Thames Water

Final Water Resources Management Plan 2019

Technical Appendices

Appendix B: Strategic environmental assessment - environmental report

Final Water Resources Management Plan 2019 Appendix B: Strategic Environmental Assessment – April 2020

Environmental Report

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Non-Technical Summary

In accordance with relevant guidance, this Non-Technical Summary sets out the findings of the Strategic Environmental Assessment (SEA) of Thames Water's Water Resources Management Plan 2019 (WRMP19) in accessible plain English to ensure they can be readily and easily understood by non-experts as well as decision makers.

The Non-Technical Summary is followed by the contents page and the main body of the Environmental Report. Signposting to the relevant sections of the main body of the Environmental Report is also provided to indicate where further details can be found.

WATER RESOURCES MANAGEMENT PLAN

Every five years water companies in England and Wales are required to produce a Water Resources Management Plan (WRMP). The WRMP sets out how water companies aim to manage customer demands while meeting their requirements over the long term, ensuring sufficient water supplies are available to meet customers' needs. It consists of several elements, including:

- A long-term demand forecast describing how much water customers will need in the future, considering factors such as changing behaviours and population growth;
- A long-term supply forecast describing how much water is available for use now and how this may change in the future, considering the potential impacts of climate change, the risk of more extreme drought events occurring and potential reductions to water source availability to address environmental concerns;
- An assessment of a wide range of options to manage the demand for water, including installing water meters at customers' properties, helping customers to be more water-efficient, and reducing leakage; and
- An assessment of a wide range of options for supplying more water, such as groundwater and surface water schemes, desalination and water reuse schemes, river transfer and inter-company water transfer schemes.

The WRMP also informs the Thames Water business plan and forms a major part of the price review process undertaken by the water industry regulator, Ofwat. Price Review 2019 (PR19) is the seventh price review since the water industry was privatised in 1989. Engagement with regulators, licensed water suppliers, other water companies, customers and stakeholders is key to the WRMP development process, and extensive consultation on the development of the WRMP19 has been undertaken with these interested parties since 2015. The draft WRMP19 was published in February 2018 for full consultation with the public, Thames Water's customers, stakeholders and regulatory bodies. Updates to the draft plan that had regard to consultation responses were made and in Autumn 2018 Thames Water produced a revised draft WRMP19 for further comment. In addition to responses being provided to these consultation responses received an addendum to the WRMP19 was produced in April 2019. Thames Water has had careful regard to consultation responses in preparing the Final WRMP19 and supporting documents.

Further information on the Thames Water's WRMP19 is presented in Section 2 of the Environmental Report.

THE THAMES WATER SUPPLY AREA

Thames Water's supply area is divided into six independent water resource zones (WRZs) reflecting different characteristics of the supply areas and associated risks to meeting demand. The London WRZ is the largest of the six zones and covers the Greater London area. The next largest is the Swindon and Oxfordshire WRZ (SWOX). Current water resources for both of these zones are largely based on abstraction of water from the River Thames for storage in large reservoirs.

The other WRZs to the west of London are Kennet Valley (which includes Reading and Newbury); Henley; Slough/Wycombe/Aylesbury (SWA); and Guildford. These four WRZs are largely reliant on groundwater abstraction although there are significant abstractions directly from local rivers, notably the River Kennet in Reading and the River Wey and Tillingbourne near Guildford.

Further information on the Thames Water Supply Area is contained in Section 2.2 of the Environmental Report.

STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA) OF THE WRMP19

Thames Water, as a responsible authority under the UK (SEA) Regulations, determined that its WRMP19 falls within the scope of the EU SEA Directive. Thames Water must also ensure the WRMP19 meets the requirements of the Habitats Regulations and Water Framework Directive (WFD) and related national regulations before implementation. This SEA Environmental Report is therefore supported by the findings of the Habitats Regulations Assessment (HRA) and WFD assessments carried out on the WRMP. The detailed findings of these assessments are provided in accompanying HRA and WFD assessment reports.

In the context of water resources planning, SEA identifies the likely significant environmental effects of the various measures, both individually and in-combination, required to provide a reliable and resilient water supply service to Thames Water's customers. These effects can then be used to help define the preferred programme of schemes for each WRZ to meet this objective, and which together form the WRMP. Environmental effects relating to carbon emissions arising from construction and/or operational activities have been monetised and considered alongside other financial parameters in the decision-making process. Care has been taken to ensure that these monetised environmental and social effects of carbon emissions are not 'double counted' through the use of SEA processes in supporting WRMP decision-making so as not to skew the programme appraisal process.

The SEA process was used by Thames Water to help inform a final decision on the most appropriate programme of measures to include in the WRMP19.

POLICY CONTEXT

Relationship with Other Relevant Plans, Programmes and Environmental Protection Objectives

The WRMP19 forms a key part of the supply/demand planning component of Thames Water's 2019 Business Plan submission to Ofwat. The WRMP has been prepared in accordance with the Water Resources Management Plan (England) Direction 2017, Defra guiding principles and the Water Resources Planning Guideline (April 2017), along with consideration to ensure compliance with a wide body of international and national legislation.

In the preparation of the WRMP19, Thames Water has sought the views of its customers, stakeholders and regulatory bodies through detailed research, customer surveys, regular stakeholder meetings, and public consultation activities. The SEA scoping consultation process during the period 25th July 2016 and 7th September 2016 invited comments from statutory consultees, stakeholders and the public on a review of other plans, programmes and environmental protection objectives. The SEA Environmental Report was published alongside the draft WRMP19 between 9 February and 29 April 2018 on the Thames Water website and issued to the statutory consultation bodies. This Final WRMP19 has been prepared taking into consideration the representations received on the draft plan. As some schemes under consideration for the WRMP were in part located in Wales, important relevant Welsh plans and programmes were also included.

Environmental Context

The SEA Scoping process also included a review of relevant environmental characteristics of the area that could be affected by the WRMP, and a consideration of the likely evolution of the environment in the absence of the WRMP. This helped to establish the current and future baseline such that the potential effects of the WRMP and its schemes can be identified, monitored and if necessary mitigated. Baseline data were drawn from a variety of sources, and the spatial area considered for the baseline was very extensive to account for schemes under consideration to transfer water from the River Severn catchment (mid-Wales and the Midlands). Baseline information at local, regional and national resolutions was reviewed.

The policy context for Thames Water's WRMP19 is discussed further in Section 3 of the Environmental Report, and the environmental baseline is detailed in Section 4.

SEA OBJECTIVES

The key issues identified in the area and policy context as described above were brought together to form a suite of SEA objectives under each of the SEA topics (as indicated by the SEA Directive). A set of indicator questions was also developed for each objective to ensure that the assessments were comprehensive and consistent. The SEA Scoping Report sought views on the proposed SEA objectives for the WRMP and how these would be used to assess the environmental effects of the WRMP. The final SEA objectives have formed the basis for the assessment. It was not considered appropriate to scope any topics out of the SEA.

An assessment framework was developed and consulted upon as part of the SEA Scoping Report consultation. This included the proposed approach to the measurement of effect significance which assigns assessed effects according to a seven point scale (from major beneficial to major adverse, including a negligible effects category) which was considered to provide an appropriate level of distinction between effects, according to combinations of impact magnitude and receptor sensitivity. The assessment considered both adverse and beneficial effects, with the assessment findings for each kept separate throughout the SEA process in line with best practice to avoid adverse and beneficial effects being 'mixed' together. This approach provides a general indication of the significance of environmental and social effects of the WRMP19.

Comments received on the Scoping Report consultation were used to refine and finalise the SEA objectives and assessment approach. Responses to consultation on the SEA Scoping Report are included as **Appendix A** to this report.

The SEA assessment method is presented in detail in Section 5 of the Environmental Report.

INITIAL SEA CONSIDERATONS OF ALTERNATIVE OPTIONS

An integrated approach has been adopted to the SEA of the WRMP19 and has included the HRA and WFD assessments to ensure compliance with international and national legislation.

The initial stages of the SEA involved the screening of a large number of water resource options in an 'Unconstrained' List. The environmental performance of each option was considered against SEA principles, HRA and the WFD, no deterioration, screening criteria were also considered and this information used to help decide which options should be rejected and not taken further in the planning process. At this stage, several options were rejected on environmental grounds (as well as having regard to other factors such as planning or engineering feasibility), mainly due to their likely major adverse effects on international environmental designations (for example, on European conservation sites or UNESCO World Heritage Sites).

Remaining options were then considered in more detail as part of a Feasible List of options through a Feasibility Assessment process. This process included assessment of each feasible option against key SEA, HRA screening and WFD screening criteria. This process also involved engagement with regulators and stakeholders. The environmental assessments formed part of a wider set of assessments of each option, including appraisal against economic, engineering, resilience and planning considerations. From these assessments, decisions were made about which options should be taken forward to the Fine Screening process.

The Fine Screening process included comparing options of the same option type (e.g. reservoirs, desalination schemes, water reuse schemes) against SEA, HRA and WFD criteria. Those options that performed best against all of the Fine Screening assessment 'dimensions' and criteria were taken forward to the Constrained List of options for further evaluation, including development of environmental mitigation measures, where required, as part of the conceptual design of each option.

The Fine Screening process was subject to extensive consultation with regulators and stakeholders. Feedback from this engagement activity helped to refine and finalise the final decisions on which options were taken forward to the Constrained List of options for further development and detailed SEA, HRA and WFD assessment.

SEA OF CONSTRAINED LIST OPTION ELEMENTS

For those options taken forward to the Constrained List, the options were disaggregated into their key component 'elements' and a conceptual design was developed for each of these 'option elements'

(e.g. water source, raw water conveyance pipeline, water treatment works). Consideration of mitigation measures was a key component of the development of the conceptual designs, and of assessing the potential adverse effects and beneficial effects of each option element and identifying mitigation measures to reduce adverse effects or, where feasible, to enhance beneficial effects.

There were two key mitigation considerations:

- modifying the design to eliminate or reduce adverse effects, or enhance beneficial effects;
- mitigating or enhancing the residual effects of the modified design where feasible.

The final conceptual designs for each option element were then assessed through the SEA, HRA and WFD assessment processes based on their **residual** effects after application of the mitigation measures. The mitigation measures were developed in an iterative manner between the design engineers and the environmental assessment team. The SEA findings were set out in detailed assessment tables for each option element as presented in this Environmental Report.

The SEA findings of the different types of options (i.e. the combination of relevant option elements) considered for inclusion in the WRMP19 can be summarised as follows:

- **demand management (including leakage reduction) measures** generally cause few significant adverse effects. The main adverse effects relate mainly to disruption and traffic congestion effects during the construction phase, water pipe repair or replacement activities or equipment installation. These measures provide benefits by reducing the volume of water that needs to be abstracted, treated and put into supply. The magnitude of the benefit varies widely from negligible to major, depending on the implementation scale of the measure and consequent volume of water savings delivered.
- effects from **water transfer schemes** vary considerably according to the scale of the scheme and the associated transfer and water treatment infrastructure required. The larger scale schemes, such as those considered for transferring water from the River Severn to the River Thames, can have many potential adverse effects during both construction and operation. However, the larger schemes and the schemes designed to reduce abstraction from environmentally sensitive watercourses can bring beneficial effects by improving water supply resilience and helping to adapt to the risks presented by climate change.
- the **removal of resource and network constraints and treatment** capacity upgrades may have adverse impacts on the physical environment if there is potential for increasing abstraction above recent levels to have an adverse environmental impact, even though this may be within the abstraction licence limits. However, this could assist with ensuring the optimal use of existing water resources, maintenance of the water supply system and contributing to the protection of health, well-being and socio-economic development.
- smaller **inter-zone and inter-company** treated water transfers generally have fewer environmental effects, but this is dependent on the precise location of the construction activities relative to natural, built and human receptors.
- **groundwater (including artificial storage and recovery – ASR)** schemes generally have few impacts, although there can sometimes be consequences of the abstractions for recharge on the WFD status of the source water bodies.
- **new reservoir schemes** can have significant adverse effects during a prolonged construction period. Both adverse and beneficial effects can arise during operation: from potential adverse effects on visual amenity in the medium to long term before the reservoir landscaping is fully established, to beneficial effects from the recreational resources and compensatory habitat provision.
- **the water reuse** schemes make use of water which would otherwise be lost to the sea as a useable resource and provide increased resilience to the effects of climate change. However, the schemes can remove “freshwater” inputs to estuarine environments such as the Thames Tideway. The schemes have a high energy demand arising from intensive water treatment processes, with adverse effects on carbon emissions. For some of the schemes, construction of the water conveyance pipelines or tunnels may temporarily adversely affect natural, built or human receptors.

- **desalination schemes** using estuarine water also have high energy demands due to intensive water treatment processes, with consequent effects on carbon emissions. For some of the schemes, construction of the water conveyance pipelines or tunnels may temporarily adversely affect natural, built or human receptors. Desalination schemes are more resilient to climate change but elevated salinity concentrations can arise in the estuarine water body due to the discharge of the treatment process wastewater which can contain a high saline content.
- **raw water purchase** options have very limited environmental effects but provide a range of beneficial outcomes whilst maintaining a neutral effect on the overall volume abstracted from the environment.

These detailed findings were discussed and presented to regulators and stakeholders. The draft option element assessments were made available to regulators and stakeholders via the Thames Water website: comments and challenges provided through this consultation activity helped to refine and finalise the assessments for use in the programme appraisal model.

In conclusion, the earlier stages of the WRMP environmental assessment process had largely ensured that the Constrained List of option elements for selection within the programme appraisal process did not include options that would have unacceptable environmental or social impacts, particularly where there may have been implications for internationally designated sites (e.g. European sites, landscapes or heritage sites) or high risks of WFD status deterioration.

Section 6 of the Environmental Report presents the SEA of alternative options.

Changes since the draft WRMP

Thames Water published the draft WRMP19 for public consultation in February 2018. The public consultation ran from 9 February to 29 April 2018. A revised draft WRMP19 was issued for further public consultation in Autumn 2018. This further consultation closed on 28 November 2018.

Work continued to develop the water resource options identified in the draft and revised draft WRMP19 in parallel with the two public consultations. As a result, some of the options on the Constrained List of options were updated: to incorporate new information received; to take account of the output of ongoing investigations; or in response to consultee comments. In addition, where new options were identified, they were assessed for inclusion in this WRMP19. Furthermore, options which have been delivered in the current AMP, or have been withdrawn by third parties, or which have proved to be unsustainable on the basis of new information received, or in response to consultee comments were removed from the WRMP19.

Further details of the changes to the water resource options since the publication of the draft WRMP19 in February 2018 and following consultation on the revised draft WRMP19 are presented in section 1.8 of this Environmental Report.

PROGRAMME APPRAISAL

SEA was carried out on alternative programmes of schemes to maintain the supply-demand balance in each WRZ. The programmes were generated through a detailed programme appraisal process, facilitated by the use by Thames Water of a sophisticated, multi-criteria optimisation model.

A wide range of alternative programmes were generated from the Thames Water programme appraisal model for consideration. Thames Water commissioned an online visualisation tool (PolyVis) to help analyse the performance of the programmes across seven defined metrics. Two environmental metrics were included, derived from the SEA (and HRA and WFD assessments) of each of the option elements: one reflecting adverse effects and the other beneficial effects so as to avoid the 'mixing' (or trading) of these different effects. The environmental metrics comprised numerical gradings, from 0 to +10 for beneficial effects and 0 to -10 for adverse effects. In this way, the optimisation process was able to have regard to the potential environmental effects. Trade-offs could be identified and programmes filtered and selected based on their performance across all the metrics and their likelihood of providing reasonable alternative solutions. For example, higher cost programmes could be removed as unaffordable and the remainder tested against key drivers, such as the most sustainable, the highest resilience, or increased environmental benefits.

A short-list of six reasonable alternative programmes was selected by Thames Water, taking account of the SEA of the option elements that made up each of the potential alternative programmes, for detailed consideration through the SEA process (including HRA and WFD assessment). The non-shortlisted programmes offered either no improvement compared to the shortlisted programmes or marginal improvements in some metrics and significant detriment to others.

The six alternative programmes short-listed for SEA (and HRA and WFD assessments) were:

- Favouring intergenerational equity (Min_IGEQ) [1]
- Favouring resilience and cost equally (Multi-obj_RES)
- Favouring customer preference for the frequency of restrictions and cost equally (Multi-obj_FP)
- Favouring resilience with a programme cost restriction of 120% of least cost (NearO_RES)
- Favouring customer preference for type of options with a programme cost restriction of 120% of least cost (NearO_TP)[2]
- Least cost programme (Phased_LC)

For each of these short-listed programmes, environmental assessment was carried out for each of the schemes included within the programme individually and then cumulatively across the WRZs in the Thames Water supply area. Importantly, the assessments were based on the **residual** effects after application of mitigation measures included in the conceptual design (and cost) of each scheme.

Many of the schemes are common to all six of the alternative programmes, although the construction and implementation dates and in some cases capacities of these options vary between the programmes.

The least-cost programme included several major water supply schemes: the Beckton Desalination scheme; expansion of both the Kempton and Coppermills WTW's; The South East Strategic Reservoir Option (125 million cubic metre capacity); the Oxford canal transfer scheme; and the Deephams Reuse scheme.

