groundwater concentrations were forecast to exceed the nitrate threshold. The model then had the alternative of delivering options to recover the DO from the source or to accept the loss of DO with the resulting need to develop new resources.
- 5.86. In the model there were two distinct approaches taken in order to reduce nitrate levels at the identified sources. The first approach targeted six sites that were identified as being at high risk in the Drinking Water Safety Plan. The option to recover the DO at these sites involved initial use of conventional nitrate treatment. Catchment management measures to reduce the nitrate load of aquifer recharge would also be implemented at the same time. Conventional treatment options would remove the immediate risk of nitrate breaches at the source, whereas catchment management options would lower the nitrate levels over a period of time, with no immediate effect on nitrate already stored in groundwater which might continue to increase nitrate concentrations observed in abstracted water. The choice of conventional treatment against catchment management therefore has to consider the risks of exceedances and when these might occur and balance these against the more expensive and assured conventional treatment.
- 5.87. The second approach targeted sites that were expected to breach the nitrate threshold in the mid-2020s. To restore the DO at these sources the model was given the option to install catchment management measures, which included appointing catchment management officers to work with farmers and other upstream users to attempt to reduce nitrate pollution.
- 5.88. Where catchment management options have been selected in the plan, the date shown is the earliest date the company would expect to see benefit from the options. It has been assumed that a ten year period of implementation is required prior to this date to allow sufficient time to build relationships with farmers and stakeholders and to monitor and demonstrate that nitrate reductions were being achieved. Under this approach there would still be enough time to implement conventional nitrate treatment if the catchment option was not shown to be reducing nitrate levels.
- 5.89. The list of all sources considered to be at risk of exceeding nitrate PCV threshold is provided in Appendix H.

Assessment of climate change on supplies

Vulnerability assessment

- 5.90. The vulnerability assessment to determine the level of investigation required for climate change assessment was conducted following the methodology set out in the EA's Water Resource Planning Guideline (WRPG), with an additional high-level assessment of other factors potentially affecting supply and demand. This was submitted to the EA on 7th August 2012. Effectively, the vulnerability classification of each WRZ was determined by its position on a magnitude versus sensitivity plot, based on data from the previous WRMP (from 2009). A full description of the methodology and findings is contained in Appendix D. A summary of the findings of the classification process is provided in Table 5.4.

Table 5.4 Summary of vulnerability classifications for each WRZ

Low	Medium	High
Hampshire South Hampshire Andover Hampshire Kingsclere Isle of Wight Sussex North Sussex Brighton Sussex Worthing		Sussex Hastings Kent Medway Kent Thanet

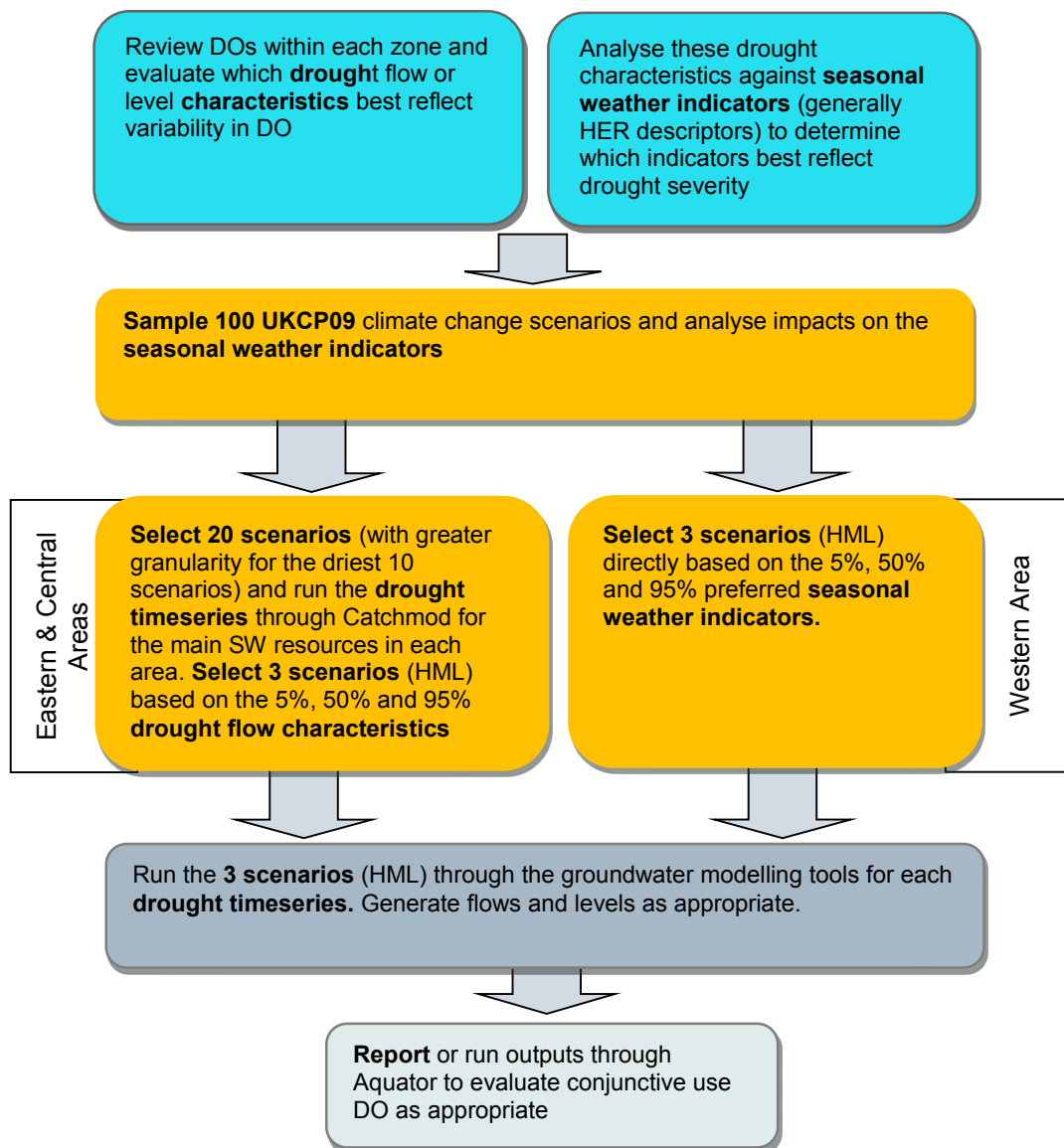
- 5.91. The following additional considerations beyond the basic WRPG methodology were also taken into account when the approach to evaluating climate change was being developed:

- Sources in Hampshire South WRZ may be more vulnerable than the evaluated risk once the potential sustainability reduction on the River Itchen has been implemented. However, water resource modelling for this WRMP showed that the MRF that would be implemented would serve to limit minimum DO for the River Itchen sources, and the other sources within the WRZ will still have practically no vulnerability to climate change. The analysis therefore concentrated on the Lower River Itchen surface and groundwater sources;
- It was considered that surface sources in Sussex North WRZ may be more vulnerable than the assessment suggested due to the lack of medium term storage within the WRZ. However, water resource modelling showed that the MRF near Pulborough and current assumptions about net exports from Weir Wood reservoir serve to limit this vulnerability. Modelling also confirmed that groundwater sources across the Sussex Brighton and Sussex Worthing WRZs demonstrate a low vulnerability, and so the vulnerability classification for the Supply Area as a whole remained valid; and
- Many of the groundwater sources in the Eastern Area may not be as vulnerable as the scoring matrix suggested. The majority of the assessed vulnerability to climate change lies with the surface water sources in Kent Medway and Sussex Hastings WRZs (the reservoir system). The DO from the Kent Medway WRZ groundwater sources (which is larger than the reservoir system) demonstrates a low vulnerability to climate change. Similarly, whilst there is some vulnerability in the Kent Thanet WRZ groundwater sources, infrastructure constraints do limit this to a certain extent. Approaches to climate change assessment that were suitable for high vulnerability zones were therefore used for all three WRZs, but with some practical limitations. As discussed below, the understanding of resources in this Supply Area gained from the water resource modelling, the availability of 'proxy' indicators, and the variety of drought scenarios that were modelled meant that these limitations did not prevent a satisfactory understanding of potential climate change impacts being achieved.

Impact of climate change of supplies

- 5.92. The approach that was used for climate change assessment was compliant with the Water Resources Planning Guidelines, as it involved sampling for the UKCP09 climate change scenarios (which are the revised climate change projections published by Defra in 2009) to provide a range of possible impacts for all WRZs. A full description of the sampling methods and approach to impact calculation is provided in Appendix D. A summary of the proposed modelling approach was provided to the EA on 9th October 2012. The overall approach that was used is shown in Figure 5.7.
- 5.93. There was one key area in which Southern Water's approach built on the WRPg, and that was in assessing how climate change impacts differ across a range of drought types and severities. In many supply systems, the critical potential effect from climate change on water resources actually relates to the impact that it might have on drought characteristics such as persistence and duration, which are not reflected in the UKCP09 perturbation factors. The stochastic modelling described previously significantly improved understanding of baseline climatic variability during drought events, particularly in relation to higher return period events. The approach adopted for this Draft WRMP was therefore extended beyond the basic requirements of the WRPg, and used both conventional historic and stochastically generated drought sequences to ensure that the impact of climate change on drought type (e.g. duration and pattern) was assessed along with the basic DO/severity impact. Each climate change perturbation was thus evaluated against a generated time sequence that included all of the drought sequences of interest to the WRMP process, as described in Appendix D.
- 5.94. Whilst this approach provided a much greater reliability in the evaluation of climate change impacts, it did mean that the number of runs of groundwater and conjunctive use water resource models had to be limited for the Eastern Area. This was because the effects of climate change were being tested for a wide range of drought types, and the baseline modelling had shown that the variability of climate change impacts according to different drought characteristics was likely to be at least as important as the range of climate change scenarios. Compliance with the WRPg was still sought through the use of 'smart sampling', which allowed specific scenarios to be selected on the basis of an initial large number of samples (100) and the assessment of hydrologically effective rainfall (HER) and river flow impacts from those samples.

Figure 5.7 Approach taken to climate change analysis



- 5.95. In accordance with the WRP, impacts from the 'most likely' scenario for each WRZ were included in the baseline supply forecast of the WRMP tables. The 'minimum' and 'maximum' scenarios were then added to the headroom model, based on the deviation from the 'most likely' scenario. The values all represent the impact at the end of the WRMP planning period, i.e. 2040, and impacts were assumed to increase linearly from zero in the base year to the assessed value in 2040. In terms of the selected confidence intervals, the 'maximum' scenario was taken as being equal to the 5th percentile of the assessed scenarios, the 'most likely' was the 50th percentile, and the 'minimum' was equal to the 95th percentile (for scenarios grouped from driest to wettest).
- 5.96. A summary of the results for the Western Area is provided in Table 5.5. For the Hampshire WRZs, modelling and analysis confirmed that there are unlikely to be any significant impacts from climate change for any of the resources under the current licensing system, even under extreme drought conditions. However, with the proposed imposition of a 198 MI/d MRF at the Allbrook & Highbridge gauge under the River Itchen Sustainability Reductions, the DO from the Lower Itchen sources became drought constrained, and hence vulnerable to climate change. It should be noted that, for the 'most likely' scenario, the impacts on MDO tended to be limited by the fact that flows in the Itchen are close to the MRF in any case, which is why the impact is 7 MI/d for both the most likely and maximum scenarios. For the Isle of Wight WRZ, as the key works constraint at the surface water source remains the limiting factor under most scenarios, the impact of climate change is small and restricted to groundwater sources only.

Table 5.5 Summary of climate change impacts for the Western Area

Planning Condition	Scenario	Hampshire South	Hampshire Andover	Hampshire Kingsclere	Isle of Wight
PDO	Minimum	+8 MI/d	No impact	No impact	+0.2 MI/d
	Maximum	-28 MI/d	No impact	No impact	-0.5 MI/d
	Most Likely	-13 MI/d	No impact	No impact	-0.2 MI/d
MDO	Minimum	+4 MI/d	No impact	No impact	+0.1 MI/d
	Maximum	-9 MI/d	No impact	No impact	-0.3 MI/d
	Most Likely	-9 MI/d	No impact	No impact	-0.1 MI/d

- 5.97. A summary of the results for the Central Area is provided in Table 5.6. For the Sussex North WRZ, the MRF near Pulborough and the operational controls on Weir Wood tended to limit the impact of climate change on MDO. For PDO, all significant resources other than the abstraction near Pulborough are effectively limited by infrastructure rather than hydrology, and so the impact is limited, and smaller than the MDO impact. The nature of the aquifer and the presence of non-hydrogeologically constrained sources within the coastal WRZs (Sussex Brighton and Worthing) mean that climate change impacts are predicted to be very small for these WRZs (less than 2% of DO).

Table 5.6 Summary of climate change impacts for the Central Area

Planning Condition	Scenario	Sussex North	Sussex Brighton	Sussex Worthing
PDO	Minimum	+4 MI/d	+1 MI/d	+1 MI/d
	Maximum	-4 MI/d	-2 MI/d	-2 MI/d
	Most Likely	-1.4 MI/d	No impact	No impact
MDO	Minimum	+2 MI/d	+2 MI/d	+1 MI/d
	Maximum	-6 MI/d	-3 MI/d	-1.5 MI/d
	Most Likely	-1.5 MI/d	No impact	No impact

- 5.98. A summary of the results for the Eastern Area is provided in Table 5.7. The surface water reservoir system accounted for most of the impacts of climate change on the Eastern Area DOs, accounting for all of the impacts shown for Sussex Hastings, and most of the impacts shown for the Kent Medway WRZ ADO condition. Kent Medway WRZ groundwater was much less vulnerable to climate change, with maximum impacts in the order of 3% of DO. For Kent Thanet WRZ, the results showed a high degree of variability according to drought type, but overall impacts on DO were within a reasonably limited range. Groundwater levels under the majority of droughts tended to reduce under all three scenarios (i.e. DO is predicted to fall even under the minimum scenario), and it was found that the overall impact on DO was very similar for both the 'maximum' and 'most likely' scenarios. Since DO was slightly lower than the baseline even under the wettest conditions modelled, it was assumed that the baseline view represented the minimum impact that could occur due to climate change (i.e. no change from current conditions). As both the most likely and dry scenarios were similar, the most likely impact is likely to be skewed towards the maximum scenario, so a weighted average of 75% of the driest scenario was taken as the most likely impact. The maximum impact was set to equal to the driest conditions modelled.

Table 5.7 Summary of climate change impacts for the Eastern Area

Planning Condition	Scenario	Sussex Hastings	Kent Medway	Kent Thanet
PDO	Minimum	No change	+1 MI/d	No Change
	Maximum	No change	-3.7 MI/d	-3.6 MI/d
	Most Likely	No change	+0.6 MI/d	-1.9 MI/d
ADO	Minimum	+2.3 MI/d	+8.2 MI/d	No Change
	Maximum	-4.4 MI/d	-13.7 MI/d	-2.1 MI/d
	Most Likely	-1.7 MI/d	-3.2 MI/d	-0.9 MI/d

Impact of climate change on options

- 5.99. All options that might feasibly be included within the WRMP were screened to determine if there was a risk that climate change might significantly affect DO, as shown in Section 8. This was carried out based on the nature of the scheme and the dependency of its output on climatic variability.
- 5.100. From this, any option that might be significantly affected by climate change was run through the same analysis described for the WRZ level DO. The screening process showed that this was only necessary for two options, namely the potential raising of Bewl reservoir and Darwell reservoir. The sensitivity of the DO was graphed for each option according to drought severity and used to evaluate the average impact that climate change might have at severities that are equivalent to the design condition in the Eastern Area. This showed that the Bewl option is reasonably resilient to climate change (DO reduced by around 20% under the dry 'high' climate change scenario), but that raising Darwell is potentially very vulnerable to climate change (DO reduced by around 60% under the dry scenario).

Outage allowance

- 5.101. Outage refers to the planning allowance made for the temporary loss of deployable output from a source. An allowance for outage is made in the supply demand balance, calculated at the level of the WRZ.
- 5.102. In the previous WRMP, an assessment of the outage allowance was carried out using a risk-based approach, based on actual recorded data. The outage allowances were based solely on outage at groundwater sources, with the sole exception of Sussex Hastings WRZ, where the estimates took into account known outages to surface water sources.
- 5.103. Additional outage data has been collected during the current AMP period, however it has been identified that actual outage levels reported during AMP5 have been higher than those set out in the previous WRMP (2009). One of the main reasons for this has been the triple validation system that has been installed throughout the company's water supply works. The system was

installed to reduce water quality failings as sites now operate to more stringent chlorine and turbidity standards. A consequence of this has been that sites have been more likely to shut down due to water quality triggers than previously.

- 5.104. This company is committed to returning outage levels to those of the WRMP by the end of AMP5, this is to be achieved through a combination of greater operational focus on dealing with site shutdowns, as well as some asset maintenance undertakings.
- 5.105. In producing this WRMP the company took the decision not use outage figures for AMP5 as they were skewed as outlined above. With the company committed to returning to the WRMP09 figures by the end of AMP5 the company proposes to maintain outage figures through AMP6 at the same level as in the WRMP09.
- 5.106. As a result, Southern Water has reviewed the outage allowances and believes that it is most appropriate to use the outage figures from the previous WRMP. These figures are presented in Table 5.8, and in Appendix E.

Table 5.8 Outage allowances assumed for each WRZ

WRZ	Outage allowance at DYMDO / DYAA (MI/d)	Outage allowance at DYCP (MI/d)
Western Area		
Hampshire Andover	1.52	2.44
Hampshire Kingsclere	0.77	1.49
Hampshire South	4.59	6.54
Isle of Wight	1.93	2.34
Central Area		
Sussex North	2.34	2.30
Sussex Worthing	3.07	4.39
Sussex Brighton	3.63	5.18
Eastern Area		
Kent Medway	4.06	5.90
Kent Thanet	3.62	4.64
Sussex Hastings	1.62	3.94
Total for the company	27.15	39.15

- 5.107. The company will continue to monitor actual outage, both planned and unplanned, on a continuous basis, to provide additional data for a further reassessment of outage for the next WRMP.

Sharing and transferring resources – existing water transfers and bulk supplies

- 5.108. There are a number of bulk transfers of water, both raw and potable, within the Southern Water area of supply. These can be both from a WRZ (export), or to a WRZ (import). There are two basic types of transfer, as follows:
- Inter-zonal, whereby the transfer takes place between Southern Water WRZs; and
 - Inter-company, whereby the transfer takes place between a Southern Water WRZ and another water company.

Inter-zonal transfers between Southern Water WRZs

- 5.109. There are a number of existing inter-zonal transfers between the WRZs within Southern Water. These allow the transfer of supplies from WRZs with a surplus supply demand balance to those with a deficit. The transfers will have a given capacity, which may not need to be fully utilised at the start of the planning period for all planning scenarios because the transfer is optimised to meet the deficit year by year. Thus, spare capacity may exist for future increases in transfers to support the recipient WRZ. This in turn allows for the possibility of increasing the capacity of the transfer if further spare supplies become available in the donor WRZ. It also has the implication that, should further supplies be required in the inter-connected WRZs, then it may be more appropriate to develop resources in either the donor, or recipient, WRZ. This gives flexibility to the choice of scheme option selection within the least cost investment model.

Table 5.9 Current inter-zonal transfer capacities in the baseline

Area	From	To	Name	Capacity (Ml/d)
Western	HS	IW	Cross-Solent main	12.0
Central	SN	SW	Bi-directional Rock Road transfer	15.0
	SW	SN	Bi-directional Rock Road transfer	15.0
	SW	SB	Trunk main “v6” transfer	7.0
Eastern	KM	SH	Bewl-Darwell transfer	35.0
	KM	KT	Selling-Fleete main	13.0

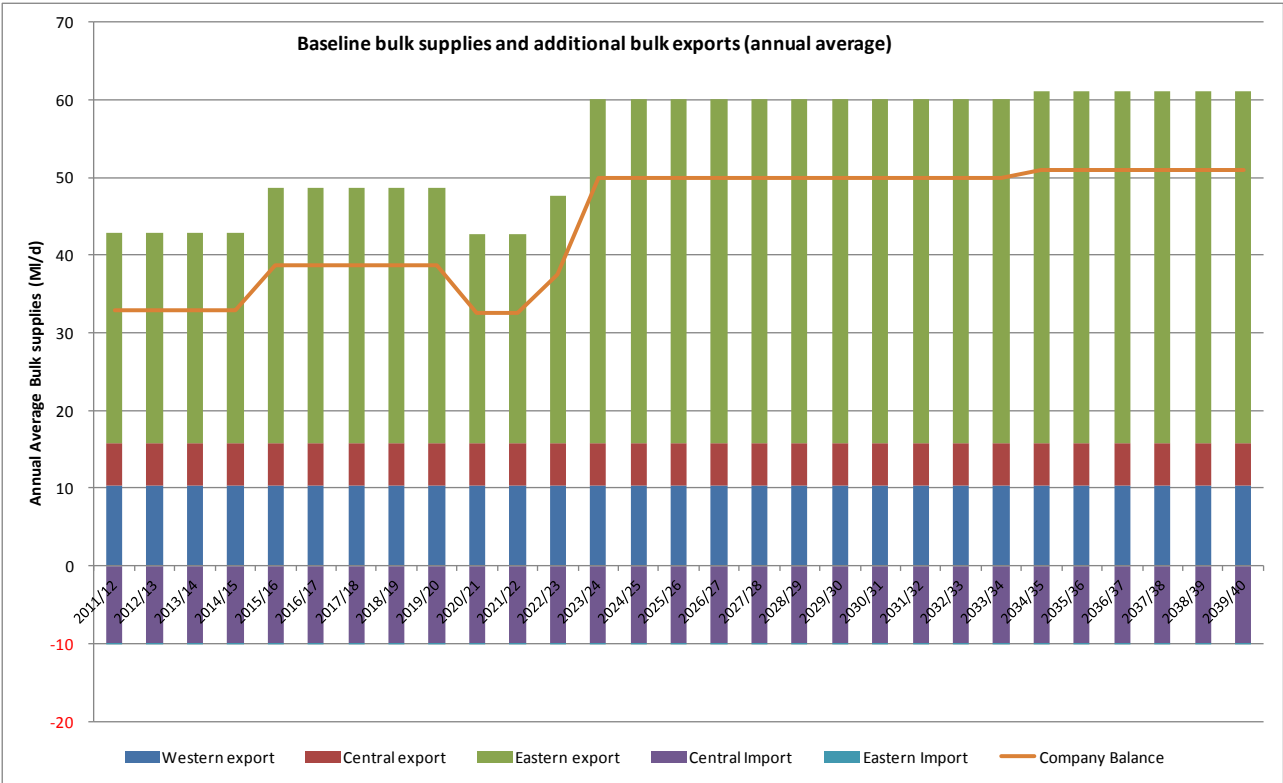
Inter-company bulk supplies

- 5.110. There are a number of inter-company transfers, some of which are of significant volume, and others, such as the small metered supplies, which serve a limited number of properties. Southern Water is a net exporter of water, with current exports of about 42 Ml/d at both MDO and PDO, compared to imports of about 15 Ml/d at both MDO and PDO. The existing bulk supplies are summarised below in Table 5.10. Currently, these contractual volumes have to be taken into account in the baseline supply demand balance.
- 5.111. The terms and conditions of the larger inter-company transfers are set out in agreements between the companies. These agreements will normally state such aspects as: volume; duration of the agreement; and financial arrangements, although no two agreements are the same. However, many of the current agreements are due to expire during the current planning period.
- 5.112. The volumes quoted for the bulk supplies with South East Water from Kent Medway WRZ have been agreed following discussions between the companies with regard to South East Water's entitlement from the Bewl system, and additional bulk supplies that they require over the planning period.
- 5.113. All of the WRZs that provide these bulk exports will develop a supply demand balance deficit during the planning period (apart from Hampshire Andover). Southern Water has included in the baseline supply demand balance an assumption of renewal of all existing bulk supplies until the end of the planning period at the volumes that are applicable at the time of contract renewal.
- 5.114. It should be noted that Table 5.10 only identifies the existing transfers and bulk supplies. Southern Water has reaffirmed its commitment to the development of a regional solution within the context of the WRSE group of companies. A number of potential inter-company transfers have been identified as part of the work of the WRSE group modelling work. These additional bulk transfers are discussed further in Section 8. Where an additional export is agreed between Southern Water and the recipient company, this is included in the supply demand balance. A summary of new bulk exports is provided in Appendix E. However, where a potential new import has been identified, this is considered as an option to increase the company's water resources, and so new imports are included in the least cost economic model for the baseline scenario.

Table 5.10 Current water transfers and bulk supplies with other water companies in the baseline

WRZ	Bulk import	Imports		
		ADO (MI/d)	MDO (MI/d)	PDO (MI/d)
Western				
HA	<i>None</i>	-	-	-
HK	<i>None</i>	-	-	-
HS	<i>None</i>	-	-	-
IW	<i>None</i>	-	-	-
Central				
SN	Portsmouth Water to Sussex North	10.00	15.00	15.00
SW	<i>None</i>	-	-	-
SB	<i>None</i>	-	-	-
Eastern				
KM	<i>None</i>	-	-	-
KT	Affinity Water	0.10	0.10	0.10
SH	<i>None</i>	-	-	-
Total company imports		10.10	15.10	15.10
WRZ	Bulk export	Exports		
		ADO (MI/d)	MDO (MI/d)	PDO (MI/d)
Western				
HA	Wessex Water	0.33	0.31	0.41
HK	<i>None</i>	-	-	-
HS	Commercial supply	10.00	10.00	10.00
IW	<i>None</i>	-	-	-
Central				
SN	South East Water	5.40	5.40	5.40
SW	<i>None</i>	-	-	-
SB	<i>None</i>	-	-	-
Eastern				
KM	South East Water	0.10	0.10	0.50
KM	South East Water	10.7	10.7	10.7
KM	South East Water	6.85	6.79	7.39
KT	Affinity Water	1.33	4.00	0.00
SH	South East Water	8.00	8.00	8.00
Total company exports		42.71	45.30	42.40

Figure 5.8 Summary of net bulk supply balance for the company in the annual average scenario



Treatment works losses

- 5.115. The treatment of water from most sources will result in process and operational losses, except when treatment is in the form of simple chlorination. The following data therefore relates to the treatment process water, i.e. the net loss of water, excluding water returned to the source.
- 5.116. A review of the estimation of such losses has been made for all Southern Water's Water Supply Works (WSWs). Estimates of the revised process losses are summarised for each WRZ for the DYMDO (or DYAA in the Eastern Area) and DYCP planning scenarios in Table 5.11.

Table 5.11 Treatment works losses assumed for each WRZ

WRZ	Treatment works losses at DYMDO / DYAA (MI/d)	Treatment works losses at DYCP (MI/d)
Western Area		
Hampshire Andover	0.21	0.21
Hampshire Kingsclere	0.08	0.08
Hampshire South	1.30	1.30
Isle of Wight	0.47	0.48
Central Area		
Sussex North	0.50	0.45
Sussex Worthing	0.84	0.84
Sussex Brighton	0.57	0.57
Eastern Area		
Kent Medway	1.40	1.40
Kent Thanet	0.65	0.65
Sussex Hastings	0.34	0.38
Total for the company	6.36	6.36

6. Demand for water

Section summary

This Section provides a detailed technical explanation of how the demand forecast has been developed for the 25 year planning period

Aspect of the WRMP addressed in this section of the Technical Report	Reference
Assessment of the climatic conditions in the base year and clarification of the type of year in relation to factors influencing demand	Para.6.9-6.16
Justification and information to support the adjustment of base year demand to represent a normal year , based on clear and detailed historical weather records	Para. 6.9-6.24
Description of the type and duration of critical periods , along with assumptions and identification of operational constraints which may affect the management of the critical period demand	Para.6.7, 6.9-6.12
Description of assessment of dry year demand , including assumptions and adjustment factors with support from historical data	Para.6.17-6.22
Discussion of rebasing techniques used to estimate how historic demands would have looked if they had occurred with the current customer base (in terms of metering levels, population, leakage levels, etc.)	Para.6.13-6.21
Relation of the assumptions within the dry year demand analysis to the water use restrictions in the planned levels of service in section 3.	Para. 6.7
Summary of the approach used to develop assessments of populations and properties for households and non-households	Para. 6.28-6.34 (and Appendix F01)
Description of occupancy rate survey , including sample size, response rate, breakdown by customer group, and calculation of occupancies representing the company's customer base	Para.6.31-6.32 (and Appendix F01)
Description of the population and properties forecasting approach and findings, including details of liaison with local authorities, and sub-division into sub-categories	Para.6.25-6.35 (and Appendix F)
Presentation of base year household demand , including information on how customers use water	Para.6.5, 6.24, 6.36-6.39 (and Appendix F)
Description of the development of a micro-component PCC assessment, including explanation of data sources used to derive current and forecast micro-component consumption, and any effects of socio-economic or geographical differences. Explanation of assumptions underpinning each micro-component category	Para.6.36-6.39 (and Appendix F)
Description of inclusion of demand management savings in the baseline demand forecast , from continuation of metering policies, maintaining leakage at the 2015 target level, and water efficiency activity associated with a statutory duty to promote water efficiency	Para.6.38, 6.50-6.62, 6.66-6.68 6.70, 6.72-6.74
Description of allowance for climate change impacts on demand , including derivation of factors where appropriate.	Para.6.63-6.65
Description of the method to estimate the base year non-household demand , broken down into different sectors.	Para. 6.19, 6.27
Presentation of forecast assumptions for non-household demand , accounting for socio-economic growth, and potential technology and regulatory changes	Para.6.45, 6.66-6.68

Description of the derivation of base year leakage levels and the profile to reach the target level of leakage agreed with Ofwat	Para.6.21, 6.70-6.74
Statement about how the company intends to control leakage in its current operations	Para.6.73-6.74
Description of how other components of demand have been assessed	Para.6.49

Statutory requirements addressed in this section

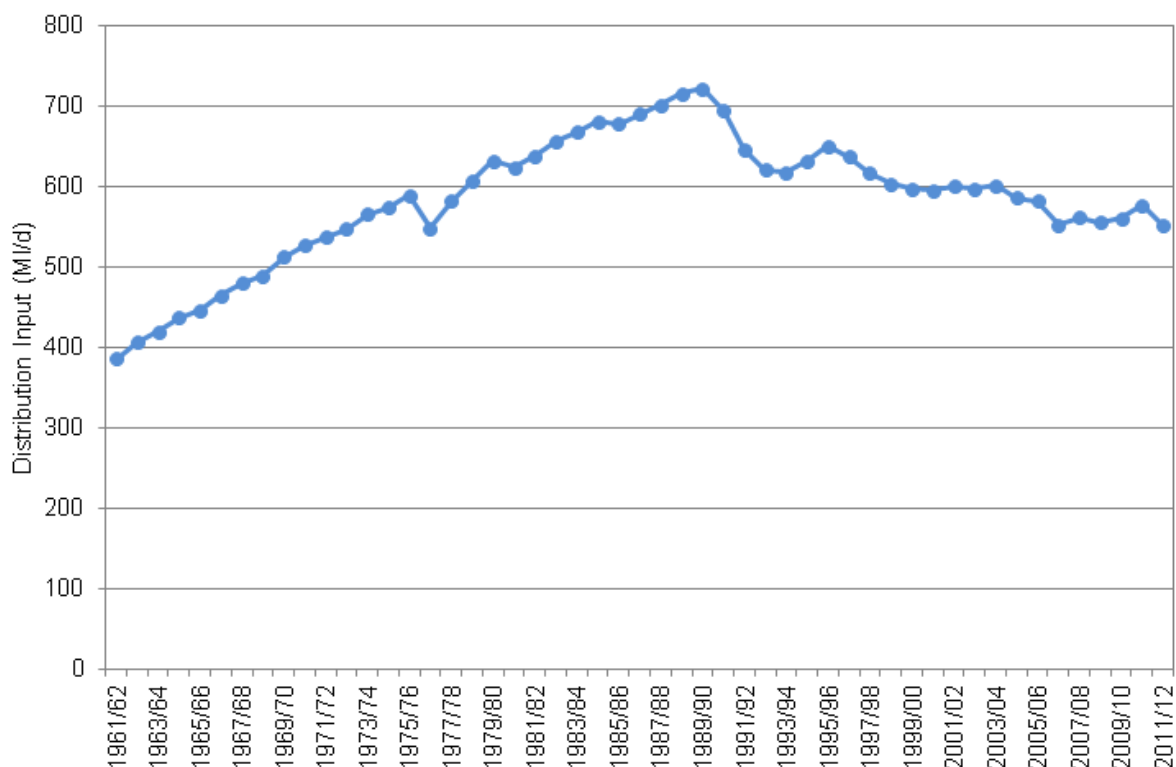
The following table summarises the statutory requirements (legislation, regulations and directions) applied to the water resource planning process, and provides a cross reference to the relevant part of this section of the WRMP.

Legislation ref.	Description of matter to be addressed	Reference
Dir 2012 S3(d)	How the supply and demand forecasts contained in the WRMP have taken into account the implications of climate change	Para. 6.63-6.65 (Para.5.90-5.100, Appendix D & F)
Dir 2012 S3(e)	How it has estimated future household demand in its area over the planning period, including assumptions made in relation to population and housing numbers	Para. 6.25-6.26, 6.28-6.32, 6.36-6.39, 6.41-6.44, 6.46-6.48 & 6.69
Dir 2012 S3(f)	Its estimate of the increase in the number of domestic premises in its area over the planning period in respect of which it will be required to fix charges by reference to volume of water supplied under S144A WIA 1991	Para. 6.41-6.44 (Appendix F)
Dir 2012 S3(g)	Where the whole or part of its area has been designated as an area of serious water stress, its estimate of the number of domestic properties which are in the area of serious water stress and in respect of which it will fix charges by reference to volume of water supplied to those premises over the planning period	See above
Dir 2012 S3(h)	Its estimate of the increase in the number of domestic premises in its area(excluding those under S3(g)) over the planning period, in respect of which S144B(2) WIA 1991 will not apply because the conditions referred to in S144B(1)(c) WIA 1991 are not satisfied and in respect of which it will fix charges by reference to volume of water supplied to those premises	See above
Dir 2012 S3(k)	A programme for the implementation of what is forecasted pursuant to S3(g) and (h)	Para. 6.44

Introduction

- 6.1. This section sets out Southern Water's demand forecast for the WRMP which has been derived in line with the recommended Best Practice as outlined in WRP. A detailed description of demand forecast is attached as Appendix F01 and supporting data are presented in Appendix F02. A summary is presented herein.
- 6.2. During 2011/12, Southern Water supplied 551 MI/d on average which is the lowest since 1978/79, despite the increase in population during this time, and is a continuation of the overall lowering trend since privatisation in 1989/90 (Figure 6.1).

Figure 6.1 Average annual Distribution Input from 1961/62 to 2011/12



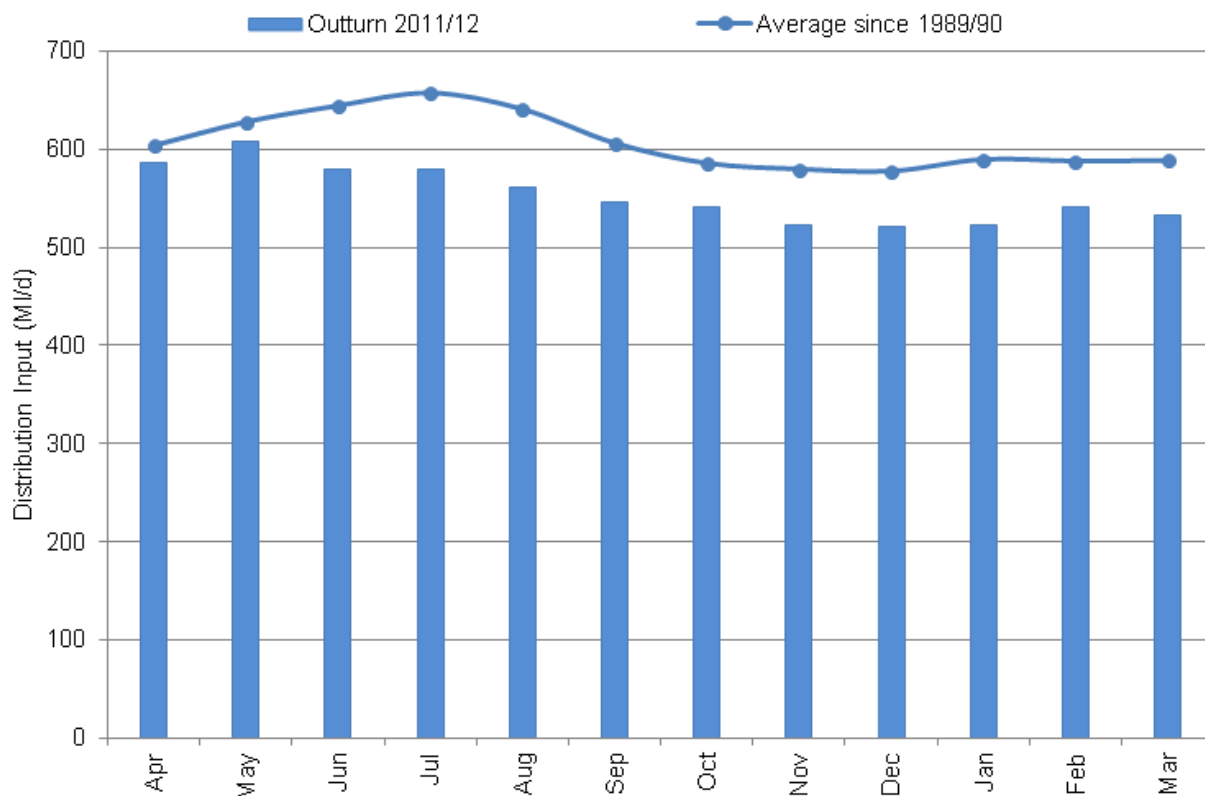
- 6.3. The reduction in Distribution Input (DI) since privatisation has been a result of decline in both household and non-household consumption as well as leakage. Decrease in household demand has been driven by increased customer awareness, changes in lifestyle, development of more efficient devices such as WCs, washing machines and dishwashers, on-going water efficiency campaigns run by Southern Water as well as increased domestic metering. Non-household demand has declined due to both increased water-use efficiency as well as a reduction in the non-household customer base.
- 6.4. The base year for the forecast is 2011/12. In 2011/12, 47% of Southern Water's domestic customers were being charged on metered basis. As part of the Universal Metering Programme (UMP) being run by the company, the figure will increase to 92% by 2015/16.
- 6.5. Salient features of the revised demand forecast are:
- Total population supplied is forecast to increase from 2,396,191 in 2011/12 to 2,933,878 in 2039/40;
 - The number of total connected properties is forecast to increase from 1,064,641 in 2011/12 to 1,267,863 in 2039/40;
 - Average daily household demand in a normal year is projected to increase by 1% from 356 MI/d to 364 MI/d in 2039/40. This figure includes climate change impact on

household demand. If climate change impact is excluded, then the final year figure is 362 MI/d;

- Non-household demand is forecast to increase by 6% over the planning period from 103 MI/d to 110 MI/d;
- Average per capita consumption under normal year conditions is projected to decrease from 152 l/h/d to 128 l/h/d in 2039/40 reaching the Government's aspirational target of 130 l/h/d in 2026/27. Excluding climate change impact, per capita consumption drops to 127 l/h/d in 2039/40.

6.6. Domestic demand varies seasonally and with prevailing weather conditions. It increases during late spring/early summer, driven primarily by increases in discretionary use, and declines during autumn/winter (Figure 6.2). A hot, dry summer typically leads to a pronounced 'summer peak' in demand whereas a wet summer results in a lower contrast between summer and winter demand profiles. 'Peak demand' for planning purposes is based on average demand over a 7-day rolling period; the highest value over a year defines the 'average day peak week' or 'critical period' demand.

Figure 6.2 Average monthly Distribution Input from 1989/90 to 2011/12 and its comparison with 2011/12 outturn data



Demand scenarios

- 6.7. This WRMP presents demand forecasts for a range of design scenarios:
- Normal Year Annual Average demand (NYAA) – developed by normalising the base year (2011/12) demand to account for the influence of population increase, metering, weather and demand restrictions. The estimate represents demand that would occur under ‘normal’ conditions;
 - Dry Year Annual Average demand (DYAA) – the annual average demand in a year with low rainfall, but without any demand restrictions in place. This demand is used with the average deployable output (ADO) supply scenario. SWS’s Target Level of Service is for hosepipe bans to be introduced no more than once in ten years;
 - Dry Year Critical Period demand (DYCP) – the peak week demand during summer in a dry year. This demand is used with the peak deployable output (PDO) supply scenario; and
 - Dry Year Minimum Deployable Output demand (DYMDO) – the autumn demand in a dry year when ground water levels and river flows are generally at their lowest and sources are operating close to their minimum deployable outputs. Whilst demand in this period is generally not as high as in the summer, it is important to investigate this scenario because the available supplies are generally vulnerable.
- 6.8. The WRP Guideline requires all water companies to develop demand forecasts for the NYAA and DYAA scenarios. However, in some WRZs the main drivers for investment could be DYCP and DYMDO scenarios depending on local characteristics such as volume of storage available, composition of sources etc. These scenarios are therefore also considered for the WRMP, as discussed previously in paras.3.38-3.54.

The base year

- 6.9. Temperature and rainfall are the main climatic variables that influence water demand. A comparison of long-term (since 1910) average monthly rainfall and temperature data for Southern and South East England against the base year (2011/12) is shown in Figure 6.3. With the exception of April and September, average temperatures in 2011 during the period of higher than average demands (April through September - Figure 6.3), were similar to the long-term average, and there was an exceptionally cold spell in December 2011. However, parts of the summer, normally the period with highest demand, were wetter than average (Figure 6.3). The lower than average rainfall from September to November 2011 was more important for water resources than for demand.
- 6.10. The highest monthly Distribution Input (DI) in 2011/12 was recorded in May, which was slightly warmer and, along with April, was significantly drier than average. Traditionally the period from June to August has had higher DI (Figure 6.2). Therefore in the context of the climatic variables that influence demands, 2011/12 is not considered to be a normal year; neither is it considered to be a dry year as higher than average rainfall during July and August (Figure 6.3) appears to have a suppressed demand when it would typically be higher. Towards the end of 2011/12, SWS announced plans to impose hosepipe ban for its household customers from 06 April 2012 i.e. not during the base year but in 2012/13. The announcement of hosepipe ban may also have led to a lower DI in March 2012.
- 6.11. The annual average DI for the year (551 Ml/d) is the second lowest since privatisation in 1989-90 (Figure 6.3). This resulted from a significant drop in leakage (lower by 11 Ml/d compared to 2010/11) and non-household demand (lower by 33 Ml/d compared to 2010/11). In contrast, household consumption (363 Ml/d excluding supply pipe leakage) has been the highest since 2004/05, likely to be linked to the generally warmer and drier 2011/12 with the exceptions noted above.
- 6.12. As mentioned above, demand is typically higher during the summer months. Figure 6.4 shows a plot of total monthly rainfall and average monthly temperature during the summer (April – September) months since 1910/11. As can be seen from the figure, there are very few years over the past 100 years that fall in the central area of the chart. It is also worth noting that while temperature varies over a relatively narrow range (+2°C), rainfall can vary over a much larger range (+200 mm). When summer months are considered as a whole, 2011/12 is seen to be an average year in terms of temperature but drier in terms of rainfall (Figure 6.4).

Figure 6.3 Comparison of average monthly rainfall and temperature data for Southern and South East England since 1910/11 with 2011/12 figures (source: www.metoffice.gov.uk)

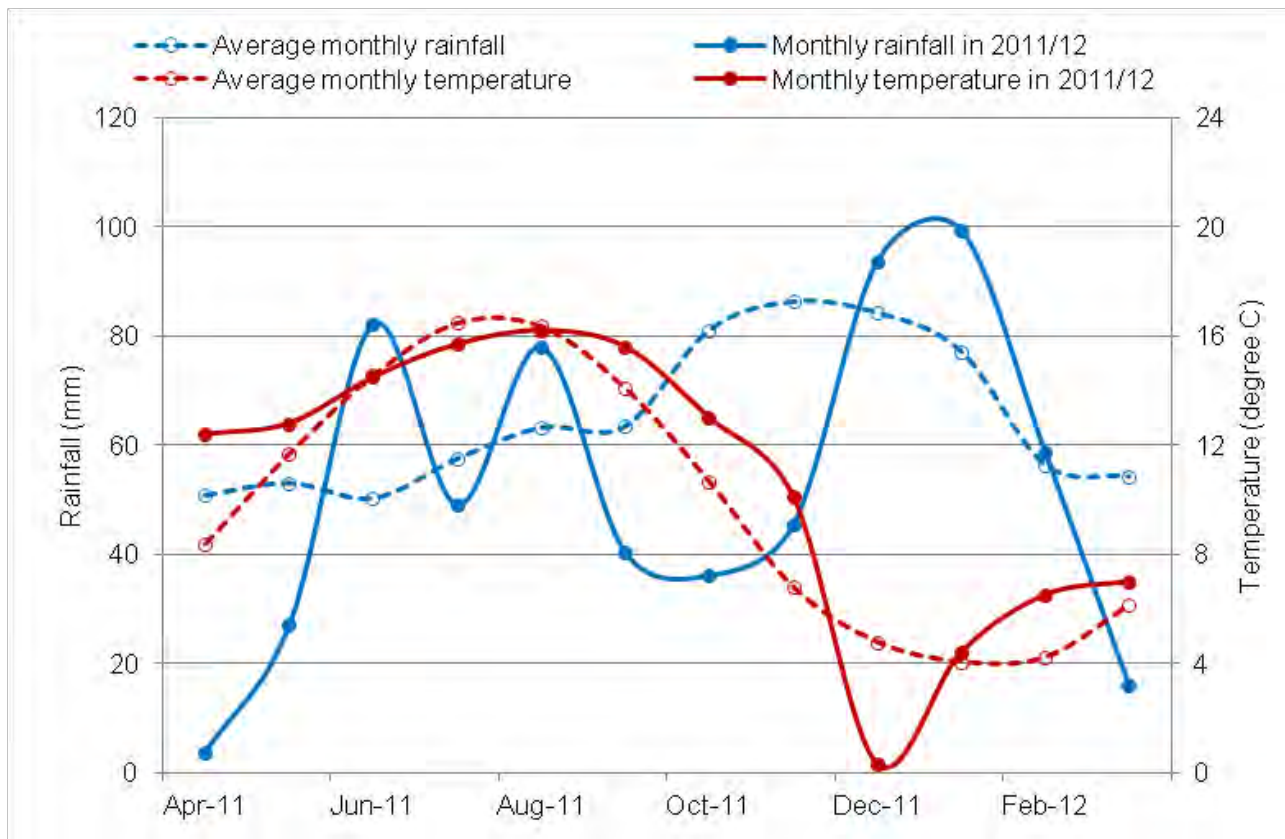
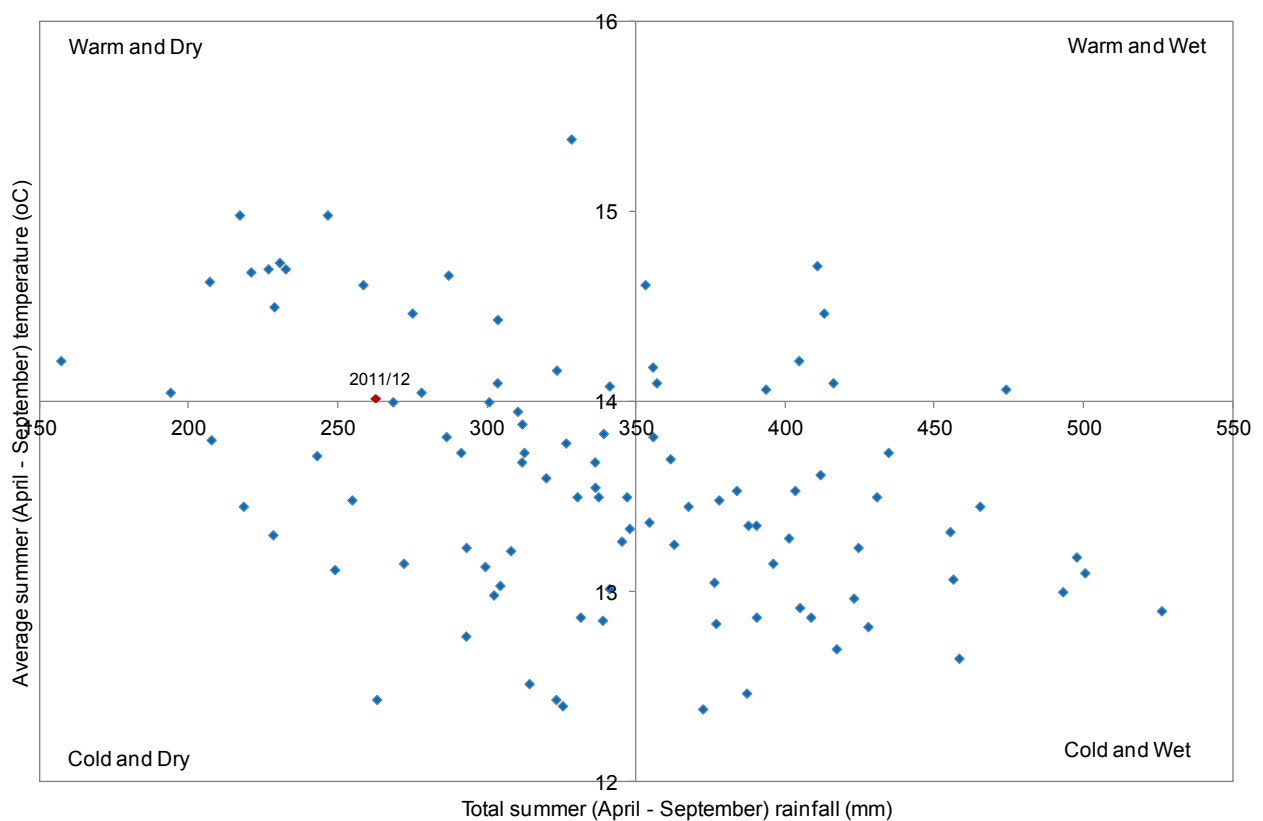


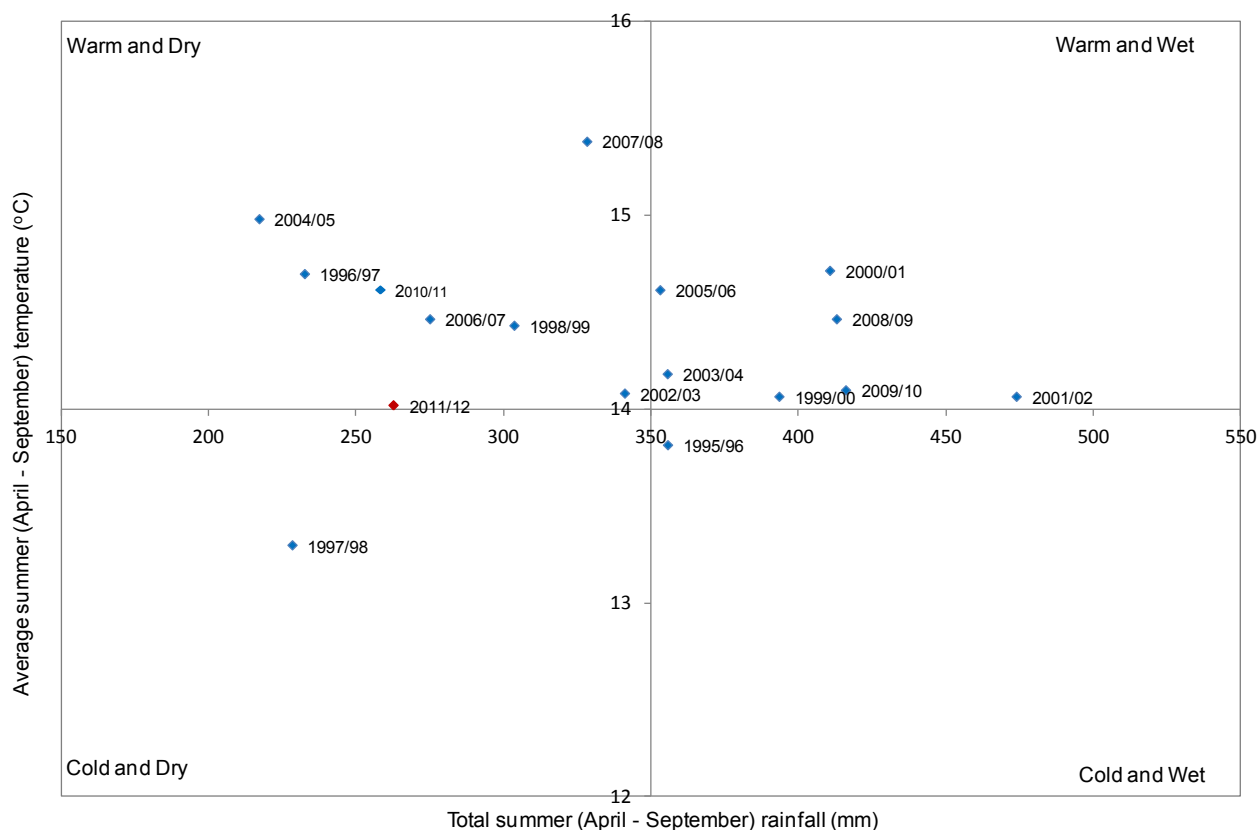
Figure 6.4 Total rainfall and average monthly temperature during the summer (April-September) months since 1910/11



Normalisation of base year demand

- 6.13. The WRPG requires water companies to produce a 'weighted average demand forecast'. The component of demand most directly impacted by weather is household demand, particularly outdoor activities such as garden watering. Non-household demand is largely independent of weather with the exception of perhaps agriculture and beverages industry, neither of which constitutes a significant component of Southern Water's total non-household customer base.
- 6.14. Figure 6.4 highlights the difficulty in precisely defining an 'average weather' year in terms of temperature and rainfall. Secondly, although it is possible to broadly link daily DI with mean daily rainfall and temperature, it is usually not possible to separate consumption from other components (e.g. leakage, water taken unbilled etc.) of DI as they are typically estimated on an annual basis. Moreover, while weather is a key influence on demand there are other factors, most notably household occupancy and meter penetration levels that can significantly impact demand.
- 6.15. The aim of normalising base year demand has therefore been to estimate demand that would have been experienced in previous years if the customer base and meter penetration level were the same as in the base year and then derive a value of for the base year that is reflective of average weather condition over the period of interest.
- 6.16. In order to normalise base year demand, data from 1995/96 to 2011/12 have been used as data prior to 1995/96 are considered to be less robust. Figure 6.5 shows the same data as in Figure 6.4 but from 1995/96 onward. Comparison of Figures 6.4 and 6.5 shows that summers over the recent past have been generally warmer with only one summer (1997/98) falling in the 'cold and dry' quadrant and one (1995/96) in the 'cold and wet' quadrant. Figure 6.5 also shows that there have been almost equal instances of 'wet' and 'dry' summers since 1995/96.

Figure 6.5 Total rainfall and average monthly temperature during the summer (April-September) months since 1995/96



- 6.17. Base year demand was normalised as follows:
- a. For each year, leakage was removed from DI as it does not represent true consumption;
 - b. The DI minus leakage figure was then corrected for any restrictions that may have been in place during that year; this was done in accordance with UKWIR methodology (UKWIR, 2007);
 - c. Non-household demand was then removed from the figure calculated in step 'b' and the derived household consumption corrected for changes in metering levels and population; correction for metering assumed 10% and 15% reduction in demand during normal and peak conditions respectively;
 - d. Non-household demand and leakage were then added back to the figure calculated in step 'c' to derive rebased or normalised demand for that year;
 - e. Steps a-d were repeated for Peak DI and MDO DI. Peak DI was calculated over a 7-day rolling period whereas MDO was based on 30-day rolling average during October-November;
 - f. Steps a-e were repeated for each year from 1995/96 to 2011/12 for each WRZ.
- 6.18. Base year demand under the NYAA is the arithmetic average of the rebased NYAA DI from 1995/96 to 2011/12. As the period contains wet and dry years in roughly equal proportions, this is also considered to represent the weighted average demand. For the draft demand forecast, DYAA demand was calculated by taking the 90th percentile of the rebased NYAA DI. This is considered to be equivalent to the 1 in 10 year demand. Similarly, for DYCP and MDO scenarios, 90th percentile of the rebased Peak DI and MDO DI respectively were used and are considered to represent 1 in 10 year demand.
- 6.19. Base year non-household demand is based on 2011/12 post-accrual outturn data (103 MI/d) rather than the average of last three years' figures (122 MI/d) used in draft demand forecast. This has resulted in a lower NYAA figure for the revised demand forecast.
- 6.20. Weighted average demand figures will be used by Ofwat to set tariffs. Southern Water faces significant revenue shortfall in AMP5 and a lower figure for NYAA demand has been adopted to mitigate against the risk of a repeat in AMP6. However, it does present a planning risk in terms of underestimating demand in the event that the economy improves earlier and/or at a faster rate than forecast. One option for balancing the risk of overestimating revenue with that of underestimating demand was to retain DYAA, DYCP and DYMDO demand forecasts from the DWRMP. However, this results in household demand being higher than it otherwise would be as household demand is considered to be the only component of DI that is significantly impacted by weather. Following discussions with the Environment Agency, DYAA, DYCP and DYMDO demand scenarios have been developed by updating all components of DYAA, DYCP and DYMDO demand forecasts in the DWRMP with revised figures. The resulting difference in DI for the three scenarios effectively represents the risk around non-household demand, which has been incorporated into the headroom.
- 6.21. The base year leakage figure is the Ofwat agreed target for 2011/12 (93 MI/d for the company) rather than the outturn leakage figure. The low outturn leakage in 2011/12 was achieved through committing extra resources to leak detection and repairs implemented in accordance with the Drought Plan as part of the drought management initiative in response to the worsening water resources position over the winter of 2011/12, and also aided by a mild winter. It is therefore considered to be too low to be representative of an average year.
- 6.22. Total base year DI under various scenarios is summarised in Table 6.1.

Table 6.1 Base year Distribution Input (MI/d) under various scenarios

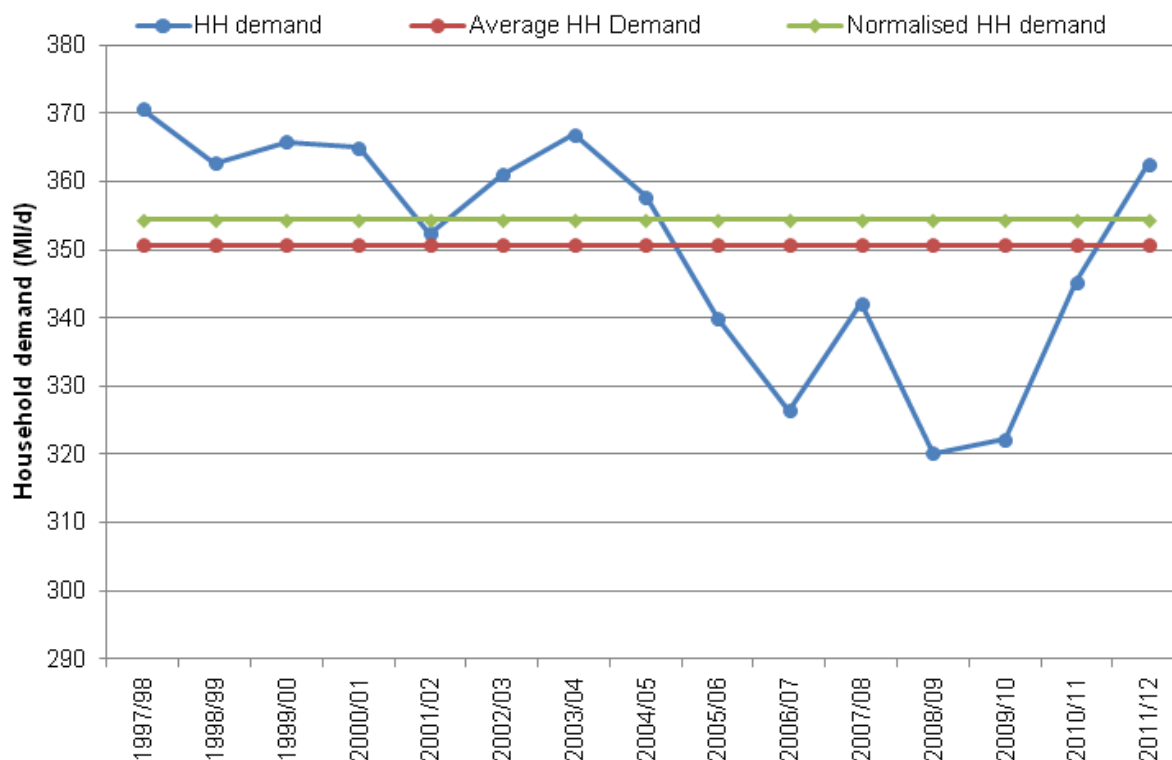
	NYAA	DYAA	DYCP	DYMDO
Hants Andover	15.2	16.3	21.1	17.2
Hants Kingsclere	4.2	4.8	6.9	4.6
Hants South	145.0	158.6	204.5	153.0
Isle of Wight	31.8	34.6	44.4	33.0
Western Area	196.3	214.3	276.9	207.8
Sussex North	59.2	61.7	80.0	61.0
Sussex Worthing	42.1	43.7	52.9	42.7
Sussex Brighton	81.7	84.6	102.3	82.6
Central Area	182.9	190.0	235.2	186.3
Kent Medway	115.6	121.0	148.0	115.2
Kent Thanet	44.8	46.0	60.5	43.5
Sussex Hastings	24.5	25.5	31.4	25.1
Eastern Area	184.9	192.5	239.9	183.8
SWS	564.1	596.7	752.0	577.9

- 6.23. Normalised household demand is less than the outturn figure both in absolute terms (MI/d) and as a percentage of total DI (Table 6.2).
- 6.24. Normalised household demand is slightly higher than the average household demand since 1997/98 (Figure 6.6). However, average household demand does not take account of the effects of any restrictions that were in place during this time nor is it weighted for changes in customer base and metering levels over time. The rise in demand from 2009/10 to 2011/12 can be attributed to the shift from 'warm and wet' to 'warm and dry' summers (Figure 6.5).

Table 6.2 Comparison of normalised base year demand with outturn figures for 2011/12

	Normalised figure		Outturn figure	
	MI/d	% DI	MI/d	% DI
Unmetered household demand	218.8	39%	236.6	43%
Metered household demand	137.4	24%	125.3	23%
Unmetered non-household demand	4.7	1%	4.5	1%
Metered non-household demand	98.5	17%	89.4	16%
Distribution losses	76.6	14%	64.6	12%
Supply pipe leakage	16.4	3%	16.4	3%
Distribution System Operational Use	2.8	0%	2.8	1%
Water taken unbilled - legally	3.3	1%	3.2	1%
Water taken unbilled - illegally	5.8	1%	8.6	2%
Total DI	564.1	100%	551.4	100%

Figure 6.6 Household demand (Ml/d) from 1997/98 to 2011/12



Customer segmentation - household customers

6.25. The WRPG recommends segmentation of customers beyond the traditional unmetered and metered categories into further metering categories such as meter optants, change of occupancy metering, selective metering and compulsory metering. As a result of UMP, sub-categories of metered household customers are not considered to be applicable to Southern Water customers beyond 2014/15. In order to have a better understanding of its customer base, and any consumption variations therein, the company has adopted the socio-economic ACORN (A Classification of Residential Neighbourhoods) classification by CACI Ltd for further subdividing both its unmetered and metered customers. Although ACORN classification does not take water consumption explicitly into account, it considers a number of factors such as property type, occupancy, age profile of occupants, income levels etc. that have been shown to impact domestic consumption. Recent work (see Appendix F01) suggests property type and ACORN category to be the main influences on domestic consumption. There are five main ACORN categories:

- ACORN 1 (Wealthy Achievers)
- ACORN 2 (Urban Prosperity)
- ACORN 3 (Comfortably Off)
- ACORN 4 (Moderate Means)
- ACORN 5 (Hard Pressed)

For the purpose of this demand forecast, the following categories have been used based on analysis of a sample of metered customers that typically showed either ACORN 1 or ACORN 5 to be the highest users with ACORN 2-4 showing no consistent pattern:

- ACORN 1 (most affluent)
- ACORN 2-4
- ACORN 5 (least affluent)

- 6.26. ACORN categories have been assigned to SWS customers based on postcodes. Overall, ACORN 2-4 is the dominant category among both unmetered and metered households but a greater proportion of metered households fall into ACORN 1. Unmetered households have a greater proportion of ACORN 5 (Table 6.3).

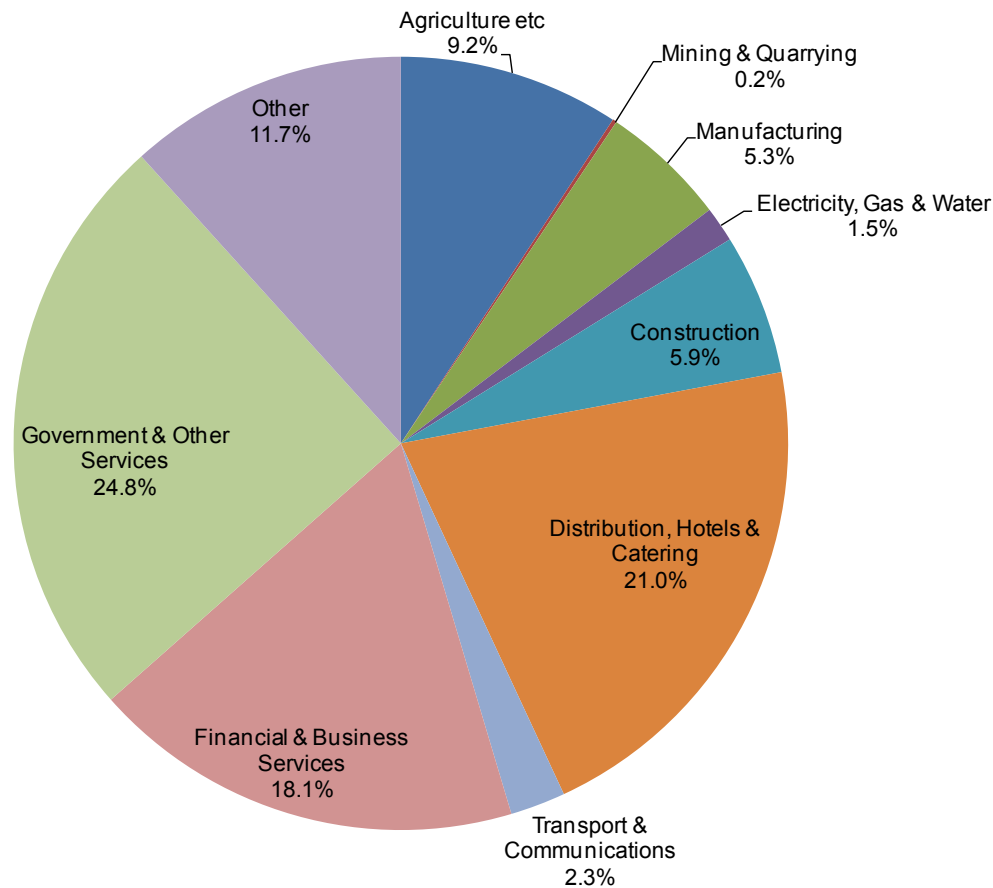
Table 6.3 Base year breakdown of SWS's domestic customers by ACORN

	Unmetered households			Metered households		
	ACORN 1	ACORN 2-4	ACORN 5	ACORN 1	ACORN 2-4	ACORN 5
Hants Andover	29%	54%	17%	36%	52%	12%
Hants Kingsclere	62%	28%	10%	70%	21%	9%
Hants South	27%	51%	22%	32%	55%	13%
Isle of Wight	28%	64%	9%	33%	55%	13%
Western Area	28%	51%	21%	33%	54%	13%
Sussex North	27%	53%	21%	41%	49%	10%
Sussex Worthing	16%	73%	11%	26%	67%	7%
Sussex Brighton	8%	68%	23%	17%	72%	11%
Central Area	15%	65%	20%	27%	63%	10%
Kent Medway	16%	66%	18%	25%	65%	10%
Kent Thanet	12%	67%	20%	19%	68%	12%
Sussex Hastings	14%	66%	20%	27%	60%	12%
Eastern Area	15%	67%	19%	24%	65%	11%
SWS	19%	61%	20%	28%	60%	11%

Customer segmentation - non-household customers

- 6.27. The WRPB recommends production of a sectoral based forecast of non-household demand using either Standard Industrial Classification (SIC) codes or some other form of classification. Southern Water engaged Cambridge Econometrics (CE) to provide the non-household demand forecast. CE subdivided non-household customers into 9 broad sectors and 42 sub-sectors based on SIC codes (see Appendix F02 for details). The base year distribution of non-household customers by CE sector is given in Figure 6.7.

Figure 6.7 Breakdown of 2011/12 non-household customer base by sector



Household population, property and occupancy estimates

6.28. Population and property forecasts have been provided by Experian Business Services Ltd (Experian) (see Section 4.2 in Appendix F01). A comparison of base year household population figures from Experian with 2011/12 outturn data is shown in Table 6.4.

Table 6.4 Comparison of household population breakdown by WRZ and supply area for 2011/12

	Outturn 2011/12	Experian 2013	Difference (absolute)	Difference (percentage)
Hants Andover	63,016	65,427	2,411	3.8%
Hants Kingsclere	15,199	15,212	13	0.1%
Hants South	614,093	609,165	-4,928	-0.8%
Isle of Wight	139,030	133,561	-5,469	-3.9%
Western Area	831,338	823,365	-7,973	-1.0%
Sussex North	252,045	250,098	-1,947	-0.8%
Sussex Worthing	170,884	176,021	5,137	3.0%
Sussex Brighton	327,846	345,196	17,350	5.3%
Central Area	750,775	771,315	20,540	2.7%
Kent Medway	448,856	459,612	10,756	2.4%
Kent Thanet	183,094	187,341	4,247	2.3%
Sussex Hastings	100,938	105,005	4,067	4.0%
Eastern Area	732,888	751,957	19,069	2.6%
SWS	2,315,001	2,346,637	31,636	1.4%

- 6.29. As can be seen from Table 6.4, base year population figures from Experian are higher for all WRZs except Isle of Wight WRZ (-3.9%), Hampshire South WRZ (-0.8%) and Sussex North WRZ (-0.8%). Overall, there is a 1% reduction in base year population in Western Area whereas Central and Western areas show increases of 2.7% and 2.6% respectively with a 1.4% increase at the company level. The demand forecast is based on figures provided by Experian.
- 6.30. In the case of household properties, the number of households from the billing system is retained as it provides a direct measure of the number of properties connected to the Southern Water supply network and future monitoring of new connections will also be based on Southern Water billing system (see Appendix F02).
- 6.31. In order to update base year occupancy estimates, Southern Water commissioned a customer survey in April 2012. A total of 4,500 households were interviewed over the phone; 1,500 in each of the three main supply areas.
- 6.32. The ACORN distribution in the survey sample was different from the ACORN distribution in the Southern Water customer base. In addition, households with exclusively over-65 year old occupants were over-represented in the respondents when compared with ONS estimate for parts of South East England supplied by Southern Water. Occupancy estimates from the survey therefore had to be adjusted for these biases (see Section 4.2.3 in Appendix F01 for details). The adjusted occupancy estimates are given in Tables 6.5 and 6.6.

Table 6.5 Base year occupancies for unmetered households

	ACORN 1	ACORN 2-4	ACORN 5	Overall
Hampshire Andover	2.46	2.62	3.14	2.66
Hampshire Kingsclere	2.70	2.51	3.00	2.68
Hampshire South	2.73	2.78	2.43	2.69
Isle of Wight	2.24	1.98	2.34	2.09
Western Area	2.69	2.73	2.49	2.67
Sussex North	3.10	2.82	2.89	2.91
Sussex Worthing	2.95	2.46	2.67	2.56
Sussex Brighton	2.91	2.62	2.78	2.68
Central Area	3.01	2.63	2.80	2.72
Kent Medway	2.47	2.97	2.68	2.84
Kent Thanet	2.61	2.59	2.75	2.62
Sussex Hastings	2.72	2.44	2.68	2.53
Eastern Area	2.53	2.80	2.70	2.74
Southern Water	2.73	2.72	2.66	2.71

Table 6.6 Base year occupancies for metered households

	ACORN 1	ACORN 2-4	ACORN 5	Overall
Hampshire Andover	2.76	2.16	1.80	2.33
Hampshire Kingsclere	2.64	2.51	2.36	2.59
Hampshire South	2.53	2.20	2.23	2.31
Isle of Wight	2.11	2.19	2.17	2.16
Western Area	2.41	2.20	2.19	2.27
Sussex North	2.28	2.04	2.24	2.16
Sussex Worthing	2.27	1.99	2.18	2.08
Sussex Brighton	2.46	1.96	1.92	2.04
Central Area	2.32	1.99	2.08	2.09
Kent Medway	2.54	1.92	1.88	2.07
Kent Thanet	1.91	1.79	1.59	1.79
Sussex Hastings	2.32	2.00	1.83	2.07
Eastern Area	2.36	1.90	1.79	1.99
Southern Water	2.37	2.04	2.05	2.13

Non-household population, property and occupancy estimates

- 6.33. Estimates of non-household population in Experian have been adopted which are significantly lower than 2011/12 outturn data (Table 6.7).

Table 6.7 Comparison of 2011/12 outturn non-household population figure with Experian MLS

	2011/12 Outturn figure	Experian 2013	Difference (absolute)	Difference (percentage)
Hants Andover	4,861	973	-3,888	-80%
Hants Kingsclere	173	268	95	55%
Hants South	12,706	16,305	3,599	28%
Isle of Wight	4,590	4,631	41	1%
Western Area	22,330	22,177	-153	-1%
Sussex North	3,995	3,765	-230	-6%
Sussex Worthing	5,926	2,981	-2,946	-50%
Sussex Brighton	12,375	8,233	-4,142	-33%
Central Area	22,296	14,978	-7,318	-33%
Kent Medway	9,491	6,835	-2,656	-28%
Kent Thanet	5,534	3,559	-1,974	-36%
Sussex Hastings	4,069	2,005	-2,064	-51%
Eastern Area	19,093	12,399	-6,695	-35%
SWS	63,720	49,554	-14,166	-22%

- 6.34. 2011/12 outturn figures for non-household properties (Appendix F02) have been retained.

- 6.35. As the non-household demand forecast is based on sectoral analysis, population and property numbers are not explicitly used as drivers of non-household demand.

Base year per capita consumption

- 6.36. Household demand for the base year and the forecast over the planning period has been based on micro-component analysis (MCA) as recommended in the WRP. In carrying out MCA, domestic consumption is broken down into typical domestic activities (i.e. micro-components) and consumption is estimated separately for each activity using ownership, frequency-of-use and volume-per-use data. The sum of all micro-components gives overall PCC. It thus represents a bottom-up approach to domestic demand forecasting. The following micro-components have been used for PCC estimation:

- Toilet flushing
- Personal washing
- Clothes washing
- Dish washing
- Garden watering
- Miscellaneous indoor use
- Miscellaneous outdoor use

- 6.37. For MCA, ownership figures were based on the 2012 customer survey. Volume estimates were based on published data and ages of devices. Frequency-of-use estimates for various ACORN categories were set in view of occupancy and took account of studies carried out using loggers. See Section 4.3 in Appendix F01 for details.

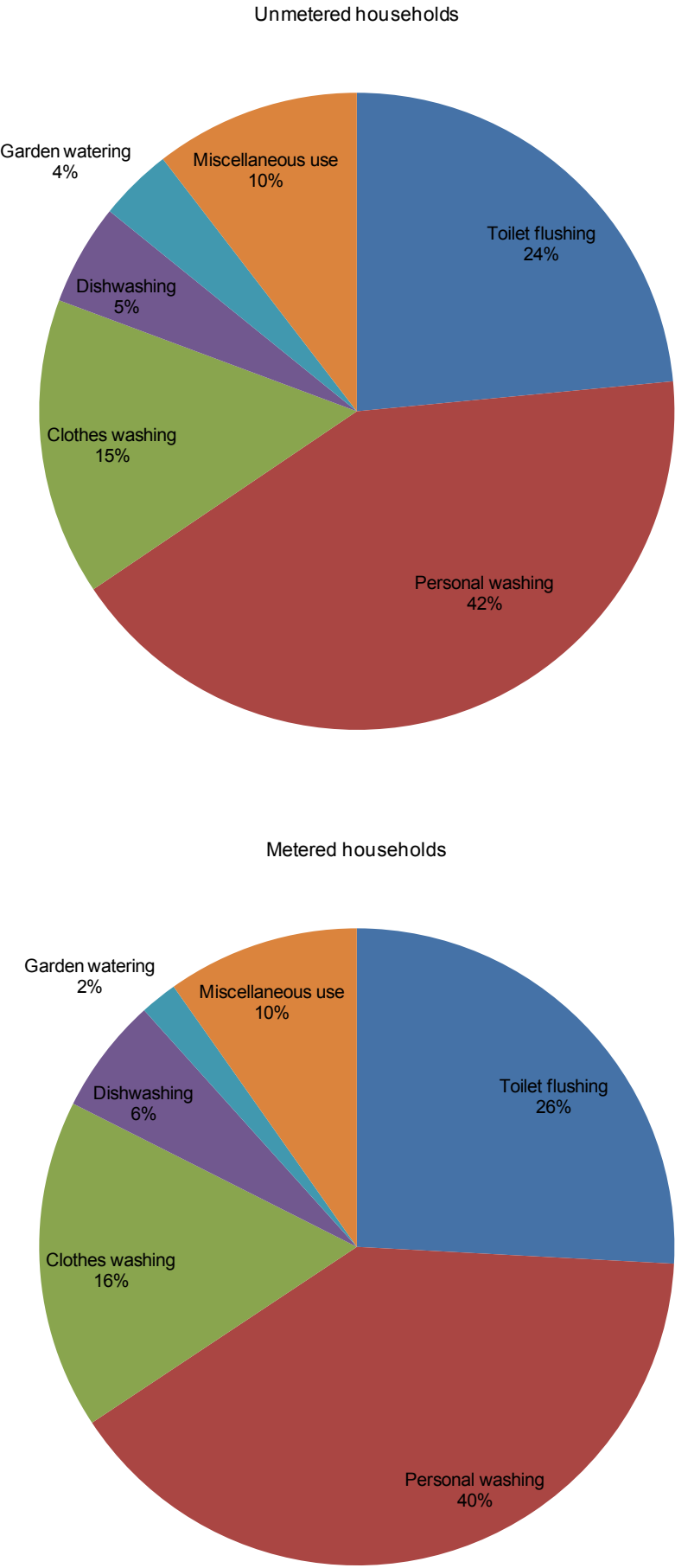
- 6.38. Total domestic PCC based on MCA is shown in Table 6.8. Unmetered household PCC since 1997/98 as reported in annual regulatory submissions has varied from 148.4 l/h/d to 169.8 l/h/d with a median value of 160.2 l/h/d. Over the same period, metered household PCC has varied from 132.6 l/h/d to 150.7 l/h/d with a median value of 136.5 l/h/d. Base year PCC estimates from MCA are lower than the median value for unmetered households and higher than the median value for metered households. This is because meter optant households have historically made up a significant proportion of metered households. As these households are typically low water users and possibly further reduce their consumption upon switching, the switching effect appears larger than for other categories of switchers. Under UMP, all types of household customers, including large users, will be metered and although metering is expected to lead to a lowering in consumption for the majority of customers, the impact may not be as large as in the case of switching dominated by meter optants. Base-year difference between unmetered and metered customers is therefore kept at ca. 10%. Using historical gap between unmetered and metered consumption risks underestimating metered household consumption.

Table 6.8 Base year breakdown of total PCC (litres/head/day) by ACORN and WRZ

	Unmetered households				Measured households			
	ACORN 1	ACORN 2-4	ACORN 5	Overall	ACORN 1	ACORN 2-4	ACORN 5	Overall
Hants Andover	165.4	163.7	140.0	159.3	140.2	139.8	161.8	142.1
Hants Kingsclere	198.0	180.1	164.1	189.4	180.6	154.2	163.7	173.9
Hants South	156.1	152.6	155.8	154.2	140.5	133.8	132.2	136.0
Isle of Wight	206.2	205.7	186.4	204.0	142.2	126.4	129.8	131.9
Western Area	160.5	155.2	154.7	156.6	141.7	131.9	133.2	135.5
Sussex North	159.6	161.8	155.6	159.9	150.4	149.9	145.7	149.7
Sussex Worthing	161.2	157.2	151.2	157.2	144.0	146.2	142.2	145.3
Sussex Brighton	156.8	155.7	154.6	155.5	142.3	141.9	142.6	142.0
Central Area	159.2	157.6	154.6	157.3	146.6	145.2	143.7	145.4
Kent Medway	175.9	161.6	175.6	165.9	149.0	152.0	152.2	151.1
Kent Thanet	152.6	150.3	154.1	151.4	152.4	141.7	148.3	144.6
Sussex Hastings	159.4	160.0	153.2	158.5	143.5	148.3	146.9	146.7
Eastern Area	168.4	158.6	166.2	161.3	148.5	148.7	150.1	148.8
SWS	162.2	157.4	158.7	158.6	144.7	140.9	140.2	142.1

- 6.39. The base year breakdown of household consumption by micro-component at the company level is shown in Figure 6.8. The percentage contribution of different micro-components to overall PCC is broadly consistent with published results (see Section 4.3.10 in Appendix F01 for details).

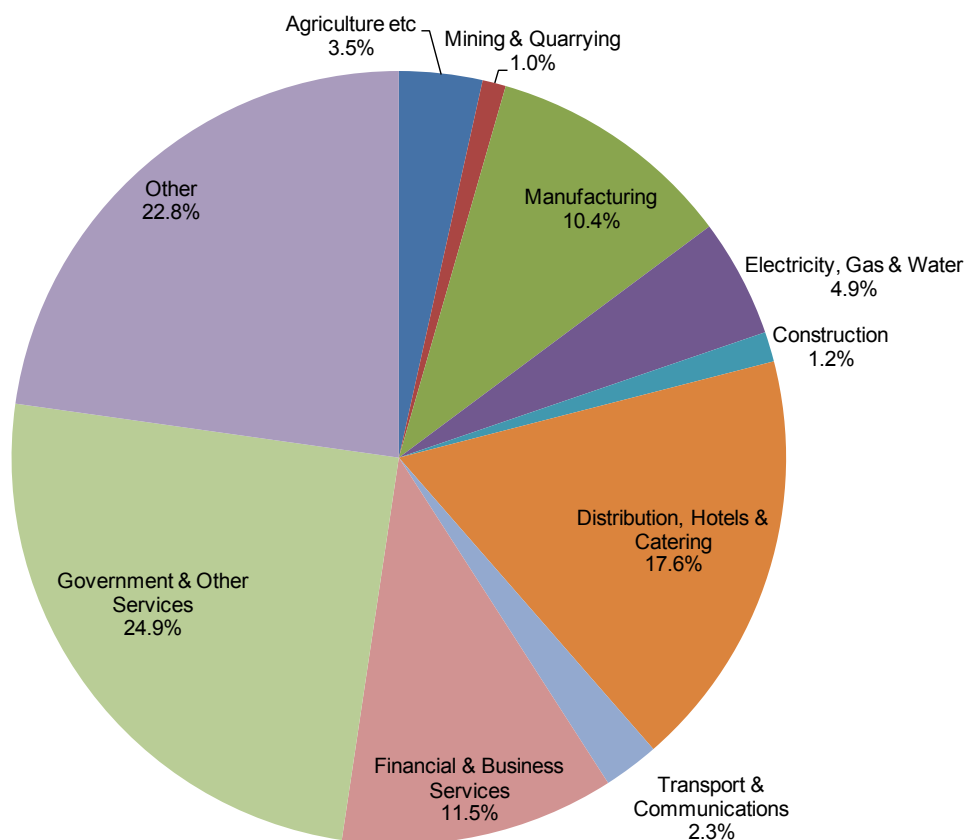
Figure 6.8 Breakdown of base year PCC for unmetered (above) and metered (below) households



Non-household demand

- 6.40. Base year non-household demand is set at 103 MI/d which is the post-accrual outturn figure for 2011/12. The breakdown of base year non-household demand by sector is shown in Figure 6.9.

Figure 6.9 Breakdown of 2011/12 non-household consumption by sector



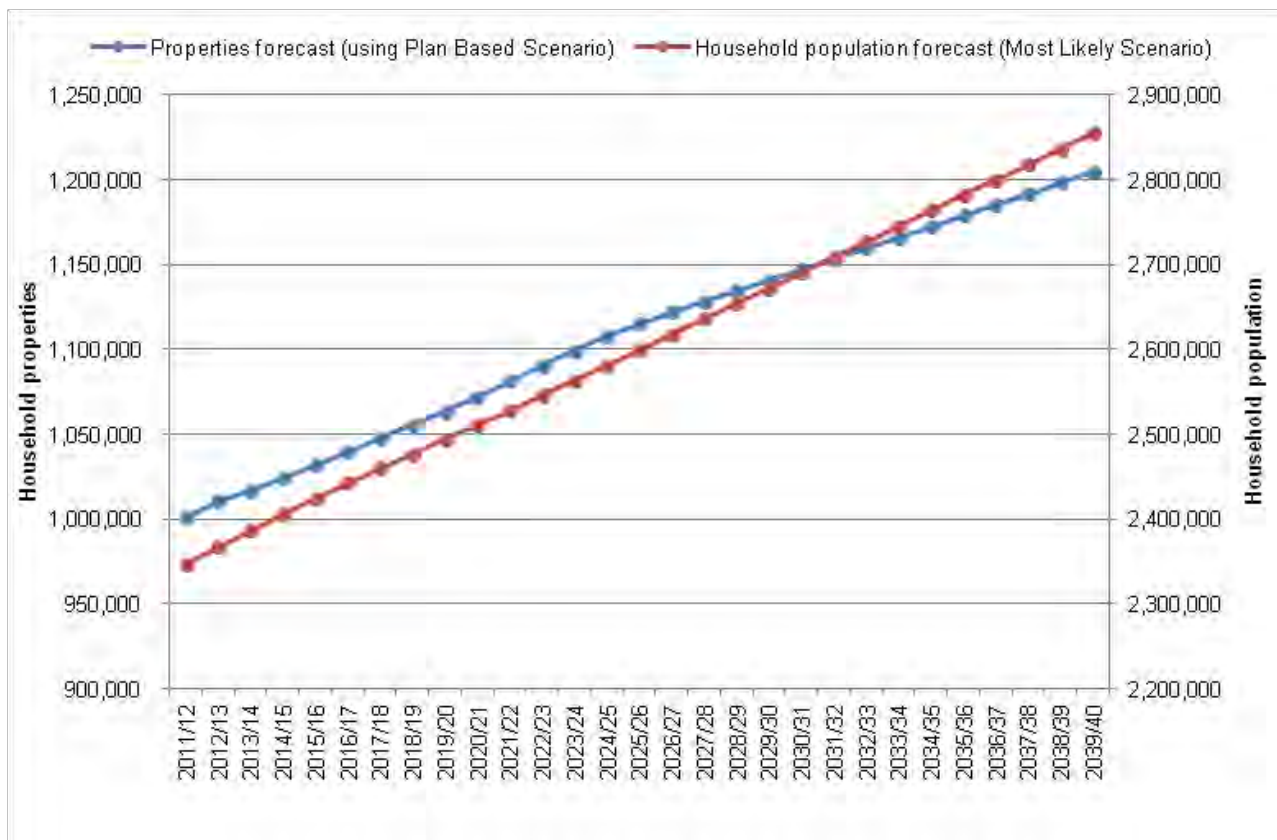
Demand forecast

Household population and property forecast

- 6.41. The WRPB recommends the use of Plan based scenario for growth forecasts. Southern Water has adopted Most Likely scenario for population forecast. This is based on comparisons of population projections for both PR09 and PR14 by Experian with projections by Office of National Statistics (ONS), covering the period from 2011 to 2021, which show that Most Likely scenario had matched ONS projections more closely than the Plan based scenario. Details are given in Section 4.2.1 of Appendix F01.
- 6.42. As recommended in the WRPB, forecast for new connections during the planning period are based on Plan based scenario. In view of the trend during AMP5 in which building of new homes has been lower than expected, the forecast has been adjusted slightly for AMP6 and AMP7. Experian forecast 43,129 new dwellings during AMP6 and 40,820 during AMP7. It is assumed that there will be a six month delay in the delivery of new properties during AMP6, which will be made up during AMP7. Accordingly, the number of new connections during AMP6 is revised down to 39,208 while the forecast for AMP7 is revised up to 44,741 such that the total number of new connections during AMP6 and AMP7 remain unchanged at 83,949. See Appendix F02 for annual breakdown of growth figures.

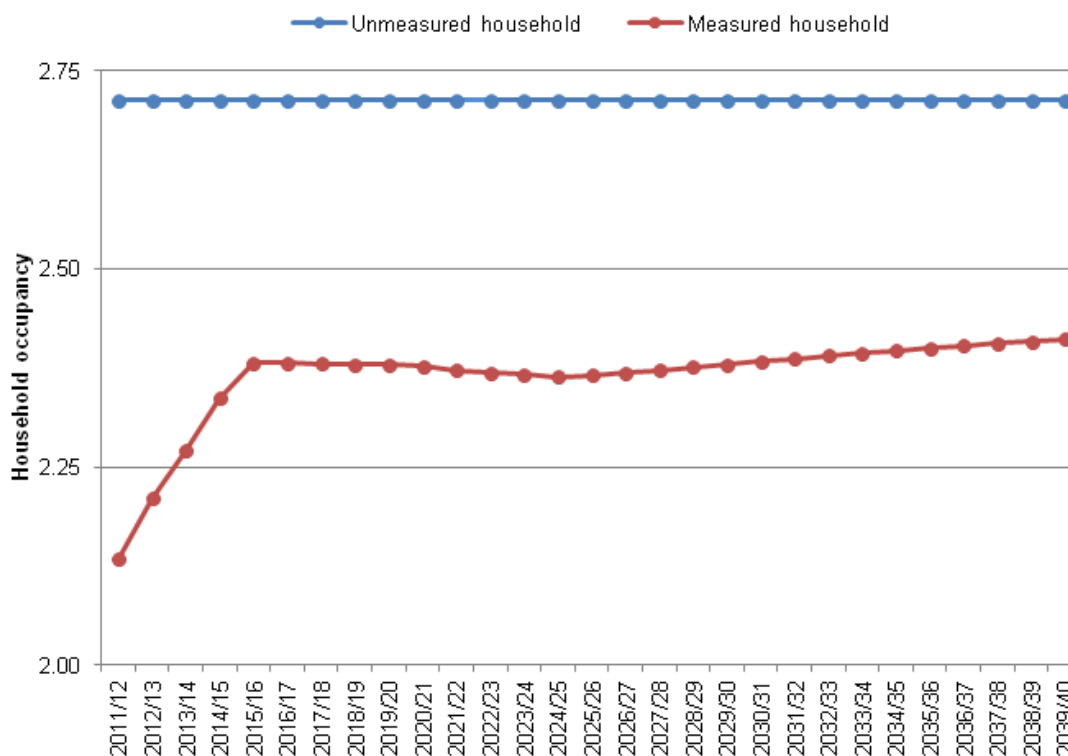
- 6.43. Population and properties forecasts used for the demand forecast are shown in Figure 6.10 and occupancy forecast is shown in Figure 6.11. A detailed breakdown by WRZ is given in Appendix F02.

Figure 6.10 Household population forecast by Experian (Most Likely Scenario) and Plan based household properties forecast



- 6.44. ACORN and occupancy distribution are likely to change post UMP due to migration of unmetered households to metered status. However, the migration is not expected to be uniform across the board as the ca. 77,000 households that will remain unmetered post UMP will mainly be properties with joint supplies or properties where a meter cannot be installed for operational reasons. The geographical distribution of unmetered households post UMP is also likely to be different. As the UMP is currently at the mid-point of its 5-year duration, it is not possible to accurately project the make-up of 'unmeterables' and their distribution across the Southern Water supply area. The demand forecast therefore assumes that such households will be distributed uniformly across all postcodes. Consequently, unmetered household occupancy remains unchanged throughout the 25-year forecasting period. This also means that unmetered household population remains unchanged post UMP and all population change is assumed to occur in metered households. Given the proportion of unmetered households post UMP, any errors in total household demand forecast due to this assumption are not likely to be significant. See Appendix F02 for the detailed occupancy forecast.

Figure 6.11 Occupancy forecast for metered and unmetered households



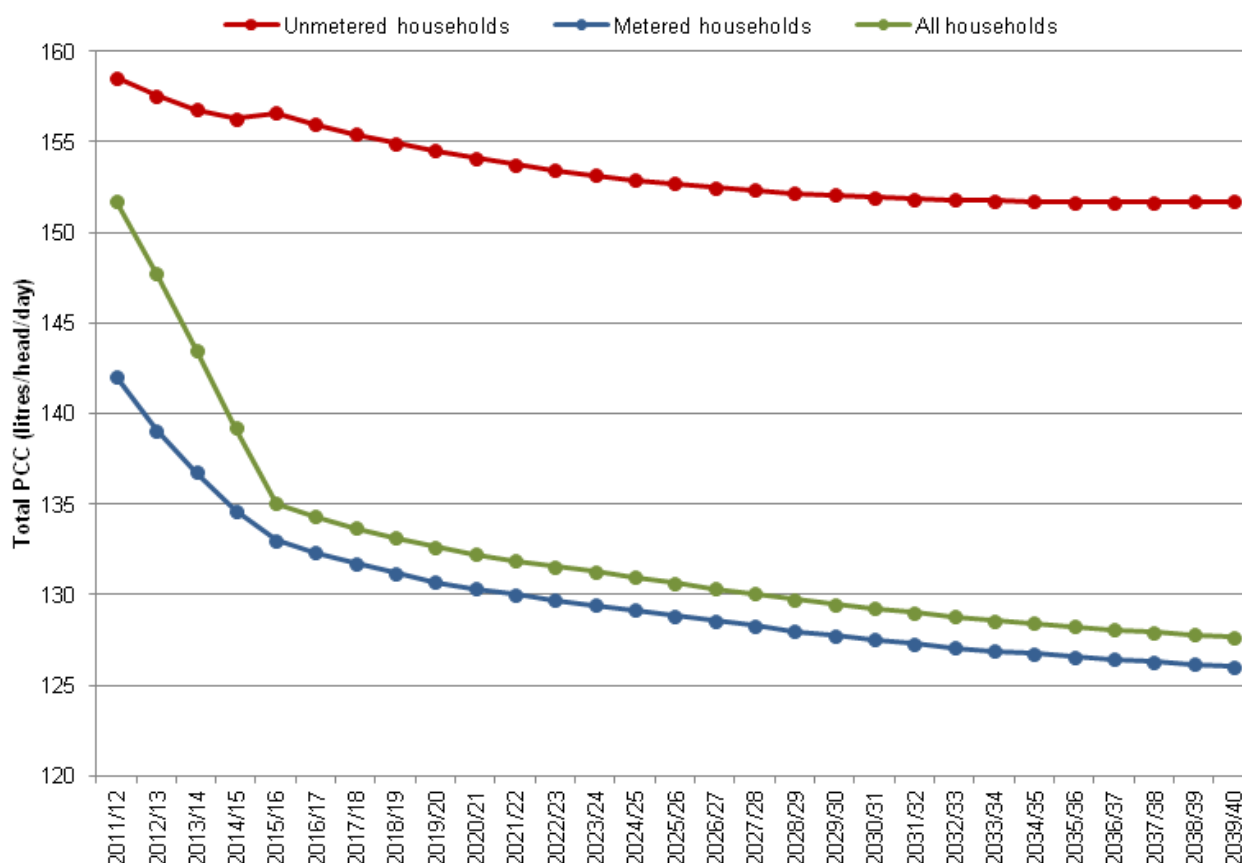
Non-household property and population forecasts

- 6.45. The non-household population forecast produced by Experian is adopted for the WRMP (see Appendix F02). Non-household property numbers are held at the base year level. As the forecast is based on sectoral growth, which is a function of both size of the sector and its economic output, non-household population and property numbers per se are not seen to be critical for the purpose of forecast.

Per capita consumption forecast

- 6.46. The PCC is forecast to decline for both unmetered and metered households (Figure 6.12). This is true for all ACORN categories in all WRZs (Appendix F02).
- 6.47. Consumption associated with toilet flushing, clothes- and dishwashing washing are forecast to drop due to the replacement of older models with newer, more water efficient ones. The volumes associated with personal washing (baths and showers) are forecast to increase due to a shift from baths to showers. Baths typically consume more water than showers but bathing frequency is generally lower than showering frequency. The effect of switching is exacerbated in the case of power showers (i.e. showers that are fitted with an internal pump to enhance flow). Other components of domestic demand (i.e. garden watering, miscellaneous indoor- and outdoor use) are forecast to remain more or less consistent over the planning period (see Appendix F01 for details).

Figure 6.12 Total PCC over the forecasting period



New properties consumption

- 6.48. Recent work on consumption of households built to Code for Sustainable Homes (CSH) suggests that homes built to a design standard of 105 l/h/d are more likely to exceed their design standard than homes built to a design standard of 125 l/h/d (see Appendix F01). The period covered in the analysis includes 2012/13 which was one of the wettest years on record. The PCC of new properties is therefore taken to be 125 l/h/d based on the assumption that all new homes built in the Southern Water will comply with Part G of the Building Regulations which cap the PCC of new homes at 125 l/h/d. Separate micro-component analysis has not been carried out for new properties.

Other components of demand

- 6.49. Base year Distribution System Operational Use (DSOU) and water taken unbilled values are taken from 2011/12 outturn data. DSOU and water taken unbilled (legally) values are held constant throughout the forecasting period at 2.81 Ml/d and 3.27 Ml/d respectively. For water taken unbilled (illegally), which represents water consumed by properties classified as 'voids' on the billing system but are in reality occupied, the value is forecast to change with the change in property numbers. Southern Water has recently completed a project with the aim of reducing the number of void properties on the billing system. The number of voids is therefore expected to be lower than the levels seen up to 2011/12. Going forward, the number of void properties is set at 2.8% of total billed households. For calculating of water taken unbilled (illegally), it is assumed that 35% of the voids in a given year are occupied and have the same PCC as an average unmetered household in the same year. See Section 7 in Appendix F01 for details.

Water efficiency

- 6.50. As part of UMP during AMP5, Southern Water set up an extensive water efficiency programme to ensure smooth transition of customers being metered to the new charging regime. The water efficiency programme includes provision of free advice on saving water at home, distributing free save-a-flush bags and offering discounts on a range of water-saving products such as water butts, low-flow showerheads, tap aerators, shower regulators, shower timers, dual flush retrofits for toilets and water saving crystals for gardens. In addition, the company offers free water audits to vulnerable customers who are likely to see an increase in their water bills as a result of metering.
- 6.51. In consultation with stakeholders, Southern Water has developed six key outcomes as part of its future strategy and promoting water efficiency features in four of them i.e. a constant supply of high quality drinking water, looking after the environment, affordable bills and better information and advice. This commitment to promote water efficiency is incorporated in the demand forecast.
- 6.52. Metering is commonly considered to result in a 10% reduction in domestic demand and this has been incorporated in developing base year PCC. In addition, metering is also likely to make households more receptive to water efficiency campaigns run by their water supplier or other organisations.
- 6.53. A key assumption in developing base year PCC is that for equivalent unmetered households, in terms of occupancy and ACORN grouping, metered households will have a lower frequency-of-use for micro-components that use ownership, frequency and volume (OFV) for estimating volume; and use lower volumes for micro-components such as miscellaneous use that are not determined using OFV.
- 6.54. Future volumes associated with various micro-components are influenced by two key factors;
- Advances in technology that result in more water efficient devices such that when older devices are replaced there is an automatic reduction in consumption as long as frequency of use does not increase; and
 - Behaviour change, whereby there is a conscious effort by customers to reduce their consumption.
- 6.55. Behaviour change may include 'soft' measures (e.g. only using dishwashers and washing machines when fully loaded, turning off the tap when brushing teeth etc.) as well as 'hard' measures (e.g. using low-flow showerheads and tap inserts) such that there is a reduction in volume even when there is no reduction in the duration of the associated activity.
- 6.56. As a result of metering, there will be a change in consumption related to changes in occupancy. Demand forecast incorporates this by using adjustment factors for frequency-of-use. In addition, demand forecast assumes behaviour change upon metering. This is achieved by assuming that an unmetered household acquires the characteristics of a metered household (in the same ACORN category) upon metering for discretionary aspects of water use such as shower duration, miscellaneous use and garden watering.
- 6.57. In the case of discretionary use (i.e. miscellaneous indoor use and outdoor use), this results in ca. 5.2 l/h/d (ca. 31%) overall reduction in consumption at the company level in 2015-16. Some of this reduction is to be expected as a consequence of metering alone and one option for forecasting future consumption of metered households would be to use the average of unmetered and metered households for switching households. However, the forecast assumes that greater savings can be achieved through a focussed and sustained water efficiency campaign and at least half of the ca.5.2 l/h/d savings can be attributable to water efficiency through a combination of both 'soft' and 'hard' measures.
- 6.58. Given that the average household occupancy through the planning period is ca. 2.4, this translates into ca. 1 litre/property/day (l/prop/d) saving throughout the planning period.
- 6.59. Demand forecast considers water efficiency to be part of Business As Usual throughout the planning period and assumes no deterioration in savings over time.
- 6.60. While both unmetered and metered household show a decline in PCC over the planning period as a result of replacement of older devices with newer ones, metered household show a much

greater decline (11%) compared to unmetered households (4%) (see Appendix F01) and this is partly due greater reduction from the water efficiency programme than would be expected from metering alone.

- 6.61. The demand forecast also applies an additional 1 l/prop/d saving in each year of the planning period but does not use it cumulatively to account for water efficiency measures adopted in-year that may not exist the following year as result of device replacement or change of occupier.
- 6.62. In addition to the 'baseline water efficiency' activity described above that targets household consumption, 'enhanced water efficiency' options have also been identified that are primarily, but not exclusively, aimed at non-household customers. These include carrying out water audits and retrofitting devices at domestic properties, schools, small and medium enterprises as well as large businesses. These 'enhanced water efficiency' options are included in the options set for investment modelling.

Climate change impact on demand

- 6.63. Water companies are required to consider impacts of climate change on both supply and demand. The current view on climate change is that it is likely to lead to a generally drier and warmer climate with an increased frequency of extreme events (storms, floods, droughts etc.). The component of domestic demand that is most likely to be impacted by such a shift in climate is external use (garden watering, filling up paddling pools etc.) but it may also result in a higher frequency of personal washing and clothes washing. However, it is difficult to quantify the magnitude of any such changes in terms of ownership, frequency and volume. Moreover, there is also the possibility of changes in behaviour in response to climate change (e.g. allowing the garden to be 'brown' for parts of the year) such that the shift to drier, warmer climate may not necessarily lead to an increase in consumption. There is therefore considerable uncertainty as to how climate change will manifest itself over various timescales and the behavioural response it will invoke.
- 6.64. Following a recent assessment by UKWIR, household demand is forecast to increase by 0.74% over the planning period. No adjustment has been applied to the non-household demand forecast (see Section 6.0 in Appendix F01 for details).
- 6.65. Excluding climate change impacts, total household demand increases from 356.1 MI/d in 2011/12 to 361.7 MI/d in 2039/40. When climate change impacts are included, household demand in 2039/40 increases to 364.4 MI/d (Appendix F02). PCC declines in both cases i.e. with and without climate change impacts (Appendix F02).

Non-household demand forecast

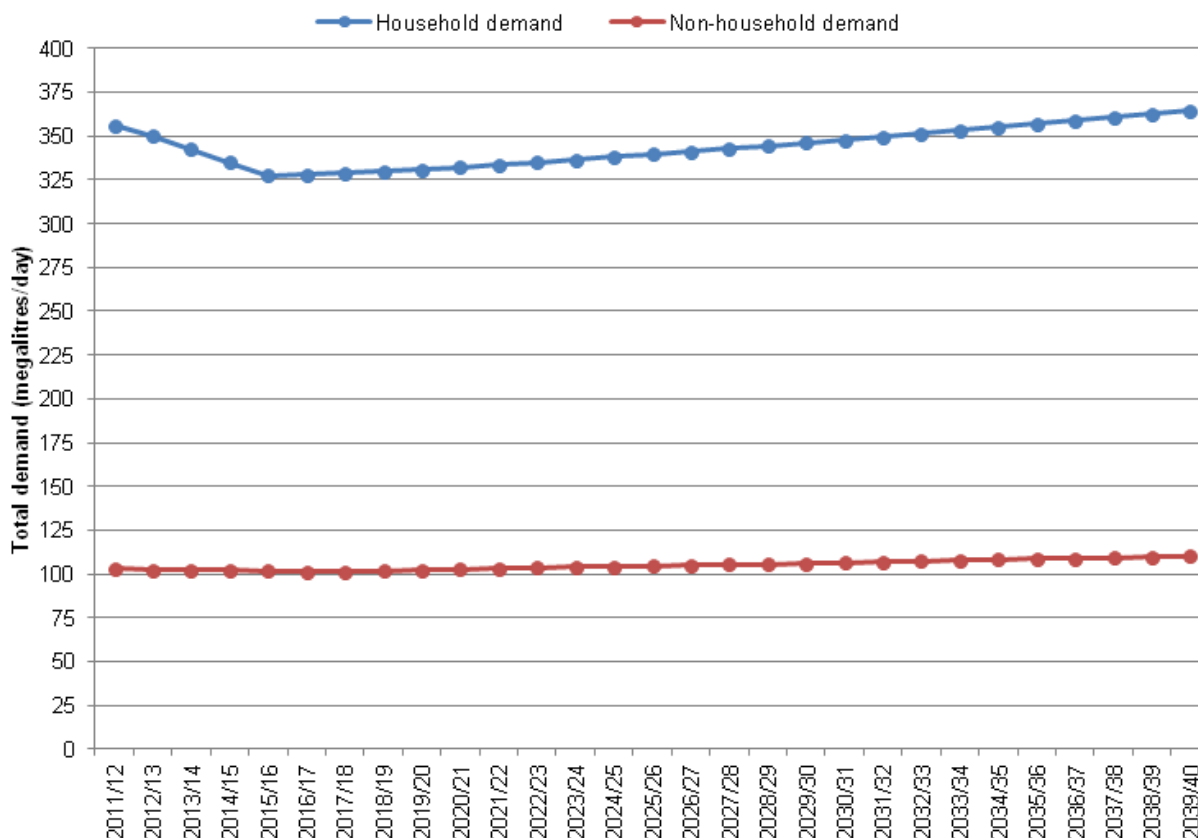
- 6.66. Cambridge Econometrics have developed the non-household demand forecast based on four parameters that are considered to be key influences on demand, namely water efficiency, economic output, price of water and weather. The length of available data has been insufficient to allow a full econometric analysis and derivation of robust coefficients to link demand to the four parameters. Forecasts have therefore been based on water efficiency trends and elasticity of output. The three modelled scenarios are as follows:
- Baseline scenario (water efficiency 2% p.a. consistent with trend observed over the years; output elasticity 0.6; no link to water price or weather)
 - Higher water efficiency (water efficiency 3% p.a.; elasticity of output 0.6; no link to water price or weather)
 - Weaker water efficiency (water efficiency 1% p.a.; elasticity of output 0.6; no link to water demand or weather)
- 6.67. The number of non-household customers is not included in the modelling tool so 'water efficiency' effectively represents a decrease in consumption due to both a decrease in customer numbers as well as water efficient practices.
- 6.68. The 'weaker water efficiency' scenario is adopted for the demand forecast based on the assumption that most of the water efficiency savings have been achieved over the past 10-15 years and therefore the potential for water savings going forward will not be as great as it has been in the past. Secondly, it is assumed that while a decline in demand will continue for a few

more years, it will eventually start to recover. See Appendix F02 for the detailed demand forecast by sector.

Total household and non-household demand

- 6.69. Household and non-household demand forecasts are shown in Figure 6.13. Both household and non-household demands are projected to increase through the planning period. The increase in household demand is driven by an increase in population even though average PCC is forecast to decrease over the planning period. An increase in non-household demand is due to expected economic growth. See Appendix F02 for a detailed breakdown by WRZ.

Figure 6.13 Total household and non-household demand over the forecasting period



Leakage

- 6.70. Leakage is comprised of two components:

- Distribution losses - which includes losses from trunk mains, distribution mains, service reservoirs and communications pipes; and
- Underground supply pipe losses - which are those losses occurring between the point of delivery at the property boundary and the point of consumption.

- 6.71. Distribution losses are the responsibility of the company. Supply pipe losses are the responsibility of the householder, but the company has provided a free supply pipe repair service for many years in order to contain this component of leakage.

- 6.72. In 2011/12, leakage from Southern Water's distribution system and customer supply pipes was 82 ML/d. This is significantly below the 93 ML/d target agreed with Ofwat. Leakage for the remainder of AMP5 (up to 2014/15) is set to decline, consistent with the annual target values agreed with Ofwat. The 2014/15 target value (88 ML/d) is held constant throughout the forecasting period as baseline leakage.

- 6.73. Going forward, Southern Water's leakage management strategy has three main strands:

- Leakage improvement initiatives with the following key components:
 - Trunk Main Monitoring,
 - Sub-division of large District Metering Areas (DMAs)
 - Optimisation of Pressure Management Areas (PMAs)
 - Installation of a new leakage management and reporting system
 - Installation of new and superior data loggers
- Operational leakage activities to include:
 - Leakage targeting and repair
 - Monthly performance monitoring
 - Periodic determination of trunk main and reservoir losses
- Asset and data maintenance activities, consisting of:
 - Revised calibration schedule for all reservoir and DMA meters
 - Maintenance of accurate and consistent DMA and PMA records

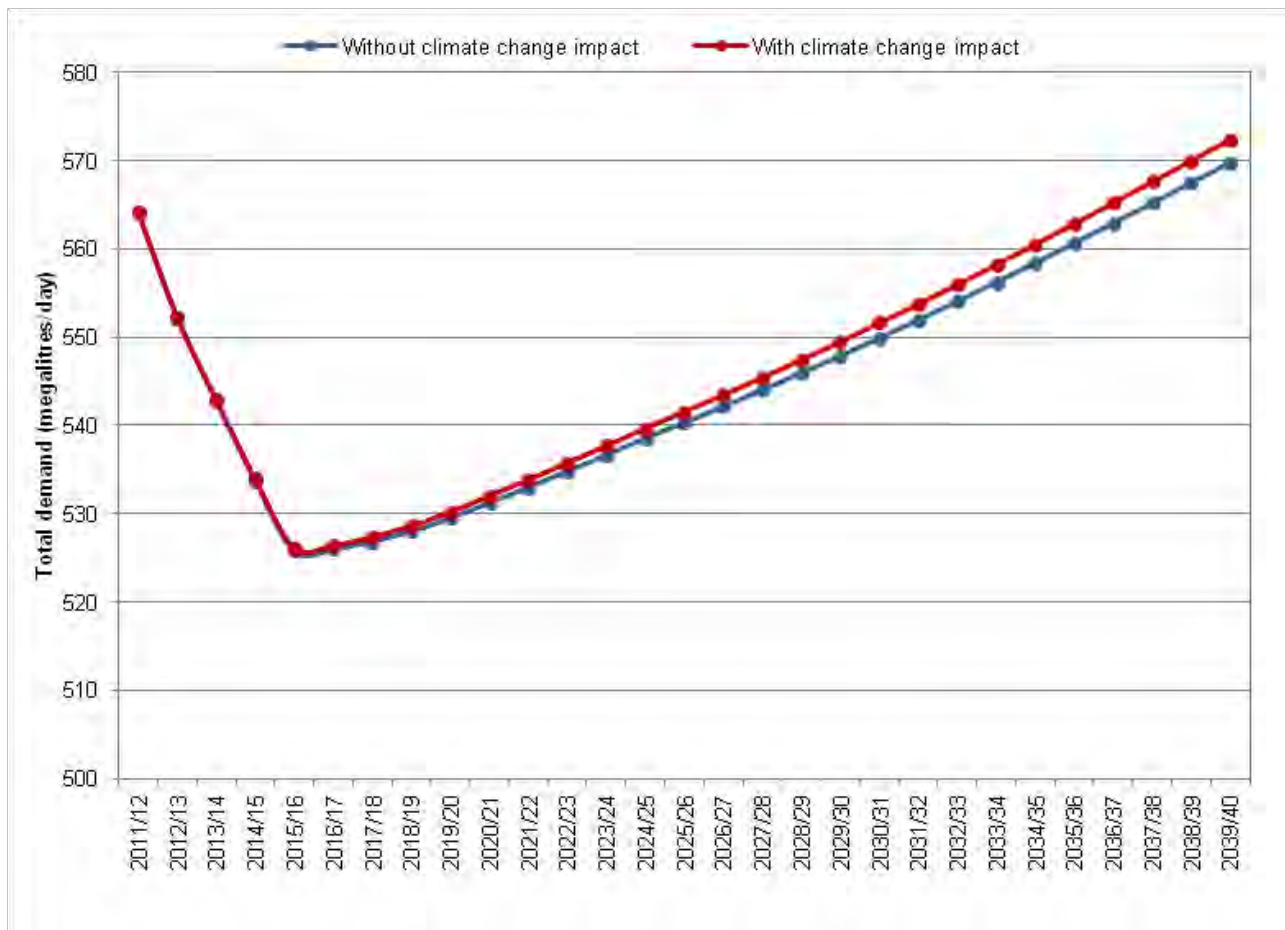
6.74. Further leakage reduction is included in the options appraisal (see Section 8).

Total demand

NYAA scenario

- 6.75. Total NYAA demand, excluding climate change impacts, increases from 564.2 MI/d in the base year to 569.8 MI/d in 2039/40; representing an increase of 1% over the planning period (Figure 6.14). With climate change impact, the DI in 2039/40 increases to 572.4 MI/d; an increase of 1.5% over the planning period (Figure 6.14). Total demand forecast by WRZ is given in Appendix F02.

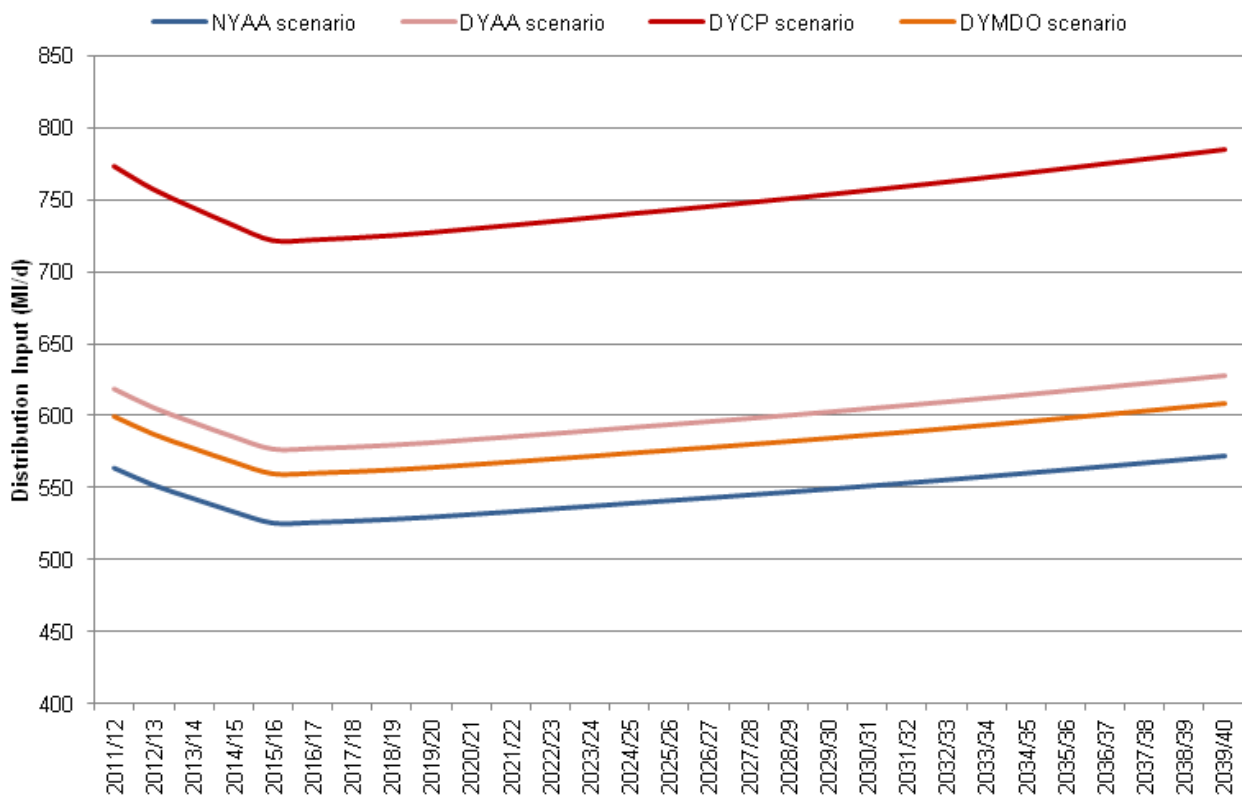
Figure 6.14 Total demand (NYAA scenario) over the planning period



Dry year scenarios

6.76. Demand under various dry year scenarios is shown in Figure 6.15.

Figure 6.15 Total Distribution Input over the planning period under various scenarios



Sensitivity testing

6.77. A number of uncertainties are associated with various components of the demand forecast. While it would not be feasible to test the sensitivity of the demand forecast to every uncertainty, a few key sources of uncertainty have been tested for their impact on the modelled forecast. These include (see Section 9 in Appendix F01).

- Population growth scenarios
- Behavioural change scenarios
- Leakage scenarios

6.78. In addition, a number of sensitivity tests were carried out to inform headroom analysis (see Section 10 in Appendix F01).

7. Target headroom – allowing for variability and uncertainty in the supply demand balance

Section summary

This Section explains how risk and uncertainty are taken into account within the supply demand balance.

Aspect of the WRMP addressed in this section of the Technical Report	Reference
Description of method used in headroom analysis, including how assessment is applied to critical period planning scenarios	Para.7.1-7.25 (Appendix G)
Explanation of assumptions applied to headroom analysis, including: explanation of choice of probability distributions used; and treatment of inter-dependencies, correlation and mutual exclusion between different sources of uncertainty	Para.7.19-7.25 (Appendix G)
Explanation of approach to risks associated with revocation of licences or time-limited licences	Para.7.19-7.25
Description and justification of how climate change impacts have been included within the target headroom analysis	Para.7.19-7.25 (Appendix G)
Justification of level of risk accepted by company over the planning period (i.e. how exceedence percentiles have been used), and comparison of results to previous target headroom estimates	Para.7.9-7.18
Presentation of results of headroom analysis , including the relative contributions of sources of uncertainty to overall headroom allowances to identify which uncertainties are driving headroom	Para.7.26-7.34, Table 7.1 & Table 7.2, Figure 7.1 to Figure 7.4

Overview

- 7.1. This section of the WRMP describes the approach used by Southern Water to address the risks associated with variability and uncertainty in the Supply Demand Balance. It describes the development of 'Target Headroom' and sets out an approach that allows Target Headroom, Levels of Service and the derivation of "utilisation factors" for different planning scenarios to be determined within a single, internally coherent, modelling approach.
- 7.2. The approach described here builds on the stochastically derived water resource modelling described in Section 5. The methodology combines conventional water industry approaches with more sophisticated risk modelling techniques that are commonplace in many other industries. This allows a much more integrated approach to managing risk and uncertainty with the following specific benefits:
- 1) It enables the chosen 'Target Headroom' to directly reflect the adopted Level of Service. This is a key regulatory requirement of WRMP14.
 - 2) It allows the direct inclusion of a utilisation factor calculation within the investment model, thus addressing the potential bias in option selection that arises from an unrealistic representation of operating costs. This is also a key regulatory requirement of WRMP14.
 - 3) The elements of uncertainty in the supply demand balance can still be categorised in the same way as the elements of uncertainty that are used in the UKWIR 2002

methodology. The approach is therefore not only linked to Levels of Service but is also familiar in regulatory terms.

- 4) The approach can accommodate realistically large levels of uncertainty for individual elements without generating excessive Target Headroom allowances, a common problem with the existing methodology.

Target headroom

- 7.3. 'Target Headroom' refers to a planning "margin of safety" that allows for uncertainty in the supply and demand forecasts. It is defined as the threshold of minimum acceptable headroom (i.e. surplus of supply over demand) which, if breached, would represent an increased risk that the Company would not be able to meet its Target Levels of Service. The EA Water Resource Planning Guidelines (WRPG) do not prescribe the level of uncertainty that is acceptable for planning purposes, and therefore what level of Target Headroom allowance to use. It is left to each company to determine the target headroom that is used, although the guidance requires that links are made to a stated Level of Service.
- 7.4. Southern Water's WRMP09 approach to assessing Target Headroom used the standard methodology, as described in the UKWIR 2002 document 'Improved Methodology for Assessing Headroom'. The major drawback to this approach is that there is no link through to Level of Service. Instead a range of uncertainty is evaluated and the acceptable percentage risk is **arbitrarily** selected from this range. Some additional guidance was developed by UKWIR for WRMP14 (WR27 – Water Resources Planning Tools 2012), but this just requires that investment models are run for a range of Target Headroom percentiles. The selection of the preferred plan is still essentially arbitrary and is not linked to Level of Service.
- 7.5. As indicated above, the methodology developed by Southern Water for WRMP14 and described in this section builds on the standard UKWIR 2002 approach but uses more sophisticated risk modelling techniques from other industries to integrate all of the risks and variability that occur within the supply demand balance. A more detailed explanation is given in Appendix G.

Sources of uncertainty in the supply demand balance

- 7.6. In water resources planning there are three main sources of uncertainty that may cause the supply demand balance to deviate from the expected mean in any given year. These are:
 - Natural annual variability in both deployable output (DO) and demand, which mainly relates to random weather fluctuations between years;
 - Longer-term influences on supply and demand such as climate change and changes in demographics, along with the uncertainties associated with such forecasts; and
 - Other uncertainties, such as those associated with inaccuracies in measurements and modelling outputs.
- 7.7. The second and third sources, termed "*epistemic*" uncertainty, are addressed in the standard headroom methodology (UKWIR, 2002). This type of uncertainty relates to a lack of knowledge about the system itself, including uncertainties such as those relating to source yields and the effects of metering on demand.
- 7.8. In contrast, the natural, quantifiable variation in a system (the first source of uncertainty above), known as "*aleatory*" variability, is not an embedded element of the standard methodology. In previous WRMPs the uncertainty associated with this component has therefore been derived and stated separately with no linkage to Level of Service.
- 7.9. The approach taken in this WRMP allows the epistemic and aleatory uncertainties to be combined, with the significant benefit that planning allowances such as 'Target Headroom' can be linked explicitly to the planning assumptions and hence the Level of Service being used to drive the supply demand balance calculations.
- 7.10. The framework and calculations that were used to achieve this integrated approach to uncertainty in the supply demand balance are fully described in Appendix G. This includes a description of the integrated risk model (IRM) built using the @Risk software platform.

Planning Conditions and links to Levels of Service

- 7.11. The IRM provides supply and demand outputs for two states of “uncertainty”:
- Without uncertainty – the range of supply and demand that could occur in each year of the planning horizon if Southern Water could be sure of the accuracy of their modelling and forecasts; and
 - With uncertainty – the range of supply and demand that could actually occur, given that there are uncertainties in the models and forecasts used in the supply/demand balance.
- 7.12. These two ranges of outputs allowed the calculation of a Target Headroom that was compatible with the chosen Level of Service based on the following definition:
- Target Headroom is the effect that uncertainty in supply/demand modelling has on the supply demand balance at the level of risk that defines the Level of Service design event.*
- 7.13. In other words, if a 1 in 200 year drought event is under consideration, then the difference in the modelled supply demand balance at the 0.5% level of risk (i.e. the supply demand balance that could occur in 0.5% of years) *with and without uncertainty* is equal to the Target Headroom for the chosen Level of Service planning scenario.
- 7.14. The approach not only links Target Headroom to Level of Service but expresses the elements of uncertainty in the same way as the elements of uncertainty that are used in the more conventional UKWIR 2002 methodology. **Significant components of the approach are therefore familiar in regulatory terms.**
- 7.15. **Furthermore, this integrated approach can also accommodate realistically large levels of uncertainty without generating excessive Target Headroom allowances.** This is because the ‘rules of probability’ mean that uncertainty tends to reduce on a relative basis as more elements of risk are integrated in a probabilistic fashion. For example, supply uncertainty (UKWIR component S6) and demand uncertainty (UKWIR component D2) within the Sussex North model were over 15% and 12% respectively for the design scenario towards the end of the planning period, with additional climate change supply uncertainty of nearly 10%. However, the overall impact of uncertainty on the supply demand balance, even at the 0.5% risk level (a 1 in 200 year drought event), was less than 6%. Experience from previous WRMPs showed that either uncertainty ranges tended to have to be artificially constrained, or artificial ‘glidepaths’ in the percentiles had to be adopted in order to produce Target Headroom values that were within “acceptable” ranges. The new methodology has not required any such artificial manipulation of the values actually used for Target Headroom in the subsequent economic modelling.
- Link with the WRPg and WRMP tables**
- 7.16. Although it is not stated, the WRPg makes some key assumptions about the relationships that exist between supply variability and demand variability, which effectively dictate how planning conditions are linked to Level of Service within the existing methodology. The supply demand balance lines within the WRPg assume that a level of demand that is encountered in ‘dry years’ and which is unconstrained (i.e. immediately prior to the introduction of Temporary Use Bans) occurs at the same time as the design scenario drought event that defines the available supply. For example, if the design supply event is equal to a 1 in 100 year drought, the WRPg effectively assumes that a water company should plan to meet a ‘dry year’ 1 in 10 year demand (for Southern Water) during that event. In general, this seems to be a sensible assumption, as dry weather that causes drought will tend to result in higher levels of demand, but there is variability around that relationship.
- 7.17. Within the integrated risk model it is possible to reproduce this relationship by choosing the appropriate *correlation coefficient* between the *aleatory* supply and demand inputs. Once this is included, the percentile range in the supply demand balance outputs from the model can be directly related to the Level of Service planning scenario. For those WRZs where the 1 in 200 year event has been directly chosen based on the analysis described in Section 5, the Target Headroom that needs to be applied is therefore calculated as the difference between the 0.5% level of risk in the supply demand balance range *with and without uncertainty*. Importantly, if the correct correlation coefficient is used, then the 0.5% level of risk in the supply demand balance

without uncertainty is also exactly the same as the supply demand balance that is calculated deterministically within the WRMP tables.

- 7.18. As described in Appendix G, for some WRZs it was not possible or appropriate to include a probability distribution for supply within the *aleatory* side of the model. In that case a single, deterministic value of supply was selected that was equal to the input used for the WRMP tables. The Level of Service level of risk therefore became entirely dependent on the demand *aleatory* variability, so the uncertainty was calculated at the level of risk represented by the key LoS trigger – i.e. at the 10% (1 in 10 year) risk level for the Eastern Area and the 5% risk level (1 in 20 year) for the Western Area. .

Elements of risk and uncertainty used in the model

- 7.19. A full description of the uncertainty inputs used in the models, including the types of probability distributions and the derivation of the ranges used, is provided in Appendix G. In summary, all of the elements described in the UKWIR 2002 guidance document were reviewed and included, with the following exclusions:
- S1-S3 (vulnerable licences): excluded as required by the WRPg;
 - S9 (uncertainty from new sources): these were not included. Analysis showed that the level of uncertainty for new options was generally not significantly greater than existing resources, so the net effect on Target Headroom as a percentage was negligible. .
- 7.20. All other elements within the UKWIR methodology were included in this methodology (including the choice and format of probability distributions), with one or two justified variations as described in Appendix G.
- 7.21. One key exception was related to uncertainty around the base year non-household demand and its forecast. The base year (2011/12) non-household (NHH) demand used for the Draft WRMP was based on the average of the previous three years' NHH demand figures. However, actual demand in 2011/12 (based on post-accrual outturn data) was significantly lower than this estimated base year value. This is thought to have resulted from the recent economic downturn.
- 7.22. Use of the higher estimated base year figure for the Final WRMP would represent a revenue risk to the Company in AMP6 because weighted average demand figures are used by Ofwat to set tariffs. On the other hand, underestimation of NHH demand represents a planning risk in the event that the economy improves earlier and/or at a faster rate than is forecast. In the Revised DWRMP, the approach used to balance these two risks was to retain the dry year (DYAA, DYCP and DYMDO) demand forecasts from the Draft WRMP whilst reducing the NYAA figure in line with the post-accrual outturn data.
- 7.23. However, this resulted in household demand being higher than it otherwise would be as household demand is considered to be the only component of DI that is significantly impacted by weather. Following discussions with the Environment Agency, for the Final WRMP DYAA, DYCP and DYMDO demand scenarios have been developed by updating all components of DYAA, DYCP and DYMDO demand forecasts in the Draft WRMP with revised figures. The resulting difference in DI for the three scenarios effectively represents the risk around NHH demand, which has been incorporated into the Target Headroom value as an additional component. The 'NHH adjustment' figures were added into Target Headroom as fixed values, rather than being modelled using Monte Carlo analysis.
- 7.24. Correlations between *aleatory* variables have been discussed previously. It is noted that there are mathematical *dependencies* (a form of second order correlation) between some of the *epistemic* elements and the *aleatory* variability, as described in Appendix G. All other correlations and exclusions were in line with the UKWIR methodology.
- 7.25. The probability distributions for the *aleatory* supply and demand ranges were specifically designed to ensure that they were fully compatible with the outputs from the stochastic supply side modelling described in Section 5, and the 'normal' and 'dry year' demand described in Section 6. This required the use of customised distribution functions within the @Risk software, which ensured that the cumulative distribution functions (cdfs) for supply side variability were accurately reflected, even for very low percentage risks. For the demand side, a deliberately

constrained Beta distribution was used to ensure that demand would not increase significantly beyond the 'dry year' value, even in severe drought circumstances.

Results and Sensitivities

- 7.26. The Target Headroom calculation within the IRM used the calculated probability distributions with and without the uncertainty (*epistemic*) components to calculate the impact of uncertainty at the percentile that was equivalent to the chosen Level of Service.
- 7.27. A summary of the percentage Target Headroom values for each WRZ under the PDO and MDO/ADO conditions is provided in Table 7.1 and Table 7.2. Charts of the sensitivity of the Target Headroom values to the individual components are provided in Figure 7.1 to Figure 7.4. The NHH adjustment has been included under headroom component D2 within these charts, since this component represents uncertainty in the demand forecast and the NHH adjustment is associated with uncertainty in the NHH demand forecast.
- 7.28. Target Headroom has been completely revised and an integrated approach has been adopted, so comparisons have not been carried out for individual WRZs. However, overall the comparison between WRMP09 and WRMP14 is as follows:
- For WRMP09 an arbitrary 'glidepath' was used, which took percentiles from the uncertainty range from 90% at the end of the first AMP period down to 80% 15 years later. Headroom in MI/d terms was then kept constant for the remainder of the planning period. For the company as a whole, percentage headroom moved from 5.3% (percentages are expressed relative to Distribution Input) at the end of the first AMP period, to 5.9% 15 years later.
 - The new methodology has a smaller uncertainty at the start of the planning period, which increases as uncertainty (primarily over demand and climate change) increases. Excluding the NHH adjustment, at the end of the first AMP period (2014/15) the range is between 1.4% and 4.2%, with an average of around 2.9%, so Target Headroom is generally lower than PR09. This then increases to a range of between 2.0% and 6.1% by the end of AMP8 (15 years later), with an average of around 3.9%, which is therefore comparable with WRMP09. This average (excluding the NHH adjustment) then increases to around 4.5% on MDO and 4.9% on PDO at the end of the planning period, which is marginally lower than WRMP09.
 - The addition of the NHH adjustment then adds between 1.3% and 7.3% to Target Headroom in each year across the planning period (with the exception of Hampshire Kingsclere, which is higher due to the low baseline demand).
- 7.29. Thus, not only do the results show Target Headroom values that are within 'sensible' ranges, but they demonstrate that the methodology can reflect the underlying risks and sensitivities of the WRZs in a more robust way than the existing Target Headroom approach.
- 7.30. In general, the key factor that tends to dictate Target Headroom in the early part of the planning period is the uncertainty in the supply assessment (S6 – accuracy of supply-side data) and uncertainty in the demand forecast (D2 – demand forecast variation), with some impact from uncertainty in the demand assessment (D1 - uncertainty in the accuracy of sub-component data). The percentages in Table 7.1 and Table 7.2 reflect the level of uncertainty in the supply demand balance, and they also reflect the risk profile of the WRZ through time.
- 7.31. In many cases there is a slight drop in Target Headroom towards the end of AMP5 and/or AMP6. This is caused by assumptions relating to the impact of metering, which used non-symmetrical triangular distributions. This effectively means that the risk from the impact on metering is on the 'upside' which reduces Target Headroom accordingly.
- 7.32. Towards the end of the planning period, uncertainty in the demand forecast (D2) becomes even more important, as do climate change impacts on supply (S8) in some WRZs. Generally speaking, the impacts of climate change reflect the sensitivities of supply systems as described in Section 5. For Hampshire South WRZ, the impact of climate change on Target Headroom for the MDO condition is negative (see Figure 7.2) because impacts on MDO tended to be limited by the fact that flows in the Itchen are close to the MRF. Therefore the impact is 8.5 MI/d for both the most likely and maximum scenarios (i.e. climate change is only likely to increase supply).

- 7.33. Excluding the impact of the NHH demand uncertainty adjustment, the only Target Headroom values that increase beyond 7% overall are those for the PDO condition in the Sussex Brighton and Kent Medway WRZs. The risk model indicates that, for these WRZs, the consequences of high levels of demand uncertainty in the latter part of the planning horizon do need to be considered when the investment programme is being developed, and options that allow greater flexibility for improving the supply demand balance at a lower cost in future years should be considered.
- 7.34. It is noted that for the conventional ‘historically based’ alternative plan, the same Target Headroom was applied to the supply demand balance as was used for the preferred resilience scenario. This was done for the purposes of consistency and simplicity.

Table 7.1 MDO/ADO results for Target Headroom, including NHH adjustment

WRZ	MDO/ADO: headroom as a % of distribution input						
	2011/12 (Base year)	2014/15 (end of AMP5)	2019/20 (end of AMP6)	2024/25 (end of AMP7)	2029/30 (end of AMP8)	2034/35 (end of AMP9)	2039/40 (end of AMP10)
HA	5.0%	6.1%	6.6%	6.8%	7.3%	7.8%	8.2%
HK	15.1%	16.5%	17.2%	17.9%	18.1%	18.5%	19.0%
HS	5.4%	6.0%	5.9%	5.8%	5.8%	5.8%	5.6%
IW	7.0%	8.0%	8.4%	8.7%	8.8%	9.3%	9.5%
SN	9.1%	10.7%	10.6%	11.3%	11.2%	12.0%	12.7%
SW	9.4%	9.4%	10.0%	10.8%	11.1%	11.8%	12.3%
SB	8.8%	9.4%	9.9%	10.8%	11.3%	12.2%	12.8%
KM	6.1%	6.3%	7.5%	7.7%	8.4%	8.3%	10.0%
KT	6.4%	6.4%	7.0%	7.6%	8.2%	8.9%	9.4%
SH	7.4%	6.7%	7.2%	7.2%	8.3%	8.0%	9.1%

Table 7.2 PDO results for Target Headroom, including NHH adjustment

WRZ	PDO: design drought headroom as a % of distribution input						
	2011/12 (Base year)	2014/15 (end of AMP5)	2019/20 (end of AMP6)	2024/25 (end of AMP7)	2029/30 (end of AMP8)	2034/35 (end of AMP9)	2039/40 (end of AMP10)
HA	4.6%	5.7%	6.0%	6.2%	6.8%	7.2%	7.6%
HK	10.1%	11.1%	11.8%	12.3%	12.7%	13.1%	13.7%
HS	4.0%	4.6%	4.9%	5.0%	5.4%	5.7%	5.9%
IW	5.5%	6.4%	6.7%	6.9%	7.1%	7.3%	7.6%
SN	6.5%	7.4%	7.7%	8.3%	7.8%	8.1%	8.3%
SW	8.0%	8.3%	8.8%	9.5%	9.9%	10.8%	11.1%
SB	8.9%	9.2%	10.0%	10.6%	11.5%	12.7%	13.8%
KM	6.6%	6.9%	7.8%	8.9%	9.9%	10.9%	11.7%
KT	5.4%	5.6%	6.1%	6.6%	7.1%	7.7%	8.0%
SH	7.3%	7.0%	7.5%	7.7%	8.0%	8.3%	8.4%

Figure 7.1 Target Headroom sensitivities for MDO/ADO – 2011/12

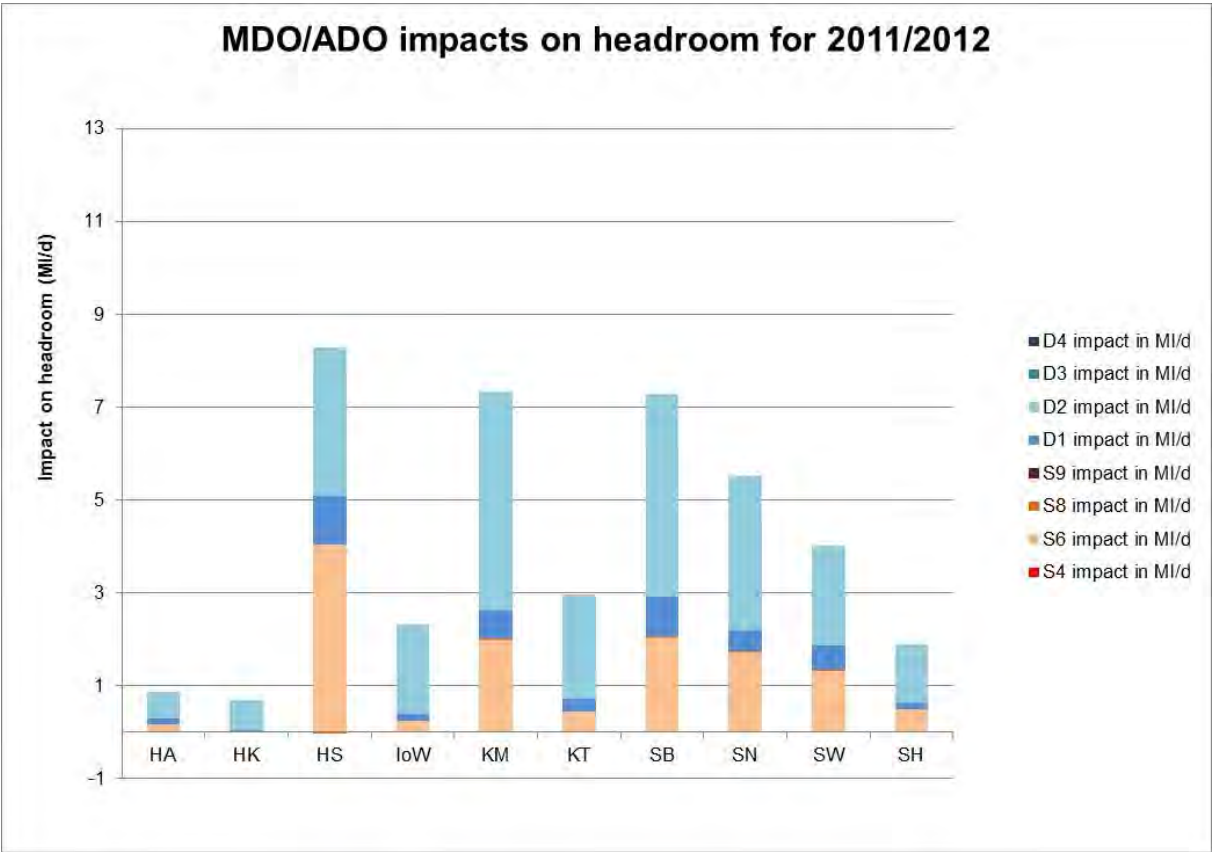


Figure 7.2 Target Headroom sensitivities for MDO/ADO – 2039/2040

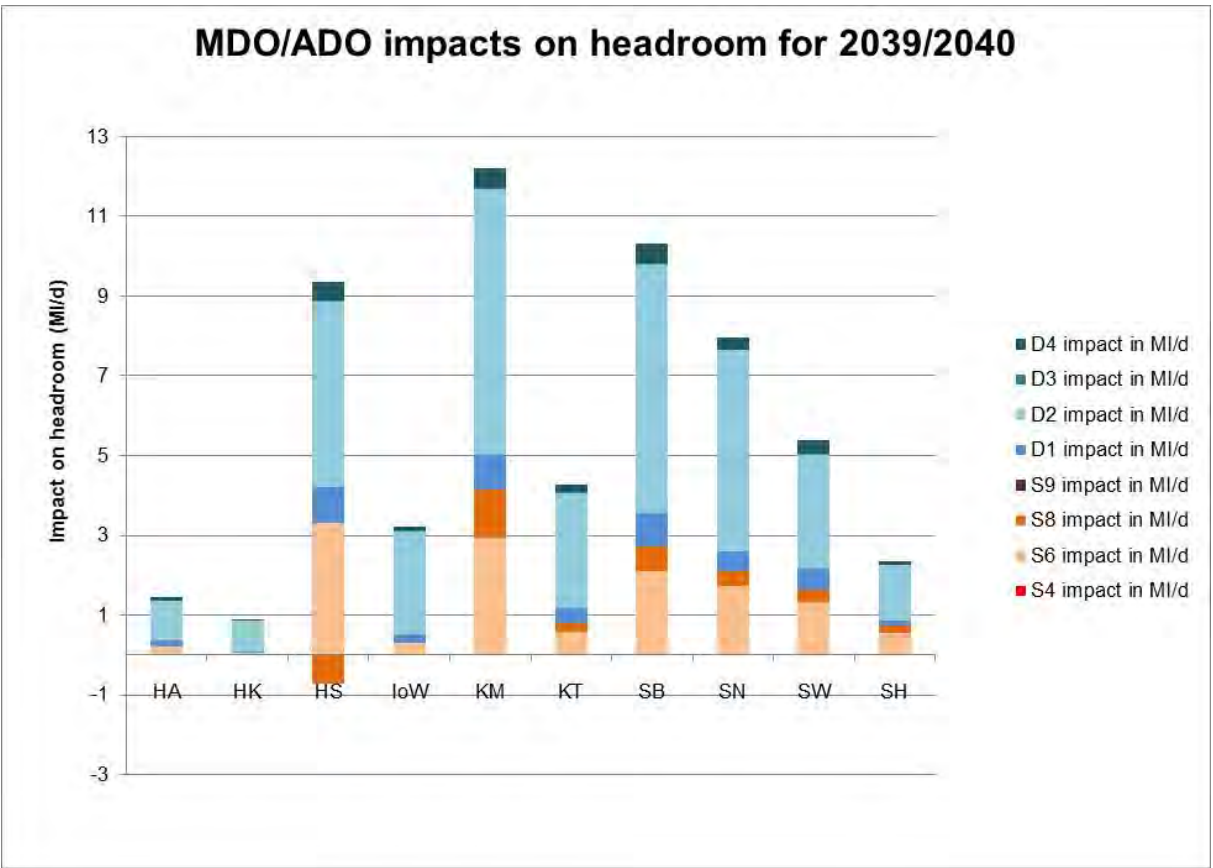


Figure 7.3 Target Headroom sensitivities for PDO – 2011/12

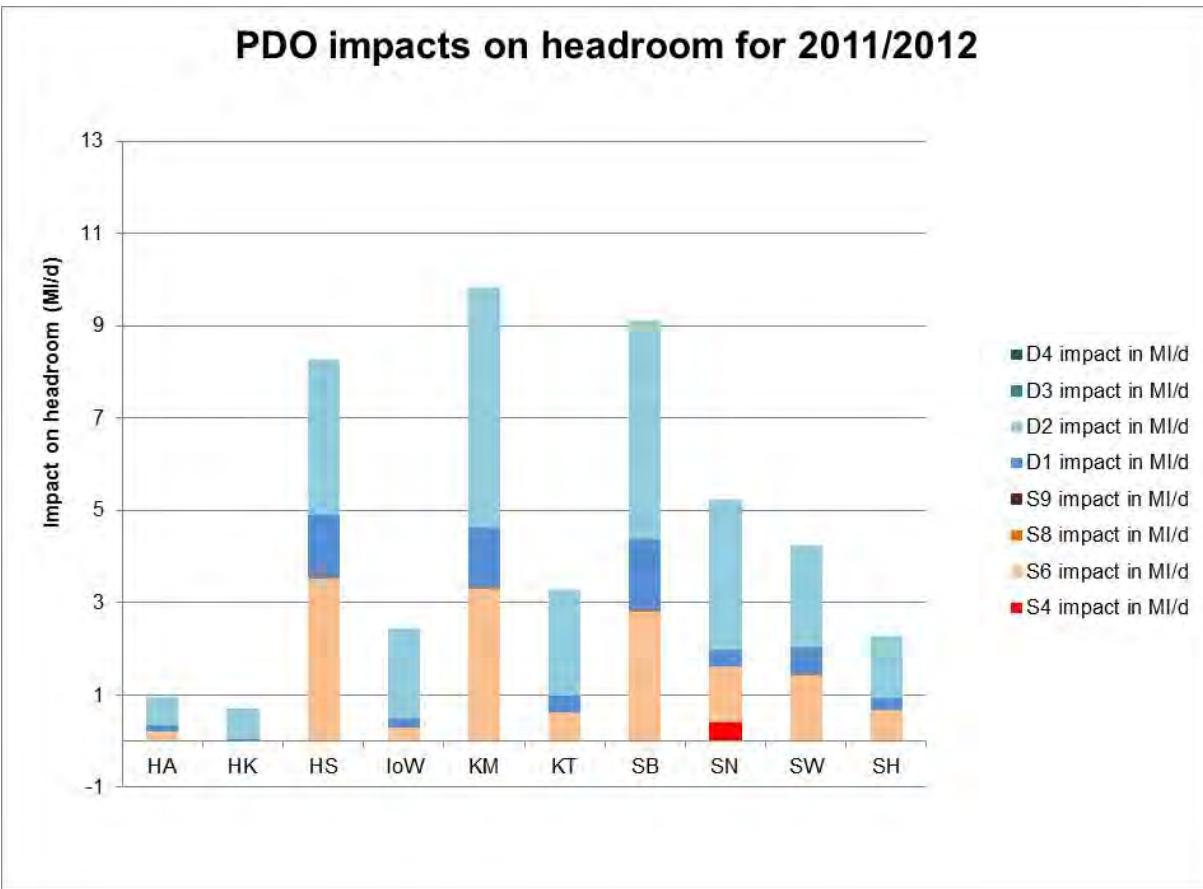
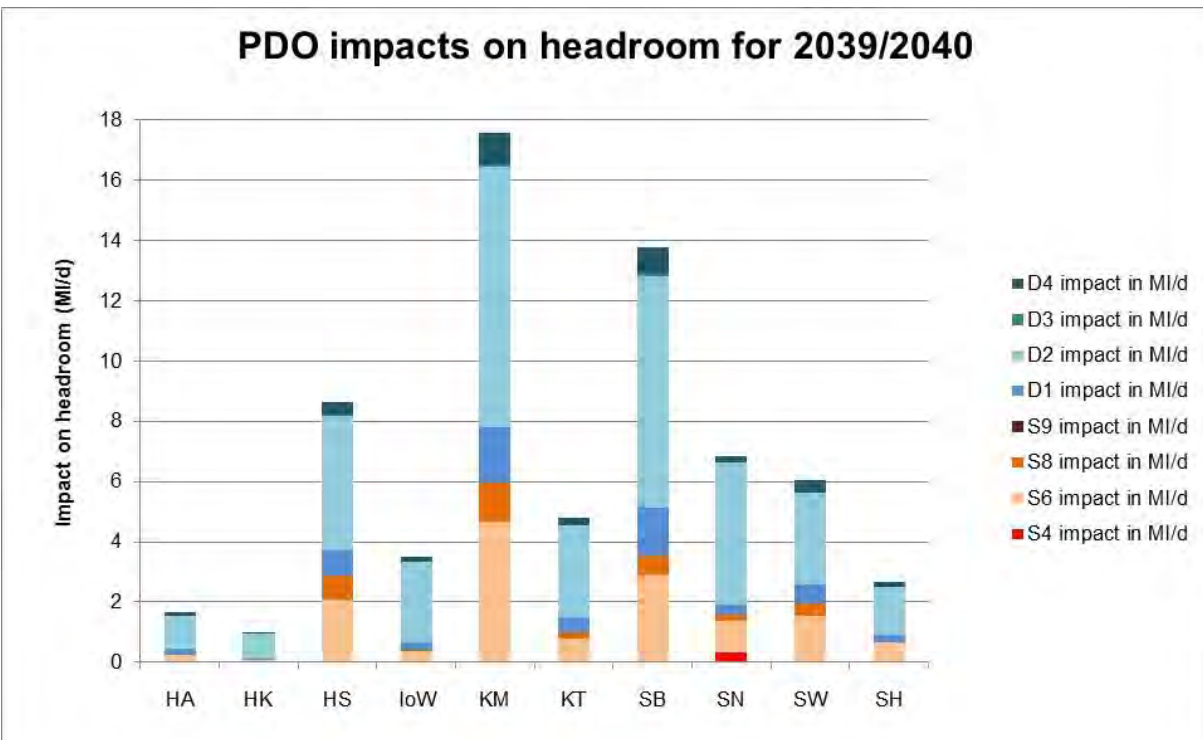


Figure 7.4 Target Headroom sensitivities for PDO – 2039/40



Derivation of utilisation factors

- 7.35. As well as providing the Target Headroom assessment, the IRM was also used to provide an estimate of “utilisation” factors for use in the economic modelling. This is described in Section 8 and is another key benefit of the IRM approach.

Approach to reducing uncertainty

- 7.36. Southern Water will continue to assess the uncertainty in its supply demand calculations through an ongoing mix of modelling, investigation and measuring of the components of supply and demand, but only where it is cost effective to do so. Specific initiatives that have been carried out during AMP5 and are programmed to continue in AMP6 include:

- Metering of the customer base (which improves understanding of demand forecasts);
- Development of operational groundwater models; and
- Groundwater source investigations to confirm constraints and operational capabilities.

8. Options to balance supply and demand

Section summary

This Section describes the options appraisal process and the key types of options considered to meet any potential forecast supply demand balance shortfalls. It also explains how the least cost solution is derived and how the preferred programme of options is developed.

Aspect of the WRMP addressed in this section of the Technical Report	Reference
Inclusion of the views of statutory consultees , customers and other stakeholders in the development of the plan, and taken these into account in the appraisal of the cost effectiveness of options. This includes Willingness to Pay survey information	Para.8.13-8.15, 8.225-8.232 (& 4.15-4.26)
Incorporation of environmental and social costs and benefits where these can be monetised, using the EA's <i>Benefits Assessment Guidance</i>	Para.8.34-8.42
Strategic Environmental Assessment and incorporation of non-monetary costs and benefits of feasible options	Para.8.32-8.33, 8.43-8.48
Habitats Regulation Assessment for feasible options potentially affecting designated European sites	Para.8.49-8.52
Use of the SEA and HRA to inform decision-making for options selection, where possible	Para.8.3, 8.32-8.33, Figure 8.1
Assessment of the impact of changes in the operation of existing sources and new abstractions of WFD water body status at a catchment and WRZ level to demonstrate 'no deterioration'	Para.8.53-8.71
Description of the screening criteria used to select the feasible options list, and provision of a table summarising reasons for not progressing unconstrained options	Para.8.19-8.31 (Appendix H)
Adoption of a consistent approach to the appraisal and cost estimates for all of the options in the plan so that the results are comparable	Para.8.195-8.208
Provision of description for each feasible option	Appendix H
Assessment of the risks and uncertainty associated with each option , including discussions of the resilience of options to climate change impacts, and resultant resilience of the system	Summary section for each option type in Sect 8 (Section 10, Appendix H)
Assessment of the time needed to investigate and implement an option , and provision of an earliest start date	Para.8.209-8.210 (WRP Table 3a, Section 9 & 10)
Estimates of confidence grades associated with option cost estimates	(Appendix H)
Description of inter-dependencies, links and synergies between options, consideration of whether different combinations of options would provide better or more resilient solutions	(Section 10, Appendix H)
Detailed consideration of potential water trading options , both with other water companies and other parties with supplies, and description of potential future transfers in the options set	Para.8.184-8.194 (9.9-9.20)
Discussion of development of a South East England regional solution, through the Water Resources in the South East (WRSE) group, and the company's role	Para.8.184-8.194 (9.9-9.20)

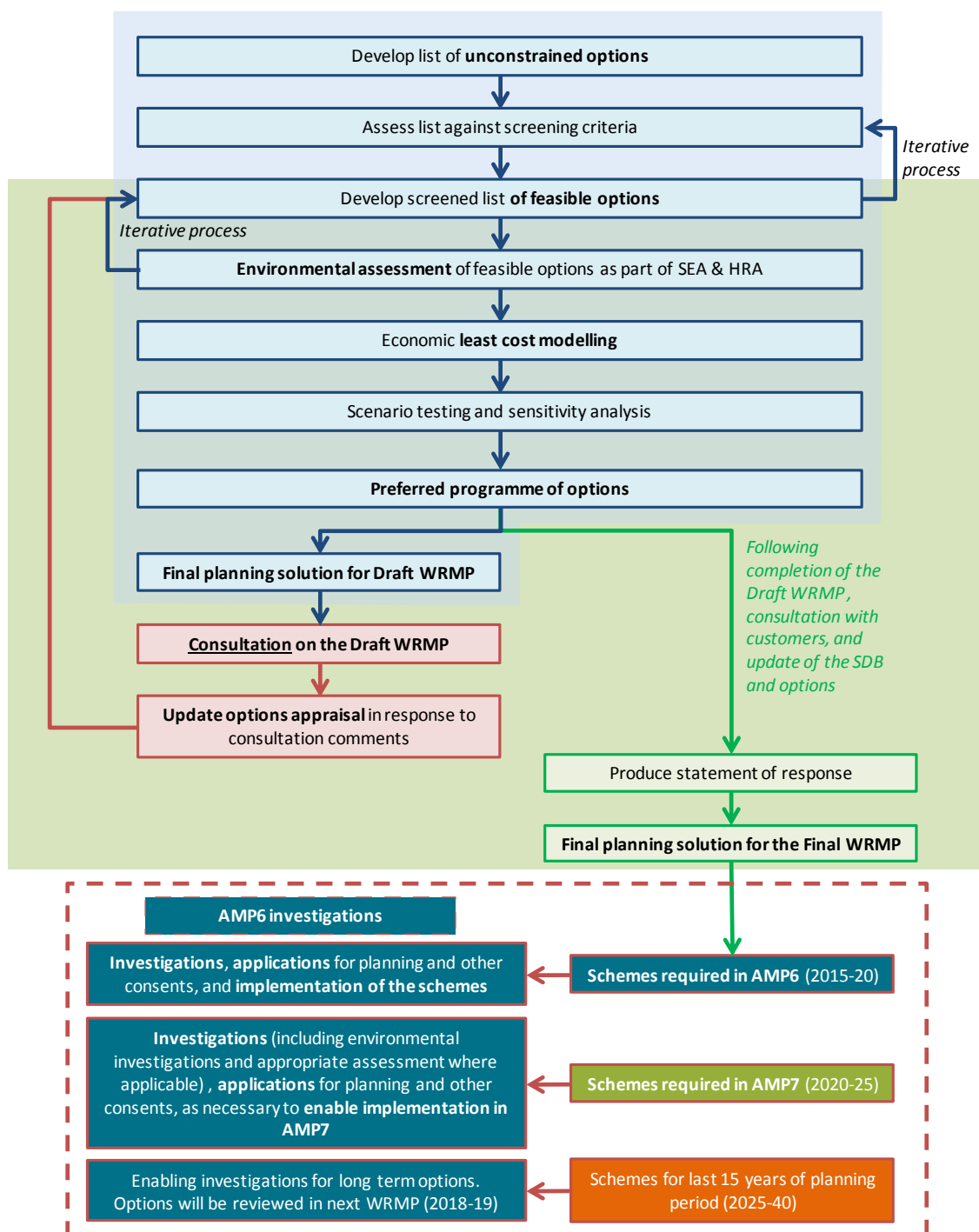
Provision of background investigations and discussions into water trading options held with other water companies or third parties. This includes a “neighbour contact plan” and “third party contact plan”	(Appendix I)	
Description of demand management activities , particularly water efficiency and leakage reduction, in accordance with WRP Guidelines appendices 10 and 11	Para.8.75-8.119 (para.10.128-10.132, Figure 10.5)	
Description of the assumed savings from water efficiency measures and outline of whether savings will be sustained through time	Para.8.81-8.84 (para.10.128-10.132, Figure 10.5)	
Presentation of profiles of water available for use or water savings (based on the capacity of the options) and all estimated costs (capital, operating, carbon costs and monetary social and environmental costs and benefits)	(WRP Table 3a)	
Description of approach to ensuring that variable costs are based on reasonable assumptions of utilisation , rather than what would occur if every year in the planning horizon were dry.	Para.8.211-8.224	
Statutory requirements addressed in this section		
The following table summarises the statutory requirements (legislation, regulations and directions) applied to the water resource planning process, and provides a cross reference to the relevant part of this section of the WRMP.		
Legislation ref.	Description of matter to be addressed	Reference
Dir 2012 S3(b)	The appraisal methodologies which it used in choosing the measures it intends to take or continue and its reasons for choosing those measures	Para.8.1-8.74, & 8.195-8.232
Dir 2012 S3(j)	The estimated cost to it in relation to the installation and operation of water meters to meet what is forecasted pursuant to S3(f) to (h) and a comparison of that cost with the other measures which it might take to manage demand for water, or increase supplies of water in its area to meet its obligations	Para. 8.102-8.105

Options appraisal process

- 8.1. Where there are forecast deficits in the baseline supply demand balance, taking account of target headroom, these can be met through the introduction of supply-side options to increase supplies, or demand management options to reduce demand. The effect of these two different types of options on the supply demand balance is shown in Figure 3.9 in Section 3.
- 8.2. As set out in the EA's WRP:
- “a water company should decide on the best option for its customers (on the basis of cost and what customers would like) and for the environment (local and global). Deciding which option to choose is known as 'option appraisal' and must include both monetary and non-monetary costs and benefits”.*
- 8.3. The process sets out a number of key steps:
- Develop a **list of unconstrained options** – to consider a generic list of options as well as government policy and aspirations;
 - Produce a screened list of **feasible options** which are then tested on grounds of both monetised and non-monetised costs and benefits. This assessment should

- incorporate a **Strategic Environmental Assessment** (SEA) to refine the list in terms of non-monetised costs and benefits; and
- Derive a **least cost solution** and **preferred programme of options** to meet a given supply demand balance deficit.

Figure 8.1 Process for options appraisal, derivation of preferred programme and implementing the WRMP strategy



Unconstrained list of options

- 8.4. The unconstrained list of options has been developed from a generic list of options, based on the UKWIR report *Economics of Balancing Supply and Demand*.
- 8.5. Using the UKWIR report above, a comprehensive study of options was conducted during AMP4, where Water Resource Investigations were carried out for each of Southern Water's three Supply Areas: Western, Central and Eastern. The extensive and detailed AMP4 Water Resource Investigations were used to inform the development of a feasible list of options for the previous WRMP (submitted in 2009). As that options list was extensively reviewed and consulted upon during development of the previous WRMP, it logically forms the basis for the list of options that have been used to feed into this current WRMP options appraisal process.
- 8.6. However, whilst the AMP4 Water Resource Investigations formed the starting point for developing the options list for the Draft WRMP that was consulted on during the summer of 2013, Southern Water also took the opportunity to consult with key stakeholders, conduct customer focus groups, and undertake a thorough review of the options to ensure that additional potential options have been considered, and changes in regard to the feasibility of options previously considered. Where any additional options were identified, these were included for consideration in the unconstrained options list.
- 8.7. Southern Water adopted the following approach to ensuring that all relevant options were included in the unconstrained options list:
- Engage with customers and stakeholders to elicit their views on the proposed options categories;
 - Continue its active participation in the Water Resources in South East (WRSE) group, a grouping of regulators and other water companies whose aim is to identify regional solutions to water resources problems;
 - Conduct internal reviews of proposed options as part of the WRMP process; and
 - Consult on the draft unconstrained list with the EA and NE.

Demand management options

- 8.8. Demand management options can be effective in controlling what might otherwise be unrestricted growth in demand for water, which could consequently trigger investment in resource developments earlier in the planning period than would otherwise be necessary. The implementation of demand management measures is therefore an important component of the company's approach to water resources planning.
- 8.9. An unconstrained list of demand management options was developed, based on previous work conducted as part of the AMP4 Water Resources Investigations and the previous WRMP. The unconstrained options were then reviewed in accordance with the screening criteria. The range of options considered included:
- **Enhanced water efficiency** options – i.e. options that encourage or enable customers to reduce their demand, and therefore provide additional savings over and above those assumed in the demand forecast as part of Southern Water's baseline water efficiency activity and promotion;
 - **Leakage reduction** options;
 - Introduction of **variable metering tariffs**; and
 - **Metering** – an option to try to meter the remaining 8% of customers not metered under the company's Universal Metering Programme during AMP5.
- 8.10. There are political and environmental reasons for promoting demand management measures, however the precise role of such measures in a long-term least cost investment plan will depend on the characteristics of the supply demand balance, in particular:
- The magnitude of any deficits;
 - The year when deficits occur; and
 - The earliest date at which new supply-side options are available.

- 8.11. Where there are large deficits that arise from step changes in the supply side of the supply demand balance (for example, as a result of sustainability reductions and/or reappraisal of deployable output using more robust and long-term hydrological and operational data), then it is unlikely that demand management measures on their own would be sufficient to maintain the supply demand balance. Instead they would need to form part of a **least-cost twin-track approach**. (See Figure 3.9)

Supply-side options

- 8.12. A number of supply side options have been investigated for this WRMP. The range of options considered can be divided into a number of option categories:

- **Water trading**, including **bulk supplies** and **third party supplies**;
- **Water re-use**;
- **Aquifer storage and recovery (ASR)**;
- **Desalination**;
- **Catchment management**;
- Increases in **surface or groundwater abstractions**;
- New surface **storage reservoirs** or **enlargement of existing reservoirs**;
- Upgrading **water treatment works** facilities;
- **Re-commissioning old or existing licences**; and
- **Licence variations**.

Pre-draft consultation on unconstrained list of options

- 8.13. In order to develop a comprehensive “unconstrained” list of potential options to mitigate any supply demand balance deficits, Southern Water sought to elicit the views of customers and key stakeholders through a range of activities including stakeholder workshops, customer focus groups, and a customer online survey.
- 8.14. A draft of the unconstrained list of options was also issued to the Environment Agency on 17th August and was reviewed at a meeting on 25th September 2012 as part of a programme of monthly pre-draft consultation meetings. Comments from the EA were used to update and finalise the unconstrained options list. A draft final list of options was also issued to Natural England on 4th February 2013, to which no comments were received.
- 8.15. A description of the pre-draft consultation activity, much of which was focused on the list of options, is provided in Section 4.

Regional options

- 8.16. The Southern Water area of supply is complex in nature due to the fragmented geographical areas of supply and the inter-connections between its own supply areas, as well as those with a number of other water companies.
- 8.17. As a member of the WRSE group, Southern Water and its neighbouring water companies submitted their feasible options to the regional modelling group. The aim of this work was to derive a least cost “regional solution”, which can provide the water companies in the region with a view of potential bulk import requirements and bulk export availabilities. The options within Southern Water’s WRMP therefore included potential transfers between the water companies, above those that are currently in place, with the aim of facilitating the trading of water in the most cost effective manner. The regional transfers were reviewed in discussions between the water companies during consultation on the Draft WRMP. Any refinements have been included in the Final WRMP.
- 8.18. Whilst the work of the WRSE group helps to facilitate appropriately integrated solutions across the region, each company remains responsible for developing its own strategy. There are a number of instances where the company-preferred strategy might differ from that proposed by modelling undertaken by the WRSE group. For example:

- Where a solution proposed by the WRSE group might result in higher bills to Southern Water's customers than might have been the case were an alternative solution to be pursued;
- Where a solution might lead to a reduction in the security of supplies to Southern Water's customers; or
- Where the WRSE model results in Southern Water, which already leads the water industry in terms of its levels of leakage and metering, having to undertake further demand management measures in order to facilitate an export to a neighbouring company that has made less progress in these key areas of demand management. In such cases, Southern Water would clearly wish to resist its customers having to subsidise less stringent demand management activities in other companies.

Options screening applied to the unconstrained list of options

- 8.19. Following the development of the unconstrained list of options, each option was initially assessed using screening criteria to determine whether it should proceed to the feasible list of options for more detailed analysis and derivation of detailed costs.
- 8.20. An equivalent screening process was developed as part of the detailed studies conducted by Atkins under the AMP4 Water Resources Investigation projects, which covered all of Southern Water's Supply Areas. That same screening process was used for the previous AMP4 WRMP (published in 2009 following public consultation) and subject to review and endorsement by regulators and the consultation process for the previous WRMP.
- 8.21. It was therefore deemed appropriate to adopt and apply the same screening process and criteria to the unconstrained list of options for this Draft WRMP. The objectives of the screening process were:
- 1) To provide a comprehensive list of 'unconstrained' options that could be considered in order to provide additional water supplies to each of Southern Water's Water Resource Zones; and
 - 2) To provide a summary technical evaluation of each option, to determine whether it represents a viable water resource development that should be considered in greater detail or whether there are fundamental reasons why the option is unsuitable for further investigation. The following could be justifiable reasons for exclusion of such options in the initial stages:
 - **Technical feasibility;**
 - **Practicality, reliability and deliverability;** and
 - **Environmental or social impacts** that mean the option is likely to be fundamentally unacceptable.
- 8.22. Options that address improving deployable output at existing sources through routine asset maintenance / source improvements were not included within the options appraisal process for this WRMP. These types of options (where feasible and practicable) would be incorporated as completed options in the supply demand balance.
- 8.23. Once the screening had been undertaken to develop an initial set of constrained options, a second round of screening was carried out to identify which options should remain in the set of feasible options, which are included in the least cost optimisation model. This second round of screening included consideration of:
- The **practicability** of the option;
 - Its **potential benefit in water resource terms** – i.e. the potential that an option has to reduce demand or increase deployable output to meet a given deficit;
 - The extent of potential **environmental impact**, on both aquatic and terrestrial ecology, and whether measures might be available to mitigate risks of impacts;
 - Its potential **impact on other factors**, such as heritage, noise and air pollution;

- Any **constraints in planning terms**; and
- Its **cost**, in terms of both the capital and the subsequent operational costs required, including an allowance for the **cost of carbon**.

- 8.24. There may also be a number of other factors which influence the selection and timing of options, and so may influence the viability of a given option. These factors (set out below) were also considered, where applicable, to establish the viability of each of the options prior to inclusion in, and finalisation of, the feasible set of options for least cost investment modelling.
- 8.25. *The nature of the deficit:* In any given WRZ, a forecast supply demand balance deficit may arise under one or more of the conditions defined by the annual average, critical period (peak demand) or minimum deployable output (MDO) scenarios. This deficit triggers the need for new investment in demand or supply side options. However, the conditions which drive the need for investment may have a direct bearing on the appropriateness of one option over another. For instance, a deficit under a peak period scenario may be able to be solved through increased treatment capacity or higher meter installation, whereas average or minimum resource period imbalances may require the development of other types of options, such as more storage, the provision of a more reliable supply of water such as water re-use or desalination, increased meter installation or further leakage reduction.
- 8.26. *Timing of availability:* Some options require a long lead-time before they can contribute to the supply demand balance. Both the lead-time and the confidence in that lead-time (i.e. the likelihood that it will be available when it is required) are important factors. Confidence in lead times reduces sharply with an increase in the number and complexity of factors on which an option depends that are outside the control of the company.
- 8.27. *Social and political acceptability:* Some options for demand management or new supply-side water resources are subject to greater social and/or political acceptability criteria than others. Furthermore, most options on the supply side will require some form of consent, for example planning permission or an abstraction licence. The potential risks associated with securing these consents must be considered.
- 8.28. *Energy and carbon costs:* Similar to environmental impacts, energy and carbon costs need to be understood. The monetary costs of energy will be automatically taken into account as part of the assessment of capital and operational costs of an option. It should also be understood that high energy costs should not automatically be equated with high carbon costs, since the company may choose to supply the energy needs of an option from renewable sources.
- 8.29. *System resilience:* As discussed in Section 3, groundwater sources and the different types of surface water sources will react differently to differing hydrological conditions; hence WRZs may incur differing degrees of stress under the same hydrological conditions due to their different composition of types of source. In order to develop a system that is as resilient as possible to different types of drought, due consideration must be given to the optimum balance of the type of sources that the company has in any given WRZ and how those sources will respond under a variety of drought conditions. This should be an important consideration in the choice of new resources.
- 8.30. *Source resilience:* The resilience of an option is an indication of the confidence that the option will “deliver” the required reduction in the supply demand balance deficit. Where an option depends heavily on assumptions about changes in customer behaviour, or may be significantly impacted by different climatic conditions, it is less reliable than an option that is unaffected by such factors (e.g. water re-use and desalination).
- 8.31. Appendix H provides a summary table of all the options that were screened out during the assessment of unconstrained options, together with a brief explanation for the rationale for doing so. The result of the option screening process is to produce a list of “feasible” options.

Environmental considerations

- 8.32. There are two key aspects involved with including environmental considerations into the options appraisal process:
- **Monetary valuation** of environmental and social costs and benefits, where possible, for inclusion in least cost economic modelling; and
 - **Non-monetary valuation** of options:
 - Initial assessment of potential environmental or social impacts that mean the option is fundamentally unacceptable as part of the screening of unconstrained options;
 - Strategic Environmental Assessment (SEA) of the feasible list of options;
 - Habitats Regulation Assessment (HRA) of feasible options that have the potential to result in significant impacts on European sites; and
 - Water Framework Directive (WFD) assessment to consider the potential impacts on WFD objectives and water body classification.
- 8.33. Both the monetary and non-monetary valuations enable environmental considerations to influence and inform the selection of the preferred programme of options to meet a supply demand balance deficit.

Valuation of environmental costs and benefits

- 8.34. Where possible, the potential environmental and social impacts of feasible options were monetised using the Benefits Assessment Guidance (BAG). The BAG methodology was originally developed by the Environment Agency to support options appraisal for the 2004 Periodic Review of price limits (PR04), and was updated in 2012.
- 8.35. The BAG approach is based on cost-benefit analysis, in which both positive and negative impacts are quantified in monetary terms. This enables the net environmental and social cost or benefit to be compared against the capital and operating costs of the scheme. The BAG also allows for qualitative and semi-quantitative assessment of impacts where this is more appropriate.
- 8.36. The BAG methodology uses the approach of 'value transfer' or 'benefits transfer', which refers to the process of estimating environmental and social impacts in monetary terms using values available from existing studies. Although this is a widely used approach for monetising environmental and social impacts across a range of public policy areas, it does have well-recognised limitations.
- 8.37. The principal limitations arise from the use of studies that may not perfectly match the situation in question, and the judgement required in applying the studies and methodology. Nevertheless, the BAG provides a consistent framework for assessing a large number of schemes at a desk-based level, where primary valuation studies for each scheme would be too resource-intensive. The values produced for each scheme therefore provide a high-level indication of the benefits or dis-benefits of a scheme, rather than an accurate estimation, and therefore should be treated as such.
- 8.38. The methodology requires users to first assess impacts in qualitative terms, followed by a quantitative assessment (for example, the likely number of fishermen affected), before using a benefits transfer approach to evaluate the impacts in monetary terms where there is an appropriate benefits transfer value and the impacts are likely to be significant.
- 8.39. Given the subjective nature of the likely scale of impacts for each assessment, a set of secondary assumptions were developed where necessary and used across all schemes in order to ensure consistency. This was particularly important for the large number of pipeline or transfer schemes, for which the BAG is less suited.
- 8.40. The environmental and social economic costs and benefits derived using the BAG methodology were included in the least cost investment modelling of feasible options to assist in the selection of the preferred strategy.

- 8.41. The environmental and social costs of leakage reduction were also estimated, only the BAG methodology does not apply to this option set. Instead, the Ofwat, 2008 report *Providing Best Practice Guidance on the Inclusion of Externalities in the ELL Calculation* was followed, as described in Appendix H10.
- 8.42. Carbon costs were also examined for each option, both in terms of embedded / construction carbon, and the estimated tonnes of carbon dioxide emitted through operation of the scheme on a whole life cost basis. The traded and non-traded price of carbon was applied to the profile of tonnes of carbon dioxide through the planning period to derive a carbon cost through the planning period.

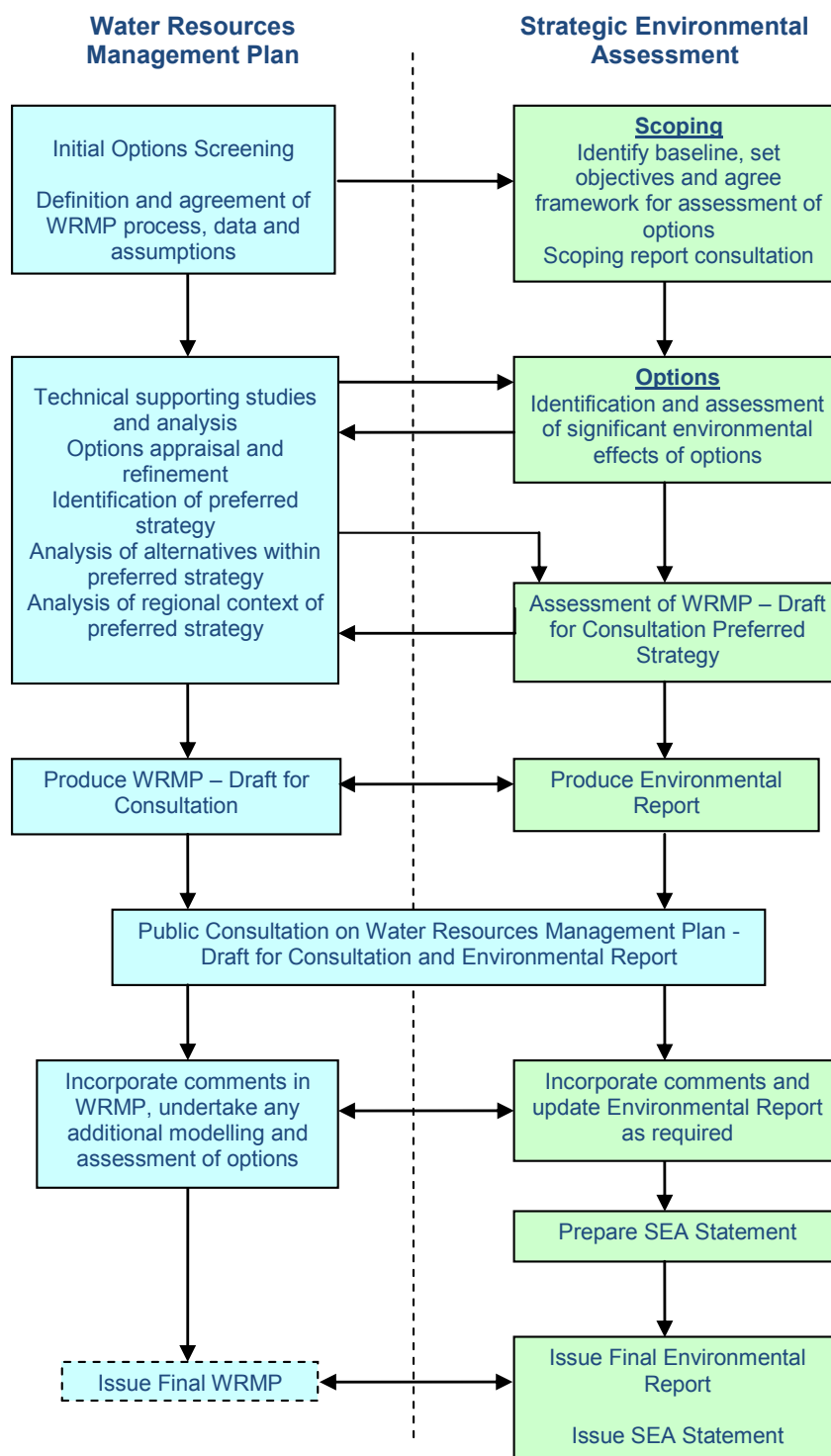
Strategic Environmental Assessment

- 8.43. The requirement to undertake Strategic Environmental Assessment (SEA) in the European Union (EU) came about when the EC Directive (2001/42/EC) 'on the assessment of the effects of certain plans and programmes on the environment', known as the 'SEA Directive', came into force. The Directive was subsequently transposed into law in England in 2004 by the Environmental Assessment of Plans and Programmes Regulations (SI 2004/1633). The Directive and associated regulations make SEA a mandatory requirement for certain plans and programmes which are likely to have significant effects on the environment. The overarching objective of the SEA Directive (Article 1) is:

"To provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans...with a view to promoting sustainable development, by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans...which are likely to have significant effects on the environment".

- 8.44. WRMPs are statutory plans prepared at a sub-regional level, and may give rise to projects that would require assessment under the requirements of the EIA Directive and its enabling legislation in England. The WRMP can also be categorised as a "water management plan", as it will set the framework for future development consents for these projects. Therefore the WRMP, as a statutory plan with potential significant environmental effects, is considered to be subject to SEA as defined by SI 2004/1633.
- 8.45. SEA is a process that identifies and reports on the likely significant environmental effects of the plan or programme concerned. The SEA involves an iterative process of collecting information, defining alternatives, identifying environmental effects, developing mitigation measures and revising proposals in the light of predicted environmental effects. SEA is therefore fully integrated into the plan-making process, both informing and being informed by it.
- 8.46. Figure 8.2 illustrates how the SEA and WRMP preparation processes are integrated. The SEA is used to ensure that consideration is given to the wider potential environmental implications of options choices, over and above what can be quantified in monetary terms as part of the economic options appraisal.

Figure 8.2 Relationship between WRMP and SEA processes



8.47. The feasible options identified by the screening process were subject to a Strategic Environmental Assessment. Each of the supply-side resource development options were assessed against 14 SEA objectives in order to identify potential conflicts in the short, medium and long term. A brief summary of the findings of this assessment has been provided for each of the general option types later in this section.

8.48. Overall, a number of potential conflicts between WRMP supply-side resource development options and SEA objectives were identified. Where appropriate, high level mitigation measures were identified in order to reduce the scale of potential impacts. These are discussed in the SEA Environmental Report, which was published for consultation alongside the Draft WRMP. An independent review of the approach to SEA undertaken for the Draft WRMP is included as Appendix M. The SEA Environmental Report was updated for the revised Draft WRMP in

November 2013 and takes account of consultation responses to the Draft WRMP and supporting documentation and the independent review.

Habitats Regulations Assessment

- 8.49. If it cannot be demonstrated that a plan or project is not likely to have a 'significant effect' on any site that is designated under the European Habitats or Birds Directives, an assessment is required under the Conservation of Habitats and Species Regulations 2010 (the Habitats Regulations). This assessment is more commonly referred to as a Habitats Regulations Assessment (HRA). Sites designated under the European Habitats and Birds Directives are Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) respectively. HRA is also required, as a matter of UK Government policy for potential SPAs (pSPA), candidate SACs (cSAC) and Wetlands of International Importance designated under the Ramsar Convention of 1979 (Ramsar sites). All of these sites may be referred to as 'European Sites'.
- 8.50. The responsibility for undertaking HRA falls to the relevant 'Competent Authority' within the Habitats Regulations. Water companies are classed as Statutory Undertakers and hence are 'Competent Authorities' under the Habitats Regulations. Therefore, Southern Water is responsible for considering the need for HRA for its plans, in line with the requirements of the Habitats Regulations.
- 8.51. Southern Water's water supply area contains a number of European sites, and some of the options shortlisted for possible inclusion in the WRMP have the potential, either alone or in combination, to result in significant effects on one or more European sites.
- 8.52. An HRA Screening was completed to determine whether the Plan and its composite measures could be considered to have a likely significant effect on designated sites of European and international nature conservation importance, and an Appropriate Assessment for those measures for which the screening was unable to conclude no likely significant effect was undertaken. The Appropriate Assessment considered the implications of the Plan on the identified sites in view of their conservation objectives. The assessment for the Draft WRMP concluded that, with suitable mitigation measures and the requirement for HRA at the more detailed project level consenting and licensing stage, the plan would not adversely affect the integrity of the protected sites. However following the consultation responses on the Draft WRMP and supporting documentation and discussions with both EA and NE, the HRA was reviewed and updated.

Water Framework Directive

- 8.53. The Water Framework Directive (WFD) is a European legislative approach to managing and protecting water, based on river basin management. The WFD is designed to protect and improve the environmental condition of all waters, including rivers, lakes, groundwaters, estuaries and coastal waters out to one nautical mile. The fundamental objectives of the WFD are to prevent any deterioration in the existing status of waters and to aim to achieve 'good status' in relation to all waters, or 'good potential' in heavily modified water bodies.
- 8.54. For the second cycle of river basin planning, the Environment Agency has indicated that the default objective is to 'aim to achieve good status by 2021' (Paper by EA Head of Catchment Management, January 2013). If this is not achievable because specific exemptions apply, then alternative objectives may be set including extended deadlines (e.g. aim to achieve good status by 2027); and less stringent objectives (e.g. aim to achieve moderate status by 2027). The Paper, circulated to River Basin Management Plan liaison panels, sets out the criteria for these exemptions and corresponding alternative objectives.
- 8.55. The EA Water Resource Planning Guideline instructs companies to assess the impact of both changes to the operation of existing sources and of new abstractions on water body status. Changes to the operations of existing sources are to be assessed at either catchment or water resource zone level to demonstrate that there has been 'no deterioration'.
- 8.56. The EA's pre-draft consultation letter (dated 21 Dec 2012) expands on the content of the WRP. It notes that the company should review existing operations and the use of existing surplus within licensed headroom. Furthermore, it states that the company should demonstrate that options have been screened against WFD criteria to ensure that an option would not cause deterioration in a water body's status.

- 8.57. If an option is predicted to cause a deterioration in water body status or prevent the water body from meeting its objectives, an assessment would need to be made against Article 4.7, which allows for new modifications affecting water bodies if: practicable steps are taken to mitigate adverse impacts; no other significantly better option exists; and in light of overriding public interest.
- 8.58. However, without detailed investigation of each option that has the potential to impact on WFD objectives, it is not possible to meet the EA's obligation of conducting screening "to ensure that an option would not cause deterioration in a water body's status". To 'ensure' that this is the case goes beyond what is practical for a strategic plan. What can instead be achieved is to exclude options that are likely to have significant environmental impacts, bearing in mind the WFD objectives, and to raise potential environmental issues associated with the feasible options set. This is the approach that company has taken, and which is outlined below.
- 8.59. It should also be noted that almost all the supply-side resource development options will be subject to some form of planning constraints and/or application to the EA for a licence or licence amendments. Hence there will be the need for an appropriate level of environmental investigation and assessment at that stage, which would include compatibility with WFD objectives. This represents a more appropriate stage to make detailed assessments about WFD objectives.

WFD assessment approach

- 8.60. The Environment Agency issued a briefing to water companies in May 2013 regarding no deterioration assessments for water resources. The briefing stated that Environment Agency would support companies by providing relevant results and it provided links to the Environment Agency's recently completed risk assessments for surface water status deterioration; however the briefing did not include any detailed advice on approach. Finally, the briefing noted that "Water companies may need to undertake further investigations where an initial assessment of increased abstraction ... suggests there is a likely risk of deterioration." Given the time constraints and availability of data we have undertaken an assessment in line with the principles set out in the guidance.
- 8.61. As suggested in the Environment Agency's briefing, information on the WFD datashare was accessed and the method statement and high level results for the surface water risk assessments were reviewed. SWS wished to follow a compatible approach to assess the likely risk of deterioration for its WRMP and in order to do this various components of data were requested, covering Southern Water's water resources zones.
- 8.62. Unfortunately due to data licensing constraints much of the information requested could not be provided. Therefore, the approach used by the company to assess the impact of both changes to the operation of existing sources and of new abstractions on water body status aims to balance the high level nature of the water resource planning process with the need to ensure that an option and overall plan would not cause deterioration in water body status. The three tier approach chosen was therefore pragmatic, transparent and designed to be used at the strategic planning level. It has been guided by the methodology developed by Cascade Consulting for several water companies' Draft WRMPs using documentation in the public domain. Natural England has indicated that this methodology is considered to be practical and appropriate for the high level WRMP process.
- 8.63. The first step involved an initial screening of all feasible options to determine whether they have any potential WFD implications. The following scheme types were considered to have no potential negative WFD impacts (Table 8.1) and were therefore excluded at the first stage:

Table 8.1 Summary of option types which do not have the potential to impact on WFD objectives

Option type	Reason for exclusion
Catchment management	Likely to have a positive impact on WFD status (e.g. chemistry, biology).
Existing inter-zonal transfers	Does not involve a change to the operation of existing sources.
Nitrate removal using conventional treatment technology	Will enable the continued operation of the source at current capacity.
River restoration	Likely to have a positive impact on WFD status (e.g. flow, morphology).
New bulk supplies	Water resource impacts assessed under separate options.
Water efficiency	Likely to have a positive impact on WFD status (e.g. chemistry, biology and flow).
Leakage mains renewal and management	Likely to have a positive impact on WFD status (e.g. chemistry, biology and flow).

- 8.64. The following remaining option types were considered to have potential WFD implications (Table 8.2):

Table 8.2 Summary of option types which have the potential to impact on WFD objectives

Option type	Potential WFD implications
Desalination	Brine discharge effects on adjacent coastal or estuarine waters and habitats.
Surface water abstractions	Potential implications on hydromorphological status in relation to the WFD. Mitigation for these risks may be available, e.g. in the timing of the abstractions or ensuring compliance with existing minimum residual flow limits. But further detailed studies may be needed to confirm the likely effects and mitigation required.
Surface storage reservoirs	New reservoir options will also require further consideration of their compliance with WFD.
Water re-use	Potential issue with the quality of the treated wastewater, although the scale of impact varies depending on the nature of the receiving waters.
Licence variations	Potential for changes to hydromorphological conditions or quantitative status from variations to some types of licences would need to be assessed in detail.
Borehole rehabilitation and reconfiguration of groundwater abstractions	The quantitative status of the groundwater body, and the potential for groundwater continuity with adjacent surface water bodies (with potential secondary impacts on aquatic ecology). Generally these uncertainties can only be resolved with further investigation.
Licence trading	Potential impacts of using the licensed source on adjacent water bodies and WFD status would require further investigation.

- 8.65. The second step involved a high level assessment of the potential impacts of the remaining options on the WFD status of water bodies that could be affected by each scheme. Where negative post-mitigation impacts on water body status were considered to be extremely unlikely, the relevant options were screened out at this stage (for example, schemes that would result in minimal flow or water quality changes). However, if selected as part of the preferred plan, the combined impacts of some of these options are further considered at a WRZ level in paras. 8.70 to 8.71 and in Table 8.4 below.