The main difference between the least-cost programme and the programme favouring intergenerational equity were the inclusion of the larger capacity 150 million cubic metre South East Strategic Reservoir Option.

The main differences between the least-cost programme and the programme favouring resilience and cost equally were the exclusion of the Beckton Desalination and Deephams Reuse schemes and the inclusion of a Severn-Thames Transfer scheme and the Beckton Reuse (200Mld) option as well as the larger capacity 150 million cubic metre South East Strategic Reservoir Option.

The main difference between the least-cost programme and the programme favouring customer preference for the frequency of restrictions and cost equally were the inclusion of a Severn-Thames Transfer scheme and the Beckton Reuse (300Mld) option.

The main differences between the least-cost programme and the programme favouring resilience with a programme cost restriction of 120% of least cost were the exclusion of a South East Strategic Reservoir Option and the inclusion of a Severn-Thames Transfer scheme and the Beckton Reuse (200Mld) option.

The main differences between the least-cost programme and the programme favouring customer preference for type of options with a programme cost restriction of 120% of least cost were the exclusion of the Deephams Reuse scheme, Oxford Canal transfer option as well as several

[1] Min_IGEQ = (Minimum Intergenerational Equity) An optimisation run that uses a 1% discount rate instead of 3.5% in order to decrease the incentive to defer spend to the future.

[2] NearO_TP = (Near optimal type preference) An optimisation run that meets customer preferences for option type, constrained to within 120% of the Least Cost

groundwater schemes. Along with the inclusion of the larger capacity 150 million cubic metre South East Strategic Reservoir Option.

Assessments of the preferred programme and reasonable alternative programmes are presented in Section 7 of the Environmental Report.

ASSESSMENT OF REASONABLE ALTERNATIVE PROGRAMMES

The SEA findings of the six reasonable alternative programmes are summarised below and were used by Thames Water to help inform its decision-making on the final preferred programmes for the WRMP19.

Initially, each scheme included in a programme was assessed in isolation (taking account of the various option elements that make up each of these options which had been previously assessed through the SEA, HRA and WFD process), and then in-combination with the other options included in the same programme (both construction and operational effects, as applicable).

All six alternative programmes considered included a major demand management programme to deliver reductions in demand growth through a combination of leakage reduction, water metering and water efficiency engagement and delivery activities. These demand management programmes were assessed as providing moderate to major beneficial effects depending on the scale of the reduction in demand growth to be delivered.

SEA of Least-cost programme

The options forming this least-cost programme are, with the application of mitigation measures, compliant with Habitats Regulations and WFD objectives, but there remains uncertainty as to whether mitigation measures for the Britwell option would remove the uncertain risks of WFD status deterioration. The programme presents some environmental challenges, mainly during the construction phase, but most major effects can be mitigated such that, overall, the environmental and social effects of this programme are predominately of a **minor to moderate** significance (both adverse and beneficial effects).

Some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the South East Strategic Reservoir Option and Beckton desalination scheme) or may be permanent in nature.

This environmental performance of this programme is relatively less challenging compared to most of the other reasonable alternative programmes considered with the exception of the NearO_TP and Min_IGEQ programmes.

SEA of programme favouring intergenerational equity (Min_IGEQ)

The options forming this programme are, with the application of mitigation measures, compliant with Habitats Regulations and WFD objectives, but there remains uncertainty as to whether mitigation measures for the Britwell option would remove the uncertain risks of WFD status deterioration. The programme presents some environmental challenges, mainly during the construction phase, but most major effects can be mitigated such that, overall, the environmental and social effects of this programme are predominately of a **minor to moderate** significance (both adverse and beneficial effects).

Some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the South East Strategic Reservoir Option and Beckton desalination scheme) or may be permanent in nature.

This environmental performance of this programme is relatively less challenging compared to most of the other reasonable alternative programmes considered with the exception of the NearO_TP programme.

SEA of programme favouring resilience and cost equally (Multi-obj_RES)

The schemes forming this programme are compliant with Habitats Regulations with delivery of specified mitigation measures for Beckton reuse, Coppermills WTW and Kempton Park WTW.

The programme presents several WFD status and compliance challenges. There remains uncertainty as to whether mitigation measures for the Britwell option would remove the uncertain risks of WFD status deterioration. The Minworth effluent transfer element of a supported Severn-Thames Transfer option carries a greater level of WFD compliance risk and currently presents a challenge to develop additional mitigation measures to secure WFD compliance. The Vyrnwy support element of a Severn-Thames Transfer option requires the collection and consideration of further evidence prior to confirming WFD compliance or implementing mitigation measures. Concurrent operation of the Severn-Thames transfer scheme with discharges from the South East Strategic Reservoir presents WFD risks to the Middle River Thames.

Overall, the environmental and social effects of this programme are predominately of **minor to moderate** significance (both adverse and beneficial effects). However, some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the South East Strategic Reservoir Option, Severn-Thames transfer scheme pipeline and Beckton reuse scheme) or may be permanent in nature.

This programme would be challenging to promote from a planning and environmental perspective, requiring agreement of extensive mitigation measures for various strategic schemes to avoid adverse effects in relation to European environmental legislation. The environmental performance of this programme is adverse when compared to most of the other reasonable alternative programmes considered, with the exception of the programme favouring customer preference for the frequency of restrictions and cost equally (Multi-obj_FP). It is of a similar scale of challenge as the Near_O RES programme, but with issues focused on the Middle Thames rather than the Thames Tideway.

SEA of programme favouring customer preference for the frequency of restrictions and cost equally (Multi-obj_FP)

The schemes forming this programme are compliant with Habitats Regulations with delivery of specified mitigation measures for Beckton desalination scheme, Beckton and Deephams reuse schemes, Coppermills WTW and Kempton Park WTW.

This programme presents multiple WFD compliance challenges on the River Avon, River Thames and Thames Tideway.

Overall, the environmental and social effects of this programme are predominately of a **minor to moderate** significance (both adverse and beneficial effects).

Some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the South East Strategic Reservoir Option, Severn-Thames Transfer, Beckton reuse and Beckton desalination schemes) or may be permanent in nature.

This programme would be very challenging to promote from a planning and environmental perspective, requiring agreement of extensive mitigation measures for various strategic schemes to avoid adverse effects in relation to European environmental legislation. The environmental performance of this programme is the most adverse relative to all of the other five reasonable alternative programmes considered.

SEA of programme favouring resilience with a programme cost restriction of 120% of least cost (NearO_RES)

The schemes forming this programme are compliant with Habitats Regulations with delivery of specified mitigation measures for Beckton desalination scheme, the Beckton and Deephams reuse schemes, Coppermills WTW and Kempton Park WTW.

The programme presents several WFD challenges, principally in respect of concurrent operation of the Beckton reuse scheme, Beckton desalination scheme and Deephams reuse scheme on the Thames Tideway (and risks to the Recommended Thames Estuary Marine Conservation Zone). There remains uncertainty as to whether mitigation measures for the Britwell option would remove the uncertain risks of WFD status deterioration. The Minworth effluent transfer element of a supported Severn-Thames Transfer option carries a greater level of WFD compliance risk and currently presents a challenge to develop additional mitigation measures to secure WFD compliance.

Overall, the environmental and social effects of this programme are predominately of **minor to moderate** significance (both adverse and beneficial effects). However, some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the Severn-Thames transfer scheme pipeline, Beckton reuse scheme and Beckton desalination scheme) or may be permanent in nature.

This programme would be challenging to promote from a planning and environmental perspective, requiring agreement of extensive mitigation measures for various strategic schemes to avoid adverse effects in relation to European environmental legislation. The environmental performance of this programme is adverse when compared to most of the other reasonable alternative programmes considered, with the exception of the programme favouring customer preference for the frequency of restrictions and cost equally (Multi-obj_FP). It is of a similar scale of challenge as the Multi_Obj_RES programme, but with issues focused on the Thames Tideway rather than the Middle Thames (as this programme does not include both the Severn-Thames Transfer and the South East Strategic Reservoir options).

SEA of programme favouring customer preference for type of options with a programme cost restriction of 120% of least cost (NearO_TP)

The schemes forming this programme are compliant with Habitats Regulations with the inclusion of mitigation measures for the Beckton desalination scheme and the Coppermills and Kempton water treatment works. The programme is also compliant with WFD objectives.

Overall, the environmental and social effects of this programme are considered of a **moderate** significance (both adverse and beneficial effects).

Some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the South East Strategic Reservoir Option and the Beckton desalination schemes) or may be permanent in nature.

This programme has the fewest number of strategic schemes. It is noted that small schemes (less than 50 Ml/d), with the exception of the Britwell groundwater scheme, have fewer adverse environmental effects than the larger strategic schemes, both individually and cumulatively. However, it is equally recognised that larger strategic schemes are essential to address the future supply deficit. This programme presents the fewest environmental challenges relative to the other reasonable alternative programmes considered.

Alternative programme assessment conclusions

The SEA of each of the reasonable alternative programmes has highlighted that:

- Given the scale of the supply deficit faced over the next 80 years, it is not considered feasible to develop a programme that would lead to only minor adverse cumulative effects. Some

major adverse effects from options are therefore inevitable, albeit that they can be mitigated such that, overall, the environmental and social effects of the programmes are predominately of a **minor to moderate** significance (both adverse and beneficial effects).Three of the six programmes (Multi_Obj_RES, Multi_Obj_FP and NearO_RES) are assessed as having potential for some cumulative major adverse effects, with the Multi_Obj_FP programme having the greatest magnitude of cumulative adverse effects. All of these programmes have several WFD cumulative compliance risks. They would present significant challenges for promotion and obtaining required permissions and approvals.

- The other three programmes are assessed as having the potential for cumulative moderate adverse effects. These are broadly similar in overall scale of effects with little to choose between them, but a relative ranking shows that the NearO_TP has the fewest environmental challenges due to a much smaller programme of schemes. For these programmes, WFD risks can be addressed if the Britwell groundwater option is removed from relevant programmes and mitigation measures are applied where identified for specific other options in the WFD assessments.
- Effects are geographically spread across the Thames river basin: some programmes lead to greater effects in the Thames Tideway whilst some others result in the concentration of effects in the Middle Thames. Some programmes also affect the Severn river basin, increasing the overall magnitude of cumulative effects (mainly due to inclusion of the Minworth flow support option for programmes that include the Severn-Thames Transfer) which brings WFD compliance risks.
- Programmes that involve both the South East Strategic Reservoir and the Severn-Thames Transfer give rise to WFD cumulative compliance risks in the Middle River Thames as discharges to the river would exceed the approximate 500 Ml/d threshold above which changes to the low flow regime may start to adversely affect aquatic ecology and geomorphology of the river reach downstream of Culham.
- Programmes that involve both desalination and reuse schemes at a cumulative capacity above 275 Ml/d give rise to possible WFD compliance risks in the Thames Tideway due to potential effects on saline-sensitive aquatic species, and may also affect the Recommended Thames Estuary Marine Conservation Zone.

These assessments also demonstrated that there are viable alternative options available to each of the different programmes at comparable levels of environmental effects.

PREFERRED PROGRAMME FOR WRMP19

Development of the preferred programme for the WRMP19 was informed by the SEA considerations of the short-listed reasonable alternative programmes. Given that all of the alternative programmes are characterised by at least moderate adverse cumulative environmental effects, consideration was given as to how each of these alternative programmes might be improved to improve the environmental performance. This process helped to further identify those features of each programme that present the greatest environmental challenges and which should be avoided in developing the preferred programme.

Discussions on the selection of a preferred programme also explored the potential additional measures that could be incorporated into the preferred programme to improve the overall environmental outcomes of the plan. Such considerations also reflected the strong stakeholder feedback on the draft WRMP19 that Thames Water needed to secure greater environmental benefits from delivery of its WRMP19 given the environmental dis-benefits associated with development of major new water sources.

Key findings from the SEA of the reasonable alternative programmes and the subsequent review of opportunities for reducing programme cumulative adverse effects and increasing cumulative beneficial effects were taken into consideration in making decisions on the preferred programme.

In developing the preferred programme, the major cumulative adverse effects highlighted in the SEA of the reasonable alternative programmes (and particularly in respect of WFD cumulative compliance risks) have been avoided.

Additionally, Thames Water has proposed the largest (150 Mm^3) South East Strategic Reservoir option in 2037, timed with the need from Affinity Water. Thames Water considers that if a reservoir is selected it should be built to maximise its potential benefit to the supply demand balance. The delivery of largest South East Strategic Reservoir option creates sufficient surplus in the supply demand balance which can be used to facilitate a reduction in some of Thames Water's abstractions that are perceived to have an adverse impact on vulnerable chalk streams and water courses. Thames Water's groundwater abstractions at Pann Mill (River Wye), Waddon (River Wandle) and North Orpington (River Cray) have previously been examined for environmental impact but the investigations concluded that it was not cost beneficial to reduce abstraction at these sites. The South East Strategic Reservoir option with its low annual operating costs will help to reduce abstraction at these sites and thereby address the concerns voiced by environmental groups. Delivering this environmental improvement will require a number of new pipelines and pumping stations to be constructed to ensure that customers continue to receive a resilient water supply. These additional "chalk stream assets" have been assessed as part of the SEA of the preferred programme.

This preferred programme was subject to SEA, HRA and WFD assessment, including cumulative assessment with other programmes, plans and projects, as summarised in the following sections.

SEA of preferred programme

The schemes forming this programme are compliant with Habitats Regulations with delivery of specified construction mitigation measures identified in the HRA report. The schemes are also compliant with the WFD objectives, with no risk of WFD status deterioration. Following options appraisal, mitigation measures may be necessary to be implemented in the form of additional flow augmentation support and/or abstraction licence controls to avoid WFD deterioration risks in respect of the Epsom groundwater option once more detailed investigations of the effects of increasing abstraction within existing licence limits are completed in dialogue with the Environment Agency.

Overall, the environmental and social effects of this programme are predominately of **minor to moderate** significance (both adverse and beneficial effects). Some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the Severn-Thames transfer scheme pipeline and the South East Strategic Reservoir) or may be permanent in nature. Major beneficial effects are identified in respect of the long-term provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. The scheme also reduces the impact of additional abstraction from the River Thames at times of low river flows to meet demand growth in both London and SWOX. There are likely to be opportunities to provide numerous recreational benefits over the long term and construction will bring employment opportunities for residents in the local area, with the potential for longer term job opportunities once the reservoir is operational. Additionally, the development of the 150 Mm3 capacity reservoir provides supply headroom from 2037 to reduce abstraction from vulnerable chalk streams and water courses as summarised earlier.

This programme presents several challenges in delivery and operation from a planning and environmental perspective, requiring agreement of extensive mitigation measures for several schemes to avoid adverse effects in relation to European Sites and national environmental designations (including SSSIs, AONBs and heritage designations). The environmental performance of this programme is characterised by moderate adverse effects but has the advantage over the reasonable alternative programmes considered by:

- Removing schemes with WFD compliance risks (Minworth and Britwell options)
- Reducing the scale of the cumulative effects of the Severn Thames transfer and South East Strategic Reservoir at Culham to an acceptable level that avoids cumulative WFD compliance risks
- Avoids cumulative WFD and Recommended MCZ compliance risks for the Thames Tideway by only developing the Deephams reuse scheme
- Provides for a material reduction in abstraction by Thames Water in low flow conditions from various vulnerable chalk streams and water courses by creating sufficient supply headroom

and developing additional water supply transfer infrastructure from 2037. This measure materially improves the overall environmental performance of the WRMP19.

In the period to 2022/23 Thames Water has set out a continuing programme of ongoing studies to be undertaken with regulators, other water companies and third party organisations to continue to examine the feasibility of a number of options. Through the assessment of several alternative programmes the SEA has identified that feasible alternative schemes exist that could be developed with acceptable environmental and social effects that are comparable to those schemes included in the preferred programme of the WRMP19. Substitute schemes are therefore available for consideration if it becomes necessary to adapt to changing conditions over the long-term implementation of the WRMP19.

CUMULATIVE EFFECTS OF PREFERRED PROGRAMME WITH THAMES WATER REVISED DRAFT DROUGHT PLAN 2018

Thames Water's revised draft Drought Plan 2018[3] (covering the period to 2023) sets out the range of demand management and supply augmentation measures that the company may need to implement during drought conditions to maintain essential water supplies to its customers.

The WRMP19 and the revised draft Drought Plan 2018 are fundamentally linked, with the measures contained in each plan acting in combination to provide a resilient water supply to customers in the Thames Water region and safeguard the provision of essential water supplies in drought conditions. In particular, the Final WRMP19 includes schemes to provide greater resilience to severe drought conditions by ensuring that, despite significant growth in demand for water, there are sufficient water supplies reliably available to sustain essential water supplies during a severe drought that may only occur on average once in every 200 years. The supply schemes are complemented by a very substantial programme of demand management measures to reduce the scale of future growth in demand.

The demand management measures in the revised draft Drought Plan 2018 have **moderate beneficial** effects on the water environment in combination with the extensive demand management programmes included in the WRMP19 by reducing the pressure on water resources in periods of prolonged dry weather when river flows and groundwater levels are well below normal.