- 8.66. The final step involved a more detailed assessment of the impacts of the remaining feasible options on WFD status to determine whether they could potentially contravene the WFD 'no deterioration' requirement. The aim was to ensure that any option likely to cause deterioration in status was excluded from the feasible options list.
- 8.67. This final step involved assessment of the option against each relevant WFD element for each water body potentially affected using expert judgement. Based on this assessment, a conclusion was drawn on whether the option could potentially cause deterioration in status, could compromise the attainment of WFD objectives for the water body, could affect any other water bodies or could in fact aid the attainment of WFD objectives. Overall impacts were summarised for each option as (i) unlikely; (ii) possible or (iii) uncertain. The results of the assessment were recorded in a standard proforma (see Appendix H08).
- 8.68. Options for which impacts on WFD status were considered to be possible were subsequently excluded from the feasible options list or flagged for further review in AMP6. The following options fall into this category (Table 8.3):

Table 8.3 Options with potential WFD implications

Option	Potential WFD implications
N5 New reservoir	Effects of the abstraction from the River Adur could result from increased salinities due to reduced dilution and a resultant shift in species distributions. In addition, if flows are reduced in the eastern branch there may be a significant aquatic impact on fish. Proposed abstraction rates could represent up to 37% of flows; therefore impacts during dry winters are a possibility. Retained in feasible list, but option to be kept under review - earliest start date not until end of AMP7, so allows time for further review in AMP6.
N6a-20 New surface storage reservoir	Concerns relate to the changes in flows and levels associated with the abstraction, which could impact on habitats, water quality and consequently species. Retained in feasible list, but with earliest start date after three AMP periods to allow for potential issues with investigations and planning permissions.
N3 MRF Seasonal Variation (incl. River restoration)	Modelling has been undertaken to determine impacts on flows and water quality in the tidal River Arun downstream. This has concluded that significant impacts on flows levels and salinity are unlikely. However there are some risks regarding increases in the levels of orthophosphates and some herbicides/pesticides. This could result in algal blooms which could have knock on effects on water quality and in-river ecology during the summer months when flows are lower. This requires further investigation/modelling. In addition, immediately downstream of the Southern Water abstraction the flows will be significantly reduced. However within a short distance the river joins the Arun, restoring flow levels downstream of the confluence.
NR2b Water reuse with BAFF treatment	SIMCAT modelling has shown that, with a suitable degree of treatment, there is an acceptable level of impact on water quality under WFD. The intermittent / temporary operation of the scheme also reduces the impact on water quality that will be realised. However, BAFF treatment may not be sufficient to prevent impacts on WFD status. Variants using Reverse Osmosis have been retained within the feasible options list.
C4 River Adur Abstraction	During low flows there are significant concerns regarding the quality of the water in the River Adur. A reduction in flows due to the abstraction could further increase risks to water quality, with associated impacts on fisheries and biodiversity downstream of the abstraction. Water quality modelling may be required in order to determine whether the impacts of abstraction during low flows would be.

Option	Potential WFD implications
H3+H7 - Re-introduction of borehole source	Although the proposed abstraction volume from this source is small (0.9 Ml/d), the aquifer is unconfined and may have connectivity with adjacent water bodies, which are relatively small. Operation of scheme could therefore reduce baseflow, which could potentially affect WFD status.
IWL1 groundwater rehabilitation with marginal treatment onsite	The source has not been used since the mid 1980s. Test pumping from around that time resulted in an immediate impact on baseflow in a connected water body, which could potentially affect WFD status.

- 8.69. Options for which it was not possible to conclude that there would be no likely impact will, if selected to form part of the preferred plan, undergo further investigation and assessment prior to implementation to ensure that they do not result in any deterioration of water body status. Alternative options may be selected at a later date following these investigations if it cannot be demonstrated that there will be no deterioration.

Potential cumulative impacts of the preferred plan

- 8.70. Appendix 14 (Environmental and Social Impacts of an Option) of the revised Water Resource Planning Guideline states that “*water companies should assess the net impact of changes to their operations at a catchment and WRZ level and demonstrate ‘no deterioration’ against water body status*”.
- 8.71. Cumulative environmental and social impacts of the preferred plan are assessed as part of the Strategic Environmental Assessment (SEA) and reported within the SEA Environmental Report. Potential negative cumulative effects on WFD water body status of the preferred plan at a WRZ level are summarised below in Table 8.4.

Table 8.4 Potential cumulative effects of the preferred plan on water body status

WRZ	Potential cumulative effects of plan on water body status
Western Area	
Hampshire Andover	No new supply-side options planned for this WRZ.
Hampshire Kingsclere	No new supply-side options planned for this WRZ.
Hampshire South	Potential cumulative effects on downstream water quality and quantity from the HSL3+HST2 Conjunctive use scheme and the JO3a groundwater scheme for river augmentation in relation to the Rivers Test and Itchen, which both flow into the Solent coastal water body. However, the large volume of water in the Solent compared with the anticipated change in flows is likely to limit the extent of any cumulative effects. Any cumulative effects from changes to flow regimes should be addressed through changes to and/or new conditions in abstraction licences.
Isle of Wight	No likely cumulative impacts of the preferred plan. There are two planned supply-side options in the Isle of Wight WRZ: IWL6 groundwater rehabilitation and the IWL7 utilise the full capacity of existing cross-Solent main scheme. No impacts on river flows are anticipated as a result of IWL6 because the abstraction takes place from a highly confined source. Option IWL7 is not anticipated to have any effects on water quality or flows.
Central Area	
Sussex Brighton	No likely cumulative impacts of the preferred plan as no supply-side options selected that are likely to significantly affect water quality or quantity in any water bodies.

WRZ	Potential cumulative effects of plan on water body status
Sussex North	No likely cumulative impacts of the preferred plan. There are two supply-side options in Sussex North WRZ that interact with the Western Rother water body. Option N10 Well field reconfiguration could have a potential positive impact on WFD status as the ability to increase groundwater abstraction during low river flow periods may reduce the stress on the surface water ecosystem. With the NR2c 10MI/d Water reuse option the temporary operation of the scheme during drought conditions, together with the use of Reverse Osmosis technology, will limit any impacts on water quality under the WFD.
Sussex Worthing	No likely cumulative impacts of the preferred plan as no supply-side options selected that are likely to significantly affect water quality or quantity in any water bodies.
Eastern Area	
Kent Medway	Potential cumulative effects on water quality and quantity in the River Medway and Medway Estuary of several options: the M10 River Medway licence Variation, the M9 groundwater source licence variation, the MR3 20MI/d Water reuse scheme and the M21 Licence trading scheme. The exact nature of these cumulative impacts cannot be confirmed at this stage and will need to be assessed within any further investigations undertaken in support of these options.
Kent Thanet	No likely cumulative impacts of the preferred plan as no supply-side options selected that are likely to significantly affect water quality or quantity in any water bodies.
Sussex Hastings	No likely cumulative impacts of the preferred plan as no supply-side options selected that are likely to significantly affect water quality or quantity in any water bodies.

Feasible list of options

- 8.72. A feasible list of options is defined by the EA in the Water Resource Planning Guideline (p.107) as:

“... a set of options that a company considers to be suitable for taking forward for assessment as part of the preferred programme. It is a subset of the unconstrained list. The feasible list should contain options which have a reasonable chance of implementation and therefore should not include options with unalterable constraints or which have a high risk of failure.”

- 8.73. The result of the option screening process, described above, was to produce a list of “feasible” options for each of Southern Water’s three Supply Areas (Western, Central, and Eastern). Once assessed for associated costs, these feasible options could then be used in the investment model to derive a least-cost plan over the 25-year planning period.
- 8.74. The sub-sections below provide a list of the generic options types that comprise the list of feasible options. A general description is provided for each of the option types, a discussion of how option types are viewed by customers, and identification of the potential SEA implications.

Reducing demand: enhanced water efficiency options

- 8.75. Water companies have a statutory duty to promote the efficient use of water. Every year Southern Water carries out water efficiency programmes to meet the regulator Ofwat's target of saving one litre of water per property per day – adding up to 1 million litres. This is achieved by, for example:
- Carrying out water and energy audits in customers' homes;
 - Running education programmes in primary and secondary schools;
 - Offering discounted water-saving products on the company's website; and
 - Working in partnership with Waterwise and the Energy Saving Trust.
- 8.76. There is an implicit assumption that the level of water efficiency activity that is included in the base year demand will continue through the planning period. This is built into the demand forecast.
- 8.77. It is therefore important to emphasise that the water efficiency options considered as part of the options appraisal and detailed in this section are **enhanced** water efficiency options. They are options which provide additional savings over and above those assumed as part of Southern Water's baseline water efficiency activity and promotion included within the baseline demand forecast.
- 8.78. Section 6, covering the demand forecast, describes the baseline water efficiency activity and the assumed savings expected throughout the planning period.
- 8.79. The company also aspires to drive down household consumption to below 130l/h/d by 2030, which is achieved under normal year annual average conditions (without climate change impacts).
- 8.80. A wide range of water efficiency options were identified for their potential to contribute to reducing household and non-household demand. An unconstrained list of feasible options is provided in Appendix H.
- 8.81. The options were assessed in terms of their estimated costs and water savings, and any practical considerations in their implementation were identified. A number of options were not feasible for implementation in the context of the company's water efficiency strategy. For instance, grey water recycling in the home was excluded due to its current very low cost effectiveness. However, the company aims to conduct investigations of a range of potential water efficiency schemes during AMP6.
- 8.82. In line with current best practice, the deterioration in the effectiveness of each water efficiency measure over time, due to various reasons such as breakdown, lack of maintenance, and removal or replacement, was modelled using a time varying yield curve assumption based on the asset life of each measure.
- 8.83. Detailed cost and savings estimates were produced for each of the options at the company scale. The options costs and savings were then disaggregated to WRZ level, based on the number of either household or non-household properties in the base year.
- 8.84. The water efficiency options in the feasible list has been revised and updated following the publication of the Draft WRMP. Given that there is an implicit assumption of continued water efficiency activity by the company throughout the planning period, primarily relating to household customers, the focus of the new set of "enhanced" water efficiency options in the feasible list was therefore primarily targeted at non-households. As a result, there were four enhanced water efficiency options included as options in the least cost economic model. The options are as follows:
- Home audits with retrofits;
 - School water audits;
 - Water audits of Small and Medium Enterprises (SME); and
 - Large business audits.

Customer preferences

- 8.85. Southern Water customers expressed strong support for increased water efficiency options and education during consultation on the draft WRMP and the draft Business Plan for 2015-2020. Ninety two per cent of respondents in the WRMP consultation supported our proposals to continue to set a target to save one litre of water per property per day until 2040. Many commented that this target was modest and should be a minimum, however, customers also appreciated that water efficiency options are not able to secure water resources in isolation and should be cost beneficial.
- 8.86. There was also support for campaigns on an ongoing basis (i.e. as part of the baseline water efficiency activity) to influence customers taking a long-term view that would encourage a permanent change in behaviour.

SEA findings

- 8.87. Water efficiency measures are regarded as a preferred demand management measure from the SEA perspective as they have no potential conflicts with the SEA objectives.

Summary of feasible options

- 8.88. There is considerable uncertainty over a number of factors influencing the long-term effectiveness of water efficiency measures, including the long term savings associated with many water efficiency devices, how customers use and maintain the devices, and how customer behaviour may change in future. As a result, the option cannot be considered resilient because the potential saving cannot be guaranteed at all times of the year under all types of dry year conditions, and the options in themselves cannot guarantee that supplies will be available during drought events.
- 8.89. However, demand management schemes in general are likely to enhance the **resilience of supply side options**, because they act to generally reduce demand, which will be beneficial in the run up to a potential or actual drought event.



Enhanced water efficiency

A range of enhanced water efficiency activity including providing water savings kits, low flow taps and subsidies to use more water efficient devices

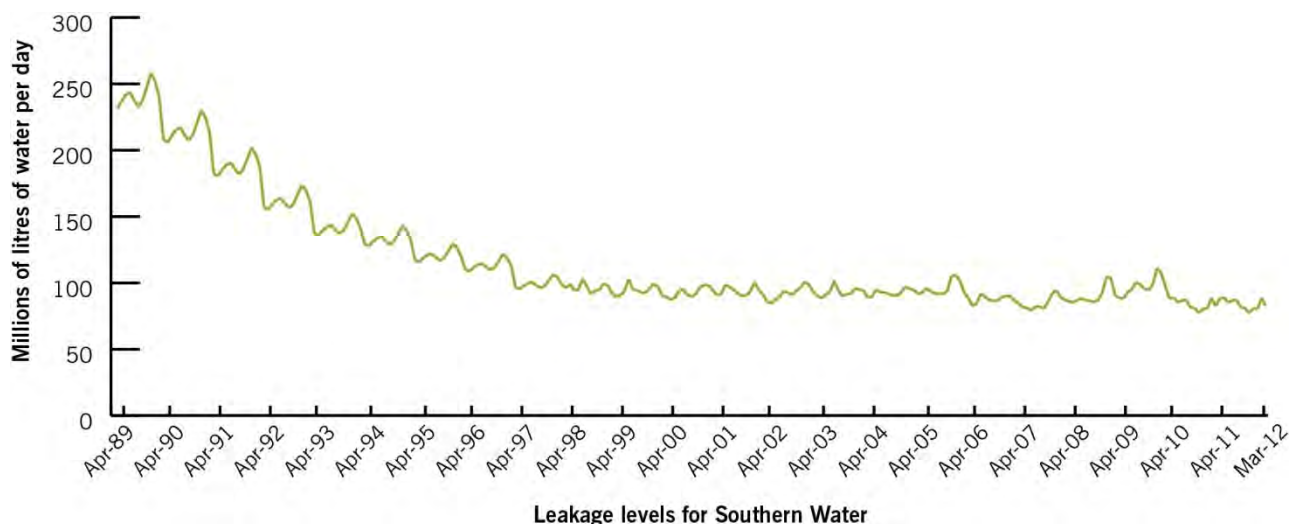
Pros Raises awareness of water-saving and reduces demand for water

Cons Expensive for the amount of water saved and does not secure supplies during droughts

Reducing demand: leakage

- 8.90. Since the water industry was privatised in 1989, Southern Water has reduced leakage to such an extent that the amount of water abstracted each day has actually reduced, despite an increase in population being supplied by Southern Water.
- 8.91. Southern Water remains the water and sewerage company with the lowest leakage level per property, and has beaten the target set by our regulator Ofwat, by 11 million litres a day.

Figure 8.3 Average leakage levels since privatisation



- 8.92. The set of leakage reduction options incorporates the following combination of leakage management policies:
- Active leakage control (ALC) – find and fix leaks;
 - New leakage technology;
 - Pressure management; and
 - Mains renewal resulting from non-leakage drivers, but which consequently have a beneficial impact on leakage levels.
- 8.93. The company employs a 200-strong team of leakbusters who work around-the-clock to find and repair the leaks; more than 27,000 leaks were repaired last year.
- 8.94. However, at a certain level, it becomes more expensive to find and repair more leaks than to develop other water supply options. Therefore, the aim is to balance the leakage reduction work with the cost to customers.

Mains renewal options

- 8.95. Leakage-driven mains renewal, as opposed to find and fix leakage reduction, forms another options set of potential leakage reduction options. It comprises replacement of non-polyethylene (non-PE) pipes. The company's experience shows that these tend to be very expensive to do, in comparison to the leakage savings achieved.

Table 8.5 Mains renewal leakage reduction options

WRZ	Total mains length renewal (km)	Estimated leakage saving (MI/d)	Capital cost of mains renewal (£k)
Hampshire South	7.80	0.09	1,202
Isle of Wight	2.64	0.03	406
Sussex North	5.08	0.07	783
Sussex Worthing	2.30	0.03	354
Sussex Brighton	6.04	0.08	930
Kent Medway	14.19	0.14	2,186
Hampshire South – stage 2	5.93	0.04	913
Sussex Brighton – stage 2	15.82	0.11	2,438
Kent Medway – stage 2	50.11	0.35	7,721

Customer preferences

- 8.96. Reduction of leakage was supported by around three-quarters of customers. Only 8% of customers did not support leakage reduction options. Most customers (93%) would include leakage reduction in their preferred set of options to meet a deficit
- 8.97. Participants in customer focus groups felt that Southern Water should, as a matter of course, do what they can to minimise leakage on its network. However, many were surprised to understand the levels of investment required to do so.

SEA findings

- 8.98. The demand management options under consideration in this WRMP were generically assessed for their environmental effects in the SEA. They were found to be broadly compatible with the majority of SEA objectives, having a net positive environmental effect due to the minimal amount of physical intervention required in implementing each measure.

Summary of feasible options

- 8.99. Leakage reduction options are an essential part of a twin track approach. But it is important to recognise that, below a certain level, it will become uneconomic to reduce leakage further. That is, there is a **sustainable economic level of leakage** (SELL) which companies should seek to achieve.
- 8.100. It is also important to remember that with leakage reduction options, there is an initial cost involved in increased activity to “find and fix” leakages, but an ongoing operational cost to keep leakage at that level. Therefore, if the enhanced leakage reduction activity is relaxed, then leakage will gradually rise as pipes deteriorate over time. This means that leakage reduction schemes tend to have **relatively high ongoing annual costs** to maintain leakage at the desired level.
- 8.101. Finally, whilst leakage reduction can generally contribute to reduced demand and hence reduced need for abstractions, the level of leakage is a function of climatic conditions. If there is, for example, a very cold winter, then leakage will increase due to increased pipe bursts. As a result, it is not possible for companies to guarantee the level of leakage that they can achieve in any given year. Ofwat recognises this when it sets leakage targets for companies, requiring them to meet the target as an average over a three year period.



Leakage reduction

The repair of water mains and connection pipes which leak water

Pros Reduces need to abstract water

Cons Can be relatively expensive and does not help secure supplies during droughts



Mains renewal

Replacement of non-polyethylene (non-PE) pipes

Pros Reduces need to abstract water

Cons Very expensive for relatively small savings in leakage (although cost benefit is improved if other drivers are taken into account)

Reducing demand: metering and tariff options

Metering

- 8.102. The previous WRMP provided a case for compulsory universal metering, which was accepted by the regulators. As a result, Southern Water initiated a £83 million Universal Metering Programme to install water meters for the majority of domestic customers by 2015.
- 8.103. Households with a water meter generally use about 10 per cent less water which equates to a saving of more than 17 MI/d with full uptake. The meters include leak alarms which will help save an extra 5 MI/d from reduction of leakage in customers' supply pipes.
- 8.104. The Universal Metering Programme aims to achieve a level of domestic meter installation of 92% at the end of AMP5 (i.e. for the start of the planning period); with current technology, it is not generally considered feasible or economic to install meters in all properties, because the configuration of some houses and flats can make the installation of meters in all cases prohibitively expensive.
- 8.105. However, following pre-draft consultation with the Environment Agency for the Draft WRMP, Southern Water included an option to meter the remaining 8% of customers, or around 80,500 households. The option was not selected as part of least cost modelling, and so has not been replicated as part of this Final WRMP.

Tariff options

- 8.106. Variable tariffs based on volume of water usage provide a potential mechanism for encouraging lower water use, particularly at peak times (e.g. during summer months). The success of a varying tariff structure is clearly going to depend on the level of meter installation across the company's customers, and so this option would only become viable and socially fair following completion of the company's Universal Metering Programme.
- 8.107. There are a number of potential tariff options, of which the most beneficial are considered to be:

- Rising block tariffs – which are designed to reduce customer's demand by charging relatively more for higher rates of consumption. These tend to allow customers a "free" block of water, but with consumption above this block charged at a higher than usual volumetric rate; and
- Seasonal tariffs – which aim to encourage reduced customer demand in peak summer periods by charging more during June to August. Such a tariff could be designed to be cost-neutral to the average household's bill.

- 8.108. Research suggests that, on completion of the Universal Metering Programme, the development of appropriate tariffs could lead to further reductions in demand of up to 5% on average across the year, and potentially up to 10% in peak periods, over and above the effect of metering alone (Herrington 2007). However, there does remain a significant degree of uncertainty over the potential savings which may be achieved through seasonal or rising block tariffs, for a number of reasons, which are outlined below.
- 8.109. The tariff structure would be limited by the meter technology currently in place, and these advanced tariff options only become available with the use of "smart" meters. The Universal Metering Programme, which is currently underway, makes use of Automatic Meter Reading (AMR) technology, which allows Southern Water to collect readings using drive-by means.
- 8.110. However, the existing metered stock (i.e. the meters in place prior to the Universal Metering Programme) would also need to be replaced by AMR or smart meters before a different tariff structure could be considered. Southern Water anticipates that approximately 64% of its metered customers will have AMR-type meters following completion of the Universal Metering Programme in 2015. Replacement of meters is generally required every 10-15 years, and so it is unlikely that a seasonal tariff could be reasonably applied to all metered customers before 2025 at the earliest, without customer support for an accelerated meter replacement programme.
- 8.111. A second key consideration is how customers tend to pay for their water bills. Many now choose to pay by direct debit on a monthly basis throughout the year. As a result, the key financial messages associated with varying tariff structures are likely to be missed by these customers. There will thus be much greater uncertainty over potential savings that could be achieved, but it seems likely that the overall savings across the customer base will be lower than otherwise expected.
- 8.112. A final point of consideration is the potential social implications that differing tariff structures could have in terms of the impact on customers' bills and vulnerable customers.

Customer preferences

- 8.113. Less than a quarter of customers (22%) supported the introduction of a seasonal tariff, and more than half (56%) actually opposed it. This option was the least popular amongst customers.
- 8.114. The customer focus groups concluded that, whilst many respondents may have this tariff in place already with their gas and electricity supplies, they did not wish to do this with their water as well. There were also real concerns that it could impact vulnerable customers.

SEA findings

- 8.115. The demand management options under consideration in the WRMP were generically assessed for their environmental effects in the SEA. They were found to be broadly compatible with the majority of SEA objectives, having a net positive environmental effect due to the minimal amount of physical intervention required in implementing each measure

Summary of feasible options

- 8.116. An option to extend the Universal Metering Programme to cover the remaining 8% of customers that could not be economically metered during AMP5 is likely to be prohibitively costly for a relatively small anticipated saving of around 3.6 Ml/d across the company supply area. There would be a good deal of uncertainty surrounding the meter installation costs.
- 8.117. As a consequence of the uncertainties involved with regards to the potential savings from tariff options, Southern Water proposes to undertake a trial of different tariff structures during AMP6

to provide direct evidence for the viability of tariff options, their impact on customers and the potential savings that may be achievable. This would allow the next WRMP to assess the likely costs and benefits of tariff options more fully.

- 8.118. It is also clear that customers would need to be persuaded of the potential benefits that tariff structures could bring in terms of potential demand management and environmental benefits. However, in order to make this case, Southern Water would need more detailed evidence from a trial, or trials from other similar companies, to demonstrate that real savings are achievable, long lasting and worth the cost to the customer – i.e. Southern Water would need to ensure that their customers were willing to pay for such an option.
- 8.119. As a result, **none of these options can be considered resilient** options, as the potential saving cannot necessarily be guaranteed at all times of the year under all types of dry year condition, and the options in themselves cannot guarantee that supplies will be available during drought events. However, demand management schemes in general are likely to **enhance the resilience of supply side options**, because there may be reduced demand in the run up to the design drought event.



Seasonal tariffs

A higher charge is applied in the summer than during the winter, although overall bills should remain the same

Pros Would encourage reduced demand in the summer when the network is under most pressure

Cons Does not secure a reliable supply during droughts and could cause hardship



Rising block tariffs

A higher charge is made as more water is used

Pros Could reduce demand by up to 5 per cent so we can take less from the environment

Cons Does not secure a reliable supply during droughts and could cause hardship



Metering

Extension of the Universal Metering Programme to cover the remaining 8% of households that could not be economically metered during 2010-15

Pros Reduced demand and all household customers paying a metered tariff

Cons Proportionately very expensive to install meters in remaining households not covered by the current Universal Metering Programme for a relatively small saving in demand

New water sources

8.120. This section on new water sources includes desalination and new surface water abstractions.

Desalination

8.121. Desalination options seek to make use of saline groundwater or coastal and tidal river waters which cannot be exploited by traditional treatment techniques. This is an approach that is widely practised in arid countries. It has become less expensive in recent years as the cost of the technologies has reduced. The potential sources of saline water are:

- Coastal waters;
- Tidal rivers;
- Offshore waters;
- Deep groundwater; and
- Coastal aquifers.

8.122. The first two sources, coastal waters and tidal rivers, are the two most commonly utilised, and are probably the easiest to design and manage from an operational viewpoint.

8.123. A number of environmental factors were taken into account when considering desalination during the AMP4 Water Resources Investigations, among which are:

- Construction and the subsequent abstraction and brine discharge may have adverse environmental impacts on coastal and marine habitats and wildlife;
- Treatment works may have significant visual impacts, especially in residential, tourist and designated areas along the coastline. These impacts can be mitigated to some extent, however, the mitigation measures clearly attract additional costs;
- Significant supporting infrastructure (roads, power, pipelines) is required, which may have social and environmental impacts;
- Tidal rivers in the South and South East of England are considered a valuable habitat and many of those within or near the company's supply area are subject to one or more environmental designation;
- Groundwater aquifers, given that they are likely to be non-renewable (i.e. a fossil aquifer), when subject to abstraction may deplete adjacent aquifers;
- Extraction from coastal aquifers may result in saline intrusion into fresh groundwater sources; and
- The potential requirements in terms of energy, although these can be reduced if the plant is only used intermittently, and modern design includes the facility for much enhanced energy recycling and the use of green energy source.

8.124. Owing to the environmental designations that apply to large stretches of the southern coastline within the Southern Water area of supply, potential locations for desalination were considered in existing industrial areas where there was the possibility of combined abstraction and/or wastewater discharge, so as to minimise the environmental impact.

8.125. The exact location of desalination plants was selected within existing or potential industrial developments where the visual and environmental impacts could be minimised.

Surface water abstraction

8.126. A range of potential surface water abstraction options have been considered, including new abstraction locations, amending the volumes taken at existing abstractions, and the relocation of existing abstractions.

8.127. The resilience of these options is limited, as abstraction licences may contain conditions that restrict abstractions during periods of low-flow, so that sufficient residual flows remain in the river for environmental purposes. The effect of a drought in reducing river flow is therefore absorbed entirely by the water abstraction in order to protect the environmental flow

requirements. Flows are also affected by licensed abstractions upstream (for instance for agricultural use).

Customer preferences

- 8.128. Around 51% of customers supported desalination schemes, while around 27% opposed such schemes.
- 8.129. The customer focus groups found that the concept of desalination was appreciated by many people because it deals directly with the resilience issue by ensuring there is always an available supply of water; subsequently it was quite well supported. However, for some, this option was dismissed on the grounds of cost and/or the large carbon footprint.

SEA findings

- 8.130. The SEA assessment of desalination found that it generally has the potential for conflicts with a number of SEA objectives relating to terrestrial and aquatic biodiversity, landscape, greenhouse gas emissions and waste production. The scale and nature of impacts vary according to the location of individual desalination options and any associated infrastructure (e.g. pipeline connections to supply). Generally, potential effects are related to both the construction and operational phases of a desalination plant, its visual impact and effects on adjacent coastal or estuarine waters and habitats due to abstraction and discharge. A particular issue across all desalination options is the highly energy-intensive nature of the desalination process, and the generation of brine waste.
- 8.131. Increases in abstraction from surface water have potential conflicts with most water related SEA objectives. Key issues relate to the current availability of water in the affected surface water bodies and their relative ecological sensitivity. New surface water abstractions also have potential implications on hydromorphological status in relation to the Water Framework Directive. Mitigation for these risks may be available, for example in the timing of the abstractions or ensuring compliance with existing minimum residual flow limits, but generally most of these options will require further detailed studies to confirm the likely effects and any mitigation required.

Summary of feasible options

- 8.132. Desalination options can provide a reliable and resilient water supply during drought events, however, there are obvious concerns regarding the carbon footprint of these schemes, and potential conflicts from the SEA objectives.
- 8.133. Surface water abstractions may not provide much additional system resilience without additional associated storage. Additional abstractions may also conflict with Water Framework Directive objectives.



Desalination

Sea water is abstracted and turned into drinking water

Pros Reliable water supply in drought, can be switched on and off

Cons High energy use, costs and carbon footprint. Brine by-product to dispose of



Surface water abstraction

New surface water abstraction, additional volume from and existing abstraction or relocation of existing abstraction

Pros Could provide reasonable volume of water

Cons Can only abstract when river levels exceed the minimum residual flow, so not considered to provide much system resilience without associated storage. May conflict with WFD status

Storing water

- 8.134. This section addresses options that store water, including aquifer storage and recovery and storage reservoirs.

Aquifer Storage and Recovery (ASR)

- 8.135. The principle of ASR is that either potable water, or raw water that could be used for potable purposes, is injected into a confined aquifer to create a 'bubble' of fresh water than can be re-abstracted when required, generally in summer or autumn.
- 8.136. A detailed investigation of potential ASR options was carried out in AMP4 as part of a programme of wider Water Resources Investigations. However, very few applicable sites were identified in the Southern Water region as there are constraints in terms of the appropriate confined aquifers, sources for providing the potable or raw water to be stored, and proximity to existing water supply infrastructure and abstraction boreholes.
- 8.137. The environmental applicability of ASR essentially relates to the impacts such a scheme could have on unconfined parts of aquifers that either affect surface water bodies or sources that are currently used for potable water.
- 8.138. The company is currently investigating a potential ASR scheme in Sussex Worthing WRZ to pump water from the River Arun during winter for storage and subsequent use in droughts. This scheme would pump water from the river when flows are high and store it underground in a confined aquifer ready to be pumped back to the surface and put into supply when needed.

Storage reservoirs

- 8.139. Reviews of potential options covered impounding reservoirs, pumped bankside storage, enlargement of existing water storage facilities and use of quarries/sandpits for new sources, in addition to enlarging existing reservoirs.
- 8.140. They can provide flexibility to meet peak demands, as water can be abstracted for short periods at high rates without significant environmental impact.
- 8.141. Storage reservoirs rely on rain in the winter to guarantee supplies for the following year. They provide some degree of resilience, although after one or two dry winters they can become depleted. However, abstraction from reservoirs may be maximised during the winter to rest groundwater sources and maximise the benefits of recharge.

Customer preferences

- 8.142. There was particularly strong support for ASR, supported by over nine tenths of respondents (91%). There was very little opposition to this option, with only one in twenty respondents expressing opposition to the scheme.
- 8.143. The customer focus groups also found that ASR was one of the most preferred solutions because it used water that was already in the system which could be stored and used as

needed. Two other positive aspects were that it represented a relatively inexpensive option and was considered not to impact on the environment.

8.144. By contrast, new storage reservoirs were only supported by a third of respondents (31%), while 44% opposed them.

8.145. The customer focus group identified that the key advantage of a storage reservoir was that it can improve resilience by ensuring the availability of additional water in supply, as opposed to solely conserving it. Although there was limited support for this option, some questioned why existing reservoirs could not be expanded, thus having a less detrimental impact on the environment.

SEA findings

8.146. The SEA found that ASR is broadly compatible with SEA objectives, and that schemes generally require less infrastructure than other resource development options; however pumping and treatment facilities may be required and energy use was found to be high. Potential effects on groundwater and terrestrial SEA objectives such as biodiversity and landscape were found to be largely dependent upon implementation and can be reduced in the medium/long term through mitigation measures. Taking into consideration its broad compatibility with SEA objectives, subject to the nature of implementation and potential mitigation measures, the SEA concluded that ASR was the preferred resource development option.

8.147. From an SEA perspective, it was found that both the construction of new surface storage reservoirs and the enlargement of existing ones have the potential for conflict with a range of SEA objectives, both in the short and long term, although these options do also create habitat in the long term. Identified impacts are related to the location of the reservoir, requirements for land take, and associated effects on terrestrial biodiversity, landscape and aquatic ecology, depending on the source of water used to fill the reservoir. New reservoir options will also require further consideration of their compliance with the Water Framework Directive. Energy use during construction was also found to be fairly high due to the intensive construction activity and earthworks needed, alongside requirements for materials to be imported to construct embankments.

Summary of feasible options

8.148. ASR schemes were the most popular with customers. The chief limitation is the lack of suitable locations in the South East, despite extensive investigations, because of hydrogeological constraints and the need for locations to also be in proximity to existing water supply infrastructure and abstraction boreholes.

8.149. Storage reservoirs were considerably less popular with customers, and have some significant risks and uncertainties associated with them, not least the potential time associated with planning applications and the long lead-in time to build the schemes. There are also potentially significant environmental impacts, although once a reservoir is built, it generally provides other amenity and recreational benefits.



Aquifer Storage and Recovery (ASR)

Pumping water from rivers or groundwater in winter to store in underground aquifers

Pros Improves storage to provide extra water in summer and droughts, and makes use of the natural environment

Cons There are few suitable locations in the South East



Storage reservoirs

Building a new storage reservoir or enlarging an existing one

Pros Improves storage for extra water in summer and provides longer term artificially created habitat

Cons Lengthy planning and long lead-in times, and impacts on the environment

Water re-use

- 8.150. The re-use of water, to reduce pressure on existing water abstractions and further resource development options, can be sub-divided into a number of categories:
- Direct potable re-use, so that treated wastewater is supplied direct to customers' taps;
 - Direct non-potable re-use, where treated wastewater is used directly for non-potable uses – an example of this is grey water recycling;
 - Indirect potable use: recharge of groundwater aquifers; and
 - Indirect potable use: supplementing river flows and surface water storage.
- 8.151. There are a number of considerations with water re-use if it is to be widely adopted in the future. These relate to environmental impact of wastewater discharge, public health, public perception and cost. The only categories considered for the WRMP process were direct non-potable re-use and indirect potable use by augmenting river flows and surface water storage. Direct potable re-use is generally unacceptable due to the high levels of risk and the recharge of groundwater using wastewater is not permitted under European legislation.
- 8.152. The advantages of water re-use schemes are that they tend to be resilient to climate change and resilient to different drought events, and offer flexibility in implementation and operation. However, there could be concerns regarding the energy usage involved to operate such schemes, bearing in mind the possibility of multiple pumping and treatment required.
- 8.153. A variant of the water re-use schemes is to supply industry directly with treated wastewater for non-potable uses. A number of these options were included to provide a large industrial user in Hampshire South, although it can be a relatively costly option, so would only be advocated as an approach where it was assessed to be an economically viable option.

Customer preferences

- 8.154. About three quarters of respondents supported water re-use (77%). However, only 23% of respondents strongly supported its use (compared to, for example, 39% who strongly supported leakage reduction). There was very little opposition to these options, with less than one in ten respondents opposing each of them (9%).
- 8.155. Water re-use was also a well supported solution in the customer focus groups because it utilised water that was already available, without additional net abstraction from the environment. Provided that reassurances could be given around safeguarding public health, and that the environment would not be harmed as a result, this was considered a strong candidate for helping to solve the long term issue of water shortages.

SEA findings

- 8.156. The SEA found that, while compatible with some SEA objectives, water re-use has the potential for negative environmental impacts. These are associated with the potential infrastructure and additional pipelines required to transfer water, and the quality of the treated wastewater. The

scale of impacts varies depending on the nature of the receiving waters. Some of the required water treatment processes also have high energy use requirements. The SEA concluded that the potential impacts could be reduced by appropriate mitigation measures.

Summary of feasible options

- 8.157. Water re-use was generally well supported by customers. It provides a reliable and resilient source of water. In order to implement a water re-use option, the appropriate discharge consents would need to be agreed and secured with the Environment Agency to ensure that the environment is protected. Public perception over potential health implications would also need to be addressed.
- 8.158. Using water re-use to directly supply industry is a useful option, and avoids the need for using drinking water for industrial processes.

	Water re-use Re-using wastewater to a river for downstream abstraction for drinking water Pros Reliable supply of water, even in drought, and extra water in the environment Cons May require relatively expensive treatment processes

	Water for industry Treating wastewater to a higher standard and using for industry Pros Avoids using drinking water for industrial processes (which is the standard practice at present) Cons Can be relatively expensive

Managing the water environment

- 8.159. This section contains options which arise through efforts to manage the water environment and the company's infrastructure, including catchment management, asset enhancement, borehole rehabilitation and reconfiguration of groundwater abstractions, supporting river flows and variations to licences of existing abstractions.

Catchment management

- 8.160. Catchment management schemes have the potential to provide significant benefits to the environment, in terms of biodiversity and water quality, at relatively low cost, whilst potentially reducing treatment costs and increasing the water available for abstraction.
- 8.161. However, whilst there have been a number of pilot schemes around the country, the realisation of these benefits is not yet certain. The *Blueprint for Water*, a coalition of environmental organisations, emphasise in their report *Blueprint for PR14: environmental outcomes for the price review*

“Catchment management is long-term, taking many years before the full range of benefits are realised. Patience and continuing monitoring efforts are needed”

- 8.162. Southern Water held a workshop with key stakeholders interested in promoting catchment management options in May 2012. The result of this was the identification of potential schemes for developing restoration measures that could be used to offset potential sustainability reductions. These were included in the options list.
- 8.163. The company is currently conducting a scoping study to investigate the possibility of offsetting some of the demand that is placed on the Western Rother by negotiating legal agreements with the farmers that currently abstract from the river upstream of the WSW. Under such agreements the farmers would cease to irrigate under certain conditions, and would be financially compensated by Southern Water as a result of their anticipated crop losses.
- 8.164. The company is committed to undertaking further pilot studies during AMP6 to investigate other potential catchment management options, and the feasibility for achieving benefits associated with such schemes. Southern Water is committed to exploring with other stakeholders the potential for catchment management not only as part of the Western Area strategy needed to meet the challenges posed by the notified River Itchen sustainability reductions, and/or in response to any potential future sustainability reductions that may be considered, but also as part of more integrated management of the water environment. The Company believes that such solutions may well provide the best outcomes for both customers and the environment.

Nitrate removal

- 8.165. As discussed previously in Section 5, Southern Water is reviewing its sources in terms of their vulnerability to rising nitrate concentrations in groundwater that mean the nitrate drinking water limit would be exceeded. Options to recover any anticipated loss in DO at susceptible sources through some form of nitrate treatment were then included in the least cost investment model.
- 8.166. For those sources at immediate risk of nitrate pollution, the option to recover the lost DO comprised conventional nitrate treatment combined with catchment management processes, to prolong the usable life of the source and over time to minimising the operational costs of the treatment plant.
- 8.167. However, where a source was likely to exceed the nitrate threshold later in the planning period, a catchment management only option was developed, involving allowance for a catchment management officer to work with farmers and other upstream users to try to reduce nitrate pollution.
- 8.168. For the catchment management options, it was assumed that these would need to be implemented early in AMP6 to allow sufficient time to build relationships with upstream farmers and to demonstrate that nitrate reductions were being achieved. If not, then there would still be sufficient time to introduce conventional nitrate technology in AMP7, prior to the nitrate threshold being exceeded.

River restoration

- 8.169. Options to undertake restoration along key river stretches were included in the options list to mitigate potential sustainability reductions or to minimise the magnitude of a sustainability reduction.

Asset enhancement

- 8.170. This includes any options that Southern Water is able to implement to potentially increase the existing Deployable Output within a Water Resource Zone, and for which no external permissions are required. Such options could include:
- Re-introduction of existing resources (under existing licences) through enhanced treatment or pump alterations;
 - Improvements to and replacement of existing mains;
 - Increases to pump size or capacity;
 - Lowering of borehole pumps or lower low-level 'cut-outs';
 - Re-introduction of well and adits at certain groundwater sources;

- Re-lining of existing boreholes;
- Altered operation of an existing source;
- Increased use of an existing (and under-utilised) licence or new boreholes under existing licences; and
- Treatment work upgrades (e.g. iron treatment).

8.171. However, these asset enhancements are dependent on the current assessment of DO for each site. Southern Water reviews its existing asset sites on a regular basis to identify practicable schemes where there is a realistic, reliable opportunity for increasing the DO. Where these are identified, then any resultant DO increase is reflected in the DO assessments, rather than the options appraisal process.

8.172. One key option in this category relates to network constraints which result in “locked in DO”, whereby the combined DO of sources in an area cannot be utilised in full in some WRZs. An option has been included to release the “locked in DO” that has been identified in the Kent Medway WRZ, as discussed in Section 5.

Borehole rehabilitation and reconfiguration of groundwater abstractions

8.173. Schemes typically involve the refurbishment or rehabilitation of disused groundwater sources for which abstraction licences remain. It may also entail drilling new boreholes and new onsite treatment of water.

8.174. In addition, an option was considered to reconfigure the well field near Pulborough to optimise the configuration of groundwater sources to improve the seasonal management flexibility, without increasing the annual abstraction volume.

Supporting river flows

8.175. The JO3 groundwater scheme for river augmentation option could be used to regulate flows in the River Itchen during periods of low flow. The scheme would help mitigate the MRF conditions and other licence restrictions that comprise the Sustainability Reduction to be introduced on the Lower Itchen sources.

Licence variations

8.176. Licence variations could apply to remove certain licence constraints or revise any minimal residual flow (MRF) constraints, enabling greater Deployable Outputs to be achieved.

8.177. A key example is the proposed licence variation for the River Medway Scheme. Discussions have been held with the EA about the potential options for this scheme, and the company are in the process of preparing a licence application.

Customer preferences

8.178. These schemes were not included in the online customer survey. The customer focus groups identified that people found catchment management options quite difficult to conceptualise and some customers wondered about the relevance of this approach to water companies when most of the responsibility seemed to be with the agricultural community. However, as these options are relatively inexpensive and that they benefit the wider environment, some people thought it could be worth exploring despite the fact that it was not guaranteed to work.

SEA findings

8.179. The re-commissioning of old/existing sources, licence variations and the upgrading of water supply works treatment facilities were found to be likely to have a range of effects on SEA objectives. The implications of variations to some types of licences in terms of compliance with the Water Framework Directive (due to the potential for changes to hydromorphological conditions or quantitative status) would also need to be assessed in detail. The SEA concluded that the effects strongly depend on the nature of implementation and mitigation measures used, and that the licensing process should determine whether the environmental effects are acceptable.

- 8.180. Increases in abstraction from groundwater sources has the potential to conflict with most water related SEA objectives. Issues relate to the current availability of water in the affected aquifers, the quantitative status of the groundwater body in relation to the Water Framework Directive, and the potential for groundwater continuity with adjacent surface water bodies (with potential secondary impacts on aquatic ecology). Where existing abstraction licences have not already been assessed under European or National programmes, these uncertainties would need to be assessed through further investigation of the possible effects.
- 8.181. Catchment management options were found to be broadly compatible with the majority of SEA objectives, and have a net positive environmental effect due to the minimal amount of physical intervention required and the potential for improvements to water quality and/or hydromorphology.

Summary of feasible options

- 8.182. The company is keen to explore catchment management solutions as a cost effective means to secure supplies whilst providing wider environmental benefits. However, there is significant uncertainty over whether and what timescale the benefits could actually be achieved in practice. Where funding can be secured, the company would aim to conduct various investigations in AMP6 to clarify this uncertainty, with a view to considering other catchment management options in future WRMPs, if they are found to realise benefits.
- 8.183. Discussion of potential variations of certain abstraction licences with the EA, where no adverse environmental impacts can be clearly demonstrated, would maximise the supplies of water that could be derived from sources that are not under pressure. However, these variations may not provide significant increases in resilience under severe drought conditions.



Catchment management solutions

Working in partnership with landowners and river guardians to better manage the flow and quality of rivers

Pros Cost effective to secure supplies and benefits the wider environment

Cons Benefits are uncertain, and it is difficult to secure and police agreements that will allow benefits to be realised in perpetuity.



Licence variation

Changing an abstraction licence with the Environment Agency to allow the abstraction of different volumes of water from existing sources such as rivers or groundwater. This is only possible where there would be no significant impact on the environment

Pros Maximises supplies of water from sources which are not under pressure

Cons The extra water may not be always be available all year round or in droughts



Supporting river flows

Pumping water from aquifers to augment low flows in rivers

Pros Relatively inexpensive to operate and protects flows in rivers

Cons Water might not be available in drought conditions to secure a reliable supply

Trading water and enabling transfers

Bulk supplies

8.184. Bulk transfers are a means of supplying additional water to a WRZ with a supply demand balance deficit from a WRZ with a surplus. The range of possible transfer options open to Southern Water includes:

- Enabling transfers (inter-zonal transfers between Southern Water WRZs);
- Inter-company bulk transfers within the South East region;
- Termination of existing bulk supplies to other water companies; and
- Transfers from outside the South East region.

8.185. The transfer of water from areas of surplus to those of deficit has always been a fundamental part of Southern Water's water resources strategy, as demonstrated by its participation in the WRSE group. It is actively practised and forms a key component of the company's current approach to providing security of water supplies. However, a key consideration is the availability of surplus supplies in potential donor WRZs or other companies in the future. Consideration also needs to be given to other factors such as the magnitude of the surplus available, the timing of availability and the duration for which it is available.

8.186. The water supply system within the south east of England is complex. There are a number of water companies, each sharing boundaries with a number of other companies. It is also the area with the most environmental and resource pressures in the country, being not only classified as an area of serious water stress, but also likely to be in the forefront of the effects of climate change. Given the dynamics of the situation, there are a number of benefits arising from the development of a regional strategy which is reflected through the harmonisation of the strategies of the neighbouring companies. This can help to progress regional solutions that limit unnecessary developments which could result in greater environmental impact, a non-least cost solution (for the region as a whole) and customer bills that are higher than they need to be.

8.187. The work of the WRSE group has focused on sharing resource developments to create the building blocks for a regional solution. It is then the responsibility of the companies to identify, investigate and agree on the potential bulk supply and/or shared resource schemes. Southern Water has always adopted the bulk supplies that have been derived through the WRSE process and confirmed by the recipient/donor company. This has been discussed in Section 3, and earlier in this section (para. 8.16 to 8.18).

Licence trading

8.188. The company's activities and investigations into potential water trading options were described previously in Section 4 (para. 4.27 to 4.36). In addition to contacting neighbouring water companies and participating in the WRSE group to investigate potential bulk supply options, the company also considered other means of licence trading or third party supplies:

- 1) Publication of a notice in the Official Journal of the European Union (OJEU) to seek third party supplies;
- 2) Publication of a “statement of need” on the company’s website to seek third party supplies, including from neighbouring companies; and
- 3) Contacting large abstraction licence holders within the company supply area with a view to initiating water trading discussions.

8.189. Only two responses were received from potential trading parties or third party supplies, and none that were considered feasible at the scale required. Southern Water has, however, included one potential option for purchasing a licence in its Kent Medway WRZ. At the time of finalising this WRMP, there is still some uncertainty surrounding the viability of this option as no formal agreement has yet been reached with the owners of the licence.

Customer preferences

8.190. Licence trading schemes were not generally discussed by customers during focus groups. However, this option forms a key part of government’s *Water for life* document.

SEA findings

8.191. The SEA found that bulk transfers were generally compatible with a number of SEA objectives, but depending on the requirement for construction of additional pipelines and routing, they may have potential conflicts against some SEA objectives, particularly during the construction phase, although these impacts can generally be managed or mitigated.

8.192. The licence trading option that was considered for the WRMP was assessed as generally presenting a low risk of conflict with the SEA objectives due to the small amount of new infrastructure required. Most conflicts were related to the construction phase for the associated pipeline route, but this could be managed with appropriate mitigation. There is some uncertainty relating to the potential impacts of using the licensed source on adjacent water bodies (and WFD status) that would require further investigation, but overall this option was considered to be largely compatible with the SEA objectives.

Summary of feasible options

8.193. Options to import water from neighbouring water companies, or from other third parties who may have a surplus of water available, form part of a reasonable and rational strategy. Southern Water is a net exporter of water, and WRSE regional modelling suggests that this should remain through the planning period.

8.194. Licence trading options have been investigated, although few feasible options were identified.



Bulk supplies

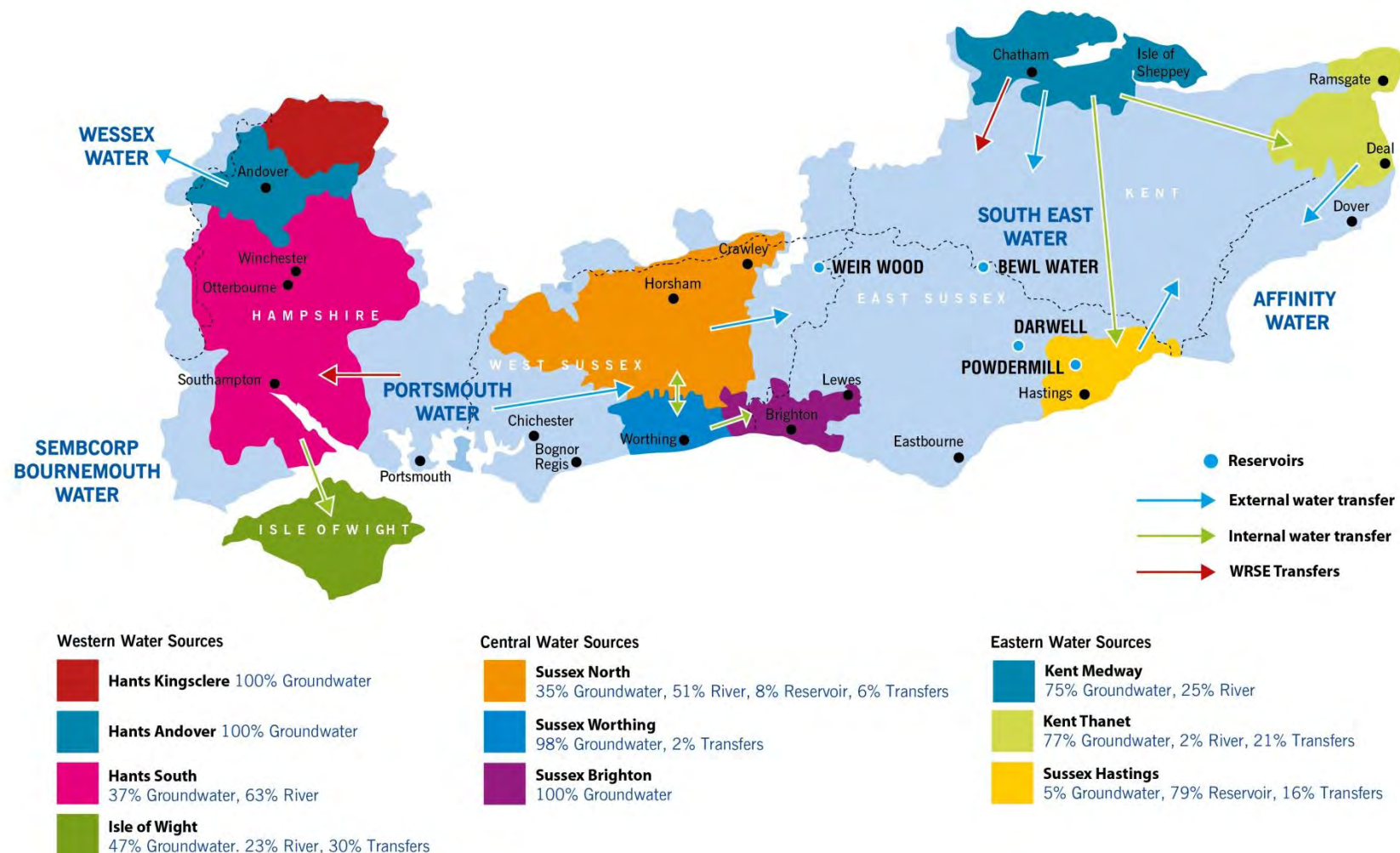
Buying and selling large supplies of water from or to neighbouring water companies

Pros Moves water around the South East to where sources are under pressure and helps deliver a “regional grid”

Cons Not producing any ‘new water’

	Licence trading Buying existing abstraction licences to abstract water from industry or agriculture Pros Uses a water allowance which is already available for abstraction Cons The water traded might not be available if this conflicts, for example, with the ‘no deterioration’ commitment in the Water Framework Directive

Figure 8.4 Proposed new bulk supplies from WRSE modelling



Economic appraisal of feasible options

- 8.195. Where there is a supply demand balance deficit for any WRZ in any planning scenario during the 25-year planning period, an economic least cost model (the “investment model”) was used to select the option, or combination of options, which maintains the supply demand balance at least cost (discounted), given the assumptions for the model run.
- 8.196. Separate investment models were developed for each of the three sub-regional Supply Areas (Western, Central and Eastern), which are geographically separate areas consisting of three or four Water Resource Zones (WRZs). Although the building blocks for the strategy are the WRZs, there are inter-connections (either current or potential) between them, and thus actions in one WRZ can have an impact on other inter-connected WRZs within that sub-regional Area. As a result, the model had to take account of the supply demand balances for each planning scenario, including transfers and bulk supplies, in all the WRZs in a given Supply Area at the same time in order to develop a co-ordinated least-cost solution.
- 8.197. The investment model incorporates all the feasible supply and demand side options. These were all made available within the model to solve any given supply demand balance deficit at least cost.
- 8.198. Leakage reduction options were incorporated into the model and selected when they present the least cost solution. The leakage options themselves were entered as a series of discrete steps, each of which the model could select in turn. This approach represents the progressively increasing costs that occur as leakage is reduced further. Constraints on the amount of leakage reduction were also included to ensure the model selected a leakage reduction plan that is operationally feasible in addition to being economically optimal.
- 8.199. Enhanced water efficiency options (over and above the existing water efficiency activity already being conducted by the company) were also available for selection in the model. These options incorporate the yearly variable costs and yields associated with rolling out a water efficiency scheme. The largest saving may therefore not occur in the first year of selection, but a few years post-implementation. In this situation the model is able to pre-emptively select a water efficiency scheme to have its greatest impact during a critical year and therefore defer another scheme, if that is the least cost solution.
- 8.200. Inter-company bulk imports and exports were included within the model as “fixed” baseline transfers, so they formed part of the supply demand balance that the model aimed to solve. The reason for this is that bulk supplies are treated as contractual volumes of water to be supplied in almost all cases, except where severe drought affects the ability of the donor company to provide the contractual amount, and some form of “pain share” is introduced. It is therefore prudent to plan on the basis of meeting the bulk supply commitments. This is explicitly stated in the company’s current Drought Plan (published 1 Feb 2013).
- 8.201. Inter-zonal transfers were treated differently within the model. These are internal transfers between Southern Water’s own WRZs. As such, all inter-zonal transfers were set at “zero” in the supply demand balance for a given WRZ, and options for transferring between zones were then selectable as part of the optimisation. This is because an internal transfer does not affect the overall water balance for the company, or for one of the Supply Areas (Central, Eastern or Western); they are just a different way of balancing the water available between connected WRZs. The model was therefore allowed to vary transfers from zero up to the capacity of a given transfer within the optimisation process to derive a least-cost solution. This allowed the model to select the least cost overall strategy for all transfers, resource development and demand management options to derive the least-cost solution.

Discount rates and net present value (NPV)

- 8.202. **Discounting** is a technique that is used to compare costs and benefits that occur in different time periods. It is based on the principle that people generally prefer to receive goods and services now rather than later, which is a concept known as ‘time preference’. For individuals, time preference can be measured by the real interest rate on money lent or borrowed. The concept can be expanded to society as a whole; where there is also a general preference to receive goods and services sooner rather than later, and to defer costs to future generations.

This is known as ‘social time preference’. The ‘social time preference rate’ (STPR) is thus the rate at which society values the present compared to the future. (*The Green Book*, HM Treasury 2003).

- 8.203. When undertaking an economic appraisal of feasible options over the entire planning period it is important to account for this social time preference. Discounting is the process by which all the future costs and benefits are converted to today’s (present) value, so that they can be compared on a like-for-like basis. By summing the present values of all the costs and benefits associated with an option, the Net Present Value (NPV) of that option is derived. This is used to compare all feasible options in the investment model, and hence to derive the least cost set of options which are needed to meet a given supply demand balance deficit.
- 8.204. All costs and benefits in the options appraisal and least cost economic model were discounted using a rate of 4.50%, as directed by the EA’s Water Resource Planning Guidelines, rather than the rate of 3.5% as specified in the Treasury’s *Green Book*.
- 8.205. The treatment of carbon costs is slightly different, as the costs are derived from the estimates of tonnes of carbon dioxide equivalent generated by the options in each year of the planning period, multiplied by either the traded or non-traded price of carbon. These are values specified in guidance produced by the Department of Energy and Climate Change (Oct 2011) for each year through to 2050. The values increase through time to reflect the likely increasing costs of carbon to the economy in future. This profile was included within the model and the profile of carbon costs was then discounted in the same way as all other costs within the model, to allow derivation of the net present value.

Costs

- 8.206. The capital costs (or capital expenditure, or “capex”) for each resource scheme were developed from a detailed assessment of project work items required. Asset lives were derived for each project work item. Costs were derived primarily using cost curves Southern Water has developed for its PR14 Business Plan. These costs were annuitised to take account of renewals through the asset lives of project work items.
- 8.207. The capex associated with water efficiency schemes was assumed to be applied over a five year period. Strictly speaking, many of the costs would be incurred under operational expenditure. However, for the purposes of investment modelling they were assumed to apply as capex, as the costs would only be incurred for a short time (i.e. they are not ongoing operational costs). It was assumed that there would be no renewal or replacement costs, as the water efficiency scheme is a “one-off” that is implemented over a 5 year period; hence there was no need to calculate an annuitised capex. However, the asset life of water efficiency devices was used to assess how the yield of the scheme will decrease through time (due to maintenance and replacement of water using devices with other newer devices).
- 8.208. For the leakage reduction schemes, there was no capex in the conventional sense. However, there was a “transitional cost”, which reflects the cost required initially to move to the next step change reduction in leakage. There was additionally an annual opex cost applied to maintain the leakage at that reduced level. Hence, for leakage options, there was a “capex” assumed for transitional cost only in the year in which a step reduction in leakage occurred, and therefore no need to annuitise this value.

Earliest start years

- 8.209. The earliest potential start years for schemes were assessed on the basis of scheme and construction complexity, likely planning constraints and risks, and environmental or other investigations likely to be needed to support the implementation of the scheme.
- 8.210. For the majority of new resource developments, the preparatory feasibility and environmental investigations and planning approvals required, as well as the engineering design and construction time, meant that options could generally not be relied upon to start producing yield until the end of the following AMP period (AMP6) at the earliest (i.e. until 2019/20), and in some cases not until into the AMP period following that (AMP7 – between 2020 and 2025).

Utilisation

- 8.211. In previous WRMPs, the least cost investment modelling focused only on the design planning scenarios (at annual average or MDO, and at critical period). For cost calculations, it was effectively assumed that the preferred options would be operating under the design conditions (i.e. at drought levels) for the entire planning period. While this is conservative for ensuring the supply demand balances are met, it could introduce a bias in the selection of some options, as clearly many years will not be subject to drought.
- 8.212. To overcome this problem the investment model for this current WRMP was required to satisfy several different supply demand balances simultaneously. Each supply demand balance was derived under a given “reference condition” and for each “reference condition” supply demand balance a utilisation factor was assigned that represents the frequency with which the supply demand balance is expected to occur during the planning period.
- 8.213. The utilisation factors only applied to the variable operating costs (opex). This included environmental and carbon variable components, but excluded all other fixed costs. This is because fixed costs must be incurred if the option is selected, regardless of how much that option is actually used. Therefore the investment model must balance between the fixed and variable opex costs while satisfying all the supply demand balances and their respective utilisation factors.
- 8.214. It should be noted that the factors that have been used in the WRMP tables relate to inputs to the investment model. The actual utilisation calculation for each option has been carried out as a frequency weighted evaluation of opex for each scheme that allows for the capacity utilisation under both normal and drought conditions within the model. The actual process of calculation that has been used is described below.

Reference conditions

- 8.215. For each of Southern Water’s three Supply Areas, up to three “reference conditions” were used in the derivation of utilisation factors for use in the investment model. These essentially comprise the Design (or drought year) condition, a Normal year and, for the Central Area, an Intermediate condition. The use of the Integrated Risk Model (IRM) described in Section 7 to define reference conditions for each supply Area is described briefly below.
- 8.216. The reference condition inputs to the investment model for the purposes of utilisation calculations were taken from the supply and demand values inputs used for the *aleatory* ranges in the IRM (see detailed discussion in Section 7), with the “design” condition equal to the 0.5% level for supply (1% for the Western Area as the design drought was modified to a 1 in 125 year return period) and the 90% level for demand. The ‘normal year’ condition was equal to the 50%ile supply and demand, without Target Headroom. For the Central Area, the 1%ile supply was also used as an ‘intermediate’ condition in the utilisation factor calculation.
- 8.217. For the Eastern Area the situation is more complex, as the drought vulnerability of the system is dominated by the surface water reservoirs, which have defined control curves. The reduction in reservoir output down to the DO calculated for the design event would therefore be triggered every time Bewl passed its drought bounding curve, which would occur once every 5 years on average. The Eastern Area system is therefore effectively operated in either ‘drought’ or ‘non-drought’ mode, so there are only two ‘reference conditions’ - the design condition and the normal condition.
- 8.218. It should be noted that the Integrated Risk Model was designed to ensure that the supply demand balance inputs to the investment model completely reconciled with the supply and demand lines presented within this Draft WRMP. All bulk imports, exports, outage, and sustainability reductions were applied as post processing between the Integrated Risk Model and the least cost investment model.

Calculation of utilisation factors based on operational frequency

- 8.219. The Integrated Risk Model works on outturn risks for each year – i.e. it is an evaluation of what the outturn DO and demand might look like for any given year in the planning period, once the point of resource stress has been experienced. As described in Section 5, drought operations and Level of Service interventions will have to be applied far more frequently than this, and it is the frequency of drought operations (i.e. how frequently sources are operated under design

drought conditions) that needs to be accounted for in the investment model, not outturn drought risk.

- 8.220. The utilisation factors were therefore calculated based on a detailed analysis that relies on the stochastic resource modelling described in Section 5 and the risk / Level of Service analysis described in Section 7. The key elements were as follows:
- Up to three 'reference conditions' were used, relating to the supply and demand that occur in a 'normal' (1 in 2 year) and the 'design' (1 in 200 year for Central & Eastern and 1 in 125 year for Western) events, plus an 'intermediate' event (1 in 100 year) for the Central Area;
 - The Level of Service analysis described in Section 5 was used to evaluate how often the operational response associated with preparing for the 'design' and 'intermediate' reference conditions would be required, based on the translation factor described above; and
 - The frequency of operation for each reference condition was then expressed as an annual risk normalised percentage, which was then weighted between ADO/MDO and PDO based on the proportion of the year that each condition covers, and the critical period factor for each WRZ.
- 8.221. The analysis described in Section 5 provides details of the relationship between the design conditions that have been adopted and the actual Levels of Service triggers that have been used to derive those design conditions. Logical and operational experience shows that sources will tend to be operated in accordance with the design condition once the relevant LoS trigger has been breached, although the exact relationship depends on the nature of sources and the dependency on long term storage within the system. It is therefore necessary to translate the frequency of the design condition into a frequency that represents how often Southern Water will need to operate its sources to allow it to manage the drought within that design condition. This has been termed the 'translation' factor within this WRMP, and has been calculated based on the assessments described below:
- *Central Area*: design drought is 1 in 200 years, based on a 1 in 20 year LoS trigger curve. Operations for the design condition will therefore be instigated approximately 10 times as often as the design condition (translation factor of 10). For the intermediate scenario it has therefore been assumed that the operational response will be instigated once every 10 years on average.
 - *Western Area*: design drought is 1 in 125 years (due to the less flashy, more predictable nature of the River Itchen) based on a 1 in 20 year LoS trigger curve, giving a translation factor of 6.25. The return period of the design drought is low enough not to require an intermediate condition within the investment modelling – the translation factor means that resources will be operated to design conditions once every 20 years on average, when the LoS trigger is breached.
 - In the *Eastern Area*, sources need to be operated at their design condition as soon as the operational drought bounding curve on Bewl is breached, otherwise the outturn DO of the reservoir system will not achieve its DO under the design drought. Because the bounding curve is set at a 1 in 5 year trigger level (in accordance with the Drought Plan), the translation factor is very high (40). This ensures that sources are set to operate at the design condition (approximately 1 in 200 year event) once every 5 years on average within the investment model.
- 8.222. The utilisation factors were calculated separately for each Supply Area. For the design and intermediate conditions, the frequency of operation is simply calculated as the frequency of the design condition, multiplied by the translation factor. Table 8.6 summarises the utilisation factors and reference conditions used in each of the Supply Areas within the investment model.
- 8.223. The opex for each scheme was therefore calculated according to the amount that the scheme is required to match the supply/demand balance under each condition, multiplied by the utilisation factor for that reference condition.

Table 8.6 Utilisation factors used in the least cost investment model

Reference condition	Eastern Area		Central Area		Western Area	
	ADO	PDO	MDO	PDO	MDO	PDO
Normal	80.0%		81.0%		90%	
Intermediate			8.9%	2.6%		
Design	15.1%	4.4%	5.4%	1.6%	7.5%	2.1%

- 8.224. It should be noted that the utilisation factors do not sum exactly to 100% due to the application of the critical period factor in the DYCP scenarios. This essentially reflects the fact that the DYCP condition relates to supply and demand during the peak week in summer, but utilisation and associated opex needs to be evaluated over the whole summer (i.e. it is assumed that this could occur at any point over a 3 month period). The peaking factor translates from this absolute peak week to an average over the summer critical period.

Programme appraisal

- 8.225. There may be a range of different options that could be selected to solve any given supply demand balance deficit. Although the optimum solution was developed using an investment model to derive the least cost solution, this solution must then be considered against other criteria as part of a **programme appraisal** (i.e. a 'sense check' of outcomes).
- 8.226. The criteria which need to be considered include:
- Total costs of solution – i.e. capex and opex;
 - Customer preferences;
 - Environmental considerations, for example from non-monetised impacts identified by the SEA and/or HRA;
 - Other significant risks or uncertainties that have not been fully encapsulated during the options appraisal process, including planning and public perception risks;
 - Lead-in times for development of options and potential feasibility and environmental investigations that may be required in AMP6 to confirm that an option is feasible in practice;
 - Inclusion of outputs from the WRSE regional model; and
 - Whether the option will lead to a sustainable and resilient system.
- 8.227. Ultimately, there still remains the need for the company to make **sensible strategic decisions** regarding options. For example, if the forecast supply demand balance deficit is relatively small and unlikely to grow significantly over time, a single solution, or a series of small-scale solutions may be appropriate. However, if demand is forecast to increase significantly over time, leading to a potentially large supply demand balance deficit, the situation may need to be considered from a strategic viewpoint. Therefore, while a series of smaller scale options may be appropriate, there may be some circumstances in which investment in a single, much larger option is the best way forward. Although this may result in a significant surplus of resources in the short-term, it may prove to be the most effective long-term solution and facilitate the provision of bulk supplies to other companies in the interim should they be required.
- 8.228. The need to make strategic decisions does not remove the requirement for very clear arguments to support them, but it does mean that it is always important for the company to review the outputs from its options appraisal and investment modelling process to ensure that the company preferred strategy really is the optimal solution for the company, its customers and the environment.

- 8.229. Taking account of cost and other considerations such as those outlined above, allows a final solution to be developed to meet a given supply demand balance deficit. This is known as the **preferred programme of options**, or the **final planning solution**.

“The final preferred programme will be the optimum balance of financial, environmental and social costs” (EA WRP)

- 8.230. It is important to note that **the whole options appraisal process is iterative, to ensure that any solution is robust and achievable given the inherent uncertainties involved with forecasting over a 25 year planning horizon against risks associated with the planning process and environmental regulations**.
- 8.231. Clearly, uncertainty in the supply and demand forecasts will increase through time. Thus, the **critical period is the next five years** (AMP6, 2015-20), because it is the one for which the company will need to obtain funding through the Business Plan process. The **following five-year period (AMP7) is also important**, as options which are required from 2020-25 are likely to require some form of investigation to be carried out during AMP6, to ensure that any required planning permissions can be obtained and any environmental issues can be addressed and mitigated. The final 10 to 25 years of the planning period are used to understand the strategic nature of the schemes which may be required, but are subject to greater uncertainty and will need to be confirmed or revised in subsequent WRMPs.
- 8.232. The scenarios, sensitivity analysis and iterations of investment modelling runs described in Section 9 have been used to identify the company’s final preferred programme of options.

9. Formulation of the preferred programme of options & testing the plan

Section summary

This Section describes the derivation of the preferred plan, including testing of the plan to ensure that the preferred plan is robust

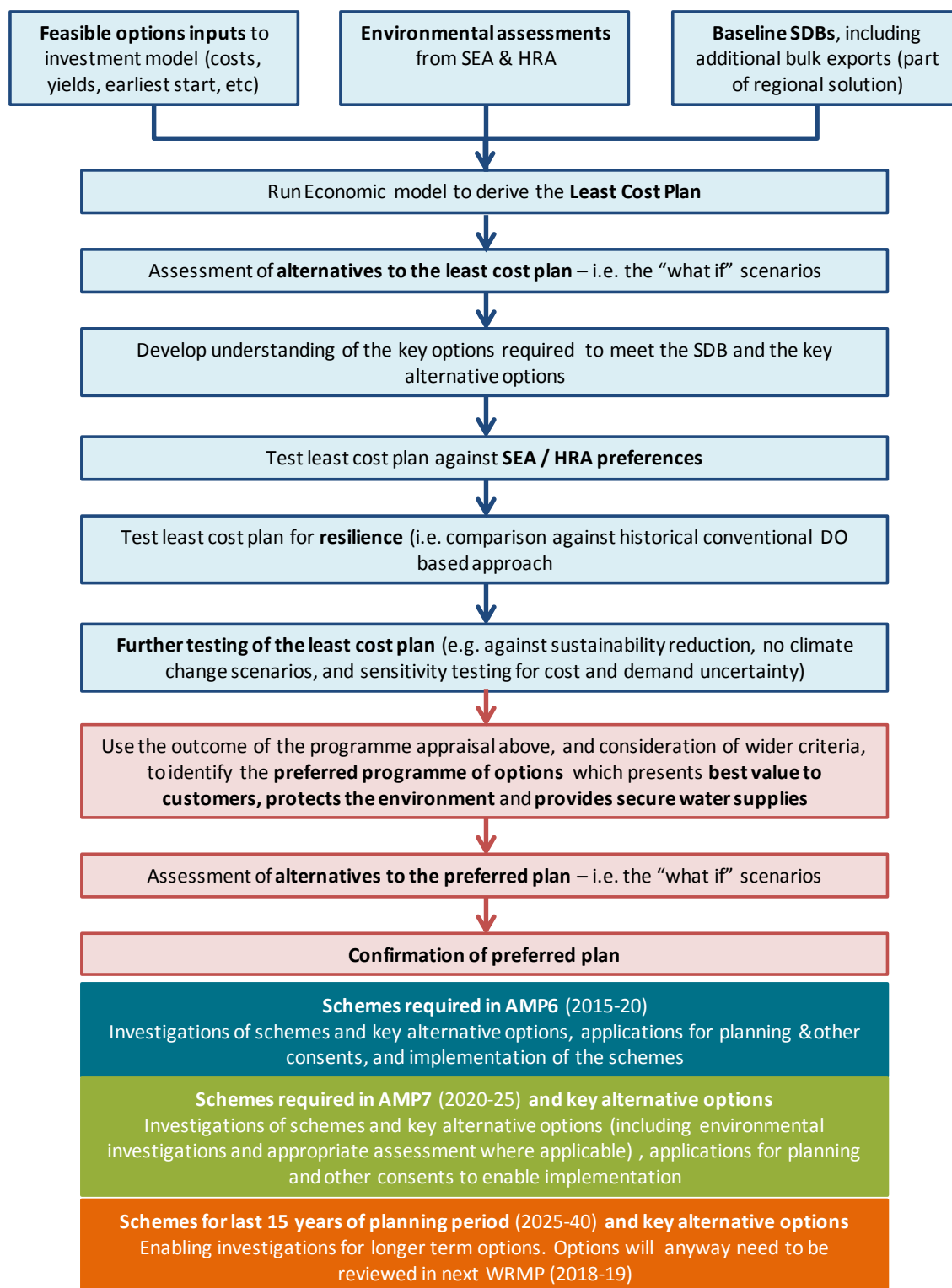
Aspect of the WRMP addressed in this section of the Technical Report	Reference
Demonstration that the plan is robust enough to allow for minor changes to supply and demand forecasts in the near future, and moderate change later in the planning period	Para.9.30-9.122
Development of a plan to secure the supply of water to address any deficits through the planning period, and which provides best value to customers and the environment .	Para.9.123-9.138, Figure 9.1 (Section 10)
Summary of the likely social and environmental impact of the preferred programme solution , including potential effects on Water Framework Directive ecological status	9.60-9.66 (Section 10)
Discussion of the main risks to develop appropriate scenarios and sensitivity testing	Para.9.30-9.122
Identification of main factors which affect the plan , and the potential timing of these impacts to demonstrate key decision milestones	Para.9.30-9.122
Presentation of the set of scenarios and rationale for selecting them on the basis of risk and uncertainty	Para.9.30-9.122, Figure 9.1
Presentation of scenarios to demonstrate potential impacts from uncertainties in sustainability reductions .	Para.9.24-9.25, 9.41-9.44, 9.85-9.98 (Section 5)
Discussion of the flexibility and adaptability of the final solution using the output from scenario and sensitivity testing	Para.9.30-9.59, 9.122-9.138 (Section 10)
Justification for the choice of the optimum or preferred programme solution , including taking account of the views of customers, the costs and benefits of options and the overall value of the solution to the environment and society	Para.9.30-9.59, 9.122-9.138, Figure 9.1 (Section 10)
Discussion of alternative programmes of solutions , should the preferred programme fail to deliver the expected yield on time	Para.9.30-9.59 (Section 10)
Summary of further investigations of options , particularly those that may be appropriate to manage sources of uncertainty	Para. 9.122-9.138 (Table 10.7)
Discussion of what the company will monitor to manage risk and uncertainty to ensure decisions are taken at the right time	Para.9.2

Introduction

- 9.1. This section sets out how the plan has been formulated through an iterative process of economic least cost modelling (as described previously in Figure 8.1). The ultimate objective of this process is to define a **preferred planning solution** that:
- Provides **secure supplies of water**;
 - **Protects the environment**; and
 - Represents **best value for customers**.
- 9.2. Uncertainty in the supply and demand forecasts will increase through time, and so it is logical to divide the water resource strategy into three key segments of the planning period:
- The first identifies the **next strategic schemes required for which funding for implementation must be sought through the forthcoming Business Plan**;
 - The second identifies those schemes for which implementation is not required in the next 5 years but which will require **further investigation in the next AMP period to ensure that they are feasible before the next WRMP is produced** in 2018, and to **ensure that any required planning permissions can be obtained and any environmental issues can be addressed and mitigated**;
 - The third considers scheme options that may well be required in the longer term. The purpose is to understand the strategic nature of schemes which may be required in the longer term, but which are subject to greater uncertainty and will need to be confirmed or revised in subsequent WRMPs.
- 9.3. The timescale for implementation of the schemes encompassed within each of these components correspond with the three time periods of the 25 year planning period defined below. Note that the colours used are also reflected in the tables summarising the results of various economic modelling results and scenario and sensitivity analysis – i.e. they are used to provide an easy visualisation of the time period in which options are being selected.

- | |
|--|
| • The next five years : from 2015/16 to 2019/20 – also known as AMP6 |
| • Years five to ten : from 2020/21 to 2024/25 – also known as AMP7; and |
| • The remainder of the planning period : from 2025/26 to 2039/40. |

Figure 9.1 Flow diagram of process to formulate the preferred programme of options



Economic modelling to derive the least cost solution

- 9.4. This section presents, for each of the three supply Areas, the least cost plan based on the supply demand balance deficits or surpluses available in each WRZ, the transfers available to each WRZ, and the options in the feasible list.
- 9.5. As discussed in Section 8, the full list of feasible resource development, leakage reduction and water efficiency options was used as inputs to the water resources least cost economic model (the “investment model”). This model takes into account all environmental costs and benefits associated with each option that can be monetised in accordance with the best practice methodology. Separate investment models were developed for each of the three Supply Areas (Western, Central and Eastern), which are geographically separate areas consisting of three or four Water Resource Zones (WRZs) each. Where there is a supply demand balance deficit for any WRZ in any planning scenario during the 25-year planning period, the investment model selects the option, or combination of options, that maintains the supply demand balance at least cost (discounted) to customers, given the assumptions for the model run. That is, the results of the economic modelling enable the derivation of a **least-cost plan** for the 25-year planning period.
- 9.6. Therefore, **where an option is not selected it is because it does not form part of the overall least cost strategy for the supply Area when compared to the other feasible options that are available for selection.**
- 9.7. There are inter-connections (either current or potential) between a number of WRZs in each of the discrete Supply Areas, and so the plan has to take account of the supply demand balances in all the WRZs in each Area at the same time in order to develop a co-ordinated least-cost solution for that Area.
- 9.8. The investment model output for the company least cost set of options was based on some key assumptions, as outlined below:
- Deployable outputs based on a stochastic approach (outlined in Section 5), which is introduced from 2019/20 onwards, to ensure that the solution would be more resilient to drought events than the solutions developed in previous plans using more conventional approaches;
 - Renewal of existing bulk supplies to other water companies (and the assumption that Southern Water’s current import from Portsmouth Water to Sussex North is also maintained) throughout the planning period;
 - Inclusion of additional bulk supplies that were identified as optimal from WRSE group regional modelling and subsequent discussions with neighbouring water companies;
 - Inclusion of sustainability reductions that have been assigned a status of either “confirmed” or “likely” by the EA. This means that the River Itchen Sustainability Reduction was included in full;
 - Inclusion of climate change allowances on both supply and demand forecasts;
 - Meeting the leakage targets agreed with Ofwat at the start of the planning period (2015/16), and including further leakage reduction options in the feasible options list, to be selected where they form the least cost solution (i.e. leakage reductions down to a “sustainable economic level of leakage”);
 - Continuation of baseline water efficiency activity throughout the plan and implicit assumptions around water efficiency improvements in water-using devices through technological improvements and customer behaviour changes, which are incorporated into the micro-component demand forecast; and
 - Completion of the company’s Universal Metering Programme by the end of AMP5.

Regional transfers – the WRSE model

- 9.9. As discussed throughout this revised Draft WRMP (see Sections 3 and 8 in particular), the water supply system in the South East of England is complex, due to the nature of the individual company systems which have developed independently over more than a century. Southern Water is one of a number of water companies sharing boundaries with other companies. The

South East is also the area with the greatest environmental and resource pressures in the country, being not only classified as an “area of serious water stress”, but also likely to be the most susceptible to the effects of climate change.

- 9.10. Central to the work of the Water Resources in South East (WRSE) group during AMP4 was the development of a regional water resources investment model under the direction of the Environment Agency. This regional modelling work has continued and been expanded during AMP5 with the development of a new regional least-cost option selection optimisation model to explore options and scenario solutions across the companies of the WRSE group to balance supply and demand across the South East of England.
- 9.11. Input data was provided by each of the individual companies and has been subjected to cost consistency checks. A number of different scenarios were investigated. As the data was provided by the companies themselves, there should be some consistency with the modelling work that each company has undertaken individually. However, there will also be some differences in the design standards used by the various companies, such as: target Levels of Service for the frequency of restrictions; design conditions for the estimation of Deployable Output and the approach to inclusion of target headroom.
- 9.12. It is also important to realise that it has never been the intention that the regional model will give a single, definitive solution that should override the more detailed modelling work of each water company. Each company will anyway select its preferred plan as the one which provides best value, not necessarily least cost. This is in accordance with the EA’s Water Resource Planning Guidelines. Nevertheless, by investigating a number of different scenarios in the regional WRSE group modelling work, those schemes which are most commonly selected can be identified, which consequently allows companies to validate the schemes from their own preferred plans. As such, the **results of the regional model should be used to inform the formulation of strategy at the individual company level.**
- 9.13. Arguably, the most important output of the WRSE group regional modelling process is that it identifies the most often selected ways of allocating or sharing such resource developments to create the building blocks for a regional solution. It is then the responsibility of the companies to identify, investigate and agree on the arrangements to implement these.
- 9.14. There was a substantial set of model runs undertaken during 2012, in January and February 2013 for draft WRMPs and since then for the revisions to draft WRMPs, to refine the WRSE output. **Southern Water has included in its baseline scenario the renewal of all existing bulk supplies until the end of the planning period at the pre-existing volumes, in order to support the notion of a regional solution.**
- 9.15. Given the dynamics of the situation, there are a number of benefits arising from the development of a regional strategy which is reflected through the integration of the strategies of the individual companies. These include the following:
- It demonstrates an integrated approach between companies, and identifies synergies with the strategic plans of other companies;
 - It avoids the potential for the selection of mutually incompatible or even mutually exclusive schemes to be selected;
 - It creates a progression of regional developments that might otherwise be avoided if pursued through individual company strategies;
 - It creates the opportunity to make the optimum use of limited resources, and realise any potential for economies of scale with minimum impact/cost; and
 - It provides validation of the efficacy of Southern Water’s WRMP against the wider context of the WRSE group.
- 9.16. The bulk supply schemes that have been included within the Southern Water company preferred regional strategy as a result of the WRSE group regional modelling work, and subsequent discussions between the companies as part of the WRMP consultation process, are:
- Continuation of existing bulk supplies through the planning period;

- A new bulk import of 10 MI/d from Portsmouth Water to Hampshire South available from 2017;
- Continuation of the export from Bewl to South East Water of 16.8 MI/d through to 2019, before dropping to 10.7 MI/d from 2020 onwards, in accordance with a new stochastically-derived DO for the source. In South East Water's dWRMP between 2015 and 2020 they incorporated 25% of the DO of the RMS that Southern Water calculated for WRMP09 i.e. South East Water's DO from the RMS was estimated as 16.8MI/d. However, Southern Water has undertaken more work on the resilience of supplies, and as a result, the entitlement of the yield for South East Water has been subsequently reduced to 10.7MI/d. South East Water has agreed to include these further reductions in its Final WRMP, but not until 2020. This is to allow time for alternative supplies to meet the shortfall created by this reduction to be developed and operational.
- An additional 5 MI/d to South East Water from 2022 onwards, identified in WRSE modelling and confirmed as required by SEW;
- An additional bulk export to South East Water of 12.5MI/d from 2023. In SEW's dWRMP they included a jointly developed and utilised scheme, to take the tertiary treated water from a wastewater treatment works and treat for potable supply (the MR3 20MI/d water reuse scheme). In consultation with South East Water, we understand that they require a yield from the scheme of 12.5MI/d in 2023. Southern Water has advised South East Water to assume that the additional water it requires will be provided through a bulk supply. However, Southern Water has agreed with SEW to seek funding during AMP6 to progress with feasibility studies and planning to develop the MR3 20MI/d water reuse scheme option, to which SEW may be required to pay a contribution;
- An additional supply to South East Water of 1.25MI/d equivalent to 25% of the benefit from the M10 River Medway licence variation, dependent on their agreement to contribute financially to the scheme; and
- Cessation of the existing bulk supply from Kent Thanet to Affinity Water from the base year until 2034, at which point a new bulk export of 1MI/d will be made available.

9.17. A further series of bulk imports of 10MI/d and 20MI/d from Portsmouth Water were considered, as these were options that were incorporated into the WRSE model. However, the availability of this additional water is contingent upon Portsmouth Water developing additional resources. PWC have indicated that they could supply, under the design conditions adopted by Southern Water, a total of 25MI/d to Southern Water. Initially, 10MI/d will be transferred from PWC to the Hampshire South WRZ, as proposed in the DWRMP. The infrastructure for up to a 30MI/d transfer is proposed to be implemented from the outset, with the volumes transferred being increased as the supply demand balance requires it, and as PWC is able to guarantee the provision of the water. Further options will, where feasible, be considered in future WRMPs, and Southern Water will continue to discuss water sharing options with PWC.

9.18. In addition, the WRSE group regional model indicated the need for an export of 4 MI/d from Sussex Brighton to South East Water in 2021. Discussions between Southern Water and South East Water have explored transfers in Sussex between the two companies. Work has shown that for AMP6 no transfers are needed, but both companies are committed to reviewing this again in future through the WRSE group and jointly as part of ongoing studies. These options were included in the recent WRSE work, and rarely selected, but we will work with SEW to review the potential for them in the future.

General principles for the provision of bulk supplies

9.19. The inclusion of some regional schemes within the baseline condition of this WRMP, either for joint scheme development and/or shared resources and bulk exports, will result in additional costs over and above a "company only" strategy (conversely, increased bulk imports will result in a lower cost plan compared to a "company only" strategy). The risk is that the resulting final planning scenario may not be the least cost strategy for Southern Water on its own. It is therefore essential to state the conditions that will ensure that the customers of Southern Water are not unduly disadvantaged by the inclusion of these schemes in the company preferred regional strategy.

- 9.20. The exact terms and conditions of any future agreements between Southern Water and other companies for the provision of supplies, either from bulk transfers or joint development, will be determined on a case-by-case basis. The following points set out, without prejudice, the general principles that will underlie any inclusion of regional strategy schemes within the company's WRMP:
- The company's own customers, and their security of water supply, are of paramount importance in the provision of bulk supplies;
 - Water is a commodity which can be sold, and as such, may be used for the provision of bulk supplies to other wholesalers;
 - Any incremental expenditure on the company, be it from the renewal of existing bulk supplies, or the provision of new ones, should be met entirely by the recipient company; and
 - The promotion of any new scheme that allows the provision of new bulk supplies would be expected to be subject to the same level of environmental scrutiny as any other scheme.

Least cost plans

- 9.21. The investment model was run initially to generate the least cost plan for each supply area. The least cost plan is described below, and is then presented in the tables and text in paras. 9.30-9.59 on programme appraisal, where alternatives to the least cost plan have been explored. The results of all these economic modelling runs are presented for each Area in Table 9.1 through to Table 9.3. However, the general findings from the initial least cost plan are set out below.

Western Area

- 9.22. Under the baseline scenario for the two small WRZs in northern Hampshire, there was no deficit forecast in Hampshire Andover WRZ, and only a small deficit at the end of the planning period in Hampshire Kingsclere WRZ. A demand management solution was used to meet this deficit. There was neither sufficient surplus nor strategic rationale for considering an internal transfer from either of these WRZs back into the Hampshire South WRZ.
- 9.23. The Isle of Wight is effectively linked to the large Hampshire South WRZ via the cross-Solent main. The Isle of Wight does not have sufficient resources on its own to meet the dry year demands used in the design scenarios. The use of the cross-Solent main is therefore critical. However, the corollary of this is that the very large River Itchen Sustainability reduction will affect not only the Hampshire South WRZ, but also the Isle of Wight WRZ, through the reduced availability of water to transfer through the cross-Solent main.
- 9.24. Southern Water is committed to implementing the River Itchen Sustainability Reduction as quickly as it can in AMP6 through the gradual phasing of components of the Sustainability Reduction, aiming for full implementation by 2018/19. Thus it was assumed that the following components of the licence amendments would be implemented as follows:
- The Lower Itchen surface water and groundwater licence change for monthly totals in 2015. Note that this licence change does not actually impact on the DO's, hence does not register in the supply demand balance;
 - The Lower Itchen surface water Minimum Residual Flow (MRF) licence change in 2017, which equates to loss of the full Lower Itchen surface water DO in that year; and
 - The Lower Itchen groundwater licence change in 2018, and hence result in the full implementation of all the components of the Sustainability Reduction in this year.
- 9.25. However, **Southern Water could only allow the full implementation of such a large sustainability reduction once there were sufficient alternative supplies in place to ensure that customers were not at undue risk of a supply failure.** This will require the implementation of a series of schemes to be used conjunctively. Where sufficient alternative

supplies are not available, the implementation of the River Itchen Sustainability Reduction would have to be delayed.

9.26. The key strategic options selected to achieve a least cost solution are:

- T-HSO-3a 10MI/d bulk supply from Portsmouth Water in 2017/18. The infrastructure for this option is sized to provide greater than 10MI/d so as to allow potential future bulk supplies from Portsmouth Water to be provided, where it is economic to do so. The 10MI/d makes use of Portsmouth Water's forecast surplus under design drought conditions that are similar to the levels Southern Water plans against;
- JO3a MDO groundwater scheme for river augmentation in 2018/19. This scheme is currently owned by, licensed to and operated by the Environment Agency; however, it is assumed that ownership of the sources and existing infrastructure will be transferred to Southern Water in order to realise the full DO benefits of this augmentation option. If the EA continues to own and operate the scheme, there is currently no guarantee for Southern Water that the scheme would be operated under the supply demand conditions when it would be needed. The outcome of maintaining the status quo is that the contribution of the scheme to maintaining the supply demand balance would be zero;
- HSL3+HST2 conjunctive use scheme in 2018/19. The scheme is available at peak periods only (PDO), and would rely upon the upgrade of the Water Supply Works to allow the abstraction and treatment during the PDO period up to the current limit of the abstraction licence. Construction of a new pipeline linking this WSW to the Lower Itchen WSW will allow the conjunctive use of the two WSWs;
- Two catchment management schemes in HS WRZ in 2024/25 (HSC-a and HSC-b). These schemes are required at two sources which will be at risk of nitrate pollution by the mid-2020's (and hence would otherwise not be able to provide any output). The catchment management schemes require a long lead in time to ensure that processes are in place to reduce nitrate loads in the catchment and to provide sufficient time to monitor nitrate levels to ensure that the scheme is effective at recovering what would otherwise be lost DO. Hence work to deliver the schemes would commence at the beginning of AMP6 (2015/16), although the benefits are not expected to be available until AMP7 (2024/25);
- IWL6 groundwater rehabilitation scheme in 2024/25. This is a small rehabilitation scheme on the Isle of Wight;
- HTD4 25MI/d desalination scheme in 2025/26 (start of AMP8). This is a seawater desalination plant within the existing site of a power station on the western side of Southampton Water;
- IWL7 utilise full capacity of existing cross-Solent main in 2032. The scheme involves the upgrade of infrastructure to allow the full capacity of the cross-Solent main to be used so that the mainland could provide up to 20MI/d to the island. The scheme is dependent on resources being available on the mainland for transfers to the Isle of Wight;
- Leakage reduction below current target levels of 0.4MI/d by the end of AMP6 (2019/20), reduction to 4.2MI/d below current target levels by the end of AMP7 (2024/25), and reduction to 5.8MI/d below current target levels by the end of the planning period; and
- Various combinations of enhanced water efficiency options, primarily focused on non-household customers (household customers are anyway targeted as part of Southern Water's commitment to ongoing baseline water efficiency activity (i.e. activity that is not selected on a least cost basis as it forms part of the company's efforts to promote water conservation)).

Central Area

9.27. The key strategic options selected to achieve a least cost solution are:

- Conventional and catchment management schemes in 2016/17 to recover lost DO from sources which would otherwise have to be taken out of service due to exceedence of nitrate thresholds;
- N8a winter transfer stage 1 scheme in 2018/19. The scheme involves replacing the a main in order to relieve pressure issues and allow additional water to be transferred, to supply the area normally supplied by Weir Wood Reservoir. This allows Weir Wood Reservoir to enter a 'non consumptive mode' during the winter and spring, which ensures that it can be filled even during severe drought events;
- N10 wellfield reconfiguration scheme in 2019/20. Analysis suggests that the potential MDO impact from a wellfield re-configuration at the sourcworks near Pulborough could be significant. This would require that boreholes are spaced at least 300m apart and be better designed to take an even load, which will require the drilling of a number of test/investigation boreholes and up to 6 production boreholes, with associated pumps, headworks and pipelines. It would also require a new licence application to replace the existing abstraction licence;
- N20 asset enhancement scheme in 2021/22. The scheme involves increasing pump capacity and WSR connectivity so that the groundwater source works can pump to its Middle or High water reservoir;
- Numerous catchment management schemes in all three WRZ in 2024/25. These schemes are required at sources which will be at risk of nitrate pollution by the mid-2020's (and hence would otherwise not be able to provide any output). The catchment management schemes require a long lead in time to ensure that processes are in place to reduce nitrate loads in the catchment and to provide sufficient time to monitor nitrate levels to ensure that the scheme is effective at recovering what would otherwise be lost DO. Hence the work to deliver the schemes would commence at the beginning of AMP6 (2015/16), although the benefits are not expected to be available until AMP7 (2024/25);
- NR2c 10MI/d water reuse scheme in 2027/28. The proposed option is to transfer 10 MI/d of treated effluent from the WWTW, which currently being discharged to sea at Littlehampton, to support flows within the River Rother;
- Leakage reduction below current target levels of 1MI/d by the end of AMP6 (2019/20), and reduction to 3MI/d below current target levels by the end of AMP7 (2024/25), and reduction to 4.5MI/d below current target levels by the end of the planning period; and
- Various combinations of enhanced water efficiency options, primarily focused on non-household customers (household customers are anyway targeted as part of Southern Water's commitment to ongoing baseline water efficiency activity (i.e. activity that is not selected on a least cost basis as it forms part of the company's efforts to promote water conservation).

Eastern Area

9.28. A key feature of the Eastern Area is its role in providing significant bulk supplies to neighbouring water companies, in particular South East Water, as part of a regionally optimal solution to the water resources situation. An outcome from the WRSE modelling was that the volume of bulk supplies is set to increase significantly over the planning period. . This was discussed earlier in paras. 9.9-9.20. These bulk supplies form part of the baseline supply demand balance for the preferred plan.