In terms of geographic location, a review of the Thames Water's revised draft Drought Plan 2018 supply augmentation options identified the following possible cumulative effects with the WRMP19 supply augmentation schemes and/or drought order/drought permit options for the period up to end 2023:

- The Horton Kirby ASR option is common to both the WRMP19 and the revised draft Drought Plan 2018. After the planned operational date of the WRMP19 option in 2022, the option would no longer be considered as a drought management option for the Drought Plan.
- the WRMP19 includes a groundwater removal of constraints option at Southfleet/Greenhithe in the River Darent catchment, with construction commencing in 2021, which would be operational after the end of the period covered by the revised draft Drought Plan 2018. The potential for cumulative effects between this WRMP19 option and groundwater options in the revised draft Drought Plan 2018 which potentially affect surface flows in the River Darent catchment (Sundridge, Eynsford, Wansunt, Crayford) will be screened in the next Drought Plan.
- no cumulative effects are anticipated to arise from the Waddon groundwater drought permit and the ASR South East London scheme in the WRMP19.

Cumulative effects of the preferred programme and reasonable alternative programmes with other plans, programmes and projects are discussed in Section 8 of the Environmental Report.

[3] Thames Water (2018). Revised Draft Drought Plan. September 2018.

CUMULATIVE EFFECTS OF PREFERRED PROGRAMME WITH OTHER WATER COMPANY PLANS

The 2019 WRMPs of the other water companies include significant demand management components. Improved water efficiency, additional water metering coverage and leakage reduction measures across the southern half of England and Wales will give rise to cumulative **major beneficial** effects in terms of the overall reduction in the growth of water abstraction from the water environment, as well as lower energy use and carbon emissions from reduced water pumping and treatment.

The WRMP19 programmes do include for the additional demands on the Thames Water supply system from some of the neighbouring water companies for additional bulk water supply exports. These extra supplies provide cumulative **major beneficial** effects by using sustainable water resource developments to secure reliable and resilient water supplies to the wider South East of England.

A report has been produced 'Environmental Information to Inform Water Company SEAs - Identification of potential for cumulative effects between water companies for WRMP19 SEAs, December 2017' and completes a region wide cumulative effects assessment. This assessment was updated in 2018 using the current preferred programme as at 13 August 2018. This assessment indicates that there is the potential for cumulative operational effects in the North Medway Chalk groundwater body and the Thames wider catchment from concurrent operation of possible new water source schemes across different water companies. However, having considered the nature of the schemes that are included by the other companies in their WRMPs, cumulative effects are assessed as negligible with the Southfleet/Greenhithe groundwater option included in the preferred programme. No cumulative construction effects on the North Wessex Downs AONB have been identified between the South East Strategic Reservoir and a small number of relatively small-scale schemes included in Southern Water's and South East Water's WRMPs due to different timing of construction activities. The nature of any residual operational effects on the setting of this AONB arising from these other water company schemes alongside the South East Strategic Reservoir leads to an assessment of cumulative negligible adverse effects after consideration of mitigation measures. No other cumulative construction or operational effects have been identified.

We have reviewed the Thames Water preferred programme against the potential for cumulative effects with the Affinity Water WRMP19.

The HRA report considered potential in-combination effects of two Affinity Water WRMP19 schemes AFF-RTR-WRZ1-4010 (Abingdon Reservoir to Harefield Transfer 50Ml/d) and AFF-RTR-WRZ4-4011 (Abingdon to Iver 2 50Ml/d) with Kempton Park WTW, Datchet Groundwater scheme and South West London Pipelines (Chalk Streams) on the South West London Waterbodies SPA and Ramsar site.

The HRA concludes no in-combination adverse effects with Kempton WTW as there is no overlap in construction period. No in-combination effects are likely between Datchet Groundwater scheme and the Affinity Water schemes as the Affinity WRMP19 indicates that construction of the Abingdon Reservoir transfer schemes will take place after construction of the Datchet scheme (2036-2038). Even if construction was to be concurrent, the HRA concludes that there will be no in-combination adverse effects with the Datchet scheme due to a combination of distance from the SPA waterbodies, existing disturbance levels to closer water bodies and visual screening from tree lines and high reservoir embankments.

The Appropriate Assessment for South West London Pipelines identified potential in-combination effects with the Affinity Water schemes. However, as the South West London pipelines (Chalk Streams) scheme will be constructed between 2033-2037 and the two Affinity Water Abingdon Reservoir transfer schemes will be constructed after 2038, then no adverse cumulative effects will arise. Even if construction was to occur simultaneously, by implementing appropriate mitigation measures, no in-combination adverse effects will arise. Therefore, no cumulative adverse effects are anticipated between the Thames Water preferred programme and Affinity Water's WRMP19 preferred programme."

No cumulative adverse effects have been identified in relation to other water companies outside of the WRSE group with the WRMP19. This review included the WRMP19 preferred programmes of United

Utilities, Severn Trent Water, Welsh Water and Bristol Water in the context of the Severn-Thames Transfer option set out in Thames Water's WRMP19.

Cumulative effects have also been assessed in respect of the current published Drought Plans of neighbouring water companies. The SEA has concluded that:

- the demand management measures in the WRMP19 have a **moderate beneficial** cumulative effect on the water environment in combination with the demand management measures contained in the Drought Plans of the other companies, reducing the pressure on water resources in the River Thames catchment during periods of prolonged dry weather when river flows and groundwater levels are well below normal.
- by increasing the drought resilience of the Thames Water supply system to withstand a severe drought that may occur on average only once in every 200 years, the WRMP19 will have **moderate beneficial** cumulative effects with those neighbouring water companies that are reliant on bulk water supply exports from Thames Water during drought.
- no cumulative effects are anticipated between the Thames Water Waddon groundwater drought permit, the Addington groundwater scheme and ASR South East London scheme in the WRMP19 and the potential drought permit option in SES Water's Drought Plan relating to three groundwater abstraction sites in the same vicinity.
- no other cumulative effects between the WRMP19 and other water company current published Drought Plans are anticipated.

Drought Plans are required to be updated every five years by water companies. The cumulative effects assessments will need to be updated over time to reflect any changes to the Drought Plans.

CUMULATIVE EFFECTS OF PREFERRED PROGRAMME WITH THAMES RIVER BASIN MANAGEMENT PLAN

The WRMP19 may have cumulative effects with the Thames River Basin Management Plan (RBMP) 2015[4] and the Severn RBMP 2015[5]. The RBMPs acknowledge that, to support economic growth and development, significant or large scale infrastructure projects will occasionally take place within the river basin district. In line with the RBMP expectations, the SEA, HRA and WFD assessments of the WRMP19 supply augmentation schemes have taken account of the environmental objectives within the RBMPs, with specific assessment objectives included to evaluate the effects on RBMP measures.

In accordance with the RBMP, the WRMP19 includes measures to maintain a supply-demand balance while addressing the need to deliver sustainable abstraction from water bodies. The WFD assessment of the WRMP19 demonstrates that there will be no deterioration in water body status subject to implementing relevant mitigation measures. The WRMP19 includes measures to maximise the use of existing water resources in a sustainable manner and to develop a major water reuse scheme to reduce the need for additional abstraction from freshwater resources in the Thames basin. Overall, the SEA has concluded there may be minor cumulative adverse effects with the RBMP due to the need to increase the overall volume of water being abstracted from the Thames and Severn basins to meet future demand growth for water. However, the WRMP19 also includes a very substantial programme of demand management activities that have been assessed in the SEA as having cumulative major beneficial effects with the Thames RBMP measures targeted at implementing and encouraging water efficiency measures.

Additionally, the WRMP19 includes commitments by Thames Water to carry out further investigations in consultation with the Environment Agency of some existing water sources to assess whether abstraction licence conditions should be modified to ensure a long-term sustainable water environment.

[4] Defra and Environment Agency (2016). Water for life and livelihoods: Thames river basin district River Basin Management Plan 2015. Updated December 2015.
[5] Defra and Environment Agency (2016). Water for life and livelihoods: Severn river basin district River Basin Management Plan 2015. Updated December 2015.

CUMULATIVE EFFECTS OF PREFERRED PROGRAMME WITH LAND USE AND DEVELOPMENT PLANS

With careful planning and dialogue with the Greater London Authority (GLA) and relevant London Boroughs, no material adverse effects are anticipated on the aims and objectives of the London Plan designated areas for employment and economic growth ('Opportunity' and 'Intensification' areas); there may be opportunities for the WRMP schemes to support these aims and objectives and these will be explored as appropriate as WRMP schemes are brought forward for development. It should be noted that some schemes will not be developed for many decades and therefore the cumulative effects assessment will need to be updated in the future to take account of the prevailing London Plan or equivalent strategic plan.

Outside of Greater London, no specific cumulative effects with land use and development plans have been identified, noting that the planning horizon of the WRMP19 extends well beyond the planning periods of the land use and development plans (early 2030s generally). All local authorities Local Plans (adopted or in development) are particularly focused on delivering government targets for new house building. Cumulative adverse effects may arise at any location of new housing developments if the construction were to coincide spatially and temporally with construction of WRMP19 schemes; due to the uncertainties relating to the housing developments, it is not possible to identify specific risks at this strategic plan stage and these will need to be assessed with local planning authorities as and when schemes are brought forward for detailed development and planning permissions.

Beneficial cumulative effects may arise in conjunction with the local housing development schemes in respect of the Demand Management Programme, in particular engaging with developers to build water efficient homes and consider use of rainwater harvesting and local water recycling processes to reduce the growth in demand for water.

The cumulative effects assessment with local development plans will need to be updated in the future to take account of the prevailing plans as schemes are brought forward for development.

In respect of the South East Strategic Reservoir Option, Thames Water has actively engaged with the local planning authority (Vale of White Horse District Council) and its latest Local Plan (Part 1, adopted in December 2016 and setting planning policy out to 2031) includes a policy ("CP14") to safeguard the land required for the reservoir site for Thames Water. The Vale of White Horse District Council Local Plan 2031 Part 2: Detailed Policies and Additional Sites was adopted on 9 October 2019 and includes Policy 14a and Appendix C that safeguards land for a reservoir and ancillary works between the settlements of Drayton, East Hanney and Steventon.

CUMULATIVE EFFECTS OF PREFERRED PROGRAMME WITH OTHER INFRASTRUCTURE SCHEMES

Most of the confirmed or well-developed plans for significant infrastructure schemes are scheduled to be constructed and commissioned within the next 5-10 years. Relevant schemes have been reviewed in relation to spatial and temporal proximity to the WRMP19 schemes to assess whether any cumulative effects might arise.

Some temporary cumulative moderate adverse effects are anticipated in relation to the flood alleviation schemes for the main River Thames referenced above during construction depending on the precise timing of the construction. There may be potential for cumulative moderate beneficial effects as part of operational mitigation measures for both the flood alleviation schemes and the WRMP19 schemes. Thames Water will liaise closely with the Environment Agency on these schemes over the next few years as they are progressed.

Thames Water and the Environment Agency have been in close liaison regarding whether there is any impact of the potential South East Strategic Reservoir Option on the Abingdon Flood Alleviation Scheme. The Flood Alleviation Scheme is expected to be constructed in the early 2020s.

Mitigation measures are built into the Reservoir Option design to ensure that there is no increase in flood risk. These mitigation measures will be reviewed, and updated if necessary, once the Abingdon Flood Alleviation Scheme design is finalised to ensure that there remains no increase in flood risk, as part of the ongoing dialogue between Thames Water and the Environment Agency that has been taking place over recent years.

No cumulative adverse construction effects will arise in connection with the Thames Tideway Tunnel project (construction due to be completed by 2023) as construction programmes do not overlap. No cumulative adverse operational effects are anticipated.

Crossrail 2 has been developed to the stage of an outline strategy with an indicative route and stations, but no firm decisions have yet been reached on the funding of the line. Should Crossrail 2 gain approval in the next few years, there is a possible risk of some temporal and spatial overlaps of construction activities with some of the new conveyance routes in south-west London and Merton groundwater scheme is in a similar area. To the north of London there are potential overlaps with parts of the Deephams Reuse scheme. No operational cumulative effects are anticipated. Thames Water will need to liaise closely with the Department for Transport and Transport for London to assess the potential risks of construction cumulative effects.

No specific cumulative effects were identified in relation to HS2 Phase 1 (no spatial proximity) and Crossrail 1 (works due to be complete before 2020). Thames Water will need to take account of the new underground infrastructure of the Northern Line extension routes where these overlap with the proposed WRMP19 new water conveyance routes. Thames Water will need to liaise closely with Transport for London and the relevant railway authorities as planning for these conveyance routes progresses.

There are no likely cumulative construction effects associated with the Deephams Reuse scheme together with the North London Heat and Power Project and the North London (Electricity Line) Reinforcement as both are anticipated to be operational before construction for the Deephams Reuse starts in 2026.

The construction periods for the A2 Bean and Ebbsfleet Junction Improvements and the Southfleet/Greenhithe option are close and there is potential for overlap and therefore potential cumulative construction effects.

There are no known other confirmed or well-developed plans for significant infrastructure scheme, and particularly none beyond 2030, although a number of significant developments are probable (for example, further expansion of Heathrow airport). The cumulative effects assessment will therefore need to be updated in the future to take account of the prevailing plans for such schemes as Thames Water brings forward its WRMP19 schemes for development over the coming decades.

HABITATS REGULATIONS ASSESSMENT (HRA)

The HRA of the WRMP19 has concluded that the preferred programme is compliant with the Habitats Directive. A Stage 2 Appropriate Assessment was required for seven options for which likely significant effects on European sites could not be ruled out without mitigation. For all of these seven options, no adverse effects on the European sites or their ability to achieve their conservation objectives were anticipated, subject to appropriate mitigation measures. In particular, three schemes (Deephams reuse, Coppermills WTW and Kempton WTW) will require careful planning and design of the proposed mitigation measures to protect Special Protection Areas and Ramsar sites (designated to protect internationally important bird species) during construction activities.

WATER FRAMEWORK DIRECTIVE (WFD) ASSESSMENT

The WFD compliance assessment of the WRMP19 has concluded that the preferred programme is considered compliant with the WFD objectives of the relevant water bodies, now and in the future, as no WFD non-compliance has been confirmed. There is currently one compliance uncertainty in respect of the Epsom groundwater (removal of constraints) option. That option alone requires further investigation and assessment to confirm there is no WFD deterioration risk to the surface water linked to the groundwater abstraction from the aquifer. The option involves abstraction within the existing abstraction licence conditions which will be subject to review of its sustainability under the Water Industry National Environment Programme (WINEP) in AMP7. Currently impacts are mitigated by 3rd party flow augmentation. The proposed increase in abstraction at Epsom (within current licence) may be mitigated through an increase in flow augmentation, however this is subject to the planned investigation and would need to be agreed with the Environment Agency. Following options appraisal, with any required mitigation in place the scheme would be considered WFD compliant. Should the planned investigation identify the option as non-sustainable, or where the

incorporating mitigation measures are considered not to be appropriate or effective, then the option programmed for operation in 2030 would be replaced in the 2024 WRMP by another groundwater option.

The Environment Agency and Natural Resources Wales require the collection and consideration of further evidence for three of the options within the preferred programme to either confirm the provisional assessment of WFD compliance, or to identify appropriate mitigation actions to ensure this. These options are:

- The Vyrnwy support element of a Severn-Thames Transfer requires the collection and consideration of further evidence, and if necessary the provision of additional mitigation measures, prior to confirming WFD compliance in the Afon Vyrnwy WFD water bodies downstream of Vyrnwy Reservoir.
- The Deephams Reuse option requires the collection and consideration of further evidence, and if necessary the provision of additional mitigation measures, prior to confirming the assessment of WFD compliance in the lowest freshwater water body of the River Lee and the potential for interaction with tidal Middle Thames estuary.
- The Oxford Canal Transfer to Cropredy option requires the collection and consideration of further evidence, and if necessary the provision of additional mitigation measures, prior to confirming the assessment of WFD compliance local to the source waters in the Birmingham groundwater (both groundwater and linked surface waters) and in the River Cherwell from the point it would receive transferred water and downstream.

In-combination, a South East Strategic Reservoir Option, a Culham to Farmoor transfer and a supported Severn Thames Transfer to modulate flow in the River Thames locally at Culham and downstream may impact on several River Thames water bodies. For these options a combined operating strategy would be developed with regulators and other stakeholders to manage these effects as WFD compliant in terms of the potential ecological impacts on the River Thames locally and downstream.

There are no in-combination WFD compliance effects from Thames Water's WRMP19 preferred programme with the WRMP preferred programmes of any other water companies.

Further details on the WFD, HRA and other designated site assessments are outlined in Section 9 of the Environmental Report.

MITIGATION

Consideration of mitigation measures has been an integral part of the SEA (and associated HRA and WFD assessments) process in development of the WRMP19 from the very outset. An iterative approach has been followed, with the initial screening assessments identifying potential adverse effects and mitigation measures being explored to reduce their magnitude. As more detailed assessments of the feasible options were carried out and consultees provided feedback on the options, the mitigation measures were further refined and incorporated into the conceptual design (and costs) of the option elements included in the programme appraisal model. Following the development of the preferred programmes for each WRZ, the SEA, HRA and WFD assessments have, in some cases, identified additional mitigation measures to address adverse effects. In a similar way, opportunities for enhancing identified beneficial effects have also been considered throughout the SEA, HRA and WFD assessment process.

A wide range of mitigation and enhancement measures have been incorporated into the option element conceptual designs to address both construction-related effects and operational effects, for example:

- best practice construction methods to protect the environment, built environment and local communities (including formal Construction Environmental Management Plans)
- a wide variety of landscaping measures to address landscape and visual amenity effects, as well as to enhance biodiversity
- operational and regulatory control measures to avoid adverse effects on the environment
- seeking opportunities for use of, or generation of, renewable energy to help offset additional operational carbon emissions

- enhanced water and wastewater treatment processes to protect water bodies
- temporary diversion or temporary provision of alternative Public Rights of Way during construction activities
- noise, vibration and dust abatement measures to protect people and the environment during construction activities
- archaeological asset 'watching briefs' during excavation activities to identify any opportunities for new heritage asset discoveries and ensure no damage to such assets
- preventing construction and/or HGV movements during certain times of the day or particular seasons to avoid adverse effects on people or particular species
- using barges and railway lines to deliver heavy construction materials to minimise impacts on traffic and air quality effects on local communities

Mitigation measures have been incorporated into the conceptual design of all the schemes included in the WRMP19 as explained in this Environmental Report. The SEA, HRA Appropriate Assessments and WFD assessments of the environmental effects have been based on the **residual** effects after application of the mitigation measures.

Additionally, several specific additional mitigation measures have been identified by the options and the programme SEA, HRA and WFD assessment process as set out earlier. Thames Water will continue to work closely with the Environment Agency, Historic England and Natural England to agree these mitigation measures.

Further work will be also carried out as part of the detailed design and refinement of all schemes in the WRMP19 as they are brought forward for more detailed planning, in order to seek opportunities to further reduce the identified adverse residual effects and increase beneficial residual effects. Further details of the studies are set out in Appendix XX.

The development of additional "chalk stream assets" along with the new strategic water sources will enable Thames Water to deliver environmental improvements to vulnerable chalk streams and water courses through the reduction and re-location of abstraction. This responds to a number of stakeholder responses raised during the consultation process about the WRMP19 delivering environmental improvement alongside enhanced water supply resilience.

Mitigation and enhancement measures are outlined in Section 10 of the Environmental Report.

SEA MONITORING

The natural, built and human SEA receptors potentially affected by the WRMP19 have been set out in the table below with monitoring indicators alongside. These will enable a monitoring programme to be undertaken to establish whether the WRMP is performing as expected over the coming years as anticipated by the SEA findings.

Impacted Receptor	Monitoring Indicators
Water resources, water quality, biodiversity	Changes in WFD condition status (both adverse and positive) of surface waters and groundwater waterbodies and number of water bodies where no deterioration to current WFD status has arisen Site-specific Protected Species and habitats surveys Condition of European Sites and SSSIs according to Natural England condition assessments Progress against the Thames Water publication: Our Biodiversity Policy
Climate Factors	Net greenhouse gas emissions per Ml (million litres) of treated water (kg CO^2 equivalent emissions per Ml) reported annually by Thames Water

Impacted Receptor	Monitoring Indicators
Transport	Transport fleet fuel consumption, emissions and mileage, as monitored routinely by Thames Water Scheme level traffic disruption due to construction works / during operation (where applicable) would be monitored through appropriate Environmental Management Plan agreed as part of the planning permission process which would establish agreed traffic routes and traffic levels and timings
Nuisance/ Community Amenity Effects	Scheme level community disruption due to construction works / during operation (where applicable) would be monitored through Environmental Management Plan's such as a Construction Environmental Management Plan (CEMP) and Transport Logistics Plans agreed as part of the planning permission process Complaints logged with Thames Water and Local Authority Environmental Health Officers or equivalent Responses gauged through customer satisfaction surveys and reported in Thames Water's annual performance processes Surveys of recreational and other amenities likely to be affected, including assessment of the success of agreed mitigation measures.
Air Quality	Scheme-specific monitoring during construction works / during operation (where applicable) would be monitored through an Environmental Management Plan agreed as part of the planning permission process Changes in air quality as monitored by the Defra Automatic Urban and Rural Network, including using these data to establish the baseline conditions.
Landscape and visual amenity	Baseline, construction phase and operational phase Landscape and Visual Impact Assessments or equivalent assessment techniques of sensitive landscapes (including townscapes where applicable) and visual amenity identified in the SEA (and subsequent planning application submissions) as being at a major or moderate adverse effect. Assessments to be carried out in consultation with appropriate bodies, such as the relevant AONB committees and Natural England. These surveys will aid planning and evaluation of the success of proposed mitigation measures to reduce adverse effects on the landscape and visual amenity.
Cultural Heritage	Condition of buried archaeology would be monitored during construction works as part of a Watching Brief and associate response measures as set out in the Environmental Management Plan agreed as part of the planning permission process Consultation with Historic England, heritage asset owners and other relevant stakeholders to ensure adverse impacts are minimised and opportunities sought for heritage discovery and/or maintenance. Reference to Historic England's monitoring of heritage assets such as Listed Buildings and Scheduled Monuments, Registered Battlefields, Registered Parks and Gardens, in particular the 'Heritage at risk' register.

These proposed indicators would form the core component of the monitoring programme to assess whether the identified environmental effects in the SEA are occurring as anticipated, or whether it is

giving rise to greater or lesser effects (adverse or beneficial). In turn, the monitoring may identify changes to the mitigation measures necessary to minimise adverse effects and/or modifications to scheme design or operation to further augment beneficial effects.

The monitoring plan will be owned and implemented by Thames Water and will be developed to reflect the phasing of the preferred programme. As options are brought forward for development, further specific monitoring requirements may be set out in detailed designs and plans accompanying scheme development (including, where applicable, formal applications for any required environmental permits or abstraction licences, planning permission, as well as any scheme-specific HRA and WFD assessments). These will be discussed with relevant regulatory and statutory bodies and stakeholders to agree the appropriate scale and duration of such scheme-specific monitoring activities proportionate to the assessed environmental risks.

Section 11 of the Environmental Report contains the monitoring proposals.

TECHNICAL CHALLENGES

Integration of SEA with the WRMP19 development process has been carried out over an extended period since 2015 and presented some challenges in respect of the multi-stages of option element and option screening and detailed assessments prior to confirming the final options and programmes for evaluation. Over this prolonged period, it has been important to refine options in light of the SEA findings, including modifying design to address identified adverse effects and considering additional mitigation measures.

There have also been challenges around integrating SEA findings in respect of the option elements and options, a qualitative assessment, with the mathematical WRMP programme appraisal modelling which is primarily driven by costs and other more easily quantifiable parameters. The use of summary environmental metrics derived from the detailed SEA of the option elements inevitably masks some of the specific effects identified in the SEA, but the benefit has been that the optimisation model has been able to take account of adverse and beneficial environmental effects unlike previous WRMP developments. To guard against the summary metrics missing specific effects, it has been important to consider the impacts of the alternative programmes carefully through the detailed SEA process to help inform the final decision-making.

SEA STATEMENT

Following publication of the WRMP19, Thames Water will publish a SEA ‘Post Adoption’ Statement setting out how the SEA and any views expressed by the consultation bodies or the public have influenced the content of the WRMP19.

SEA CONCLUSIONS

The environmental assessment of the WRMP19 indicates an overall minor to moderate adverse effect and minor to moderate beneficial effect of the plan and programme on the environment and society.

The WRMP19 is compliant with the Habitats Directive and associated national Habitats Regulations with the undertaking of appropriate mitigation measures.

The plan also meets the WFD Regulations and associated objectives, subject to agreeing and implementing appropriate site-specific investigations and, if necessary, following options appraisal, mitigation measures through ongoing dialogue with the Environment Agency and Natural Resources Wales.

In line with the requirements of the Water Resources Planning Guideline, the SEA has also demonstrated that there are viable alternative options available at comparable levels of environmental effects.

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Appendices

1 Introduction

This Environmental Report provides details of the Strategic Environmental Assessment (SEA) undertaken for the Thames Water Utilities Ltd (Thames Water) Water Resources Management Plan 2019 (WRMP19).

1.1 Strategic Environmental Assessment

SEA became a statutory requirement following the adoption of Directive 2001/42/EC (the SEA Directive) on the assessment of effects of certain plans and programmes on the environment. The Directive was transposed into English legislation by the SEA Regulations[6].

The objective of SEA, according to Article I of the SEA Directive, 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.'*

The SEA Directive requires plans and programmes that are prepared for purposes including water management to undergo environmental assessment, and indicates in Article 5(1) and Annex 1 that, among other factors, the likely significant effects of the plan or programme on human health, population and water are to be assessed.

Article 2(b) of the SEA Directive defines 'environmental assessment' as:

- the preparation of an Environmental Report documenting the likely significant environmental effects of the implementation of the plan, including reasonable alternatives;
- undertaking consultation on the draft plan and accompanying Environmental Report;
- taking into account of the Environmental Report and the results of the consultations in decision-making; and
- providing information when the plan is adopted and showing how the results of the SEA have been taken into account.

The UK Government has produced generic SEA guidance that sets out the stages of the SEA process - the "Practical Guide"[7]. Additionally, the Welsh Government has produced guidance to be read in conjunction with the Practical Guide[8]. These, along with specific guidance for undertaking SEA and Habitats Regulations Assessment (HRA) of WRMPs[9], are used to inform the SEA of Thames Water's WRMP19. The 2018 Water Resources Planning Guideline[10] (WRPG) also provides guidance on the role of SEA within the water resources management planning process.

SEA incorporates the following generic stages:

- **Stage A:** Setting the context, identifying objectives, problems and opportunities, and establishing the baseline (scoping)
- **Stage B:** Developing and refining options and assessing effects (impact assessment)
- **Stage C:** Preparing the Environmental Report (recording results)
- **Stage D:** Consulting on the Draft Plan and the Environmental Report (consensus)

[6] The Environmental Assessment of Plans and Programmes Regulations 2004 (Statutory Instrument 2004 No. 1633) apply to any plan or programme which relates solely or in part to England.
[7] Office of the Deputy Prime Minister (2005) A Practical Guide to the Strategic Environmental Assessment Directive.
[8] Welsh Government, Strategic Environmental Assessment in Wales
[9] UKWIR (2012) Strategic Environmental Assessment and Habitats Regulations Assessment - Guidance for Water Resources Management Plans and Drought Plans.
[10] Defra, Welsh Government, Ofwat, Environment Agency, Natural Resources Wales (2017) Water Resources Planning Guideline: interim update. July 2018

- **Stage E:** Monitoring the significant effects of the plan or programme on the environment (verification).

1.2 Purpose of the Environmental Report

This Environmental Report (comprising Stage C of the SEA) documents Stage B of the SEA process undertaken by Thames Water to establish the environmental effects of meeting its obligation to maintain a long term reliable supply of water within its operating area to meet forecast future demand for water from its customers and neighbouring water companies as set out in the company's WRMP19. The purpose and scope of the WRMP19 is explained further in Section 2.

A SEA Scoping Report (output of Stage A) was produced and issued for consultation to the public, stakeholders, the SEA statutory consultees (Environment Agency, Natural England, Historic England, Natural Resources Wales, Cadw) and the Welsh Government from 25th July 2016 to 7th September 2016. The Scoping Report is available for inspection on the Thames Water website. The basis and approach for the SEA was developed through the scoping process and refined as a result of consultation feedback.

This consultation on the Scoping Report was undertaken in accordance with Regulation 12(5) of the SEA Regulations. Responses received and the actions taken by Thames Water as a result of the feedback provided are documented in **Appendix A** of this report.

This Environmental Report documents the assessment stage of the SEA as applied to the WRMP19. It identifies the likely significant environmental effects of the options which have been selected for inclusion in the preferred plan, individually, and cumulatively with each other and with other plans and programmes and also the effects of the whole plan. It also identifies potential mitigation and enhancement measures, as well as monitoring to be undertaken to track the environmental effects of the WRMP19 once adopted and during its implementation.

The requirements of the Environmental Report are set out in Regulation 12 of the SEA Regulations. By Regulation 12(2) the Environmental Report shall:

> *'identify, describe and evaluate the likely significant effects on the environment of-*
> *a) implementing the plan or programme; and*
> *b) reasonable alternatives taking into account the objectives and the geographical scope of the plan or programme.*

Schedule 2 of the SEA Regulations lists specific items of information which shall be included in the Environmental Report. These have been reproduced in **Table** 1-1 with an indication of where each item can be found in this report.

Table 1-1 SEA Regulations Schedule 2 Requirements and their Locations

SEA Regulations Requirement	Location
Outline of the contents, main objectives of the plan or programme and its relationship with other relevant plans and programmes	Section 2 and Section 3. The plans and programmes review can be found in Appendix C
Relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan	Summarised in Section 4 and Appendix D
Environmental characteristics of areas likely to be significantly affected	Section 4 and Appendix D
Any existing environmental problems which are relevant to the plan or programme including, in particular, those relating to any areas of a particular environmental importance, such as areas designated pursuant to Directives 79/409/EEC (Birds Directive) and 02/43/EEC (Habitats Directive)	Section 4 and Appendix D

SEA Regulations Requirement	Location
Environmental protection objectives, established at international, Community or Member State level, which are relevant to the plan and the way those objectives and any environmental considerations have been taken into account during its preparation	Section 3 and Appendix C
The likely significant effects on the environment, including short, medium and long-term effects, permanent and temporary effects, positive and negative effects, and secondary, cumulative and synergistic effects, on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors	Full assessment tables are contained in Appendices E and F. These assessments are summarised in Section 6
The measures envisaged to prevent, reduce and as fully as possible, offset any significant adverse effects on the environment of implementing the plan or programme	The assessment tables in Appendices E and F recommend mitigation that can be undertaken within scheme costs. Further mitigation and enhancement is proposed in Section 10
An outline of the reasons for selecting the alternatives dealt with, and a description of how the assessment was undertaken, including any deficiencies (such as technical difficulties or lack of know-how) encountered in compiling the required information	Section 7 explains how environmental effects as identified by the SEA have been considered in developing the WRMP
A description of the measures envisaged concerning monitoring	Section 11
A non-technical summary of the information provided under the above headings	Non-technical summary at the front of this document

The Practical Guide provides a Quality Assurance checklist to help ensure that the requirements of the SEA Directive are met throughout the entire process. The checklist is reproduced in **Appendix B**.

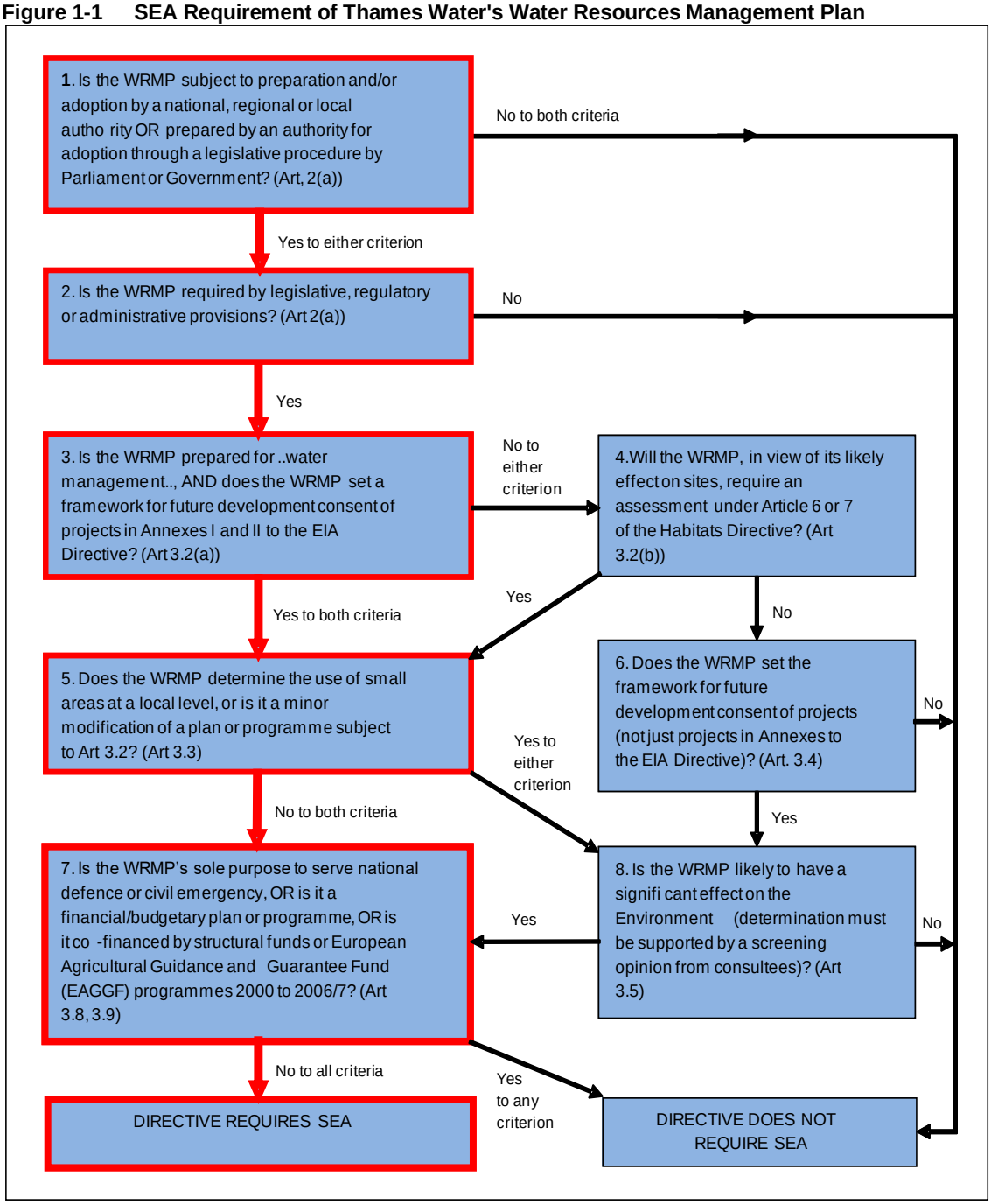
1.3 Requirement for SEA of Thames Water's Water Resources Management Plan

As stated in the WRPG[11], water companies need to demonstrate that they have investigated whether a SEA is required. As responsible authorities under the SEA Regulations, a water company must itself determine if their WRMP falls within the scope of the SEA Directive.