9.29. The key strategic options selected to achieve a least cost solution are:

- The M10 River Medway licence variation scheme in 2015/16. This proposed surface water licence variation to the existing River Medway Scheme has already been subject to a detailed investigation in 2012/13, culminating in a detailed

environmental report and initial discussions around the preparation of supporting documents for a licence variation application with the EA;

- The M9 groundwater source licence variation scheme in 2016/17. This is a proposal to alter the existing licence which forms part of the Sittingbourne group licence. This will remove the annual licence constraint and hence allow abstraction at the daily rate over the whole year;
- The MT10 asset enhancement scheme in 2017/18. This option looks to install a short spur main to better connect a couple of water service reservoirs, to improve the connectivity within the KM WRZ and release the output from sources that would otherwise have been constrained. It helps to increase operational flexibility. The scheme should be technically feasible, although detailed network modelling is required to ensure that the benefits can be fully realised;
- KMC-b conventional and catchment management scheme in 2019/20 to recover lost DO from sources which would otherwise have to be taken out of service due to exceedence of nitrate thresholds;
- Various combinations of enhanced water efficiency options, primarily focused on non-household customers (household customers are anyway targeted as part of Southern Water's commitment to ongoing baseline water efficiency activity (i.e. activity that is not selected on a least cost basis as it forms part of the company's efforts to promote water conservation));
- The MR3 20MI/d water reuse scheme in 2022/23. This option involves the transfer of 20 MI/d of treated effluent from the WWTW to the River Medway upstream of Southern Water's abstraction. This would be used to supplement flows within the Medway during low flow periods, thus reducing the releases from Bewl Water and conserving storage;
- Two catchment management schemes (KMC-a and KTC-a) in 2024/25. These schemes are required at sources which will be at risk of nitrate pollution by the mid-2020's (and hence would otherwise not be able to provide any output). The catchment management schemes require a long lead in time to ensure that processes are in place to reduce nitrate loads in the catchment and to provide sufficient time to monitor nitrate levels to ensure that the scheme is effective at recovering what would otherwise be lost DO. Hence work to deliver the schemes would commence at the beginning of AMP6 (2015/16) although the benefits are not expected to be available until AMP7 (2024/25); and
- M21 licence trading scheme in 2034/35. The option entails taking ownership of a large existing unused licence in the KM WRZ.

Programme appraisal – assessment of alternatives to the least cost plan

9.30. It is essential to check the robustness of a given solution to underlying assumptions, and to test alternative solutions or “what if” scenarios.

9.31. The approach used in this WRMP was to change the baseline input data, in terms of either components of the supply demand balance or in the assumptions surrounding the available options, re-run the model, and then compare the resulting solution against the baseline least cost solution.

Alternative options

9.32. The first step in this process was to test various “what if” scenarios – to identify what alternative options would be selected (at least cost) if the ones available in the least cost plan could not be delivered, for whatever reason.

Western Area assessment of alternatives to the least cost plan

9.33. The key strategic options that are required in the next AMP period (AMP6, from 2015/16 to 2109/20) were selected in all scenarios. That is, schemes T-HSO-3a 10MI/d bulk supply from

Portsmouth Water in 2017/18; JO3a MDO groundwater scheme for river augmentation in 2018/19; and HSL3+HST2 conjunctive use scheme in 2018/19. (Although note that, under the scenario where the HSL3+HST2 conjunctive use scheme is not deliverable, it is the PDO variant of the JO3a groundwater scheme for river augmentation that is required, because the HSL3+HST2 scheme itself only provides output at PDO). If the magnitude and timing for implementation of the River Itchen Sustainability Reductions are to be met, then these schemes are critical. It is the scale and timing of the Sustainability Reductions, as opposed to other factors, that determine the type, timing and costs of the options that are needed to maintain the supply demand balance in Hampshire South and the Isle of Wight WRZs.

- 9.34. It should also be noted that, where one of these three options was not available for selection, the model brought forward all water efficiency options and initial leakage steps into AMP6, but did not have sufficient alternative options available to be able to solve the deficit created by the River Itchen Sustainability Reduction. Therefore, if one of the above options could not be delivered, it would not be possible to implement the Itchen Sustainability Reduction in full without putting Southern Water's customers in HS and IW WRZs at risk of a supply shortfall.
- 9.35. In addition, under some scenarios a new strategic option was required at the end of AMP6 – this was the HR9c non-potable water reuse at an industrial site scheme. Where any of the above three AMP6 strategic schemes is not required, then HR9c would be needed in their place. Where one of the later least cost plan schemes is not delivered (i.e. IWL6, HTD4, or IWL7), then the HR9c non-potable water reuse at industrial site scheme is also required in AMP7 in 2023 or 2024. This scheme is therefore an important alternative strategic scheme to those in the least cost plan.
- 9.36. The two catchment management schemes in HS WRZ in 2024/25 (HSC-a and HSC-b) were required under all “what if” scenarios.
- 9.37. Where either the IWL6 groundwater rehabilitation scheme on the Isle of Wight or the HTD4 25MI/d desalination scheme is not available, the next best least cost solution is identical. This results in the strategic selection of:
- The slightly smaller HDT2 20MI/d coastal desalination scheme (proposed to be situated in an industrial park on the tidal part of the River Test upstream of the confluence with Southampton Water), but not until 2030/31; and
 - The HR9c non-potable water reuse at an industrial site scheme at the end of AMP7 in 2024/25.

The IWL7 option to utilise the full capacity of existing cross-Solent main scheme is required earlier in the planning period in 2028/29 (rather than in 2032/33), with no need for the IWL6 groundwater rehabilitation scheme.

- 9.38. The total cost of the above alternatives is only marginally more expensive than the least cost solution presented in para.9.24. It is therefore reasonable to conclude that the least cost Western Area strategy requires a desalination scheme (either HTD2 or HTD4) in the period 2025-2030 (i.e. in AMP8), and that the HR9c non-potable water reuse at an industrial site scheme could be implemented as well in order to enable a smaller desalination scheme. The IWL7 utilise full capacity of existing cross-Solent main scheme may be required as early as 2028/29 (AMP8), although it is more likely to be needed in the early 2030's, and the IWL6 groundwater rehabilitation scheme is not as strategically important as the other schemes.
- 9.39. The final run tests what would happen if the Island had to rely on its current lower transfer from the mainland (i.e. if the IWL7 utilise full capacity of existing cross-Solent main scheme was not available). The resulting solution requires:
- A smaller desalination scheme on the mainland (the 10MI/d variant of HDT4 rather than the 25MI/d variant) and this is not required until much later, in 2035/36;
 - The HR9c non-potable water reuse at an industrial site scheme towards the end of AMP7 in 2023/24; and
 - The IWR1 5MI/d water reuse scheme on the Isle of Wight.

The IWL6 groundwater rehabilitation scheme is again not required under this “what if” scenario. The total cost of this alternative scenario is close to the least cost solution, implying that if the

company were to consider a Western Area solution in which the Isle of Wight was less reliant on the mainland for its water, then this set of schemes should be considered.

- 9.40. The company intends to investigate the strategic options identified as part of least cost modelling and alternative testing more extensively during the next AMP period to determine their viability in order to inform the next iteration of the WRMP for 2019.

Timing of the Itchen Sustainability Reductions

- 9.41. As described previously in paras.5.68-5.805.79 and 9.24-9.25, the company is committed to implementing the Itchen Sustainability Reduction as quickly as it can. However, the company would only be able to fully implement the Itchen Sustainability Reduction through a series of new supply schemes to be used conjunctively combined with demand management measures to ensure that customers are not put at risk of supply shortfalls.
- 9.42. The other aspect is that, if the model tries to solve for the Itchen Sustainability Reduction before sufficient options are available, then the result could be sub-optimal for Southern Water and its customers, as well as presenting a risk to security of supply. To understand this, a further “what if” scenario was investigated, where the implementation date for the full Itchen Sustainability Reduction was set at 2029/30 instead of 2018/19. The results of this scenario are presented in Table 9.1.
- 9.43. What this scenario demonstrates is that the preferred strategy for the Western Area is the optimal way to solve for the very large River Itchen Sustainability Reduction. The key strategic options required to meet the sustainability reduction under all the other scenarios are all still selected under this scenario, although the implementation date is delayed to the date of implementation of the Itchen Sustainability Reduction, as there is otherwise no significant deficit to satisfy.
- T-HSO-3a 10Ml/d bulk supply from Portsmouth Water in 2029/30;
 - HSL3+HST2 conjunctive use scheme in 2029/30;
 - HTD4 25Ml/d desalination scheme in 2029/30;
 - IWL7 utilise full capacity of existing cross-Solent main in 2031/32;
 - JO3a MDO groundwater scheme for river augmentation, delayed until 2035/36; and
 - Leakage reduction below current target levels and various combinations of enhanced water efficiency options.
- 9.44. Note that the cost of the solution in NPV terms over the planning period is cheaper where the Itchen Sustainability Reduction is delayed in time, as would be expected with discounted costs.

Central Area assessment of alternatives to the least cost plan

- 9.45. There are two strategic resource options required in AMP6. The first is the N10 well field re-configuration, an option to optimise the groundwater source configuration of the well field to improve the seasonal management flexibility, without increasing the annual abstraction volume. The second option required is N8a winter transfer stage 1, which involves replacing mains to relieve pressure issues and allow Weir Wood to enter a ‘non consumptive mode’ during the winter / spring so it can be filled even during severe drought events. These options are required at the end of AMP6 in all the alternative scenarios.
- 9.46. The conventional & catchment management, and the catchment management only schemes for sources which will be at risk of nitrate pollution (and hence would otherwise not be able to provide any output) are selected in all the alternative scenarios. However, the timing of these schemes varies through the planning period depending on the other options that are available/selected. But in general the conventional & catchment management options are selected at their earliest start date in 2016/17, while the catchment management only options are selected in their earliest start year of 2024/25 (which means they must start to be implemented in 2015, given a two AMP period lead in time).

- 9.47. Under the scenario where the N10 well field reconfiguration scheme is excluded, the key changes from the least cost plan are that the NR2c 10MI/d water reuse scheme is required 5 years earlier in 2022/23; the N20 asset enhancement scheme is also required earlier in 2018/19. There is also generally more leakage reduction required.
- 9.48. The impact of excluding the N8a winter transfer stage 1 scheme is similar: to bring forward the NR2c 10MI/d water reuse scheme to 2024/25 and the N20 asset enhancement scheme to 2018/19.
- 9.49. Under the scenario in which the N20 asset enhancement scheme is excluded, there is very little change to the strategy, with the key difference being that one the SBC-d conventional & catchment management scheme, which under the least cost plan is not selected until 2030, is brought forward to 2022. The sensitivity of the Central Area plan to this scheme can therefore be said to be limited.
- 9.50. Finally, the scenario which excludes all magnitudes of the NR2 water reuse scheme results in significantly more leakage reduction and mains renewal than in the least cost plan, but with water efficiency options in SN and SW WRZs pushed back until the end of the planning period. The other key strategic resources adopted are the CA1 4MI/d MDO aquifer storage and recovery (ASR) scheme in 2029, and the N8b and N8c winter transfers (stages 2 and 3) in 2033 and 2035 respectively.

Eastern Area assessment of alternatives to the least cost plan

- 9.51. The key strategic options that are required in the next AMP period (AMP6, from 2015/16 to 2109/20) were selected in all scenarios. That is, schemes M10 River Medway licence variation, M9 groundwater source licence variation and MT10 asset enhancement scheme.
- 9.52. In addition, the MR3 20MI/d water reuse scheme is also required in all the “what if” scenarios. The key point to note is that this scheme is sometimes required earlier at the end of AMP6 (where any of M10, M9 and MT10 were not available). Under the “what if” scenario in which the MR3 water reuse scheme is not available, the key strategic alternative is to bring forward the M21 licence trading scheme in its place (in 2023/24).
- 9.53. Where either of the AMP6 schemes M10, M9 and MT10 are not available, the M21 licence trading scheme gets brought forward from 2034/35 to as early as 2025/26 (the start of AMP8).
- 9.54. It will therefore be critical for Southern Water to carry out technical investigations, a preliminary design and costing exercise, licence discussions, stakeholder engagement, and preparation of an environmental report including EIA Screening and Scoping, and supporting documentation for planning permissions, for both the MR3 20MI/d water reuse scheme and the M21 licence trading scheme in parallel during AMP6. However, the intention would be that the company would only actually submit the complete application and EIA for one of these schemes in AMP6, depending on the outcome of the investigations.
- 9.55. The conventional & catchment management, and the catchment management only schemes for sources which will be at risk of nitrate pollution (and hence would otherwise not be able to provide any output) are selected in all the alternative scenarios. In general the conventional & catchment management option is selected at its earliest start date in 2016/17, while the catchment management only options are always selected in their earliest start year of 2024/25 (which means they must start to be implemented in 2015, given a two AMP period lead in time).
- 9.56. Under the “what if” scenario in which the MR3 water reuse scheme is not available, the other key alternative resource scheme required is the M5a reservoir raising scheme in 2027/28.
- 9.57. Under the above what if scenario, and also where the M21 licence trading scheme is unavailable, significant additional leakage reduction is triggered over the planning period – up to 5MI/d reduction below current target levels in KM, 1.5 MI/d reduction in KT and 1.2 MI/d reduction in SH by the end of the planning period.

Table 9.1 Western Area least cost plan and alternatives

Scenario	Least cost plan	No HSL3+HST2 conjunctive use	No JO3a groundwater scheme for river augmentation	No T-HSO-3 10MI/d bulk supply from PWCo	No IWL6 groundwater rehabilitation	No HTD4 desalination	No IWL7 full capacity of existing cross-Solent main	Itchen SR in 2029
Total (£k) (NPV discounted over 80 years)	115,376	127,674	138,717	144,618	116,108	116,108	116,917	83,343
Difference from least cost (£k)	n/a	12,298 Unsolvable deficit	23,340 Unsolvable deficit	29,241 Unsolvable deficit	731	731	1,541	-32,034
Options	Year	Year	Year	Year	Year	Year	Year	Year
Leakage reduction in HK to 0.2MI/d below current level	2038	2038	2038	2038	2038	2038	2038	2038
HK-WE-B Water Efficiency school audits	2033	2033	2033	2033	2033	2033	2033	2033
HK-WE-C Water Efficiency SME audits	2035	2035	2035	2035	2035	2035	2035	2035
HK-WE-D Water Efficiency large business audits	2033	2033	2033	2033	2033	2033	2033	2033
T-HSO-3a 10MI/d Bulk supply (with 30MI/d infrastructure) from PWCo	2017	2017	2017		2017	2017	2017	2029
HSC-a Catchment management	2024	2024	2024	2024	2024	2024	2024	2024
HSC-b Catchment management	2024	2024	2024	2024	2024	2024	2024	2024
HTD2 20MI/d Coastal desalination			2021		2030	2030		
HTD4 10MI/d Desalination							2035	
HTD4 25MI/d Desalination	2025	2022		2024				2029
JO3a - MDO groundwater scheme for river augmentation	2018			2018	2018	2018	2018	2035
JO3a - PDO groundwater scheme for river augmentation		2018						
Phase 1 Mains renewal in Hampshire South		2021						
Phase 2 Mains renewal in Hampshire South		2021						
Leakage reduction in HS to 1MI/d below current level	2020	2018	2018	2017	2022	2022	2020	2033
Further leakage reduction in HS to 2MI/d below current level	2020	2019	2035	2021	2022	2022	2020	2033
Further leakage reduction in HS to 3MI/d below current level	2024	2030	2039	2034			2028	2037
Further leakage reduction in HS to 4MI/d below current level	2039	2034		2038			2033	
Further leakage reduction in HS to 5MI/d below current level		2038						
HS-WE-A Water Efficiency home audits	2035	2015	2015	2015	2025	2025	2030	2035
HS-WE-B Water Efficiency school audits	2020	2015	2015	2015	2019	2019	2030	2035
HS-WE-C Water Efficiency SME audits	2020	2015	2015	2015	2019	2019	2030	2036
HS-WE-D Water Efficiency large business audits	2020	2015	2015	2015	2019	2019	2030	2036
HR9c Non-potable water reuse at industrial site		2019	2019	2019	2024	2024	2023	
HSL3+HST2 Conjunctive use	2018		2018	2018	2018	2018	2018	2029
IWL6 Groundwater rehabilitation	2024	2018	2018	2017				
Mains renewal on Isle of Wight		2021						
Leakage reduction on IoW to 0.4MI/d below current level	2015	2015	2015	2015	2015	2015	2015	2015
Further leakage reduction on IoW to 0.8MI/d below current level	2021	2019	2019	2021	2021	2021	2020	2021
Further leakage reduction on IoW to 1.2MI/d below current level	2024	2026	2027	2026	2026	2026	2024	2024
Further leakage reduction on IoW to 1.6MI/d below current level	2029	2029		2029			2029	2029
IWL7 Utilise full capacity of existing cross-Solent main	2032	2032	2030	2032	2028	2028		2031
IW-WE-A Water Efficiency home audits	2020	2015	2015	2015	2021	2021	2021	2026
IW-WE-B Water Efficiency school audits	2020	2015	2015	2015	2019	2019	2026	2026
IW-WE-C Water Efficiency SME audits	2020	2015	2015	2015	2019	2019	2018	2024
IW-WE-D Water Efficiency large business audits	2020	2015	2015	2015	2019	2019	2025	2026
IWR1 5MI/d Water reuse							2031	

9.58. Note: there are an unsolvable deficits under the following scenarios:

- “No HSL3+HST2 conjunctive use” – deficit in 2018 only in HS of 9MI/d at MDO. This scenario would therefore require a one year delay to the full implementation of the River Itchen Sustainability Reduction.
- “No JO3a groundwater scheme for river augmentation” – deficit in 2018 only in HS of 9MI/d at MDO. This scenario would therefore require a one year delay to the full implementation of the River Itchen Sustainability Reduction.
- “No T-HSO-3 10MI/d bulk supply from PWCo” – deficit in 2017 only in IW of 7MI/d at PDO. This scenario would therefore require a delay to the implementation of the early stages of the River Itchen Sustainability Reduction.

Table 9.2 Central Area least cost plan and alternatives

Scenario	Least cost plan	No N10 Well field reconfiguration	No N8a Winter transfer stage 1	No N20 Asset enhancement schemes	No NR2 Water reuse
Total (£k) (NPV discounted over 80 years)	68,607	75,482	71,142	70,162	76,017
Difference from least cost (£k)	n/a	6,876	2,535	1,555	7,410
Options	Year	Year	Year	Year	Year
SNC-a Catchment management	2024	2036	2037	2024	2024
SNC-b Catchment management	2024	2024	2026	2024	2024
N10 Well field reconfiguration	2019		2019	2019	2019
Mains renewal in Sussex North					2039
Leakage reduction in SN to 1MI/d below current level	2023	2019	2018	2021	2023
Further leakage reduction in SN to 2MI/d below current level	2026	2019	2021	2024	2023
Further leakage reduction in SN to 3MI/d below current level		2034			2027
Further leakage reduction in SN to 4MI/d below current level		2038			2036
N8a Winter transfer stage 1	2018	2019		2018	2018
SN-WE-A Water Efficiency home audits	2022	2035	2035	2035	2035
SN-WE-B Water Efficiency school audits	2022	2017	2019	2024	2035
SN-WE-C Water Efficiency SME audits	2022	2017	2019	2024	2036
SN-WE-D Water Efficiency large business audits	2022	2017	2019	2024	2036
NR2c 10MI/d Water reuse	2027	2022	2024	2029	
N20 Asset enhancement schemes	2021	2018	2018		2021
SBC-a Conventional & catchment management	2016	2016	2016	2016	2016
SBC-b Catchment management	2024	2024	2024	2024	2024
SBC-c Catchment management	2024	2024	2024	2024	2024
SBC-d Conventional & catchment management	2030	2030	2030	2022	2027
SBC-e Catchment management	2024	2024	2024	2024	2024
SBC-f Catchment management	2024	2024	2024	2024	2024
Leakage reduction in SB to 0.75MI/d below current level	2025	2039	2039	2039	
Further leakage reduction in SB to 1.5MI/d below current level	2026		2039	2039	
N8b Winter transfer stage 2					2033
N8c Winter transfer stage 3					2035
N8c Winter transfer stage 3 (transfer component)					2035
SB-WE-A Water Efficiency home audits	2035	2035	2025	2035	
SB-WE-B Water Efficiency school audits	2035	2025	2025	2035	2022
SB-WE-C Water Efficiency SME audits	2015	2035	2035	2015	2015
SB-WE-D Water Efficiency large business audits	2022	2026	2020	2036	2022
CA1 4MI/d MDO Aquifer Storage and Recovery					2029
SWC-a Conventional & catchment management	2016	2016	2016	2016	2016
SWC-b Conventional & catchment management	2016	2016	2016	2016	2016
SWC-c Catchment management	2024	2032	2034	2024	2024
Mains renewal in Sussex Worthing					2038
Leakage reduction in SW to 0.5MI/d below current level	2016	2015	2016	2016	2016
Further leakage reduction in SW to 1MI/d below current level	2022	2015	2021	2024	2020
Further leakage reduction in SW to 1.5MI/d below current level		2019	2038		2024
Further leakage reduction in SW to 2MI/d below current level		2036			2028
Further leakage reduction in SW to 2.5MI/d below current level					2038

Scenario	Least cost plan	No N10 Well field reconfiguration	No N8a Winter transfer stage 1	No N20 Asset enhancement schemes	No NR2 Water reuse
SW-WE-A Water Efficiency home audits	2022	2035	2035	2024	2035
SW-WE-B Water Efficiency school audits	2022	2017	2019	2024	2035
SW-WE-C Water Efficiency SME audits	2022	2016	2019	2024	2035
SW-WE-D Water Efficiency large business audits	2022	2017	2036	2024	2036

Table 9.3 Eastern Area least cost plan and alternatives

Scenario	Least cost plan	No M10 River Medway licence Variation	No M9 groundwater source licence variation	No MT10 Asset enhancement schemes	No MR3 Water reuse	No M21 Licence trading scheme
Total (£k) (NPV discounted over 80 years)	56,468	65,265	61,428	62,761	60,630	60,879
Difference from least cost (£k)	n/a	8,797 Unsolvable deficit	4,959	6,293	4,162	4,410
Options	Year	Year	Year	Year	Year	Year
MT10 Asset enhancement schemes	2017	2018	2019		2017	2017
KMC-a Catchment management	2024	2024	2024	2024	2024	2024
KMC-b Conventional & catchment management	2019	2016	2016		2019	2019
M21 Licence trading scheme	2034	2029	2033	2025	2023	
Leakage reduction in KM to 1MI/d below current level		2015		2017	2019	2019
Further leakage reduction in KM to 2MI/d below current level				2039	2019	2019
Further leakage reduction in KM to 3MI/d below current level					2024	2029
Further leakage reduction in KM to 4MI/d below current level					2034	2033
Further leakage reduction in KM to 5MI/d below current level					2038	2037
M10 River Medway licence Variation	2015		2015	2015	2015	2015
M9 groundwater source licence variation	2016	2016		2016	2016	2016
M5a3000 Reservoir raising					2027	
KM-WE-A Water Efficiency home audits		2015		2035	2035	2035
KM-WE-B Water Efficiency school audits	2015	2015	2028	2015	2035	2035
KM-WE-C Water Efficiency SME audits	2015	2015	2028	2015	2035	2035
KM-WE-D Water Efficiency large business audits	2015	2015	2028	2015	2036	2036
MR3 20MI/d Water reuse	2022	2019	2019	2019		2023
KTC-a Catchment management	2024	2024	2024	2024	2024	2024
Leakage reduction in KT to 0.75MI/d below current level				2039	2037	2037
Further leakage reduction in KT to 1.5MI/d below current level					2037	2037
KT-WE-A Water Efficiency home audits				2035	2035	2035
KT-WE-B Water Efficiency school audits	2035	2035	2035	2035	2035	2035
KT-WE-C Water Efficiency SME audits	2035	2035	2035	2035	2036	2036
KT-WE-D Water Efficiency large business audits	2035	2035	2035	2036	2036	2036
Leakage reduction in SH to 0.4MI/d below current level	2019	2015			2016	2016
Further leakage reduction in SH to 0.8MI/d below current level					2019	2019
Further leakage reduction in SH to 1.2MI/d below current level					2024	2036
SH-WE-A Water Efficiency home audits		2015		2017	2035	2035
SH-WE-B Water Efficiency school audits	2015	2015	2035	2015	2018	2018
SH-WE-C Water Efficiency SME audits	2017	2015	2035	2015	2036	2036
SH-WE-D Water Efficiency large business audits	2015	2015	2035	2015	2036	2036

9.59. Note: there are an unsolvable deficits under the “No M10 River Medway licence Variation” scenario – there is a deficit in 2015 only in SH of 0.7MI/d at ADO. This is an artificial deficit, and is due to the assumption that the M10 scheme would be selected, and therefore that SEW would take 25% of the yield of this scheme (as they have a 25% entitlement to the RMS), and hence an bulk export has been built into the baseline to account for this. In reality, if it were not possible to deliver the M10 scheme, then there would be no need to supply an additional 1.25MI/d to SEW, and hence there would not be this deficit in 2015.

Environmental considerations

- 9.60. As discussed in Section 8, the potential environmental and social impacts of feasible options were monetised using the Environment Agency's Benefits Assessment Guidance (BAG), where it was possible to do so. Hence, the environmental and social economic costs and benefits were included in the least cost economic modelling of feasible options to assist in the selection of the preferred strategy. However, there are limitations to the BAG methodology, and consequently the values produced for each scheme only provide a high-level indication of the benefits or dis-benefits of a scheme, rather than an accurate estimation, which would generally require a detailed location/scheme specific study to be undertaken.
- 9.61. There may also be environmental considerations, with both positive and negative impacts, which are difficult to express purely in monetary terms. The SEA process has therefore been used to help identify and evaluate such environmental considerations. Each option was assessed against a series of pre-determined environmental objectives to judge to what degree it would either meet with or contribute to achieving each SEA objective, or would conflict with them. For each objective the strength of support or conflict from high to low or neutral was reviewed, and an overall (subjective) assessment of the performance of each option across all the objectives was made to allow the options to be ranked into one of three 'risk' categories (High, Medium or Low) according to their performance against the objectives. In addition, the Habitats Regulation Assessment (HRA) for the plan was also used in developing this ranking.
- 9.62. In general, the worst case scenario was taken where appropriate, rather than an average of the overall score of an option against all objectives. This is important to avoid the risk of 'trading' potential adverse impacts against positive impacts. This information was incorporated into an "SEA preferred" scenario run, where any high risk schemes were excluded from the feasible options list that the model could choose from. Those schemes that were deemed to potentially be of high environmental risk and therefore excluded from the model run for this scenario are presented in Table 9.4, Table 9.5, and Table 9.6 for each of the supply areas, along with identification of potential mitigation measures to address the risks.

Table 9.4 Summary of feasible options which may potentially present high environmental risk from SEA – Western Area

Option	Key environmental risks	Mitigation measures available
HTD2 Coastal desalination	No designations at the proposed site itself. The banks upstream and downstream are part of the Solent Maritime SAC and Solent & Southampton Water SPA/Ramsar. Approx 4.5km downstream both 'banks' of Southampton Water are internationally designated. Intake of water may result in a loss of marine flora and fauna due to entrainment and impingement. The brine discharge from the plant could adversely affect marine habitats and species immediately around the outfall and in the plume area. The location and potential impacts of the brine outfall plume on the nearby designated estuary sites will also need to be fully assessed. The impact of the abstraction and discharge on flows and water quality in the estuary, and potential impacts on migratory fish will need to be determined. Initial modelling for HTD1 indicates that impacts are likely to be small, but this is unconfirmed. Otherwise freshwater fisheries are unlikely to be affected. The impact of the brine discharge on any local coastal fisheries and shell fisheries will also need to be considered. The water discharged from the desalination plant is likely to have an impact of the quality of the water in the receiving water (e.g.: higher salt concentrations and temperatures and chemicals used in pre-treatment and cleaning). The Southampton Water estuarine waterbody is currently at Moderate Potential. The impact of the discharge on the waterbody status (quality and quantity) will need to be assessed.	Initial modelling for the alternative site to the north (HTD1) has indicated that brine dilution and mixing should be effective, due to the deep shipping channel in Southampton Water, plus possible effects of the WWTW outfall. Considering the outputs of the modelling and the distance between the outfall and the SPA /Ramsar site (0.8km), the brine discharge is not considered likely to have a significant effect on the qualifying features of designated sites. The operation of the scheme is not anticipated to have any hydrological impacts if designed appropriately, however, detailed 3D modelling into the impact of the discharge into the receiving water should be carried out to inform the design and therefore a conservative assessment has been taken at this stage. Currently it is anticipated that use of this site would have limited environmental impacts. The timing of the abstraction during tidal cycles will determine the degree of impact and manage the effects. Modelling of the effect on estuarine flows and levels may be required, as above. A conservative assessment is therefore required at this stage. Marine ecological and fisheries surveys would be required, and plume dispersion modelling would determine the scale of impact and any required mitigation. Use of appropriate technology to minimise risk.

Option	Key environmental risks	Mitigation measures available
HTD4 Desalination	No designations at the proposed site itself. The Southampton Water foreshore at this location is part of the Solent Maritime SAC and Solent & Southampton Water SPA/Ramsar. Also designated SSSI. It is assumed that the existing intake would be shared with the power station, but the impact of any additional abstraction on marine flora and fauna will need to be considered. No new discharge infrastructure is assumed to be required. The brine discharge from the plant could adversely affect marine habitats and species immediately around the outfall and in the plume area (required particular consideration wrt designated sites), but impacts would be reduced if it was diluted with plant cooling water (current discharge of 5500Ml/d). The impact of the abstraction and discharge on flows and water quality in the estuary, and potential impacts on migratory fish will need to be determined. Otherwise freshwater fisheries are unlikely to be affected. The impact of the brine discharge on any local coastal fisheries and shell fisheries will also need to be considered. The pipeline route crosses or passes close to designated sites and part of the route runs through the New Forest National Park, which receives very high visitor numbers, particularly in the summer. Calshot Local Nature Reserve is located close by, noise and traffic disruption could be issues for both of these designations.	The strategic HRA screened this option and concluded that an Appropriate Assessment of this option may be required. However, the mixing of the brine outfall with the thermal outfall from the power station should provide considerable in pipe dilution prior to discharge into the receiving water. Considering the in-pipe dilution and distance between the outfall and the SPA /Ramsar, the brine discharge is not considered likely to have a significant effect on the qualifying features of the SPA. Further research and more detailed 3D modelling into the impact of the brine discharge into Southampton Water would have to be carried out should this option be selected. It is assumed that the outfall and abstraction could be designed to avoid significant adverse effects; however, a conservative assessment has been undertaken at this stage. The timing of the abstraction during tidal cycles may affect the degree of impact and manage the effects. Modelling of the effect on estuarine flows and levels may be required, as above. A conservative assessment is therefore required at this stage. Marine ecological and fisheries surveys would be required, and plume dispersion modelling would determine the scale of impact and any required mitigation. Traffic management measures and good construction practices. Consider timing of pipeline works to take place outside of peak summer season.
IWD1 Coastal desalination	No designations at the proposed site itself, although there is an SNCI between the treatment works and the coast. Sandown Bay is within the South Wight Maritime SAC Intake of water may result in a loss of marine flora and fauna due to entrainment and impingement. The brine discharge from the plant could adversely affect marine habitats and species immediately around the outfall and in the plume area. The location and potential impacts of the brine outfall plume on the designated coastal sites will also need to be fully assessed. Freshwater fisheries will not be affected, but the impact of the brine discharge on any local coastal fisheries and shell fisheries will also need to be considered. The impact of the abstraction and discharge on coastal water quality will need to be determined. Initial modelling for HTD1 indicates that impacts are likely to be small, but this is unconfirmed. The water discharged from the desalination plant is likely to have an impact on the quality of the water in the receiving water (eg: higher salt concentrations and temperatures and chemicals used in pre-treatment and cleaning). The Isle of Wight East coastal waterbody is currently at Good Potential. The impact of the discharge on the waterbody status (quality and quantity) will need to be assessed under the WFD. The option is located outside of any statutory landscape designations and within the curtilage of an existing WWTW, but the area is considered to be of medium to high sensitivity in landscape terms. Addition of pumping station on seafront will have some additional landscape impacts.	The strategic HRA screened this option and concluded that an Appropriate Assessment of this option would be required Further research and more detailed modelling into the impact of the brine discharge into the receiving water would have to be carried out should this option be taken forward. Initial modelling results show that good dilution of the brine is to be expected because the outfall location is open to the elements and ocean currents and provides sufficient depths, even at lowest tides, to aid dispersion. Marine ecological surveys of the outfall location would probably be required. If the dispersion modelling and subsequent assessment indicates that the brine could have an adverse effect on the SAC, design modifications would be required, for example extending the outfall to beyond the boundary of the designation. The final mitigation can only be confirmed by further work and the project level HRA, in consultation with Natural England and the Environment Agency. A conservative assessment is therefore required at this stage. Marine ecological and fisheries surveys would be required, and plume dispersion modelling would determine the scale of impact and any required mitigation (including possible design modifications). Use of appropriate technology to minimise risk. Plume dispersion modelling would determine the scale of impact and any required mitigation. Good design and scale and siting of the plant and seafront pumping station. Standard good practice measures in construction.

Table 9.5 Summary of feasible options which may potentially present high environmental risk from SEA – Central Area

Option	Key environmental risks	Mitigation measures available
CD3 10MI/d Tidal river desalination	Movement of saline interface due to abstraction, potential impacts on European designated sites upstream. Movement of the saline interface would result in a small potential change to fish habitats in the lower Arun. Some impacts on fish populations (distress, fish kills) could occur if the scheme is used during low flows, especially as the abstractions are from an area which experiences oxygen sags during summer.	The strategic HRA screened this option and concluded that an Appropriate Assessment of this option may be required. Mitigation could be incorporated within the abstraction licence. This may include specifying flow or tidal conditions under which the abstraction can take place in order to avoid any adverse impacts occurring. Design of intake will ensure that velocities do not risk entraining fish in the intake. Intake will also be screened if necessary. Mitigation may not be available for particular changes to fish habitats. It is likely that further modelling of the river to determine the scale of the impact of changes in salinity (and under what particular conditions) would be required. Modelling of the likely water quality impacts on the river would be required to better assess this impact. Operating conditions may have to be placed on the abstraction licence in order to protect fish populations.
N5 New reservoir	There are no international or national nature conservation designations at the reservoir site or on or adjacent to any intended pipeline route. The potential for impacts of the abstraction on the Adur Estuary SSSI have been identified. Effects could result from increased salinities due to reduced dilution and a resultant shift in species distributions, particularly that of macroinvertebrates, which could in turn affect the important bird populations that the estuary supports. The River Adur is designated as a salmonid fishery for both sea trout and brown trout. If flows are reduced in the eastern branch there may be a significant aquatic impact. Proposed abstraction rates could represent up to 37% of flows, therefore impacts during dry winters are a possibility. The abstraction would result in a reduction in flows in the eastern branch of the Adur all year round. The flows in this section of the Adur currently support 'Good' ecological status (in terms of the Water Framework Directive). Consideration would need to be given to whether a reduction in flows could affect WFD status and whether this would constitute a deterioration. Connected impacts on ecology will be part of this consideration. There are no statutory landscape designations at the proposed site, but the scale of the reservoir (which would be at a maximum height of around 12m above existing ground levels) would be significant, and would be likely to result in landscape and visual impacts.	This option has been screened in the strategic HRA as not likely to have a significant effect on European sites, and therefore an Appropriate Assessment is not required. Mitigation for changes to salinity downstream of the scheme could be incorporated within the abstraction licence. This may include specifying flow or tidal conditions under which the abstraction can take place in order to avoid any adverse impacts occurring. It is likely that any potential adverse effects can be mitigated to ensure that there are no significant effects on any designated sites. The mitigation required for this possible impact is uncertain, but may need to be applied through licence conditions, as described above. It is likely that this would need to be supported by detailed modelling of the scheme to analyse the likely implications of the abstraction on flows and fish movement. If this option is pursued, further studies (e.g. hydrological modelling) of the river and the effect of the abstraction may be required in order to determine the effect on flows and ensure compliance with the WFD. Mitigation would most likely be in the form of specific abstraction licence conditions to be agreed with the Environment Agency. Use of grassed embankment slopes, screen planting and grading of reservoir into existing landforms, as appropriate. It is assumed that the pipeline will be mostly buried and that reinstatement will take place following its installation. The selected routing of the pipeline along existing roads will reduce the temporal scale of impacts on landscape, as following reinstatement impacts should be reversed. Further measures include minimising working corridors and avoiding mature trees and other important landscape features wherever possible.

Option	Key environmental risks	Mitigation measures available
N6a-20 New surface storage reservoir	The reservoir footprint is large and will result in the permanent loss of 3ha of ancient woodland (Ides Copse). Intake pipeline will result in the loss of some BAP grazing marsh habitat. There are potential operational impacts on the River Arun SSSI. Concerns relate to the changes in flows and levels associated with the abstraction, which could impact on habitats, water quality and consequently the species (including the dragonflies for which the SSSI is notified). The changes in flows (particularly spate flows) may be of concern for salmon and trout migration past Pallingham Weir. The scheme could also result in a reduction in dissolved oxygen levels in the tidal Arun downstream of Pallingham, which could increase risks to fish populations. RBMP notes that the W Rother waterbody is failing on fish status. The exact reasons for failure are not known, but will need to be investigated with the Environment Agency to determine whether the scheme would result in a deterioration under WFD. The abstraction would result in a reduction in flows in the W Rother and Upper Arun. The RBMP notes that flows in this section of the W Rother do not currently support 'Good' ecological status. Consideration would need to be given to whether a further reduction in flows could affect WFD status (deterioration) or prevent Good status from being reached. Connected impacts on ecology will be part of this consideration. Reservoir is sited in the South Downs National Park. The embanked reservoir would be at a maximum height of around 15m above existing ground levels (although some use will be made of sloping topography at the site). The reservoir will be partially visible from footpaths and possibly from Fittleworth. The relatively recent construction of another bankside storage reservoir nearby (and cumulative impacts) may be a material consideration for this scheme.	The woodland would need to be replanted at a ratio of up to 5:1 (15ha). Encroachment of the pipeline routes into local designations or HPIBs would be avoided wherever possible. Where impacts are unavoidable habitat replacement measures or compensation will be developed. The intake pipeline could be directionally drilled beneath the grazing marsh habitat in order to avoid impacts on this area. Other mitigation measures would include appropriate timing of the works, and pollution risks could be managed by good practice. Further work required will include undertaking habitat and protected species surveys of the reservoir site and pipeline route and working corridor in order to inform the development of detailed mitigation measures. This scheme has been screened in the strategic HRA as potentially requiring an Appropriate Assessment as the operational impacts of the scheme are relatively uncertain. Impacts on the Arun SSSI could only be mitigated by opting for a lower abstraction rate (10Mld rather than 20Mld). This would be a necessity to make the scheme acceptable. Maintenance of appropriate MRFs at Pallingham Weir would probably reduce effects, but this is not certain and further investigation will be required. If fish status is linked to poor fish passage at Pallingham Weir, consider installation of a fish pass as a mitigation/compensation measure for the scheme. If this option is pursued, further studies (e.g. hydrological modelling) of the river and the effect of the abstraction may be required in order to determine the effect on flows and ensure compliance with the WFD. A project level WFD assessment would be required for this option. Mitigation for any effects may include restrictions on the licence to specify times when abstraction would have to cease. These would need to be discussed with the Environment Agency as part of the option planning stage, but effects cannot be discounted at this stage. Careful design and extensive landscaping (including screening if required) will be required if the scheme is to gain approval. Early consultation with the South Downs National Park Authority would be required to determine the likely acceptability (in principle) of this scheme. Impacts of the pipeline routes would also need to be considered as part of the landscape mitigation package. Key issues would be to avoid sensitive habitats and significant features such as trees and hedges.

Table 9.6 Summary of feasible options which may potentially present high environmental risk from SEA – Eastern Area

Option	Key environmental risks	Mitigation measures available
HD4 5Ml/d Desalination	The proposed site of the desalination plant lies outside the boundary of any statutory designations, but is close to them. There is therefore the potential for construction noise disturbance to the SPA and impacts on SPA/SAC habitats e.g. from dust, traffic etc. Operational noise may also be a concern for the SPA. The 14km pipeline connection to the WSR skirts the boundary of some of the designated sites but otherwise follows local roads. Noise is likely to be the key issue, and pollution control when crossing minor watercourses (particularly near designated sites). The raw water intake may result in the loss of river flora and fauna due to entrainment and impingement. The brine discharge from the plant could adversely affect marine habitats and species around the outfall and in the plume area. The impact of the abstraction on flows in the estuary and potential impacts on migratory fish will need to be determined. However given the tidal dominance of the estuary system impacts are likely to be small. Otherwise freshwater fisheries are unlikely to be affected, provided best practice is also used during pipeline construction. The impact of the brine discharge on coastal fisheries and shell fisheries will also need to be considered.	The strategic HRA screened this option and concluded that an Appropriate Assessment of this option may be required The SPA supports both breeding and wintering birds and therefore construction timings may be very limited to avoid impacts. Good construction practice should manage potential dust/air quality/water pollution issues. Assume directional drilling under watercourses. Operational noise could be mitigated through engineering design. The timing of the abstraction during tidal cycles will determine the degree of impact on the tidal River Rother, and manage the effects. Marine ecological surveys would be required, and plume dispersion modelling would determine the scale of impact and any required mitigation. The timing of the abstraction during tidal cycles will determine the degree of impact on the tidal River Rother, and manage the effects. Modelling of the effect on estuarine flows and levels may be required. Marine ecological and fisheries surveys would be required, and plume dispersion modelling would determine the scale of impact and any required mitigation.
H1 Reservoir enlargement	Darwell Reservoir and the surrounding area is a locally designated SNCI. There is also a SSSI woodland to the south. There will be changes to 37ha of SNCI habitats (reduction in heathland, ancient & wet woodland and increase in open water), and losses of 1.9ha from the SSSI woodland to the south. Protected species are present within the enlarged footprint of the reservoir and are also dependent on the habitats that currently occupy this area. These species would be displaced and/or lost to the raising of the reservoir. Impacts on the ecology of the reservoir will result from an increase in water depth and impacts from inundation of a larger area of surrounding land which have not previously been flooded. It is likely that this option will favour the growth of the invasive <i>Crassula helmsii</i> over native macrophyte species. Macroinvertebrates will be temporarily displaced and some may be lost while the macrophyte beds re-establish. The potential change in macrophyte composition may also alter the current range of macroinvertebrate species. Certain fish species will be temporarily displaced and some may be lost while the macrophyte beds re-establish. This option could create the ideal conditions for the growth of problem algal blooms, due to an increase in the area of shallow water, combined with good light penetration and increased temperature. This could also adversely affect fish species in the reservoir.	At this stage it is uncertain whether losses from the SSSI could be mitigated to an acceptable level to allow Natural England to support this option. Habitat translocation or creation of compensatory habitats (if this is feasible/possible) would be required to compensate for losses from designated sites. There would still be an adverse impact on the sites, this would reduce into the future assuming that the proposed mitigation/compensation measures are effective. Detailed surveys would be required in advance of developing a full mitigation programme. This is likely to involve the relocation of species where possible, and/or the creation of new habitats suitable for these species. The availability of suitable mitigation is uncertain at this stage. A slower rate of water level raising would allow some terrestrial species to be gradually displaced from the area. In terms of the aquatic impacts, slow filling of the reservoir would allow more time for shift in the macrophyte beds and may help to reduce the likelihood of <i>C. helmsii</i> establishing preferentially. A slow water level increase would help mitigate some of the short-medium term impacts associated with macrophytes. Mitigation is unlikely to be available for the effects of shallower water depths resulting in algal blooms (with consequent fish impacts).

Option	Key environmental risks	Mitigation measures available
	Darwell has a car park and enhanced walking access around the reservoir. Exclusive fishing rights are held by Cranbrook Fishing Club. Footpath users will be impacted as the higher water level will cut the path in three places. In addition, the site may need to be closed for periods. Fishing will also be disrupted for a period. It is not clear yet how the fishery business will be affected (fish mortality, access, fish breeding, growth and productivity etc). There are possible secondary impacts of algal blooms on the enjoyment of the reservoir and the fishery. Impacts on surface water quality are a potential issue, both for the reservoir and the river downstream. Increases in temperature and increased potential for algal blooms could result in consequent impacts on quality parameters downstream. Two WFD mitigation measures for Darwell listed in the RBMP and currently not in place are: Ensure that the thermal regime in waters downstream of the impounding works is consistent with good status conditions. Ensure that good status of dissolved oxygen levels is being achieved downstream of the impounding works Temperature increases and increased risk of algal blooms could potentially compromise the ability to implement these mitigation measures. The scheme is located within the High Weald AONB. Landscape and visual quality is considered to be high and sensitive to change. This option is likely to have a significant impact on the landscape associated with loss of woodland within the AONB designation (part of which is also SSSI), impacts on recreational users from changes to visual environment.	Footpath closure notices will be needed from the council and an alternative route identified. Negotiated agreement and compensation will need to be undertaken for fishery business. There are other alternative fishing sites in the area available to anglers. Mitigation for increased risk of algal blooms may not be available. There may therefore be a long term reduction in amenity value (intermittent, temporary impacts). Further investigation and water quality modelling may be required to ascertain impacts and risks. A WFD assessment of this option would probably be required. Use of grassed embankment slopes, screen planting and grading of reservoir into existing landforms, as appropriate. Careful design and extensive landscaping will be required if the scheme is to gain approval. Early consultation with the AONB board would be required to determine the likely acceptability (in principle) of this scheme. Impacts of the pipeline routes would also need to be considered as part of the landscape mitigation package. Key issues would be to avoid sensitive habitats and significant features such as trees and hedges.
M5a3000 Reservoir raising	The raised water levels could potentially result in losses of ancient woodland and deciduous woodland (BAP habitats) from the edge of the reservoir. Potential for protected species to be affected by the construction (access and/or embankment works), or displaced due to habitat loss due to the reservoir raising. There are potential aquatic environmental impacts associated with the displacement of macrophytes and the potential growth of invasive species, due to the physical raising of the scheme. Impacts on the Bewl Water SNCI designation. Impacts on the amenity value of the reservoir during construction, including angling, boating etc. In operation, possible impacts on the Sussex Border Long Distance Walking Path at the western edge of the reservoir. Raising will narrow gaps between private land and the water's edge. Could reduce access or enjoyment for visitors. The scheme is located within the High Weald AONB. Landscape and visual quality is therefore considered to be high and sensitive to change. This option would have impacts on the landscape associated with loss of woodland within the AONB designation. The raising of the embankment and draw-off tower would also have an impact. Impacts on recreational users from changes to visual environment during construction are likely to be high.	Compensatory habitat would need to be provided for the loss of ancient woodland. Raising would need to be supported by a comprehensive survey programme for flora and fauna and development of an appropriate package of mitigation as required. Slow raising of the reservoir levels could help to accommodate a slow shift in the distribution of aquatic macrophytes and reduce the risk of invasive species dominating. Construction traffic would need to be managed, as would construction activities themselves. Some disruption would be unavoidable. The raising would require the purchase of additional land and/or renegotiation with adjacent landowners to ensure that access could be maintained. Footpaths would require permanent relocation if they are inundated. No long term impacts are anticipated. Use of grassed embankment slopes, screen planting and grading of reservoir into existing landforms, as appropriate. Careful design and extensive landscaping will be required if the scheme is to gain approval. Early consultation with the AONB board would be required to determine the likely acceptability (in principle) of this scheme. Impacts of the pipeline routes would also need to be considered as part of the landscape mitigation package. Key issues would be to avoid sensitive habitats and significant features such as trees and hedges.

Option	Key environmental risks	Mitigation measures available
MD1 10M/d Desalination	The proposed site of the desalination plant lies outside the boundary of any statutory designations, but is close to them. There is therefore some potential for construction noise disturbance to the SPA and impacts on SPA/SAC habitats e.g. from dust, traffic etc. Operational noise may also be a concern for the SPA. The pipeline connection to the WSR skirts the boundary of some of the designated sites but otherwise follows local roads. Noise is likely to be the key issue. The raw water intake may result in the loss of estuarine flora and fauna due to entrainment and impingement. The brine discharge from the plant could adversely affect marine habitats and species immediately around the outfall and in the plume area. The location and potential impacts of the brine outfall plume on the nearby designated estuary sites will also need to be fully assessed. The impact of the abstraction on flows in the estuary and potential impacts on migratory fish will need to be determined. However given the tidal dominance of the estuary system impacts are likely to be small. Otherwise freshwater fisheries are unlikely to be affected. The impact of the brine discharge on coastal fisheries and shell fisheries will also need to be considered. There is likely to be noise and traffic disturbance to local communities during the construction phase. The pipeline route is also likely to cause some disruption, however the route is short and this should be slight. Impacts of the brine discharge on the local fishing industry and perceptions of risk will also be an important consideration. The water discharged from the desalination plant is likely to have an impact of the quality of the water in the receiving water (eg: higher salt concentrations and temperatures and chemicals used in pre-treatment and cleaning). The Medway and Thames Lower estuarine waterbodies are both currently at Moderate Potential. The impact of the discharge on the waterbody status will need to be assessed. Very high carbon costs associated with both construction and operation, associated with the large energy demands of desalination/ reverse osmosis.	The strategic HRA screened this option and concluded that an Appropriate Assessment of this option may be required. Good construction practice should manage potential dust/air quality/water pollution issues. Operational noise could be mitigated through engineering design. The timing of the abstraction during tidal cycles will determine the degree of impact on the estuary, and manage the effects. Further information is required on the outfall location and modelling of the brine discharge. Marine ecological surveys would be required, and plume dispersion modelling would determine the scale of impact and any required mitigation. The timing of the abstraction during tidal cycles will determine the degree of impact and manage the effects. Modelling of the effect on estuarine flows and levels may be required. Marine ecological and fisheries surveys would be required, and plume dispersion modelling would determine the scale of impact and any required mitigation. Further mitigation for the brine discharge may include the addition of diffusers to the outfall pipe to aid dispersal, or the extension/relocation of the pipe to avoid sensitive areas. Traffic management measures and good construction practices. Early consultation with local fishermen will be required to understand concerns and address them accordingly Plume dispersion modelling would determine the scale of impact and any required mitigation.

9.63. In the Western Area, the “SEA preferences” scenario provides a different solution to the least cost plan. The three key strategic options required in AMP6 to enable the full implementation of the River Itchen Sustainability Reduction are all selected. The key differences are:

- No selection of a desalination scheme on the mainland – neither the HTD4 (least cost plan) nor the HTD2 (alternative) schemes are selected, as these both have a potentially high environmental risk;
- The IWL6 groundwater rehabilitation scheme is brought forward by a couple of years, although is still required in the same AMP7 period;
- The HR9c non-potable water reuse at industrial site scheme is required in 2023/24;
- Leakage, mains renewal and water efficiency options are all utilised in full over the planning period in the HS and IW WRZs; and
- The IWL7 utilise full capacity of existing cross-Solent main option is no longer selected, primarily because there is insufficient surplus available in Hampshire to provide enhanced support to the Isle of Wight; and
- The IWR1 5M/d water reuse scheme is therefore required to provide additional supplies on the island in 2030/31.

- 9.64. As a result of the above, under the SEA preferences scenario there is an unsolvable deficit in IW from 2034 onwards at PDO - increasing in magnitude from only 0.1MI/d in 2034 to over 6MI/d in 2039. This scenario demonstrates the lack of options available in the Western Area. So whilst the NPV cost presented in Table 9.1 is actually cheaper than the least cost plan, this is misleading because there is effectively a scheme missing from the SEA preferences solution.

Table 9.7 Least cost and SEA preferences – Western Area

Scenario	Least cost plan	SEA preferences
Total (£k) (NPV discounted over 80 years)	115,376	106,751
Difference from least cost (£k)	n/a	-8,625
Options	Year	Year
Leakage reduction in HK to 0.2MI/d below current level	2038	2038
HK-WE-B Water Efficiency school audits	2033	2033
HK-WE-C Water Efficiency SME audits	2035	2035
HK-WE-D Water Efficiency large business audits	2033	2033
T-HSO-3a 10MI/d Bulk supply (with 30MI/d infrastructure) from PWCo	2017	2017
HSC-a Catchment management	2024	2024
HSC-b Catchment management	2024	2024
HTD4 25MI/d Desalination	2025	
JO3a - MDO groundwater scheme for river augmentation	2018	2018
Phase 1 Mains renewal in Hampshire South		2034
Phase 2 Mains renewal in Hampshire South		2034
Leakage reduction in HS to 1MI/d below current level	2020	2021
Further leakage reduction in HS to 2MI/d below current level	2020	2021
Further leakage reduction in HS to 3MI/d below current level	2024	2026
Further leakage reduction in HS to 4MI/d below current level	2039	2030
Further leakage reduction in HS to 5MI/d below current level		2034
HS-WE-A Water Efficiency home audits	2035	2036
HS-WE-B Water Efficiency school audits	2020	2036
HS-WE-C Water Efficiency SME audits	2020	2036
HS-WE-D Water Efficiency large business audits	2020	2036
HR9c Non-potable water reuse at industrial site		2023
HSL3+HST2 Conjunctive use	2018	2018
IWL6 Groundwater rehabilitation	2024	2022
Mains renewal on Isle of Wight		2034
Leakage reduction on IoW to 0.4MI/d below current level	2015	2015
Further leakage reduction on IoW to 0.8MI/d below current level	2021	2020
Further leakage reduction on IoW to 1.2MI/d below current level	2024	2026
Further leakage reduction on IoW to 1.6MI/d below current level	2029	2029
Further leakage reduction on IoW to 2MI/d below current level		2034
IWL7 Utilise full capacity of existing cross-Solent main	2032	
IW-WE-A Water Efficiency home audits	2020	2036
IW-WE-B Water Efficiency school audits	2020	2036
IW-WE-C Water Efficiency SME audits	2020	2036
IW-WE-D Water Efficiency large business audits	2020	2036
IWR1 5MI/d Water reuse		2030

- 9.65. In the Central Area, the SEA preference scenario, which excludes any options considered as potentially “high risk” from an environmental perspective, is identical to the company’s preferred scenario in this area, at identical cost.

Table 9.8 Least cost and SEA preferences – Central Area

Scenario	Least cost plan	SEA Preferences
Total (£k) (NPV discounted over 80 years)	68,607	68,607
Difference from least cost (£k)	n/a	0
Options	Year	Year
SNC-a Catchment management	2024	2024
SNC-b Catchment management	2024	2024
N10 Well field reconfiguration	2019	2019
Leakage reduction in SN to 1MI/d below current level	2023	2023
Further leakage reduction in SN to 2MI/d below current level	2026	2026
N8a Winter transfer stage 1	2018	2018
SN-WE-A Water Efficiency home audits	2022	2022
SN-WE-B Water Efficiency school audits	2022	2022
SN-WE-C Water Efficiency SME audits	2022	2022
SN-WE-D Water Efficiency large business audits	2022	2022
NR2c 10MI/d Water reuse	2027	2027
N20 Asset enhancement schemes	2021	2021
SBC-a Conventional & catchment management	2016	2016
SBC-b Catchment management	2024	2024
SBC-c Catchment management	2024	2024
SBC-d Conventional & catchment management	2030	2030
SBC-e Catchment management	2024	2024
SBC-f Catchment management	2024	2024
Leakage reduction in SB to 0.75MI/d below current level	2025	2025
Further leakage reduction in SB to 1.5MI/d below current level	2026	2026
SB-WE-A Water Efficiency home audits	2035	2035
SB-WE-B Water Efficiency school audits	2035	2035
SB-WE-C Water Efficiency SME audits	2015	2015
SB-WE-D Water Efficiency large business audits	2022	2022
SWC-a Conventional & catchment management	2016	2016
SWC-b Conventional & catchment management	2016	2016
SWC-c Catchment management	2024	2024
Leakage reduction in SW to 0.5MI/d below current level	2016	2016
Further leakage reduction in SW to 1MI/d below current level	2022	2022
SW-WE-A Water Efficiency home audits	2022	2022
SW-WE-B Water Efficiency school audits	2022	2022
SW-WE-C Water Efficiency SME audits	2022	2022
SW-WE-D Water Efficiency large business audits	2022	2022

- 9.66. In the Eastern Area, the SEA preference scenario, which excludes any options considered as potentially “high risk” from an environmental perspective, is identical to the company’s preferred scenario in this area, at identical cost.

Table 9.9 Least cost and SEA preferences – Eastern Area

Scenario	Least cost plan	SEA Preferences
Total (£k) (NPV discounted over 80 years)	56,468	56,468
Difference from least cost (£k)	n/a	0
Options	Year	Year
MT10 Asset enhancement schemes	2017	2017
KMC-a Catchment management	2024	2024
KMC-b Conventional & catchment management	2019	2019
M21 Licence trading scheme	2034	2034
M10 River Medway licence Variation	2015	2015
M9 groundwater source licence variation	2016	2016
KM-WE-B Water Efficiency school audits	2015	2015
KM-WE-C Water Efficiency SME audits	2015	2015
KM-WE-D Water Efficiency large business audits	2015	2015
MR3 20MI/d Water reuse	2022	2022
KTC-a Catchment management	2024	2024
KT-WE-B Water Efficiency school audits	2035	2035
KT-WE-C Water Efficiency SME audits	2035	2035
KT-WE-D Water Efficiency large business audits	2035	2035
Leakage reduction in SH to 0.4MI/d below current level	2019	2019
SH-WE-B Water Efficiency school audits	2015	2015
SH-WE-C Water Efficiency SME audits	2017	2017
SH-WE-D Water Efficiency large business audits	2015	2015

Resilience – comparison of plans using stochastic and conventional DO approaches

9.67. As explained in detail in sections 3 and 5, the company has prepared its plan using a new approach to assessing deployable outputs (DO), which are introduced from 2019/20 onwards. The company believes that a move towards a stochastic approach to estimating DO is the best way to ensure a resilient supply system in the future, and the only way to ensure that target Levels of Service can be met. Therefore, it is instructive to compare the least cost plan, which is based on a stochastic approach to the estimation of DOs, against the solution for the supply demand balance based on deployable outputs calculated using the conventional historic time series method. The most critical aspect is which options are selected over the next ten to fifteen years, and whether the options in the plan differ from those that are selected under an approach based on the more conventional historic time series record.

9.68. In the **Western Area**, the result of using a historic DO approach is as follows:

- The strategic resource options selected over the first 10 years of the planning period are all required in the historic DO approach scenario in the same year (the exception being the IWL6 groundwater rehabilitation scheme which is delayed by 3 years);
- No selection of a desalination scheme on the mainland – neither the HTD4 (least cost plan) nor the HTD2 schemes are selected;
- The IWL7 utilise full capacity of existing cross-Solent main option is no longer selected, primarily because there is insufficient surplus available in Hampshire to provide enhanced support to the Isle of Wight;
- The IWR1 5Ml/d water reuse scheme is therefore required to provide additional supplies on the island in 2029/30;
- The HR9c non-potable water reuse at an industrial site scheme is required in 2033/34; and
- Delays the required start date of the mix of demand management options until later in the planning period.

The HR9c and IWR1 water reuse schemes therefore effectively replace the HTD4 desalination scheme and IWL7 increased transfer along the cross-Solent main, because there is a smaller deficit to solve than in the baseline least cost plan. However, as noted previously, the historic DO approach does not provide the resilience that the stochastically-based DO approach does, and hence has in the past meant that Southern Water has been unable to meet its target Levels of Service in terms of drought measures (restrictions on demand and drought permits/orders) across all its Supply Areas.

Table 9.10 Least cost and resilience scenario – Western Area

Scenario	Least cost plan	Historic DO approach
Total (£k) (NPV discounted over 80 years)	115,376	91,105
Difference from least cost (£k)	n/a	-24,272
Options	Year	Year
Leakage reduction in HK to 0.2Ml/d below current level	2038	2038
HK-WE-B Water Efficiency school audits	2033	2033
HK-WE-C Water Efficiency SME audits	2035	2035
HK-WE-D Water Efficiency large business audits	2033	2033
T-HSO-3a 10Ml/d Bulk supply (with 30Ml/d infrastructure) from PWCo	2017	2017
HSC-a Catchment management	2024	2024
HSC-b Catchment management	2024	2024
HTD4 25Ml/d Desalination	2025	
JO3a - MDO groundwater scheme for river augmentation	2018	2018
Leakage reduction in HS to 1Ml/d below current level	2020	2026
Further leakage reduction in HS to 2Ml/d below current level	2020	2026
Further leakage reduction in HS to 3Ml/d below current level	2024	2030
Further leakage reduction in HS to 4Ml/d below current level	2039	2037
HS-WE-A Water Efficiency home audits	2035	2035
HS-WE-B Water Efficiency school audits	2020	2035
HS-WE-C Water Efficiency SME audits	2020	2028
HS-WE-D Water Efficiency large business audits	2020	2036
HR9c Non-potable water reuse at industrial site		2033
HSL3+HST2 Conjunctive use	2018	2018
IWL6 Groundwater rehabilitation	2024	2027

Scenario	Least cost plan	Historic DO approach
Leakage reduction on IoW to 0.4MI/d below current level	2015	2015
Further leakage reduction on IoW to 0.8MI/d below current level	2021	2019
Further leakage reduction on IoW to 1.2MI/d below current level	2024	2024
Further leakage reduction on IoW to 1.6MI/d below current level	2029	2030
IWL7 Utilise full capacity of existing cross-Solent main	2032	
IW-WE-A Water Efficiency home audits	2020	2035
IW-WE-B Water Efficiency school audits	2020	2021
IW-WE-C Water Efficiency SME audits	2020	2022
IW-WE-D Water Efficiency large business audits	2020	2036
IWR1 5MI/d Water reuse		2029

9.69. For the **Central Area**, the result of using a historic DO approach is that the strategic resource options selected over the first 10 to 15 years of the planning period are essentially the same, except for the following:

- The N20 asset enhancement scheme is required 3 years earlier, in AMP6;
- The NR2c 10MI/d water reuse scheme is no longer required;
- The introduction of the CA1 8MI/d annual average ASR scheme in 2033/34; and
- The introduction of the N8b winter transfer stage 2 is introduced in 2037

Table 9.11 Least cost and resilience scenario – Central Area

Scenario	Least cost plan	Historic DO approach
Total (£k) (NPV discounted over 80 years)	68,607	61,922
Difference from least cost (£k)	n/a	-6,685
Options	Year	Year
SNC-a Catchment management	2024	2027
SNC-b Catchment management	2024	2024
N10 Well field reconfiguration	2019	2022
Leakage reduction in SN to 1MI/d below current level	2023	2030
Further leakage reduction in SN to 2MI/d below current level	2026	2030
Further leakage reduction in SN to 3MI/d below current level		2035
N8a Winter transfer stage 1	2018	2018
SN-WE-A Water Efficiency home audits	2022	2035
SN-WE-B Water Efficiency school audits	2022	2035
SN-WE-C Water Efficiency SME audits	2022	2036
SN-WE-D Water Efficiency large business audits	2022	2036
NR2c 10MI/d Water reuse	2027	
N20 Asset enhancement schemes	2021	2018
SBC-a Conventional & catchment management	2016	2016
SBC-b Catchment management	2024	2024
SBC-c Catchment management	2024	2024
SBC-d Conventional & catchment management	2030	2024
SBC-e Catchment management	2024	2024
SBC-f Catchment management	2024	2024
Leakage reduction in SB to 0.75MI/d below current level	2025	
Further leakage reduction in SB to 1.5MI/d below current level	2026	
N8b Winter transfer stage 2		2037
SB-WE-A Water Efficiency home audits	2035	2035
SB-WE-B Water Efficiency school audits	2035	2035
SB-WE-C Water Efficiency SME audits	2015	2019
SB-WE-D Water Efficiency large business audits	2022	2036
CA1 8MI/d Annual average Aquifer Storage and Recovery		2033
SWC-a Conventional & catchment management	2016	2016
SWC-b Conventional & catchment management	2016	2016
SWC-c Catchment management	2024	2024
Leakage reduction in SW to 0.5MI/d below current level	2016	2016
Further leakage reduction in SW to 1MI/d below current level	2022	2027
Further leakage reduction in SW to 1.5MI/d below current level		2032
SW-WE-A Water Efficiency home audits	2022	2035
SW-WE-B Water Efficiency school audits	2022	2035
SW-WE-C Water Efficiency SME audits	2022	2036
SW-WE-D Water Efficiency large business audits	2022	2036

9.70. For the **Eastern Area**, the key strategic options needed in AMP6 are the same as in the least cost plan. The key differences are:

- The MR3 20MI/d water reuse scheme is not required. It is replaced by the M21 licence trading scheme in 2023/24;
- The KMC-b conventional and catchment management scheme (to recover DO from a source at risk from nitrate pollution in 2016) is delayed until 2027/28 – i.e. the source would effectively be shut down for over 10 years;
- The TT3 reverse existing KM-KT main scheme is selected in 2035/36, so that the KT WRZ ends up providing support to KM at the end of the planning period. This is the only scenario in which this option is actually selected; and
- There is increased leakage reduction activity required – 4MI/d in KM, 1.5MI/d in KT and 2MI/d in SH – although the majority of this is not needed until the 2030's.

Table 9.12 Least cost and resilience scenario – Eastern Area

Scenario	Least cost plan	Historic DO approach
Total (£k) (NPV discounted over 80 years)	56,468	38,066
Difference from least cost (£k)	n/a	-18,403
Options	Year	Year
MT10 Asset enhancement schemes	2017	2017
KMC-a Catchment management	2024	2024
KMC-b Conventional & catchment management	2019	2027
M21 Licence trading scheme	2034	2023
Leakage reduction in KM to 1MI/d below current level		2031
Further leakage reduction in KM to 2MI/d below current level		2031
Further leakage reduction in KM to 3MI/d below current level		2035
Further leakage reduction in KM to 4MI/d below current level		2038
M10 River Medway licence Variation	2015	2015
M9 groundwater source licence variation	2016	2016
TT3 Reverse existing KM-KT main		2035
KM-WE-A Water Efficiency home audits		2035
KM-WE-B Water Efficiency school audits	2015	2035
KM-WE-C Water Efficiency SME audits	2015	2036
KM-WE-D Water Efficiency large business audits	2015	2036
MR3 20MI/d Water reuse	2022	
KTC-a Catchment management	2024	2024
Leakage reduction in KT to 0.75MI/d below current level		2036
Further leakage reduction in KT to 1.5MI/d below current level		2036
KT-WE-A Water Efficiency home audits		2035
KT-WE-B Water Efficiency school audits	2035	2035
KT-WE-C Water Efficiency SME audits	2035	2035
KT-WE-D Water Efficiency large business audits	2035	2036
Leakage reduction in SH to 0.4MI/d below current level	2019	2016
Further leakage reduction in SH to 0.8MI/d below current level		2026
Further leakage reduction in SH to 1.2MI/d below current level		2035
Further leakage reduction in SH to 1.6MI/d below current level		2039
SH-WE-A Water Efficiency home audits		2035
SH-WE-B Water Efficiency school audits	2015	2035
SH-WE-C Water Efficiency SME audits	2017	2035
SH-WE-D Water Efficiency large business audits	2015	2036

9.71. **In summary**, the key strategic options generally continue to get selected under both planning approaches, but some cost savings are achieved by taking a less resilient approach and delaying the implementation of these strategic schemes. Given that the purpose of this WRMP is to ensure secure supplies over a 25 year planning period, the company considers that the plan based on stochastic DOs provides the most appropriate solution.

Testing the least cost plan

9.72. A variety of scenarios were examined to test the robustness of the least cost plan to various assumptions used in the supply demand balance and options inputs to the economic least cost model:

- Regional modelling outcomes;
- Uncertainties over future possible Sustainability Reductions;
- Climate change uncertainty and minimising carbon emissions;
- Cost uncertainty; and
- Demand uncertainty.

Each of these steps is discussed in turn below and the outcome of outputs from this process are then used to assist in progressing from the **least cost plan** into the company's **preferred plan**, which is then summarised in Section 10.

Regional outcomes – WRSE and company only

9.73. A WRSE scenario was explored, which incorporated the other WRSE-selected strategic schemes, in addition to the bulk supplies included under the preferred plan. This included the schemes outlined below, which were forced to be selected in Southern Water's investment model in the years they were required from the WRSE group modelling exercise, whose results were available prior to the publication of the Draft WRMP. The rationale was to assess the robustness of the strategy and associated costs of a "full WRSE group solution set" in comparison to the company's preferred solution.

9.74. Western Area – WRSE-selected schemes:

- Leakage reduction of 1.75 MI/d in Hants South and 0.5 MI/d on the Isle of Wight in 2015, primarily to address initial deficits in the planning period when there tends to be few other options available to meet a deficit;
- Three enhanced water efficiency schemes in Hants South and one on the Isle of Wight in 2015, primarily to address initial deficits in the planning period when there tends to be few other options available to meet a deficit;
- Utilise the full licence of 136 MI/d at WSW near Southampton (and enabling pipeline) in 2015;
- Two groundwater source rehabilitation schemes on the Isle of Wight in 2016;
- A 10 MI/d bulk supply from Portsmouth Water in 2017;
- Utilise the full 20 MI/d capacity of the existing cross-Solent main in 2017;
- Triplicate the cross-Solent main in 2020; and
- Pro-actively operate the JO3a groundwater scheme for river augmentation in 2020.

9.75. Central Area – WRSE-selected schemes:

- Leakage reduction from 2015, primarily to address initial deficits in the planning period when there tends to be few other options available to meet a deficit; and
- Water efficiency schemes from 2015, primarily to address initial deficits in the planning period when there tends to be few other options available to meet a deficit.

9.76. Eastern Area – WRSE-selected schemes:

- Implementation of the River Medway Scheme licence variation in 2015;
- Water re-use scheme near Maidstone in 2018;
- WSW in East Kent (at 10 MI/d) in 2019;
- Leakage reduction of 0.5 MI/d in Kent Medway in 2025;
- Leakage reduction of 0.5 MI/d in Sussex Hastings in 2026;
- Leakage reduction of a further 0.5 MI/d in Kent Medway in 2030;

- Raising Bewl Water by 3m in 2031; and
- River Stour desalination in 2035.

9.77. It should be noted that many of the schemes were selected in the company's own preferred model, although the timing of implementation tended to differ. This is highlighted in the tables below for each Supply Area.

9.78. In contrast to the full WRSE group solution, a second scenario was also investigated to show the typical least cost strategy without regional bulk supplies (both existing and proposed). This company only solution excludes any new bulk supplies (both imports and exports), and terminates any existing bulk imports/exports at the point where the contract ends if this occurs during the planning period (i.e. the assumption being that the bulk supplies are not renewed).

Western Area

9.79. For the Western Area, the results show that the WRSE group full solution set is significantly more expensive than the company's own preferred plan. This is primarily due to the WRSE group solution aiming to solve for 2015 with an associated assumption that the Itchen Sustainability Reduction is also implemented in full in 2015. As has been explained previously, the company would only be able to fully implement the Itchen Sustainability Reduction where new supplies and demand management measures are available to ensure that customers are not put at risk of supply shortfalls. With the timings of the WRSE solution, there is an unsolvable deficit in Hampshire South in 2018 of 9MI/d at MDO, which would prevent the Itchen Sustainability Reduction from being implemented in full in that year.

9.80. Under the company only scenario, the cost of the plan is also greater than the least cost plan, because this scenario would not have a bulk supply from Portsmouth Water. In its place, the HR9c non-potable water reuse scheme at an industrial site would be required. The plan can also not be solved – there is a deficit in 2017 on the Isle of Wight of 7MI/d at PDO.

Table 9.13 Regional testing scenarios for the Western Area

Scenario	Least cost plan	Company only	WRSE full solution
Total (£k) (NPV discounted over 80 years)	115,376	144,618	179,983
Difference from least cost (£k)	n/a	29,241	64,607
		Unsolvable deficit	Unsolvable deficit
Options	Year	Year	Year
Leakage reduction in HK to 0.2MI/d below current level	2038	2038	2038
HK-WE-B Water Efficiency school audits	2033	2033	2033
HK-WE-C Water Efficiency SME audits	2035	2035	2035
HK-WE-D Water Efficiency large business audits	2033	2033	2033
T-HSO-3a 10MI/d Bulk supply (with 30MI/d infrastructure) from PWCo	2017		2017
HSC-a Catchment management	2024	2024	2024
HSC-b Catchment management	2024	2024	2024
HTD2 20MI/d Coastal desalination			2030
HTD4 25MI/d Desalination	2025	2024	
JO3a - MDO groundwater scheme for river augmentation	2018	2018	2020
Leakage reduction in HS to 1MI/d below current level	2020	2017	2015
Further leakage reduction in HS to 2MI/d below current level	2020	2021	2019
Further leakage reduction in HS to 3MI/d below current level	2024	2034	
Further leakage reduction in HS to 4MI/d below current level	2039	2038	
HS-WE-A Water Efficiency home audits	2035	2015	2015
HS-WE-B Water Efficiency school audits	2020	2015	2015
HS-WE-C Water Efficiency SME audits	2020	2015	2015
HS-WE-D Water Efficiency large business audits	2020	2015	2015
HR9c Non-potable water reuse at industrial site		2019	2019
HSL3+HST2 Conjunctive use	2018	2018	2015
IWL6 Groundwater rehabilitation	2024	2017	2016
Leakage reduction on IoW to 0.4MI/d below current level	2015	2015	2015
Further leakage reduction on IoW to 0.8MI/d below current level	2021	2021	2019
Further leakage reduction on IoW to 1.2MI/d below current level	2024	2026	
Further leakage reduction on IoW to 1.6MI/d below current level	2029	2029	
IWL7 Utilise full capacity of existing cross-Solent main	2032	2032	2017
IWT3 Triplicate cross-Solent main			2020
IW-WE-A Water Efficiency home audits	2020	2015	2015
IW-WE-B Water Efficiency school audits	2020	2015	2015
IW-WE-C Water Efficiency SME audits	2020	2015	2015
IW-WE-D Water Efficiency large business audits	2020	2015	2015

Central Area

- 9.81. There are only limited options required under the WRSE group regional model. The solution is therefore very similar to the least cost plan.
- 9.82. Under a “company only” scenario, which terminates any existing supplies if the contract ends during the planning period, Southern Water incurs a net loss of resources. Although the 5.4 MI/d export to South East Water is terminated in 2021/22 under this scenario, the Portsmouth Water import of 15 MI/d to Sussex North is also terminated (in 2024/25). Hence the solution is more expensive because additional supplies are needed. The key strategic change is that the larger 20MI/d variant of the NR2a water reuse scheme is required (rather than the 10MI/d variant selected in the least cost plan). The other schemes required are all broadly similar, although the timings of when these are needed varies across the planning period.

Table 9.14 Regional testing scenarios for the Central Area

Scenario	Least cost	Company Only	WRSE full solution
Total (£k) (NPV discounted over 80 years)	68,607	80,008	68,985
Difference from least cost (£k)	n/a	11,401	378
Options	Year	Year	Year
SNC-a Catchment management	2024	2032	2024
SNC-b Catchment management	2024	2024	2024
N10 Well field reconfiguration	2019	2019	2019
Leakage reduction in SN to 1MI/d below current level	2023	2038	2015
Further leakage reduction in SN to 2MI/d below current level	2026	2039	2019
N8a Winter transfer stage 1	2018	2034	2020
SN-WE-A Water Efficiency home audits	2022	2035	2015
SN-WE-B Water Efficiency school audits	2022	2015	2023
SN-WE-C Water Efficiency SME audits	2022	2015	2023
SN-WE-D Water Efficiency large business audits	2022	2015	2023
NR2a 20MI/d Water reuse		2023	
NR2c 10MI/d Water reuse	2027		2028
N20 Asset enhancement schemes	2021	2018	2018
SBC-a Conventional & catchment management	2016	2016	2016
SBC-b Catchment management	2024	2024	2024
SBC-c Catchment management	2024	2024	2024
SBC-d Conventional & catchment management	2030	2030	2031
SBC-e Catchment management	2024	2024	2024
SBC-f Catchment management	2024	2024	2024
Leakage reduction in SB to 0.75MI/d below current level	2025	2039	2027
Further leakage reduction in SB to 1.5MI/d below current level	2026		
SB-WE-A Water Efficiency home audits	2035	2035	
SB-WE-B Water Efficiency school audits	2035	2025	2022
SB-WE-C Water Efficiency SME audits	2015	2035	2022
SB-WE-D Water Efficiency large business audits	2022	2024	2022
SWC-a Conventional & catchment management	2016	2016	2016
SWC-b Conventional & catchment management	2016	2016	2016
SWC-c Catchment management	2024	2028	2024
Leakage reduction in SW to 0.5MI/d below current level	2016	2037	2021
Further leakage reduction in SW to 1MI/d below current level	2022	2037	2024
SW-WE-A Water Efficiency home audits	2022	2035	2023
SW-WE-B Water Efficiency school audits	2022	2015	2023
SW-WE-C Water Efficiency SME audits	2022	2035	2023
SW-WE-D Water Efficiency large business audits	2022	2016	2023

Eastern Area

- 9.83. The WRSE solution is significantly more expensive than the least cost plan, and also triggers some additional schemes that were not selected as part of Southern Water’s plan, such as the M5a reservoir raising scheme, the T5 10MI/d Water reuse, and the TD2 20MI/d Desalination. The WRSE group regional model was trying to solve the supply demand balance as soon as possible, and so some schemes selected may have been selected simply because they were available rather than being optimal schemes.
- 9.84. The “company only” plan is less costly than the least cost “regional” plan, which is as expected given the large amounts of bulk supplies the company provides to South East Water from this

Supply Area (as described previously in Table 5.10 and para.9.16). The key strategic points to note are as follows:

- The key schemes needed in AMP6 are all still required at the same time under the company only scenario, with the exception of water efficiency schemes, which are delayed until later in the planning period; and
- The MR3 20MI/d water reuse scheme is not needed, and is effectively replaced by the M21 licence trading scheme in 2022/23.

Table 9.15 Regional testing scenarios for the Eastern Area

Scenario	Least cost	Company Only	WRSE full solution
Total (£k) (NPV discounted over 80 years)	56,468	28,603	125,167
Difference from least cost (£k)	n/a	-27,865	68,699
Options	Year	Year	Year
MT10 Asset enhancement schemes	2017	2017	2017
KMC-a Catchment management	2024	2024	2024
KMC-b Conventional & catchment management	2019	2019	
M21 Licence trading scheme	2034	2022	
Leakage reduction in KM to 1MI/d below current level		2019	2025
Further leakage reduction in KM to 2MI/d below current level		2019	
M10 River Medway licence Variation	2015	2015	2015
M9 groundwater source licence variation	2016	2016	2016
M5a3000 Reservoir raising			2031
KM-WE-A Water Efficiency home audits		2035	
KM-WE-B Water Efficiency school audits	2015	2020	2015
KM-WE-C Water Efficiency SME audits	2015	2035	2035
KM-WE-D Water Efficiency large business audits	2015	2036	2015
MR3 20MI/d Water reuse	2022		2018
KTC-a Catchment management	2024	2024	2024
TD2 20MI/d Desalination			2035
Leakage reduction in KT to 0.75MI/d below current level		2039	
KT-WE-A Water Efficiency home audits		2035	
KT-WE-B Water Efficiency school audits	2035	2035	2035
KT-WE-C Water Efficiency SME audits	2035	2035	2035
KT-WE-D Water Efficiency large business audits	2035	2036	2035
T5 10MI/d Water reuse			2019
Leakage reduction in SH to 0.4MI/d below current level	2019	2016	2026
Further leakage reduction in SH to 0.8MI/d below current level			2026
SH-WE-A Water Efficiency home audits		2035	
SH-WE-B Water Efficiency school audits	2015	2016	2035
SH-WE-C Water Efficiency SME audits	2017	2035	2035
SH-WE-D Water Efficiency large business audits	2015	2016	2015

Uncertainties in future possible Sustainability Reductions

- 9.85. Another important scenario that was considered in all three Supply Areas was to test the assumptions regarding sustainability reductions, for which there was a great deal of uncertainty, as discussed in detail in Section 5.
- 9.86. Two sustainability reduction scenarios were developed:
- The **pragmatic inclusion of “unknowns” sustainability reduction scenario** – in order to provide a measure of pragmatic estimate of the potential impacts that ongoing investigations could have on supplies for Southern Water if they were later deemed to require a sustainability change. This scenario assumes that 10% of the DO of the sources potentially affected by the “unknowns” will be lost as part of the sustainability changes. It should be noted that this is a planning scenario only; it is an attempt to try to provide some indication of the potential magnitude of the impacts that sustainability changes could have on supplies to enable the company to investigate what other options this might trigger.
 - The **reasonable worst case sustainability reduction scenario** – in order to investigate the possible upper scale of effect of sustainability reductions on the

company's supplies, a second scenario which uses as its basis a paper the EA produced for the Water Resources in the South East group, which provides estimates of how much flow might need to be improved to support good ecological status under the Water Framework Directive (WFD) for each WRZ in the South East, using an approach based on Environmental Flow Indicators (EFI). The values used for our "reasonable worst case" scenario were based on improving the flow in all water bodies to achieve the EFI. If sustainability reductions at these levels were to occur, a fundamental change to the company's supplies would be required, although some WRZs would be more significantly affected than others. Nevertheless, the scenario was deemed to be instructive to inform the debate of what could happen under the worst case, especially given the scale of sustainability reductions the company faces on the River Itchen in its Hampshire South WRZ.

Western Area

- 9.87. Under both the sustainability reduction scenarios, some options are triggered in Hampshire Andover and/or Hampshire Kingsclere – both WRZs for which there was little or no deficit in the baseline case. The schemes triggered in these WRZs are primarily leakage reduction and water efficiency options although the reasonable worst case also requires the HAT1 HS-HA transfer scheme (which requires supplies to be available in HS) and the HKL1 asset enhancement and new pipeline scheme in order to be able to meet the deficit under this scenario.
- 9.88. Under the "pragmatic inclusion of unknown sustainability reductions" scenario, the solution set in the HS and IW WRZs is similar to the preferred plan, particularly in the first ten years. After 2025, the key changes are:
- The HDT4 25MI/d desalination scheme is replaced by the slightly smaller HDT2 20MI/d coastal desalination scheme in 2025/26 and the HR9c non-potable water reuse at industrial site scheme in 2034/35 (which can provide 10MI/d); and
 - The IWL7 utilise full capacity of existing cross-Solent main scheme is required 5 years earlier in 2027/28.
- 9.89. Under the "reasonable worst case sustainability reduction" scenario, the key points to note in the HS and IW WRZs are:
- The strategic options selected in the first 10 years are the same as those in the least cost plan;
 - The HR9c non-potable water reuse at an industrial site scheme is required in 2022/23;
 - The HTD4 25MI/d desalination scheme can thus be delayed by two years to 2027/28;
 - However, a large desalination scheme is also required on the Isle of Wight – the IWD1 20MI/d coastal desalination option in 2027/28; and
 - Consequently, the IWL7 utilise full capacity of existing cross-Solent main option is not required, as the large desalination scheme provides for the island's water resource needs, reducing the requirement for supplies from the mainland.

The cost over the planning period (in NPV terms) of meeting the deficits for this scenario are significantly higher than for the least cost plan.

Table 9.16 Sustainability reduction uncertainties – Western Area

Scenario	Least cost plan	Pragmatic inclusion of unknown SRs	Reasonable worst case SRs
Total (£k) (NPV discounted over 80 years)	115,376	122,806	207,102
Difference from least cost (£k)	n/a	7,430	91,726
Options	Year	Year	Year
Leakage reduction in HA to 0.4MI/d below current level		2033	2037
Further leakage reduction in HA to 0.8MI/d below current level		2037	2037
HAT1 HS-HA transfer			2027
HA-WE-A Water Efficiency home audits		2035	2035
HA-WE-B Water Efficiency school audits		2035	2035
HA-WE-C Water Efficiency SME audits		2029	2036
HA-WE-D Water Efficiency large business audits		2036	2036
HKL1 Asset enhancement schemes and new pipeline			2027
Leakage reduction in HK to 0.2MI/d below current level	2038	2038	2027
Further leakage reduction in HK to 0.4MI/d below current level			2030
Further leakage reduction in HK to 0.6MI/d below current level			2034
HK-WE-A Water Efficiency home audits			2035
HK-WE-B Water Efficiency school audits	2033	2033	2035
HK-WE-C Water Efficiency SME audits	2035	2035	2035
HK-WE-D Water Efficiency large business audits	2033	2033	2035
T-HSO-3a 10MI/d Bulk supply (with 30MI/d infrastructure) from PWCo	2017	2017	2017
HSC-a Catchment management	2024	2024	2024
HSC-b Catchment management	2024	2024	2024
HTD2 20MI/d Coastal desalination		2025	
HTD4 25MI/d Desalination	2025		2027
JO3a - MDO groundwater scheme for river augmentation	2018	2018	2018
Leakage reduction in HS to 1MI/d below current level	2020	2020	2017
Further leakage reduction in HS to 2MI/d below current level	2020	2020	2020
Further leakage reduction in HS to 3MI/d below current level	2024	2024	2035
Further leakage reduction in HS to 4MI/d below current level	2039		2039
HS-WE-A Water Efficiency home audits	2035	2035	2035
HS-WE-B Water Efficiency school audits	2020	2020	2015
HS-WE-C Water Efficiency SME audits	2020	2020	2015
HS-WE-D Water Efficiency large business audits	2020	2020	2015
HR9c Non-potable water reuse at industrial site		2034	2022
HSL3+HST2 Conjunctive use	2018	2018	2018
IWD1 20MI/d Coastal desalination			2027
IWL6 Groundwater rehabilitation	2024	2024	2017
Leakage reduction on IoW to 0.4MI/d below current level	2015	2015	2015
Further leakage reduction on IoW to 0.8MI/d below current level	2021	2021	2019
Further leakage reduction on IoW to 1.2MI/d below current level	2024	2024	2036
Further leakage reduction on IoW to 1.6MI/d below current level	2029		2039
IWL7 Utilise full capacity of existing cross-Solent main	2032	2027	
IW-WE-A Water Efficiency home audits	2020	2035	2035
IW-WE-B Water Efficiency school audits	2020	2020	2015
IW-WE-C Water Efficiency SME audits	2020	2020	2036
IW-WE-D Water Efficiency large business audits	2020	2020	2015

9.90. In addition, further scenarios were assessed to help understand the potential impact of future sustainability reductions in Hampshire. It was assumed that these could remove 45, 65 and 105 MI/d from the Hampshire South WRZ SDB in both MDO and PDO planning scenarios, over and above the River Itchen Sustainability Reduction volumes.

9.91. The results of the least cost economic runs are presented below. Note that these runs assume, given the scale of additional sustainability reduction, that a “new” option providing an additional 5MI/d from Portsmouth Water to the Hampshire South WRZ, (contingent on a corresponding 5MI/d reduction of the existing baseline supply of 15MI/d from Portsmouth to Sussex North) is included. The other inclusion is that it has been assumed that the company would promote its enhanced water efficiency options into AMP6 as water efficiency is popular with customers.

Table 9.17 Impact of further sustainability reductions in Hampshire South WRZ

Scenario	Preferred plan (see end of Section 9)	Future SR of 45MI/d in HS (Itchen SR in 2025)	Future SR of 65MI/d in HS (Itchen SR in 2025)	Future SR of 105MI/d in HS (Itchen SR in 2025)
Total (£k) (NPV discounted over 80 years)	102,714	191,763	242,079	290,946
Difference from preferred plan (£k)	n/a	89,049	139,364	188,232
Options	Year	Year	Year	Year
Leakage reduction in HK to 0.2MI/d below current level	2038	2038	2038	2038
HK-WE-B Water Efficiency school audits	2033	2033	2033	2033
HK-WE-C Water Efficiency SME audits	2035	2035	2035	2035
HK-WE-D Water Efficiency large business audits	2033	2033	2033	2033
T-HSO-3a 10MI/d Bulk supply (with 30MI/d infrastructure) from PWCo	2017	2017	2017	2017
T-HSO-3d increase bulk supply from PWCo to HS by 5MI/d (contingent on PWCo-SN bulk supply reduction)	2024	2020	2020	2020
HSC-a Catchment management	2024	2024	2024	2024
HSC-b Catchment management	2024	2024	2024	2024
HTD2 20MI/d Coastal desalination	2028		2025	2025
HTD4 60MI/d Desalination		2025	2025	2025
JO3a - MDO Groundwater augmentation	2018			2025
JO3a - PDO Groundwater augmentation		2025	2023	
Phase 1 Mains renewal in Hampshire South				2025
Phase 2 Mains renewal in Hampshire South				2025
Leakage reduction in HS to 1MI/d below current level	2022	2018	2026	2018
Further leakage reduction in HS to 2MI/d below current level	2022	2019	2026	2019
Further leakage reduction in HS to 3MI/d below current level	2026	2025	2030	2024
Further leakage reduction in HS to 4MI/d below current level	2038	2029	2034	2029
Further leakage reduction in HS to 5MI/d below current level		2038	2038	2034
HS-WE-A Water Efficiency home audits	2019	2019	2019	2019
HS-WE-B Water Efficiency school audits	2019	2019	2015	2019
HS-WE-C Water Efficiency SME audits	2019	2019	2015	2019
HS-WE-D Water Efficiency large business audits	2019	2019	2015	2019
HR9c Non-potable water reuse at industrial site		2034	2033	2025
HSL3+HST2 Conjunctive use	2018			
IWD1 15MI/d Coastal desalination				2025
IWL6 Groundwater rehabilitation	2027	2028	2028	
Leakage reduction on IoW to 0.4MI/d below current level	2015	2015	2015	2015
Further leakage reduction on IoW to 0.8MI/d below current level	2022	2019	2019	2019
Further leakage reduction on IoW to 1.2MI/d below current level	2025	2025	2025	
Further leakage reduction on IoW to 1.6MI/d below current level	2029	2029	2029	
IWL7 Utilise full capacity of existing cross-Solent main	2032			
IW-WE-A Water Efficiency home audits	2019	2019	2019	2019
IW-WE-B Water Efficiency school audits	2019	2019	2019	2019
IW-WE-C Water Efficiency SME audits	2019	2019	2019	2019
IW-WE-D Water Efficiency large business audits	2019	2019	2018	2016
IWR1 5MI/d Water reuse		2031	2030	

9.92. In all of the above scenarios, it was assumed that all Sustainability Reductions would be implemented in 2025/26 to allow sufficient time for the large scale alternative water resource schemes to be developed.

9.93. Note that, under the most extreme scenario (further reduction of 105MI/d), there is an unsolvable deficit of up to 50MI/d. Under such a scenario, a larger desalination plant would need to be considered within the feasible options list, so that the total desalination capacity within Hampshire South WRZ was in the order of 130MI/d (this could be from a number of desalination options at different locations or a single desalination scheme).

Central Area

9.94. The pragmatic inclusion of “unknown” sustainability reductions results in a broadly similar strategy for the first ten years of the planning period. However, from 2025 the key changes to note are:

- The replacement of the NR2c 10MI/d water reuse scheme for the larger NR2a 20MI/d variant, in the same year (2027/28);

- The introduction of the N8b winter transfer stage 2 scheme in 2025/26, followed by the N8c winter transfer stage 3 in 2027/28.

9.95. There is the potential for some exceptionally large sustainability reductions in the Central Area, as demonstrated under the “reasonable worst case” scenario. These affect the supply demand balance from 2027 onwards. The scale of potential sustainability reductions triggers the selection of a large number of other schemes at a very large cost over the planning period in NPV terms. This includes:

- The replacement of the NR2c 10MI/d water reuse scheme for the larger NR2a 20MI/d variant, in the same year (2027/28);
- The introduction of both the N8b winter transfer stage 2 scheme and the N8c winter transfer stage 3 in 2027/28, followed by the N8d winter transfer stage 4 in 2031/32
- The N5 new reservoir in 2027/28;
- The CA1 4M/d MDO aquifer storage and recovery scheme in 2027/28;
- The CD3 10MI/d tidal river desalination scheme in 2027/28;
- The C3 new reservoir on the coast in 2027/28;
- The large CD1 40 MI/d coastal desalination scheme in 2027/28; and
- The N1 irrigation licences management scheme in 2034/35;

Table 9.18 Sustainability reduction uncertainties – Central Area

Scenario	Least cost plan	Pragmatic inclusion of unknown SRs	Reasonable worst case SRs
Total (£k) (NPV discounted over 80 years)	68,607	85,146	351,327
Difference from least cost (£k)	n/a	16,539	282,721
Options	Year	Year	Year
N1 Irrigation licences management			2034
SNC-a Catchment management	2024	2024	2024
SNC-b Catchment management	2024	2024	2024
N10 Well field reconfiguration	2019	2019	2019
Mains renewal in Sussex North			2038
Leakage reduction in SN to 1MI/d below current level	2023	2023	2023
Further leakage reduction in SN to 2MI/d below current level	2026		2023
Further leakage reduction in SN to 3MI/d below current level			2028
Further leakage reduction in SN to 4MI/d below current level			2032
Further leakage reduction in SN to 5MI/d below current level			2037
N5 New reservoir			2027
N8a Winter transfer stage 1	2018	2018	2018
SN-WE-A Water Efficiency home audits	2022	2022	2035
SN-WE-B Water Efficiency school audits	2022	2022	2035
SN-WE-C Water Efficiency SME audits	2022	2020	2036
SN-WE-D Water Efficiency large business audits	2022	2022	2036
NR2a 20MI/d Water reuse		2027	2027
NR2c 10MI/d Water reuse	2027		
N20 Asset enhancement schemes	2021	2018	2018
SBC-a Conventional & catchment management	2016	2016	2016
SBC-b Catchment management	2024	2024	2024
SBC-c Catchment management	2024	2024	2024
SBC-d Conventional & catchment management	2030	2034	2027
SBC-e Catchment management	2024	2024	2024
SBC-f Catchment management	2024	2024	2024
CD1 40MI/d Coastal desalination			2027
Leakage reduction in SB to 0.75MI/d below current level	2025	2039	2025
Further leakage reduction in SB to 1.5MI/d below current level	2026	2039	2026
Further leakage reduction in SB to 2.25MI/d below current level			2037
N8b Winter transfer stage 2		2025	2027
N8c Winter transfer stage 3		2027	2027
N8c Winter transfer stage 3 (transfer component)		2027	2027
N8d Winter transfer stage 4			2031
SB-WE-A Water Efficiency home audits	2035	2035	2035
SB-WE-B Water Efficiency school audits	2035	2035	2035
SB-WE-C Water Efficiency SME audits	2015	2030	2036
SB-WE-D Water Efficiency large business audits	2022	2035	2036
CA1 4MI/d MDO Aquifer Storage and Recovery			2027
SWC-a Conventional & catchment management	2016	2016	2016
SWC-b Conventional & catchment management	2016	2016	2016

SWC-c Catchment management	2024	2024	2024
CD3 10MI/d Tidal river desalination			2027
Mains renewal in Sussex Worthing			2039
Leakage reduction in SW to 0.5MI/d below current level	2016	2016	2016
Further leakage reduction in SW to 1MI/d below current level	2022	2022	2020
Further leakage reduction in SW to 1.5MI/d below current level			2024
Further leakage reduction in SW to 2MI/d below current level			2030
Further leakage reduction in SW to 2.5MI/d below current level			2036
C3 New reservoir on coast			2027
SW-WE-A Water Efficiency home audits	2022	2022	2035
SW-WE-B Water Efficiency school audits	2022	2022	2035
SW-WE-C Water Efficiency SME audits	2022	2022	2035
SW-WE-D Water Efficiency large business audits	2022	2022	2036

Eastern Area

- 9.96. The pragmatic inclusion of “unknown” sustainability reductions results in a broadly similar strategy for the first five to ten years of the planning period, which is as expected given that the unknowns are not assumed to affect the supply demand balance until 2027. However, the key changes to note are:
- The M21 licence trading scheme is brought forward earlier to 2023/24 (rather than 2034 in the least cost plan);
 - The implementation of the MR3 20MI/d water reuse scheme can then be delayed by 5 years until 2027/28; and
 - There is additional leakage reduction required over the planning period (3MI/d in KM and 2.25MI/d in KT).
- 9.97. There is the potential for some exceptionally large sustainability reductions in the Eastern Area, affecting in particular the two Kent WRZs, as demonstrated under the “reasonable worst case” scenario. These affect the supply demand balance from 2027 onwards.
- 9.98. The strategy for the first ten years of the planning period is similar to the preferred plan. However, after this, the scale of potential sustainability reductions triggers the selection of a large number of other schemes at a very large cost over the planning period in NPV terms. This includes:
- The M21 licence trading scheme is brought forward earlier to 2023/24 (rather than 2034 in the least cost plan);
 - The implementation of the MR3 20MI/d water reuse scheme can then be delayed by 5 years until 2027/28;
 - The MD2 20MI/d desalination scheme in 2027/28;
 - The TD2 20MI/d desalination scheme in 2027/28;
 - The TT1a utilise full capacity of existing KM-KT transfer in 2027/28;
 - The HR1a water reuse scheme in 2027/28; and
 - There is additional leakage reduction required over the planning period (5MI/d in KM, 2.25MI/d in KT, and 1.2MI/d in SH).