The UKWIR SEA Guidance, from which **Figure 1-1** is adapted, provides directions as to how the requirement for SEA should be determined for WRMPs. The boxes and arrows highlighted in red on **Figure 1.1** describe the provisions and route through the flow chart applicable to Thames Water's WRMP19, and demonstrate that the WRMP19 falls within the scope of the SEA Directive. It demonstrates that it is likely that the WRMP19 will include schemes that will require Environmental Impact Assessment (EIA) (Box 3).

[11] Defra, Welsh Government, Ofwat, Environment Agency, Natural Resources Wales (2018) Final Water Resources Planning Guideline. Interim Update. July 2018.

Figure 1-1 SEA Requirement of Thames Water's Water Resources Management Plan



1.4 SEA and Water Resources Management Planning

In the context of water resource management planning, SEA can assist in the identification of the likely significant environmental effects (adverse and beneficial) of the options available to ensure long-term reliable and resilient water supplies to Thames Water's customers. Knowledge of these effects can help to identify a preferred (or 'best value') programme of options for each of the water resource zones (WRZ)[12] that makes up the Thames Water supply area to ensure a balance is

[12] UK Water Industry Research/Environment Agency define a WRZ 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.'

maintained between available water supplies and future demand for water. The SEA informs the consideration of each of the stages of the WRMP development – from the initial screening of a very broad range of options through to the programme appraisal process, as well as the final decisions on the 'best value' programmes and the overall measures to be include in the WRMP19. The SEA can identify effects and cumulative effects as between different environmental and social aspects of a particular option, programme or plan, as well as between alternative options and programmes. SEA also enables identification of potential cumulative effects of the WRMP19 with other plans, programmes and projects. It also facilitates consultation, and complements consideration of the Habitats Regulations[13] and Water Framework Directive (WFD) environmental implications of the WRMP19 (as explained further in Sections 1.5 and 1.6 below).

1.4.1 Area under consideration for the SEA

The area under consideration for the SEA of the Thames Water's WRMP19 (**Figure 1-2**) reflects the spatial scope of the WRMP19 which extends beyond the boundaries of the Thames Water supply area (**Figure 1-3**) to include the whole of the Thames river basin (reflecting the natural catchment area for Thames Water's existing water supplies). It also includes:

- Specific areas within the River Severn catchment area:
  - River Severn corridor, from the confluence with the River Vyrnwy to the Severn Estuary
  - Lake Vyrnwy Reservoir in Powys (Wales) and the downstream River Vyrnwy catchment to the River Severn confluence
  - Warwickshire River Avon
- Part of the River Tame catchment (downstream of the Minworth sewage treatment works discharge)
- A small area of the Somerset River Avon catchment adjacent to the extreme western boundary of the Thames Water supply area
- The River Wye catchment (predominately located within Wales)

This large geographical "footprint" of the SEA reflects the fact that water supply options have been considered by Thames Water to transfer water from specific water supply sources within these areas, into the Thames Water supply area. These options are consistent with Defra policy and Environment Agency expectations (as confirmed in the WRPG), that water companies with forecast supply deficits must consider options for transferring water supplies from water companies who have surplus water resources. Water supply option areas are therefore identified that relate to the study areas identified for the groups of options being examined in the WRMP19 process.

[13] The Conservation of Habitats and Species Regulations 2017

Figure 1-2 Thames Water: Water Supply Area and WRZs

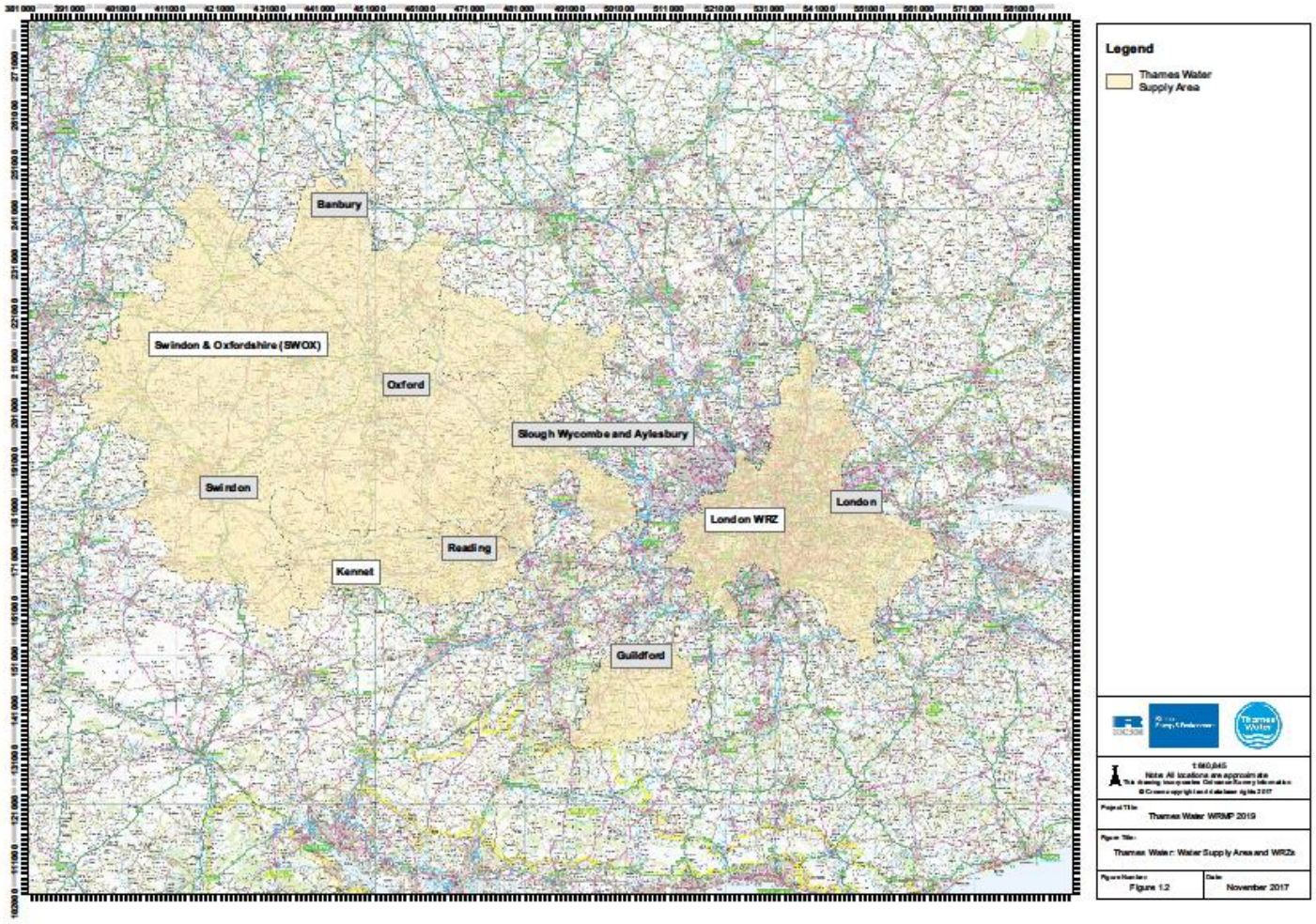
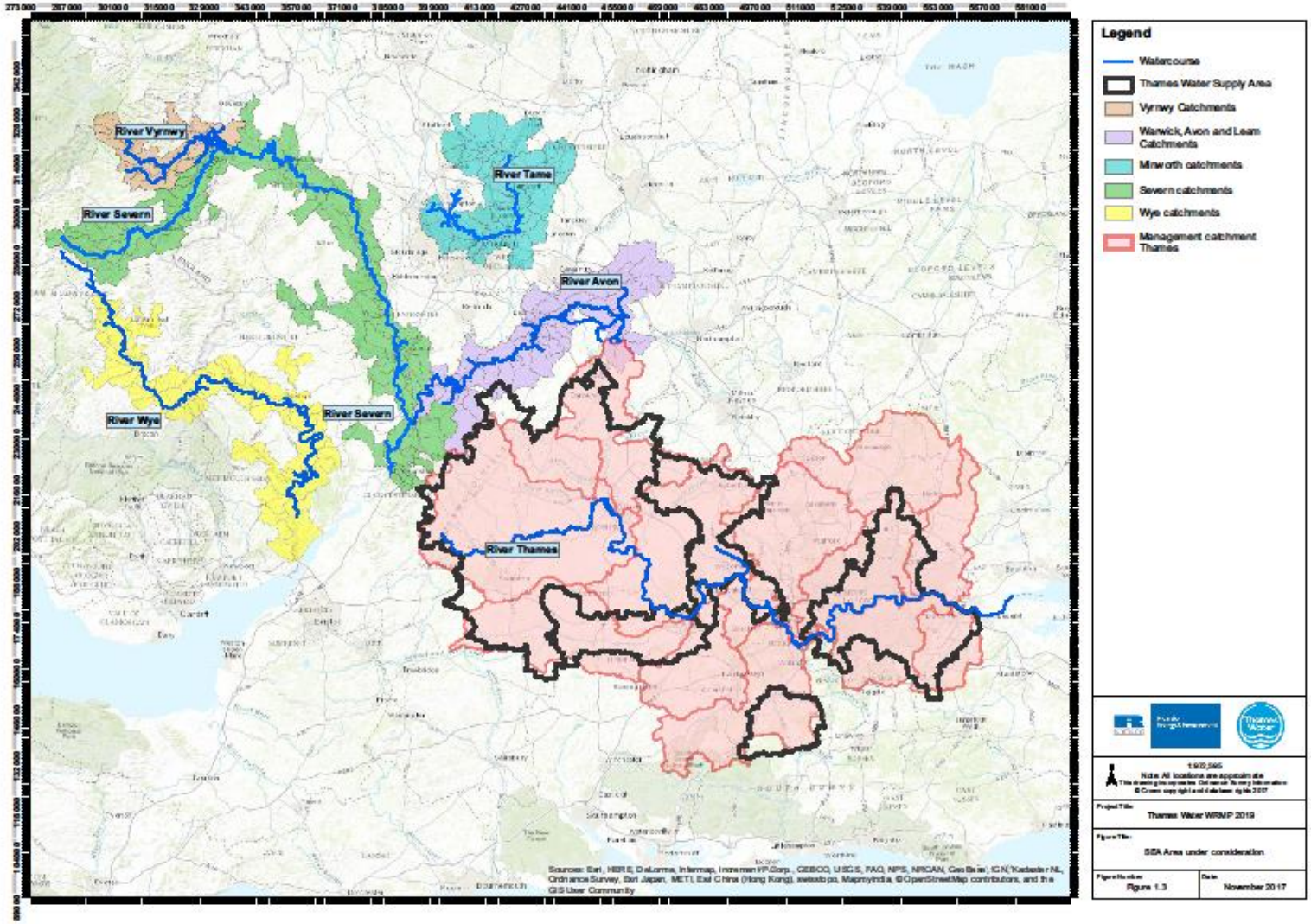


Figure 1-3 SEA Area under Consideration



1.4.2 Temporal scope of the SEA

The temporal scope of a WRMP must cover a minimum statutory planning period of 25 years. However, due to the longer-term challenges of population growth and climate change (for example, as set out in the London Climate Change Adaptation Strategy[14]), water resources planning horizons of up to 80 years (i.e. to 2099) have been considered by Thames Water.

In Section 4 (and **Appendix D**) of this Environmental Report, the current environmental and social baseline for the area under consideration is described together with the likely future changes to this baseline as currently understood. Over the 80 year planning horizon, there is uncertainty as to how the future baseline will evolve (including changes to water demand and water supply that are already confirmed or are highly likely to occur). Consequently, a scenario-based approach is appropriate to test the sensitivity of the WRMP19 and associated assessment of environmental and social effects which have been based on the known or highly likely changes to the baseline conditions. In this way, the resilience of the WRMP19 options, programmes and the overall plan, can be assessed and used to inform decision-making, as well as to inform recommendations for future monitoring to provide data for subsequent WRMPs and the associated SEA.

In considering this approach to understanding the risks presented by future changes to the environmental and social baseline conditions, it is important to recognise that WRMP19 measures for implementation beyond the mid-2020s will be further assessed by Thames Water in the next statutory WRMP process up to 2024, including SEA. This process is currently assumed to be repeated every subsequent 5 years. This regular statutory update and review will ensure that actual changes to the baseline and updated forward projections can be taken into account in subsequent WRMPs and SEAs.

1.5 Habitats Regulations Assessment (HRA)

The Habitats Regulations 2017 implement the Habitats Directive (Council Directive 92/43/EEC) in England and Wales. Thames Water must ensure that its WRMP19 meets the requirements of the Habitats Regulations prior to implementation. If the WRMP19 (i.e. one or more of the schemes within it) may cause a 'likely significant effect' on one or more European sites[15], either alone or in-combination with other schemes, plans or projects, the WRMP19 must be subject to the Appropriate Assessment (AA) process. In accordance with Habitats Regulations, Thames Water has undertaken an HRA of its WRMP19. The process has four stages:

1. Screening, which identifies likely effects, alone or in combination with other projects or plans, and considers whether these effects are likely to be significant.
2. Appropriate assessment, specifically the assessment of the effects of the WRMP (alone and in combination with other plans and projects) on European sites such that a conclusion can be made as to whether the WRMP will affect site integrity, taking into account potential alternative solutions and mitigation measures.
3. Assessment of alternative solutions, where alternative solutions are identified, and consideration of their effects are given in comparison to those in the WRMP.
4. Assessment where no alternatives exist, and adverse effects remain, which provides an assessment of imperative reasons of overriding public interest and compensatory measures required.

[14] Mayor of London (2011) Managing Risks and Increasing Resilience: The Mayor's Climate Change Adaptation Strategy. https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/Adaptation-oct11.pdf
[15] European sites are taken to include Special Areas of Conservation (SACs), candidate SACs, Special Protection Areas (SPAs), potential SPAs, Ramsar and proposed Ramsar sites, and sites identified as compensatory habitat for any of the aforementioned designations

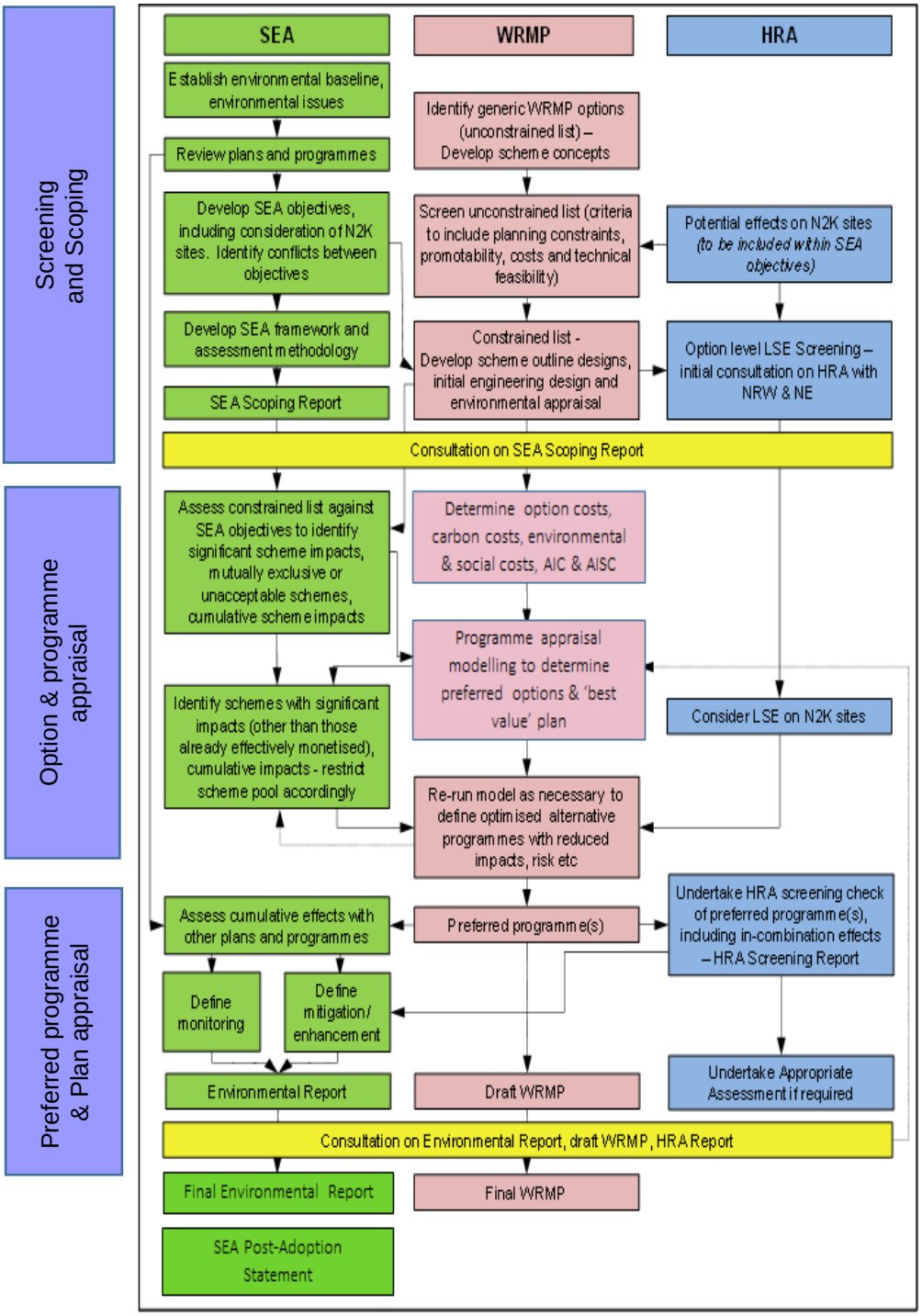
Screening of the options considered for the WRMP19 has been a core part of the development of the Plan from the outset to minimise the risk of adverse effects on European sites. Screening assessments and outcomes of the option appraisal process has been discussed with Natural England and Natural Resources Wales at each key stage of the option assessment process. HRA screening of the WRMP19 alternative and preferred ('best value') programmes was also undertaken and is documented in the HRA Report (which accompanies the WRMP19). Outcomes of the HRA process informed assessment of the WRMP19 against the SEA objectives and a summary of these is provided in section 9.

A 2018 European Court of Justice ruling[16] has stated that Article 6(3) of the Habitats Directive must be interpreted as meaning that mitigation measures should be assessed within the framework of AA and that it is not permissible to take account of measures intended to avoid or reduce the harmful effects of the plan or project on a European site at the screening stage. In consequence, Stage 1 HRA screening assessments no longer have regard to mitigation measures to conclude no Likely Significant Effect, with mitigation measures now only being considered at Stage 2 AA. We have considered this ruling in the WRMP19 and HRA assessment report contained in the WRMP19 Appendix C: HRA Report.

Figure 1-4 illustrates how the SEA and HRA processes are aligned with the WRMP development process.

[16] Case C-323/17 (*People Over Wind*).

Figure 1-4 SEA and HRA Aligned with the WRMP Process (adapted from UKWIR Guidance)[17]



[17] Note: Reference to 'N2K' in the table means the Natura 2000 network of conservation sites designated under the EU Habitats and EU Birds Directives

1.6 Water Framework Directive (WFD) Assessment

The requirements for a Water Framework Directive (WFD) assessment are set out in the WRPG section 6.11 which provides guidance as to what the WRMP should take into account to meet the requirements of the WFD in the assessment of environmental and social impacts of a scheme. It states the following:

> "*You [water companies] must take account of the requirements of the WFD, including the legally binding environmental objectives in the river basin management plans, when considering your proposed solution(s). You should consider solutions that promote the requirements of Article 7 of WFD (that seeks, as a minimum, to prevent deterioration of water with the aim of reducing the treatment needed to produce drinking water) and look to work in partnership with others. You should review solutions that have been identified in RBMP and this may require partnership working with others in the catchment to achieve the solution.*
>
> *WFD promotes increased awareness of catchment processes and challenges the established dependence on a 'treatment-led approach' for the supply of European Drinking Water Directive (DWD) compliant potable water. In particular, Article 7 promotes a 'prevention-led approach' to DWD compliance, based on pollution prevention at source to reduce treatment.*
>
> *You should confirm that there is no risk of deterioration from a potential new abstraction or from increased abstraction at an existing source before you consider it as a feasible option. In addition, you should ensure that any options do not prevent the achievement of good status (or potential). You should talk to the Environment Agency or Natural Resources Wales about any intended actions that may cause deterioration of status (or potential) or prevent the achievement of the water body status objectives in the river basin management plans or for new modifications the achievement of good status (or potential). You should do this as soon as possible before developing your plan and you should make a clear statement in your plan about any potential impacts.*
>
> *Your plans should include targeted and cost-effective implementation of restoration measures required at the catchment scale, either working solely or in partnership with other catchment based organisations. Given the uncertainty over the level of confidence you should consider the principles of adaptive management, with associated pre and post project monitoring*".

The report of the WFD assessment is provided in Appendix BB of the WRMP19. In the absence of specific guidance for undertaking WFD assessment of WRMPs, Thames Water developed an appropriate assessment approach and consulted on this with the Environment Agency and published the methodology for comment alongside the SEA Scoping Report consultation. Feedback from consultation was used to update and finalise the methodology. Full details are provided in the WFD Assessment Report at Appendix BB of the WRMP19

The outcomes of the WFD assessment informed assessment of the WRMP19 against the SEA objectives and a summary of these is provided in section 9.

1.7 Consultation

The SEA Regulations require consultation at two stages in the SEA process: at the scoping stage and on the assessments as documented in the Environmental Report. The SEA Regulations define the consultation bodies according to the spatial extent of the plan. If a plan will only affect England, the consultation bodies are the Environment Agency, Natural England and Historic England. If the plan may affect other parts of the UK, the consultation bodies are widened to reflect this. The Scoping Report was issued to the English and Welsh statutory consultation bodies. The Welsh bodies (Natural Resources Wales, Cadw) plus Welsh Government were included because schemes to transfer water from part of the River Severn catchment and part of the River Wye catchment on the England/Wales border were included on the constrained list of schemes being considered by Thames Water.

Consultation with the consultation bodies as defined by the Regulations is mandatory at both stages. Consultation with the public is only mandatory at the Environmental Report stage. However, Thames Water has consulted both the statutory consultation bodies and the public on the Scoping Report and on the draft findings of the SEA of the option elements that were considered for the programme appraisal stage of the planning process. In each case, the key findings have been presented at stakeholder and regulatory consultation meetings and the details made available on the Thames Water website, with comments invited from the public, stakeholders and regulators.

Extensive consultation has also been carried out as part of the overall draft WRMP19 planning process with government, regulators, stakeholders and customers. Findings from initial SEA screening through to the draft WRMP19 option element assessments have been communicated, discussed and comments invited from all parties, particularly through the regular Water Resources Forum established by Thames Water to facilitate stakeholder engagement on the draft WRMP19. A regular series of Technical Stakeholder Meetings have also been held at which emerging findings from the SEA have been presented and discussed. Additionally, a range of specific meetings with regulators and stakeholders on particular options have been held to examine environmental issues in more detail.

Consultation on the SEA Scoping Report took place between 25th July 2016 and 7th September 2016 (7 weeks). The responses received during this consultation period, and how they have since been addressed, can be found in **Appendix A**.

The SEA Environmental Report was published alongside the draft WRMP19 between 9 February and 29 April 2018 on the Thames Water website and issued to the statutory consultation bodies. This provided an opportunity for the statutory bodies, stakeholders and the public to express their views on the findings of the Environmental Report along with their views on the draft WRMP19. A wide range of representations were received on the SEA Environmental Report as set out in the Statement of Response published by Thames Water on its website in September 2018. A revised draft WRMP19 was prepared taking into consideration the representations received on the draft plan and the Statement of Response and this indicated the changes made to the draft WRMP19 and to the SEA Environmental Report as a result of the representations. An updated SEA Environmental Report was produced alongside the revised draft WRMP19 and was used to inform engagement with regulators and stakeholders. A second Statement of Response was produced along with an addendum to this revised draft WRMP19 in April 2019 detailing the consideration given to these further representations received and any changes or revisions made to the revised draft WRMP19 as a result of that consideration.

Following publication of the WRMP19, Thames Water will publish a SEA Statement setting out how the SEA and any views expressed by the consultation bodies or the public have influenced the WRMP. The SEA Statement will also set out the monitoring that will be required during implementation of the plan to assess any significant effects of the plan on the environment (Stage E of the SEA process).

1.8 Changes since the draft WRMP

Work continued to develop the water resource options identified since publication of the draft WRMP19 and taking account of the feedback from the public consultation. As a result, some of the options on the Constrained List of options were updated to:

- incorporate new information received
- take account of the output of ongoing investigations
- take account of consultee feedback
- take account of continuing dialogue with regulators and statutory bodies
- take account of continuing dialogue with other water companies about water trading and bulk water supplies (imports and exports)

In addition, as a result of the above, new options were identified, which have been assessed and included in the WRMP19, and subject to SEA, HRA and WFD assessment using the same methodologies as for the options considered for the draft WRMP19. Furthermore, options which have now been delivered by Thames Water, withdrawn by third parties or which have proved to be unsustainable on the basis of new information received and or in response to consultee comments have been removed from the WRMP19.

A summary of these changes to the water resource options since the publication of the draft WRMP19 in February 2018 and revised draft WRMP19 in Autumn 2018 is presented below.

The demand management programmes have been modified in light of the strong representations on the draft WRMP19 that these programmes should be enhanced to achieve greater demand savings, in particular to further reduce leakage levels. A 15% leakage reduction target by 2025 and 50% by 2050 is now included in the WRMP19, reflective of customer, regulatory and government expectations.

The following new water resource options were identified:

- Groundwater
    - Horton Kirby aquifer storage and recovery (ASR);
    - Honor Oak groundwater development;
    - New River Head groundwater development;
    - Epsom removal of constraints;
    - Britwell removal of constraints;
- Removal of Constraints
    - Queen Mary removal of outlet constraint;
    - Queen Mary removal of low water constraint;
    - Queen Mary removal of baffle;
- Raw Water Purchase
    - Chingford raw water purchase.

The following existing water resource options were updated:

- Raw Water Transfers
    - River Wye to Deerhurst (60.3 Ml/d) (previously listed as South-East Wales Resource)
    - Great Spring (previously listed as South-East Wales Resource)
- Netheridge STW to River Severn 35 Ml/d (some of the Dry Weather Flow (42.8 Ml/d) will continue to be discharged at Netheridge, under the flow support scheme)
    - Minworth STW to River Avon 115 Ml/d
    - Minworth Canal Transfer 75 Ml/d
- Direct River Abstractions
    - Teddington DRA
- Reuse
    - Mogden Reuse
- Groundwater
    - Groundwater Datchet

    - Ashton Keynes removal of constraints
    - North London Licence Trading
- Inter Zonal Transfers
    - Henley to SWOX 5 Ml/d – Inter-zonal transfer
    - Henley to SWA 5 Ml/d – Inter-zonal transfer
- Conveyance: Raw Water System
    - Medmenham Intake – 53 Ml/d
    - Abingdon to Farmoor pipeline
- Network Reinforcement
    - SWOX to SWA (48 Ml/d)

The following elements were removed:

- Raw Water Transfer Support
    - Hayden STW to River Severn
    - Draycote Reservoir Extension
- Groundwater
    - Eton removal of constraints
    - Datchet main replacement
- Direct River Abstractions
    - Teddington DRA

Further details on the new, amended and removed option elements listed above are provided in the Fine Screening Report. A brief summary of the reasons for the option elements that subsequent to the draft WRMP19 were removed from the Constrained List of options in the WRMP19 is provided below.

Both the Hayden STW to River Severn and Draycote Reservoir Extension Severn-Thames Transfer (STT) support options were offered by Severn Trent Water and listed in the Raw Water Transfers Feasibility Report (February 2018); however, the assessment was put on hold, pending a review of new information regarding the option. Further work was commissioned by Severn Trent Water from environmental consultants and the option was also reviewed by Thames Water's environmental consultant and discussed with the Environment Agency. This ultimately led to these two options being withdrawn.

Both the Eton removal of constraints and Datchet main replacement options have been removed from the WRMP19 as they have now been delivered.

Further work on the Teddington Direct River Abstraction (DRA) option was undertaken following the draft WRMP19 to understand the impact of the option on the hydrology and ecology of the River Thames upstream and downstream of Teddington Weir. The work undertaken set out both an ecological need for mitigation of the temperature effects of the DRA option on the freshwater River Thames and estuarine Tideway and potential mitigation approaches. The findings were discussed at meetings with the Environment Agency in May and July 2018. Based on these further discussions both parties agree that the compliance with WFD objectives of a Teddington DRA option remains uncertain. Uncertainty remains in a WFD context around the required extent of temperature mitigation. Research to date has not been sufficient to satisfactorily determine the required extent of, or to identify, a viable mitigation option to deliver this. In consequence it is not considered on the basis of current information that acceptable mitigation for the impacts could be provided and a Teddington DRA option cannot be considered a feasible option in a proposed WRMP programme at this time.

1.9 Structure of the Environmental Report

This Environmental Report documents and is the output of Stages B and C of the process described in Section 1.1. The Environmental Report is structured as follows:

- **Section 1** (this section) - describes the requirement for, purpose and process of the SEA, and its context in relation to the WRMP19.

- **Section 2** – Thames Water supply system and Water Resources Management Planning; describes how Thames Water plans to provide reliable and resilient water supplies to customers over a long-term period horizon.
- **Section 3** - Policy context; identifies key messages and environmental protection objectives from other relevant law, plans, policies and programmes. Further details are provided in **Appendix C**.
- **Section 4** - Environmental baseline review; draws out the key environmental issues Thames Water intends to consider in the SEA. Identifies the current and future baseline conditions within the area of potential influence of the WRMP19. Baseline data are summarised in **Appendix D**.
- **Section 5** – Assessment methodology; explains how objectives are derived to form the basis of the assessment, introduces the assessment approach and framework to consider the environmental effects of the schemes and programmes included in the WRMP19.
- **Section 6** – Assessment of options; summarises the results of the assessment of individual water resources supply and demand option elements considered in the WRMP19.
- **Section 7** – SEA and programme appraisal; describes the assessments of the reasonable alternative programmes including potential cumulative impacts between the schemes, describes how the SEA findings were used to inform development of the preferred programmes and the WRMP19 and describes the assessment of the preferred programme for each WRZ including potential cumulative impacts between the schemes.
- **Section 8** – Cumulative Effects of the WRMP19; considers cumulative effects of the preferred programmes that make up the WRMP19 with other plans, programmes and projects.
- **Section 9 –** Summary of HRA, WFD assessment and other designated sites assessments.
- **Section 10** – Mitigation and Enhancement.
- **Section 11** – Monitoring Proposals.
- **Section 12** – Next Steps.

2 Thames Water Supply System and Water Resources Management Planning

2.1 Introduction

This section provides an overview of the water resources management planning process, the Thames Water supply system and Thames Water's WRMP19. Section 2.2 and **Figure 1-2** provide an overview of the Thames Water supply system and Water Resource Zones (WRZs)**.**

Water resources management planning is undertaken by all water companies in England and Wales in order to ensure reliable, resilient water supplies over the long term planning horizon. The minimum planning horizon is at least 25 years, but in view of the water supply-demand challenges in its supply area, Thames Water has adopted a much longer 80 year planning horizon to 2099. This particularly reflects the high anticipated population growth in many of its WRZs over this period as described in detail in the WRMP19. The planning process includes working out and forecasting how much water customers will need over the planning period (assessing future demand) and how best to provide it (assessing options to reduce or constrain demand growth and/or augment reliable supplies of water) in an efficient, timely manner (programme appraisal). Companies seek to identify the preferred, 'best value' programme of demand management and water supply options to maintain a balance between reliable supply and demand in each WRZ and for their supply area as whole (the WRMP).

Water companies in England and Wales have a statutory requirement to prepare a WRMP every five years. The draft WRMP19 was submitted to Defra on 1 December 2017 and was published for public consultation in February 2018. In light of the representations received from the public consultation and other developments (such as changes to demand forecasts and requirements for water supplies from neighbouring water companies), a revised draft WRMP19 was prepared and an SEA Environmental Report updated to reflect the revisions made. This updated SEA Environmental Report was used to inform engagement with regulators and stakeholders. An addendum to this revised draft WRMP19 was published in April 2019 detailing the consideration given to any representations received and any changes or revisions made to the revised draft WRMP19 as a result of that consideration.

The WRMP also informs the regulatory water company business planning 'Price Review' process through which the Water Services Regulation Authority (Ofwat) sets the price that a water company can charge its customers for water (and wastewater) services. The Business Plan submission for the 2019 Price Review ('PR19') was submitted to Ofwat in 2018.

Engagement with government, regulators, other licensed water suppliers and water companies, customers and a wide range of stakeholders is key to the WRMP process. Thames Water's WRMP19 consultation programme began in 2015 and included regular Water Resources Forum meetings where a wide range of stakeholders and the regulators met to discuss Thames Water's emerging plans for water resources management. Information and consultation documents are also provided on Thames Water's website.