Table 9.19 Sustainability reduction uncertainties – Eastern Area

Scenario	Least cost plan	Pragmatic inclusion of unknown SRs	Reasonable worst case SRs
Total (£k) (NPV discounted over 80 years)	56,468	64,124	191,335
Difference from least cost (£k)	n/a	7,656	134,866
Options	Year	Year	Year
MT10 Asset enhancement schemes	2017	2017	2017
KMC-a Catchment management	2024	2024	2024
KMC-b Conventional & catchment management	2019	2019	2019
MD2 20Ml/d Desalination			2027
M21 Licence trading scheme	2034	2023	2023
Leakage reduction in KM to 1Ml/d below current level		2019	2019
Further leakage reduction in KM to 2Ml/d below current level		2019	2019
Further leakage reduction in KM to 3Ml/d below current level		2026	2024
Further leakage reduction in KM to 4Ml/d below current level			2035
Further leakage reduction in KM to 5Ml/d below current level			2039
M10 River Medway licence Variation	2015	2015	2015
M9 groundwater source licence variation	2016	2016	2016
KM-WE-A Water Efficiency home audits		2035	2035
KM-WE-B Water Efficiency school audits	2015	2022	2035
KM-WE-C Water Efficiency SME audits	2015	2022	2036
KM-WE-D Water Efficiency large business audits	2015	2018	2036
MR3 20Ml/d Water reuse	2022	2027	2027
KTC-a Catchment management	2024	2024	2024
TD2 20Ml/d Desalination			2027
Leakage reduction in KT to 0.75Ml/d below current level		2034	2034
Further leakage reduction in KT to 1.5Ml/d below current level		2035	2034
Further leakage reduction in KT to 2.25Ml/d below current level		2039	2038
TT1a utilise full capacity of existing KM-KT transfer			2027
KT-WE-A Water Efficiency home audits		2035	2035
KT-WE-B Water Efficiency school audits	2035	2035	2035
KT-WE-C Water Efficiency SME audits	2035	2036	2035
KT-WE-D Water Efficiency large business audits	2035	2036	2036
Leakage reduction in SH to 0.4Ml/d below current level	2019	2016	2016
Further leakage reduction in SH to 0.8Ml/d below current level		2020	2019
Further leakage reduction in SH to 1.2Ml/d below current level			2026
SH-WE-A Water Efficiency home audits		2035	2022
SH-WE-B Water Efficiency school audits	2015	2022	2022
SH-WE-C Water Efficiency SME audits	2017	2022	2019
SH-WE-D Water Efficiency large business audits	2015	2022	2018
HR1a Water reuse			2027

Climate change uncertainty and minimising carbon emissions

- 9.99. One potential component of the supply demand balance which could lessen any deficits is the uncertainty surrounding potential climate change impacts. A “no climate change” scenario was therefore developed to test the least cost plan.
- 9.100. A “minimum carbon emissions” scenario was also developed to investigate what the solution would be if the investment model optimised on the basis of minimum carbon footprint (assuming that all options use the same mix of energy sources). This has a general tendency to introduce demand management measures over resource developments.
- 9.101. It should be noted, however, that new resource developments can utilise renewable energy sources, which would consequently reduce their carbon impact. For instance, the company currently obtains 13 per cent of its electricity requirements from its 13 Combined Heat and Power (CHP) units, which provide renewable energy. The company target is to produce 20 per cent of electricity from renewable sources by 2020. In addition to electricity use, the embedded carbon costs associated with maintaining and renewing existing assets (in preference to developing new resources) would also need to be considered. However, no allowance for this is included in the least cost investment model, as the objective of investment modelling is primarily to identify the new schemes required over the next 25 years.

Western Area

9.102. Under the “no climate change” sensitivity run, the cost over the planning period (in NPV terms) is significantly less than the least cost plan. The key changes to note are:

- The strategic resource options selected over the first 10 years of the planning period are all required in the no climate change scenario in the same year (the exception being the IWL6 groundwater rehabilitation scheme which is delayed by 6 years to 2030/31). This confirms that the Western Area strategy is entirely driven by the magnitude of the River Itchen Sustainability Reductions;
- The HDT4 25MI/d desalination scheme is replaced by the HR9c non-potable water reuse at an industrial site scheme, and this is now not required until later in the planning period in 2031/32; and
- The need for the IWL7 utilise full capacity of existing cross-Solent main is delayed by 2 years to 2034/35.

Because these changes only occur in the last 15 years of the planning period, these scenario results do not represent an issue because the strategy for options needed in the later stages of the period would anyway be reviewed in future WRMPs in AMP6 and AMP7.

9.103. Under the “minimum carbon” scenario, the model utilises leakage reduction, mains renewal and water efficiency schemes, including in the HA and HK WRZs. In terms of strategic changes:

- The three AMP6 strategic schemes are still chosen;
- A desalination scheme is still required, but the model chooses the smallest one available in HS – the HTD2 10MI/d coastal desalination option;
- The small IWR1 2.5MI/d water reuse option is chosen for the Isle of Wight, and the IWL7 utilise full capacity of existing cross-Solent main scheme is not required. Additional leakage reduction and mains renewal are required in order to support the island’s demands for water;
- The HR9c non-potable water reuse at an industrial site scheme is required in 2029/30

This scenario is significantly more expensive than the least cost plan.

Table 9.20 Climate uncertainty scenarios – Western Area

Scenario	Least cost plan	Minimum carbon emissions	No climate change
Total (£k) (NPV discounted over 80 years)	115,376	201,886	76,153
Difference from least cost (£k)	n/a	86,510	-39,223
Options	Year	Year	Year
HAC-a Conventional & catchment management		2016	
Leakage reduction in HA to 0.4MI/d below current level		2015	
Further leakage reduction in HA to 0.8MI/d below current level		2019	
Further leakage reduction in HA to 1.2MI/d below current level		2024	
Further leakage reduction in HA to 1.6MI/d below current level		2029	
Further leakage reduction in HA to 2MI/d below current level		2034	
HA-WE-A Water Efficiency home audits		2036	
HA-WE-B Water Efficiency school audits		2036	
HA-WE-C Water Efficiency SME audits		2036	
HA-WE-D Water Efficiency large business audits		2036	
Leakage reduction in HK to 0.2MI/d below current level	2038	2015	2039
Further leakage reduction in HK to 0.4MI/d below current level		2019	
Further leakage reduction in HK to 0.6MI/d below current level		2024	
Further leakage reduction in HK to 0.8MI/d below current level		2029	
Further leakage reduction in HK to 1MI/d below current level		2034	
HK-WE-A Water Efficiency home audits		2036	
HK-WE-B Water Efficiency school audits	2033	2036	2035
HK-WE-C Water Efficiency SME audits	2035	2036	2034
HK-WE-D Water Efficiency large business audits	2033	2036	2034
T-HSO-3a 10MI/d Bulk supply (with 30MI/d infrastructure) from PWCo	2017	2017	2017
HSC-a Catchment management	2024	2024	2024
HSC-b Catchment management	2024	2024	2024
HTD2 10MI/d Coastal desalination		2025	
HTD4 25MI/d Desalination	2025		

Scenario	Least cost plan	Minimum carbon emissions	No climate change
JO3a - MDO groundwater scheme for river augmentation	2018	2018	2018
Phase 1 Mains renewal in Hampshire South		2019	
Phase 2 Mains renewal in Hampshire South		2019	
Leakage reduction in HS to 1MI/d below current level	2020	2015	2026
Further leakage reduction in HS to 2MI/d below current level	2020	2019	2026
Further leakage reduction in HS to 3MI/d below current level	2024	2024	2030
Further leakage reduction in HS to 4MI/d below current level	2039	2029	2039
Further leakage reduction in HS to 5MI/d below current level		2034	
HS-WE-A Water Efficiency home audits	2035	2036	2035
HS-WE-B Water Efficiency school audits	2020	2036	2026
HS-WE-C Water Efficiency SME audits	2020	2036	2035
HS-WE-D Water Efficiency large business audits	2020	2036	2036
HR9c Non-potable water reuse at industrial site		2029	2031
HSL3+HST2 Conjunctive use	2018	2018	2018
IWL6 Groundwater rehabilitation	2024		2030
Mains renewal on Isle of Wight		2019	
Leakage reduction on IoW to 0.4MI/d below current level	2015	2015	2015
Further leakage reduction on IoW to 0.8MI/d below current level	2021	2019	2022
Further leakage reduction on IoW to 1.2MI/d below current level	2024	2024	2025
Further leakage reduction on IoW to 1.6MI/d below current level	2029	2029	2029
Further leakage reduction on IoW to 2MI/d below current level		2034	
IWL7 Utilise full capacity of existing cross-Solent main	2032		2034
IW-WE-A Water Efficiency home audits	2020	2036	2035
IW-WE-B Water Efficiency school audits	2020	2036	2026
IW-WE-C Water Efficiency SME audits	2020	2036	2026
IW-WE-D Water Efficiency large business audits	2020	2036	2026
IWR1 2.5MI/d Water reuse		2023	

Central Area

- 9.104. Under the “no climate change” sensitivity run, the cost over the planning period (in NPV terms) is less than the preferred plan. However, the important thing to note is that the general strategy remains the same. The schemes which need to be developed over the first 10 years of the planning period remain the same (albeit that some schemes are slightly delayed). The key difference is that the NR2c 10MI/d water reuse scheme is replaced by the smaller NR2d 5MI/d variant, which is also delayed by 5 years to 2033/34. The implementation of the demand management measures also tends to be delayed. These sensitivity results do not represent an issue because the strategy for options needed in the last 15 years of the planning period would anyway be reviewed in future WRMPs in AMP6 and AMP7.
- 9.105. Under the “minimum carbon” scenario, the model utilises all leakage reduction options, as well as mains renewal and water efficiency schemes. In terms of strategic changes:
- The two AMP6 strategic schemes are still chosen;
 - The NR2c 10MI/d water reuse scheme is no longer selected;
 - The N20 asset enhancement scheme is brought forward by 3 years into AMP6;
 - The N8b winter transfer stage 2 scheme is introduced in 2018/19; and
 - The CA1 4MI/d MDO aquifer storage and recovery scheme is introduced in 2029/30.

This scenario is significantly more expensive than the least cost plan.

Table 9.21 Climate uncertainty scenarios – Central Area

Scenario	Least cost plan	Minimum Carbon Emissions	No climate change
Total (£k) (NPV discounted over 80 years)	68,607	110,118	63,351
Difference from least cost (£k)	n/a	41,511	-5,255
Options	Year	Year	Year
SNC-a Catchment management	2024	2024	2024
SNC-b Catchment management	2024	2024	2024
N10 Well field reconfiguration	2019	2019	2019
Mains renewal in Sussex North		2019	
Leakage reduction in SN to 1Ml/d below current level	2023	2015	2024
Further leakage reduction in SN to 2Ml/d below current level	2026	2019	2025
Further leakage reduction in SN to 3Ml/d below current level		2024	
Further leakage reduction in SN to 4Ml/d below current level		2029	
Further leakage reduction in SN to 5Ml/d below current level		2034	
N8a Winter transfer stage 1	2018	2018	2019
SN-WE-A Water Efficiency home audits	2022	2036	2028
SN-WE-B Water Efficiency school audits	2022	2036	2028
SN-WE-C Water Efficiency SME audits	2022	2036	2028
SN-WE-D Water Efficiency large business audits	2022	2036	2028
NR2c 10Ml/d Water reuse	2027		
NR2d 5Ml/d Water reuse			2033
N20 Asset enhancement schemes	2021	2018	2022
SBC-a Conventional & catchment management	2016	2016	2016
SBC-b Catchment management	2024	2024	2024
SBC-c Catchment management	2024	2024	2024
SBC-d Conventional & catchment management	2030	2016	2027
SBC-e Catchment management	2024	2024	2024
SBC-f Catchment management	2024	2024	2024
Phase 1 Mains renewal in Sussex Brighton		2019	
Phase 2 Mains renewal in Sussex Brighton		2019	
Leakage reduction in SB to 0.75Ml/d below current level	2025	2015	2036
Further leakage reduction in SB to 1.5Ml/d below current level	2026	2019	2036
Further leakage reduction in SB to 2.25Ml/d below current level		2024	
Further leakage reduction in SB to 3Ml/d below current level		2029	
Further leakage reduction in SB to 3.75Ml/d below current level		2034	
N8b Winter transfer stage 2		2018	
SB-WE-A Water Efficiency home audits	2035	2036	2035
SB-WE-B Water Efficiency school audits	2035	2036	2035
SB-WE-C Water Efficiency SME audits	2015	2036	2035
SB-WE-D Water Efficiency large business audits	2022	2036	2036
CA1 4Ml/d MDO Aquifer Storage and Recovery		2029	
SWC-a Conventional & catchment management	2016	2016	2016
SWC-b Conventional & catchment management	2016	2016	2016
SWC-c Catchment management	2024	2024	2024
Mains renewal in Sussex Worthing		2034	
Leakage reduction in SW to 0.5Ml/d below current level	2016	2015	2023
Further leakage reduction in SW to 1Ml/d below current level	2022	2015	2024
Further leakage reduction in SW to 1.5Ml/d below current level		2019	2029
Further leakage reduction in SW to 2Ml/d below current level		2024	
Further leakage reduction in SW to 2.5Ml/d below current level		2029	
SW-WE-A Water Efficiency home audits	2022	2036	2028
SW-WE-B Water Efficiency school audits	2022	2036	2028
SW-WE-C Water Efficiency SME audits	2022	2036	2028
SW-WE-D Water Efficiency large business audits	2022	2036	2028

Eastern Area

9.106. Under the “no climate change” sensitivity run, the cost over the planning period (in NPV terms) is less than the preferred plan. Due to the potentially large impact of climate change in the Eastern Area (as discussed in Section 5), a number of schemes are delayed or are no longer required in the event that climate change does not materialise. The key differences are:

- The M21 licence trading scheme is brought forward earlier to 2023/24 (rather than 2034 in the least cost plan);
- The 20Ml/d variant of the MR3 water reuse scheme is not required, the smaller 5Ml/d variant is selected instead, but is not needed until much later, in 2034/35;

- There is additional leakage reduction required over the planning period (4MI/d in KM and 1.2MI/d in SH).

This provides confidence in the overall strategy, and as has been noted elsewhere, the strategy for options required later in the planning period would be reviewed in future WRMPs in AMP6 and AMP7, when there is likely to be greater understanding of the impacts of climate change, for example. The critical timeframe is therefore the next 5 to 10 years.

9.107. Under the “minimum carbon emissions” scenario, the model utilises all leakage reduction options, as well as mains renewal and water efficiency schemes. In terms of strategic changes:

- The three AMP6 strategic schemes are still chosen;
- The M21 licence trading scheme is brought forward earlier to 2023/24 (rather than 2034 in the least cost plan);
- The MR3 20MI/d water reuse scheme is not selected;
- The introduction of the M5a reservoir raising scheme in 2028/29; and
- The introduction of the H8 new surface water abstraction.

This scenario is significantly more expensive than the least cost plan.

Table 9.22 Climate uncertainty scenarios – Eastern Area

Scenario	Least cost plan	Minimise Carbon Emissions	No climate change
Total (£k) (NPV discounted over 80 years)	56,468	94,408	44,621
Difference from least cost (£k)	n/a	37,939	-11,848
Options	Year	Year	Year
MT10 Asset enhancement schemes	2017	2017	2017
KMC-a Catchment management	2024	2024	2024
KMC-b Conventional & catchment management	2019	2016	2019
M21 Licence trading scheme	2034	2023	2023
Phase 1 Mains renewal in Kent Medway		2019	
Phase 2 Mains renewal in Kent Medway		2019	
Leakage reduction in KM to 1MI/d below current level		2015	2026
Further leakage reduction in KM to 2MI/d below current level		2019	2026
Further leakage reduction in KM to 3MI/d below current level		2024	2030
Further leakage reduction in KM to 4MI/d below current level		2029	2038
Further leakage reduction in KM to 5MI/d below current level		2034	
M10 River Medway licence Variation	2015	2015	2015
M9 groundwater source licence variation	2016	2016	2016
M5a3000 Reservoir raising		2028	
KM-WE-A Water Efficiency home audits		2036	2029
KM-WE-B Water Efficiency school audits	2015	2036	2029
KM-WE-C Water Efficiency SME audits	2015	2036	2029
KM-WE-D Water Efficiency large business audits	2015	2036	2029
MR3 20MI/d Water reuse	2022		
MR3 5MI/d Water reuse			2034
KTC-a Catchment management	2024	2024	2024
Leakage reduction in KT to 0.75MI/d below current level		2015	
Further leakage reduction in KT to 1.5MI/d below current level		2019	
Further leakage reduction in KT to 2.25MI/d below current level		2024	
Further leakage reduction in KT to 3MI/d below current level		2029	
Further leakage reduction in KT to 3.75MI/d below current level		2034	
KT-WE-A Water Efficiency home audits		2036	
KT-WE-B Water Efficiency school audits	2035	2036	2035
KT-WE-C Water Efficiency SME audits	2035	2036	
KT-WE-D Water Efficiency large business audits	2035	2036	2035
Leakage reduction in SH to 0.4MI/d below current level	2019	2015	2022
Further leakage reduction in SH to 0.8MI/d below current level		2019	2026
Further leakage reduction in SH to 1.2MI/d below current level		2024	2032
Further leakage reduction in SH to 1.6MI/d below current level		2029	
Further leakage reduction in SH to 2MI/d below current level		2034	
H8 New surface water abstractions		2027	
SH-WE-A Water Efficiency home audits		2036	2029
SH-WE-B Water Efficiency school audits	2015	2036	2029
SH-WE-C Water Efficiency SME audits	2017	2036	2029
SH-WE-D Water Efficiency large business audits	2015	2036	2029

Cost uncertainty

- 9.108. A further set of sensitivity testing was based on the cost uncertainties associated with the feasible options list. A “cost confidence” grade was assigned to each option in the feasible list, in accordance with the EA’s WRP Guidance. Those options with the greatest uncertainty in cost estimates attracted the greatest percentage change in cost in the sensitivity analyses (as discussed in Appendix H11). All costs were inflated under one sensitivity scenario, and all were then deflated under the other scenario, but by differing percentages dependent on the cost confidence grades.
- 9.109. There is also potentially a great deal of uncertainty involved deriving monetary values for environmental and social costs using the EA BAG methodology. This was discussed in detail in Section 8. Given the extensive review of potential environmental impacts inherent in the options appraisal work conducted in AMP4 and described in the previous WRMP (published in 2009), which were reviewed and updated for the current AMP period, the feasible list of options should generally include only those options for which there are not significant environmental and social costs. Nevertheless, as part of the testing of least cost plan against cost sensitivity, the environmental and social costs were also adjusted by the same proportions as other costs as part of the cost increase and cost decrease scenarios.

Western Area

- 9.110. The comparison of the least cost plan to the solutions for the cost uncertainty sensitivity runs is identical throughout the planning period. The impact of this sensitivity analysis suggests a band around the least cost plan over the planning period in NPV terms of $\pm\text{£}11\text{M}$. This provides confidence in the robustness of the preferred plan.

Table 9.23 Cost uncertainty – Western Area

Scenario	Least cost plan	Increased costs	Decreased costs
Total (£k) (NPV discounted over 80 years)	115,376	126,347	104,430
Difference from least cost (£k)	n/a	10,970	-10,946
Options	Year	Year	Year
Leakage reduction in HK to 0.2Ml/d below current level	2038	2038	2038
HK-WE-B Water Efficiency school audits	2033	2033	2033
HK-WE-C Water Efficiency SME audits	2035	2035	2035
HK-WE-D Water Efficiency large business audits	2033	2033	2033
T-HSO-3a 10Ml/d Bulk supply (with 30Ml/d infrastructure) from PWCo	2017	2017	2017
HSC-a Catchment management	2024	2024	2024
HSC-b Catchment management	2024	2024	2024
HTD4 25Ml/d Desalination	2025	2025	2025
JO3a - MDO groundwater scheme for river augmentation	2018	2018	2018
Leakage reduction in HS to 1Ml/d below current level	2020	2020	2020
Further leakage reduction in HS to 2Ml/d below current level	2020	2020	2020
Further leakage reduction in HS to 3Ml/d below current level	2024	2024	2024
Further leakage reduction in HS to 4Ml/d below current level	2039	2039	2039
HS-WE-A Water Efficiency home audits	2035	2035	2035
HS-WE-B Water Efficiency school audits	2020	2020	2020
HS-WE-C Water Efficiency SME audits	2020	2020	2020
HS-WE-D Water Efficiency large business audits	2020	2020	2020
HSL3+HST2 Conjunctive use	2018	2018	2018
IWL6 Groundwater rehabilitation	2024	2024	2024
Leakage reduction on IoW to 0.4Ml/d below current level	2015	2015	2015
Further leakage reduction on IoW to 0.8Ml/d below current level	2021	2021	2021
Further leakage reduction on IoW to 1.2Ml/d below current level	2024	2024	2024
Further leakage reduction on IoW to 1.6Ml/d below current level	2029	2029	2029
IWL7 Utilise full capacity of existing cross-Solent main	2032	2032	2032
IW-WE-A Water Efficiency home audits	2020	2020	2020
IW-WE-B Water Efficiency school audits	2020	2020	2020
IW-WE-C Water Efficiency SME audits	2020	2020	2020
IW-WE-D Water Efficiency large business audits	2020	2020	2020

Central Area

- 9.111. Under both the “cost increase” and “cost decrease” sensitivity runs there is almost no change to the strategy, with the exception of slight timing adjustments in the “cost increase” scenario for the leakage and water efficiency options. The impact of this sensitivity analysis suggests a band around the least cost plan over the planning period in NPV terms of $\pm£4\text{M}$. This provides some confidence in the robustness of the preferred plan.

Table 9.24 Cost uncertainty – Central Area

Scenario	Least cost plan	Increased Costs	Decreased Costs
Total (£k) (NPV discounted over 80 years)	68,607	72,617	64,589
Difference from least cost (£k)	n/a	4,010	-4,018
Options	Year	Year	Year
SNC-a Catchment management	2024	2024	2024
SNC-b Catchment management	2024	2024	2024
N10 Well field reconfiguration	2019	2019	2019
Leakage reduction in SN to 1MI/d below current level	2023	2022	2023
Further leakage reduction in SN to 2MI/d below current level	2026	2024	2026
N8a Winter transfer stage 1	2018	2018	2018
SN-WE-A Water Efficiency home audits	2022	2023	2022
SN-WE-B Water Efficiency school audits	2022	2023	2022
SN-WE-C Water Efficiency SME audits	2022	2023	2022
SN-WE-D Water Efficiency large business audits	2022	2023	2022
NR2c 10MI/d Water reuse	2027	2028	2027
N20 Asset enhancement schemes	2021	2021	2021
SBC-a Conventional & catchment management	2016	2016	2016
SBC-b Catchment management	2024	2024	2024
SBC-c Catchment management	2024	2024	2024
SBC-d Conventional & catchment management	2030	2031	2030
SBC-e Catchment management	2024	2024	2024
SBC-f Catchment management	2024	2024	2024
Leakage reduction in SB to 0.75MI/d below current level	2025	2026	2025
Further leakage reduction in SB to 1.5MI/d below current level	2026	2030	2026
SB-WE-A Water Efficiency home audits	2035		2035
SB-WE-B Water Efficiency school audits	2035	2022	2035
SB-WE-C Water Efficiency SME audits	2015	2015	2015
SB-WE-D Water Efficiency large business audits	2022	2023	2022
SWC-a Conventional & catchment management	2016	2016	2016
SWC-b Conventional & catchment management	2016	2016	2016
SWC-c Catchment management	2024	2024	2024
Leakage reduction in SW to 0.5MI/d below current level	2016	2016	2016
Further leakage reduction in SW to 1MI/d below current level	2022	2024	2022
SW-WE-A Water Efficiency home audits	2022	2023	2022
SW-WE-B Water Efficiency school audits	2022	2023	2022
SW-WE-C Water Efficiency SME audits	2022	2023	2022
SW-WE-D Water Efficiency large business audits	2022	2023	2022

Eastern Area

- 9.112. Under both the “cost increase” and “cost decrease” sensitivity runs there is no change to the strategy. The impact of this sensitivity analysis suggests a band around the preferred plan cost over the planning period in NPV terms of $\pm£4\text{M}$. Overall, the results of this analysis provide confidence in the robustness of the preferred plan.

Table 9.25 Cost uncertainty – Eastern Area

Scenario	Least cost plan	Increased Costs	Decreased Costs
Total (£k) (NPV discounted over 80 years)	56,468	60,429	52,508
Difference from least cost (£k)	n/a	3,960	-3,960
Options	Year	Year	Year
MT10 Asset enhancement schemes	2017	2017	2017
KMC-a Catchment management	2024	2024	2024
KMC-b Conventional & catchment management	2019	2019	2019
M21 Licence trading scheme	2034	2034	2034
M10 River Medway licence Variation	2015	2015	2015
M9 groundwater source licence variation	2016	2016	2016
KM-WE-B Water Efficiency school audits	2015	2015	2015
KM-WE-C Water Efficiency SME audits	2015	2015	2015
KM-WE-D Water Efficiency large business audits	2015	2015	2015
MR3 20Ml/d Water reuse	2022	2022	2022
KTC-a Catchment management	2024	2024	2024
KT-WE-B Water Efficiency school audits	2035	2035	2035
KT-WE-C Water Efficiency SME audits	2035	2035	2035
KT-WE-D Water Efficiency large business audits	2035	2035	2035
Leakage reduction in SH to 0.4Ml/d below current level	2019	2019	2019
SH-WE-B Water Efficiency school audits	2015	2015	2015
SH-WE-C Water Efficiency SME audits	2017	2017	2017
SH-WE-D Water Efficiency large business audits	2015	2015	2015

Demand uncertainty

- 9.113. Two scenarios were considered to test the least cost plan in terms of demand uncertainty. The first used a demand forecast that was based on the plan-based population and property forecast (i.e. derived from Local Authority plans, where available). This was in contrast to the population and property forecast used in the baseline demand, which was based on a most likely population and property forecast, which also took into account trends in population and property growth. The approach to population and property forecasting is described in Section 6.
- 9.114. The second scenario considered the potential for the enhanced water efficiency options to not deliver the savings anticipated at the cost estimated. Southern Water have put forward ambitious enhanced water efficiency options, over and above the water efficiency activity which is built into the baseline demand forecast. There is a large degree of uncertainty associated with water efficiency options, particularly in regard to potential savings, rates of customer uptake of options, potential changes to customer behaviour, whether customers maintain water efficiency devices and so on. So the purpose of this scenario, termed the “reduced water efficiency effectiveness” scenario, was to see what would happen to the options solution if the water efficiency options could only achieve half the anticipated saving at double the cost, to understand the sensitivity of the plan to these options.

Western Area

- 9.115. Under the plan-based population forecast scenario, the small deficit at the end of the planning period in HK WRZ no longer exists, and so the water efficiency and leakage reduction options are not required in that zone. In the HS and IW WRZs, there is no change to the strategy, but the timing of introduction of some schemes is brought forward by a year (e.g. HTD4, IWL6, IWL7, and the water efficiency options). The cost in NPV terms is therefore marginally more expensive, but this run suggests that the least cost solution is relatively insensitive to the plan-based versus most likely population and property forecast.
- 9.116. The “reduced water efficiency effectiveness” scenario requires the three key strategic options in AMP6. After that, it tends to alter the timing and combination of demand management options used, and instead requires:

- The implementation of the HR9c non-potable water reuse at industrial site scheme in 2023/24 and the smaller desalination option, the HTD2 20MI/d coastal desalination scheme, in place of the larger HTD425MI/d desalination scheme.
- The earlier implementation of the IWL7 utilise full capacity of existing cross-Solent main, and consequently no requirement for the IWL6 groundwater rehabilitation option.

The cost of this scenario is only slightly more expensive than the least cost plan, and reinforces the conclusions in the Programme appraisal section (para.9.38).

Table 9.26 Demand uncertainty – Western Area

Scenario	Least cost plan	Plan-based population forecast	Reduced effectiveness of water efficiency options
Total (£k) (NPV discounted over 80 years)	115,376	116,471	117,986
Difference from least cost (£k)	n/a	1,094	2,610
Options	Year	Year	Year
Leakage reduction in HK to 0.2MI/d below current level	2038		2037
HK-WE-B Water Efficiency school audits	2033		
HK-WE-C Water Efficiency SME audits	2035		
HK-WE-D Water Efficiency large business audits	2033		2033
T-HSO-3a 10MI/d Bulk supply (with 30MI/d infrastructure) from PWCo	2017	2017	2017
HSC-a Catchment management	2024	2024	2024
HSC-b Catchment management	2024	2024	2024
HTD2 20MI/d Coastal desalination			2030
HTD4 25MI/d Desalination	2025	2024	
JO3a - MDO groundwater scheme for river augmentation	2018	2018	2018
Leakage reduction in HS to 1MI/d below current level	2020	2020	2021
Further leakage reduction in HS to 2MI/d below current level	2020	2020	2021
Further leakage reduction in HS to 3MI/d below current level	2024	2036	
Further leakage reduction in HS to 4MI/d below current level	2039		
HS-WE-A Water Efficiency home audits	2035	2035	
HS-WE-B Water Efficiency school audits	2020	2019	2025
HS-WE-C Water Efficiency SME audits	2020	2019	2018
HS-WE-D Water Efficiency large business audits	2020	2019	2018
HR9c Non-potable water reuse at industrial site			2023
HSL3+HST2 Conjunctive use	2018	2018	2018
IWL6 Groundwater rehabilitation	2024	2023	
Leakage reduction on IoW to 0.4MI/d below current level	2015	2017	2015
Further leakage reduction on IoW to 0.8MI/d below current level	2021	2021	2020
Further leakage reduction on IoW to 1.2MI/d below current level	2024	2028	2025
Further leakage reduction on IoW to 1.6MI/d below current level	2029		
IWL7 Utilise full capacity of existing cross-Solent main	2032	2031	2028
IW-WE-A Water Efficiency home audits	2020	2019	
IW-WE-B Water Efficiency school audits	2020	2019	2024
IW-WE-C Water Efficiency SME audits	2020	2015	2023
IW-WE-D Water Efficiency large business audits	2020	2015	2018

Central Area

- 9.117. Under the plan-based population forecast scenario, there is more leakage reduction in the SN and SW WRZs, while there is less leakage reduction in SB WRZ. The Water efficiency schemes tend to be pushed back until the end of the planning period. There is a delay in the need to implement the N8a winter transfer stage 1 scheme of 2 years (to 2020/21), and a 3 year delay for the N20 asset enhancement scheme until 2024/25. The cost of this scenario in NPV terms is, however, quite significantly cheaper than the least cost scheme.
- 9.118. The “reduced water efficiency effectiveness” scenario requires the two key strategic options in AMP6, and also brings forward the N20 asset enhancement scheme by 3 years into AMP6. After that, it tends to alter the timing and combination of demand management options used. The cost of this scenario is only slightly more expensive than the least cost plan.

Table 9.27 Demand uncertainty – Central Area

Scenario	Least cost plan	Plan-based population forecast	Reduced effectiveness of water efficiency options
Total (£k) (NPV discounted over 80 years)	68,607	53,475	70,175
Difference from least cost (£k)	n/a	-15,132	1,568
Options	Year	Year	Year
SNC-a Catchment management	2024	2024	2024
SNC-b Catchment management	2024	2024	2024
N10 Well field reconfiguration	2019	2019	2019
Leakage reduction in SN to 1MI/d below current level	2023	2028	2023
Further leakage reduction in SN to 2MI/d below current level	2026	2029	2025
Further leakage reduction in SN to 3MI/d below current level		2033	
Further leakage reduction in SN to 4MI/d below current level		2037	
N8a Winter transfer stage 1	2018	2020	2018
SN-WE-A Water Efficiency home audits	2022	2035	
SN-WE-B Water Efficiency school audits	2022	2035	2021
SN-WE-C Water Efficiency SME audits	2022	2036	2021
SN-WE-D Water Efficiency large business audits	2022	2036	2021
NR2c 10MI/d Water reuse	2027		2026
N20 Asset enhancement schemes	2021	2024	2018
SBC-a Conventional & catchment management	2016	2016	2016
SBC-b Catchment management	2024	2024	2024
SBC-c Catchment management	2024	2024	2024
SBC-d Conventional & catchment management	2030	2034	2030
SBC-e Catchment management	2024	2024	2024
SBC-f Catchment management	2024	2024	2024
Leakage reduction in SB to 0.75MI/d below current level	2025		2024
Further leakage reduction in SB to 1.5MI/d below current level	2026		2025
SB-WE-A Water Efficiency home audits	2035	2029	
SB-WE-B Water Efficiency school audits	2035	2029	2035
SB-WE-C Water Efficiency SME audits	2015	2029	2021
SB-WE-D Water Efficiency large business audits	2022	2029	2035
SWC-a Conventional & catchment management	2016	2016	2016
SWC-b Conventional & catchment management	2016	2016	2016
SWC-c Catchment management	2024	2024	2024
Leakage reduction in SW to 0.5MI/d below current level	2016	2025	2016
Further leakage reduction in SW to 1MI/d below current level	2022	2025	2021
Further leakage reduction in SW to 1.5MI/d below current level		2031	
Further leakage reduction in SW to 2MI/d below current level		2035	
SW-WE-A Water Efficiency home audits	2022	2035	
SW-WE-B Water Efficiency school audits	2022	2035	2021
SW-WE-C Water Efficiency SME audits	2022	2035	2021
SW-WE-D Water Efficiency large business audits	2022	2036	2021

Eastern Area

- 9.119. Under the plan-based population forecast scenario, there is more leakage reduction in the KM and SH WRZs. The M21 licence trading scheme is brought forward earlier to 2023/24 (rather than 2034 in the least cost plan), while the 20MI/d variant of the MR3 water reuse scheme is not required, as the smaller 5MI/d variant is selected instead, but is not needed until much later, in 2035/36.
- 9.120. The “reduced water efficiency effectiveness” scenario requires the three key strategic options in AMP6. The M21 licence trading scheme is brought forward earlier to 2023/24 (rather than 2034 in the least cost plan), while the 20MI/d variant of the MR3 water reuse scheme is not required, as the smaller 15MI/d variant is selected instead, but is not needed until later, in 2026/27. The cost of this scenario is only slightly more expensive than the least cost plan.

Table 9.28 Demand uncertainty – Eastern Area

Scenario	Least cost plan	Plan-based population forecast	Reduced effectiveness of water efficiency options
Total (£k) (NPV discounted over 80 years)	56,468	47,810	58,432
Difference from least cost (£k)	n/a	-8,658	1,964
Options	Year	Year	Year
MT10 Asset enhancement schemes	2017	2018	2017
KMC-a Catchment management	2024	2024	2024
KMC-b Conventional & catchment management	2019	2019	2019
M21 Licence trading scheme	2034	2023	2023
Leakage reduction in KM to 1MI/d below current level		2022	2019
Further leakage reduction in KM to 2MI/d below current level		2022	2019
Further leakage reduction in KM to 3MI/d below current level		2026	
Further leakage reduction in KM to 4MI/d below current level		2030	
M10 River Medway licence Variation	2015	2015	2015
M9 groundwater source licence variation	2016	2016	2016
KM-WE-A Water Efficiency home audits		2035	
KM-WE-B Water Efficiency school audits	2015	2030	2021
KM-WE-C Water Efficiency SME audits	2015	2028	2018
KM-WE-D Water Efficiency large business audits	2015	2036	2018
MR3 15MI/d Water reuse			2026
MR3 20MI/d Water reuse	2022		
MR3 5MI/d Water reuse		2035	
KTC-a Catchment management	2024	2024	2024
Leakage reduction in KT to 0.75MI/d below current level		2039	2039
KT-WE-B Water Efficiency school audits	2035	2035	
KT-WE-C Water Efficiency SME audits	2035	2034	2035
KT-WE-D Water Efficiency large business audits	2035	2034	2035
Leakage reduction in SH to 0.4MI/d below current level	2019	2019	2016
Further leakage reduction in SH to 0.8MI/d below current level		2025	2021
Further leakage reduction in SH to 1.2MI/d below current level		2029	
SH-WE-A Water Efficiency home audits		2035	
SH-WE-B Water Efficiency school audits	2015	2030	2018
SH-WE-C Water Efficiency SME audits	2017	2029	2018
SH-WE-D Water Efficiency large business audits	2015	2029	2018

Comparison of all scenarios

- 9.121. Table 9.29 below provides a summary of the costs for each scenario compared to the least cost plan.
- 9.122. The key schemes needed over the next 5 to 10 years are selected under most of the scenarios tested and this will drive the investment required in terms of scheme implementation and investigation in AMP6. The schemes required in the longer term (the last 10 to 15 years of the planning period) provide an indication of which schemes are likely under the various scenarios and the need for these schemes and the timing of their implementation will be reviewed again in the next WRMP, the draft of which will be published in 2018.

Table 9.29 Comparison of NPV costs over planning period for each scenario and Supply Area

Test scenario	NPV costs over 80 year discount period for each Supply Area, compared to least cost scenario			
	Western	Central	Eastern	Company
Least cost plan	£115.4M	£68.6M	£56.5M	£240.5M
<i>Least cost modelling alternatives & assessment</i>				
Exclude HSL3+HST2 conjunctive use	+£12.3M (unsolvable)	n/a	n/a	n/a
Exclude JO3a groundwater scheme for river augmentation	+£23.3M (unsolvable)	n/a	n/a	n/a
Exclude T-HSO-3 10MI/d bulk supply from PWCo	+£29.2M (unsolvable)	n/a	n/a	n/a
Exclude IWL6 groundwater rehabilitation	+£0.7M	n/a	n/a	n/a
Exclude HTD4 desalination	+£0.7M	n/a	n/a	n/a
Exclude IWL7 full capacity of existing cross-Solent main	+£1.5M	n/a	n/a	n/a
Itchen SR in 2029	-£32.0M	n/a	n/a	n/a
Exclude N10 Well field reconfiguration	n/a	+£6.9M	n/a	n/a
Exclude N8a Winter transfer stage 1	n/a	+£2.5M	n/a	n/a
Exclude N20 Asset enhancement schemes	n/a	+£1.6M	n/a	n/a
Exclude NR2 Water reuse	n/a	+£7.4M	n/a	n/a
Exclude M10 River Medway licence Variation	n/a	n/a	+£8.8M	n/a
Exclude M9 groundwater source licence variation	n/a	n/a	+£5.0M	n/a
Exclude MT10 Asset enhancement scheme	n/a	n/a	+£6.3M	n/a
Exclude MR3 Water reuse	n/a	n/a	+£4.2M	n/a
Exclude M21 Licence trading scheme	n/a	n/a	+£4.4M	n/a
SEA & HRA preferences	-£8.6M	£0.0M	£0.0M	-£8.6M
Resilience – conventional DO approach	-£24.3M	-£6.7M	-£18.4M	-£49.4M
<i>Testing the least cost plan & assessing uncertainties</i>				
WRSE full solution	+£64.6M (unsolvable)	+£0.4M	+£68.7M	+£133.7M
Company only	+£29.2M (unsolvable)	+£11.4M	-£27.9M	+£12.7M
Pragmatic inclusion of unknown Sustainability Reductions	+£7.4M	+£16.5M	+£7.7M	+£31.6M
Reasonable worst case Sustainability Reductions	+£91.7M	+£282.7M	+£134.9M	+£509.3M
Future SR of 45MI/d in HS (<i>Itchen SR delayed until 2025</i>) ^[2]	+£89.0M	n/a	n/a	n/a
Future SR of 65MI/d in HS (<i>Itchen SR delayed until 2025</i>) ^[2]	+£139.4M	n/a	n/a	n/a

	NPV costs over 80 year discount period for each Supply Area, compared to least cost scenario			
Test scenario	Western	Central	Eastern	Company
Future SR of 105MI/d in HS (<i>Itchen SR delayed until 2025</i>) ^[2]	+£188.2M (unsolvable)	n/a	n/a	n/a
No climate change	-£39.2M	-£5.3M	-£11.8	-£56.3M
Minimising carbon emissions	+£86.5M	+£41.5M	+£37.9M	+£165.9M
Cost uncertainty – increase	+£11.0M	+£4.0M	+£4.0M	+£19.0M
Cost uncertainty – decrease	-£10.9M	-£4.0M	-£4.0M	-£18.9M
Plan-based demand forecast	+£1.1M	-£15.1M	-£8.7M	-£22.7M
Reduced effectiveness of water efficiency options	+£2.6M	+£1.6M	+£2.0M	+£6.2M
Preferred plan (difference from least cost plan)	-£12.6M	+£23.7M	+£0.6M	+£11.7M
Preferred plan total	£102.7M	£92.3M	£57.1M	£252.1M
Combined Western & Central Area preferred plan	£195.0M		n/a	n/a
Difference from combined Least Cost plan	+£11.0M		n/a	n/a

Note:

[1] The costs are all in terms of NPV over an 80 year discount period, and are presented for each scenario relative to the least cost scenario, so should be added to the least cost plan cost to derive the scenario cost. Hence, positive costs are more expensive than the least cost plan, whilst negative costs are less expensive

[2] The delay in the implementation of the Itchen Sustainability Reduction results in a reduced cost to address that sustainability reduction compared to the least cost plan due to discounting of costs

The preferred plan

- 9.123. As discussed at the end of Section 8, the various iterations of investment modelling runs, and subsequent testing of the least cost plan, enables the derivation of the **preferred programme of options**, which is also known as the **final planning solution**. This **may differ from the least cost solution**, as it takes into account other criteria to ensure that the plan represents the optimum balance of financial, environmental and social costs, and takes into account other non-monetary issues, risks and uncertainties, and customer preferences. It is critical for the company to review the outputs from its options appraisal and investment modelling to ensure that the company preferred strategy is the optimal solution for the company, its customers and the environment.
- 9.124. Section 10 provides a summary of the preferred plan for each Supply Area, and the total cost over the planning period in NPV terms to implement this final planning strategy.
- 9.125. The analysis also helped to identify the key investigations that will be required over the next 5 to 10 years to ensure that options can be introduced in a timely manner when required. These are summarised in Section 10 (see Table 10.7), and in the detailed timelines covering AMP6 and AMP7 schemes and investigations, which are presented in Appendix J02. The company intends to investigate the strategic options during the next AMP period to both determine their viability and to inform the development of the next iteration of the WRMP for 2019.
- 9.126. In the **Western Area**, if the Itchen sustainability reduction is to be fully implemented by 2018/19, then the key options which will need to be available at that time are:
- T-HSO-3a 10MI/d bulk supply from PWCo;
 - JO3a MDO groundwater scheme for river augmentation; and
 - HSL3+HST2 conjunctive use.

The first step of leakage reduction (to 0.4MI/d below the current target level) on the Isle of Wight is also necessary in the first year of AMP6 to satisfy a potential deficit at the start of the planning period in this WRZ. The analysis has demonstrated that these key options are a fundamental component of the least cost plan to enable the River Itchen Sustainability Reduction to be implemented in full. Failure to secure these would result in much larger additional costs to

customers in pursuing alternative schemes, bringing other options forward into AMP6 or early AMP7, and a risk that the Itchen sustainability reduction cannot be implemented or may be delayed.

- 9.127. The chief difference between the least cost and preferred plan is due to the inclusion of an option that was not available to the least cost model. This provides an additional 5MI/d from Portsmouth Water to the Hampshire South WRZ, but this is contingent on a 5MI/d reduction of the existing baseline supply of 15MI/d from Portsmouth to Sussex North. The purpose of this option is to spread the risk associated with the River Itchen sustainability reduction across both the Western and Central Area, and to optimise how the total bulk supplies available from Portsmouth Water (of up to 25MI/d) are utilised in these two Southern Water supply areas.
- 9.128. Longer term additional schemes, which will require further investigation during AMP6 and in subsequent WRMPs, include the HTD4 and HTD2 desalination options and the HR9c non-potable water reuse at an industrial site scheme, all in Hampshire. These schemes will need further detailed assessment to verify their feasibility. Furthermore, the option IWL7 full capacity of existing cross-Solent main will need to be developed, and investigations conducted on the feasibility of the IWR1 5MI/d water reuse scheme on the Isle of Wight, or other Isle of Wight scheme, such as IWD1 8.5MI/d coastal desalination (selected against the preferred programme where the IWL7 option is not available, in preference to a Hampshire desalination option).
- 9.129. The other key change in moving from the least cost to the preferred plan is that the company would like to promote its enhanced water efficiency options into AMP6 as water efficiency is popular with customers, and it seems appropriate to try to strongly promote water conservation with all its customers given the large Sustainability Reduction faced by the company and resulting need for new resource development options in AMP6.

Table 9.30 Least cost and preferred plan for the Western Area

Scenario	Preferred plan	Least cost plan	Comments
Total (£k) (NPV discounted over 80 years)	102,714	115,376	
Difference from least cost (£k)	-12,662	n/a	
Options	Year	Year	Changes from least cost to preferred plan
Leakage reduction in HK to 0.2MI/d below current level	2038	2038	
HK-WE-B Water Efficiency school audits	2033	2033	
HK-WE-C Water Efficiency SME audits	2035	2035	
HK-WE-D Water Efficiency large business audits	2033	2033	
T-HSO-3a 10MI/d Bulk supply (with 30MI/d infrastructure) from PWCo	2017	2017	
T-HSO-3d increase bulk supply from PWCo to HS by 5MI/d (contingent on PWCo-SN bulk supply reduction)	2024		Option to spread risks across Western & Central Areas by utilising more of the available water from PWCo in the Western Area, and reducing the PWCo supply to the Central Area
HSC-a Catchment management	2024	2024	
HSC-b Catchment management	2024	2024	
HTD2 20MI/d Coastal desalination	2028		A smaller desalination scheme required due to the additional supply from PWCo
HTD4 25MI/d Desalination		2025	
JO3a - MDO groundwater scheme for river augmentation	2018	2018	
Leakage reduction in HS to 1MI/d below current level	2022	2020	Delayed, but remains in same AMP
Further leakage reduction in HS to 2MI/d below current level	2022	2020	Delayed, but remains in same AMP
Further leakage reduction in HS to 3MI/d below current level	2026	2024	Delayed, pushed back into later AMP
Further leakage reduction in HS to 4MI/d below current level	2038	2039	Required 1 year earlier within same AMP
HS-WE-A Water Efficiency home audits	2019	2035	WE options introduced earlier
HS-WE-B Water Efficiency school audits	2019	2020	WE options introduced earlier
HS-WE-C Water Efficiency SME audits	2019	2020	WE options introduced earlier
HS-WE-D Water Efficiency large business audits	2019	2020	WE options introduced earlier
HSL3+HST2 Conjunctive use	2018	2018	
IWL6 Groundwater rehabilitation	2027	2024	Delayed, pushed back into later AMP
Leakage reduction on IoW to 0.4MI/d below current level	2015	2015	
Further leakage reduction on IoW to 0.8MI/d below current level	2022	2021	Delayed, but remains in same AMP
Further leakage reduction on IoW to 1.2MI/d below current level	2025	2024	Delayed, pushed back into later AMP

Further leakage reduction on IoW to 1.6MI/d below current level	2029	2029	
IWL7 Utilise full capacity of existing cross-Solent main	2032	2032	
IW-WE-A Water Efficiency home audits	2019	2020	WE options introduced earlier
IW-WE-B Water Efficiency school audits	2019	2020	WE options introduced earlier
IW-WE-C Water Efficiency SME audits	2019	2020	WE options introduced earlier
IW-WE-D Water Efficiency large business audits	2019	2020	WE options introduced earlier

- 9.130. In the **Central Area**, the chief difference between the least cost and preferred plan is due to the inclusion of an option that was not available to the least cost model in Hampshire. This provides an additional 5MI/d from Portsmouth Water to the Hampshire South WRZ, but this is contingent on a 5MI/d reduction of the existing baseline supply of 15MI/d from Portsmouth to Sussex North. The purpose of this option is to spread the risk associated with the River Itchen sustainability reduction across both the Western and Central Area, and to optimise how the total bulk supplies available from Portsmouth Water (of up to 25MI/d) are utilised in these two Southern Water Areas. The resultant effect is that the supply demand balance in SN is reduced by 5MI/d in 2020/21.
- 9.131. The other key change in moving from the least cost to the preferred plan is that the company would like to promote its enhanced water efficiency options into AMP6, as water efficiency is popular with customers, and it seems appropriate to try to strongly promote water conservation with all its customers given the large Sustainability Reduction faced by the company and resulting need for new resource development options in AMP6.
- 9.132. As a result of the above, the key differences from the least cost plan are:
- Slight timing differences with both the leakage reduction and water efficiency options being delayed;
 - The earlier introduction of NR2c 10MI/d water reuse by one year only, but within the same AMP, in 2026/27;
 - A more significant delay to the N20 asset enhancement scheme until 2034/35 (as opposed to 2021/22);
 - The selection of the CA1 4MI/d MDO aquifer storage and recovery scheme in 2020/21; and
 - The introduction of the N8b and N8c winter transfer stages 2 and 3 towards the end of the planning period.
- 9.133. The only alternative options which get selected where some elements of the preferred plan are not available are:
- N1 irrigation licences management scheme in 2020/21 if either the N10 well field reconfiguration or the CA1 4MI/d MDO aquifer storage and recovery scheme are not available;
 - The CD3 10MI/d tidal river desalination scheme in 2031/32 if the NR2c 10MI/d water reuse scheme is not available; and
 - Potentially increased leakage reduction activity in the SN and SW WRZs.
- 9.134. Therefore, outside the immediate AMP6 schemes of N10 well field reconfiguration and N8a winter transfer stage 1, and the nitrate reduction conventional and catchment management schemes, the longer term scheme which needs investigation in the next AMP period is NR2c 10MI/d water reuse scheme. In addition the Aquifer Storage and Recovery scheme is currently under investigation during AMP5, and this investigation is likely to continue into AMP6 to ensure that it is available in early AMP7.

Table 9.31 Least cost and preferred plan for the Central Area

Scenario	Preferred Plan	Least cost plan	Comments
Total (£k) (NPV discounted over 80 years)	92,323	68,607	
Difference from least cost (£k)	23,716	n/a	
Options	Year	Year	Changes from least cost to preferred plan
SNC-a Catchment management	2024	2024	
SNC-b Catchment management	2024	2024	
N10 Well field reconfiguration	2019	2019	
Leakage reduction in SN to 1MI/d below current level	2022	2023	Required 1 year earlier within same AMP
Further leakage reduction in SN to 2MI/d below current level	2024	2026	Brought forward into earlier AMP
N8a Winter transfer stage 1	2018	2018	
SN-WE-A Water Efficiency home audits	2020	2022	WE options introduced earlier
SN-WE-B Water Efficiency school audits	2020	2022	WE options introduced earlier
SN-WE-C Water Efficiency SME audits	2020	2022	WE options introduced earlier
SN-WE-D Water Efficiency large business audits	2020	2022	WE options introduced earlier
NR2c 10MI/d Water reuse	2026	2027	Required 1 year earlier within same AMP
N20 Asset enhancement schemes	2034	2021	Option delayed by 2 AMP periods
SBC-a Conventional & catchment management	2016	2016	
SBC-b Catchment management	2024	2024	
SBC-c Catchment management	2024	2024	
SBC-d Conventional & catchment management	2016	2030	Would not want to leave source off for 15 years, so introduce on earliest start date
SBC-e Catchment management	2024	2024	
SBC-f Catchment management	2024	2024	
Leakage reduction in SB to 0.75MI/d below current level		2025	No longer required
Further leakage reduction in SB to 1.5MI/d below current level		2026	No longer required
N8b Winter transfer stage 2	2036		New option selected due to other changes made
N8c Winter transfer stage 3	2037		New option selected due to other changes made
N8c Winter transfer stage 3 (transfer component)	2037		(part of option above)
SB-WE-A Water Efficiency home audits	2019	2035	WE options introduced at end AMP6
SB-WE-B Water Efficiency school audits	2019	2035	WE options introduced at end AMP6
SB-WE-C Water Efficiency SME audits	2019	2015	WE options introduced at end AMP6
SB-WE-D Water Efficiency large business audits	2019	2022	WE options introduced at end AMP6
CA1 4MI/d MDO Aquifer Storage and Recovery	2020		New option selected due to other changes made, but is high on customer preferences
SWC-a Conventional & catchment management	2016	2016	
SWC-b Conventional & catchment management	2016	2016	
SWC-c Catchment management	2024	2024	
Leakage reduction in SW to 0.5MI/d below current level	2016	2016	
Further leakage reduction in SW to 1MI/d below current level	2019	2022	Required earlier
SW-WE-A Water Efficiency home audits	2019	2022	WE options introduced earlier
SW-WE-B Water Efficiency school audits	2019	2022	WE options introduced earlier
SW-WE-C Water Efficiency SME audits	2019	2022	WE options introduced earlier
SW-WE-D Water Efficiency large business audits	2019	2022	WE options introduced earlier

Eastern Area

9.135. In the **Eastern Area**, the only change from the least cost plan is that the company would like to promote its enhanced water efficiency options into AMP6, as water efficiency is popular with customers, and it seems appropriate to try to strongly promote water conservation with all its customers. Water efficiency was being selected in the least cost plan in AMP6 in the KM and SH WRZs anyway, so the only change was to force the water efficiency options into KT at the end of AMP6 too.

9.136. The scenario testing process has demonstrated that

- The three AMP6 resource development schemes are always required – the MT10 asset enhancement scheme, the M10 River Medway licence variation and the M9 groundwater source licence variation.

- The conventional with catchment management, and the two catchment management only schemes (KMC-a and KTC-a) at sources which will be at risk of nitrate pollution are always needed to recover the lost DO; and
- The MR3 20MI/d water reuse scheme (or smaller variants) and the M21 licence trading scheme are required in most scenarios, but may be interchanged depending on the assumptions used.

9.137. Therefore, it will be critical for Southern Water to complete all enabling work for the AMP6 resource development schemes in early AMP6, and also to carry out technical investigations, a preliminary design and costing exercise, licence discussions, stakeholder engagement, and preparation of an environmental report including EIA Screening and Scoping, and supporting documentation for planning permissions for both the MR3 20MI/d water reuse scheme and the M21 licence trading scheme in parallel during AMP6, with a view to actually submit the complete application for only one of these schemes in AMP6, depending on the outcome of investigations.

9.138. There is some uncertainty about the viability of M21 licence trading scheme, and if commercial agreement and technical feasibility cannot be resolved, then the company would also need to gear up its leakage reduction activity over AMP6 and AMP7, as leakage reduction options would become economic.

Table 9.32 Least cost and preferred plan for the Western Area

Scenario	Preferred Plan	Least cost plan	Comments
Total (£k) (NPV discounted over 80 years)	57,093	56,468	
Difference from least cost (£k)	624	n/a	
Options	Year	Year	Changes from least cost to preferred plan
MT10 Asset enhancement schemes	2017	2017	
KMC-a Catchment management	2024	2024	
KMC-b Conventional & catchment management	2019	2019	
M21 Licence trading scheme	2034	2034	
M10 River Medway licence Variation	2015	2015	
M9 groundwater source licence variation	2016	2016	
KM-WE-B Water Efficiency school audits	2015	2015	
KM-WE-C Water Efficiency SME audits	2015	2015	
KM-WE-D Water Efficiency large business audits	2015	2015	
MR3 20MI/d Water reuse	2022	2022	
KTC-a Catchment management	2024	2024	
Leakage reduction in KT to 0.75MI/d below current level	2039		Additional leakage triggered as non-household water efficiency brought forward to AMP6
KT-WE-A Water Efficiency home audits	2035		
KT-WE-B Water Efficiency school audits	2019	2035	WE options introduced earlier
KT-WE-C Water Efficiency SME audits	2019	2035	WE options introduced earlier
KT-WE-D Water Efficiency large business audits	2019	2035	WE options introduced earlier
Leakage reduction in SH to 0.4MI/d below current level	2019	2019	
SH-WE-B Water Efficiency school audits	2015	2015	
SH-WE-C Water Efficiency SME audits	2017	2017	
SH-WE-D Water Efficiency large business audits	2015	2015	

How has the plan changed from previous versions?

Comparison with previous WRMP (2009)

9.139. It is instructive to compare the preferred plan as developed for this WRMP with the previous WRMP which was published in October 2009 (referred to as “WRMP09”). Such a comparison can highlight where the strategy is largely the same, and also identify what elements of the strategy may have changed and why.

9.140. However, there will be differences between WRMP09 and this WRMP for a variety of reasons: a different base year for the WRMP that reflect demographic, economic, and climatic factors;

implementation of scheme options (such as the Universal Metering Programme) in the intervening 5 years; changes in environmental requirements; changes in raw water quality; and changes in regulatory requirements (such as discount rate).

- 9.141. All the components of the supply demand balance have been reassessed using outturn data for 2011/12 and so the surplus/deficit situation will have changed from the previous assessment for WRMP09.
- 9.142. Another key difference is that the previous WRMP (2009) provided a case for the metering of almost all (92%) of the company's domestic customers over the AMP5 period; the UMP has been largely completed.
- 9.143. The previous WRMP (2009) used a different discount rate of 3.5%. The EA's Water Resources Planning Guideline now requires companies to use 4.5% for the WRMP, and the discounting period has also been extended by the most recent WRP Guidelines to 80 years, whereas in the previous WRMP the discounting period was 25 years. The costs of the WRMP09 strategy are therefore not directly comparable with this current WRMP.
- 9.144. There are also a number of differences in the range of options available. For instance, in the previous WRMP (2009) deteriorating raw water quality as a result of rising nitrate levels in the water gathering grounds was not considered to have the potential to reduce source DO. Therefore there were no schemes to recover that lost DO; whereas this current WRMP includes schemes to address the potential loss of DO through rising nitrate levels; the scheme comprise both conventional nitrate treatment and catchment management approaches.
- 9.145. Finally, following a review of the unconstrained options available, there are some options considered and selected in this current WRMP that were not developed, or were otherwise excluded, in the previous WRMP.
- 9.146. For the **Western Area**, two of the key strategic options to address the River Itchen Sustainability Reduction remain the same as in the previous WRMP – that is JO3a groundwater scheme for river augmentation and the HSL3+HST2 conjunctive use scheme. The key difference is that in this current WRMP, there is an additional option, for a bulk import from Portsmouth Water (T-HSO-3a) that has become available since WRMP09.
- 9.147. One key difference is the level of leakage reduction – previously in the Western Area this amounted to a reduction of around 9 MI/d below the target level of leakage (but with 7.8 MI/d only required in the last quarter of the planning period). The programme of incremental leakage reductions has been reassessed in terms of operational achievability for this current WRMP leading to major reductions being deferred beyond the end of the planning period.
- 9.148. There were significant levels of increased DO assumed from source asset enhancement schemes in the previous WRMP, which were included in the baseline supply forecast so did not need to be selected or accounted for in the economic modelling. These amounted to 9.05 MI/d at MDO and 13.55 MI/d at PDO in the connected Hampshire South and Isle of Wight WRZs (and a further 0.2 MI/d at MDO and 1.4 MI/d at PDO in total in the standalone WRZs of Hampshire Andover and Hampshire Kingsclere).
- 9.149. For the **Central Area**, the only resource development option in the previous WRMP was the River Arun abstraction below tidal limit (10 MI/d), which was built as part of this current AMP5 period, so now forms part of the baseline.
- 9.150. The key difference was the significant levels of increased DO assumed from source asset enhancement schemes in the previous WRMP (2009), which were included in the baseline supply forecast so did not need to be selected or accounted for in the economic modelling. These amounted to 11.6 MI/d at MDO and 9.3 MI/d at PDO.
- 9.151. For the **Eastern Area**, one key difference is the level of additional bulk supplies to South East Water, over and above continuation of the existing bulk supplies. There are also a number of additional options that were previously not available, in particular the M21 licence trading scheme and MT10 asset enhancement scheme.
- 9.152. Previously in this Area the level of leakage reduction amounted to over 7 MI/d below the target level of leakage. The programme of incremental leakage reductions has been reassessed in

terms of operational achievability for this current WRMP leading to major reductions being deferred beyond the end of the planning period. In addition, the move to a discount period of 80 years affects the larger leakage reduction steps, which have relatively high fixed opex costs.

- 9.153. There were significant levels of increased DO assumed from asset enhancement schemes in the previous WRMP, which were included in the baseline supply forecast so did not need to be selected or accounted for in the economic modelling. These amounted to 8.75 MI/d at MDO and 10.5 MI/d at PDO.

Comparison with Draft WRMP14

- 9.154. As described in the Statement of Response and throughout this Final WRMP, there have been a number of changes to the options and supply demand balance components made following consultation on the Draft WRMP, which was published in May 2013.
- 9.155. The EA requested as part of their consultation comments on the Draft WRMP that the discounting period be extended to 80 years, whereas in the Draft WRMP the discounting period used was 25 years. The costs of the Draft WRMP strategy are therefore not directly comparable with this Final WRMP, and so have not been included in this comparison. Therefore, there are numerous reasons why the Final WRMP will not align with the DWRMP.
- 9.156. The commentary around those differences is provided in Table 9.33 to Table 9.35.
- 9.157. For the **Western Area**, one key change is how the River Itchen Sustainability Reduction is presented for implementation. In addition, the HSL3+HST2 conjunctive use option has changed to one which provides output at PDO only. The water efficiency schemes available in the feasible options have been revised to reflect assumptions with the companies' Business Plan. The preferred plan for this Final WRMP has also assumed that these water efficiency options will be forced in during AMP6.
- 9.158. For the **Central Area**, The water efficiency schemes available in the feasible options have been revised to reflect assumptions with the Company's Business Plan. The preferred plan for this Final WRMP has also assumed that these water efficiency options will be forced in during AMP6.
- 9.159. For the **Eastern Area**, the key differences are that the deficit has changed such that the MR3 20MI/d water reuse scheme is generally required in AMP7, and the M21 licence trading scheme is generally not needed until the 2030's, whereas the converse was true in the Draft WRMP.
- 9.160. The water efficiency schemes available in the feasible options have been revised to reflect assumptions with the Company's Business Plan. The preferred plan for this Final WRMP has also assumed that these water efficiency options will be forced in during AMP, although in the Eastern Area the water efficiency schemes were already being selected in AMP6 in KM and SH WRZs, so this policy has only had to be applied to the KT WRZ water efficiency options.
- 9.161. Finally, the level of leakage reduction has reduced significantly. This is in part due to the move to an 80 year discount period as stipulated by the EA, but is also a function of the deficits experienced and the options available to meet those deficits – a number of resource schemes are required and these are able to almost fully satisfy the deficits, alongside water efficiency options, without the need for leakage reduction steps. However, the scenario testing showed that under certain conditions or if some of the preferred options were not available, then significant amounts of leakage reduction would be required.

Table 9.33 Comparison with WRMP099 and Draft WRMP14 plans – Western Area

Scenario	Preferred plan	Draft WRMP final plan	Previous WRMP (2009)	Comments
Total (£k) (NPV discounted over 80 years)	102,714			
Difference from least cost (£k)	n/a			
Options	Year	Year	Year	
Leakage reduction in HK to 0.2MI/d below current level	2038			
HK-WE-B Water Efficiency school audits	2033			New option, which was not available in the Draft WRMP
HK-WE-C Water Efficiency SME audits	2035			New option, which was not available in the Draft WRMP
HK-WE-D Water Efficiency large business audits	2033			New option, which was not available in the Draft WRMP
T-HSO-3a 10MI/d Bulk supply (with 30MI/d infrastructure) from PWCo	2017	2019		Option not available at the time of producing the WRMP09
T-HSO-3d increase bulk supply from PWCo to HS by 5MI/d (contingent on PWCo-SN bulk supply reduction)	2024			Option not available in the Draft WRMP or WRMP09
HSC-a Catchment management	2024	2016		Revised nitrate risk assessment assumes scheme not required until AMP7, not available in WRMP09
HSC-b Catchment management	2024			Option not available in the Draft WRMP or WRMP09
HTD2 20MI/d Coastal desalination	2028			
JO3a - MDO groundwater scheme for river augmentation	2018		2019	Different variant selected, see change to HSL3+HST1. WRMP09 included the Arle scheme
JO3a - PDO groundwater scheme for river augmentation		2019	2019	Different variant selected, see change to HSL3+HST1. WRMP09 included the Arle scheme
Leakage reduction in HS to 1MI/d below current level	2022	2026	2025	
Further leakage reduction in HS to 2MI/d below current level	2022	2030	2027	
Further leakage reduction in HS to 3MI/d below current level	2026		2028	
Further leakage reduction in HS to 4MI/d below current level	2038		2029	
Further leakage reduction in HS to 7.8MI/d below current level			2030-34	Option considered operationally unrealistic
HS-WE-A Water Efficiency home audits	2019			New option, which was not available in the Draft WRMP
HS-WE-B Water Efficiency school audits	2019			New option, which was not available in the Draft WRMP
HS-WE-C Water Efficiency SME audits	2019			New option, which was not available in the Draft WRMP
HS-WE-D Water Efficiency large business audits	2019			New option, which was not available in the Draft WRMP
HR9c Non-potable water reuse at industrial site		2035		
HSL3+HST2 Conjunctive use	2018	2016	2015	Note revised DWRMP option provides DO at PDO only.
IWD1 5MI/d Coastal desalination		2032		
IWL6 Groundwater rehabilitation	2027	2030	2034	
Leakage reduction on IoW to 0.4MI/d below current level	2015	2017	2026-29	
Further leakage reduction on IoW to 0.8MI/d below current level	2022	2021	2029-31	
Further leakage reduction on IoW to 1.2MI/d below current level	2025	2027	2031-34	
Further leakage reduction on IoW to 1.6MI/d below current level	2029			
IWL7 Utilise full capacity of existing cross-Solent main	2032			
IW-WE-A Water Efficiency home audits	2019			New option, which was not available in the Draft WRMP
IW-WE-B Water Efficiency school audits	2019			New option, which was not available in the Draft WRMP
IW-WE-C Water Efficiency SME audits	2019			New option, which was not available in the Draft WRMP
IW-WE-D Water Efficiency large business audits	2019			New option, which was not available in the Draft WRMP
Excluded from revised WRMP				
IWL1 borehole rehabilitation		2025	2032	Option excluded from revised DWRMP on WFD grounds
HBL1 borehole rehabilitation			2033	Option excluded from WRMP14
AMP5 source asset improvements			2010-15	Option completed, so not applicable to WRMP14
Metering			2010-15	Option completed, so not applicable to WRMP14

Table 9.34 Comparison with WRMP099 and Draft WRMP14 plans – Central Area

Scenario	Preferred Plan	Draft WRMP final plan	Previous WRMP (2009)	Comments
Total (£k) (NPV discounted over 80 years)	92,323			
Difference from least cost (£k)	n/a			
Options	Year	Year	Year	
SNC-a Catchment management	2024			Option not available in the Draft WRMP
SNC-b Catchment management	2024			Option not available in the Draft WRMP
N10 Well field reconfiguration	2019	2019		
Leakage reduction in SN to 1MI/d below current level	2022	2017		
Further leakage reduction in SN to 2MI/d below current level	2024	2024		
N8a Winter transfer stage 1	2018	2018		
SN-WE-A Water Efficiency home audits	2020			New option, which was not available in the Draft WRMP
SN-WE-B Water Efficiency school audits	2020			New option, which was not available in the Draft WRMP
SN-WE-C Water Efficiency SME audits	2020			New option, which was not available in the Draft WRMP
SN-WE-D Water Efficiency large business audits	2020			New option, which was not available in the Draft WRMP
NR2c 10MI/d Water reuse	2026	2025		
N20 Asset enhancement schemes	2034	2032		
SBC-a Conventional & catchment management	2016			Option not available in the Draft WRMP
SBC-b Catchment management	2024	2024		
SBC-c Catchment management	2024	2024		
SBC-d Conventional & catchment management	2016	2024		
SBC-e Catchment management	2024	2024		
SBC-f Catchment management	2024			Option not available in the Draft WRMP
N8b Winter transfer stage 2	2036	2034		
N8c Winter transfer stage 3	2037	2035		
N8c Winter transfer stage 3 (transfer component)	2037	2035		
N8d Winter transfer stage 4		2037		
SB-WE-A Water Efficiency home audits	2019			New option, which was not available in the Draft WRMP
SB-WE-B Water Efficiency school audits	2019			New option, which was not available in the Draft WRMP
SB-WE-C Water Efficiency SME audits	2019			New option, which was not available in the Draft WRMP
SB-WE-D Water Efficiency large business audits	2019			New option, which was not available in the Draft WRMP
CA1 8MI/d Annual average Aquifer Storage and Recovery		2038		
CA1 4MI/d MDO Aquifer Storage and Recovery	2020			
SWC-a Conventional & catchment management	2016			Option not available in the Draft WRMP
SWC-b Conventional & catchment management	2016			Option not available in the Draft WRMP
SWC-c Catchment management	2024			Option not available in the Draft WRMP
Leakage reduction in SW to 0.5MI/d below current level	2016	2017		
Further leakage reduction in SW to 1MI/d below current level	2019	2023		
SW-WE-A Water Efficiency home audits	2019			New option, which was not available in the Draft WRMP
SW-WE-B Water Efficiency school audits	2019			New option, which was not available in the Draft WRMP
SW-WE-C Water Efficiency SME audits	2019			New option, which was not available in the Draft WRMP
SW-WE-D Water Efficiency large business audits	2019			New option, which was not available in the Draft WRMP
Excluded from revised WRMP				
AMP5 source asset improvements			2010-15	Option completed, so not applicable to WRMP14
Metering			2010-15	Option completed, so not applicable to WRMP14

Table 9.35 Comparison with WRMP099 and Draft WRMP14 plans – Eastern Area

Scenario	Preferred Plan	Draft WRMP final plan	Previous WRMP (2009)	Comments
Total (£k) (NPV discounted over 80 years)	57,093			
Difference from least cost (£k)	n/a			
Options	Year	Year	Year	
MT10 Asset enhancement schemes	2017	2019		Not available in WRMP09
KMC-a Catchment management	2024	2024		
KMC-b Conventional & catchment management	2019	2036		
M21 Licence trading scheme	2034	2021		Not available in WRMP09
Leakage reduction in KM to 1MI/d below current level		2025	2026	
Further leakage reduction in KM to 2MI/d below current level		2031	2027	
Further leakage reduction in KM to 6.5MI/d below current level			2028-34	
M10 River Medway licence Variation	2015	2016	2029	
M9 groundwater source licence variation	2016	2019	2024	
M5a3000 Reservoir raising			2022	
KM-WE-B Water Efficiency school audits	2015			New option, which was not available in the Draft WRMP
KM-WE-C Water Efficiency SME audits	2015			New option, which was not available in the Draft WRMP
KM-WE-D Water Efficiency large business audits	2015			New option, which was not available in the Draft WRMP
MR3 10MI/d Water reuse		2032		
MR3 20MI/d Water reuse	2022		2018	
KTC-a Catchment management	2024	2024		
Leakage reduction in KT to 0.75MI/d below current level	2039	2023	2034	In WRMP09, only 0.1MI/d selected
Further leakage reduction in KT to 1.5MI/d below current level		2027		
Further leakage reduction in KT to 2.25MI/d below current level		2031		
Further leakage reduction in KT to 3MI/d below current level		2035		
Further leakage reduction in KT to 3.75MI/d below current level		2039		
KT-WE-A Water Efficiency home audits	2035			New option, which was not available in the Draft WRMP
KT-WE-B Water Efficiency school audits	2019			New option, which was not available in the Draft WRMP
KT-WE-C Water Efficiency SME audits	2019			New option, which was not available in the Draft WRMP
KT-WE-D Water Efficiency large business audits	2019			New option, which was not available in the Draft WRMP
Leakage reduction in SH to 0.4MI/d below current level	2019	2028	2033-34	
Further leakage reduction in SH to 0.8MI/d below current level		2037		
SH-WE-B Water Efficiency school audits	2015			New option, which was not available in the Draft WRMP
SH-WE-C Water Efficiency SME audits	2017			New option, which was not available in the Draft WRMP
SH-WE-D Water Efficiency large business audits	2015			New option, which was not available in the Draft WRMP
Excluded from revised WRMP				
TW1 River restoration of the Little Stour		2019		Option excluded from Revised DWRMP, as no longer have sustainability reduction driver
H3&H7 Re-introduction of borehole source		2031	2031	Option excluded from revised DWRMP on WFD grounds
H9 Reservoir licence variation			2028	Being considered and amended in AMP5, so not available in WRMP14
AMP5 source asset improvements			2010-15	Option completed, so not applicable to WRMP14
Metering			2010-15	Option completed, so not applicable to WRMP14

10. Final planning solution – the water resources strategy

Section summary

This Section gives a summary of the baseline supply demand balance situation for each Supply Area, and the preferred plan that the company believes will lead to a more resilient and flexible supply system. It summarised the investigations that are required over the next 5-10 years to ensure that the schemes comprising the preferred plan can be implemented in a timely and efficient manner.

Aspect of the WRMP addressed in this section of the Technical Report	Reference
Presentation of the least cost solution and preferred solution , with justification for allowances made to develop the final preferred programme of options.	Para.10.18-10.120, Table 10.1-Table 10.6 (Section 9, Figure 9.1, WRP Tables)
Development of a plan to secure the supply of water to address any deficits through the planning period, and which provides best value to customers and the environment .	Para.10.18-10.120, Table 10.1-Table 10.6
Discussion of alternative programmes of solutions , should the preferred programme fail to deliver the expected yield on time	Para.10.18-10.120, Table 10.1-Table 10.6
Consideration of whether different combinations of options would provide better or more resilient solutions, as part of a programme appraisal	Para.10.18-10.120, Table 10.1-Table 10.6
Summary of the likely social and environmental impact of the preferred programme solution , including potential effects on Water Framework Directive ecological status	Para.10.18-10.120, Table 10.1-Table 10.6 (Section 9, Appendix H)
Discussion of the risks and uncertainties associated with the preferred options and overall programme	Para.10.18-10.120, Table 10.1-Table 10.6
Discussion of the flexibility and adaptability of the final solution using the output from scenario and sensitivity testing	Para.10.18-10.120, Table 10.1-Table 10.6
Discussion of the confidence that the company has in its ability to deliver the programme options set	Para.10.15-10.16, Table 10.1-Table 10.6
Presentation of a schedule of further work to reduce uncertainties , linked to the planned timing of future implementation decisions.	Para.10.135, Table 10.7, Figure 10.1-Figure 10.3, Appendix J02
Assessment of greenhouse gas emissions associated with current water supply activities and with the selection of additional options to resolve any supply demand balance deficit in each year of the planning period.	Para.10.126-10.127, Figure 10.4

Statutory requirements addressed in this section

The following table summarises the statutory requirements (legislation, regulations and directions) applied to the water resource planning process, and provides a cross reference to the relevant part of this section of the WRMP.

Legislation ref.	Description of matter to be addressed	Reference
WIA1991 S73A(3)(a)	The water undertaker's estimate of the quantities of water required to meet its obligations	Sect.10, (& Annex 1)
WIA1991 S73A(3)(b)	The measures which the water undertaker intends to take or continue to take to meet its obligations	Table 10.1-Table 10.6 (& Table 1.1)
WIA1991 S73A(3)(c)	The likely sequence and timing for implementing those measures	Table 10.1-Table 10.6 (& Table 1.1)
Dir 2012 S3(c)	The emissions of greenhouse gases which are likely to arise as a result of each measure which it has identified to meet its obligations	Para.10.126-10.127, & Figure 10.4
Dir 2012 S3(i)	Full details of the likely effect of what is forecast pursuant to S3(f) to (h) on demand for water in its area	Sect.10, (& Annex 1)

Summary of baseline supply demand balance

Western Area

- 10.1. There are four water resource zones (WRZs) within the Western Area, as described previously in Section 3. Two of these WRZs are currently “stand alone”, with no internal transfers to the other zones in the Supply Area. Completion of the Universal Metering Programme by the end of AMP5 means that 92% of household customers will be metered by the start of the planning period in 2015/16. The Isle of Wight metering levels are slightly higher than this, as they have had near universal metering for many years.
- 10.2. The Hampshire South WRZ is the largest in the company's supply area with dry year demands typically around 150 MI/d. It starts the planning period with a significant supply demand balance surplus in the region of 80 MI/d at MDO and 45 MI/d at PDO, although a significant volume of water is transferred through the cross-Solent main to support the Isle of Wight WRZ. **Full implementation of the sustainability reduction for the River Itchen will lead to immediate DO reductions of around 94 MI/d at MDO and 72 MI/d at PDO, so Hampshire South WRZ itself moves into large-scale deficit and can therefore no longer support the Isle of Wight WRZ. Without the implementation of new options the security of supplies to customers would be at risk.**
- 10.3. The NEP investigations of the Lower River Test abstraction, undertaken in AMP5, have significantly increased the knowledge and understanding of this part of the River Test SSSI. The Lower Test abstraction licence is now due to be investigated further through the 2014/15 period, as part of the Restoring Sustainable Abstraction (RSA) programme, through an options appraisal that will in turn inform the next NEP programme that is due to be published in January 2016. Pending conclusion of that process, it is not known if there is any future potential sustainability reductions on the Lower River Test abstraction. Any reduction could further worsen the supply demand balance position for Hampshire South WRZ, with knock on effects for Isle of Wight WRZ and the Western Area as a whole.

- 10.4. The Isle of Wight WRZ typically has dry year demands of around 35 MI/d, and starts the planning period with a deficit in terms of what its own sources can supply, although as mentioned above, it is supported by transfers from Hampshire South WRZ of up to 12 MI/d.
- 10.5. Hampshire Andover is a small WRZ, with dry year demand typically around 16 MI/d. It has a surplus throughout the planning period (of at least 1 MI/d at MDO at the end of the planning period), and at least 1.5 MI/d at PDO (at the end of the planning period). There is therefore no requirement for additional options to be assessed in this WRZ.
- 10.6. The Hampshire Kingsclere WRZ is very small with dry year demands of only around 5 MI/d. It has a small surplus throughout the planning period until 2036 where it then moves into a very small deficit at PDO (of around 0.1MI/d only).

Central Area

- 10.7. The Central Area is comprised of three WRZs, as described previously in Section 3. There are internal transfers allowing for limited volumes of water to be moved around the Supply Area to some extent. Completion of the Universal Metering Programme by the end of AMP5 means that 92% of household customers will be metered by the start of the planning period in 2015/16.
- 10.8. The Sussex North WRZ has dry year demands typically around 60 MI/d. The WRZ's own internal sources are supplemented by a bulk import from Portsmouth Water of 15 MI/d. However, the WRZ also provides a supply of 5.4 MI/d from Weir Wood to South East Water. There is a bi-directional transfer between Sussex North and Sussex Worthing.
- 10.9. Sussex Worthing WRZ has typical dry year demands of just under 45 MI/d. Due to DO reductions from sources at risk of nitrate pollution, there is a deficit in SW from 2016 onwards.
- 10.10. Sussex Brighton is a large WRZ with dry year demands typically around 80 MI/d. Due to DO reductions from sources at risk of nitrate pollution, there is a deficit in this WRZ from 2016 onwards. The zone can also be supported by an internal transfer from Sussex Worthing WRZ.

Eastern Area

- 10.11. The Eastern Area comprises three geographically separate WRZs, as described previously in Section 3. Completion of the Universal Metering Programme by the end of AMP5 means that 92% of household customers will be metered by the start of the planning period in 2015/16.
- 10.12. Kent Medway WRZ is the largest WRZ in the Eastern Area and is supplied by the Bewl Water reservoir. This is also able to transfer water to the Darwell reservoir to support the Sussex Hastings WRZ. Dry year demands in Kent Medway are typically around 115 MI/d. There are a number of significant bulk exports to South East Water from the Kent Medway WRZ.
- 10.13. Kent Thanet WRZ has typical dry year demands of around 45 MI/d. It can be supported by an internal transfer from the Kent Medway WRZ.
- 10.14. The Sussex Hastings WRZ is the smallest in the Eastern Area with dry year demands typically around 25 MI/d. It has two reservoirs, which comprise around 95% of its supplies. The largest of these is Darwell, which is supported by a transfer from Bewl Water reservoir in Kent Medway WRZ. Sussex Hastings provides an 8 MI/d bulk supply to South East Water.

Objective of water resources strategy

- 10.15. The objective of the water resources strategy in this WRMP is to ensure the security of supplies for the next 25 years through the development of a robust and resilient supply system that is able to:
- Reduce the risk of failure under the drought scenarios used to an absolute minimum;
 - Meet Target Levels of Service to customers and the environment;
 - Ensure development of a water supply system that can cope with increased housing development;
 - Be fully prepared to meet the challenges of climate change, and to take into account the adverse impact of carbon emissions;
 - Develop those options that are the most environmentally sustainable, whilst being economically effective, and socially and politically acceptable, from the options available;
 - Select appropriate demand and supply side options that can be implemented in a timely manner as and when they are required;
 - Be flexible enough so that it can be adapted to changing circumstances; and
 - Contribute to an integrated regional solution.
- 10.16. Uncertainty in the supply and demand forecasts will increase through time. Thus, the **critical period is the next five years (AMP6, 2015-20), because it is the one for which the company will need to obtain funding through the Business Plan process**. The **following five-year period (AMP7) is also important, as options which are required during the period 2020-25 are likely to require some form of investigation to be carried out during AMP6**, to ensure that any required planning permissions are, or can be, obtained and any environmental issues can be addressed and mitigated. The proposals identified in the final 15 years of the planning period are used to understand the strategic nature of the schemes which may be required. These are options planned for the long term, and so may be subject to greater uncertainty or risk. They will be reviewed in subsequent WRMPs prior to their implementation.
- 10.17. The water resource strategy can therefore be summarised in terms of three key periods:

- **The next five years:** from 2015/16 to 2019/20 – also known as AMP6;
- **Years five to ten:** from 2020/21 to 2024/25 – also known as AMP7; and
- **The remainder of the planning period:** from 2025/26 to 2039/40.

Overview of the Final Plan for the Western Area

Summary of the Western Area strategy

- 10.18. Table 10.1 presents a summary of the Western Area strategy, including baseline assumptions relating to the supply demand balance, assumptions regarding changes to the supply demand balance during the planning period (in *italics*), and the options selected as part of the preferred plan (in **bold**).

Table 10.1 Summary of the water resources strategy and key SDB considerations – Western Area

Period	Summary of options selected and SDB considerations in the Western Area
Baseline	• <i>Completion of Universal Metering Programme by end of AMP5</i> • <i>Continuation of baseline water efficiency activity throughout the planning period</i> • <i>Maintain leakage at agreed Ofwat target (unless leakage reduction option is selected as least cost)</i> • <i>Stochastic approach to calculation of deployable outputs from 2019/20</i> • <i>Inclusion of climate change impacts on supply and demand</i> • <i>Continuation of bulk supply to commercial customer in Hampshire South throughout planning period</i> • <i>Continuation of small existing bulk export to Wessex Water from Hampshire Andover through planning period</i> • <i>Use of existing cross-Solent main to supply the Isle of Wight (from HS)</i>
During AMP6 (2015-20)	• Investigations – NEPs, feasibility studies and enabling investigations • <i>Nitrate issues resulting in DO reduction at a source in HA from 2016</i> • Leakage reduction to 0.4 MI/d below current target level on the Isle of Wight in 2015 • <i>Itchen Sustainability Reduction implemented in phased manner from 2015 with full implementation by 2018 (where there are sufficient options available to meet this reduction)</i> • T-HSO-3a 10MI/d bulk supply from Portsmouth Water Co (with 30MI/d infrastructure) in 2017 • JO3a MDO groundwater scheme for river augmentation in 2018 • HSL3+HST2 conjunctive use in 2018 • HS-WE-A, B, C, D water efficiency schemes in 2019 • IW-WE-A, B, C, D water efficiency schemes in 2019
During AMP7 (2020-25)	• Further investigations – ongoing NEPs, feasibility studies and enabling investigations • Leakage reduction to 2MI/d below current level in Hampshire South in 2022 • Further leakage reduction to 0.8 MI/d below current target level on the Isle of Wight in 2022 • <i>Nitrate issues resulting in DO reduction at 2 sources in HS from 2024</i> • T-HSO-3d increase bulk supply from Portsmouth Water to HS by 5MI/d by 2024 (contingent on reduction of the existing PWCo-SN to 10MI/d) • HSC-a and b catchment management (to address nitrate pollution issues)
Last 15 years of the plan (2025-40)	• Further leakage reduction to 1.2 MI/d below current target level on the Isle of Wight in 2025 • Further leakage reduction to 3 MI/d below current target level In Hampshire South in 2026 • IWL6 groundwater rehabilitation in 2027 • HTD2 20MI/d coastal desalination in 2028 • Further leakage reduction to 1.6 MI/d below current target level on the Isle of Wight in 2029 • IWL7 utilise full capacity of existing cross-Solent main in 2032 • HK-WE-B, C, D water efficiency schemes in 2033-35 • Further leakage reduction to 4 MI/d below current target level In Hampshire South in 2038 • Leakage reduction to 0.2MI/d below current level in Hampshire Kingsclere in 2038
Total cost (NPV over 80 years)	£102.7M

What is driving Southern Water's Western Area Strategy?

- 10.19. Southern Water's strategy for securing public water supplies in the Hampshire and the Isle of Wight WRZs is driven by the timing and scale of the Sustainability Reductions on the River Itchen notified by the Environment Agency. **Without the Sustainability Reductions, Southern Water would not have a supply demand deficit and would not need to promote new water resource developments.** However, the scale of the Sustainability Reductions is so large that Southern Water has no choice but to promote large scale new water resource developments in order to meet its obligations under the Habitats Regulations, the Water Industry Act and the WRMP Regulations.
- 10.20. The Hampshire Andover and Hampshire Kingsclere are self-contained WRZs with deficits only occurring towards the end of the planning period in Hampshire Kingsclere (there is no deficit over the planning period in Hampshire Andover).
- 10.21. The Sustainability Reductions have been notified by the Environment Agency because it considers, following a Habitats Regulations Review of Consents, that there is a risk that Southern Water's public water supply licences at their Lower Itchen sources could, in combination, have an adverse impact on the River Itchen under specific low flow conditions. It is important to note that **water abstracted under Southern Water's abstraction licences do not have an actual adverse impact on the River Itchen under normal environmental conditions.** It is the risk that they could have an adverse impact under specific low flow conditions that is the reason for the Environment Agency notifying Southern Water that its licence must be changed as a Sustainability Reduction.
- 10.22. The effect of the notified Sustainability Reduction is to reduce, under certain flow conditions, the amount of water that Southern Water can abstract from its Lower Itchen sources. The notified new limits restrict the amount of water that can be abstracted in the months of June to September each year. When flows reach a low level in the River Itchen, the new limits would prevent any water at all being abstracted for public water supply from these sources.
- 10.23. The Water Industry Act and WRMP Regulations require Southern Water to prepare a WRMP to balance available supply and customer demand for water, allowing for risk and uncertainty. This balancing exercise has to be undertaken for a defined scenario that allows for the risks that occur.
- 10.24. The effect of the notified Sustainability Reductions reduces Southern Water's available supplies to such a significant extent under that defined scenario, that Southern Water cannot meet its legal obligations to maintain supplies to customers. As a result, the Water Industry Act and WRMP Regulations require Southern Water to undertake demand management measures and to promote, secure licences/consents, and build and operate new water resource schemes to bring the demand and supply back into balance. This is what Southern Water's strategy for the Western Area has to achieve.
- 10.25. There is also a significant timing factor that must be met as the Environment Agency has notified Southern Water that measures to meet the Sustainability Reductions should be in place by 2015. Where this is not technically feasible then a detailed implementation plan needs to be agreed by 2015. This needs to include the intermediary actions that will be taken to protect the site from damage in the time up until the implementation of the final solution.
- 10.26. A Memorandum of Understanding was agreed in early 2009, and a copy of this was reproduced in Appendix A of the Final WRMP2009. Since agreeing the Memorandum of Understanding with the Environment Agency and Portsmouth Water (whose abstractions are also affected by the Sustainability Reductions), Southern Water has undertaken various actions to enable the Sustainability Reductions to start to be implemented. This includes its programme of metering of domestic customers, being implemented between 2010 and 2015, and various studies and investigations of water resource options in Hampshire South.
- 10.27. Southern Water has been working closely with the Environment Agency, Natural England and other stakeholders to promote applications for necessary consents to implement new water resource development that would allow the 2015 date to be met. However, the nature of the sensitive environments of the Rivers Test and Itchen, and the complexity of the environmental issues that must be addressed before those consents can be issued, means that this work is still ongoing at the time of this Final WRMP.

- 10.28. The impact of the River Itchen sustainability reduction means that large schemes, requiring long lead times for planning, design, construction and commissioning, need to be in place to deliver the full sustainability reductions. Under the company's preferred plan, it should be possible to deliver the River Itchen Sustainability Reduction and maintain security of supplies to customers by 2018/19. However, the **only options available to achieve this are the HSL3+HST2 Conjunctive use, along with the T-HSO-3 10MI/d bulk supply from Portsmouth Water and the JO3a MDO groundwater scheme for river augmentation. These schemes will therefore have to be in place by 2018/19. Without them, the company would not have viable schemes in place to meet the deficit that would occur as a result of the proposed sustainability reduction.**
- 10.29. Therefore, in discussion with the Regulators, the company has agreed in principle to implement the River Itchen Sustainability Reduction as early as possible in AMP6. Southern Water will seek to agree with the EA that the **River Itchen Sustainability Reduction will be implemented through the gradual phasing of components of the Sustainability Reduction, aiming for full implementation by 2018/19** (or when viable scheme(s) are in place to meet the deficit that will occur). For example the following phasing of the licence amendments could be implemented as follows:
- **Phase 1:** The Lower Itchen **surface water and groundwater licence change for monthly totals (excluding September) in 2015**. Note that this licence change does not actually impact on the DO's, hence does not register in the supply demand balance;
 - **Phase 2:** The Lower Itchen **surface water Minimum Residual Flow (MRF) licence change in 2017**, which equates to loss of the full Lower Itchen surface water DO in that year; and
 - **Phase 3:** The Lower Itchen **groundwater licence change and the September monthly total in 2018**, and hence result in the full implementation of all the components of the Sustainability Reduction in this year.
- 10.30. However, Southern Water could only agree the implementation of the phased components of the River Itchen sustainability reduction once there were sufficient alternative supplies in place to ensure that customers were not at risk of a supply failure. The company understands it must implement the Itchen sustainability reduction as soon as possible; however it can only deliver the full reduction once sufficient alternative supplies become available. A phased implementation of the River Itchen Sustainability Reduction will be delivered as set out in the plan.
- 10.31. Therefore, although it will not now be possible for the full extent of the Sustainability Reductions to be implemented by 2015, Southern Water, in discussion with the Environment Agency, is seeking to adopt a phased implementation as soon as possible. The Environment Agency has made clear to Southern Water that if not by 2015, the Sustainability Reductions must be implemented in full as soon as possible.
- 10.32. The requirement to deliver the scale of water to replace that which would be lost under the Sustainability Reductions, to the fastest possible timescale, drives the Southern Water strategy for the Western Area to include schemes that will enable it to do this. As a fundamental requirement of this Strategy, Southern Water has to urgently promote, secure consent for, and build and operate three major schemes - the **HSL3+HST2 conjunctive use** scheme, the **JO3a groundwater scheme for river augmentation**, and the **T-HSO-3a bulk supply from Portsmouth Water** scheme in the short term, together with other smaller scale options, and a longer term desalination plant.
- 10.33. These 3 major schemes were included in the Draft WRMP and remain in the Final WRMP, but with important amendments as explained in the individual sections below. The Final WRMP also now includes schemes to improve water efficiency and reduce demand for water amongst both domestic and business customers. The longer term desalination option has also been amended in the Final WRMP, to a desalination plant on the Solent that replaces the DWRMP option of developing a desalination plant on the Isle of Wight.
- 10.34. Southern Water will build and operate its 3 major schemes on a conjunctive basis – this means that it will not build and operate them in isolation, rather it will operate and balance the existing and new sources of water in combination, in order to provide a secure supply to customers

under a planned range of environmental conditions. The WRMP Regulations require Southern Water to include an allowance for risk and uncertainty – so called ‘headroom’. This allows for the risk that a source of water may be unavailable due to pollution or unplanned maintenance, or for the demand for water increasing, or supply not increasing, as the WRMP forecasts it will.