In developing its WRMP19, Thames Water has examined the supply/demand balance for each WRZ and determine how any deficits between forecast demand and reliable water supplies should be addressed for the selected planning period. The planning process has considered key issues which affect future water supply reliability and demand for water, such as:

- population and housing growth
- water consumption behaviour and how these may change in the future
- future requirements for bulk water supplies from neighbouring water companies
- climate change implications for reliability of water supplies
- reductions to the availability of water supplies due to environmental impact of existing water source abstractions ('sustainability reductions')

- raw water quality deterioration due to land use and/or climate change

A wide range of alternative options has been considered by Thames Water to address any forecast supply shortfalls, including:

- alternative water tariffs to encourage water efficiency (linked to Thames Water's strategy to continue extending water metering to the majority of its customers)
- promotion of water efficiency measures
- reducing water leakage from the water supply network or at customers' properties
- water transfers from other water companies or other owners of water sources
- water trading, licence trading and water rights purchase
- optimising use of existing water sources by removing operational constraints
- desalination
- indirect water reuse
- river or groundwater abstraction
- new reservoirs
- increased transfer of water between WRZs

Each of these options has been assessed to understand the costs, the benefits to the supply-demand balance, the effect on carbon emissions and the environmental and social effects (through the SEA process and associated HRA and WFD assessments). The options have been subsequently compared through a comprehensive programme appraisal process (including use of a sophisticated optimisation model to examine alternative programmes) to determine the 'best value' programme of options to maintain a supply-demand balance over the planning period for each WRZ. Decisions on the best value programme have taken account of a range of factors, such as the implications for water bills, the resilience to future risks and uncertainties (e.g. climate change), deliverability considerations and the environmental and social effects of the programme (adverse and beneficial, as informed by the SEA, HRA and WFD assessments). The resulting preferred programmes developed for each WRZ collectively form the WRMP19.

2.2 Thames Water's Supply and Resource System

The Thames Water supply area extends from Cirencester in the west to Dartford in the east and from Banbury in the north to Guildford in the south and covers over 5,000 square miles. Every day, Thames Water supplies around 2,600 million litres of water to around 10 million people and 215,000 businesses[1]. Water supplies are derived from a mixture of surface water sources (mostly from large storage reservoirs supplied from the River Thames and River Lee) and groundwater sources. Thames Water also have a desalination water treatment works on the River Thames (Tideway) that can supplement water supplies at times of high demand and/or during drought conditions.

For water resource planning purposes, Thames Water's supply area is divided into six WRZs (**Figure 1-2**). Several other water companies provide water supply services to those areas of the River Thames catchment area not covered by the Thames Water WRZ. Each of these other companies will also be preparing a WRMP and consultation is ongoing with these companies, primarily through the Water Resources South East (WRSE) planning group.

[1] In April 2017 a competitive retail market for water services for business customers was introduced. This means that business customers can choose which retailer they buy their water and wastewater services from. The retailer provides billing, customer service and efficiency advice to the business customer, while Thames Water, as a wholesale water provider, still has an obligation to supply the water and sewerage services and manage the infrastructure.

The London WRZ is the largest of the six zones and covers much of the Greater London area. The next largest is the Swindon and Oxfordshire WRZ (SWOX). The water resources for both of these zones are primarily based on abstraction of water from the River Thames for storage in large reservoirs.

The other WRZs to the west of London are Kennet Valley (which includes Reading and Newbury); Henley; Slough, Wycombe and Aylesbury (SWA); and Guildford. These four WRZs are largely reliant on groundwater abstraction, although there are some significant abstractions directly from local rivers: the River Kennet in Reading and the Rivers Wey and Tillingbourne near Guildford.

Further details about the Thames Water supply system and the current plans for managing water resources are provided in the WRMP19.

2.3 Thames Water's Water Resource Management Plan 2019

Thames Water has followed a structured approach to developing its WRMP19 in line with national guidance. The process started with a review of a very broad range of 'unconstrained' options to balance identified forecast future supply deficits, examining options to reduce water demand or augment reliable water supplies.

Evaluation of this unconstrained list was carried out against a range of criteria, including SEA key topic areas (plus HRA and WFD risks) alongside considerations such as engineering risk and feasibility, resilience and political/policy acceptability. The evaluation led to some options being rejected at this stage where the option was considered unacceptable or infeasible; the remaining options were carried forward for more detailed evaluation in a 'feasible' options list.

The feasible list options were considered in detail through the feasibility assessment process, which included the assessment of each option against relevant SEA topics, HRA screening and WFD screening criteria. This process involved engagement with the regulators and stakeholders through presentation and publication of the draft feasibility assessments. The environmental assessments formed part of a wider set of assessments of each option, including appraisal against economic, engineering, resilience and planning considerations. From these assessments, Thames Water made decisions about which options should be taken forward to the 'fine screening' process.

The fine screening stage involved comparing options of the same option type (e.g. reservoirs, desalination schemes, water reuse schemes) against a wide range of evaluation 'dimensions', including cost, resilience, promotability, deliverability, flexibility and environmental (involving SEA, HRA and WFD assessment criteria). The fine screening assessment built on the findings of the feasibility assessment reports. Those options that performed best against all of the Fine Screening assessment 'dimensions' and criteria were taken forward to the constrained list of options for further evaluation,

Constrained list options were disaggregated into their key component elements (e.g. new water sources, pipelines, pumping stations, water treatment works) to facilitate the conceptual engineering design of the option, costing and more detailed environmental appraisal. Key information from these assessments of each option elements were then used as inputs to the programme appraisal optimisation model to evaluate alternative programmes of options (formed from combinations of relevant option elements) to meet the forecast supply deficit in each WRZ.

The programme appraisal model outputs were used to help inform decision-making on the best value programme of options to be included in the WRMP19, alongside other key information including the SEA, HRA and WFD assessments of the options, stakeholder and regulatory feedback from the consultation processes, alignment to wider Thames Water investment programmes and affordability considerations for Thames Water's customers.

A range of reasonable alternative programmes were considered and evaluation of the advantages and disadvantages of each helped inform the final decisions as to which programme for each WRZ to include in the WRMP19 for consultation with the public, customers, regulators and stakeholders. Full

details are provided in the WRMP19. The SEA (and associated HRA and WFD assessment) findings were used to inform Thames Water's decision-making and finalisation of the WRMP19.

Further details about the planning process and how the SEA has informed the development of the WRMP19 are provided in Sections 6 to 8 of this Environmental Report.

3 Policy Context

3.1 Introduction

Annex 1 of the SEA Directive (Directive 2001/42/EC) requires, amongst other matters, the following specific information to be included within the Environmental Report:

> *'an outline of the content, main objectives of the plan or programme and its rrelationship with other plans and programmes'*
>
> *'the environmental protection objectives, established at international, (European) Community or Member State level, which are relevant to the plan or programme and the way those objectives and any environmental considerations have been taken into account during its preparation.'*

In accordance with the Directive, a review of relevant plans and programmes is presented in Section 3.2. A summary of their key objectives is presented in **Table 3.1**. These objectives were originally identified in the SEA Scoping Report.

3.2 Review of Law, Plans, Policies and Programmes

Identifying other relevant law, plans, programmes and environmental protection objectives is one of the first steps in undertaking SEA, forming part of Stage A. A review was conducted that identified how Thames Water's WRMP19 might be influenced by other law, plans, programmes and environmental protection objectives which the Plan should take into account. This information helped to identify the objectives for the SEA process.

Relevant law, plans and programmes were identified from the wide range that has been produced at an international, national, regional and local level. Plans that had no likely interaction with the WRMP19 (i.e. that were unlikely to influence the Plan, or be influenced by it), were not included in the review. Some water resource management options considered as part of the development for the WRMP19 are in part located in Wales: important relevant Welsh plans and programmes were therefore also been included in the review.

In keeping with The Welsh Government Guiding Principles for Developing Water Resources Management Plans for 2020[18], this WRMP has taken into account the Welsh Government's priorities, principles and policy commitments set out in the Well-being of Future Generations (Wales) Act (2015), Environment Act (Wales) Act 2016 and the Water Strategy for Wales. The Well-being of Future Generations (Wales) Act (2015) places sustainable development principles on a statutory footing and places a well-being duty on public bodies. The Environment Act (Wales) Act 2016 seeks to promote a low carbon, green economy, ready to adapt to the impacts of climate change, and increased pressures and demands from society. It promotes the sustainable management and the planning of natural resources in Wales in a joined up way, including an objective to maintain and enhance the resilience of ecosystems and the benefits they provide. Additionally, it aims to support and complement work to help secure Wales' long-term well-being, so that current and future generations benefit from a prosperous economy, a healthy and resilient environment and vibrant, cohesive communities.

The review undertaken and the key objectives derived from it are documented in **Appendix C**. All data presented in this review were obtained prior to June 2017 unless otherwise stated; data or reports published after this date have not been reviewed, unless otherwise indicated by the date of the document. Alongside the current and future baseline information reviewed in Section 4, the key objectives have been used to develop assessment objectives for the SEA (Section 5).

[18] The Welsh Government (2016) *Guiding Principles for Developing Water Resources Management Plans WRMPs for 2020*. Available from http://gov.wales/docs/desh/publications/160405-guiding-principles-for-developing-water-resources-management-plans-for-2020-en.PDF.

Net environmental gain has been included as a principle in the Government's 25 year Plan to Improve the Environment[19] published in January 2018. References to achieving net gains across the three overarching objectives for sustainable development (economic, social and environmental) along with achieving net gain in biodiversity are set out in the updated National Planning Policy Framework (NPPF) 2018[20]. References to achieving net gains across each of the three sustainable development dimensions (economic, social and environmental) as well providing net gains for biodiversity were previously referenced in the 2012 NPPF[21]. Having regard to the Government's 25 year Environment Plan and the updated NPPF it is considered that the SEA objectives established, consulted upon and adopted remain relevant.

The Government states that the 'net environmental gain' principle for development aims to deliver environmental improvements locally and nationally, primarily to "enable housing development without increasing overall burdens on developers". Thames Water in its WRMP19 further explains the benefits that are expected to arise as a result of implementing its plan and measures aimed at delivering overall net environmental gain.

Thames Water has been piloting the use of Natural Capital Accounting (NCA) and associated ecosystem services assessment for application to water resource planning and our wider business planning processes. Currently there is insufficient industry-specific guidance and a continuing lack of high quality appropriate valuation data to allow Thames Water to produce a full, consistent and robust natural capital account to support water resource management planning for 2019. Thames Water has however considered potential effects on natural capital in a qualitative manner in the SEA.

Thames Water is involved with on-going water industry research to develop robust methodologies for applying Natural Capital approaches to their long-term plans, and once available will work with regulators and other stakeholders to embed them into Thames Water's future planning activities.

[19] HM Government (2018). A Green Future: Our 25 year Plan to Improve the Environment
[20] Ministry of Housing, Communities and Local Government (2018). National Planning Policy Framework (NPPF) 2018
[21] Department for Communities and Local Government (2012). National Planning Policy Framework (NPPF) 2012.

Table 3-1: Key Policy Objectives derived from the Review of Plans, Policies and Programmes

SEA Topic	Key Objectives	Plans, Policies and Programmes
Biodiversity, flora and fauna	Conservation and enhancement of the natural environment and of biodiversity, particularly internationally and nationally designated sites, whilst taking into account future climate change and ability to adapt. Promote a catchment-wide approach to water use to ensure better protection of biodiversity. To achieve favourable condition for priority habitats and species. Avoidance of activities likely to cause irreversible damage to natural heritage. Support well-functioning ecosystems, respect environmental limits and capacities, and maintain/enhance coherent ecological networks, including provision for fish passage and connectivity for migratory/mobile species. Strengthen the connections between people and nature and realise the value of biodiversity. Ensure maintenance and/or support provision of fish passage for migratory fish. Protection, conservation and enhancement of natural capital. Ecosystem services from natural capital contributes to the economy and therefore should be protected and, where possible, enhanced.	**International:** United Nations (1992) Convention on Biological Diversity (CBD) European Commission, Birds Directive (2009/147/EC) European Commission, Fresh Water Fish Directive (2006/44/EC) European Commission, Directive on Animal health requirements for aquaculture animals and products thereof, and on the prevention and control of certain diseases in aquatic animals (2006/88/EC) European Commission, Habitats Directive (1992/43/EEC) The Bonn Convention on the Conservation of Migratory Species of Wild Animals (1983) The Bern Convention on the Conservation of European Wildlife and Natural Habitats (1979) Ramsar Convention The Convention on Wetlands of International Importance (1971) European Commission The Water Framework Directive (2000/60/EC) **National:** Countryside Council for Wales (CCW) (2003) Priority Habitats of Wales MHCLG (2018) National Planning Policy Framework 2018 Defra (2002) Working with the grain of nature: a biodiversity strategy for England Defra (2011) Water for Life - Water White Paper Defra (2011) The Natural Choice: Securing the value of nature. The Natural Environment White Paper Defra (2011) Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services Defra (2010) Delivering a Healthy Natural Environment. Ecosystem Approach Action Plan (updated) Defra (2010) Making Space for Nature: A Review of England's Wildlife Sites and Ecological Network Defra (2011) UK National Ecosystem Assessment and Defra (2014) UK National Ecosystems Assessment Follow on, Synthesis of Key Findings Defra (2015) The Great Britain Invasive Non-native Species Strategy Defra (2008) England Biodiversity Strategy –climate change adaptation principles

SEA Topic	Key Objectives	Plans, Policies and Programmes
	Avoidance of activities likely to cause the spread of Invasive Non-Native species (INNS). A need to protect the green infrastructure network.	Environment Agency (undated) Hydroecology: Integration for modern regulation Environment Agency (undated) WFD River Basin Characterisation Project Environment Agency CAMS (various) Natural England's standing advice on protected species. Conservation of Habitats and Species Regulations 2017 The Environmental Damage (Prevention and Remediation) (England) Regulations 2015 The Eels (England and Wales) Regulations 2009 (as amended) Environment (Wales) Act 2016 HM Government, 2018, A Green Future: Our 25 year Plan to Improve the Environment Natural Environment and Rural Communities Act 2006 Natural Resources Wales, 2016, The State of Natural Resources Report 2016 Salmon and Freshwater Fisheries Act 1975 The Countryside and Rights of Way (CRoW) Act 2000 Wildlife and Countryside Act 1981 (as amended) Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 SI3104 Welsh Government (consultation document 2012), Sustaining a Living Wales: a green paper on a new approach to natural resource management Environment Agency (Wales) Salmon Action Plans Welsh Assembly Government (2016) Environment Act (Wales) Welsh Assembly Government (2009) Technical Advice Note 5. Nature Conservation and Planning Welsh Assembly Government (2006) Environment Strategy for Wales Planning (Wales) Act 2015 **Regional/Local:** Environment Agency and Defra (2015) Thames River Basin District River Basin Management Plan Environment Agency, Defra, Natural Resources Wales and Welsh Government (2015) River Severn Basin District River Basin Management Plan Environment Agency and Defra (2015) Humber River Basin District River Basin Management Plan

SEA Topic	Key Objectives	Plans, Policies and Programmes
Population and human health		South East England Biodiversity Forum (2009) South East Biodiversity Strategy London Biodiversity Partnership (2009) London Biodiversity Action Plan Biodiversity Action Plans Environment Agency (2004) Thames Salmon Action Plan (SAP) Environment Agency (2008). Thames Eel Management Plan. Natural England (2014) Site Improvement Plans (SIPs) for Natura 2000 Sites Natural England National Character Area (NCA) Profiles
	To ensure secure, safe, reliable, dependable, sustainable and affordable supplies of water are provided for all communities and all business sectors. Access to high quality open spaces and opportunities for sport and recreation can make an important contribution to the health and well-being of communities. To provide a clean, healthy environment that benefits both people and the economy. Water resources play an important role in supporting the health and recreational needs of local communities. Increase awareness of sustainability, the true value of water and its efficient use. Promotion of well-being and healthy communities and protection from risks to these. Promotion of a sustainable economy supported by universal access to essential utility and infrastructure services.	**International:** United Nations Economic Commission for Europe (1998) Aarhus Convention - Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters The Environment Noise Directive (Directive 2002/49/EC) HM Treasury Infrastructure UK (2014) National Infrastructure Plan The Natural Environment and Rural Communities (NERC) Act (2006) European Commission, Drinking Water Directive (1998/83/EC) **National:** Defra (2011) Water for Life -Water White Paper Defra (2011) The Natural Choice: securing the value of nature. The Natural Environment White Paper Defra (2005) Securing the Future; Delivering UK Sustainable Development Strategy Defra (2016) Single Departmental Plan 2015-2020Defra, Environment Agency, Natural England, Forestry Commission England (2016) Creating a great place for living Environment Agency (2015) Creating a Better Place: Environment Agency Corporate Strategy 2014-2016 Environment Agency (2010) Water Resources Strategy – A Regional Action Plan for Thames Region Environment Agency (2014) Corporate Plan 2014 - 2016 MHCLG (2018) National Planning Policy Framework 2018 HM Government, 2018, A Green Future: Our 25 year Plan to Improve the Environment Water UK (2016) Water Resources Planning Framework (2015-2065)