- 10.35. In practice, this ‘headroom’ means that Southern Water’s WRMP has to plan to provide much more water than would be necessary under normal operating conditions. It would be very unlikely that there would be a situation when all of the existing and proposed sources of water would need to be used to their full extent to meet demand for water. This means that some of the WRMP schemes would only be operated to their full extent on very rare occasions, or not at all. However the WRMP Regulations require Southern Water to plan for that very eventuality, as ensuring there is a continuing supply of water to customers is a fundamental legislative requirement that Southern Water must meet.
- 10.36. Southern Water recognises that there are alternative strategies that might achieve the Sustainability Reductions over a longer timescale than its proposed strategy does. However current legislative drivers require implementation sooner making these alternative strategies unviable. Those alternative strategies could involve a different phased implementation of schemes, and even alternative schemes being promoted. This Final WRMP shows how Southern Water has explored alternative strategies that could be adopted to maintain the balance between supply and demand.
- 10.37. The Western Area Strategy identified in the Final WRMP is the most appropriate strategy for meeting the requirements of the Sustainability Reductions, the Habitats Regulations, the Water Industry Act and the WRMP Regulations.

The HSL3+HST2 conjunctive use scheme

- 10.38. The Draft WRMP included the scheme to increase the treatment capacity of the River Test WSW to the full existing abstraction licence limit of 136Ml/d, and to construct a new pipeline to link the River Test and Lower Itchen treatment works, collectively known as the HSL3+HST2 conjunctive use scheme. This scheme was, and remains, a fundamental component of Southern Water’s Western Area strategy.
- 10.39. Both during the drafting of the DWRMP, and throughout the consultation period on the draft plan, Southern Water has been continuing its technical assessments of the proposed scheme, and to discuss the details of these assessments with the Environment Agency, Natural England and other stakeholders. The consultation responses on the DWRMP have identified that a wide range of stakeholders have concerns over the proposed operation of the Scheme either in principle or as described in the DWRMP.
- 10.40. For the reasons described above, Southern Water has to promote the HSL3 + HST2 conjunctive use scheme in order to enable the Sustainability Reductions to be implemented as rapidly as possible. Whilst there are many individuals and organisations who object to the principle of the scheme, Southern Water maintains that it is required to enable the Habitats Regulations, Water Industry Act and WRMP Regulation requirements to be met.
- 10.41. However, the ongoing technical assessments have enabled Southern Water to conclude that the HSL3 + HST2 conjunctive use scheme should not be operated under the terms of the existing abstraction licence at the River Test WSW, but under an amended licence. The licence changes would enable Southern Water to continue to meet its water resource responsibilities, whilst providing additional protection to the environment. This additional environmental protection will be afforded through reducing the annual quantity of water that can be abstracted at the River Test WSW. Other potential conditions and restrictions, such as monthly limits on abstraction under different levels of flow in the river, are currently being discussed with the Environment Agency and Natural England. Any new licence could also include an increase to the trigger level of river flow below which Southern Water would need to cease abstracting water. Such an amendment could secure the infrequent use of the scheme, as anticipated by the work undertaken to date.
- 10.42. The Environment Agency has recently indicated that it wishes the Lower Test abstraction to be assessed under the Restoring Sustainable Abstraction (RSA) programme. This programme of work will include a review of existing and potentially new options that would be of benefit to the supply demand balance in the Western area. This work will be completed by December 2015,

enabling the Environment Agency to determine whether any licence changes at the Lower Test abstraction need to be included as sustainability reductions within the next NEP programme, to be published in January 2016.

- 10.43. Once the licence at the River Test WSW has been amended and planning permissions granted, Southern Water will construct the scheme. Southern Water would then operate the scheme under the terms of the changed licence. For the majority of the time, the River Test WSW abstraction would be operated in a similar manner to its recent operation. However, on the very rare occasions when Southern Water's abstractions on the River Itchen sources are affected by the Sustainability Reductions, or at times when those sources are otherwise unavailable (e.g. pollution events or unplanned maintenance), this licence will need to allow Southern Water to abstract, treat and pump additional water through the new pipeline to the Lower Itchen WSW.
- 10.44. The details of any new licence, and the details of the RSA options appraisal, are being discussed with the Environment Agency and Natural England at the current time, and the Environment Agency will have to agree the changes to the licence before Southern Water can develop this scheme. It is also important to note that the changed licence would have a time limit attached to it (anticipated to be 15 years), and that a further review of the licence would need to be undertaken before the licence could be extended. The Environment Agency and Natural England also have statutory powers they can use to seek to modify the licence earlier than that should new concerns over the environmental effects of abstraction arise.
- 10.45. Southern Water is confident that changes to the licence will be approved that allow it to benefit the environment and to rely on the scheme as a core component of the Western Area Strategy in the WRMP. It does, however, also have alternatives available (see paras 10.77 to 10.95 below) that could be promoted should the HSL3 + HST2 conjunctive use scheme prove not to be deliverable. However, these alternatives would take a longer time to deliver. The work undertaken on potential alternatives identifies that irrespective of whether the HSL3 + HST2 conjunctive use scheme itself is ultimately promoted, the pipeline element of the scheme that would enable Southern Water to move large quantities of water between sources and areas of supply is likely to be required in any event. The need for the scheme would increase should other large scale water resource schemes be developed that require resources to be transferred from the west to east of Southern Water's Hampshire South WRZ to ensure supplies to customers can be protected.

The JO3a groundwater scheme for river augmentation

- 10.46. The DWRMP included the scheme to modify and utilise the existing Environment Agency groundwater river augmentation scheme for water resource purposes. This scheme was identified in WRMP09 and included in the Memorandum of Understanding, and remains, a fundamental component of Southern Water's Western Area strategy.
- 10.47. The scheme is one of two groundwater schemes for river augmentation located in the upper reaches of the River Itchen. The schemes are owned by, licensed to, and operated by the Environment Agency. The effect of pumping groundwater and discharging it directly into the river is to bypass and accelerate the natural seepage or flow of water through the aquifer to springs in the river valley. The time at which groundwater appears in the river can therefore be adjusted through operation of either scheme, but no extra water is created or lost as a result of the scheme.
- 10.48. The abstraction licence of each scheme was assessed by the Environment Agency under the River Itchen SAC Habitats Directive Review of Consents. The Habitats Directive Stage 4 Review of Consents Site Action Plan (SAP) (Environment Agency, October 2007) included conditions on the use of each scheme. The population of white-clawed crayfish in the Candover Stream would be protected by operational procedures and limits to discharge during sensitive months. No augmentation discharge would be permitted if pre-operation ecological surveys showed that the crayfish population was in poor health.
- 10.49. As part of the AMP5 National Environment Programme (NEP), Southern Water investigated the Environment Agency's groundwater schemes for augmentation of the River Itchen for their usefulness or otherwise in the management of deficits in the supply demand balance for the Hampshire South WRZ. The deficits arise as a direct result of the implementation of Habitats Directive Sustainability Reductions on Southern Water's Lower Itchen abstraction licences. The aim of the NEP investigation was to review the assumptions used for the WRMP09 analysis

against the results of a new test pumping programme. The programme was designed to establish the usefulness of either or both of the groundwater schemes for river augmentation as water resource schemes to support flows in the River Itchen and hence to partially offset the impacts of the River Itchen Sustainability Reductions.

- 10.50. The NEP study concluded that the hydrogeological characteristics of one scheme and the impacts on abstraction licence holders immediately downstream meant that the scheme could not be considered as a viable water resource scheme.
- 10.51. The NEP study also concluded that the restrictions included in the SAP on the operation of the other scheme as currently configured meant that there would be a risk that at the times when the scheme would be needed to support public water supplies in the Hampshire South WRZ it might not always be available. However the construction of a new pipeline to relocate the discharge point further downstream, thus avoiding any risk to the health of the crayfish population in the lower reaches of the Candover Stream, would mean that the scheme could be relied on for WRMP purposes.
- 10.52. The groundwater scheme for river augmentation considered as an option for this WRMP therefore requires the design, necessary consents, and construction of a new pipeline and discharge structure at a location much further downstream. Both during the preparation of the DWRMP, throughout the consultation period on the draft plan, and in preparation of the Statement of Response and the RDWRMP, Southern Water has continued to undertake technical assessments of the proposed scheme, and to discuss the details of these assessments with the Environment Agency, Natural England and other stakeholders. The consultation responses on the DWRMP have identified that a number of stakeholders have concerns about the scheme being used for water resource purposes, and also on the possible transfer of ownership of the scheme from the Environment Agency to Southern Water.
- 10.53. By increasing flows in the River Itchen through augmentation, Southern Water would be able to continue to abstract water from its Lower Itchen sources (surface water and groundwater), which would otherwise have started to become restricted due to the Sustainability Reductions notified by the Environment Agency. As noted in Paras 3.29 to 3.37 (“The Basis of a WRMP”), it is only in dry years when all options are required to maintain the supply-demand balance. Even with implementation of the River Itchen Sustainability Reductions, security of supplies could be maintained from existing sources in most years without requiring operation of the groundwater scheme for river augmentation. Southern Water has therefore continued to work on how the scheme might be used for water resource purposes in accordance with the conditions set out in the SAP.
- 10.54. The SAP sets out the licence and operational conditions that would be required if the scheme were to be operated at full licence each year. Model simulations of the supply demand balance of the Hampshire South WRZ throughout the WRMP planning period have been undertaken to show how security of supplies could be maintained following implementation of the River Itchen Sustainability Reductions. The modelling assumed that the scheme would be operated in accordance with the licence changes set out in the SAP. This included a restriction to the abstraction and hence discharges to the Candover Stream and a flow trigger on the River Itchen further downstream that would restrict operation to low-flow periods only. The modelling also assumed that the “dry year” distribution input (DI) would be required in every year, which as discussed above is a much more demanding condition than would occur in practice.
- 10.55. Southern Water’s preference would be for it to own the asset and licence of the JO3a groundwater scheme for river augmentation. The scheme would be operated in accordance with the conditions set out in the SAP and would involve taking ownership of the Environment Agency scheme but operating it in accordance with the requirements of the SAP. If the outcome of ongoing discussions about the possible transfer of the assets and the abstraction licence conclude that there is no transfer to Southern Water, then an appropriate operating regime will need to be agreed.
- 10.56. The Environment Agency has recently varied the abstraction licence with a new time limit of the end of December 2016, however the Environment Agency has a requirement to implement the recommendations of the SAP by the end of December 2015
- 10.57. Southern Water will need to modify the Environment Agency’s scheme to meet the requirements of the SAP. The modifications will be informed by the technical assessment work

that the Company has undertaken as part of the NEP during AMP5 in liaison with the Environment Agency and Natural England.

- 10.58. An operating agreement will also need to be reached to control the detail of how, when and for what duration the scheme can be run. The agreement will need to ensure that not only are flows discharged through the new pipeline and discharge location, but also that sufficient water is also discharged into the Candover Stream to protect the native Crayfish, and to protect other abstractors in the area, including watercress farms, fish farms and angling interests.
- 10.59. The details of this agreement and the required changes to the abstraction licence and other consents will need to be negotiated and agreed with the Environment Agency and Natural England. As part of this process, the potential implications of the modified scheme will need to be assessed under the Habitats Regulations. The current Environment Agency augmentation scheme has already been through that process and confirmed as being acceptable, however Southern Water's modified version of that scheme will need to be assessed in the same way.
- 10.60. Since submitting the Statement of Response and the revised draft WRMP, Southern Water has continued discussions with the Environment Agency and Natural England and has produced a draft scope of the WRMP Appropriate Assessment for the groundwater scheme for river augmentation. The Environment Agency's scoping advice (dated 10th April 2014) on the draft scope included the following recommendation:

We advise that if the [...] Scheme option selected in SWS's WRMP is to use the licence in exact accordance with the Agency's RoC stage 4 licence changes, then minimal further assessment will be required.

- 10.61. The simulation modelling referred to in para. 10.54 shows that on the basis that "dry" year demands are to be met in each year of the simulation, it is expected that the scheme would need to be operated in 15 years out of the full simulation period of 93 years, and that in 6 years the period of operation would be less than 30 days. In only one event would the scheme need to be operated for more than 120 days (4 months).
- 10.62. Southern Water is confident that an appropriate and acceptable operating agreement will be reached and that necessary consents for the new pipeline and discharge location will be secured. This enables Southern Water to rely on the scheme as a core component of the Western Area Strategy in the WRMP. It does, however, also have alternatives available (see paras 10.77 to 10.95 below) that could be promoted should the scheme prove not to be deliverable.

Transfers of water from Portsmouth Water Company (T-HSO-3 bulk supplies from PWC)

- 10.63. The DWRMP included a scheme to transfer 10MI/d from Portsmouth Water's existing abstraction on the lower River Itchen. This is water that Portsmouth Water can abstract within the terms of its existing licence but does not do so, as it does not need the water to meet its own supply demand balance requirements. This scheme was, and remains, a fundamental component of Southern Water's Western Area strategy.
- 10.64. During the consultation period on the DWRMP, and the drafting of the Statement of Response and production of the Revised Draft WRMP, Southern Water continued to discuss potential water transfers with PWC. Consultation responses on the DWRMP identified that a number of stakeholders wished Southern Water to go further in taking a greater volume of water from PWC. Southern Water has explicitly addressed this issue in direct discussions with PWC.
- 10.65. The outcome of these discussions is that we have now included additional volumes of water to be transferred from PWC in the revised draft WRMP. PWC have indicated that they could supply, under the design conditions adopted by Southern Water, a total of 25MI/d to Southern Water. Initially, 10MI/d will be transferred from PWC to the Hampshire South WRZ, as proposed in the DWRMP. This will subsequently be increased to a 15MI/d transfer, with the potential for it subsequently to be increased again to a 30MI/d transfer, should Portsmouth Water develop new resources in future. However, the increase to 15MI/d means that the existing bulk supply from PWC to Sussex North would need to be reduced from its existing level by 5MI/d, in order to provide additional support to the Western Area. The infrastructure for the full 30MI/d transfer is proposed to be implemented from the outset, with the volumes transferred being increased as

the supply demand balance requires it, and as PWC is able to guarantee the provision of the water.

- 10.66. The scheme will require the construction of additional infrastructure and a new pipeline from PWC's source to an existing Southern Water service reservoir, from where it will enter into the public supply.
- 10.67. Southern Water will need to enter into agreements with PWC to secure the water for transfer, and will need to submit applications for planning and other consents for the provision of the new infrastructure and pipeline.
- 10.68. Southern Water is confident that it will reach an acceptable agreement with PWC, and that necessary consents for the new infrastructure and pipeline will be secured. This enables Southern Water to rely on the scheme as a core component of the Western Area Strategy in the WRMP.

SEA and HRA assessment of the plan for the Western Area

- 10.69. Since the DWRMP, we have undertaken a further review of feasible options and have also updated the environmental assessments of the feasible options, resulting in revised HRA and SEA documents. The strategic level HRA identified two options within the revised plan (one in the Western Area and one in the Central Area), where the potential for Likely Significant Effects (LSE) on European sites could not be ruled out altogether, and would require a further Appropriate Assessment. However, for both cases this was a conservative assessment based on the requirement for further information to conclude with certainty no LSE. The overall work undertaken to date has enabled us to conclude that the Final WRMP will not have likely significant effects (LSE), by virtue of the options selected in the preferred plan, or alternatives to them that could be promoted should it not be possible to show no LSE for our preferred options at the consenting stage.
- 10.70. Southern Water recognises that there are uncertainties relating to some options in the DWRMP and that the SEA review has confirmed the high risk categorisation of some schemes. We are confident that further environmental work on the options of the preferred plan to be undertaken during AMP6 will address these uncertainties and risks. However, we have considered the implications for the WRMP if options that are considered to be potentially high risk against SEA objectives were excluded, as an assumed scenario to test the robustness of our available feasible options set.
- 10.71. An additional variant based on the SEA preferred scenario has therefore been assessed with the SEA high-risk and HRA uncertain likely significant effect (LSE) schemes from the preferred plan removed on environmental grounds. The SEA high risk schemes removed from the feasible options list were the HTD4 desalination scheme on the coast in Hampshire and the IWD1 desalination scheme on the Isle of Wight under this scenario. The JO3a groundwater scheme for river augmentation was rated as SEA medium risk. However, there have been strong representations surrounding this scheme, primarily from Natural England, so the JO3a scheme has been excluded from this scenario run.
- 10.72. Other Western Area strategic options, including the HSL3+HST2 conjunctive use scheme and the T-HSO-3a bulk supply from Portsmouth Water remain available for selection because the SEA doesn't identify these as high risk schemes. However, the WRMP does include separate scenarios where these individual options have been excluded, either alone or in combination, for comparison purposes (see paragraphs 10.77 to 10.95 below).
- 10.73. The investment model run for this alternative SEA and HRA based scenario shows that the supply demand balance can be satisfied, however in contrast to the preferred scenario, the full sustainability reduction cannot be met until 2019/20, with an MDO deficit of 9 MI/d in 2018/19. Under this scenario the plan would comprise the following schemes, with those that were not in the preferred plan identified in bold text:
 - T-HSO-3a 10MI/d bulk supply from Portsmouth Water Co in 2017;
 - HSL3+HST2 conjunctive use in 2018;
 - IWL6 groundwater rehabilitation in 2018;
 - **HR9c Non-potable water reuse at industrial site in 2019;**

- T-HSO-3d increase bulk supply from Portsmouth Water to HS by 5MI/d in 2021;
- Catchment management schemes to reduce nitrates in 2024;
- **IWR1 5MI/d Water reuse in 2027;** and
- HTD2 10MI/d coastal desalination in 2032

10.74. This **alternative SEA and HRA based scenario therefore demonstrates that there is a combination of preferred and alternative schemes that is capable of maintaining the supply demand balance, albeit at an additional cost** (the plan cost is £125M) and with an additional delay of a year in the full implementation of the Itchen Sustainability Reductions.

Alternatives to preferred plan options

- 10.75. As a final step in the process, various “what if” scenarios were run to identify what alternative resource options would be selected under the assumptions used for the preferred plan, if each option (in turn) in the preferred plan could not be delivered, for whatever reason.
- 10.76. The results of the assessment of each option against wider strategic criteria than least cost, along with the identification of key alternative strategic options for each option is presented in the Table 10.2 below.

Table 10.2 Summary of the development of the preferred programme of options for the Western Area

Option code and name	IW-LR Leakage reduction on Isle of Wight to 1.6 MI/d below current target level
Selected start date (& WRZ)	2015 – reduction to 0.4 MI/d below current target level
	2022 – further reduction to 0.8 MI/d below current target level
	2025 – further reduction to 1.2 MI/d below current target level
	2029 – further reduction to 1.6 MI/d below current target level
Customer preferences	Customers expressed strong support for further leakage reduction during the pre-consultation and statutory consultation on the draft WRMP and during consultation for the 25-year Strategic Statement and 2015-2020 Business Plan. Customers believe we should set an example by further reducing leakage, however it is generally accepted that there is an economic limit which below a certain point makes other water resource options more cost effective for customers. Customers expect water companies to continue to innovate to find ways to reduce water waste, without increasing customer bills.
Environmental considerations (SEA and HRA)	The leakage reduction options generally have limited environmental effects at the strategic level. Minor adverse effects are associated with the likely need for localised construction works to find and fix leaks and consequent disruption to local transport and householders/communities. However these impacts could be mitigated by appropriate working practices. In the longer term, leakage reduction is compatible with a number of the SEA objectives as it enables the best use of existing resources. There are also potential minor beneficial impacts due to the reduced losses of water which should reduce energy consumption associated with sourcing, treating and supplying potable water
Risks and uncertainties (including planning)	Southern Water already achieves one of the lowest levels of leakage in the country. There may therefore be operational or practical difficulties in reducing leakage significantly further and <u>maintaining it at this new lower level under whatever climatic conditions materialise</u> . Whilst it is quite feasible at a company level to further reduce leakage, pursuing significant targeted reductions in only one or two WRZs may not be technically feasible in terms of “find and fix” procedures and processes, even where the costs may be low enough for all leakage reduction steps to be selected. If the enhanced leakage reduction activity is relaxed, then leakage will gradually rise as pipes deteriorate over time. There may therefore be some residual risk associated with achieving and maintaining leakage at lower levels, as was reflected by the company’s experiences from the 2004-06 drought events.
Lead in times for option development & feasibility studies	It takes time to build up the required resources to reduce leakage and maintain it at its lower level, and so there may be a limit to how much reduction can be achieved in any one AMP period in reality.
Sustainable and resilient solution, WRSE regional driver	Leakage reduction options are an essential part of a twin track approach. But it is important to recognise that, below a certain level, it will become increasingly more difficult and particularly costly to reduce leakage further. Whilst leakage reduction can generally contribute to reduced demand and hence reduced need for abstractions, the level of leakage is a function of climatic conditions. If there is, for example, a very cold winter, then leakage will increase due to increased pipe bursts. As a result, it is not possible for companies to guarantee the level of leakage that they can achieve in any given year.
Alternative options selected in least cost investment model	Not tested

Option code and name	T-HSO-3a 10MI/d bulk supply (with 30 MI/d infrastructure) from PW Co
Selected start date (& WRZ)	2017 (in HS WRZ)
Customer preferences	The trading of water between neighbouring water companies was supported by 81 per cent of respondents during the public consultation. Many customers feel the extension of a water network in the South East is beneficial and secures a more reliable supply, however, this must be dependent on the water being available without further impact on the environment or to the detriment of supplies to the company's own customers.
Environmental considerations (SEA and HRA)	This option requires the construction of short linking main between an existing WSR and a WSW within Southampton, which would allow the bulk supply of 10 MI/d to the WSR. The exact route of the pipeline has yet to be determined, however is likely to be along urban roads, and will need to cross the M27. Potential adverse effects may arise during construction, including temporary impacts on biodiversity, traffic, communities, loss or damage to archaeological remains, and impacts arising from any contaminated land. Depending on the final route and techniques used during construction, this option may also result in moderate adverse effects on human Health and Population and material assets due to the crossing of the M27 and also the potential along urban roads. During operation, this option may have minor adverse effects on the sub-objective to reduce greenhouse gas emissions and maximise sustainable resource use, resulting from carbon dioxide emissions /energy requirements associated with the pumping and treatment of water.
Risks and uncertainties (including planning)	The key risks and uncertainties associated with this bulk supply option relate to reaching a commercial agreement with the supplier, Portsmouth Water, and the availability of sufficient quantities of the bulk supply for use by Southern Water customers during critical drought events. The preferred pipeline route involves pipeline sections along minor roads and a B road and a directionally drilled crossing of the M27.. Road closures may be necessary and could cause disruption. As detailed below, if this option were not available, the HR9c Non-potable water reuse at industrial site option would need to be developed and implemented in 2019. Whilst this may be achievable, it presents a potential risk to customer supplies.
Lead in times for option development & feasibility studies	Portsmouth Water has indicated that there is sufficient surplus in their supply demand balance following modelling of drought events similar to the level on which Southern Water plans. The option could be implemented by mid-AMP6 as part of the strategy to meet the River Itchen sustainability reduction.
Sustainable and resilient solution, WRSE regional driver	Most bulk supplies are subject to commercial agreements, which often stipulate some form of "pain share" in the event of a drought which affects both transacting companies. This could therefore reduce the resilience of the option. The commercial arrangements for the bulk supply are yet to be discussed in detail.
Alternative options selected in least cost investment model	If this option were no longer available, the key strategic alternatives would be the selection of: • The earlier introduction of the IWL6 Groundwater rehabilitation option in 2017 (rather than 2027); • The HR9c Non-potable water reuse at industrial site option, which would be required in 2019; and • The HTD4 25MI/d Desalination option, which would be required in 2024, replacing the HTD2 20MI/d Coastal desalination option that was selected in 2028. Under this scenario where the PW bulk supply (and subsequent additional future bulk supplies from re-balancing the total PW supply to the Central and Western Areas) are not available, there is an unsolvable deficit of 7MI/d in 2017 on the IW at PDO due to the implementation of the Itchen Sustainability Reduction in full at that point. The timing of the Itchen SR would therefore need be delayed. For the HR9c Non-potable water reuse at industrial site option there are a number of potential moderate to minor adverse effects against the SEA objectives, mainly related to the works required for a new main connecting into existing mains within and close to protected sites. Potential temporary moderate adverse effects are identified as a result of the installation of a new main where it runs along the A326 and the requirement for a railway line crossing; these impacts are likely to be effectively mitigated by traffic management measures for works on the main road, and directional drilling under the railway line. Adverse moderate effects may also arise in relation to the landscape objective where the main runs through the New Forest National Park, though impacts will be restricted mainly to the outskirts of the Park boundary and will be limited to the construction period. Depending on the time of year that the works are undertaken, this option could also result in a major adverse effect in relation to the sub-objective to protect and enhance recreation and amenity facilities due to potential traffic disruption especially during peak visitor periods to the Park. Assuming works are undertaken outside key visitor periods and traffic management plans are implemented, effects on traffic are identified to be moderate adverse. Construction works may also adversely affect the designated sites (New Forest designated SAC, SPA, Ramsar and SSSI) and Southampton Water (designated SPA, Ramsar, SAC and SSSI), which could be affected by construction noise, vibration from the directional drill and other general risks associated with construction. An Appropriate Assessment of this proposal is likely to be required. For the purposes of the SEA and HRA of the revised dWRMP, the option has been assessed on the basis that there will be strictly no encroachment into the designated sites. Further work to identify specific risks and an appropriate mitigation strategy will include habitat and protected species surveys of the route and working corridor. Planning and design of the pipeline route in consultation with EA and Natural England will be fundamental to ensuring that the option can be implemented without resulting in significant environmental effects. Furthermore, the proposed pipeline route passes close to two Scheduled Monuments. A desk study of the possible route will be required to inform the selection of the final route to avoid adverse effects on such assets. During operation, future climate change may alter the availability of effluent to supply this option, although no specific mitigation measures are identified to

	address this potentially minor adverse impact. A further major adverse impact associated with this option is the relatively high energy use associated with the new MBR and RO plant required at the WWTW. For the HTD4 25MI/d Desalination option, there are possible impacts on the Solent Maritime SAC and Solent & Southampton Water SPA Ramsar from discharge of desalination effluent. The strategic HRA concluded that considering in-pipe dilution and distance between the outfall and the designated sites, the discharge is not considered likely to have a significant effect on the qualifying features of these sites; however, further information would be required to confirm this and therefore the scheme would potentially require an Appropriate Assessment. There are potential mitigation options to dilute the discharge or extend the discharge outfall to beyond the designated sites to avoid adverse impacts. Other potential environmental concerns include possible impacts on coastal fisheries, construction of part of the pipeline route through New Forest National Park and adjacent to designated sites, landscape impacts of the pipeline and desalination plant, and energy and carbon costs (although these have been monetised and accounted for within the least cost economic model). A minor beneficial effect has been identified in relation to the objective to minimise the vulnerability of water supply to climate change, as the water provided for supply would not be vulnerable to future climate change, and would make supplies more resilient. If this alternative option were required, detailed investigations and discharge modelling would be required in AMP6.

Option code and name	JO3a – MDO groundwater scheme for river augmentation
Selected start date (& WRZ)	2018 (in HS WRZ)
Customer preferences	Not tested explicitly in customer surveys. The DWRMP consultation provided mixed support for the scheme.
Environmental considerations (SEA and HRA)	Pro-active augmentation of the Candover groundwater sources will mitigate the minimal residual flow (MRF) conditions and other licence restrictions that comprise the Sustainability Reductions to be introduced at the Lower Itchen sources. This scheme relocates the existing Candover Stream outfall to the Upper Itchen in order to bypass native crayfish population in Candover Stream. The key impacts identified for the JO3a groundwater scheme for river augmentation by the SEA are associated with the pipeline that is required for this option, and the discharge to the River Itchen SAC. These impacts have been judged to be moderate adverse, and are associated with the physical environment of the SAC (associated with the discharge), and potential issues associated with water quality. However the water will be abstracted from the chalk groundwater from which the natural baseflow in the Candover stream is derived, and the risks to water quality from the discharge water are therefore considered to be low, and no further treatment is proposed. The pipeline route has been designed to avoid the statutory nature conservation designations within the vicinity of the scheme, but there are still areas of Habitats of Principal Importance for Biodiversity (woodland) that will need to be considered. Concerns have been raised by stakeholders with regard to the potential use of the groundwater, and associated impacts on flows in the upper reaches of the River Itchen. However the existing licence for this scheme was subject to a detailed investigation as part of the Habitats Directive Stage 4 Review of Consents. The subsequent Site Action Plan (SAP) included monthly licence restrictions to protect sensitive species (crayfish) at particularly sensitive times of year. No other flow related mitigation measures were identified in the SAP. The SAP conclusions were based on the full licence operated in each year, however the frequency and duration of use of the JO3a scheme will be lower than that authorised by the existing abstraction licence, and will be within the annual licensed quantity. Operating protocols for the scheme will need to be developed and agreed with EA and NE to address the conditions set out in the SAP. Other potential environmental issues identified for this option are the current routing of the pipeline close to a Scheduled Monument (Enclosures of the Cowleys) and through a Registered Park and Garden (The Grange at Northington). There is also a general risk of encountering buried archaeology along the pipeline route. To mitigate these possible effects, the pipeline will be rerouted to avoid designated buildings/features where possible. A desk study of the possible route will be required to inform the selection of the final route, with selective trial trenching to investigate key areas of archaeological risk if required prior to construction. Overall the impacts of the JO3a scheme against the SEA objectives have been judged to be negligible to minor or moderate adverse. Investigations and discussions with the relevant regulators will be ongoing to ensure that adverse impacts are reduced further wherever possible.
Risks and uncertainties (including planning)	The scheme is currently owned and operated by the EA. If the scheme remains under the ownership of the EA, Southern Water consider the DO to be highly unreliable. This is because the scheme may be operated for environmental mitigation in preference to water resource benefit.
Lead in times for option development & feasibility studies	For the option to be feasible, a pipeline would need to be in place to protect the native crayfish population. The option is therefore considered to be available in mid-AMP6 at the earliest.
Sustainable and resilient solution, WRSE regional driver	Use of the groundwater scheme for river augmentation had been confirmed by the HD Stage 4 Review of Consents; the Southern Water scheme would contain changes to the abstraction licence and include operational procedures to provide the necessary environmental protection. The scheme is to augment river flows for abstraction further downstream and so would only be operated when the abstraction at the downstream sources is constrained by the MRF.
Alternative options selected in least cost investment model	If this option were no longer available, and if aiming to meet the full implementation of the Itchen SR in 2018, the key strategic alternatives would be the selection of: • The earlier introduction of the IWL6 Groundwater rehabilitation option in 2018 (rather than 2027); • The HR9c Non-potable water reuse at industrial site option, which would be required in 2019;

- The earlier introduction of **T-HSO-3d increase bulk supply from PWCo to HS by 5MI/d** (contingent on PWCo-SN bulk supply reduction) in 2021 (rather than 2024);
- No longer requiring the **IWL7 utilise full capacity of existing cross-Solent main** option;
- The **IWR1 5MI/d Water reuse** option in 2027; and
- The introduction of the **HTD4 10MI/d Desalination** option in 2032.

Under this scenario where the J03a groundwater augmentation is not available, there is an **unsolvable deficit** of 9MI/d in 2018 in HS at MDO due to the implementation of the Itchen Sustainability Reduction in full at that point. The timing of the Itchen SR would therefore need to be delayed. Bringing forward the alternative schemes for delivery in AMP6 or early AMP7 may also present a risk to the successful delivery of these schemes, and so the timing of the Itchen SR may need to be delayed until the schemes are in place (although note that SWS intends to implement the reduced limits on abstractions from June to August in a phased way now; it is the implementation of the 2nd phase, the minimum flow constraint element, that would be delayed).

The current infrastructure and abstraction licence already allows the Environment Agency to operate the groundwater scheme for river augmentation to support low-flows in the River Itchen, subject to undertaking the preparatory actions set out in the River Itchen SAC Site Action Plan (SAP), and that the health of the crayfish population is confirmed by survey prior to operation. Operation of the existing scheme cannot therefore be guaranteed, but through its use the Environment Agency would contribute to partial implementation of the River Itchen Sustainability Reductions.

For the **HR9c Non-potable water reuse at industrial site** option there are a number of potential moderate to minor adverse effects against the SEA objectives, mainly related to the works required for a new main connecting into existing mains within and close to protected sites. Potential temporary moderate adverse effects are identified as a result of the installation of a new main where it runs along the A326 and the requirement for a railway line crossing; these impacts are likely to be effectively mitigated by traffic management measures for works on the main road, and directional drilling under the railway line. Adverse moderate effects may also arise in relation to the landscape objective where the main runs through the New Forest National Park, though impacts will be restricted mainly to the outskirts of the Park boundary and will be limited to the construction period. Depending on the time of year that the works are undertaken, this option could also result in a major adverse effect in relation to the sub-objective to protect and enhance recreation and amenity facilities due to potential traffic disruption especially during peak visitor periods to the Park. Assuming works are undertaken outside key visitor periods and traffic management plans are implemented, effects on traffic are identified to be moderate adverse. Construction works may also adversely affect the designated sites (New Forest designated SAC, SPA, Ramsar and SSSI) and Southampton Water (designated SPA, Ramsar, SAC and SSSI), which could be affected by construction noise, vibration from the directional drill and other general risks associated with construction. An Appropriate Assessment of this proposal is likely to be required. For the purposes of the SEA and HRA of the revised dWRMP, the option has been assessed on the basis that there will be strictly no encroachment into the designated sites. Further work to identify specific risks and an appropriate mitigation strategy will include habitat and protected species surveys of the route and working corridor. Planning and design of the pipeline route in consultation with EA and Natural England will be fundamental to ensuring that the option can be implemented without resulting in significant environmental effects. Furthermore, the proposed pipeline route passes close to two Scheduled Monuments. A desk study of the possible route will be required to inform the selection of the final route to avoid adverse effects on such assets. During operation, future climate change may alter the availability of effluent to supply this option, although no specific mitigation measures are identified to address this potentially minor adverse impact. A further major adverse impact associated with this option is the relatively high energy use associated with the new MBR and RO plant required at the WWTW.

For the **IWR1 5MI/d water reuse** option, the main environmental issues are likely to arise due to the need for a pipeline to transfer treated water to the Eastern Yar. The pipeline route will most likely run through an AONB, with the possibility of encountering protected species along the route, which will require mitigation, and the potential to impact on unknown buried archaeology. The treated effluent is likely to comprise a significant proportion of the natural flow in the Eastern Yar, and therefore quality of the effluent will be critical, requiring detailed discussion and agreement of discharge consents with the EA, but also raising potential public perception issues.

For the **HTD4 10MI/d Desalination** option, there are possible impacts on the Solent Maritime SAC and Solent & Southampton Water SPA Ramsar from discharge of desalination effluent. The strategic HRA concluded that considering in-pipe dilution and distance between the outfall and the designated sites, the discharge is not considered likely to have a significant effect on the qualifying features of these sites; however, further information would be required to confirm this and therefore the scheme would potentially require an Appropriate Assessment. There are potential mitigation options to dilute the discharge or extend the discharge outfall to beyond the designated sites to avoid adverse impacts. Other potential environmental concerns include possible impacts on coastal fisheries, construction of part of the pipeline route through New Forest National Park and adjacent to designated sites, landscape impacts of the pipeline and desalination plant, and energy and carbon costs (although these have been monetised and accounted for within the least cost economic model). A minor beneficial effect has been identified in relation to the objective to minimise the vulnerability of water supply to climate change, as the water provided for supply would not be vulnerable to future climate change, and would make supplies more resilient. If this alternative option were required, detailed investigations and discharge modelling would be required in AMP6.

Option code and name	HSL3 + HST2 Conjunctive use
Selected start date (& WRZ)	2018 (in HS WRZ)
Customer preferences	Not tested explicitly in customer surveys. The DWRMP consultation provided mixed support for the scheme.
Environmental considerations (SEA and HRA)	The impacts of the abstraction for this scheme have been the subject of a detailed study during AMP5 that examined the impact of abstraction at historic and fully licensed rates, due to SSSI designations. This project concluded that the risk of adverse effects on biodiversity, fisheries and river flows was small for the current licence. In order to lower the risk even further, Southern Water has agreed to consider a voluntary change to the licence that would include a reduction to the annual volume. Studies to inform changes for a revised licence are being undertaken, and the Environment Agency has identified that an options appraisal should be undertaken of the Lower Test abstraction as part of its Restoring Sustainable Abstraction programme, to be completed by December 2015. The pipeline route and its construction has been the subject of detailed engineering and environmental investigations, including protected species surveys (Atkins, 2012). This work was undertaken in support of an EIA for a planning application for the proposed scheme, but has not yet been submitted. The route has been modified in order to avoid impacts where feasible, and mitigation has been developed for residual risks. It has been concluded that the majority of the impacts on biodiversity, habitats and species associated with the pipeline can be mitigated successfully, using appropriate techniques, and by avoiding sensitive periods of the year. Compensatory measures are proposed for the installation of the pipeline across the Test Valley SSSI. Based on the conclusions of the AMP5 studies completed to date and the detailed design and mitigation programme that has been developed for the pipeline route as part of the preliminary EIA work, it has been concluded within the SEA that the impacts of this option against the Biodiversity, Fisheries and Water SEA objectives are all minor adverse. The environmental assessment process to date has identified potential impacts on the historic environment associated with the construction of the pipeline. A draft heritage/archaeological assessment has been completed as part of the preparatory EIA work for this option (Atkins, 2012), but is unpublished at the time of writing. The pipeline route has been examined and detailed mitigation measures have been proposed to manage the potential impacts. There are potential impacts on the landscape and visual environment associated with the construction of the pipeline and associated infrastructure for HSL3+HST2. Impacts are also associated with the loss of trees and hedgerows. A draft landscape and visual assessment (LVIA) has been completed as part of the preparatory EIA work for this option (Atkins 2012), but is unpublished at the time of writing. The pipeline route has been examined and detailed mitigation measures have been proposed to manage the potential impacts. The LVIA completed in draft to date has proposed mitigation measures through the design process. These principally relate to amendment of the pipeline route for avoidance of key landscape features such as veteran trees and hedgerows, and replacement or translocation of trees and hedgerows where necessary. Given the detailed assessment work that has been undertaken to date, and the level of mitigation already developed, the SEA has concluded that the potential landscape effects of this option are minor adverse.
Risks and uncertainties (including planning)	However, the ongoing technical assessments have enabled Southern Water to conclude that this scheme should not be operated under the terms of the existing abstraction licence at the River Test WSW, but under an amended licence. The licence changes would enable Southern Water to continue to meet its water resource responsibilities, whilst providing additional protection to the environment. This additional environmental protection will be afforded through reducing the annual quantity of water that can be abstracted at the River Test WSW. Other potential conditions and restrictions, such as monthly limits on abstraction under different levels of flow in the river, are currently being discussed with the Environment Agency and Natural England. Any new licence would also include a new level of river flow below which Southern Water would need to cease abstracting water. With regard to the transfer main, a planning application and EIA would be required. The most significant planning issues are expected to relate to temporary landscape, traffic and other construction impacts, together with impacts arising from any permanent new structures.
Lead in times for option development & feasibility studies	The scheme has been investigated during AMP5. Subject to the completion of the RSA options appraisal, and confirmation of any sustainability reduction by the Environment Agency in the next NEP programme (January 2016), Southern Water is proposing to voluntarily apply for certain changes to the licence. Once the licence changes have been agreed by the Environment Agency, Southern Water would then submit applications to seek planning permission for the construction of the scheme. Once the licence has been amended and planning permissions granted, Southern Water would be able to construct the scheme.
Sustainable and resilient solution, WRSE regional driver	Abstraction licences may contain conditions that restrict abstractions during periods of low-flow, so that sufficient residual flows remain in the river for environmental purposes. Low-flow periods are taken into consideration when the terms of abstraction licences are set in order to protect the environmental flow requirements.
Alternative options selected in least cost investment model	If this option were no longer available, and if aiming to meet the full implementation of the Itchen SR in 2018, the key strategic alternatives would be the selection of: • The earlier introduction of the IWL6 Groundwater rehabilitation option in 2018 (rather than 2027); • The need for the PDO variant of the J03a groundwater augmentation option (rather than the MDO variant selected in the preferred plan); • The HR9c Non-potable water reuse at industrial site option, which would be required in 2019;

	The earlier introduction of T-HSO-3d increase bulk supply from PWCo to HS by 5MI/d (contingent on PWCo-SN bulk supply reduction) in 2021 (rather than 2024). Under this scenario where the HSL3+HST2 conjunctive use option is not available, there is an unsolvable deficit of 9MI/d in 2018 in HS at MDO due to the implementation of the Itchen Sustainability Reduction in full at that point. The timing of the Itchen SR would therefore need to be delayed. Bringing forward the alternative schemes for delivery in AMP6 or early AMP7 may also present a risk to the successful delivery of these schemes, and so the timing of the Itchen SR may need to be delayed until the schemes are in place (although note that SWS intends to implement the reduced limits on abstractions from June to August in a phased way now; it is the implementation of the 2nd phase, the minimum flow constraint element, that would be delayed). For the HR9c Non-potable water reuse at industrial site option there are a number of potential moderate to minor adverse effects against the SEA objectives, mainly related to the works required for a new main connecting into existing mains within and close to protected sites. Potential temporary moderate adverse effects are identified as a result of the installation of a new main where it runs along the A326 and the requirement for a railway line crossing; these impacts are likely to be effectively mitigated by traffic management measures for works on the main road, and directional drilling under the railway line. Adverse moderate effects may also arise in relation to the landscape objective where the main runs through the New Forest National Park, though impacts will be restricted mainly to the outskirts of the Park boundary and will be limited to the construction period. Depending on the time of year that the works are undertaken, this option could also result in a major adverse effect in relation to the sub-objective to protect and enhance recreation and amenity facilities due to potential traffic disruption especially during peak visitor periods to the Park. Assuming works are undertaken outside key visitor periods and traffic management plans are implemented, effects on traffic are identified to be moderate adverse. Construction works may also adversely affect the designated sites (New Forest designated SAC, SPA, Ramsar and SSSI) and Southampton Water (designated SPA, Ramsar, SAC and SSSI), which could be affected by construction noise, vibration from the directional drill and other general risks associated with construction. An Appropriate Assessment of this proposal is likely to be required. For the purposes of the SEA and HRA of the revised dWRMP, the option has been assessed on the basis that there will be strictly no encroachment into the designated sites. Further work to identify specific risks and an appropriate mitigation strategy will include habitat and protected species surveys of the route and working corridor. Planning and design of the pipeline route in consultation with EA & Natural England will be fundamental to ensuring that the option can be implemented without resulting in significant environmental effects. Furthermore, the proposed pipeline route passes close to two Scheduled Monuments. A desk study of the possible route will be required to inform the selection of the final route to avoid adverse effects on such assets. During operation, future climate change may alter the availability of effluent to supply this option, although no specific mitigation measures are identified to address this potentially minor adverse impact. A further major adverse impact associated with this option is the relatively high energy use associated with the new MBR and RO plant required at the WWTW.

Option code and name	HS-WE: Suite of enhanced water efficiency options
Selected start date (& WRZ)	2019 (in HS WRZ)
Customer preferences	Southern Water customers expressed strong support for increased water efficiency options and education during consultation on the draft WRMP and the draft Business Plan for 2015-2020. Ninety two per cent of respondents in the WRMP consultation supported our proposals to continue to set a target to save one litre of water per property per day until 2040. Many commented that this target was modest and should be a minimum, however, customers also appreciate water efficiency options are not able to secure water resources in isolation and should be cost beneficial.
Environmental considerations (SEA and HRA)	From an SEA perspective, achieving water efficiency is considered likely to have a number of minor beneficial effects on the SEA objectives, as it enables best use of existing resources. There are potential minor beneficial impacts against the 'climatic factors' sub objective, as the reduced losses of water should reduce energy consumption associated with sourcing, treating and supplying potable water.
Risks and uncertainties (including planning)	There is general uncertainty over a number of factors influencing the long-term effectiveness of water efficiency measures, including the long term savings associated with many water efficiency devices, how customers use and maintain the devices, and how customer behaviour may change in future.
Lead in times for option development & feasibility studies	It has been assumed that the options in the feasible list will be introduced over a 5 year programme, and that the savings will therefore gradually increase to year 5 of the programme.
Sustainable and resilient solution, WRSE regional driver	These options cannot be considered resilient, as the potential saving cannot be guaranteed at all times of the year under all types of dry year condition, and the options in themselves cannot guarantee that supplies will be available during drought events. However, demand management schemes in general are likely to enhance the resilience of supply side options, because they act to generally reduce demand, which will be beneficial in the run up to a potential or actual drought event.
Alternative options selected in least cost investment model	There is some uncertainty surrounding the potential to achieve the savings estimated for the cost. As a result, a scenario was run which examined what would happen if the savings were not achieved. This is described in Section 9 under demand uncertainty.

Option code and name	IW-WE: Suite of enhanced water efficiency options
Selected start date (& WRZ)	2019 (in IW WRZ)
Customer preferences	Southern Water customers expressed strong support for increased water efficiency options and education during consultation on the draft WRMP and the draft Business Plan for 2015-2020. Ninety two per cent of respondents in the WRMP consultation supported our proposals to continue to set a target to save one litre of water per property per day until 2040. Many commented that this target was modest and should be a minimum, however, customers also appreciate water efficiency options are not able to secure water resources in isolation and should be cost beneficial.
Environmental considerations (SEA and HRA)	From an SEA perspective, achieving water efficiency is considered likely to have a number of minor beneficial effects on the SEA objectives, as it enables best use of existing resources. There are potential minor beneficial impacts against the 'climatic factors' sub objective, as the reduced losses of water should reduce energy consumption associated with sourcing, treating and supplying potable water.
Risks and uncertainties (including planning)	There is general uncertainty over a number of factors influencing the long-term effectiveness of water efficiency measures, including the long term savings associated with many water efficiency devices, how customers use and maintain the devices, and how customer behaviour may change in future.
Lead in times for option development & feasibility studies	It has been assumed that the options in the feasible list will be introduced over a 5 year programme, and that the savings will therefore gradually increase to year 5 of the programme.
Sustainable and resilient solution, WRSE regional driver	These options cannot be considered resilient, as the potential saving cannot be guaranteed at all times of the year under all types of dry year condition, and the options in themselves cannot guarantee that supplies will be available during drought events. However, demand management schemes in general are likely to enhance the resilience of supply side options, because they act to generally reduce demand, which will be beneficial in the run up to a potential or actual drought event.
Alternative options selected in least cost investment model	There is some uncertainty surrounding the potential to achieve the savings estimated for the cost. As a result, a scenario was run which examined what would happen if the savings were not achieved. This is described in Section 9 under demand uncertainty.

Option code and name	HS-LR: Leakage reduction in Hampshire South to 4 MI/d below current target level
Selected start date (& WRZ)	2022 – reduction to 2 MI/d below current target level
	2026 – further reduction to 3 MI/d below current target level
	2038 – further reduction to 4 MI/d below current target level
Customer preferences	Customers expressed strong support for further leakage reduction during the pre-consultation and statutory consultation on the draft WRMP and during consultation for the 25-year Strategic Statement and 2015-2020 Business Plan. Customers believe we should set an example by further reducing leakage, however it is generally accepted that there is an economic limit which below a certain point makes other water resource options more cost effective for customers. Customers expect water companies to continue to innovate to find ways to reduce water waste, without increasing customer bills.
Environmental considerations (SEA and HRA)	The leakage reduction options generally have limited environmental effects at the strategic level. Minor adverse effects are associated with the likely need for localised construction works to find and fix leaks and consequent disruption to local transport and householders/communities. However these impacts could be mitigated by appropriate working practices. In the longer term, leakage reduction is compatible with a number of the SEA objectives as it enables the best use of existing resources. There are also potential minor beneficial impacts due to the reduced losses of water which should reduce energy consumption associated with sourcing, treating and supplying potable water
Risks and uncertainties (including planning)	Southern Water already achieves one of the lowest levels of leakage in the country. There may therefore be operational or practical difficulties in reducing leakage significantly further and <u>maintaining it at this new lower level under whatever climatic conditions materialise</u> . Whilst it is quite feasible at a company level to further reduce leakage, pursuing significant targeted reductions in only one or two WRZs may not be technically feasible in terms of "find and fix" procedures and processes, even where the costs may be low enough for all leakage reduction steps to be selected. If the enhanced leakage reduction activity is relaxed, then leakage will gradually rise as pipes deteriorate over time. There may therefore be some residual risk associated with achieving and maintaining leakage at lower levels, as was reflected by the company's experiences from the 2004-06 drought events.
Lead in times for option development & feasibility studies	It takes time to build up the required resources to reduce leakage and maintain it at its lower level, and so there may be a limit to how much reduction can be achieved in any one AMP period in reality.
Sustainable and resilient solution, WRSE regional driver	Leakage reduction options are an essential part of a twin track approach. But it is important to recognise that, below a certain level, it will become increasingly more difficult and particularly costly to reduce leakage further. Whilst leakage reduction can generally contribute to reduced demand and hence reduced need for abstractions, the level of leakage is a function of climatic conditions. If there is, for example, a very cold winter, then leakage will increase due to increased pipe bursts. As a result, it is not possible for companies to guarantee the level of leakage that they can achieve in any given year.
Alternative options selected in least cost investment model	Not tested

Option code and name	T-HSO-3d increase bulk supply from PWCo to HS by 5MI/d (contingent on PWCo-SN bulk supply reduction)
Selected start date (& WRZ)	2024 (in HS WRZ)
Customer preferences	The trading of water between neighbouring water companies was supported by 81 per cent of respondents during the public consultation. Many customers feel the extension of a water network in the South East is beneficial and secures a more reliable supply, however, this must be dependent on the water being available without further impact on the environment or to the detriment of supplies to the company's own customers.
Environmental considerations (SEA and HRA)	This option utilises the infrastructure installed in AMP6 for T-HSO-3a 10MI/d bulk supply (with 30MI/d infrastructure) from PWCo option. Therefore, the pipeline route will already be in place. The ability of PWCo to provide the additional water volume is dependent on the reduction of the existing supply to Sussex North from 15MI/d at PDO and MDO to 10MI/d in those periods. This therefore allows the "spare" 5MI/d of water to be supplied to Hampshire south instead. Thus the total amount of water supplied by Portsmouth Water to Southern Water is effectively fixed at 25MI/d, and this is provided from existing PWC sources without the need for new resource developments by PWC.
Risks and uncertainties (including planning)	The key risks and uncertainties associated with this bulk supply option relate to reaching a commercial agreement with the supplier, Portsmouth Water, and the availability of sufficient quantities of the bulk supply for use by Southern Water customers during critical drought events. This option effectively helps to spread the risk of shortfalls in supplies between Southern Water's Western and Central regions. Droughts do not necessarily affect all areas in the same way, and so it may be that a given drought event affects the Central Area more than the Western (or vice-versa). This option allowed Southern Water to optimise its supplies in the region that is worst affected.
Lead in times for option development & feasibility studies	There should be limited option development, as it is anticipated that the reduced water from the Portsmouth Water to SN supply can be distributed within Portsmouth Water's existing network, and that the additional supply to Hampshire South will be taken from Portsmouth Water's River Itchen source. The infrastructure required would already have been developed as part of T-HSO-3a. It has been assumed that the PWCo to SN bulk supply could be reduced from 2020 onwards, as this allows time for sufficient options to be available in the Central Area to re-balance supply and demand.
Sustainable and resilient solution, WRSE regional driver	Most bulk supplies are subject to commercial agreements, which often stipulate some form of "pain share" in the event of a drought which affects both transacting companies. This could therefore reduce the resilience of the option. The commercial arrangements for the bulk supply are yet to be discussed in detail.
Alternative options selected in least cost investment model	This was tested and described under the alternatives for the T-HSO-3a 10MI/d Bulk supply from PWCo above. In summary, if this option were no longer available, the key strategic alternatives would be the selection of: • The earlier introduction of the IWL6 Groundwater rehabilitation option in 2017 (rather than 2027); • The HR9c Non-potable water reuse at industrial site option, which would be required in 2019; and • The HTD4 25MI/d Desalination option, which would be required in 2024, replacing the HTD2 20MI/d Coastal desalination option. Under this scenario where the PW bulk supply (and subsequent additional future bulk supplies from re-balancing the total PW supply to the Central and Western Areas) are not available, there is an unsolvable deficit of 7MI/d in 2017 on the IW at PDO due to the implementation of the Itchen Sustainability Reduction in full at that point. The timing of the Itchen SR would therefore need to be delayed.

Option code and name	HSC-a and HSC-b Catchment management
Selected start date (& WRZ)	2024 (in HS WRZ)
	Although the scheme is not required to deliver full DO until 2024, it would need to commence in 2015, the start of AMP6, to allow time to achieve and monitor the benefits.
Customer preferences	Ninety six per cent of respondents to the consultation on the draft WRMP supported us working in partnership with landowners, farmers and river trusts to improve the quality and flow of water in rivers and help keep them available for water supplies for longer. The support include organisations such as the Arun and Rother Rivers Trust, the South Downs National Park and Sussex Wildlife Trust who are keen to work in partnership to develop catchment management solutions and evidence their economic and environmental benefits.
Environmental considerations (SEA and HRA)	The catchment management options involve the employment of a Catchment Management Officer or similar to liaise with farmers to promote farming practices and catchment management measures that will reduce the potential for nitrate entering local water resources. Elevated nitrate is a concern as it has to be removed before water can be supplied to customers. These options are identified as having net beneficial environmental effects when assessed against the SEA objectives. There are potential beneficial impacts on soil quality, and the quality of surface and groundwater. Consequentially there are potential beneficial secondary effects on freshwater fisheries. Depending on the exact location of the catchment management actions, there may be potential for the options to positively contribute to delivering WFD objectives, although this would require catchment specific assessment. There are also potential beneficial impacts against the 'climatic factors' sub objective, as the need for reduced treatment of water (nitrate removal) should reduce energy consumption associated with the water supply. The

Risks and uncertainties (including planning)	actual magnitude of these impacts is currently uncertain, as the scale of up-take for the catchment management actions is also uncertain. No mitigation has been identified as being required for this option.
Lead in times for option development & feasibility studies	The realisation of the benefits of catchment management schemes is not certain.
Sustainable and resilient solution, WRSE regional driver	The schemes need to be implemented early in AMP6 to allow sufficient time to build relationships with upstream farmers and to demonstrate that nitrate reductions were being achieved. If not, then there would then still be sufficient time to introduce conventional nitrate technology in AMP7, prior to the nitrate threshold being exceeded.
Alternative options selected in least cost investment model	Catchment management schemes have the potential to provide significant benefits to the environment, in terms of biodiversity and water quality, at relatively low cost, whilst potentially reducing treatment costs and increasing the water available for abstraction.
	Not tested

Option code and name	IWL6 Groundwater rehabilitation
Selected start date (& WRZ)	2027 (in IW WRZ)
Customer preferences	Not tested explicitly in customer surveys. The DWRMP consultation provided little specific comment on this scheme.
Environmental considerations (SEA and HRA)	The option to bring back online a groundwater source on the Isle of Wight (IWL6) has been identified as having minimal environmental impacts, due to limited construction requirements for this option. There is an existing service reservoir and associated supply mains so any required pipelines will be of minimal length, and booster pumps will not be required as the site currently pumps to the service reservoir. Two minor adverse effects have been identified against the biodiversity, flora and fauna and human health and population objectives. Slight impacts may arise in the reinstatement of the reservoir as it has been colonised with red and willow carr providing habitat for birds and amphibians. Badgers have also been reported on site. Site surveys will be required, and a mitigation plan developed prior to recommissioning of the site. There may also be some minor impacts on local residents associated with noise and increased traffic during the construction period, though these risks can be managed through good construction practice.
Risks and uncertainties (including planning)	One uncertainty with the IWL6 groundwater source is the level of iron. The source of the iron is the naturally occurring ferruginous Barton Sands. Treatment to remove the iron prior to entering the existing treatment works will be required. The source has been disused since 1989, so there is some uncertainty over the condition of existing infrastructure (WSR, borehole and borehole screens, rising main).
Lead in times for option development & feasibility studies	Feasibility studies and testing will be required prior to implementation
Sustainable and resilient solution, WRSE regional driver	The cost differential against the preferred scenario is very small, suggesting that the alternative option would be as viable as the preferred solution, and thus any risks associated with this option do not impact on the overall programme, provided the IWL7 Utilise full capacity of existing cross-Solent main option can be implemented in 2028.
Alternative options selected in least cost investment model	If this option were no longer available, the key strategic alternatives would be the selection of: The earlier introduction of the IWL7 Utilise full capacity of existing cross-Solent main option in 2028 (rather than 2032). The SEA has identified only limited environmental effects associated with option IWL7. The option entails the upgrade of existing pumping infrastructure, together with a new service reservoir and water main on the Isle of Wight. This will mean that the full capacity of existing infrastructure can be used to allow delivery of an additional 8Ml/d of water. The main environmental impacts are associated with the construction of the main and small service reservoir, which are located within an AONB. For this reason, the pipeline has been proposed to be routed along local roads as far as possible. This will mean that reinstatement of the pipeline work is likely to be effective within a short timeframe and landscape impacts will be limited. The use of local roads will also reduce the risk of encountering buried archaeology along the pipeline route. However it may also result in some temporary traffic disruption to local residents and road users, which would need to be managed using good practice measures during construction. The environmental effects of this scheme against the SEA objectives have been judged to be negligible or minor adverse at worst.

Option code and name	HTD2 20MI/d Coastal desalination
Selected start date (& WRZ)	2028 (in HS WRZ)
Customer preferences	Ninety two per cent of respondents to the public consultation believe desalination has a role to play in securing water supplies. The support is qualified with concerns about the operating costs and level of energy use and a need for the latest technology and renewable energy to be explored to support a scheme.
Environmental considerations (SEA and HRA)	The site of the proposed desalination plant for option HTD2 within an existing industrial site was selected to minimise possible environmental impacts (on biodiversity, heritage and landscape) from its development in the first instance. As there is existing mains infrastructure close to the site, the option also has the advantage of requiring only a very short new pipeline to connect it to the supply network. The HRA screening concluded that an Appropriate Assessment of impacts on the Solent Maritime SAC and Solent & Southampton Water SPA and Ramsar sites from discharge of desalination effluent (brine) would not be required. Other potential environmental concerns include possible impacts on coastal fisheries, the potential effects on the WFD status of the Southampton Water water body and energy and carbon costs (although these have been monetised and accounted for within the least cost economic model). A minor beneficial effect has been identified in relation to the objective to minimise the vulnerability of water supply to climate change, as the water provided for supply would not be vulnerable to future climate change, and would make supplies more resilient. Although some further work is required to confirm the actual magnitude of some of the potential impacts arising from this scheme, it is considered that mitigation and design changes are likely to be available to reduce the identified effects.
Risks and uncertainties (including planning)	A key technical uncertainty relates to the environmental impact of brine discharge into Southampton Water. Discharge modelling and environmental assessments would therefore be required to ensure that impacts were minimal or could be mitigated. The site is located within the MA1 and MA2 allocations from the Local Plan. The MA1 policy allocates land for housing and therefore a desalination plant would not be acceptable, however the majority of the site falls within the MA2 allocation which is identified for industrial or business use. There is potential for development of a desalination plant within this allocation as it will be classified as industrial use.
Lead in times for option development & feasibility studies	Feasibility studies will be required on this and other desalination options during AMP6.
Sustainable and resilient solution, WRSE regional driver	Desalination options can provide a reliable and resilient water supply during drought events, however, there are obvious concerns regarding the carbon footprint of these schemes, and potential conflicts from the SEA objectives. The cost differential against the preferred scenario is very small, suggesting that the combination of the smaller HTD4 10MI/d desalination scheme and the HR9c Non-potable water reuse at industrial site option would be as viable as the larger HTD2 20MI/d coastal desalination option in preferred solution.
Alternative options selected in least cost investment model	If this option were no longer available, the key strategic alternatives would be the selection of: • The HR9c Non-potable water reuse at industrial site option, which would be required in 2028; and • The HTD4 10MI/d desalination option in 2034; and For the HR9c Non-potable water reuse at industrial site option there are a number of potential moderate to minor adverse effects against the SEA objectives, mainly related to the works required for a new main connecting into existing mains within and close to protected sites. Potential temporary moderate adverse effects are identified as a result of the installation of a new main where it runs along the A326 and the requirement for a railway line crossing; these impacts are likely to be effectively mitigated by traffic management measures for works on the main road, and directional drilling under the railway line. Adverse moderate effects may also arise in relation to the landscape objective where the main runs through the New Forest National Park, though impacts will be restricted mainly to the outskirts of the Park boundary and will be limited to the construction period. Depending on the time of year that the works are undertaken, this option could also result in a major adverse effect in relation to the sub-objective to protect and enhance recreation and amenity facilities due to potential traffic disruption especially during peak visitor periods to the Park. Assuming works are undertaken outside key visitor periods and traffic management plans are implemented, effects on traffic are identified to be moderate adverse. Construction works may also adversely affect the designated sites (New Forest designated SAC, SPA, Ramsar and SSSI) and Southampton Water (designated SPA, Ramsar, SAC and SSSI), which could be affected by construction noise, vibration from the directional drill and other general risks associated with construction. An Appropriate Assessment of this proposal is likely to be required. For the purposes of the SEA and HRA of the revised dWRMP, the option has been assessed on the basis that there will be strictly no encroachment into the designated sites. Further work to identify specific risks and an appropriate mitigation strategy will include habitat and protected species surveys of the route and working corridor. Planning and design of the pipeline route in consultation with EA & Natural England will be fundamental to ensuring that the option can be implemented without resulting in significant environmental effects. Furthermore, the proposed pipeline route passes close to two Scheduled Monuments. A desk study of the possible route will be required to inform the selection of the final route to avoid adverse effects on such assets. During operation, future climate change may alter the availability of effluent to supply this option, although no specific mitigation measures are identified to address this potentially minor adverse impact. A further major adverse impact associated with this option is the relatively high energy use associated with the new MBR and RO plant required at the WWTW. For the HTD4 10MI/d Desalination option, there are possible impacts on the Solent Maritime SAC and Solent & Southampton Water SPA Ramsar from discharge of desalination effluent. The strategic HRA concluded that considering in-pipe dilution and distance between the outfall and the designated sites, the discharge is not considered likely to have a significant effect on the qualifying features of these sites;

	however, further information would be required to confirm this and therefore the scheme would potentially require an Appropriate Assessment. There are potential mitigation options to dilute the discharge or extend the discharge outfall to beyond the designated sites to avoid adverse impacts. Other potential environmental concerns include possible impacts on coastal fisheries, construction of part of the pipeline route through New Forest National Park and adjacent to designated sites, landscape impacts of the pipeline and desalination plant, and energy and carbon costs (although these have been monetised and accounted for within the least cost economic model). A minor beneficial effect has been identified in relation to the objective to minimise the vulnerability of water supply to climate change, as the water provided for supply would not be vulnerable to future climate change, and would make supplies more resilient. If this alternative option were required, detailed investigations and discharge modelling would be required in AMP6.

Option code and name	IWL7 Utilise full capacity of existing cross-Solent main
Selected start date (& WRZ)	2032 (in IW WRZ)
Customer preferences	Not tested explicitly in customer surveys. The DWRMP consultation provided little specific comment on this scheme, although some respondents favoured a scheme or series of schemes that would make the island more self-sufficient in water supplies, and hence rely less on the cross-Solent main supplies from the mainland.
Environmental considerations (SEA and HRA)	The SEA has identified only limited environmental effects associated with option IWL7. The option entails the upgrade of existing pumping infrastructure, together with a new service reservoir and water main on the Isle of Wight. This will mean that the full capacity of existing infrastructure can be used to allow delivery of an additional 8Ml/d of water. The main environmental impacts are associated with the construction of the main and small service reservoir, which are located within an AONB. For this reason, the pipeline has been proposed to be routed along local roads as far as possible. This will mean that reinstatement of the pipeline work is likely to be effective within a short timeframe and landscape impacts will be limited. The use of local roads will also reduce the risk of encountering buried archaeology along the pipeline route. However it may also result in some temporary traffic disruption to local residents and road users, which would need to be managed using good practice measures during construction. The environmental effects of this scheme against the SEA objectives have been judged to be negligible or minor adverse at worst.
Risks and uncertainties (including planning)	The precise nature of the planned works needs to be clarified as any changes to existing pumping station or reservoir structures (or buildings) would be likely to require planning permission. Permission should not be required for additional plant. The works to the WSR would take place within the AONB, a sensitive area in planning and EIA terms.
Lead in times for option development & feasibility studies	Would require detailed feasibility leading to engineering design.
Sustainable and resilient solution, WRSE regional driver	The cost differential against the preferred scenario is relatively small, suggesting that the combination of a smaller desalination scheme IWD1 8.5Ml/d Coastal desalination, which provides improved security of supply to the Isle of Wight through not relying as much on the transfer from the mainland, and the HR9c non-potable water reuse at industrial site option would provide a reasonable alternative solution to the larger HTD2 20Ml/d Coastal desalination option and the upgrade of the cross-Solent main.
Alternative options selected in least cost investment model	If this option were no longer available, the key strategic alternatives would be the selection of: • The HR9c Non-potable water reuse at industrial site option, which would be required in 2028; and • The IWD1 8.5Ml/d Coastal desalination option, which would be required in 2032; and • No longer requiring the HTD2 20Ml/d Coastal desalination option. For the HR9c Non-potable water reuse at industrial site option there are a number of potential moderate to minor adverse effects against the SEA objectives, mainly related to the works required for a new main connecting into existing mains within and close to protected sites. Potential temporary moderate adverse effects are identified as a result of the installation of a new main where it runs along the A326 and the requirement for a railway line crossing; these impacts are likely to be effectively mitigated by traffic management measures for works on the main road, and directional drilling under the railway line. Adverse moderate effects may also arise in relation to the landscape objective where the main runs through the New Forest National Park, though impacts will be restricted mainly to the outskirts of the Park boundary and will be limited to the construction period. Depending on the time of year that the works are undertaken, this option could also result in a major adverse effect in relation to the sub-objective to protect and enhance recreation and amenity facilities due to potential traffic disruption especially during peak visitor periods to the Park. Assuming works are undertaken outside key visitor periods and traffic management plans are implemented, effects on traffic are identified to be moderate adverse. Construction works may also adversely affect the designated sites (New Forest designated SAC, SPA, Ramsar and SSSI) and Southampton Water (designated SPA, Ramsar, SAC and SSSI), which could be affected by construction noise, vibration from the directional drill and other general risks associated with construction. An Appropriate Assessment of this proposal is likely to be required. For the purposes of the SEA and HRA of the revised dWRMP, the option has been assessed on the basis that there will be strictly no encroachment into the designated sites. Further work to identify specific risks and an appropriate mitigation strategy will include habitat and protected species surveys of the route and working corridor. Planning and design of the pipeline route in consultation with EA & Natural England will be fundamental to ensuring that the option can be implemented without resulting in significant environmental effects. Furthermore, the proposed pipeline route passes close to two Scheduled Monuments. A desk study of the possible route will be required to inform the selection of the final route to avoid adverse effects on such assets. During operation, future climate change may alter the availability of effluent to supply this option, although no specific mitigation measures are identified to

	address this potentially minor adverse impact. A further major adverse impact associated with this option is the relatively high energy use associated with the new MBR and RO plant required at the WWTW. For the IWD1 8.5MI/d Coastal desalination option, there are a number of environmental concerns. The option has been identified as potentially having major adverse effects against the biodiversity objective principally as the brine discharge from the plant could adversely affect marine habitats and species immediately around the outfall and in the South Wight Maritime SAC, and the intake of water may result in a loss of marine flora and fauna due to entrainment and impingement. The location and potential impacts of the brine outfall plume on the designated coastal sites will need to be fully assessed. The strategic HRA concluded that there is insufficient information on the nature of the proposal and likely impacts at this strategic stage to allow a conclusion to be reached regarding the potential for significant effects on the integrity of the South Wight Maritime SAC, therefore an Appropriate Assessment would be required on a more detailed design of this option to determine the likely effects of the desalination plant and implications for the features and integrity of the site. For the same reasons the option may have a moderate adverse effect on local coastal fisheries and shell fisheries and on water quality. This option also would result in very high carbon emissions both during construction and, mainly, during operation, resulting in a major adverse effect against the sub-objective to reduce greenhouse gas emissions. A minor beneficial effect has been identified in relation to the objective to minimise the vulnerability of water supply to climate change, as the water provided for supply would not be vulnerable to future climate change, and would make supplies more resilient. The WWTW is identified as being within the indicative floodplain, which could make the supply vulnerable to future flood risk caused by climate change.

Option code and name	HK-WE: Suite of enhanced water efficiency options
Selected start date (& WRZ)	2033-2035 (in HK WRZ)
Customer preferences	Southern Water customers expressed strong support for increased water efficiency options and education during consultation on the draft WRMP and the draft Business Plan for 2015-2020. Ninety two per cent of respondents in the WRMP consultation supported our proposals to continue to set a target to save one litre of water per property per day until 2040. Many commented that this target was modest and should be a minimum, however, customers also appreciate water efficiency options are not able to secure water resources in isolation and should be cost beneficial.
Environmental considerations (SEA and HRA)	From an SEA perspective, achieving water efficiency is considered likely to have a number of minor beneficial effects on the SEA objectives, as it enables best use of existing resources. There are potential minor beneficial impacts against the 'climatic factors' sub objective, as the reduced losses of water should reduce energy consumption associated with sourcing, treating and supplying potable water.
Risks and uncertainties (including planning)	There is general uncertainty over a number of factors influencing the long-term effectiveness of water efficiency measures, including the long term savings associated with many water efficiency devices, how customers use and maintain the devices, and how customer behaviour may change in future.
Lead in times for option development & feasibility studies	It has been assumed that the options in the feasible list will be introduced over a 5 year programme, and that the savings will therefore gradually increase to year 5 of the programme.
Sustainable and resilient solution, WRSE regional driver	These options cannot be considered resilient, as the potential saving cannot be guaranteed at all times of the year under all types of dry year condition, and the options in themselves cannot guarantee that supplies will be available during drought events. However, demand management schemes in general are likely to enhance the resilience of supply side options, because they act to generally reduce demand, which will be beneficial in the run up to a potential or actual drought event.
Alternative options selected in least cost investment model	There is some uncertainty surrounding the potential to achieve the savings estimated for the cost. As a result, a scenario was run which examined what would happen if the savings were not achieved. This is described in Section 9 under demand uncertainty.

Option code and name	HK-LR: Leakage reduction in Hampshire Kingsclere to 0.2 MI/d below current target level
Selected start date (& WRZ)	2038 (in HK WRZ)
Customer preferences	Customers expressed strong support for further leakage reduction during the pre-consultation and statutory consultation on the draft WRMP and during consultation for the 25-year Strategic Statement and 2015-2020 Business Plan. Customers believe we should set an example by further reducing leakage, however it is generally accepted that there is an economic limit which below a certain point makes other water resource options more cost effective for customers. Customers expect water companies to continue to innovate to find ways to reduce water waste, without increasing customer bills.
Environmental considerations (SEA and HRA)	The leakage reduction options generally have limited environmental effects at the strategic level. Minor adverse effects are associated with the likely need for localised construction works to find and fix leaks and consequent disruption to local transport and householders/communities. However these impacts could be mitigated by appropriate working practices. In the longer term, leakage reduction is compatible with a number of the SEA objectives as it enables the best use of existing resources. There are also potential minor beneficial impacts due to the reduced losses of water which should reduce energy consumption associated with sourcing, treating and supplying potable water

Risks and uncertainties (including planning)	Southern Water already achieves one of the lowest levels of leakage in the country. There may therefore be operational or practical difficulties in reducing leakage significantly further and <u>maintaining it at this new lower level under whatever climatic conditions materialise</u>. Whilst it is quite feasible at a company level to further reduce leakage, pursuing significant targeted reductions in only one or two WRZs may not be technically feasible in terms of “find and fix” procedures and processes, even where the costs may be low enough for all leakage reduction steps to be selected. If the enhanced leakage reduction activity is relaxed, then leakage will gradually rise as pipes deteriorate over time. There may therefore be some residual risk associated with achieving and maintaining leakage at lower levels, as was reflected by the company’s experiences from the 2004-06 drought events.
Lead in times for option development & feasibility studies	It takes time to build up the required resources to reduce leakage and maintain it at its lower level, and so there may be a limit to how much reduction can be achieved in any one AMP period in reality.
Sustainable and resilient solution, WRSE regional driver	Leakage reduction options are an essential part of a twin track approach. But it is important to recognise that, below a certain level, it will become increasingly more difficult and particularly costly to reduce leakage further. Whilst leakage reduction can generally contribute to reduced demand and hence reduced need for abstractions, the level of leakage is a function of climatic conditions. If there is, for example, a very cold winter, then leakage will increase due to increased pipe bursts. As a result, it is not possible for companies to guarantee the level of leakage that they can achieve in any given year.
Alternative options selected in least cost investment model	Not tested

Alternative pathways to the delivery of the Sustainability Reductions

- 10.77. Some consultation responses raised concerns about the risks to timely delivery of the Itchen Sustainability Reduction, and in relation to the three main options in the preferred plan for the Western Area in the dWRMP: the HSL3+HST2 conjunctive use scheme, the JO3a groundwater scheme for river augmentation and the T-HSO-3a bulk supply from Portsmouth Water. As discussed earlier, delivery of all of these three options, or alternatives to these options, is required to allow the Sustainability Reduction to be implemented in full (i.e. Phase 3), as soon as possible. Nevertheless, as noted previously (para. 10.28-10.31), Southern Water has proposed in principle to implement the Sustainability Reduction in a phased manner, meaning that Phase 1, which addresses changes to monthly licence totals, could still be implemented in 2015.

Confidence in the delivery of proposed schemes

- 10.78. The outcome of this work is that we do not consider that there are risks to the delivery of the T-HSO-3a bulk supply from Portsmouth Water that cannot be mitigated, such that we can remain confident that it is a deliverable option.
- 10.79. We also remain confident that the HSL3+HST2 conjunctive use scheme and the JO3a groundwater scheme for river augmentation also remain as deliverable options within our preferred plan. However, in response to requests for an explanation of the potential risks and delivery timetable for the sustainability reductions, should either or both of these schemes prove not to be deliverable in the timescales assumed within our preferred plan, we have completed additional analysis as summarised below. This analysis also considers various ‘what if’ scenarios relating to the RSA options appraisal of the Lower Test abstraction, at a range of different scales of potential sustainability reduction. It should be noted that no sustainability reduction has been notified for that source, and the WRMP is not allowed to take into account future un-notified reductions. These scenarios are included here solely to assist in demonstrating the range of potential alternative strategies available to Southern Water to meet its future supply demand balance – in effect, highlighting the robustness of the options available for selection in the Plan under a range of hypothetical scenarios.

Timelines of the preferred and alternative strategies

- 10.80. Figure 10.1, below, highlights the various potential alternative strategies that could be adopted, should either or both of the HSL3+HST2 conjunctive use scheme and the JO3a groundwater scheme for river augmentation not prove to be deliverable, and/or any future sustainability reduction be notified for the Lower Test abstraction under the next NEP programme.
- 10.81. The timeline highlights the options that the model selects under the different strategies, and the timing of the options that would be required to be delivered. The timeline also highlights the

likely timescale for implementing the final Phase 3 of the River Itchen Sustainability Reductions. The earlier Phases would already have been implemented.

What if one or more of the major schemes can't be delivered?

- 10.82. If either or both of the HSL3+HST2 conjunctive use scheme and the JO3a groundwater scheme for river augmentation prove not to be deliverable, then the full implementation date for the River Itchen Sustainability Reductions shifts backwards accordingly, whilst alternative options are promoted and delivered. Should there be sustainability reductions notified for the Lower Test abstraction in addition, this would add to the delay to the full implementation date for the River Itchen Sustainability Reductions. In order to provide some mitigation against any delays Southern Water will be investigating the alternative schemes outlined above in parallel with the preferred schemes. However, the alternative schemes will require design and environmental investigations to be undertaken before they can be progressed further. Figure 10.1 outlines the alternative timescales and Southern Water will try to fast track these alternatives as quickly as possible.
- 10.83. The current infrastructure and abstraction licence already allows the Environment Agency to operate the JO3a groundwater scheme for river augmentation to support low-flows in the River Itchen, subject to undertaking the preparatory actions set out in the River Itchen SAC Site Action Plan (SAP), and that the health of the crayfish population is confirmed by survey prior to operation. Operation of the existing scheme cannot therefore be guaranteed, but through its use the Environment Agency would contribute to partial implementation of the River Itchen Sustainability Reductions.
- 10.84. Under the different scenarios that have been assessed, the supply demand balance can be met but with a delay to the full implementation date for the River Itchen Sustainability Reductions. There is also additional cost to customers, and a significant additional cost under certain scenarios.
- 10.85. If either of the HSL3+HST2 conjunctive use scheme and the JO3a groundwater scheme for river augmentation prove not to be deliverable, then the HR9c non-potable water reuse at an industrial site scheme is required in early AMP7. The implementation of the final Phase of the Itchen Sustainability Reduction is likely to be delayed until at least 2021 as a result of the time required to investigate, secure consents and construct this scheme. Southern Water could not allow the implementation of the final Phase of the Itchen SR until the alternative water resource scheme was in place and operational. The scheme to receive an additional 5MI/d bulk supply from Portsmouth Water would also need to be brought forward to 2020 (and as this means that 5MI/d less bulk supply would be provided to the Central Area, would trigger the need for replacement schemes for the Central Area to be in place in 2020).
- 10.86. If both the HSL3+HST2 conjunctive use scheme and the JO3a groundwater scheme for river augmentation prove not to be deliverable, then additional desalination would be required – in the order of 45MI/d in Hampshire. The first 25MI/d of desalination capacity would be required in 2021, with an additional 20MI/d around 2029. The time required to investigate, secure consents and construct a significant desalination plant to be delivered early in AMP7 could mean that the final Phase of the Itchen Sustainability Reduction is delayed beyond 2021 as a result. Southern Water would not be able to implement the final Phase of the Itchen SR until the alternative water resource scheme was in place and operational.
- 10.87. However, it is critical to recall that the water abstracted under **Southern Water's abstraction licences do not have an actual adverse impact on the River Itchen under normal environmental conditions**. It is the **risk** that they could have an adverse impact **under specific low flow conditions** that is the reason for the Environment Agency notifying Southern Water that its licence must be changed as a Sustainability Reduction.
- 10.88. Irrespective of whether the HSL3 + HST2 conjunctive use scheme itself is ultimately promoted, the pipeline element of the scheme that would enable Southern Water to move large quantities of water between sources and areas of supply would be expected to be required in any event. This requirement for the pipeline scheme would be increasingly important should the need for the 45MI/d desalination plant proceed, or should other large scale water resource schemes be developed, as water resources would need to be transferred from the west to east of the Hampshire South WRZ to ensure supplies to customers can be protected.

- 10.89. In the event of the Environment Agency concluding under its Restoring Sustainable Abstraction (RSA) programme that a Sustainability Reduction to the Lower Test abstraction is required, the potential alternative options required would depend on the magnitude of any resulting Sustainability Reduction. As an extreme scenario, for example, if a Sustainability Reduction was imposed which reduced the deployable output of the Lower Test abstraction to zero, the implementation of this Sustainability Reduction, and consequently the full implementation of the Itchen Sustainability Reduction, would be significantly delayed. For assessment purposes, it was assumed that implementation of both Sustainability reductions would not be until 2025 at the earliest (conditional on the delivery of alternative water resource schemes).
- 10.90. Under the above extreme scenario, large scale desalination up to potentially 130MI/d would be required in Hampshire, and an additional IoW water resources scheme would be required – this could be a water reuse scheme or a desalination scheme (up to 15MI/d). Investigations of these and other alternative options would therefore be required in AMP6, with a view to promoting and securing planning consent during AMP7. The cost of such a scenario would be very significant – around £180M more than the company's preferred plan, in NPV terms.

The potential role of Catchment Management Solutions

- 10.91. Southern Water recognises and values the contribution that catchment management solutions can play in making our water environment more resilient to changing climatic conditions, and in delivering permanent environmental improvements in our rivers. Catchment management solutions have, to date, proved difficult to quantify in sufficiently robust and certain terms that can meet the requirements of a WRMP process that focuses on achieving a supply demand balance. However, Southern Water is committed to exploring with other stakeholders the potential for catchment management not only as part of the Western Area strategy that is necessary to meet the challenges posed by the notified River Itchen sustainability reductions, and/or in response to any potential future sustainability reductions that may be considered, but also as part of more integrated management of the water environment. The Company believes that such solutions may well provide the best outcomes for both customers and the environment.

Future investigations

- 10.92. As noted in para.10.82 above, Southern Water will be investigating the alternative schemes outlined previously in parallel with the preferred schemes in order to provide some mitigation against delays to the implementation of the River Itchen Sustainability Reductions.
- 10.93. Southern Water will therefore commence investigations on the following alternative options in parallel with its work to support delivery of the preferred schemes:
- Test & Itchen catchment management options & river restoration pilots
 - HR9c non-potable water reuse at industrial site
 - Desalination option(s) (Hants & Isle of Wight)
 - IWL7 utilise full capacity of the existing cross-Solent main
 - IWL6 groundwater rehabilitation
 - Isle of Wight water reuse options (IWR1)
- 10.94. The future investigations for the Western area, and the Central and Eastern Areas, is described further in Table 10.7, at the end of Section 10, and detailed timelines are also provided in Appendix J02.
- 10.95. Figure 10.1 below presents a timeline of schemes to be promoted and delivered under the preferred plan and various alternative scenarios, discussed previously.



Overview of the Final Plan for the Central Area

Summary of the Central Area strategy

- 10.96. Table 10.3 presents a summary of the Central Area strategy, including baseline assumptions relating to the supply demand balance, assumptions regarding changes to the supply demand balance during the planning period (in *italics*), and the options selected as part of the preferred plan (in **bold**).

Table 10.3 Summary of the water resources strategy and key SDB considerations – Central Area

Period	Summary of options selected and SDB considerations in the Central Area
Baseline	• <i>Completion of Universal Metering Programme by end of AMP5</i> • <i>Continuation of baseline water efficiency activity throughout the planning period</i> • <i>Maintain leakage at agreed Ofwat target (unless leakage reduction option is selected as least cost)</i> • <i>Stochastic approach to calculation of deployable outputs from 2019/20</i> • <i>Inclusion of climate change impacts on supply and demand</i> • <i>Use of existing internal transfer between SN and SW</i>
During AMP6 (2015-20)	• Investigations – NEPs, feasibility studies and enabling investigations • <i>Nitrate issues resulting in DO reduction at 2 sources in SB and 2 in SW in 2016</i> • SBC-a, SBC-d, SWC-a, SWC-b conventional & catchment management (to address nitrate pollution issues) • Leakage reduction to 0.5 MI/d below current target level in Sussex Worthing in 2016 and additional 0.5 MI/d reduction before the end of AMP6 • N8a winter transfer stage 1 in 2018 (replacing mains to relieve pressure issues and allow Weir Wood to enter a 'non consumptive mode' during the winter / spring s) • N10 well field reconfiguration in 2019 (without increase in overall annual abstraction volume) • SW-WE-A, B, C, D water efficiency schemes in 2019 • SB-WE-A, B, C, D water efficiency schemes in 2019
During AMP7 (2020-25)	• Further investigations – ongoing NEPs, feasibility studies and enabling investigations • <i>Reduction of bulk import from Portsmouth Water from 15MI/d to 10MI/d from 2020 onwards to allow water saved to be provided to Hampshire South</i> • CA1 4MI/d MDO aquifer storage & recovery in 2020 • SN-WE-A, B, C, D water efficiency schemes in 2020 • <i>Continuation of existing bulk export of 5.4 MI/d from Weir Wood to South East Water from 2021 onwards</i> • Leakage reduction to 1 MI/d below current target level in Sussex North in 2022 • <i>Nitrate issues resulting in DO reduction at four locations in SB from 2024</i> • Catchment management to address nitrate issues at four sources in SB, 2 sources in SN and 1 source in SW in 2024 • Further leakage reduction to 2 MI/d below current target level in Sussex North in 2024
Last 15 years of the plan (2025-40)	• NR2c 10MI/d water reuse in 2026 • N20 asset enhancement scheme in 2034 • N8b winter transfer stage 2 in 2036 (improvements to turbidity/sludge handling process to ensure treated water is available from the surface water source near Pulborough) • N8c winter transfer stage 3 in 2037 (a transfer schemes between Shoreham to Brighton)
Total cost (NPV over 80 years)	£92.3M

- 10.97. The strategy for the Central Area early in AMP6 requires that the key schemes are selected:
- The **N8a winter transfer** scheme;
 - The **N10 well field reconfiguration**; and
 - The set of **conventional & catchment management** schemes to recover DO from sources affected by nitrate pollution early in AMP6 are developed.
- 10.98. However, the other key consideration is how to optimise the available bulk supplies from Portsmouth Water. Following consultation on the Draft WRMP, Portsmouth Water confirmed that they would be able to provide bulk supplies of up to 25MI/d out of their forecast surplus (i.e. without the need for significant resource developments).
- 10.99. Portsmouth have a current commitment to supply the Sussex North WRZ with 15MI/d at PDO and MDO periods. In addition to this, Portsmouth had offered to supply the remainder of their available surplus, 10MI/d, to Hampshire from their source works on the River Itchen. This formed the basis of the baseline supply demand balances used in testing the least cost plan.
- 10.100. However, in the Western Area, as has been discussed above, there is a significant issue which has arisen from the requirement to implement a Sustainability Reduction on the River Itchen. Consequently, an additional investment model run was developed in which **the Portsmouth Water bulk supply to Sussex North was reduced by 5MI/d** from 2020 (to allow sufficient time for alternative options to be available). This would allow Portsmouth Water's customers to make use of the "released" 5MI/d, while the supply to Hampshire South from Portsmouth's Itchen source works could then be increased by 5MI/d to a total bulk supply of 15 MI/d.
- 10.101. The objective of this was to effectively spread some of the risk of the large sustainability reduction and consequent new resources required in the Western Area with the Central Area.
- 10.102. The effect of this change to the Portsmouth Water bulk supplies was to trigger an additional scheme in the Central Area. The **scheme required to help satisfy the impact of a 5MI/d reduction to the total supplies in Sussex North was a new aquifer storage and recovery scheme (CA1 4MI/d MDO)**, which would be needed in 2020. Such a scheme is currently under investigation and is likely to require further testing in AMP6 to ensure its validity. However, this scheme was also particularly popular with consumers as it provides storage without the landscape impacts seen with surface water reservoirs.
- 10.103. The other key scheme which is in the strategy occurs in the mid-2020s: it is **the NR2c 10MI/d water reuse** scheme. A key outcome from the development of WRMPs is to identify the schemes required in the next AMP, but also to identify what schemes may be necessary further in the future, to allow sufficient time for further investigations and feasibility studies to be carried out.

Timeline of the preferred strategy

- 10.104. Figure 10.2, below, highlights the options that the model selects under the different strategies, and the timing of the options that would be required to be delivered in AMP6 and AMP7.

- 10.110. The results of the assessment of each option against wider strategic criteria than least cost, along with the identification of key alternative strategic options for each option is presented in the Table 10.4 below.

Table 10.4 Summary of the development of the preferred programme of options for the Central Area

Option code and name	SBC-a, SBC-d, SWC-a, SWC-b Conventional & catchment management
Selected start date (& WRZ)	2016 (in SW and SB WRZs)
Customer preferences	Ninety six per cent of respondents to the consultation on the draft WRMP supported us working in partnership with landowners, farmers and river trusts to improve the quality and flow of water in rivers and help keep them available for water supplies for longer. The support include organisations such as the Arun and Rother Rivers Trust, the South Downs National Park and Sussex Wildlife Trust who are keen to work in partnership to develop catchment management solutions and evidence their economic and environmental benefits.
Environmental considerations (SEA and HRA)	The catchment management component of this option involves the employment of a Catchment Management Officer or similar to liaise with farmers to promote farming practices and catchment management measures that will reduce the potential for nitrate entering local water resources. Elevated nitrate is a concern as it has to be removed before water can be supplied to customers. These options are identified as having net beneficial environmental effects when assessed against the SEA objectives. There are potential beneficial impacts on soil quality, and the quality of surface and groundwater. Consequentially there are potential beneficial secondary effects on freshwater fisheries. Depending on the exact location of the catchment management actions, there may be potential for the options to positively contribute to delivering WFD objectives, although this would require catchment specific assessment. There are also potential beneficial impacts against the 'climatic factors' sub objective, as the need for reduced treatment of water (nitrate removal) should reduce energy consumption associated with the water supply. The actual magnitude of these impacts is currently uncertain, as the scale of up-take for the catchment management actions is also uncertain. No mitigation has been identified as being required for this option.
Risks and uncertainties (including planning)	There is limited risks involved with conventional nitrate treatment plant. However, the efficacy of the catchment management to help control nitrates in future is uncertain
Lead in times for option development & feasibility studies	This option is required for sources at imminent risk of exceeding nitrate thresholds. Ongoing monitoring of success of catchment management component at reducing upstream nitrate levels will be required.
Sustainable and resilient solution, WRSE regional driver	Catchment management should, if successful, help extend the life of the conventional treatment plant
Alternative options selected in least cost investment model	Not tested

Option code and name	SW-LR: Leakage reduction in SW to 1 MI/d below current target level
Selected start date	2016 – reduction to 0.5 MI/d below current target level 2019 – further reduction to 1 MI/d below current target level
Customer preferences	Customers expressed strong support for further leakage reduction during the pre-consultation and statutory consultation on the draft WRMP and during consultation for the 25-year Strategic Statement and 2015-2020 Business Plan. Customers believe we should set an example by further reducing leakage, however it is generally accepted that there is an economic limit which below a certain point makes other water resource options more cost effective for customers. Customers expect water companies to continue to innovate to find ways to reduce water waste, without increasing customer bills.
Environmental considerations (SEA and HRA)	The leakage reduction options generally have limited environmental effects at the strategic level. Minor adverse effects are associated with the likely need for localised construction works to find and fix leaks and consequent disruption to local transport and householders/communities. However these impacts could be mitigated by appropriate working practices. In the longer term, leakage reduction is compatible with a number of the SEA objectives as it enables the best use of existing resources. There are also potential minor beneficial impacts due to the reduced losses of water which should reduce energy consumption associated with sourcing, treating and supplying potable water
Risks and uncertainties (including planning)	Southern Water already achieves one of the lowest levels of leakage in the country. There may therefore be operational or practical difficulties in reducing leakage significantly further and <u>maintaining it at this new lower level under whatever climatic conditions materialise</u> . Whilst it is quite feasible at a company level to further reduce leakage, pursuing significant targeted reductions in only one or two WRZs may not be technically feasible in terms of “find and fix” procedures and processes, even where the costs may be low enough for all leakage reduction steps to be selected. If the enhanced leakage reduction activity is relaxed, then leakage will gradually rise as pipes deteriorate over time. There may therefore be some residual risk associated with achieving and maintaining leakage at lower levels, as was reflected by the company’s experiences from the 2004-06 drought events.
Lead in times for option development & feasibility studies	It takes time to build up the required resources to reduce leakage and maintain it at its lower level, and so there may be a limit to how much reduction can be achieved in any one AMP period in reality.
Sustainable and resilient solution, WRSE regional driver	Leakage reduction options are an essential part of a twin track approach. But it is important to recognise that, below a certain level, it will become increasingly more difficult and particularly costly to reduce leakage further. Whilst leakage reduction can generally contribute to reduced demand and hence reduced need for abstractions, the level of leakage is a function of climatic conditions. If there is, for example, a very cold winter, then leakage will increase due to increased pipe bursts. As a result, it is not possible for companies to guarantee the level of leakage that they can achieve in any given year.
Alternative options selected in least cost investment model	Not tested

Option code and name	N8a Winter transfer stage 1
Selected start date (& WRZ)	2018 (in SN WRZ)
Customer preferences	Not tested explicitly in customer surveys. However, there was broad support for the overall Central Area strategy from the DWRMP consultation.
Environmental considerations (SEA and HRA)	The option entails a new main installation to overcome current pressure issues. This allows the surplus water at the WTW near Pulborough during the winter to be utilised. This additional flow can be transferred to Weir Wood reservoir, allowing it to enter non-consumptive mode during the Winter and Spring, which ensures it can be filled even during severe drought events, and hence realise a DO increase. This option is identified as having minor net beneficial environmental effects in relation to the climatic factors objectives, and allowing coastal groundwater sources to be rested and hence increase groundwater capabilities during the summer and autumn of a drought year, increasing resilience to climate change. Additionally, N8a has a small construction footprint and makes use of gravity transfers, therefore no additional pumping is needed, resulting in a minor beneficial effect against the sub-objective to reduce greenhouse gas emissions and maximise sustainable resource use. Limited minor adverse environmental effects are identified related to construction activities. The route of the new main is relatively short and avoids all statutory nature conservation designations, although it passes through some areas of BAP habitat within the floodplain. The use of directional drilling will minimise habitat disturbance although some monitoring of the drill at different stages along the route may be required. There is also a risk of encountering protected species along the pipeline route. To manage potentially adverse impacts, habitat and protected species surveys of the route and working corridor should be undertaken and appropriate construction mitigation measures identified. There is also the possibility of minor impacts if the drilling route disturbs unrecorded archaeology; a desk-based study to determine risk and appropriate trial trenching/investigation of route may be required prior to construction.
Risks and uncertainties (including planning)	The scheme is expected to be relatively low risk. However, see requirement for feasibility studies below

Lead in times for option development & feasibility studies	The scheme requires further detailed modelling and feasibility assessment to ensure that estimated DO's can be achieved.
Sustainable and resilient solution, WRSE regional driver	The option contributes to the resilience of the system, by utilising and storing surplus water during winter for use during peak periods and drought events. It may also facilitate conjunctive use between storage and leakage sources during drought conditions.
Alternative options selected in least cost investment model	If this option were no longer available, the key strategic alternative is the selection of significant amounts of leakage reduction over and above that selected under the preferred scenario: • An additional 2MI/d of leakage reduction in SN down to 4MI/d below the current target level; • 3MI/d of leakage reduction in SB; and • An additional 1MI/d of leakage reduction in SW down to 2MI/d below the current target level The operational feasibility of delivering these significant increases in leakage reduction, and maintaining leakage at the new levels may present a risk to the security of customer supplies if the N8a winter transfer stage 1 option was not able to be delivered

Option code and name	N10 Well field re-configuration
Selected start date (& WRZ)	2019 (in SN WRZ)
Customer preferences	Not tested explicitly in customer surveys. However, there was broad support for the overall Central Area strategy from the DWRMP consultation.
Environmental considerations (SEA and HRA)	The option aims to increase MDO through re-configuration of an existing wellfield so that boreholes are spaced at least 300m apart and better designed to take an even load. This option will require the drilling of a number of test/investigation boreholes and up to 6 production boreholes, with associated pumps, headworks and pipelines. However the full extent of these works are uncertain at this stage. It may also require a new licence application to replace the existing licence. A potential moderate adverse effect is identified in relation to nearby designated sites Arun Valley Ramsar, Arun Valley SPA and Arun Valley SAC sites, and it is likely that a project level HRA will be required at planning stage. Minor adverse effects are also identified in relation to potential impacts on surface and groundwater quality and quantity, and further investigation will be required to assess the significance of these effects. The construction of new boreholes may have a minor adverse impact in relation to loss of arable land. There may also be a minor adverse effect on climate change objectives if there is a requirement for new pumps to be installed. No further impacts were identified at a strategic level.
Risks and uncertainties (including planning)	Limited risks – the scheme will be neutral in terms of volumetric impacts on the water environment, and will have to prove no negative impact on nearby wetland sites in order to gain planning permission.
Lead in times for option development & feasibility studies	It would require a new licence application to replace the existing licence, and, because of potential impact on a SAC, an EIA and project-level Appropriate Assessment, although the risk from this is considered low given the understanding that already exists.
Sustainable and resilient solution, WRSE regional driver	Increases the resilience of the existing wellfield.
Alternative options selected in least cost investment model	If this option were no longer available, the key strategic alternatives would be the selection of: • The earlier introduction of the CA1 4MI/d MDO Aquifer Storage and Recovery option, only by one year, but bringing the option into AMP6 • The introduction of the N1 Irrigation licences management option in 2020; • The earlier introduction of the NR2c 10MI/d Water reuse option in 2021 (rather than 2026); and • Mains renewal in SN in 2020, and increased levels of leakage reduction. There is, however, a small unsolvable deficit in 2020 in SN at MDO of 0.2MI/d. For the N1 Irrigation licences management option the exact impacts are uncertain at this stage, as the level of uptake for the replacement of spray irrigation licences with storage reservoirs is unknown, and therefore the locations of new structures is uncertain. The assumed mitigation principles for this option are that all new reservoirs will be located on farmland, with appropriate siting away from any statutory designations or locally important habitats. The potential for cumulative losses of habitats across the Western Rother area could also be an issue, however cannot be quantified at this stage. The option could have a minor benefit on the River Rother by increasing flows within part of the river during the summer months, however the impact would be spatially limited, as water would still be abstracted downstream at the company's source near Pulborough. Other potential minor adverse impacts include localised, small scale losses of lower grade agricultural land, which could be mitigated or avoided by careful selection of the sites for the new reservoirs. Construction of the reservoirs and any associated pipelines would also require consideration of impacts on local archaeology and heritage. This could be mitigated by avoiding known heritage features, and undertaking appropriate desktop studies and field investigations (if required) to identify any unknown archaeological remains prior to construction. A particular consideration for this option is the location of many of the licences within the South Downs National Park. The addition of numerous small reservoirs and pipelines within the National Park could have cumulative effects on the designated landscape. The SEA has recommended undertaking an overarching landscape and visual impact assessment for this option in order to inform the site selection and a design strategy for the new structures. Design mitigation will need to include the use of grassed earth embankments, grading of the reservoirs into the local landform and the use of screen planting where required.

Option code and name	SB-WE: Suite of enhanced water efficiency options
Selected start date (& WRZ)	2019 (in SB WRZ)
Customer preferences	Southern Water customers expressed strong support for increased water efficiency options and education during consultation on the draft WRMP and the draft Business Plan for 2015-2020. Ninety two per cent of respondents in the WRMP consultation supported our proposals to continue to set a target to save one litre of water per property per day until 2040. Many commented that this target was modest and should be a minimum, however, customers also appreciate water efficiency options are not able to secure water resources in isolation and should be cost beneficial.
Environmental considerations (SEA and HRA)	From an SEA perspective, achieving water efficiency is considered likely to have a number of minor beneficial effects on the SEA objectives, as it enables best use of existing resources. There are potential minor beneficial impacts against the 'climatic factors' sub objective, as the reduced losses of water should reduce energy consumption associated with sourcing, treating and supplying potable water.
Risks and uncertainties (including planning)	There is general uncertainty over a number of factors influencing the long-term effectiveness of water efficiency measures, including the long term savings associated with many water efficiency devices, how customers use and maintain the devices, and how customer behaviour may change in future.
Lead in times for option development & feasibility studies	It has been assumed that the options in the feasible list will be introduced over a 5 year programme, and that the savings will therefore gradually increase to year 5 of the programme.
Sustainable and resilient solution, WRSE regional driver	These options cannot be considered resilient, as the potential saving cannot be guaranteed at all times of the year under all types of dry year condition, and the options in themselves cannot guarantee that supplies will be available during drought events. However, demand management schemes in general are likely to enhance the resilience of supply side options, because they act to generally reduce demand, which will be beneficial in the run up to a potential or actual drought event.
Alternative options selected in least cost investment model	There is some uncertainty surrounding the potential to achieve the savings estimated for the cost. As a result, a scenario was run which examined what would happen if the savings were not achieved. This is described in Section 9 under demand uncertainty.

Option code and name	SW-WE: Suite of enhanced water efficiency options
Selected start date (& WRZ)	2019 (in SW WRZ)
Customer preferences	Southern Water customers expressed strong support for increased water efficiency options and education during consultation on the draft WRMP and the draft Business Plan for 2015-2020. Ninety two per cent of respondents in the WRMP consultation supported our proposals to continue to set a target to save one litre of water per property per day until 2040. Many commented that this target was modest and should be a minimum, however, customers also appreciate water efficiency options are not able to secure water resources in isolation and should be cost beneficial.
Environmental considerations (SEA and HRA)	From an SEA perspective, achieving water efficiency is considered likely to have a number of minor beneficial effects on the SEA objectives, as it enables best use of existing resources. There are potential minor beneficial impacts against the 'climatic factors' sub objective, as the reduced losses of water should reduce energy consumption associated with sourcing, treating and supplying potable water.
Risks and uncertainties (including planning)	There is general uncertainty over a number of factors influencing the long-term effectiveness of water efficiency measures, including the long term savings associated with many water efficiency devices, how customers use and maintain the devices, and how customer behaviour may change in future.
Lead in times for option development & feasibility studies	It has been assumed that the options in the feasible list will be introduced over a 5 year programme, and that the savings will therefore gradually increase to year 5 of the programme.
Sustainable and resilient solution, WRSE regional driver	These options cannot be considered resilient, as the potential saving cannot be guaranteed at all times of the year under all types of dry year condition, and the options in themselves cannot guarantee that supplies will be available during drought events. However, demand management schemes in general are likely to enhance the resilience of supply side options, because they act to generally reduce demand, which will be beneficial in the run up to a potential or actual drought event.
Alternative options selected in least cost investment model	There is some uncertainty surrounding the potential to achieve the savings estimated for the cost. As a result, a scenario was run which examined what would happen if the savings were not achieved. This is described in Section 9 under demand uncertainty.

Option code and name	SN-WE: Suite of enhanced water efficiency options
Selected start date (& WRZ)	2020 (in SN WRZ)
Customer preferences	Southern Water customers expressed strong support for increased water efficiency options and education during consultation on the draft WRMP and the draft Business Plan for 2015-2020. Ninety two per cent of respondents in the WRMP consultation supported our proposals to continue to set a target to save one litre of water per property per day until 2040. Many commented that this target was modest and should be a minimum, however, customers also appreciate water efficiency options are not able to secure water resources in isolation and should be cost beneficial.
Environmental considerations (SEA and HRA)	From an SEA perspective, achieving water efficiency is considered likely to have a number of minor beneficial effects on the SEA objectives, as it enables best use of existing resources. There are potential minor beneficial impacts against the 'climatic factors' sub objective, as the reduced losses of water should reduce energy consumption associated with sourcing, treating and supplying potable water.
Risks and uncertainties (including planning)	There is general uncertainty over a number of factors influencing the long-term effectiveness of water efficiency measures, including the long term savings associated with many water efficiency devices, how customers use and maintain the devices, and how customer behaviour may change in future.
Lead in times for option development & feasibility studies	It has been assumed that the options in the feasible list will be introduced over a 5 year programme, and that the savings will therefore gradually increase to year 5 of the programme.
Sustainable and resilient solution, WRSE regional driver	These options cannot be considered resilient, as the potential saving cannot be guaranteed at all times of the year under all types of dry year condition, and the options in themselves cannot guarantee that supplies will be available during drought events. However, demand management schemes in general are likely to enhance the resilience of supply side options, because they act to generally reduce demand, which will be beneficial in the run up to a potential or actual drought event.
Alternative options selected in least cost investment model	There is some uncertainty surrounding the potential to achieve the savings estimated for the cost. As a result, a scenario was run which examined what would happen if the savings were not achieved. This is described in Section 9 under demand uncertainty.

Option code and name	CA1 4MI/d MDO Aquifer Storage and Recovery
Selected start date (& WRZ)	2020 (in SW WRZ)
Customer preferences	Aquifer Storage and Recovery (ASR) was the first choice for customers for securing future water resources in pre-consultation research. During the consultation, customers continued to show support for the ASR scheme in the Central Area.
Environmental considerations (SEA and HRA)	The environmental applicability of ASR essentially relates to the impacts such a scheme could have on unconfined parts of aquifers that either affect surface water bodies or sources that are currently used for potable water. The option for Lower Greensand aquifer storage and recovery (CA1) has been identified as having minor beneficial effects on the water and climatic factors objectives. The use of 'spare' potable water to inject into the aquifer for later recovery will reduce the need for development of new sources from other surface or groundwater bodies and contribute to the resilience of supply to climate change. However, this option may also give rise to a number of adverse minor impacts associated with the construction period, such as localised impacts on flora and fauna and a risk of encountering unrecorded archaeology during construction of the boreholes and pumping station. The proposed option may also result in temporary, localised traffic disruption and operational noise from the pumping station, though these impacts would be mitigated through appropriate traffic management and design. Two of the boreholes are also potentially located within areas of high grade agricultural land, potentially resulting in small scale losses. Mitigation will need to be developed during the design stage, and further assessment of risks and local ground investigations may be required. One of the three potential abstraction borehole sites lies within the floodplain. Additionally Worthing has a high proportion of land which is susceptible to groundwater flooding due to its geology. By increasing the water stored within the aquifer, this could potentially lead to an increased risk of groundwater flooding. Monitoring of the groundwater levels would therefore be required at the scheme planning stage in order to ensure that the proposals did not increase the risk of groundwater flooding. Abstractions from surface waters to supply the ASR scheme will be taken from within existing abstraction licence limits, therefore no additional water will be abstracted from the aquifer, which is classified as being at Poor quantitative and chemical status under the WFD. There may be a small positive impact on quantitative status as rates of recovery are unlikely to match the quantity of water injected into the aquifer. Conversely if an increase to the abstraction licence is required, this could have an adverse effect on the quantitative status of the groundwater body. Energy requirements for abstraction and injection associated with the ASR may result in a minor adverse effect on carbon emissions.
Risks and uncertainties (including planning)	The chief limitation is the lack of suitable locations in the South East, despite extensive investigations, because of hydrogeological constraints and the need for locations to also be in proximity to existing water supply infrastructure and abstraction boreholes. A number of sites have been identified during investigations in AMP5. Testing of the viability of an ASR scheme at these sites will be ongoing through AMP6. However, there is a risk that the ASR scheme is not technically feasible, or does not provide sufficient yield.

Lead in times for option development & feasibility studies	One AMP period to complete feasibility studies and borehole testing to establish whether the scheme can achieve the yields anticipated.
Sustainable and resilient solution, WRSE regional driver	Provides resilience by storing water when there is excess during winter periods, to allow additional water to be extracted during peak periods and droughts.
Alternative options selected in least cost investment model	If this option were no longer available, the key strategic alternatives would be the selection of: • The introduction of the N1 Irrigation licences management option in 2020; • The earlier introduction of the NR2c 10Ml/d Water reuse option in 2021 (rather than 2026); and • Mains renewal in SN in 2020, and increased levels of leakage reduction. There is, however, a small unsolvable deficit in 2020 in SN at MDO of 0.2Ml/d. For the N1 Irrigation licences management option the exact impacts are uncertain at this stage, as the level of uptake for the replacement of spray irrigation licences with storage reservoirs is unknown, and therefore the locations of new structures is uncertain. The assumed mitigation principles for this option are that all new reservoirs will be located on farmland, with appropriate siting away from any statutory designations or locally important habitats. The potential for cumulative losses of habitats across the Western Rother area could also be an issue, however cannot be quantified at this stage. The option could have a minor benefit on the River Rother by increasing flows within part of the river during the summer months, however the impact would be spatially limited, as water would still be abstracted downstream at the company's source near Pulborough. Other potential minor adverse impacts include localised, small scale losses of lower grade agricultural land, which could be mitigated or avoided by careful selection of the sites for the new reservoirs. Construction of the reservoirs and any associated pipelines would also require consideration of impacts on local archaeology and heritage. This could be mitigated by avoiding known heritage features, and undertaking appropriate desktop studies and field investigations (if required) to identify any unknown archaeological remains prior to construction. A particular consideration for this option is the location of many of the licences within the South Downs National Park. The addition of numerous small reservoirs and pipelines within the National Park could have cumulative effects on the designated landscape. The SEA has recommended undertaking an overarching landscape and visual impact assessment for this option in order to inform the site selection and a design strategy for the new structures. Design mitigation will need to include the use of grassed earth embankments, grading of the reservoirs into the local landform and the use of screen planting where required.

Option code and name	SN-LR: Leakage reduction in SN to 2Ml/d below current target level
Selected start date (& WRZ)	2022 – reduction to 1Ml/d below current target level 2024 – further reduction to 2Ml/d below current target level
Customer preferences	Customers expressed strong support for further leakage reduction during the pre-consultation and statutory consultation on the draft WRMP and during consultation for the 25-year Strategic Statement and 2015-2020 Business Plan. Customers believe we should set an example by further reducing leakage, however it is generally accepted that there is an economic limit which below a certain point makes other water resource options more cost effective for customers. Customers expect water companies to continue to innovate to find ways to reduce water waste, without increasing customer bills.
Environmental considerations (SEA and HRA)	The leakage reduction options generally have limited environmental effects at the strategic level. Minor adverse effects are associated with the likely need for localised construction works to find and fix leaks and consequent disruption to local transport and householders/communities. However these impacts could be mitigated by appropriate working practices. In the longer term, leakage reduction is compatible with a number of the SEA objectives as it enables the best use of existing resources. There are also potential minor beneficial impacts due to the reduced losses of water which should reduce energy consumption associated with sourcing, treating and supplying potable water
Risks and uncertainties (including planning)	Southern Water already achieves one of the lowest levels of leakage in the country. There may therefore be operational or practical difficulties in reducing leakage significantly further and <u>maintaining it at this new lower level under whatever climatic conditions materialise</u>. Whilst it is quite feasible at a company level to further reduce leakage, pursuing significant targeted reductions in only one or two WRZs may not be technically feasible in terms of "find and fix" procedures and processes, even where the costs may be low enough for all leakage reduction steps to be selected. If the enhanced leakage reduction activity is relaxed, then leakage will gradually rise as pipes deteriorate over time. There may therefore be some residual risk associated with achieving and maintaining leakage at lower levels, as was reflected by the company's experiences from the 2004-06 drought events.
Lead in times for option development & feasibility studies	It takes time to build up the required resources to reduce leakage and maintain it at its lower level, and so there may be a limit to how much reduction can be achieved in any one AMP period in reality.
Sustainable and resilient solution, WRSE regional driver	Leakage reduction options are an essential part of a twin track approach. But it is important to recognise that, below a certain level, it will become increasingly more difficult and particularly costly to reduce leakage further. Whilst leakage reduction can generally contribute to reduced demand and hence reduced need for abstractions, the level of leakage is a function of climatic conditions. If there is, for example, a very cold winter, then leakage will increase due to increased pipe bursts. As a result, it is not possible for companies to guarantee the level of leakage that they can achieve in any given year.

Alternative options selected in least cost investment model	Not tested
Option code and name	SBC-b, SBC-c, SBC-e, SBC-f, SNC-a, SNC-b, SWC-c Catchment management
Selected start date (& WRZ)	2024 (in SB, SN & SW WRZs)
	Although the scheme is not required to deliver full DO until 2024, it would need to commence in 2015, the start of AMP6, to allow time to achieve and monitor the benefits.
Customer preferences	Ninety six per cent of respondents to the consultation on the draft WRMP supported us working in partnership with landowners, farmers and river trusts to improve the quality and flow of water in rivers and help keep them available for water supplies for longer. The support include organisations such as the Arun and Rother Rivers Trust, the South Downs National Park and Sussex Wildlife Trust who are keen to work in partnership to develop catchment management solutions and evidence their economic and environmental benefits.
Environmental considerations (SEA and HRA)	The catchment management options involve the employment of a Catchment Management Officer or similar to liaise with farmers to promote farming practices and catchment management measures that will reduce the potential for nitrate entering local water resources. Elevated nitrate is a concern as it has to be removed before water can be supplied to customers. These options are identified as having net beneficial environmental effects when assessed against the SEA objectives. There are potential beneficial impacts on soil quality, and the quality of surface and groundwater. Consequentially there are potential beneficial secondary effects on freshwater fisheries. Depending on the exact location of the catchment management actions, there may be potential for the options to positively contribute to delivering WFD objectives, although this would require catchment specific assessment. There are also potential beneficial impacts against the 'climatic factors' sub objective, as the need for reduced treatment of water (nitrate removal) should reduce energy consumption associated with the water supply. The actual magnitude of these impacts is currently uncertain, as the scale of up-take for the catchment management actions is also uncertain. No mitigation has been identified as being required for this option.
Risks and uncertainties (including planning)	The realisation of the benefits of catchment management schemes is not certain.
Lead in times for option development & feasibility studies	The schemes need to be implemented early in AMP6 to allow sufficient time to build relationships with upstream farmers and to demonstrate that nitrate reductions were being achieved. If not, then there would then still be sufficient time to introduce conventional nitrate technology in AMP7, prior to the nitrate threshold being exceeded.
Sustainable and resilient solution, WRSE regional driver	Catchment management schemes have the potential to provide significant benefits to the environment, in terms of biodiversity and water quality, at relatively low cost, whilst potentially reducing treatment costs and increasing the water available for abstraction.
Alternative options selected in least cost investment model	Not tested

Option code and name	NR2c 10MI/d Water reuse
Selected start date (& WRZ)	2026 (in SN WRZ)
Customer preferences	Extensive customer research during the pre-consultation of the draft WRMP showed strong support for water re-use as an option to secure resilient water supplies. This was reinforced by 96 per cent of customers agreeing water re-use has a role to play in securing water supplies during the public consultation. Customer research shared by Thames Water, South East Water and Anglian Water, as part of a collaborative working group on water re-use, also indicates customers recognise the benefits of schemes, provided there are no adverse impacts on public or environmental health. Customers are keen to see water re-use explored for industry and agriculture.
Environmental considerations (SEA and HRA)	The proposed option is to transfer 10 MI/d of treated effluent from the WWTW, which currently being discharged to sea at Littlehampton, to support flows within the River Rother. The scheme would also allow the company's source near Pulborough to continue pumping at volumes up to 10 MI/d greater when the river is constrained by the Minimum Residual Flow (MRF). This option may result in minor beneficial effects on river flows and groundwater resources, as the scheme will provide augmented flow in a reliable manner during its operational periods. The use of treated effluent to supplement resources may also increase resilience in relation to the vulnerability of water supply to climate change and promote adaptation to climate change. A number of moderate adverse effects have been identified, including against biodiversity objectives and cultural heritage objectives. The proposed pipeline is routed around the edge of a SSSI and several locally designated sites, resulting in the potential to impact on these sites (construction noise, dust, etc.), though good construction practices should assist in reducing impacts. The route also runs close to two Scheduled Monuments and a Registered Park & Garden. A large proportion of the pipeline route follows current roads in which areas of below ground archaeology may have already been disturbed, but given that excavation is required over a wide geographical area there is a risk of encountering unrecorded archaeology. The exact route of the pipeline may need to be reviewed to reduce potential impacts locally. During operation, moderate adverse impacts are likely to arise in relation to the sub-objective to reduce greenhouse gas emissions due to energy required for the RO treatment based scheme. There could be an opportunity for micro-generation at the discharge point, which would reduce carbon emissions. Other minor adverse impacts on traffic are anticipated during the construction period and

Risks and uncertainties (including planning)	could be managed through traffic management plans and potentially on soils depending on the presence of contamination along the route of the pipeline. If an alternative route to the pipeline for this option was used which passed through nationally designated sites, then an HRA would be required.
Lead in times for option development & feasibility studies	In order to implement a water re-use option, the appropriate discharge consents would need to be agreed and secured with the Environment Agency to ensure that the environment is protected. The HRA screening concluded that likely significant effect was uncertain. The key uncertainty about this option is the type of tertiary treatment that would be required at the WWTW in order to provide effluent of a suitable standard at the discharge point. The discharge consent process itself could be complicated and potentially lengthy. Public perception over potential health implications would also need to be addressed.
Sustainable and resilient solution, WRSE regional driver	There are a number of considerations with water re-use if it is to be widely adopted in the future. These relate to environmental impact of wastewater discharge, public health, public perception and cost.
Alternative options selected in least cost investment model	Water re-use schemes tend to be resilient to climate change and resilient to different drought events, and offer flexibility in implementation and operation. However, there could be concerns regarding the energy usage involved to operate such schemes, bearing in mind the possibility of multiple pumping and treatment required.
	If this option were no longer available, the key strategic alternatives would be the selection of: • The introduction of the CD3 10MI/d Tidal river desalination option; and • Mains renewal in SN in 2020, and increased levels of leakage reduction (e.g. to 5MI/d below the current level of leakage in SN and 2.5MI/d below the current level of leakage in SW). The CD3 10MI/d Tidal river desalination option from the lower River Arun requires the consideration of potential impacts of the abstraction on the designated sites located upstream of the proposed desalination plant. These impacts include any potential changes to the saline limit of the river, and any ecological changes that could arise at the designated sites as a result. As the scheme will be removing water from downstream of the designated sites it is more likely that the saline limit will move downstream rather than allow salinity to push upstream towards the designations. The strategic HRA concluded that there is insufficient information on the nature of the proposal and likely impacts at this stage, therefore an Appropriate Assessment is likely to be required. If necessary, mitigation could be incorporated within the abstraction licence such as specifying flow or tidal conditions under which the abstraction can take place in order to avoid adverse impacts occurring. It is likely that any potential adverse effects can be mitigated. Movement of the saline interface could result in unavoidable changes to fish or macroinvertebrate habitats within the river, which would also need to be quantified further. The intake would also need to be designed to avoid the entrainment of fish and other aquatic fauna. The abstraction of water from the river and the consequent brine discharge (which has been assumed to be via the existing waste water sea outfall) may have implications for the water quality of the lower River Arun and the adjacent coastal water body, which may have implications for compliance of the option with the Water Framework Directive. The mitigation required, which is likely to involve licence conditions agreed by the EA to abstract from the river are not known, however it is likely that conditions would be imposed to avoid or mitigate the impact of abstractions on water quality and avoid any deterioration in status. This may include specifying flow or tidal conditions under which the abstraction can take place. If the existing discharge facilities of the WTW can be used, this will enable brine discharge to be diluted. Further research and modelling would be required to fully determine the scale of any impacts. Overall, with mitigation in place, the discharge of brine is not considered likely to result in any deterioration in status of the coastal water body. The option is located outside of any statutory landscape designations, and the new desalination plant will be located within an existing industrial site. The construction of the new plant and associated pipeline would also be likely to result in disruption and disturbance to local residents and communities, which would need to be mitigated through good construction planning and practice. Careful design and selection of materials to construct the plant will be required in order to ensure that there are no implications for views towards the site from the National Park. The provisional pipeline route has been selected to run alongside local roads as far as possible in order to minimise landscape impacts and to improve the effectiveness of any post-construction reinstatement.

Option code and name	N20 Asset enhancement schemes
Selected start date (& WRZ)	2034 (in SB WRZ)
Customer preferences	Not tested explicitly in customer surveys. However, there was broad support for the overall Central Area strategy from the DWRMP consultation.
Environmental considerations (SEA and HRA)	This asset enhancement option has been identified as having minor net beneficial environmental effects in relation to the climatic factors objectives. The option seeks to maximise the use of an existing source and licence rather than developing new sources elsewhere. No other strategic level effects are anticipated for option N20, which involves increasing pump capacity and WSR connectivity so that the groundwater source works can pump to its Middle or High water reservoir.
Risks and uncertainties (including planning)	None – construction is within confines of existing assets
Lead in times for option development & feasibility studies	Limited lead in time. Network modelling to further test the expected scheme outputs.
Sustainable and resilient solution, WRSE regional driver	The scheme removes a constraint and so may improve system resilience in drought events

Alternative options selected in least cost investment model	If this option were no longer available, the key strategic alternatives would be a minor increase in the amount of leakage reduction in SB, and the slightly altered timing of other leakage reduction and water efficiency options.

Option code and name	N8b Winter transfer stage 2
Selected start date (& WRZ)	2036 (in SB WRZ)
Customer preferences	Not tested explicitly in customer surveys. However, there was broad support for the overall Central Area strategy from the DWRMP consultation.
Environmental considerations (SEA and HRA)	The option is identified as having minor net beneficial environmental effects in relation to the climatic factors objectives, by allowing coastal groundwater sources to be rested, which would help increase groundwater capabilities during the summer and autumn of a drought year, increasing resilience to climate change. As discussed previously for option N8a (stage 1 of the winter transfer scheme), this second stage has limited minor adverse environmental effects related to construction activities. Construction works associated with this option may result in minor traffic disruption to local roads and the A238, these impacts would be effectively mitigated by appropriate traffic management measures. Potential impacts on reduction of greenhouse gas emissions are likely to be low, however should be confirmed once the full extent of improved treatment and handling works is known.
Risks and uncertainties (including planning)	Extent of refurbishment/improvements required at the WTW near Pulborough to improve turbidity and sludge handling issues.
Lead in times for option development & feasibility studies	The scheme requires further detailed modelling and feasibility assessment to ensure that estimated DO's can be achieved.
Sustainable and resilient solution, WRSE regional driver	The option contributes to the resilience of the system, by utilising and storing surplus water during winter for use during peak periods and drought events. It may also facilitate conjunctive use between storage and leakage sources during drought conditions.
Alternative options selected in least cost investment model	As assessed and commented upon under N8a Winter transfer stage 1 above.

Option code and name	N8c Winter transfer stage 3
Selected start date (& WRZ)	2037 (in SB WRZ)
Customer preferences	Not tested explicitly in customer surveys. However, there was broad support for the overall Central Area strategy from the DWRMP consultation.
Environmental considerations (SEA and HRA)	This option is a transfer scheme between Shoreham to Brighton. Option 8c requires a new 11.5km pipeline, and would allow 7Ml/d to be pumped although water is only available in winter. The option is identified as having a minor beneficial impact on climatic factor objectives, as it would allow coastal groundwater sources to be rested and hence increase groundwater capabilities during the summer and autumn of a drought year, therefore increasing resilience to climate change. Construction activities are likely to result in temporary minor adverse effects against a number of SEA objectives, including biodiversity, flora and fauna due to potential disturbance, and on landscape due to the presence of the South Downs National Park adjacent to the proposed pipeline routes, the potential to uncover archaeology during laying of the pipelines and a minor adverse effect on the sub-objective to reduce greenhouse gas emissions due to the relatively large construction footprint and requirement for new pumping during operation. Moderate adverse effects are identified in relation to communities and households and material assets due to potential traffic disruption along sections of the main road during construction. There may be impacts associated with potential increases by 20Ml/d of the winter abstraction at the source near Pulborough on high flows on the Rother/tidal Arun, with consequent impacts for water quality and fish migration. There are also potential risks to the water quality in the SSSI during directional drill and general construction works.
Risks and uncertainties (including planning)	The scheme requires further detailed modelling and feasibility assessment to ensure that estimated DO's can be achieved.
Lead in times for option development & feasibility studies	The scheme requires further detailed modelling and feasibility assessment to ensure that estimated DO's can be achieved.
Sustainable and resilient solution, WRSE regional driver	The option contributes to the resilience of the system, by utilising and storing surplus water during winter for use during peak periods and drought events. It may also facilitate conjunctive use between storage and leakage sources during drought conditions.
Alternative options selected in least cost investment model	As assessed and commented upon under N8a Winter transfer stage 1 above.

Overview of the Final Plan for the Eastern Area

Summary of the Eastern Area strategy

- 10.111. The table below presents a summary of the Eastern Area strategy, including baseline assumptions relating to the supply demand balance, assumptions regarding changes to the supply demand balance during the planning period (in italics), and the options selected as part of the preferred plan (in bold).

Table 10.5 Summary of the water resources strategy and key SDB considerations – Eastern Area

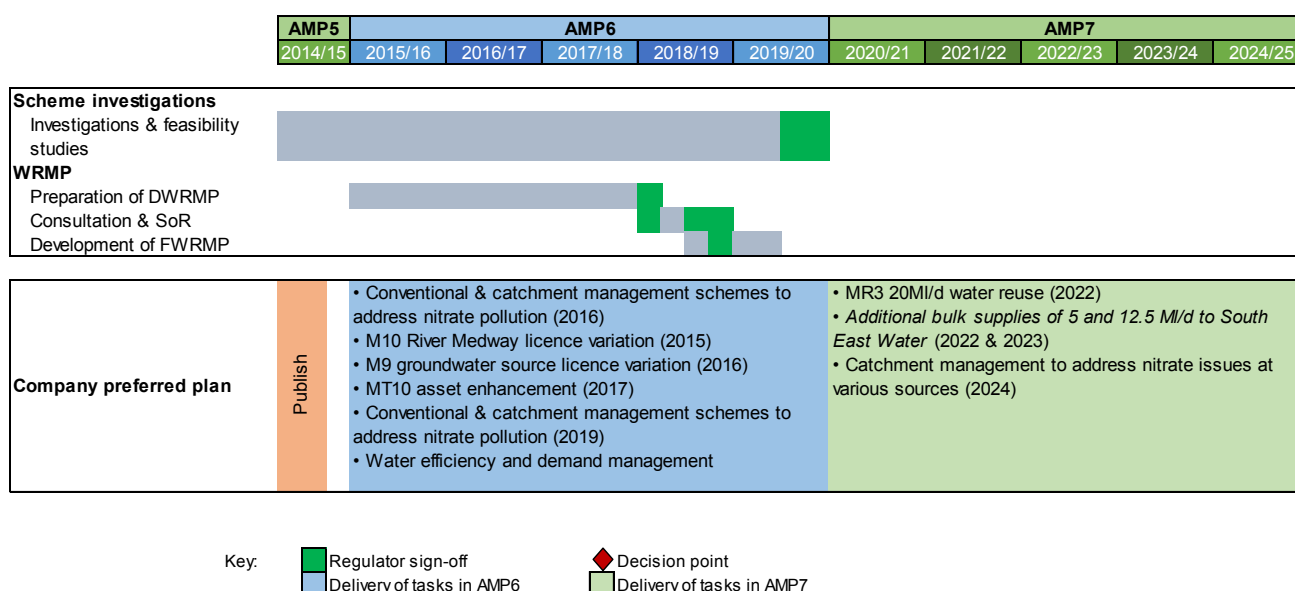
Period	Summary of options selected and SDB considerations in the Eastern Area
Baseline	• Completion of Universal Metering Programme by end of AMP5 • Continuation of baseline water efficiency activity throughout the planning period • Maintain leakage at agreed Ofwat target (unless leakage reduction option is selected as least cost) • Stochastic approach to calculation of deployable outputs from 2019/20 • Inclusion of climate change impacts on supply and demand • Continuation of existing bulk export of 10.7MI/d (stochastic estimate) from Bewl to South East Water through planning period, with additional 6.1MI/d through to 2019 before ceasing. • Continuation of small existing bulk export at Pitfield to South East Water through planning period • Continuation of existing bulk export to Affinity Water through planning period • Use of existing internal transfer from Bewl to Darwell • Reduction in DO to account for "locked in DO" in Kent Medway and Kent Thanet through planning period
During AMP6 (2015-20)	• Investigations – NEPs, feasibility studies and enabling investigations • Additional bulk export of 1.25 MI/d to South East Water from 2015 to 2019 from 25% share of the RMS licence variation • M10 River Medway licence variation in 2015 • KM-WE-B, C, D water efficiency schemes in 2015 • SH-WE-B, C, D water efficiency schemes in 2015-17 • Nitrate issues resulting in DO reduction at source in KM in 2016 • M9 groundwater source licence variation in 2016 • MT10 asset enhancement in 2017 • KMC-b conventional & catchment management (to address nitrate pollution issues) • KT-WE-B, C, D water efficiency schemes in 2019 • Leakage reduction to 0.4 MI/d below current target level in Sussex Hastings in 2019
During AMP7 (2020-25)	• Further investigations – ongoing NEPs, feasibility studies and enabling investigations • New WRSE bulk export of 5 MI/d to South East Water in 2022 • MR3 20MI/d water reuse in 2022 • New WRSE bulk export of 12.5 MI/d to South East Water in 2023 • Continuation of existing bulk export of ~7 MI/d from Belmont to South East Water from 2023 onwards • Nitrate issues resulting in DO reduction at a source in KT & a source in KM in 2024 • Catchment management in both KM and KT in 2024 (to address nitrate pollution issues)
Last 15 years of the plan (2025-40)	• Continuation of existing bulk export of 8MI/d from Darwell to South East Water from 2026 onwards • M21 licence trading scheme in 2034 • KT-WE-A water efficiency scheme in 2035 • Leakage reduction to 0.75 MI/d below current target level in Kent Thanet in 2039
Total cost (NPV over 80 years)	£57.1M

- 10.112. The scenario testing process and development of the preferred programmes demonstrated that the three AMP6 resource development schemes are always required. These are the **MT10 asset enhancement** scheme, the **M10 River Medway licence variation** and the **M9 groundwater source licence** variation. These therefore form the basis of the strategy for the Eastern Area.
- 10.113. Both the conventional with catchment management, and the two **catchment management** only schemes (KMC-a and KTC-a) are also always needed to recover the lost DO from the three sources which are affected by, or at risk of being affected by, nitrate pollution.
- 10.114. The **MR3 20MI/d water reuse** scheme (or smaller variants) and the **M21 licence trading** scheme are required in most scenarios, but may be interchanged depending on the assumptions used. One of these is needed in the early 2020's (AMP7, while the other is then required in the early 2030s. Implementation of the MR3 option allows Southern Water to provide the bulk supply requested by South East Water from 2023.
- 10.115. Therefore, it will be critical for Southern Water to complete all enabling work for the AMP6 resource development schemes in early AMP6, and also to carry out technical investigations, a preliminary design and costing exercise, licence discussions, stakeholder engagement, and preparation of an environmental report including EIA Screening and Scoping, and supporting documentation for planning permissions for both the MR3 20MI/d water reuse scheme and the M21 licence trading scheme in parallel during AMP6, with a view to actually submit the complete application for only one of these schemes in AMP6, depending on the outcome of investigations.
- 10.116. There is some uncertainty about the viability of M21 licence trading scheme, and if commercial agreement and technical feasibility cannot be resolved, then the company would also need to gear up its leakage reduction activity over AMP6 and AMP7, as leakage reduction options would become economic.

Timeline of the preferred strategy

- 10.117. Figure 10.3, below, highlights the options that the model selects under the different strategies, and the timing of the options that would be required to be delivered in AMP6 and AMP7.

Figure 10.3 Strategic-level timeline of decision triggers and outcomes for the Eastern Area



SEA and HRA assessment of the plan for the Eastern Area

- 10.118. The SEA and HRA assessment of the preferred plan for Eastern Area did not identify any of the selected options to be high risk against the SEA objectives, nor to be at risk of causing a Likely Significant Effect to a European site. Therefore the preferred plan for the Eastern Area is compliant against environmental criteria.

Alternatives to preferred plan options

- 10.119. As a final step in the process, various “what if” scenarios were run to identify what alternative resource options would be selected under the assumptions used for the preferred plan, if each option (in turn) in the preferred plan could not be delivered, for whatever reason.
- 10.120. The results of the assessment of each option against wider strategic criteria than least cost, along with the identification of key alternative strategic options for each option is presented in the Table 10.6 below.

Table 10.6 Summary of the development of the preferred programme of options for the Eastern Area

Option code and name	M10 River Medway licence Variation
Selected start date (& WRZ)	2015 (in KM WRZ)
Customer preferences	Not tested explicitly in customer surveys. However, there was broad support for the overall Eastern Area strategy from the DWRMP consultation.
Environmental considerations (SEA and HRA)	The proposed surface water licence variation to the existing River Medway Scheme (M10) has already been subject to a detailed investigation in 2012/13, culminating in a detailed environmental report and initial discussions around the preparation of supporting documents for a licence variation application with the EA. The investigations have concluded that the scheme has the potential for minor adverse effects on biodiversity (aquatic macrophyte and macroinvertebrate communities) and fisheries (fish migration through the Medway Estuary), but these risks are minimal. The strategic level HRA undertaken as part of the development of the WRMP identifies that a relatively small variation in the abstraction licence is most unlikely to have any significant effect on the tidal river Medway. However, it recommends that an appropriate assessment be carried out at the licence application stage for this proposal, at which time mitigation such as time or seasonal restrictions can be introduced to ensure that there will be no impact on the integrity of the Medway Estuary and Marshes SPA and Ramsar site. Mitigation for potential impacts on fish migration is proposed via the adoption of a more conservative winter Minimum Residual Flow condition for the scheme.
Risks and uncertainties (including planning)	The risk associated with this option is that there is a requirement for a variation in the existing licence. There may be objections to these proposals from a range of interest groups, including those with interests in the aquatic environment, other abstractors and landowners. The application for the change in the licence will require careful management to mitigate these risks. However, discussions were held with the EA in 2012/13 culminating in the submission of a draft environmental report, which was accepted by the EA. Formal application to vary the licence to be made to the EA later in AMP5.
Lead in times for option development & feasibility studies	Feasibility investigations have been conducted during AMP5. There should therefore be minimal lead in time, and it is assumed the option will be available from the start of AMP6.
Sustainable and resilient solution, WRSE regional driver	The option will propose the adjustment of the Bewl release factor from 1.2 to 1.0, as well as a varying MRF profile, which will increase the MRF from its current level during the summer, and reduce it in the winter.
Alternative options selected in least cost investment model	If this option were no longer available, the key strategic impact would be the need to bring the MR3 20Mld water reuse scheme forwarded by 3 years to 2019 (the end of AMP6). This may present a deliverability risk. Additionally, the M21 licence trading scheme would be required 5 years earlier, although this is still not until 2029. In addition, without this scheme, there would be 1.25Ml/d less water being supplied to South East Water from 2015 onwards, which may impact on their WRMP.

Option code and name	KM-WE: Suite of enhanced water efficiency options
Selected start date (& WRZ)	2015 (in KM WRZ)
Customer preferences	Southern Water customers expressed strong support for increased water efficiency options and education during consultation on the draft WRMP and the draft Business Plan for 2015-2020. Ninety two per cent of respondents in the WRMP consultation supported our proposals to continue to set a target to save one litre of water per property per day until 2040. Many commented that this target was modest and should be a minimum, however, customers also appreciate water efficiency options are not able to secure water resources in isolation and should be cost beneficial.
Environmental considerations (SEA and HRA)	From an SEA perspective, achieving water efficiency is considered likely to have a number of minor beneficial effects on the SEA objectives, as it enables best use of existing resources. There are potential minor beneficial impacts against the 'climatic factors' sub objective, as the reduced losses of water should reduce energy consumption associated with sourcing, treating and supplying potable water.
Risks and uncertainties (including planning)	There is general uncertainty over a number of factors influencing the long-term effectiveness of water efficiency measures, including the long term savings associated with many water efficiency devices, how customers use and maintain the devices, and how customer behaviour may change in future.

Lead in times for option development & feasibility studies	It has been assumed that the options in the feasible list will be introduced over a 5 year programme, and that the savings will therefore gradually increase to year 5 of the programme.
Sustainable and resilient solution, WRSE regional driver	These options cannot be considered resilient, as the potential saving cannot be guaranteed at all times of the year under all types of dry year condition, and the options in themselves cannot guarantee that supplies will be available during drought events. However, demand management schemes in general are likely to enhance the resilience of supply side options, because they act to generally reduce demand, which will be beneficial in the run up to a potential or actual drought event.
Alternative options selected in least cost investment model	There is some uncertainty surrounding the potential to achieve the savings estimated for the cost. As a result, a scenario was run which examined what would happen if the savings were not achieved. This is described in Section 9 under demand uncertainty.

Option code and name	SH-WE: Suite of enhanced water efficiency options
Selected start date (& WRZ)	2015 & 2017 (in SH WRZ)
Customer preferences	Southern Water customers expressed strong support for increased water efficiency options and education during consultation on the draft WRMP and the draft Business Plan for 2015-2020. Ninety two per cent of respondents in the WRMP consultation supported our proposals to continue to set a target to save one litre of water per property per day until 2040. Many commented that this target was modest and should be a minimum, however, customers also appreciate water efficiency options are not able to secure water resources in isolation and should be cost beneficial.
Environmental considerations (SEA and HRA)	From an SEA perspective, achieving water efficiency is considered likely to have a number of minor beneficial effects on the SEA objectives, as it enables best use of existing resources. There are potential minor beneficial impacts against the 'climatic factors' sub objective, as the reduced losses of water should reduce energy consumption associated with sourcing, treating and supplying potable water.
Risks and uncertainties (including planning)	There is general uncertainty over a number of factors influencing the long-term effectiveness of water efficiency measures, including the long term savings associated with many water efficiency devices, how customers use and maintain the devices, and how customer behaviour may change in future.
Lead in times for option development & feasibility studies	It has been assumed that the options in the feasible list will be introduced over a 5 year programme, and that the savings will therefore gradually increase to year 5 of the programme.
Sustainable and resilient solution, WRSE regional driver	These options cannot be considered resilient, as the potential saving cannot be guaranteed at all times of the year under all types of dry year condition, and the options in themselves cannot guarantee that supplies will be available during drought events. However, demand management schemes in general are likely to enhance the resilience of supply side options, because they act to generally reduce demand, which will be beneficial in the run up to a potential or actual drought event.
Alternative options selected in least cost investment model	There is some uncertainty surrounding the potential to achieve the savings estimated for the cost. As a result, a scenario was run which examined what would happen if the savings were not achieved. This is described in Section 9 under demand uncertainty.

Option code and name	M9 groundwater source licence variation
Selected start date (& WRZ)	2016 (in KM WRZ)
Customer preferences	Not tested explicitly in customer surveys. However, there was broad support for the overall Eastern Area strategy from the DWRMP consultation.
Environmental considerations (SEA and HRA)	The impacts of the proposed groundwater licence variation (M9) may include potential adverse impacts on biodiversity, fisheries, and surface and groundwater quality and quantity due to the effects of the groundwater abstractions and any hydrological connections with nearby surface waters if the aquifer is unconfined. No adverse effects on internationally/nationally designated sites however are anticipated for flora and fauna due to the distance of the works from these sites. There may also be a need for new infrastructure if pump capacity is to be increased, and this could have potential minor adverse impacts on local landscape. Specific mitigation has not been identified at this stage, beyond the need to undertake further investigation of the potential environmental impact of this option.
Risks and uncertainties (including planning)	No specific risks identified
Lead in times for option development & feasibility studies	Available early in AMP6 if required
Sustainable and resilient solution, WRSE regional driver	Increasing DO from groundwater abstractions may not be particularly sustainable in the long term, however, an assessment against WFD objectives suggested this option was not particularly at risk.
Alternative options selected in least cost investment model	If this option were no longer available, the key strategic impact would be the need to bring the MR3 20Mld water reuse scheme forwarded by 3 years to 2019 (the end of AMP6). This may present a deliverability risk.

Option code and name	MT10 Asset enhancement schemes
Selected start date (& WRZ)	2017 (in KM WRZ)
Customer preferences	Not tested explicitly in customer surveys. However, there was broad support for the overall Eastern Area strategy from the DWRMP consultation.
Environmental considerations (SEA and HRA)	The asset enhancement option to release 'locked in' water in the Kent Medway WRZ (MT10) has been identified as having minimal environmental impacts. Only limited construction activity is required for this option, and construction risks (e.g. to local communities, cultural heritage and landscape) can be managed through good construction practice. One minor beneficial effect has been identified against the climate change objective, as the option maximises sustainable resource use and is gravity fed, therefore providing additional water with only limited energy requirements in the long term.
Risks and uncertainties (including planning)	This option looks to install a short spur main to better connect two water service reservoirs. The risks associated with this option are therefore considered to be small
Lead in times for option development & feasibility studies	This option should be available in AMP6
Sustainable and resilient solution, WRSE regional driver	The option helps to improve the connectivity within the KM WRZ, and therefore release the output from sources that would otherwise have been constrained. It helps to increase operational flexibility.
Alternative options selected in least cost investment model	If this option were no longer available, the key strategic impact would be the need to bring the MR3 20Mld water reuse scheme forwarded by 3 years to 2019 (the end of AMP6). This may present a deliverability risk. Additionally, the M21 licence trading scheme would be required earlier in 2025. Small amounts of additional leakage reduction would also be required.

Option code and name	KMC-b Conventional & catchment management
Selected start date (& WRZ)	2019 (in KM WRZ)
Customer preferences	Ninety six per cent of respondents to the consultation on the draft WRMP supported us working in partnership with landowners, farmers and river trusts to improve the quality and flow of water in rivers and help keep them available for water supplies for longer. The support include organisations such as the Arun and Rother Rivers Trust, the South Downs National Park and Sussex Wildlife Trust who are keen to work in partnership to develop catchment management solutions and evidence their economic and environmental benefits.
Environmental considerations (SEA and HRA)	The catchment management component of this option involves the employment of a Catchment Management Officer or similar to liaise with farmers to promote farming practices and catchment management measures that will reduce the potential for nitrate entering local water resources. Elevated nitrate is a concern as it has to be removed before water can be supplied to customers. These options are identified as having net beneficial environmental effects when assessed against the SEA objectives. There are potential beneficial impacts on soil quality, and the quality of surface and groundwater. Consequentially there are potential beneficial secondary effects on freshwater fisheries. Depending on the exact location of the catchment management actions, there may be potential for the options to positively contribute to delivering WFD objectives, although this would require catchment specific assessment. There are also potential beneficial impacts against the 'climatic factors' sub objective, as the need for reduced treatment of water (nitrate removal) should reduce energy consumption associated with the water supply. The actual magnitude of these impacts is currently uncertain, as the scale of up-take for the catchment management actions is also uncertain. No mitigation has been identified as being required for this option.
Risks and uncertainties (including planning)	There are limited risks involved with conventional nitrate treatment plant. However, the efficacy of the catchment management to help control nitrates in future is uncertain
Lead in times for option development & feasibility studies	This option is required for sources at imminent risk of exceeding nitrate thresholds. Ongoing monitoring of success of catchment management component at reducing upstream nitrate levels will be required.
Sustainable and resilient solution, WRSE regional driver	Catchment management should, if successful, help extend the life of the conventional treatment plant.
Alternative options selected in least cost investment model	Not tested.

Option code and name	KT-WE: Suite of enhanced water efficiency options
Selected start date (& WRZ)	2019 (in KT WRZ) 2035 (home audits)
Customer preferences	Southern Water customers expressed strong support for increased water efficiency options and education during consultation on the draft WRMP and the draft Business Plan for 2015-2020. Ninety two per cent of respondents in the WRMP consultation supported our proposals to continue to set a target to save one litre of water per property per day until 2040. Many commented that this target was modest and should be a minimum, however, customers also appreciate water efficiency options are not able to secure water resources in isolation and should be cost beneficial.
Environmental considerations (SEA and HRA)	From an SEA perspective, achieving water efficiency is considered likely to have a number of minor beneficial effects on the SEA objectives, as it enables best use of existing resources. There are potential minor beneficial impacts against the 'climatic factors' sub objective, as the reduced losses of water should reduce energy consumption associated with sourcing, treating and supplying potable water.
Risks and uncertainties (including planning)	There is general uncertainty over a number of factors influencing the long-term effectiveness of water efficiency measures, including the long term savings associated with many water efficiency devices, how customers use and maintain the devices, and how customer behaviour may change in future.
Lead in times for option development & feasibility studies	It has been assumed that the options in the feasible list will be introduced over a 5 year programme, and that the savings will therefore gradually increase to year 5 of the programme.
Sustainable and resilient solution, WRSE regional driver	These options cannot be considered resilient, as the potential saving cannot be guaranteed at all times of the year under all types of dry year condition, and the options in themselves cannot guarantee that supplies will be available during drought events. However, demand management schemes in general are likely to enhance the resilience of supply side options, because they act to generally reduce demand, which will be beneficial in the run up to a potential or actual drought event.
Alternative options selected in least cost investment model	There is some uncertainty surrounding the potential to achieve the savings estimated for the cost. As a result, a scenario was run which examined what would happen if the savings were not achieved. This is described in Section 9 under demand uncertainty.

Option code and name	SH-LR Leakage reduction in SH to 0.4MI/d below current target level
Selected start date (& WRZ)	2019 (in SH WRZ)
Customer preferences	Reduction of leakage was supported by around three-quarters of customers. Only 8% of customers did not support leakage reduction options. Most customers (93%) would include leakage reduction in their preferred set of options to meet a deficit. Participants in customer focus groups felt that Southern Water should, as a matter of course, do what they can to minimise leakage on its network. However, many were surprised to understand the levels of investment required to do so.
Environmental considerations (SEA and HRA)	The leakage reduction options generally have limited environmental effects at the strategic level. Minor adverse effects are associated with the likely need for localised construction works to find and fix leaks and consequent disruption to local transport and householders/communities. However these impacts could be mitigated by appropriate working practices. In the longer term, leakage reduction is compatible with a number of the SEA objectives as it enables the best use of existing resources. There are also potential minor beneficial impacts due to the reduced losses of water which should reduce energy consumption associated with sourcing, treating and supplying potable water.
Risks and uncertainties (including planning)	Southern Water already achieves one of the lowest levels of leakage in the country. There may therefore be operational or practical difficulties in reducing leakage significantly further and <u>maintaining it at this new lower level under whatever climatic conditions materialise</u> . Whilst it is quite feasible at a company level to further reduce leakage, pursuing significant targeted reductions in only one or two WRZs may not be technically feasible in terms of "find and fix" procedures and processes, even where the costs may be low enough for all leakage reduction steps to be selected. If the enhanced leakage reduction activity is relaxed, then leakage will gradually rise as pipes deteriorate over time. There may therefore be some residual risk associated with achieving and maintaining leakage at lower levels, as was reflected by the company's experiences from the 2004-06 drought events.
Lead in times for option development & feasibility studies	It takes time to build up the required resources to reduce leakage and maintain it at its lower level, and so there may be a limit to how much reduction can be achieved in any one AMP period in reality.
Sustainable and resilient solution, WRSE regional driver	Leakage reduction options are an essential part of a twin track approach. But it is important to recognise that, below a certain level, it will become increasingly more difficult and particularly costly to reduce leakage further. Whilst leakage reduction can generally contribute to reduced demand and hence reduced need for abstractions, the level of leakage is a function of climatic conditions. If there is, for example, a very cold winter, then leakage will increase due to increased pipe bursts. As a result, it is not possible for companies to guarantee the level of leakage that they can achieve in any given year.
Alternative options selected in least cost investment model	Not tested

Option code and name	MR3 20MI/d Water reuse
Selected start date (& WRZ)	2022 (in KM WRZ)
Customer preferences	Extensive customer research during the pre-consultation of the draft WRMP showed strong support for water re-use as an option to secure resilient water supplies. This was reinforced by 96 per cent of customers agreeing water re-use has a role to play in securing water supplies during the public consultation. Customer research shared by Thames Water, South East Water and Anglian Water, as part of a collaborative working group on water re-use, also indicates customers recognise the benefits of schemes, provided there are no adverse impacts on public or environmental health. Customers are keen to see water re-use explored for industry and agriculture.
Environmental considerations (SEA and HRA)	This 20MI/d water reuse option (MR3-20) has a number of moderate adverse environmental risks associated with it, principally in operation. Some minor adverse risks (communities and transport assets) are associated with the construction of an associated pipeline, but mitigation has been proposed for these construction impacts in the form of good construction practice and appropriate investigations during the option development stage. The key issues identified are the potential risks to the Medway Estuary and Marshes SSSI/SPA/Ramsar and the Holborough to Burham Marshes SSSI as a result of changes to water quality. This risk also affects the fisheries and water quality objectives. The strategic level HRA identifies that modelling suggests that there could be a small increase in suspended sediment and total ammonia in the river water entering the estuary, but in the context of sea water dilution and the naturally high baseline levels in the estuary, this is not expected to cause any significant change to the estuarine habitats or their ability to support the waterfowl flocks, nor therefore to have any adverse effect on the integrity of the protected sites. A Habitats Regulations Assessment of this option however is likely to be required at the project level. It is proposed that if this option is progressed as part of the WRMP, a bespoke water quality model is developed as a mitigation measure to confirm the potential impacts of the option. The other moderate adverse impact associated with this option is the relatively high energy use required by the reverse osmosis treatment to provide effluent of a suitable quality for release to the river system.
Risks and uncertainties (including planning)	In order to implement a water re-use option, the appropriate discharge consents would need to be agreed and secured with the Environment Agency to ensure that the environment is protected. The discharge consent process itself could be complicated and potentially lengthy. Public perception over potential health implications would also need to be addressed. The acceptability of potential impacts from this option are the key factor in gaining planning consent, as the constraints upon the extension of the WWTW and the transfer pipeline are considered to be manageable. It is considered to be likely that a planning application and EIA would be required. There may also be a need for an Appropriate Assessment as well given the presence of European sites within the Medway estuary.
Lead in times for option development & feasibility studies	There are a number of considerations with water re-use if it is to be widely adopted in the future. These relate to environmental impact of wastewater discharge, public health, public perception and cost.
Sustainable and resilient solution, WRSE regional driver	Water re-use schemes tend to be resilient to climate change and resilient to different drought events, and offer flexibility in implementation and operation. However, there could be concerns regarding the energy usage involved to operate such schemes, bearing in mind the possibility of multiple pumping and treatment required. The scheme provides the bulk supply to South East Water required from 2023.
Alternative options selected in least cost investment model	If this option were no longer available, the key strategic impact would be the M21 licence trading scheme would be required earlier in 2023 in AMP7 (rather than 2034). Significant amounts of additional leakage reduction would also be required. The other key strategic option required would be the M5a3000 Reservoir raising option in 2027. The key environmental issues associated with raising the existing reservoir are: that the existing reservoir is situated within the High Weald AONB so is a highly sensitive landscape with potential for significant objections to the scheme; that losses of ancient woodland located in the area impacted by raised water levels; that there is potential for protected species to be displaced; and there are potential impacts on the aquatic environment (e.g. displacement of macrophytes and potential growth of invasive species). The reservoir is a SNCI, and raising the reservoir is likely to impact on this local designation. There are likely to be impacts on local communities and recreational users during construction phase, as well as impacts on footpaths around the reservoir, which will need to be relocated. Therefore, if the preferred MR3 20MI/d Water reuse were not available for development, further investigation of alternative options would be required, following development of the M21 licence trading scheme.

Option code and name	KMC-a and KTC-a catchment management
Selected start date (& WRZ)	2024 (in KM and KT WRZs)
	Although the scheme is not required to deliver full DO until 2024, it would need to commence in 2015, the start of AMP6, to allow time to achieve and monitor the benefits.
Customer preferences	Ninety six per cent of respondents to the consultation on the draft WRMP supported us working in partnership with landowners, farmers and river trusts to improve the quality and flow of water in rivers and help keep them available for water supplies for longer. The support include organisations such as the Arun and Rother Rivers Trust, the South Downs National Park and Sussex Wildlife Trust who are keen to work in partnership to develop catchment management solutions and evidence their economic and environmental benefits.
Environmental considerations (SEA and HRA)	The catchment management options involve the employment of a Catchment Management Officer or similar to liaise with farmers to promote farming practices and catchment management measures that will reduce the potential for nitrate entering local water resources. Elevated nitrate is a concern as it has to be removed before water can be supplied to customers. These options are identified as having net beneficial environmental effects when assessed against the SEA objectives. There are potential beneficial impacts on soil quality, and the quality of surface and groundwater. Consequentially there are potential beneficial secondary effects on freshwater fisheries. Depending on the exact location of the catchment management actions, there may be potential for the options to positively contribute to delivering WFD objectives, although this would require catchment specific assessment. There are also potential beneficial impacts against the 'climatic factors' sub objective, as the need for reduced treatment of water (nitrate removal) should reduce energy consumption associated with the water supply. The actual magnitude of these impacts is currently uncertain, as the scale of up-take for the catchment management actions is also uncertain. No mitigation has been identified as being required for this option.
Risks and uncertainties (including planning)	The realisation of the benefits of catchment management schemes is not certain.
Lead in times for option development & feasibility studies	The schemes need to be implemented early in AMP6 to allow sufficient time to build relationships with upstream farmers and to demonstrate that nitrate reductions were being achieved. If not, then there would then still be sufficient time to introduce conventional nitrate technology in AMP7, prior to the nitrate threshold being exceeded.
Sustainable and resilient solution, WRSE regional driver	Catchment management schemes have the potential to provide significant benefits to the environment, in terms of biodiversity and water quality, at relatively low cost, whilst potentially reducing treatment costs and increasing the water available for abstraction.
Alternative options selected in least cost investment model	Not tested

Option code and name	M21 Licence trading scheme
Selected start date (& WRZ)	2034 (in KM WRZ)
Customer preferences	Not tested explicitly in customer surveys. However, there was broad support for the overall Eastern Area strategy from the DWRMP consultation.
Environmental considerations (SEA and HRA)	A number of potential minor effects have been identified for option M21, which would involve taking over an existing disused groundwater abstraction licence. The aquifer the licence relates to is unconfined, and there are therefore potential reductions in spring-fed freshwater outflows to the adjacent Medway and Swale estuaries (designated SSSI/SPA/Ramsar). The strategic level HRA identifies no effects on internationally/nationally designated sites. A minor beneficial impact on groundwater quantity/quality could occur, as the whole licence would not be utilised, and some water would be 'retained' for environmental benefits. The other minor adverse effects are associated with the soils, climatic factors and cultural heritage/archaeology objectives. These arise due to the construction of a new pipeline and requirement for pumping. However these impacts are likely to be effectively mitigated by good construction planning and working practices.
Risks and uncertainties (including planning)	Given that the existing licence is yet to be revoked and the production capacity of the borehole is yet to be confirmed, there is much uncertainty surrounding this option. The other uncertainty is over the volume of a new abstraction licence that the EA may make available to Southern Water. A new treatment works and mains pipeline would be required in order to connect the source to the Southern Water network.
Lead in times for option development & feasibility studies	Feasibility studies and commercial discussions with the existing licence holders and EA will be required during AMP6 to establish whether the option is viable. An assessment of possible water quality issues and associated treatment requirements will also be required.
Sustainable and resilient solution, WRSE regional driver	It has been assumed that a significant proportion (greater than 50%) of the existing abstraction licence would be released.
Alternative options selected in least cost investment model	Significant amounts of additional leakage reduction would also be required. This includes 5MI/d reduction below current target levels in KM, an additional 0.75MI/d in KT, and an additional 0.8MI/d reduction in SH compared to the levels in the preferred plan

Option code and name	KT-LR Leakage reduction in SH to 0.75 MI/d below current target level
Selected start date (& WRZ)	2039 (in KT WRZ)
Customer preferences	Reduction of leakage was supported by around three-quarters of customers. Only 8% of customers did not support leakage reduction options. Most customers (93%) would include leakage reduction in their preferred set of options to meet a deficit. Participants in customer focus groups felt that Southern Water should, as a matter of course, do what they can to minimise leakage on its network. However, many were surprised to understand the levels of investment required to do so
Environmental considerations (SEA and HRA)	The leakage reduction options generally have limited environmental effects at the strategic level. Minor adverse effects are associated with the likely need for localised construction works to find and fix leaks and consequent disruption to local transport and householders/communities. However these impacts could be mitigated by appropriate working practices. In the longer term, leakage reduction is compatible with a number of the SEA objectives as it enables the best use of existing resources. There are also potential minor beneficial impacts due to the reduced losses of water which should reduce energy consumption associated with sourcing, treating and supplying potable water
Risks and uncertainties (including planning)	Southern Water already achieves one of the lowest levels of leakage in the country. There may therefore be operational or practical difficulties in reducing leakage significantly further and <u>maintaining it at this new lower level under whatever climatic conditions materialise</u>. Whilst it is quite feasible at a company level to further reduce leakage, pursuing significant targeted reductions in only one or two WRZs may not be technically feasible in terms of “find and fix” procedures and processes, even where the costs may be low enough for all leakage reduction steps to be selected. If the enhanced leakage reduction activity is relaxed, then leakage will gradually rise as pipes deteriorate over time. There may therefore be some residual risk associated with achieving and maintaining leakage at lower levels, as was reflected by the company’s experiences from the 2004-06 drought events.
Lead in times for option development & feasibility studies	It takes time to build up the required resources to reduce leakage and maintain it at its lower level, and so there may be a limit to how much reduction can be achieved in any one AMP period in reality.
Sustainable and resilient solution, WRSE regional driver	Leakage reduction options are an essential part of a twin track approach. But it is important to recognise that, below a certain level, it will become increasingly more difficult and particularly costly to reduce leakage further. Whilst leakage reduction can generally contribute to reduced demand and hence reduced need for abstractions, the level of leakage is a function of climatic conditions. If there is, for example, a very cold winter, then leakage will increase due to increased pipe bursts. As a result, it is not possible for companies to guarantee the level of leakage that they can achieve in any given year.
Alternative options selected in least cost investment model	Not tested.

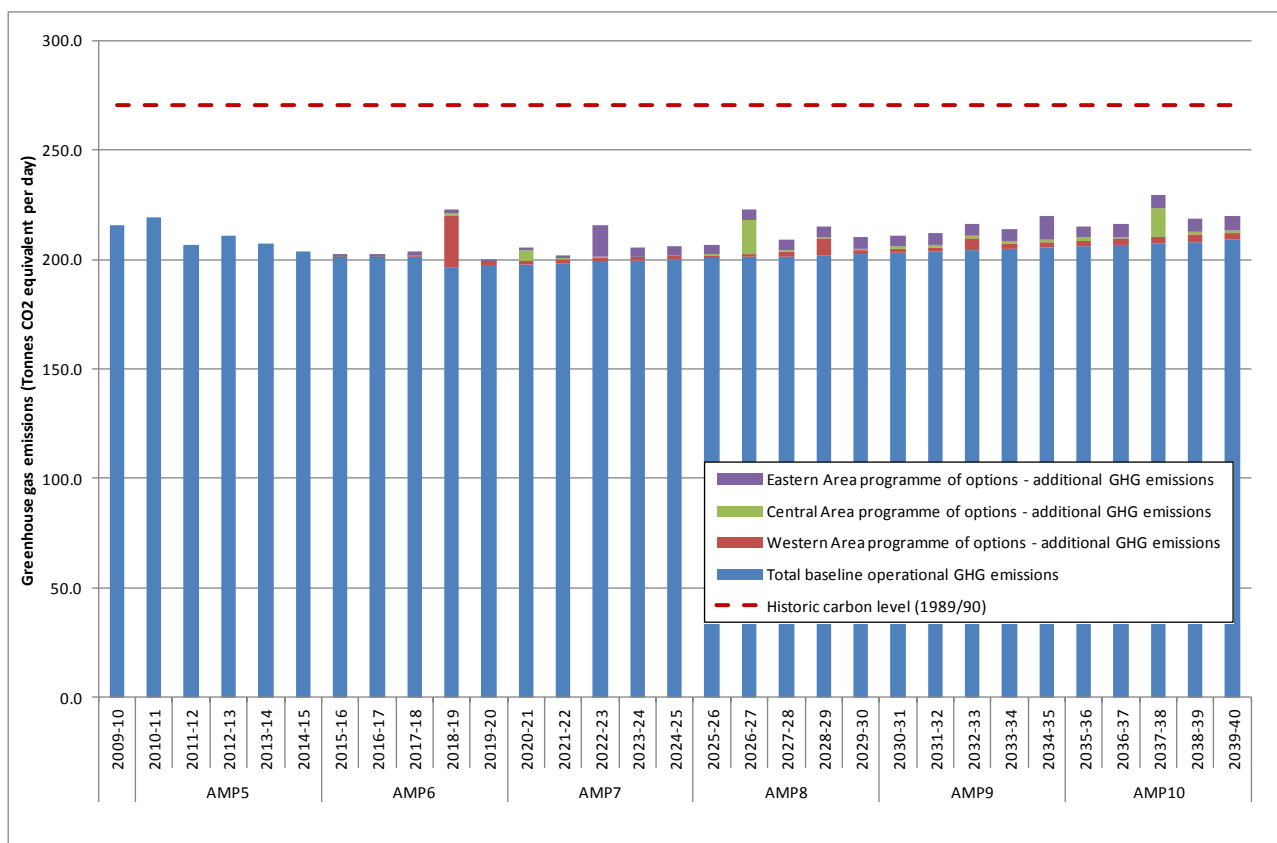
Key strategic outputs of the preferred plan

Resilience

- 10.121. The company has prepared its plan using a new approach to assessing deployable outputs (DO), which are introduced from 2019/20 onwards. The company believes that a move towards a stochastic approach to estimating DO is the best way to ensure a resilient supply system in the future, and the only way to ensure that target Levels of Service can be met. Therefore, it is instructive to compare the costs of the preferred plan, which is based on a stochastic approach to the estimation of DOs, against the costs for the plan based on deployable outputs calculated using the conventional historic time series method.
- 10.122. Effectively, the preferred plan delivers a more resilient water network to cover more severe droughts and reduce the likelihood of water restrictions. The conventional plan addresses the growing population but would not deliver the increased resilience. Southern water conducted research in development of the WRMP which found that 83% of customers supported the plan that delivered the additional resilience, recognising the impact on their bill.
- 10.123. The company calculated, as part of its Business Plan submission, the total direct cost of developing the schemes selected under both the preferred resilient plan, and the conventional plan based on historic DO, in net present value terms over a 40 year discount period.
- 10.124. The company's willingness to pay survey, conducted prior to development of the Draft WRMP showed that customers would pay more to reduce the likelihood of introducing Temporary Use Bans (which include what were previously known as hosepipe bans) from one in six years to one in 10 years; and to reduce the likelihood of introducing emergency measures such as standpipes from one in 80 years to one in 200 years.
- 10.125. The result was that the preferred resilient plan, less the customers' willingness to pay for improved resilience was less than the cost of the conventional plan by around £3M in NPV terms. Hence it can be concluded that the preferred resilient plan presented in this section is economically justified due to its drive for increased resilience and consequent reduction in drought restrictions.

Greenhouse gas emissions

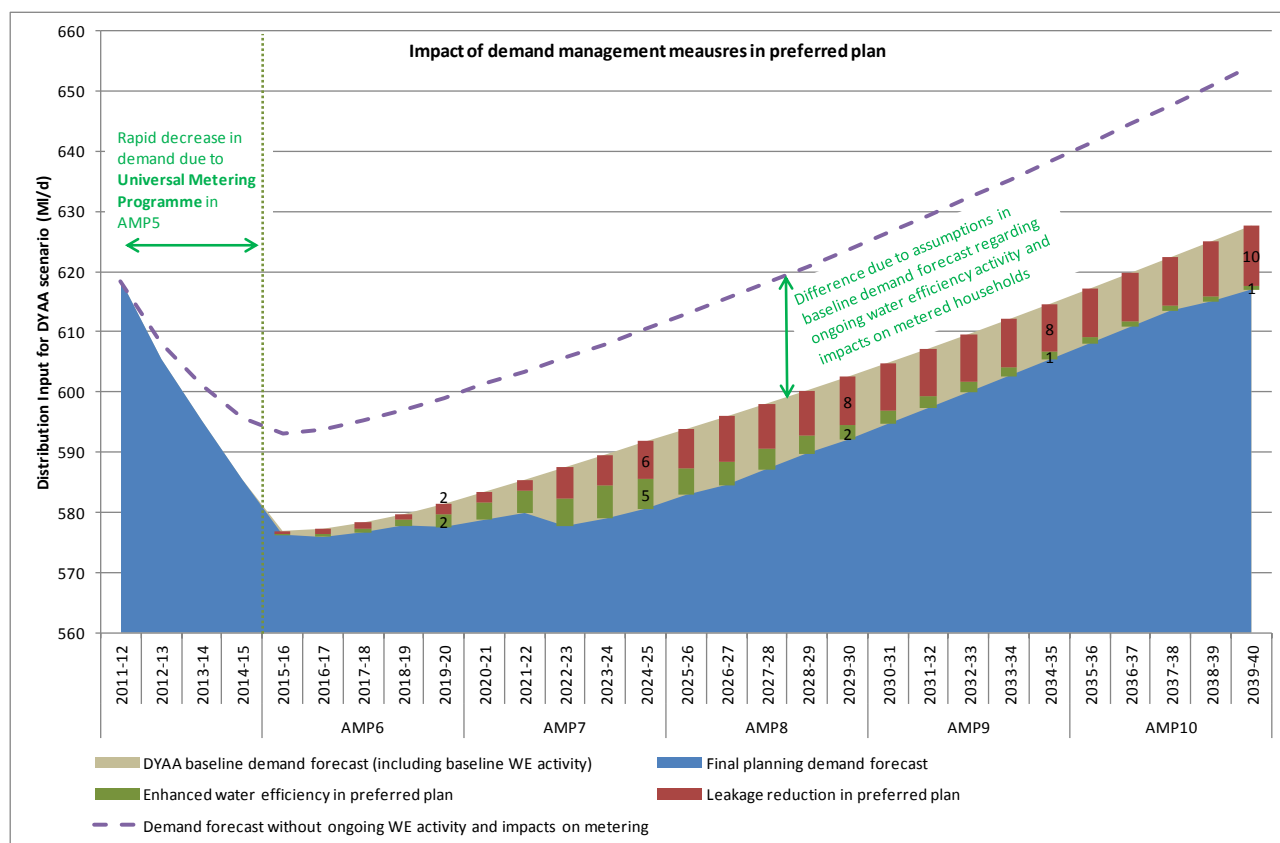
- 10.126. In the base year, 2011/12, Southern Water operational greenhouse gas emissions were around 365 kilograms of carbon dioxide equivalent (kgCO_{2e}) for every Ml of treated water on average.
- 10.127. Figure 10.4 below shows Southern Water's profile of greenhouse gas emissions from 2009/10 through to the end of the planning period in 2039/40, on average. This also show the typical carbon level from 1989/90, the point at which the water companies were privatised. The carbon footprint associated with construction, including embedded carbon, can be seen as a number of "one year" emissions – for example the Western Area emissions associated with a number of resource developments in 2018/19, to meet the implementation of the River Itchen Sustainability Reduction. Ongoing operational carbon usage is based on "average" utilisation of new sources.

Figure 10.4 Expected greenhouse gas emissions through the planning period under the company's preferred plan

Demand management

- 10.128. Figure 10.5 shows the impact of the demand management options selected as part of the preferred plan on the forecast demand.
- 10.129. The savings from the enhanced water efficiency options selected in the preferred plan is not constant, but is assumed to decline through time in accordance with best practice. However, it is important to remember that Southern Water has incorporated baseline water efficiency activity into its demand forecast, and that the micro-components forecast incorporates assumptions about future changes to water-using devices through changes in technology and customer behaviour.
- 10.130. Since the draft plan was published for consultation, we have increased the number of schemes to reduce the amount of water lost through leaking pipes in the first 10 years. This will change the leakage target to 82 MI/d by 2025, saving an extra 1.5 MI/d than the target in the draft plan.
- 10.131. By 2040, the target will have reduced to 78 MI/d, which is the new long run Sustainable Economic Level of Leakage, a slight increase on the target of 75 MI/d in the draft plan. However, when the plan is updated in five years time, the long-term target will again be re-evaluated to see if it is economic to drive it down even further. We will continue to take into account new technology, which will make our work to reduce leaks even more effective.
- 10.132. Southern Water currently has the lowest rate of leakage per property of all the water and wastewater companies. Leakage has reduced by two-thirds since 1989 and the company has beaten their target in 2012-2013 by 9 MI/d.

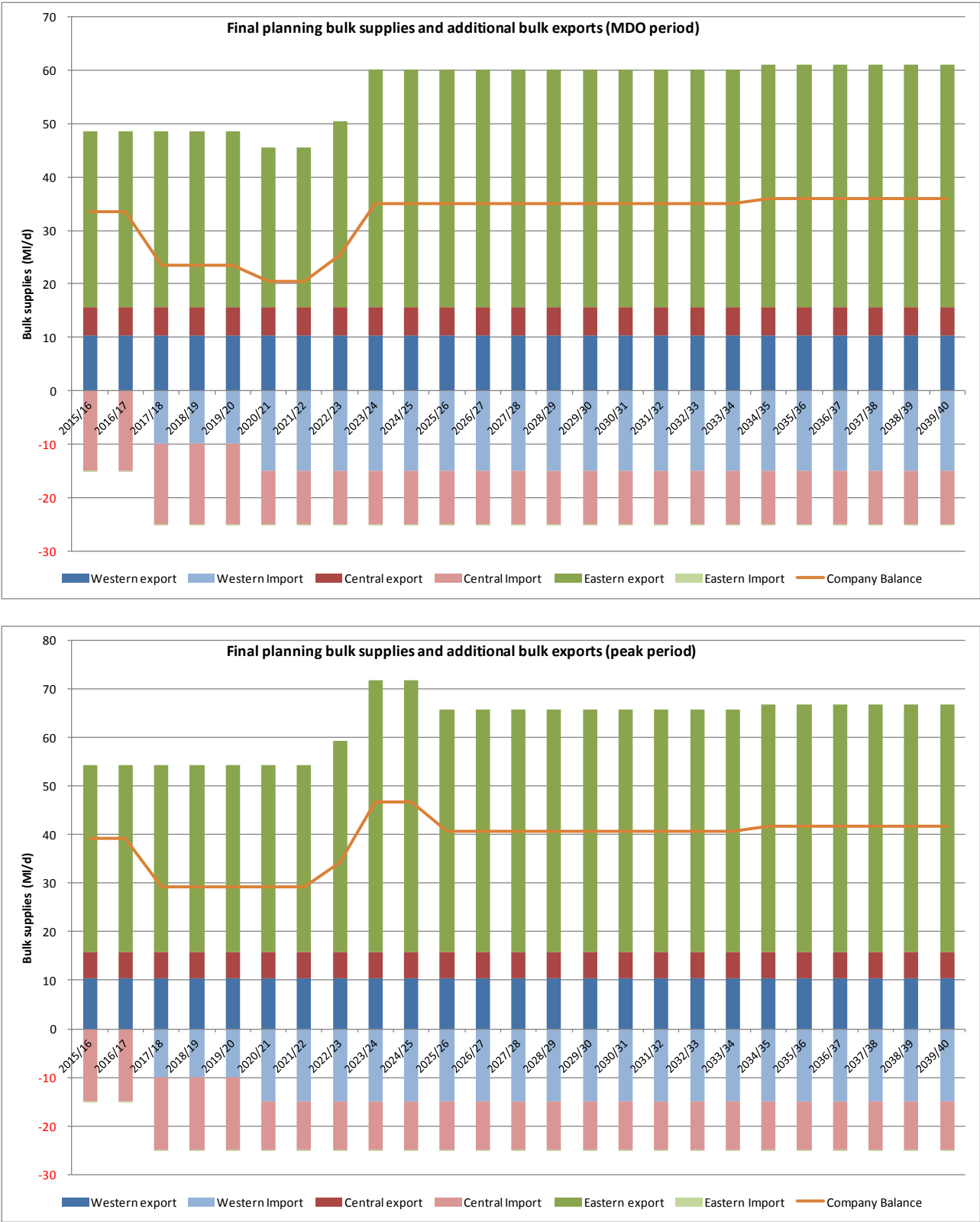
Figure 10.5 Impact of demand management measures in the preferred plan (shown for DYAA)



Regional transfers

- 10.133. As has been noted throughout this WRMP, Southern Water recognises the importance of regional water sharing between water companies in the South East of England. Southern Water is, at company level, a net exporter of water, due primarily to the significant supplies to SEW from the Eastern Area.
- 10.134. However, the preferred plan means that Southern Water expects to be a net importer in the Western and Central Areas, primarily through the provision of 25Ml/d of bulk imports from Portsmouth Water. The evolution of bulk supply exports and imports over the planning period is shown in Figure 10.6.

Figure 10.6 Final planning bulk supplies – Southern Water as a net exporter of water



Investigations and pilot trials required for AMP6

- 10.135. In order to facilitate the proposed strategy of option implementation outlined above, and taking into account the uncertainties involved in various scenarios and sensitivity analyses (as presented in Section 9), Southern Water is proposing to seek funding for a number of investigations and pilot trials during AMP6 (2015-20). Some of these may also continue into, or be primarily undertaken in, AMP7 (2020-25), although some element of scoping would generally be required during the AMP6 period.

Table 10.7 Proposed pilot trials and investigations

Pilot trial / investigation name	Area (WRZ, company)	When?	Brief description, objective, and justification
Western Area			
JO3a MDO groundwater scheme for river augmentation	HS	2014-17	Continuation of discussions and agreement with EA over ownership, operation and licensing of the scheme. Engineering design, environmental investigations and application for planning consent.
T-HSO-3a 10 MI/d bulk supply from Portsmouth Water	HS	2014-16	Engineering design, environmental investigations and application for planning consent. Finalisation of bulk supply commercial agreement and contract with Portsmouth Water
HSL3+HST2 conjunctive use	HS	2015-17	Lower Test abstraction to be assessed under Restoring Sustainable Abstraction programme, including completing an options appraisal relating to future options. This work will be completed by December 2015, enabling the Environment Agency to determine whether any licence changes at the Lower Test abstraction need to be included as sustainability reductions within the next NEP programme, to be published in January 2016. Depending on conclusions, will need to secure planning permissions in early AMP6, but may need to finalise engineering designs and investigations, including environmental and other surveys.
Water efficiency options	HS, IW	2015-19	Develop and commence the implementation of the water efficiency programmes
T-HSO-3d increase bulk supply from Portsmouth Water	HS	2015-19	Continued discussion with Portsmouth and investigation of this option, which results in a reduced supply to SN.
HSC-a and HSC-b catchment management	HS	2015-2022	Commence catchment management work to reduce nitrates, with continued monitoring to ensure the scheme is achieving the required reductions to reduce risks at the sources affected
IWL6 groundwater rehabilitation	IW	2015-19	Investigation of scheme to ensure feasibility
Desalination options (HTD2 and HDT4)	HS	2015-25	Investigation of scheme to ensure feasibility
IWL7 utilise full capacity of the existing cross-Solent main	IW	2015-25	Detailed feasibility leading to engineering design
HR9c non-potable water reuse at industrial site	HS	2015-19	Investigation of scheme to ensure feasibility
Test & Itchen catchment management & river restoration pilots & investigations	HS	2015-19	Investigation and pilot trial of catchment management and river restoration options for the Test and Itchen to negate the need for, or minimise the magnitude of, potential Sustainability Reductions
IW options - desalination (IWD1) and water reuse (IWR1)	IW	2020-25	Investigation of scheme to ensure feasibility
Central Area			
N10 well field reconfiguration	SN	2015-18	Drilling new boreholes and testing of scheme to ensure it can deliver estimated yield. Engineering design, environmental investigations and test pumping, abstraction licence variation and planning applications
N8a winter transfer	SN/SB	2015-17	Engineering design, environmental investigations and application for planning consent. Scheme testing and network modelling, and investigation of the benefits of further winter transfer schemes using the Brighton and Worthing operational groundwater model

Pilot trial / investigation name	Area (WRZ, company)	When?	Brief description, objective, and justification
Nitrate catchment management	SB	2015-22	Commence catchment management work and environmental monitoring to verify the viability of nitrate catchment management schemes to reduce nitrate levels
CA1 4MI/d MDO aquifer storage and recovery	SW	2015-19	Continuation of AMP5 scheme testing
NR2c water reuse	SN	2015-20	Feasibility study, Engineering design, environmental investigations and application for planning consent
Eastern Area			
M21 Licence trading option	KM	2015-19	Engineering design, environmental investigations and application for planning consent for licence trading option that is an alternative to the water re-use option
MR3 water reuse	KM	2015-19	Engineering design, environmental investigations and application for planning consent for water re-use option that is an alternative to the licence trading option
M10 River Medway Scheme licence variation	KM	2015-16	Ongoing investigations to support permanent licence variation agreement with the EA
MT10 Release 'locked in DO' in KM	KM	2015-18	Network modelling and engineering design
M9 groundwater source licence variation	KM	2015-19	Abstraction licence variation application to EA and engineering design
Nitrate catchment management	KM/KT	2015-22	Commence catchment management work and environmental monitoring to verify the viability of nitrate catchment management schemes to reduce nitrate levels
General enabling studies			
Refinement plan for stochastic approach	Company	2015-17	For WRMP14 Southern Water adopted a new stochastic approach to DO assessment. Adopting this approach provided useful insights into the system risks and Level of Service difficulties that have existed across the region, which in turn helps address the resilience issues of the South East. The EA has expressed a wish to follow a 'development plan' for the refinement of the stochastic approach during the first two years of AMP6. A draft of this plan was submitted to the EA in October 2013 outlining a scope of works which we intend to be delivered as part of the AMP6 investigations.
Options appraisal of other catchment management & river restoration options	Company	2015-19	Identification of further catchment management schemes, including derivation of potential scheme output and costs to test whether catchment management options present a viable solution to managing pollution issues – e.g. nitrates
Tariff trials	Company	2015-25	To provide direct evidence for the viability of tariff options, their impact on customers and the potential savings that may be achievable
NEP investigations, options appraisal and Implementations			
Lewes Winterbourne (Brighton Group licence)	SB	2015-20	National Environment Programme options appraisal
Iford Marshes (Brighton Group licence)	SB	2015-20	National Environment Programme investigation
Lukely Brook	IW	2015-20	National Environment Programme implementation
Brighton Chalk (Brighton Group licence)	SB	2015-20	National Environment Programme investigation
Bow Lake (lower)	HS	2015-20	National Environment Programme investigation
Dry Valley south of Sittingbourne	KM	2015-20	National Environment Programme investigation
Teville Stream (Worthing Group licence)	SW	2015-20	National Environment Programme investigation
North Kent Tertiaries (Various WSWs)	KM	2015-20	National Environment Programme investigation

Pilot trial / investigation name	Area (WRZ, company)	When?	Brief description, objective, and justification
Swale tributary at Lower Halstow, (Various WSWs)	KM	2015-20	National Environment Programme investigation
White Drain	KM	2015-20	National Environment Programme investigation
Little Stour	KT	2015-20	National Environment Programme implementation
Wingham River	KT	2015-20	National Environment Programme implementation
Bowl Water (River Medway Scheme)	KM	2015-20	National Environment Programme implementation
River Medway at Weir Wood Reservoir	SN	2015-20	National Environment Programme implementation

Information on "other investigations" was extracted from EA workbook *130925 draft NEP Phase 4 Southern Water.xls*.

Based on this information provided by the EA information to the company, any NEP studies which concluded no need for any licence changes have not been included in this list.

Other schemes / investigations

- 10.136. We have consulted on South East Water's dWRMP. During the consultation period we discussed South East Water's proposals for the treatment of effluent from one of our wastewater treatment works in East Sussex. We have confirmed our support for this proposal and have agreed to work with South East Water in AMP6 to assist them in completing their further feasibility studies. The scheme as proposed at this stage will deliver up to 25 Ml/d, and is required by 2027. It will not reduce the supplies available to Southern Water's customers.

Annex 1: Supply demand balance plots

This Annex provides the supply demand balance plots for the key planning scenarios associated with each water resource zone, which means either the DYAA or DYMDO (the former for the Eastern Area, the latter for the Central and Western Areas), and the DYCP (for all Supply Areas). These are provided for both:

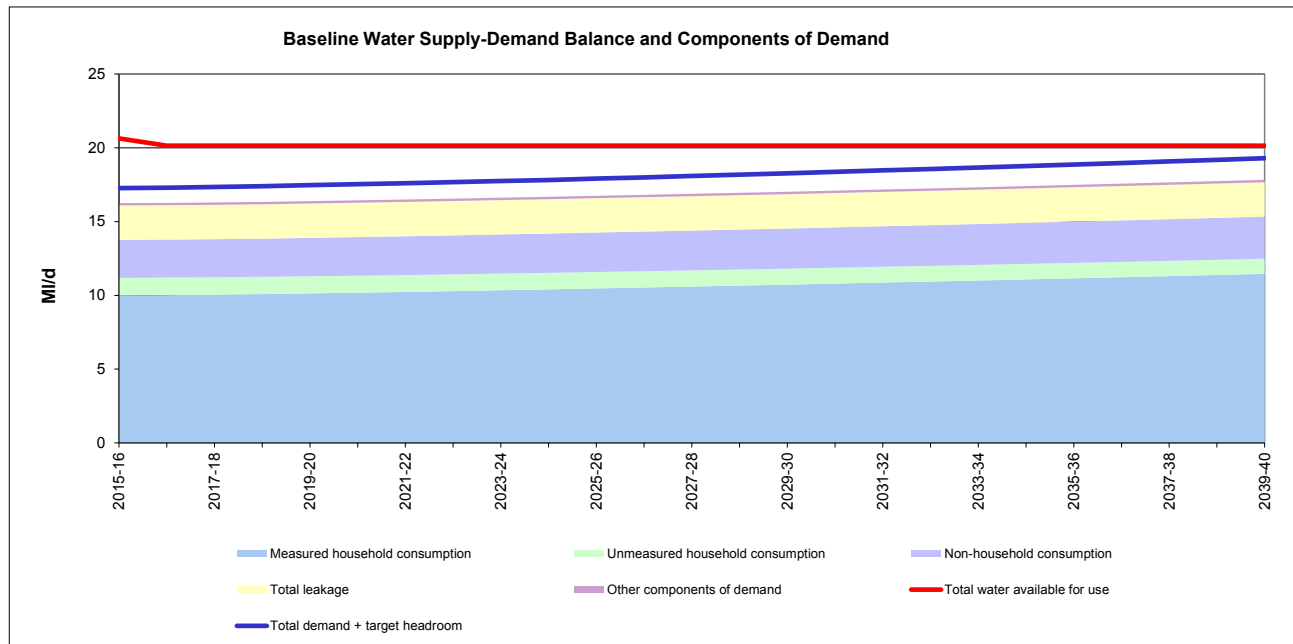
- The **baseline supply demand balance** – which is the forecast based on current estimates of the supply demand balance. It effectively demonstrates whether there is likely to be a surplus or deficit during the planning period and, therefore, whether any further action may be required. However, it is important to note that these baseline plots do not include existing inter-zonal supplies from other WRZs, as the volume of these internal transfers is optimised in the least cost investment model instead; and
- The **final planning supply demand balance** (the **preferred plan**). This is needed for any baseline cases where a deficit is identified, and shows the impact that the option(s) which are introduced to meet baseline deficits have on the supply demand balance. The plots show optimised bulk supply and transfer volumes along with the capacity of any additional resource developments.

The supply demand balance plots in this Annex are outputs generated automatically from the Environment Agency's Water Resources Planning Tables.

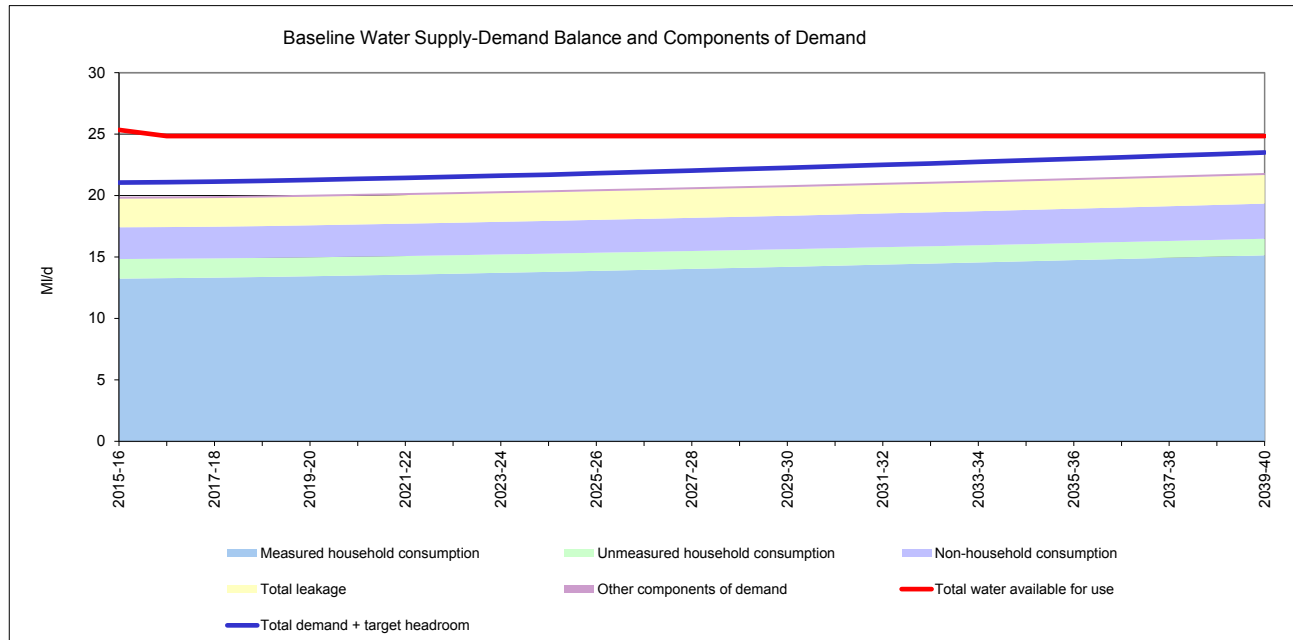
Western Area supply demand balances

Hampshire Andover

HA Baseline supply demand balance – DYMDO



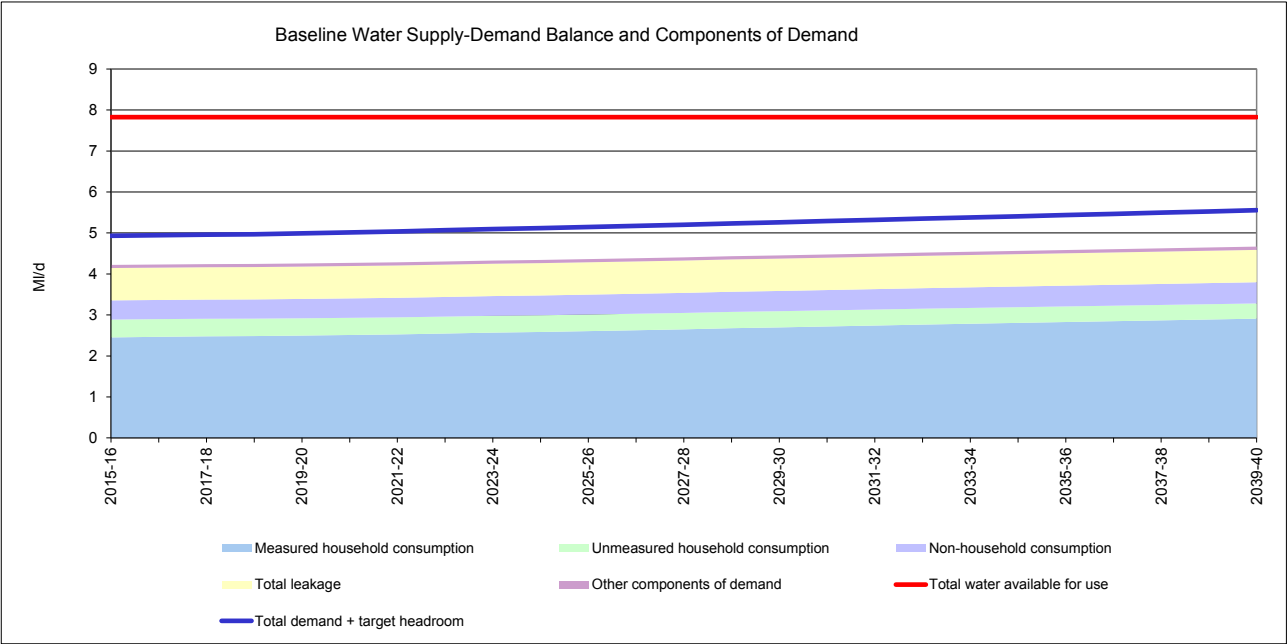
HA Baseline supply demand balance – DYCP



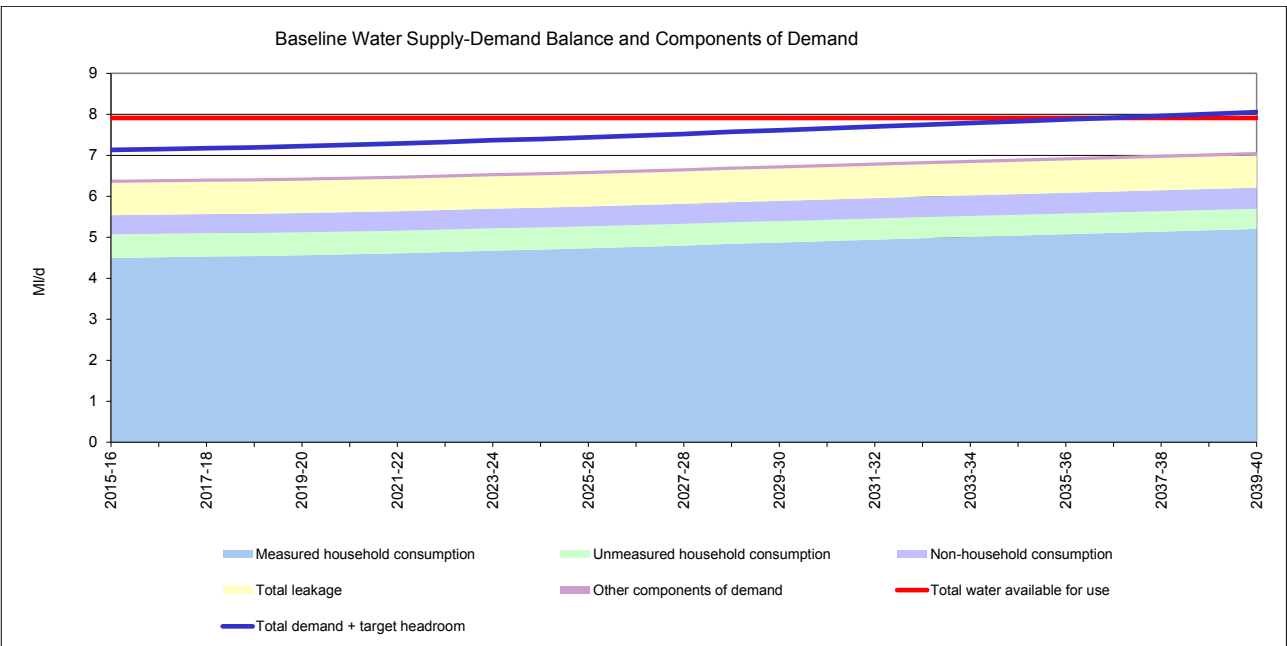
HA Final Planning supply demand balance

As there are no deficits forecast in the baseline supply demand balances for either of the planning scenarios, there is no requirement for a final planning solution in this WRZ.

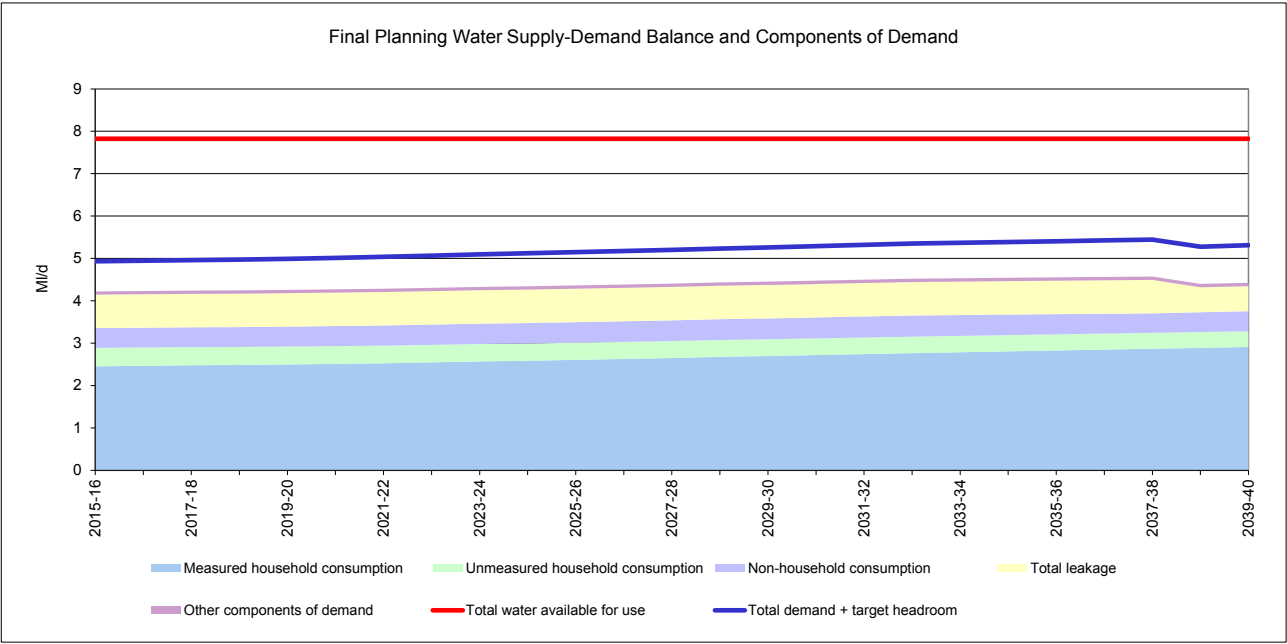
Hampshire Kingsclere
HK Baseline supply demand balance – DYMDO



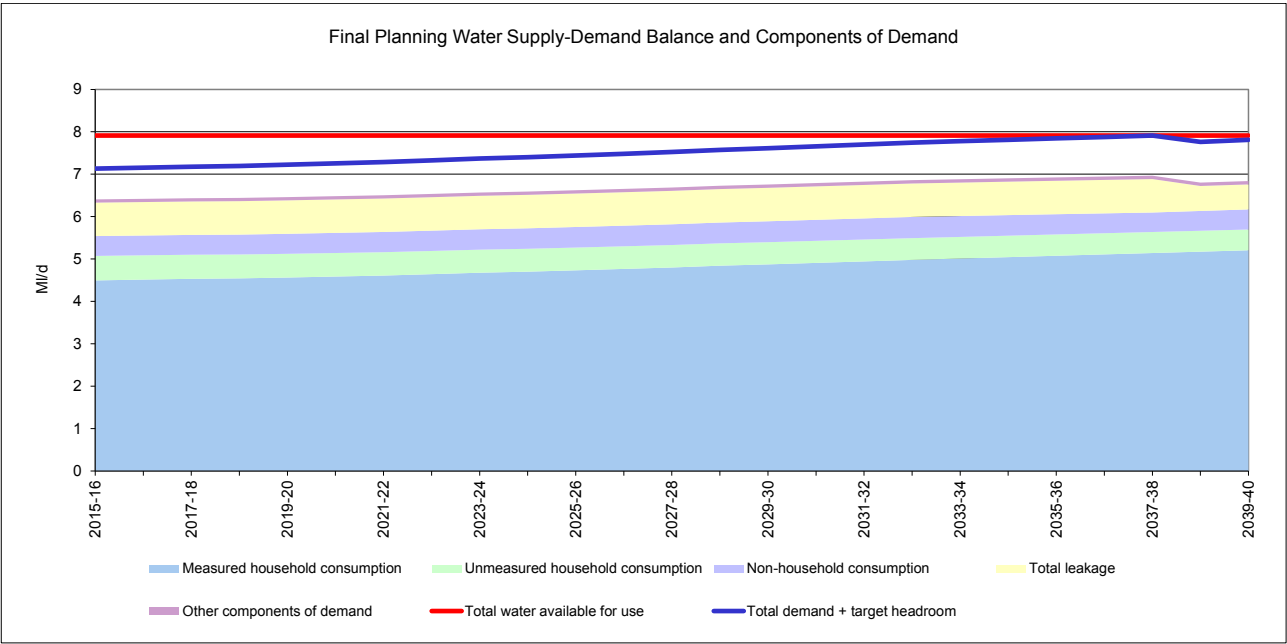
HK Baseline supply demand balance – DYCP



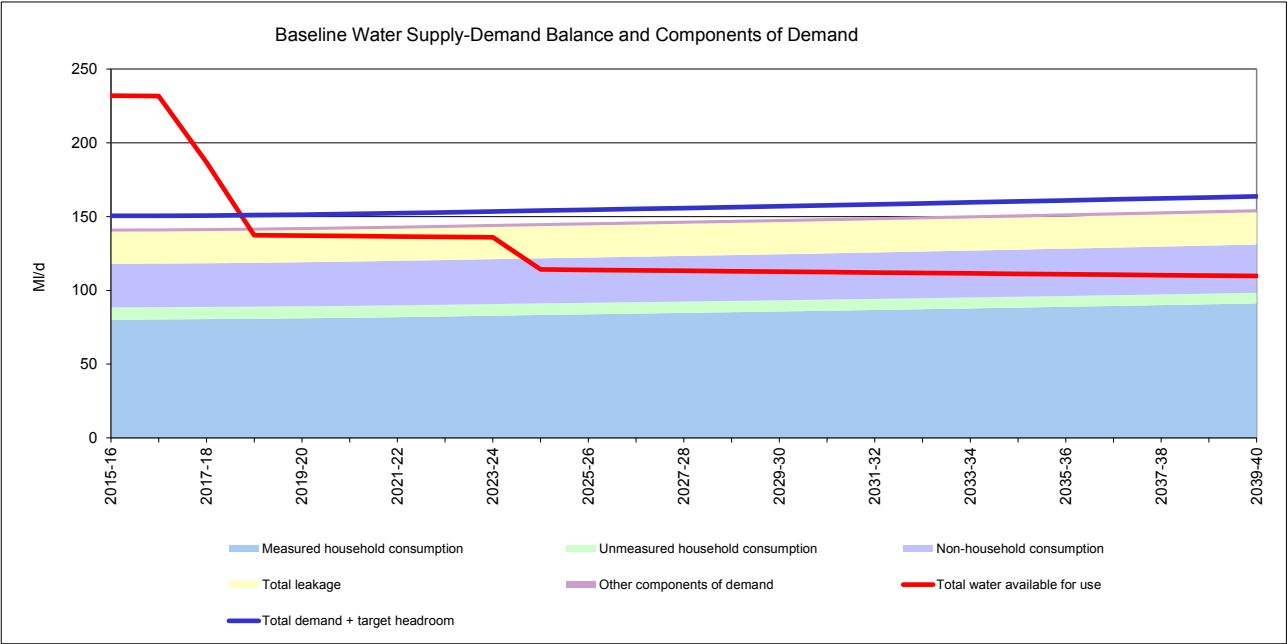
HK Final Planning supply demand balance - DYMDO



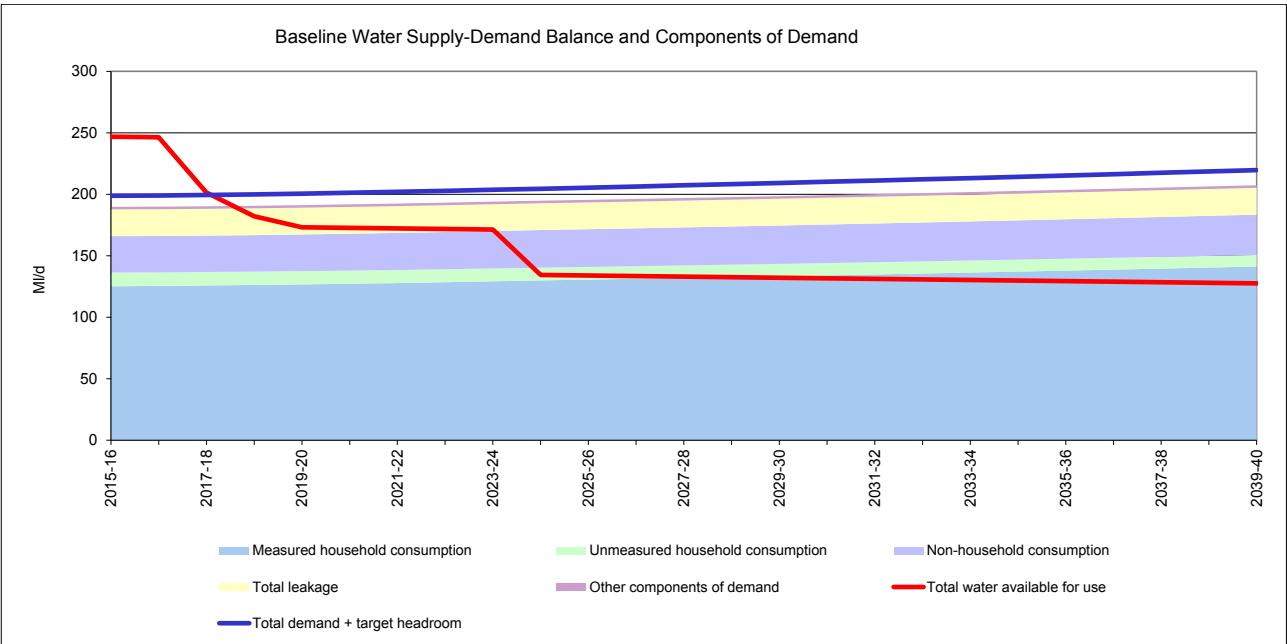
HK Final Planning supply demand balance - DYCP



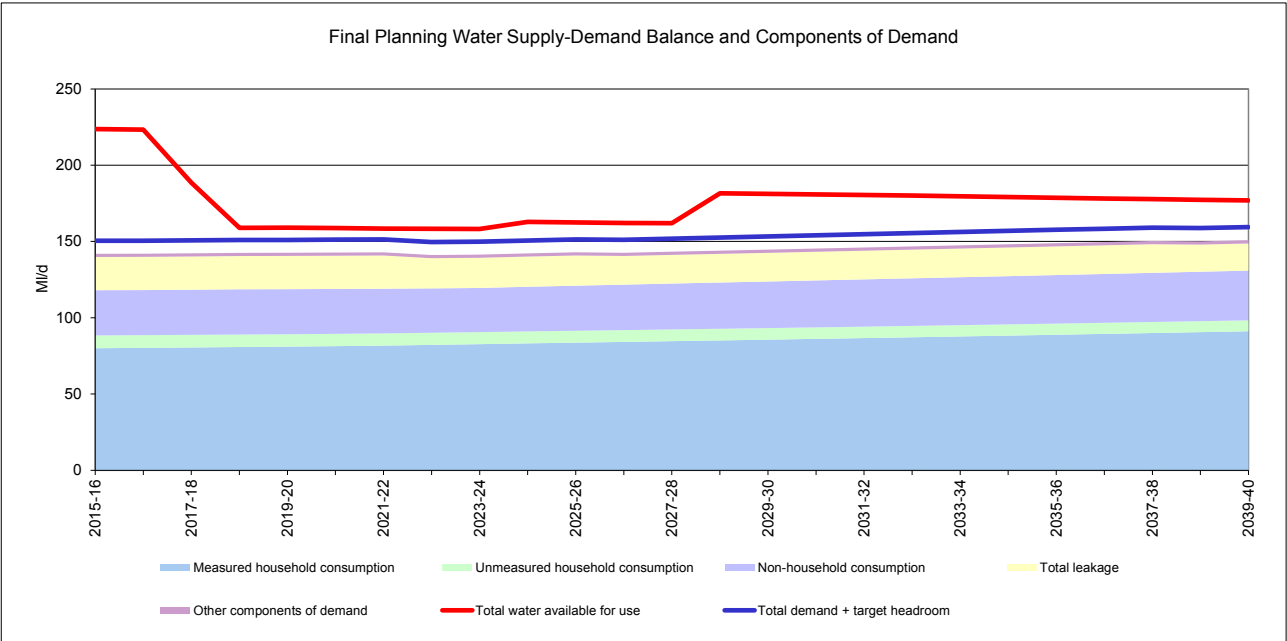
Hampshire South
HS Baseline supply demand balance – DYMDO



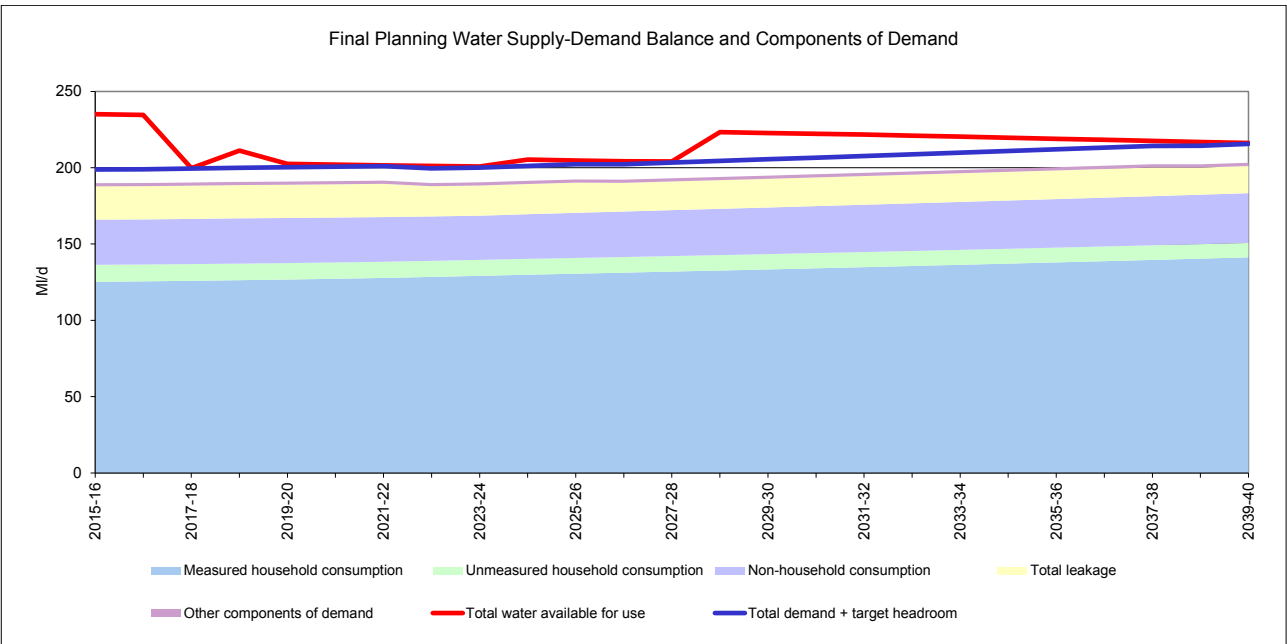
HS Baseline supply demand balance – DYCP



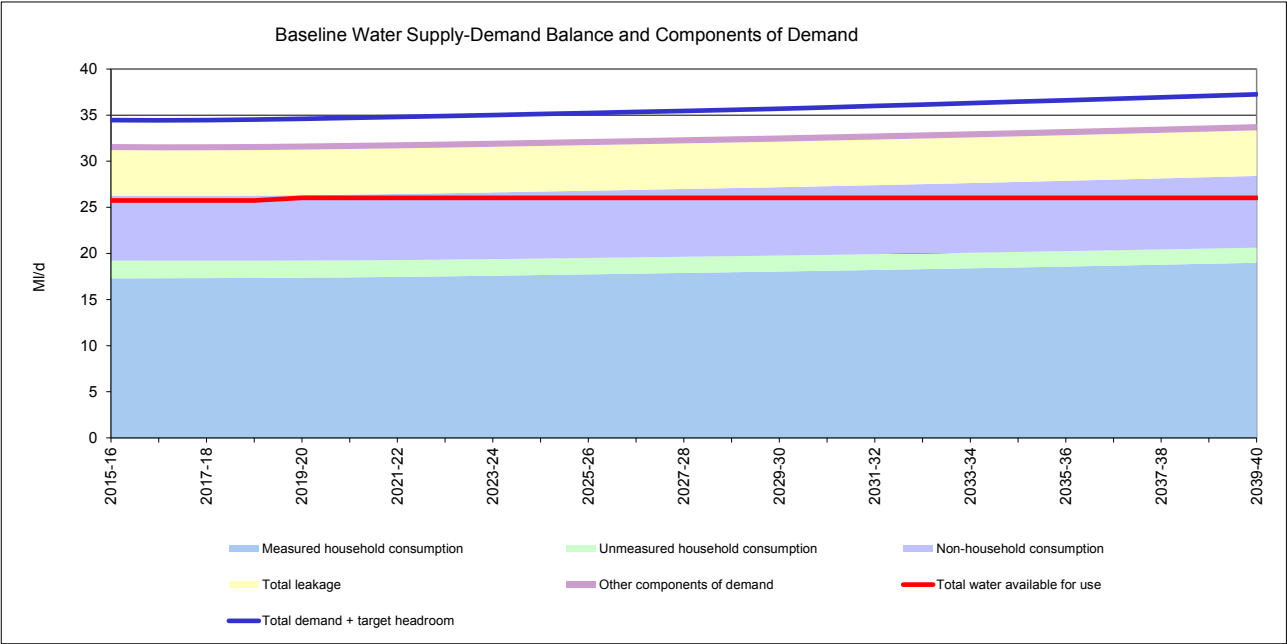
HS Final Planning supply demand balance – DYMDO



HS Final Planning supply demand balance – DYCP

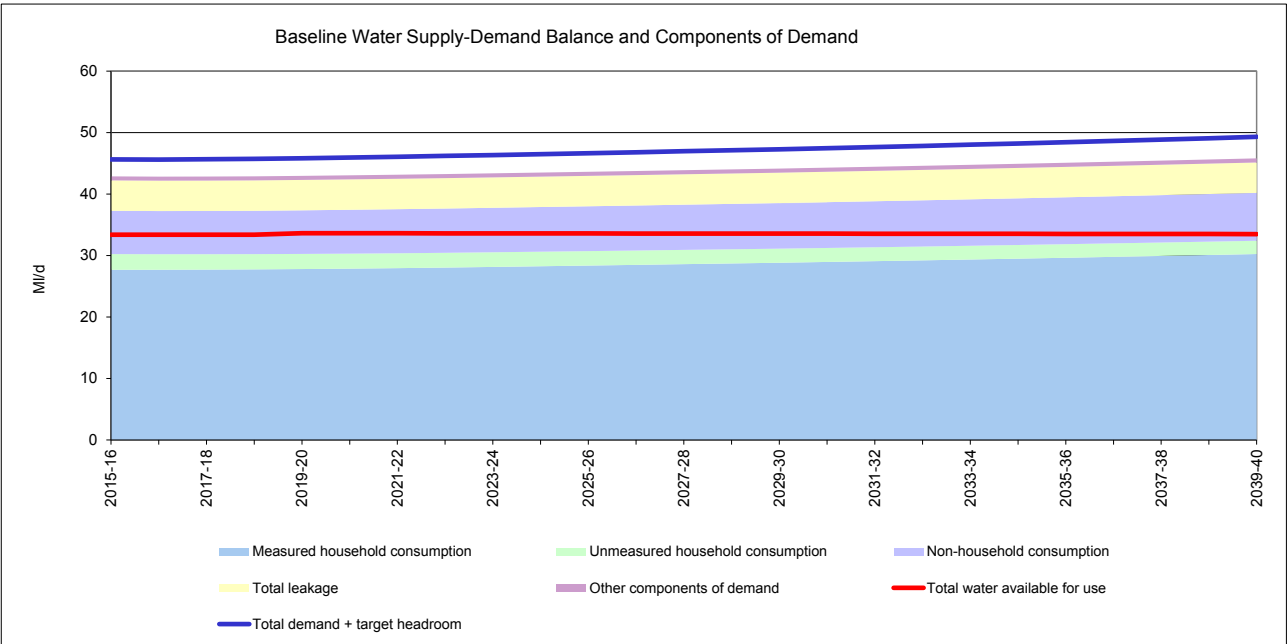


Isle of Wight
IW Baseline supply demand balance – DYMDO



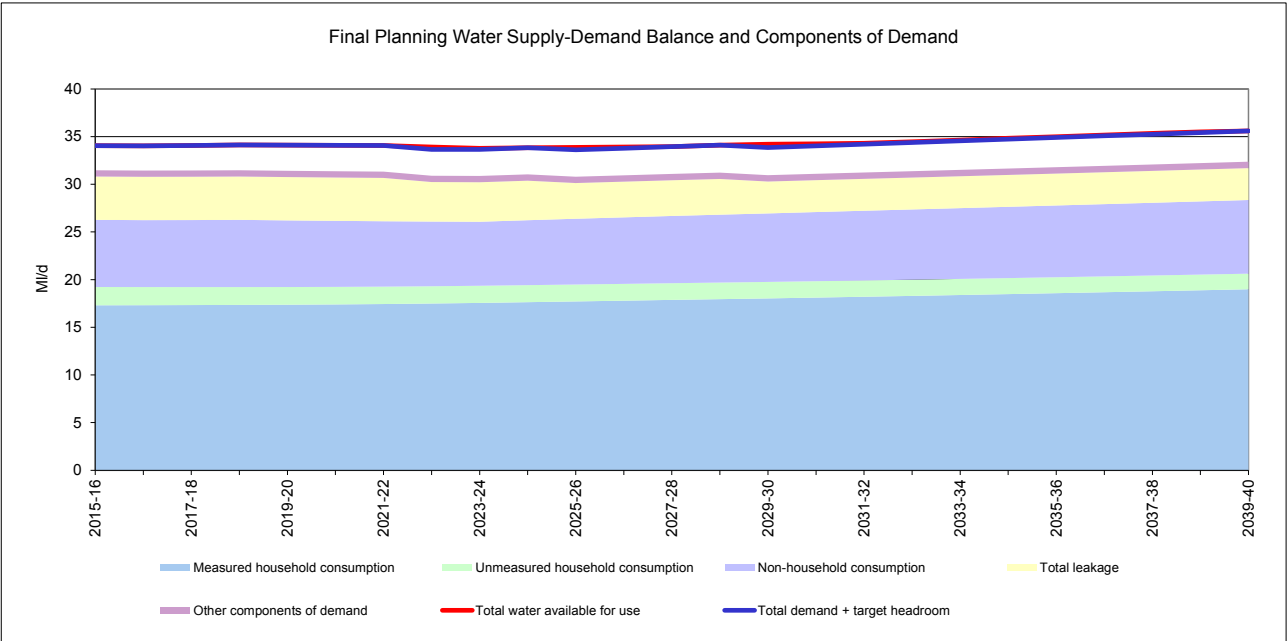
Note that this baseline does not include supplies from Hampshire South WRZ.

IW Baseline supply demand balance – DYCP

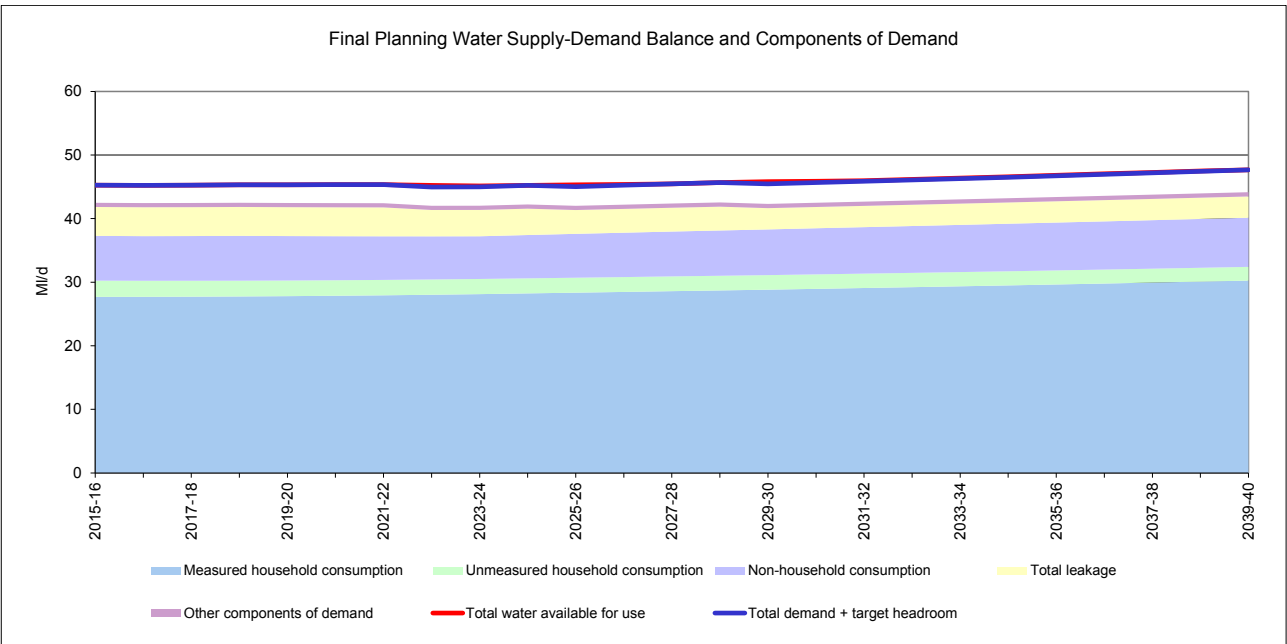


Note that this baseline does not include the internal transfer from Hampshire South WRZ.

IW Final Planning supply demand balance – DYMDO



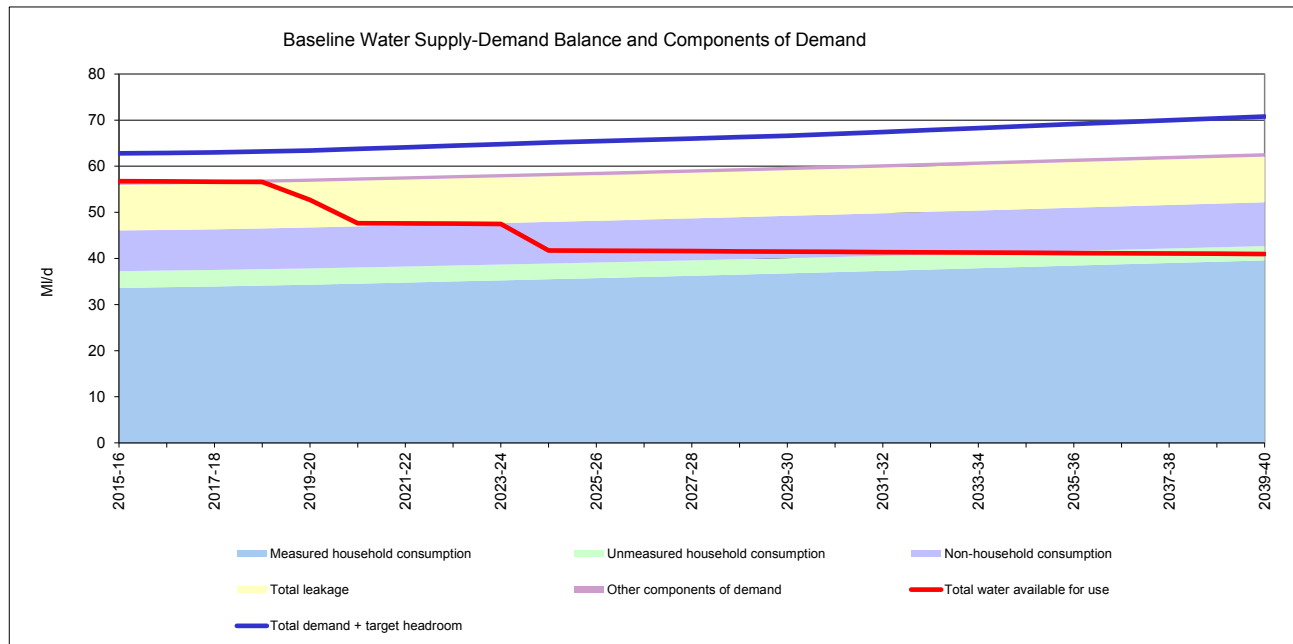
IW Final Planning supply demand balance – DYCP



Central Area supply demand balances

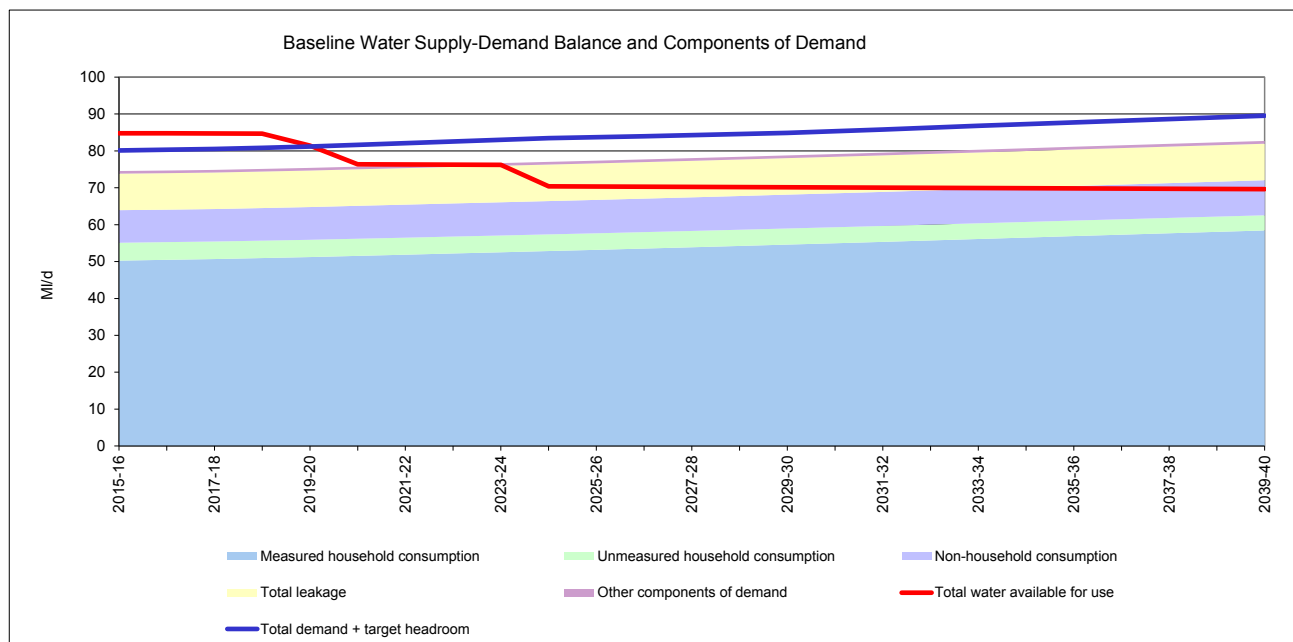
Sussex North

SN Baseline supply demand balance – DYMDO



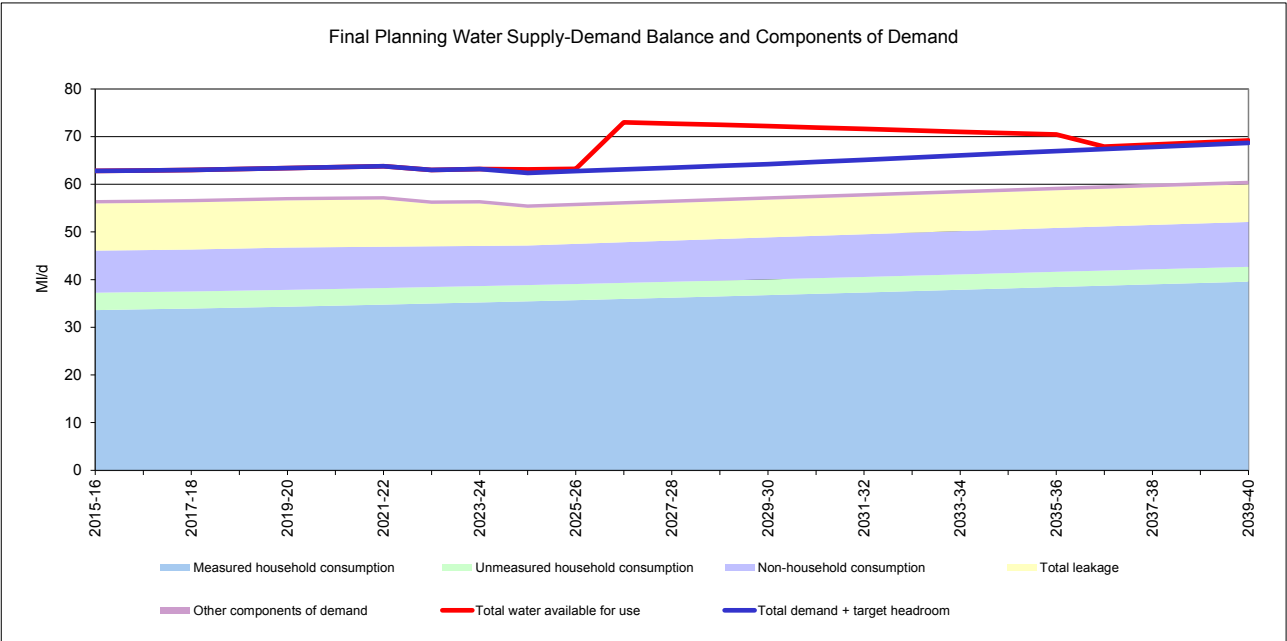
Note that this baseline does not include the internal transfer with Sussex Worthing WRZ.

SN Baseline supply demand balance – DYCP

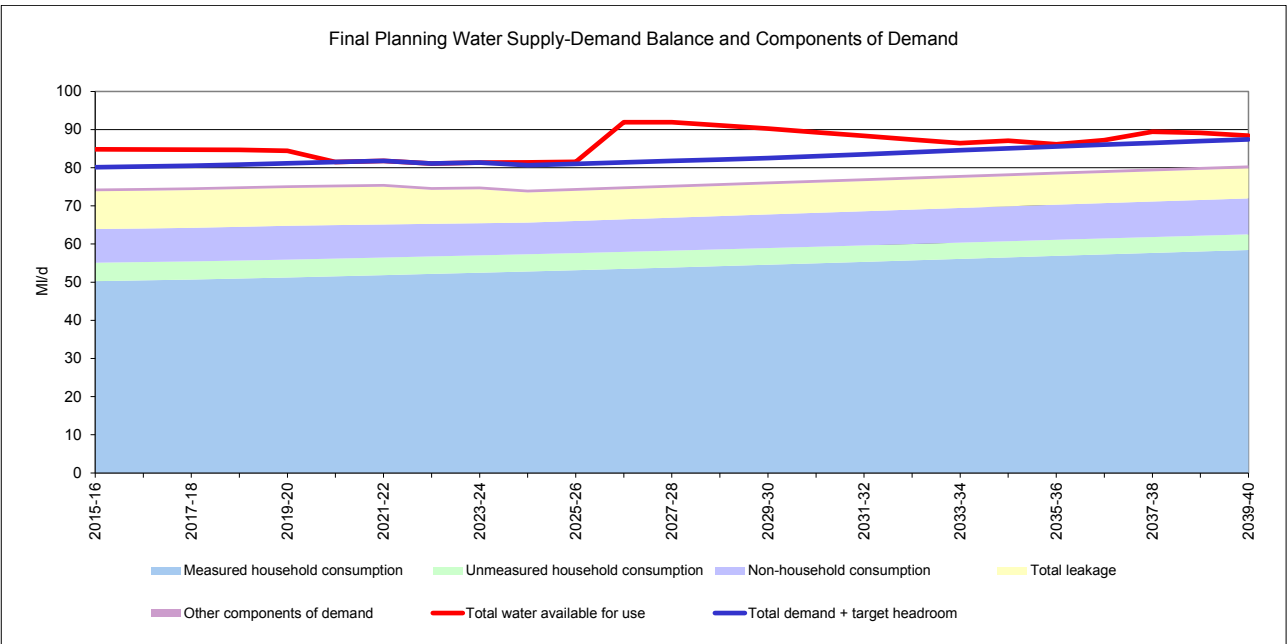


Note that this baseline does not include the internal transfer with Sussex Worthing WRZ.

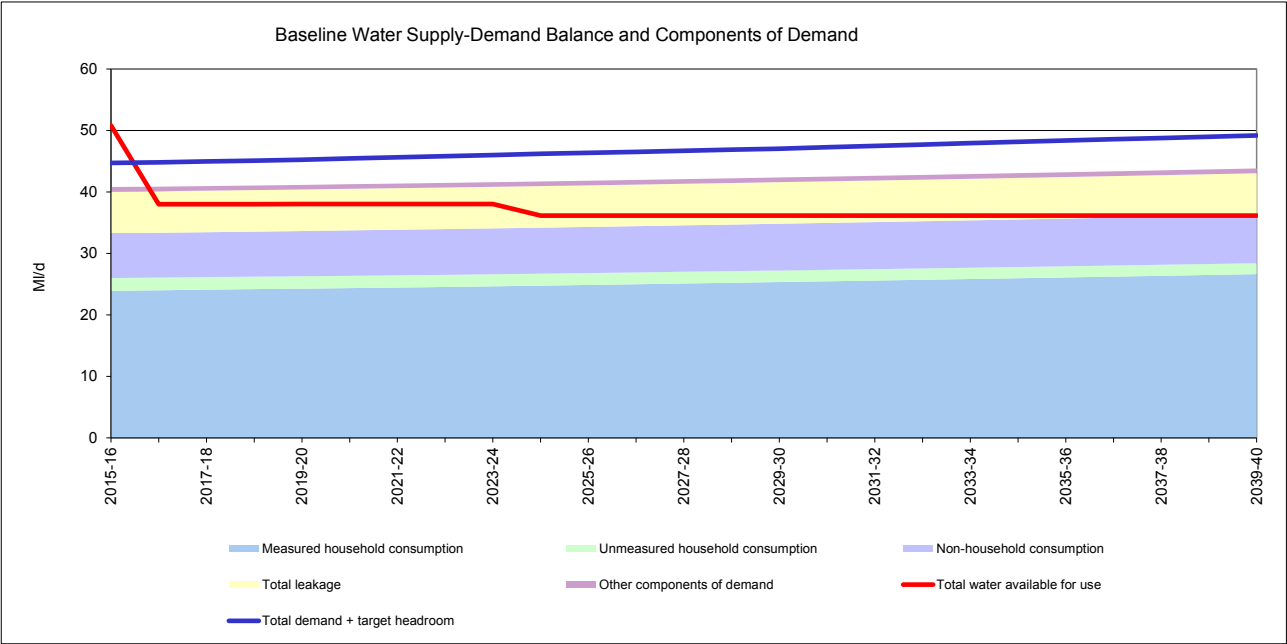
SN Final Planning supply demand balance – DYMDO



SN Final Planning supply demand balance – DYCP

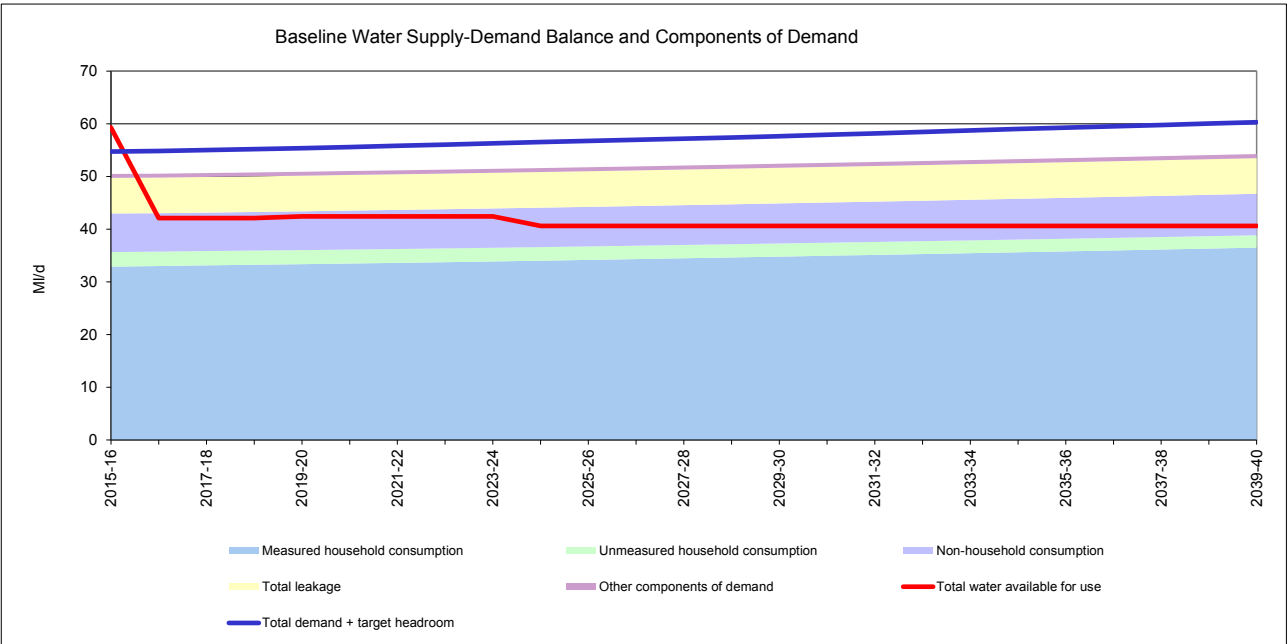


Sussex Worthing
SW Baseline supply demand balance – DYMDO



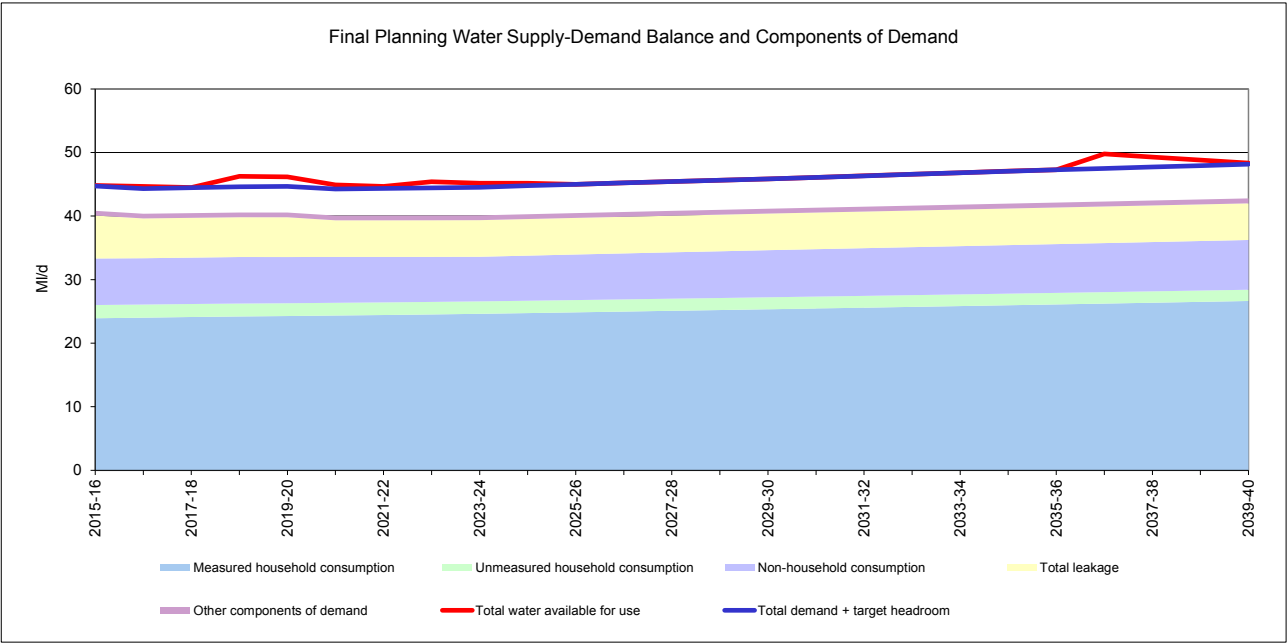
Note that this baseline does not include the internal transfer with Sussex North WRZ.

SW Baseline supply demand balance – DYCP

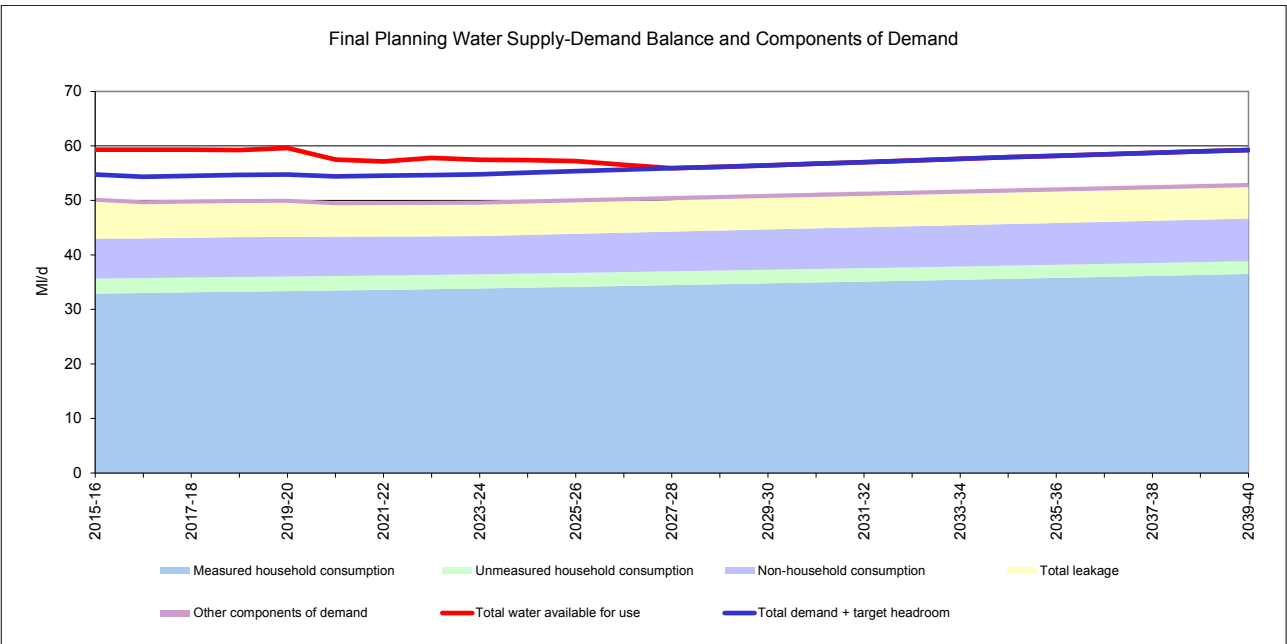


Note that this baseline does not include the internal transfer with Sussex North WRZ.

SW Final Planning supply demand balance – DYMDO

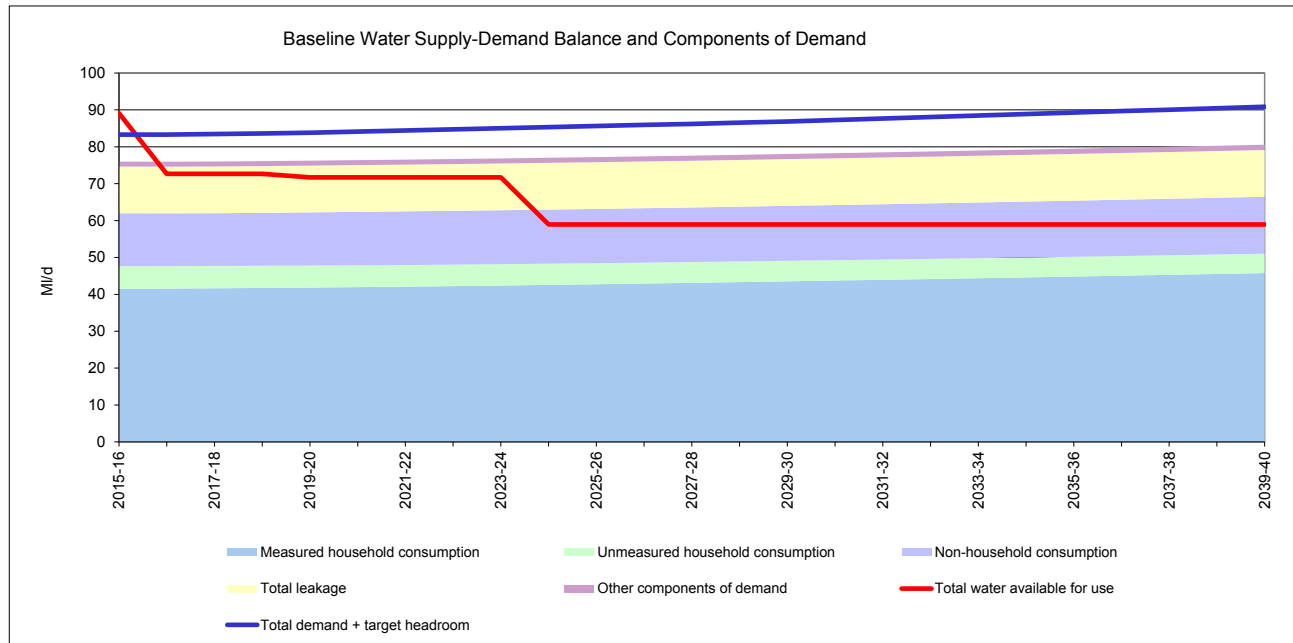


SW Final Planning supply demand balance – DYCP



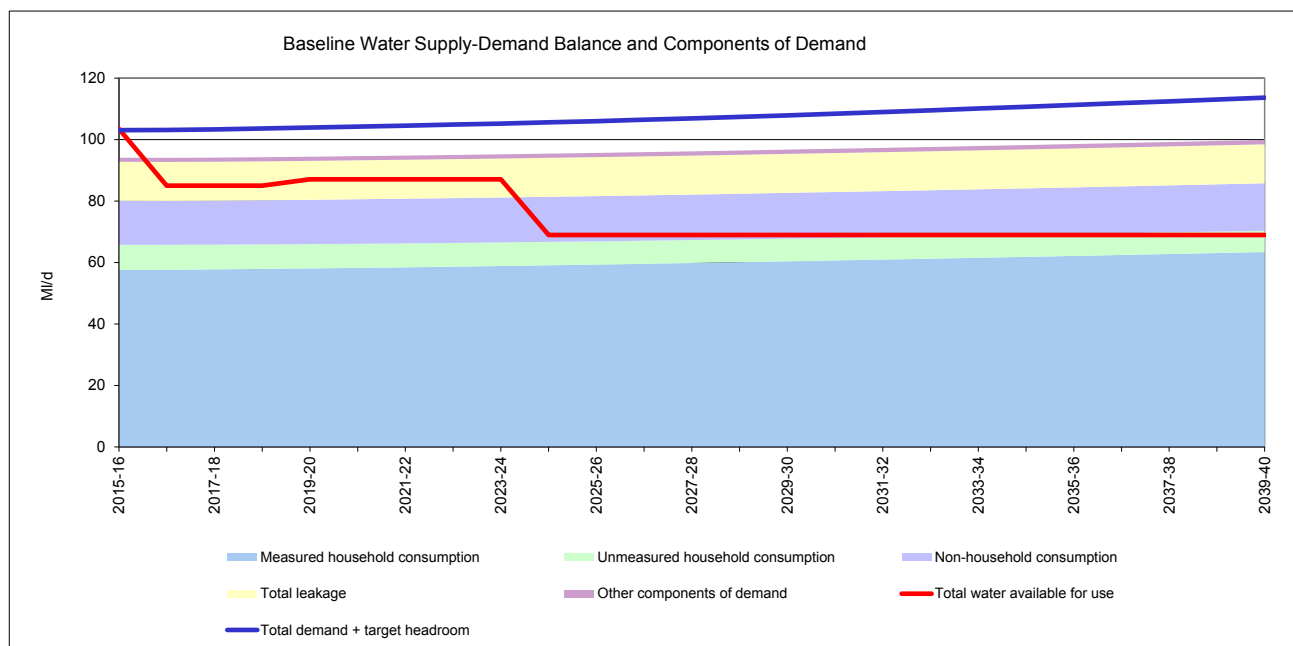
Sussex Brighton

SB Baseline supply demand balance – DYMDO



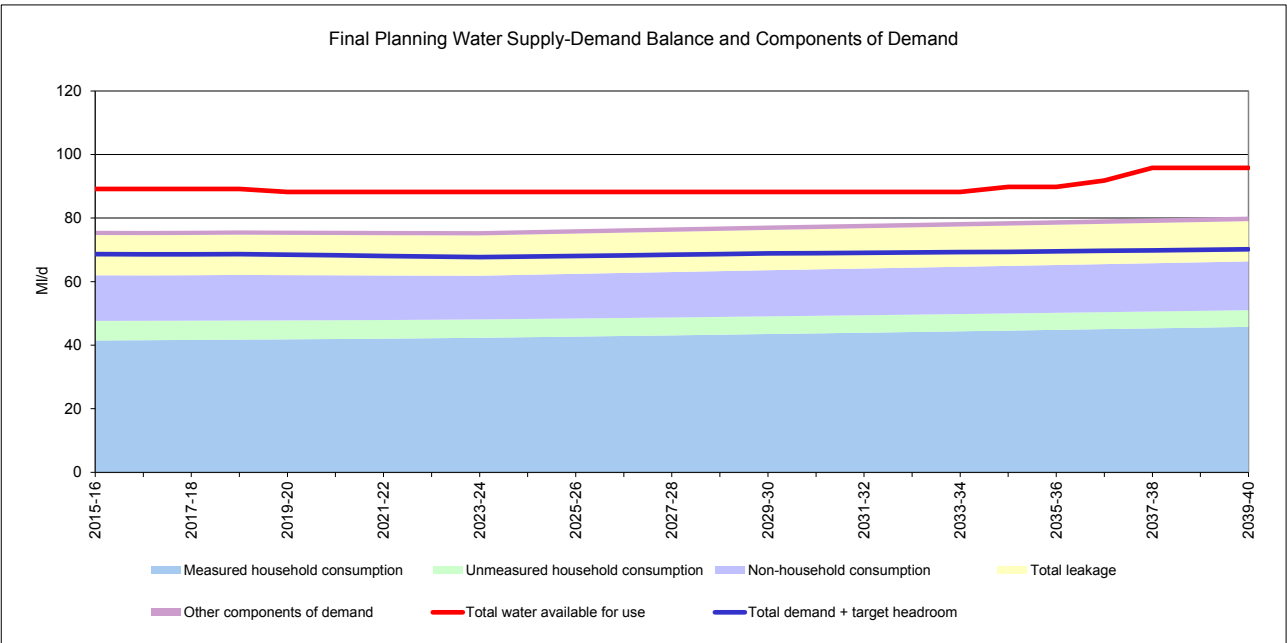
Note that this baseline does not include the internal transfer with Sussex Worthing WRZ.

SB Baseline supply demand balance – DYCP

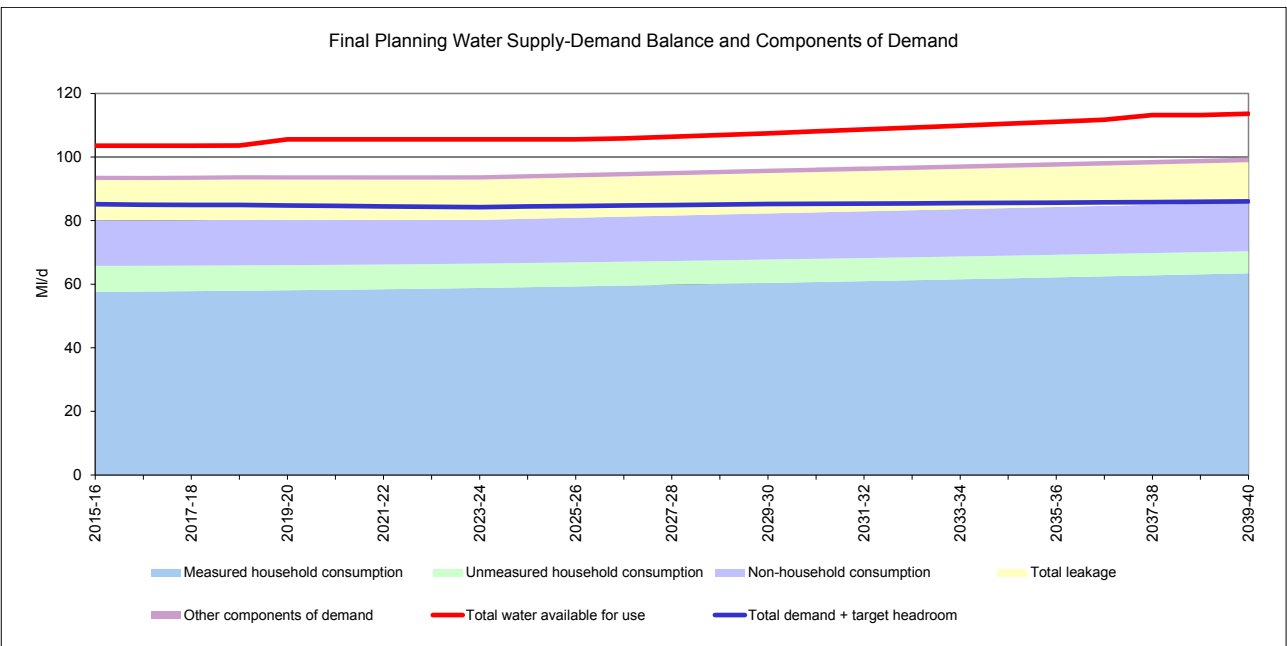


Note that this baseline does not include the internal transfer with Sussex Worthing WRZ.

SB Final Planning supply demand balance – DYMDO

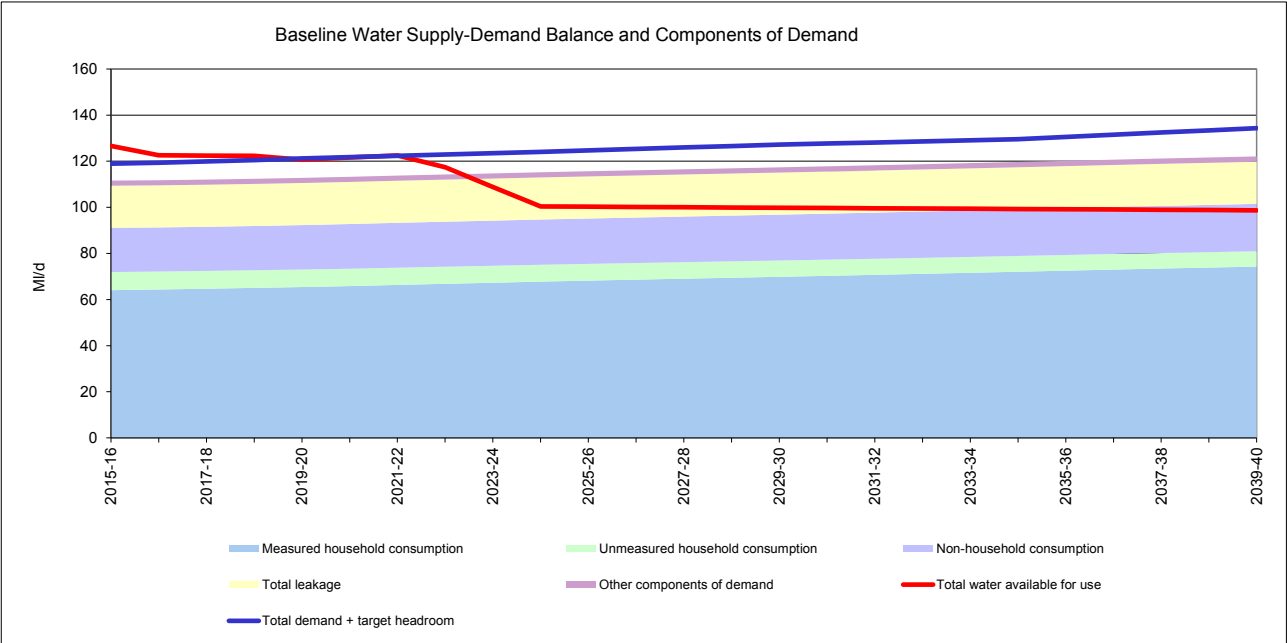


SB Final Planning supply demand balance – DYCP

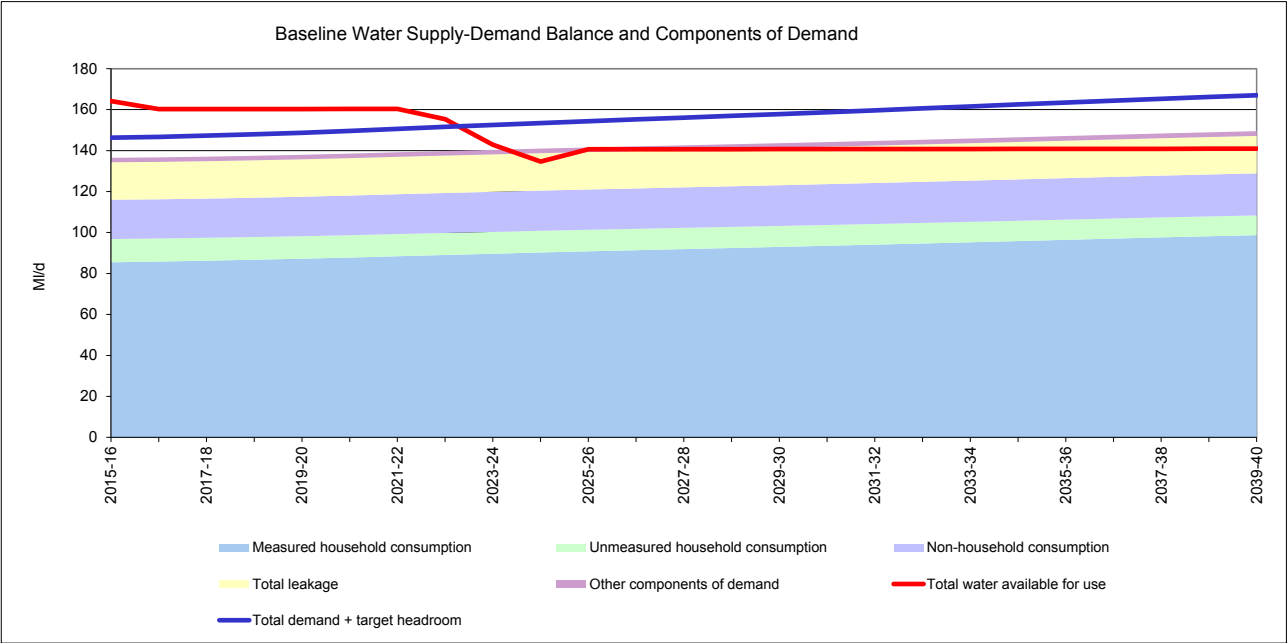


Eastern Area supply demand balances

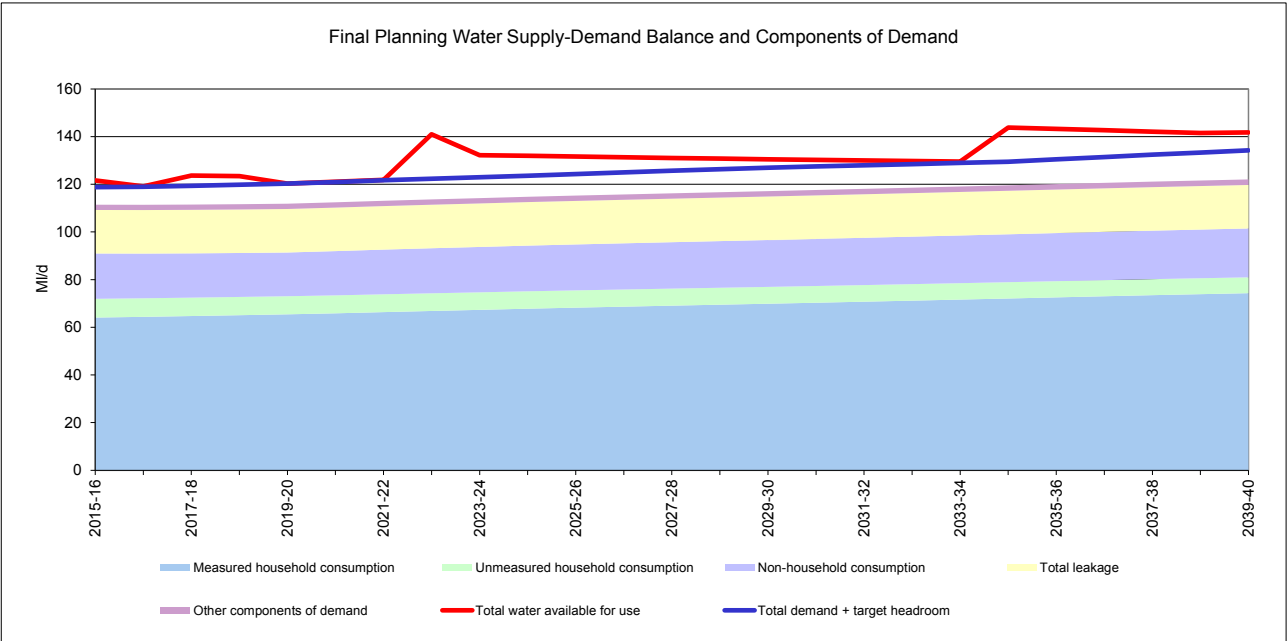
Kent Medway KM Baseline supply demand balance – DYAA



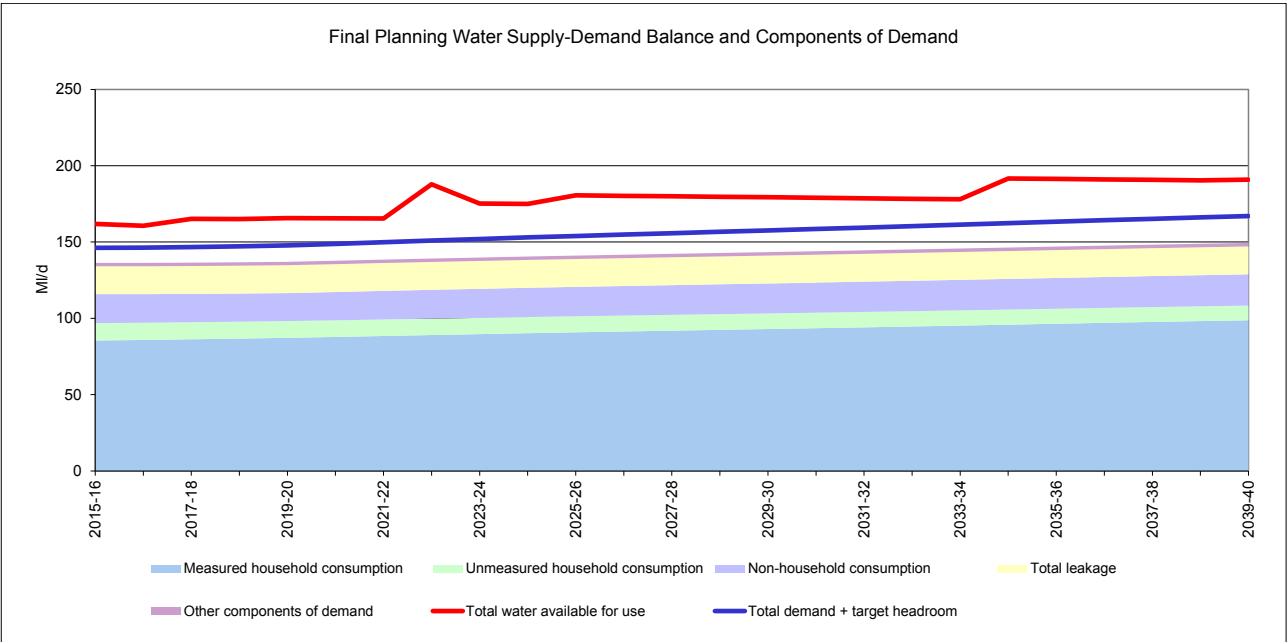
KM Baseline supply demand balance – DYCP



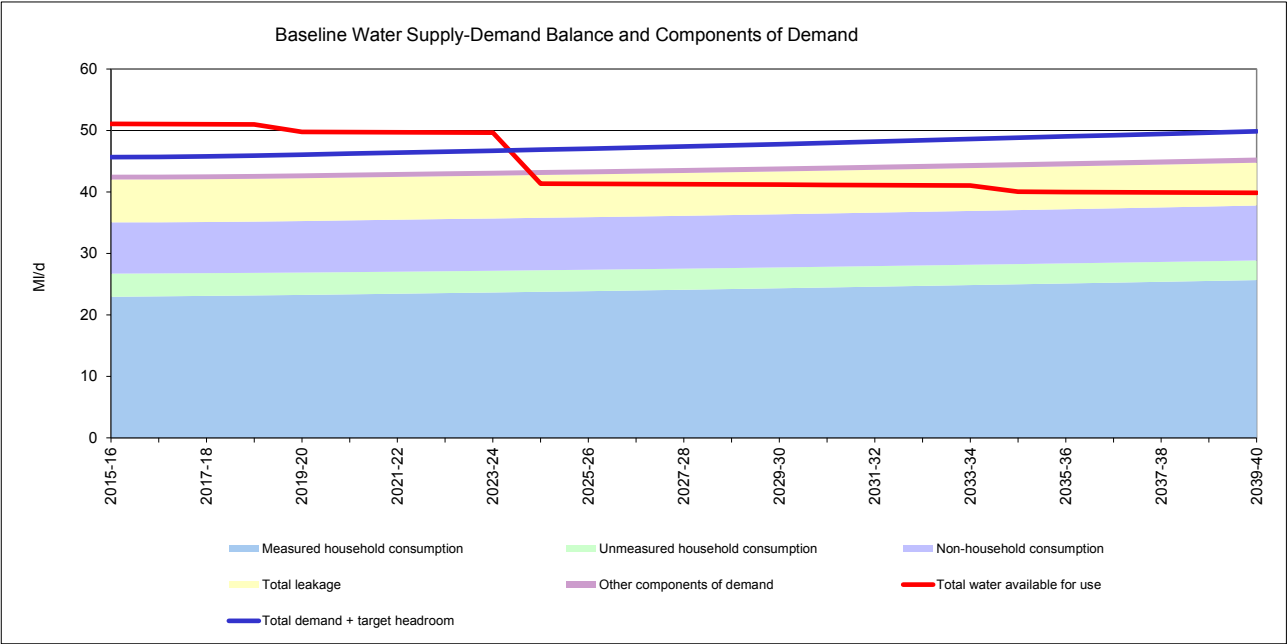
KM Final Planning supply demand balance – DYAA



KM Final Planning supply demand balance – DYCP

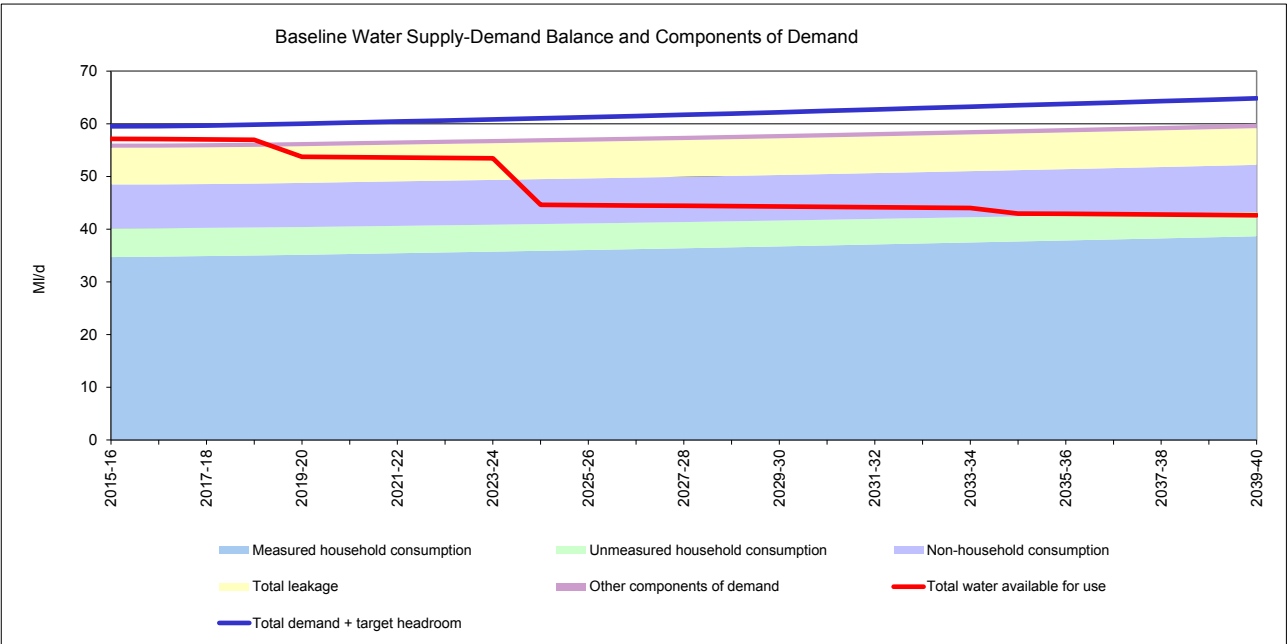


Kent Thanet
KT Baseline supply demand balance – DYAA



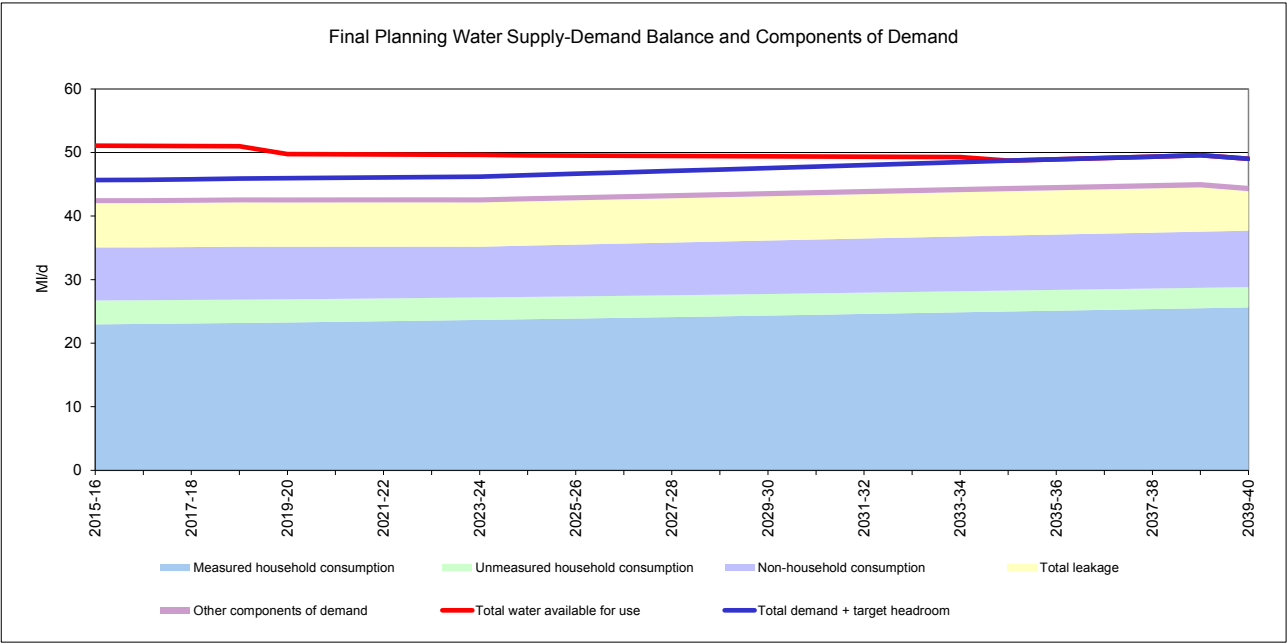
Note that this baseline does not include the internal transfer from Kent Medway WRZ

KT Baseline supply demand balance – DYCP

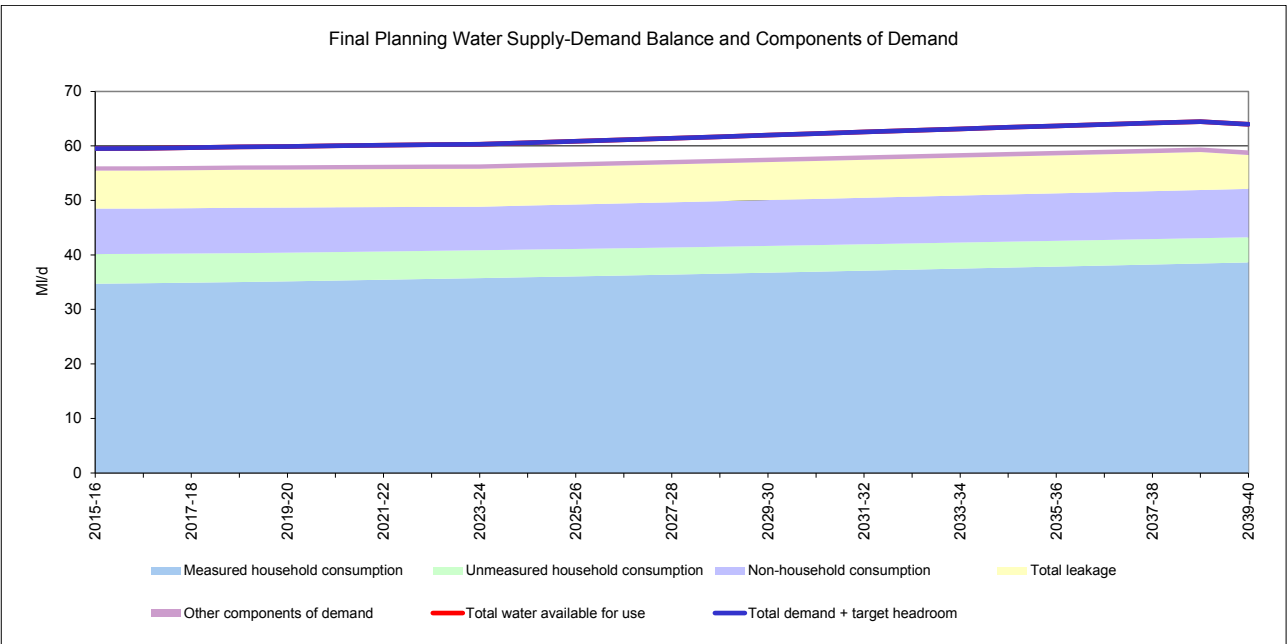


Note that this baseline does not include the internal transfer from Kent Medway WRZ

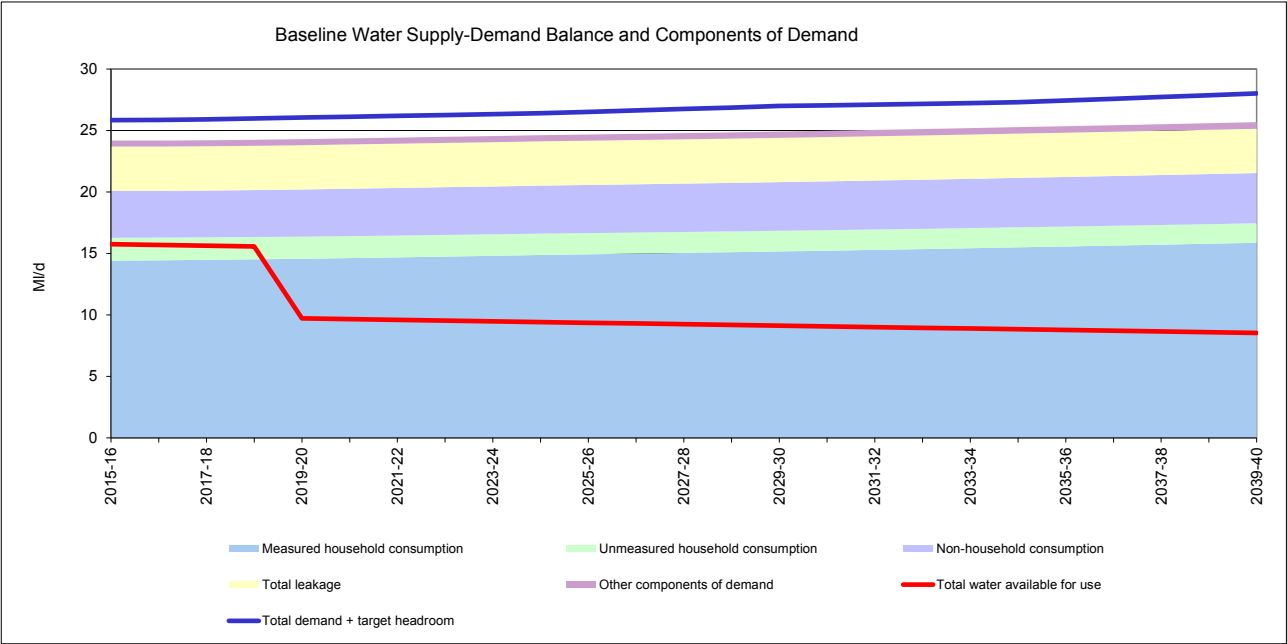
KT Final Planning supply demand balance – DYAA



KT Final Planning supply demand balance – DYCP

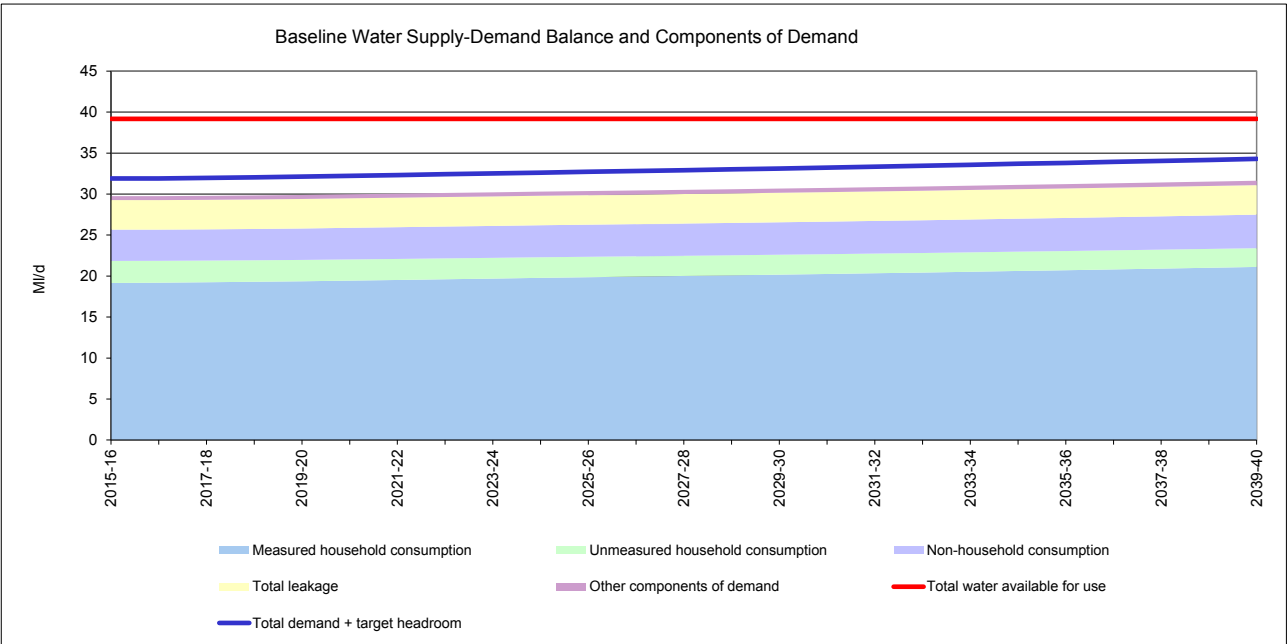


Sussex Hastings
SH Baseline supply demand balance – DYAA



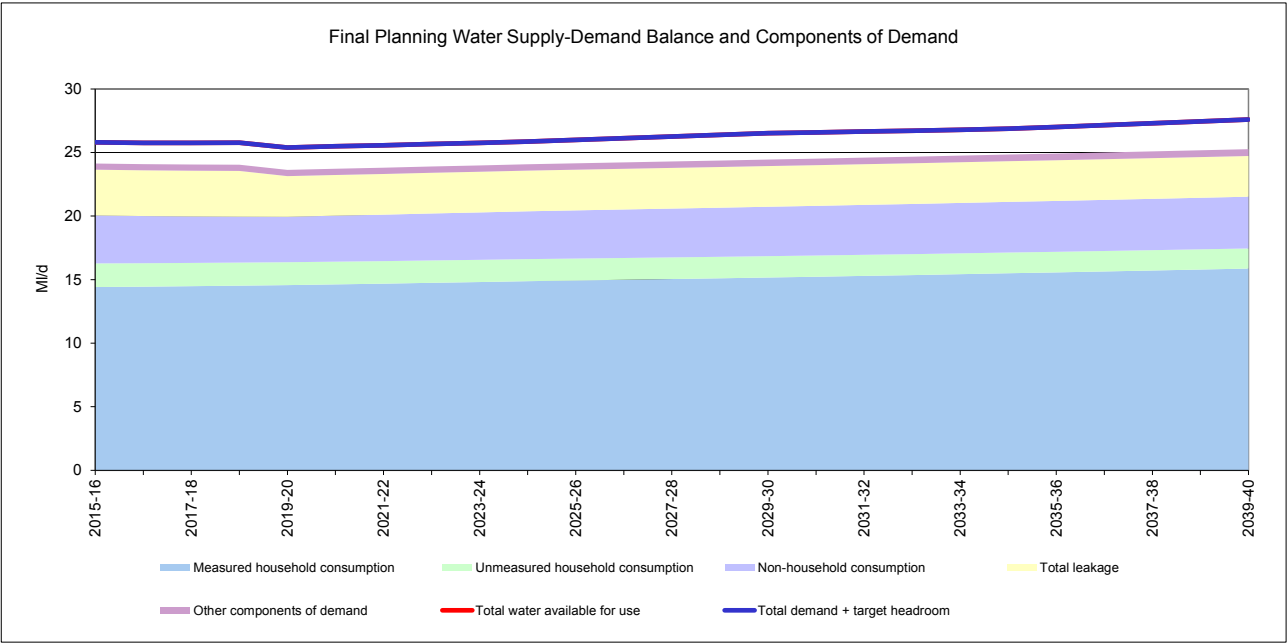
Note that this baseline does not include the internal transfer from Kent Medway WRZ

SH Baseline supply demand balance – DYCP

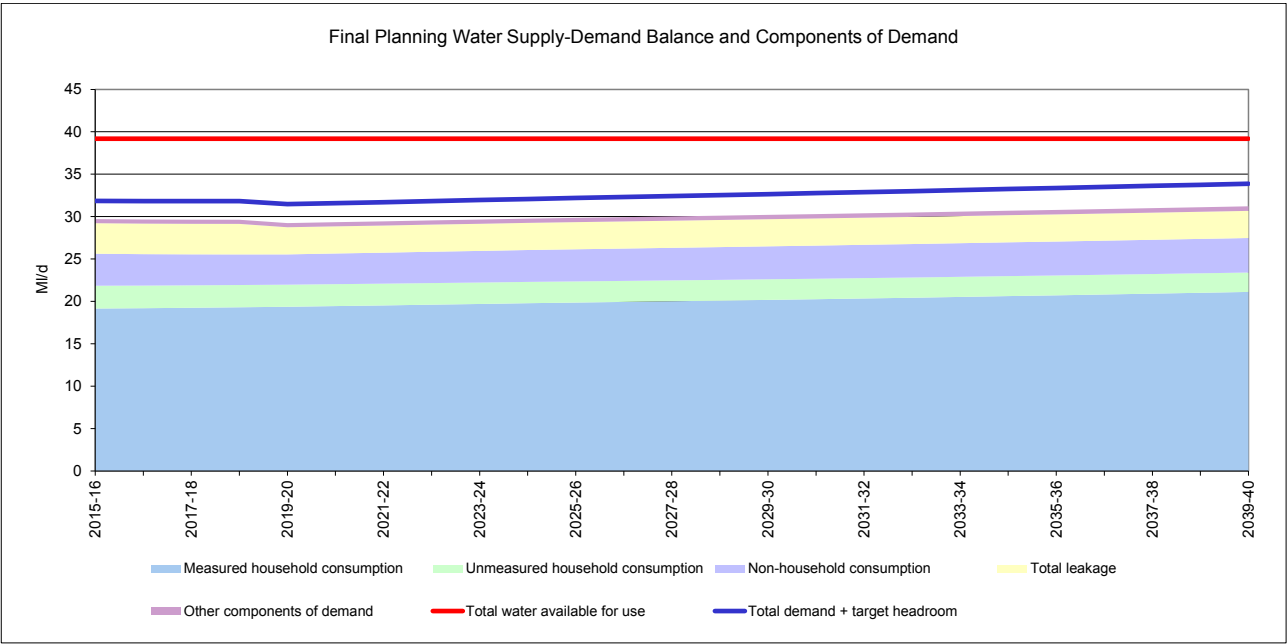


Note that this baseline does not include the internal transfer from Kent Medway WRZ

SH Final Planning supply demand balance – DYAA



SH Final Planning supply demand balance – DYCP



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J02 Detailed timelines for implementation of AMP6&7 schemes

K WRMP Tables – assumptions

L Water resources planning guideline – audit checklist

~~**M Review of draft WRMP SEA & HRA for Statement of Response**~~ *[no longer included as separate SEA and HRA have been updated]*

N Draft WRMP documentation and influence of consultation

N01 Draft WRMP Technical Report (May 2013)

N02 Draft WRMP Consultation (May-August 2013)

N03 Statement of Response to consultation on Draft WRMP (18 November 2013)

N04 Statement of Response Summary to consultation on Draft WRMP (18 November 2013)

N05 Revised Draft WRMP Technical Report (18 November 2014)



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“We need to take a fresh look at the options we have for managing future supply and demand, and ensure that we build in flexibility and resilience to uncertain and changing conditions.”

— Water for Life

October 15, 2014