SEA Topic	Key Objectives	Plans, Policies and Programmes
	Protection and improvement of drinking water quality. Social and economic consequences of severe droughts.	Welsh Assembly Government (2008) Wales Spatial Plan Welsh Assembly Government (2009) One Wales: One Planet – a new sustainable development scheme for Wales Welsh Government (2010), Technical Advice Note 6: Planning for Sustainable Rural Communities Welsh Assembly Government (1997), Technical Advice Note 13: Tourism Welsh Assembly Government (2009), Technical Advice Note 16: Sport, Recreation and Open Space Welsh Government Planning Policy Wales (2016) Edition 8 Well-being of Future Generations (Wales) Act 2015 Planning (Wales) Act 2015 **Regional/Local:** The London Plan (2016): Spatial Development Strategy for London Consolidated with Alterations since 2011 Thames Water (2009) Taking care of water - Strategic Direction Statement 2010-2035) Strategic Direction Statements (2009) for United Utilities Water, Severn Trent Water, Wessex Water and Welsh Water. Environment Agency (2006) River Thames Alliance Thames Waterways Plan 2006 – 2011 Environment Agency (2011) Enjoying Water - Strategic Priorities for Water Related Recreation in London and South East England Lee Valley Regional Park Authority (2010) Park Development Framework Mayor of London (2011) Securing London's Water Future The Mayor's Water Strategy Public Rights of Way Improvement Plans (ROWIPs) Local level Green Infrastructure Plans and strategies, including The All London Green Grid (Greater London Authority, 2012)

SEA Topic	Key Objectives	Plans, Policies and Programmes
Material assets and resource use	Promote sustainable production and consumption whilst seeking to reduce the amount of waste generated by using materials, energy and water more efficiently. Consider issues of water demand, water supply and water quality in the natural environment and ensure a sustainable use of water resources. Government expects water companies to continue reducing overall demand for water particularly in areas designated as water stressed, or where demand is above the national average. Contribute to a resource efficient, green and competitive low carbon economy. Maintain a resilient, reliable public water supply and ensure there is enough water for human uses, as well as providing an improved water environment. Minimise the production of waste, maximise resource benefits from waste and ensure waste management is in line with the 'waste hierarchy': eliminate waste sent to landfill. Promote the sustainable management of natural resources.	**International:** United Nations (2002) Commitments arising from the World Summit on Sustainable Development, Johannesburg **National:** Defra (2011) Government Review of Waste Policy in England 2011 HM Treasury Infrastructure UK (2014) National Infrastructure Plan Defra (2008) Future Water: the Government's water strategy for England Welsh Assembly Government (2006) Environment Strategy for Wales Environment Agency (2009) Water Resources Strategy for England and Wales Environment Agency (2010) Water Resources Action Plan for England and Wales Environment Agency (2010) Water Resources Strategy – A Regional Action Plan for Thames Region Welsh Government, (2014) A Water Strategy for Wales Consultation Document Environment Agency (1999) Restoring Sustainable Abstraction Programme MHCLG (2018) National Planning Policy Framework 2018 Environment Act 1995 HM Treasury (2015) Fixing the Foundations: creating a more prosperous nation. Planning (Wales) Act 2015

SEA Topic	Key Objectives	Plans, Policies and Programmes
Water	Promote sustainable water resource management, including a reduction in water consumption, to meet society's needs and offer opportunities for green growth whilst protecting and enhancing the natural environment. Maintain and improve water quality (surface waters, groundwater and bathing water). Expand the scope of water quality protection measures to all waters, surface waters and groundwater. Improve the quality of the water environment and the ecology which it supports, and continue to provide high levels of drinking water quality. Ensure appropriate management of abstractions and protect flow and level variability across the full range of regimes from low to high conditions. Prevent deterioration of waterbody status and contribute to achievement of WFD Good Status. Develop a resilient and flexible water management approach to cope with changing climate, population and economic conditions. Options for long term water needs include strategic supply options; twin tracking demand management, new resources and regional transfers; increased use of demand management; and promoting and enabling transfers.	**International:** European Commission Floods Directive (2007/60/EC) European Commission The Water Framework Directive (2000/60/EC) European Commission Drinking Water Directive (1998/83/EC) (amended 2015) European Commission Environmental Liability Directive (2004/35/EC) Directive 2006/118EC of the European Parliament and of the council of 12 December 2006 on the protection of groundwater against pollution and deterioration European Commission Revised Bathing Water Quality Directive (76/160/EEC) European Commission Urban Waste Water Treatment Directive (91/271/EEC) European Commission Nitrates Directive (91/676/EEC) **National:** National Infrastructure Commission (2018) Preparing for a drier future: England's water infrastructure needs MHCLG (2018) National Planning Policy Framework 2018 Defra (2005) Making Space for Water Defra (2012)The UK Climate Change Risk Assessment 2012 Evidence Report Defra (2011) Water for Life - Water White Paper Defra (2011) The Natural Choice: Securing the value of nature. The Natural Environment White Paper Defra (2008) Future Water: the Government's water strategy for England Defra and Welsh Government (2014) River Basin Planning Guidance Environment Agency (1999) Restoring Sustainable Abstraction Programme Environment Agency (2011) National Flood and Coastal Risk Management Strategy for England Environment Agency (2010) Water Resources Action Plan for England and Wales Environment Agency (2009) Water Resources Strategy for England and Wales Environment Agency (2013) Managing Water Abstraction Environment Agency (2014) Corporate Plan 2014 – 2016 Environment Agency (2015) Creating a Better Place: Environment Agency Corporate Strategy 2014-2016 Environment Agency CAMS (various)

SEA Topic	Key Objectives	Plans, Policies and Programmes
	Balance the abstraction of water for supply with the other functions and services the water environment performs or provides. Steer new development to areas with the lowest probability of flooding and manage any residual flood risk, taking account of the impacts of climate change. Promote measures to enable and sustain long-term improvement in water efficiency. Ensure a sustainable balance between the supply and demand for water. Reduce flood risk to people, residential and non-residential properties, community facilities and key transport links, as well as designated nature conservation sites and heritage assets and landscapes of value. Reduce risk of flooding from reservoirs. Support achievement of River Basin Management Plan objectives.	Environment Agency Catchment Flood Management Plans Environment Agency, Thames River Basin: Water Industry National Environment Programme (WINEP) (unpublished) HM Government, 2018, A Green Future: Our 25 year Plan to Improve the Environment Natural Resources Wales, 2016, The State of Natural Resources Report 2016 Thames Water (2013) Business Plan. Thames Water 2015 to 2020 Water Resources Management Plans and Drought Plans from adjacent water companies to Thames Water's supply area Water UK (2016) Water Resources Planning Framework (2015-2065) Water UK (2016) Water Resources Planning Framework (2015-2065) Environment Agency (1999) Restoring Sustainable Abstraction Programme Strategy Process Environment Agency and Defra (2015) Anglian river basin district, River basin management plan Environment Agency and Natural Resources Wales (2016) Severn river basin district flood risk management plan 2015-2021 Environment Agency and other lead authorities Shoreline Management Plans Flood and Water Management Act (2010) Natural Resources Wales, Drought Plan The Water Act (2003) The Water Environment (WFD) (England and Wales) Regulations 2017 Water Industry Act 1991 (as amended by the commencement of Section 36 of the Flood and Water Management Act 2010) Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 SI3104 The Water Resources Management Plan Regulations 2007 Welsh Government (2011) Strategic Policy Position Statement on Water 2011 Welsh Government (2014) National Strategy for Flood and Coastal Erosion Risk Management Welsh Government (2012), Sustaining a Living Wales: a green paper on a new approach to natural resource management Welsh Government (2012), State of the Environment Report – Wales Welsh Government, (2015) A Water Strategy for Wales

SEA Topic	Key Objectives	Plans, Policies and Programmes
		Welsh Assembly Government (2004), Technical Advice Note 15: Development and Flood Risk Welsh Government (2013) Wales Marine and Fisheries Strategic Action Plan Welsh Government Planning Policy Wales (2016) Edition 8 UKTAG WFD Guidance Documents (various dates) Defra (2016) Guiding principles for water resources planning for water companies operating wholly or mainly in England Environment Agency Wales (2009), Water Resources Action Plan Planning (Wales) Act 2015 **Regional/Local:** Environment Agency (2010) Water Resources Strategy – A Regional Action Plan for Thames Region Environment Agency Drought Plans (various) including West Thames Area Drought Plan and Hertfordshire and North London Area Drought Plan Environment Agency (2011) Water Resources Strategy – A Regional Action Plan for Thames Region Other relevant water company WRMPs (2014/2015) and Drought Plans (2013-2014) Environment Agency and Defra, (2015) Thames River Basin District River Basin Management Environment Agency, Defra, Natural Resources Wales and Welsh Government (2015) River Severn Basin District River Basin Management Plan Environment Agency and Defra (2015) Humber River Basin District River Basin Management Plan Environment Agency (2014) Thames Catchment Abstraction Management Strategy Environment Agency (2016) Humber River Basin District flood risk management plan 2015-2021 Environment Agency (2016) Thames River Basin District Flood Risk Management Plan 2015-2021 Environment Agency (2016) Severn River Basin District, Flood risk management plan 2015-2021 Environment Agency, Catchment Abstraction Management Strategy (various dates for relevant catchments)

SEA Topic	Key Objectives	Plans, Policies and Programmes
		Environment Agency (2007) Water for the Future - Managing Water in the South East of England. London Infrastructure Plan 2050 Mayor of London (2011) Securing London's Water Future The Mayor's Water Strategy Thames Waterways Plan 2015 – 2021, EA for the River Thames Alliance, (2015) Thames Water (2013) Business Plan. Thames Water 2015 to 2020 Thames Water/Environment Agency (2015) National Environment Programme for Thames Water 2015-2020 Port of London Authority (2016) The Thames Vision South East Marine Plan (forthcoming) Marine Management Organisation Water Resources in the South East (WRSE) Group (2014 and forthcoming) Regional water resources strategy Environment Agency (2016) River Thames Scheme: reducing flood risk from Datchet to Teddington

SEA Topic	Key Objectives	Plans, Policies and Programmes
Soil, geology and land use	Protect and enhance the quality and diversity of geology (including geological Sites of Special Scientific Interest (SSSIs)) and soils including geomorphology and geomorphological processes, which can be lost or damaged by insensitive development. Ensure that soils will be protected and managed to optimise the varied ecosystem service functions that soils perform for society (e.g. supporting agriculture and forestry, protecting cultural heritage, carbon sequestration, supporting biodiversity, as a platform for construction), in keeping with the principles of sustainable development. Promote catchment-wide approach to land management by relevant stakeholders, in order to benefit natural resources, reduce pollution and develop resilience to climate change. Promote mixed use developments, and encourage multiple benefits from the use of land in urban and rural areas, recognising that some open land can perform many functions. Encourage the effective use of land by reusing land that has been previously developed (brownfield land), provided that it is not of high environmental value. Minimise coastal erosion. Conservation and enhancement of geological SSSIs.	**International:** Council of Europe (2003) European Soils Charter European Commission (2006) Thematic Strategy for Soil Protection **National:** The Countryside and Rights of Way (CROW) Act 2000 Defra (2009) Safeguarding our Soils – A Strategy for England Defra (2004) The First Soil Action Plan for England Environment Agency (2007) Soil a precious resource: Strategy for protecting, managing and restoring soil MHCLG (2018) National Planning Policy Framework 2018 Defra (2004) Rural Strategy 2004 Defra (2006) Sustainable Farming and Food Strategy: Forward Look HMSO (1990) Environmental Protection Act Welsh Assembly Government (2006) Environment Strategy for Wales Welsh Assembly Government (2014) National Strategy for Flood and Coastal Erosion Risk Management Wildlife and Countryside Act 1981 (as amended) Planning (Wales) Act 2015 **Regional/local** Natural England - National Character Area (NCA) profiles

SEA Topic	Key Objectives	Plans, Policies and Programmes
Air and climate	Reduce greenhouse gas emissions. Targets include: reduce the UK's greenhouse gas emissions by at least 80% (relative to 1990 levels) by 2050 and cut London's CO2 emissions by 60% by 2025.In Wales at least an 80% reduction in emissions by 2020. Reduce the effects of air pollution on ecosystems. Improve overall air quality. Sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Minimise energy consumption, support the use of sustainable/renewable energy and improve resilience to climate change. Build in adaption to climate change to future planning and consider the level of urgency of associated risks of climate change impacts accordingly. Need for adaptive measures to respond to likely climate change impacts on water supply and demand.	**International:** The Cancun Agreement (2011) & Kyoto Agreement (1997) European Commission (2008) Ambient Air Quality Directive (2008/50/EC) European Commission (2009) Promotion of the use of energy from renewable sources Directive (2009/28/EC) European Commission (2005) Thematic Strategy on Air Pollution **National:** Defra (2013) The National Adaptation Programme: Making the country resilient to a changing climate MHCLG (2018) National Planning Policy Framework 2018 Defra (2012) The UK Climate Change Risk Assessment 2012 Evidence Report Department for Energy and Climate Change (2009) UK Renewable Energy Strategy Department of energy and climate change, Planning our electric future: a White Paper for secure, affordable and low carbon electricity (2011) Defra (2008) England Biodiversity Strategy –climate change adaptation principles Defra (2007) The Air Quality Strategy for England, Scotland and Wales DECC (2007) Energy White Paper: Meeting the Energy Challenge Environment Agency (2014) Corporate Plan 2014 – 2016 Environment Agency (2015) Creating a Better Place: Environment Agency Corporate Strategy 2014-2016 The Climate Change Act 2008 The Energy Act 2013 Environment (Wales) Act 2016 HM Government, 2018, A Green Future: Our 25 year Plan to Improve the Environment Natural Resources Wales, 2016, The State of Natural Resources Report 2016 UKCIP (2009) UK Climate Projections UKCP09 (2009) Welsh Assembly Government (2010) Climate Change Strategy for Wales Welsh Assembly Government (2006) Environment Strategy for Wales Welsh Assembly Government (2010), Low Carbon Revolution – The Welsh Assembly Government Energy Policy Statement

SEA Topic	Key Objectives	Plans, Policies and Programmes
		Regional/Local: Defra (2015) Climate adaptation reporting second round: South East Water London Climate Change Partnership (2009) Adapting to Climate Change, Creating Natural Resilience. Mayor of London (2011) Managing Risks and Increasing Resilience The Mayor's Climate Change Adaptation Strategy Planning (Wales) Act 2015

SEA Topic	Key Objectives	Plans, Policies and Programmes
Archaeology and cultural heritage	Built development in the vicinity of historic buildings and Scheduled Monuments could have implications for the setting and/or built fabric and cause damage to any archaeological deposits present on the site. Ensure active management of the Region's environmental and cultural assets. Ensure effects resulting from changes to water level (surface or sub-surface) on all historical and cultural assets are avoided. Consider effects on important wetland areas with potential for paleo-environmental deposits. Promote the conservation and enhancement of the historic environment, including the promotion of heritage and landscape as central to the culture of the region and conserve and enhance distinctive characteristics of landscape and settlements. Conserve and enhance the historic environment, heritage assets and their settings. Protect, enhance and manage the character and appearance of historic and cultural assets and their settings including maintaining and strengthening local distinctiveness and sense of place.	**International:** The Convention for the protection of the architectural heritage of Europe (Granada Convention) The European Convention on the protection of archaeological heritage (Valletta Convention) **National:** Ancient Monuments and Archaeological Areas Act 1979 Cadw (2013) Historic Environment Strategy for Wales MHCLG (2018) National Planning Policy Framework 2018 English Heritage (2008), Climate Change and the Historic Environment English Heritage (2010), Heritage at Risk Historic England (2013) Strategic Environmental Assessment, Sustainability Appraisal and the Historic Environment Historic England (2015) The Setting of Heritage Assets, Historic Environment Good Practice Advice in Planning 3 Department for Culture, Media and Sport (2001) The Historic Environment – A Force for the Future (2001) Historic Environment (Wales) Act 2016 Planning (Listed Buildings and Conservation Areas) Act 1990 Welsh Assembly Government (consultation document 2012), Sustaining a Living Wales: a green paper on a new approach to natural resource management Cadw, CCW and ICOMOS (UK) (International Council on Monuments and Sites) (2001) - Register of Landscapes of Historic Importance Planning (Wales) Act 2015

SEA Topic	Key Objectives	Plans, Policies and Programmes
Landscape and visual amenity	Protection and enhancement of landscape (including designated landscapes, landscape character, distinctiveness and the countryside) Take account of the different roles and character of different areas, promoting the vitality of main urban areas, protecting the Green Belts around them, recognising the intrinsic character and beauty of the countryside and supporting thriving rural communities within it. Enhance the value of the countryside by protecting the natural environment for this and future generations. Improve access to valued areas of landscape character in sustainable ways to enhance its enjoyment and value by visitors and stakeholders.	**International:** Council of Europe (2006) European Landscape Convention **National:** The Countryside and Rights of Way (CRoW) Act (2000) Wildlife and Countryside Act 1981 (as amended) MHCLG (2018) National Planning Policy Framework 2018 Defra (2011) The Natural Choice: Securing the value of nature. The Natural Environment White Paper Defra (2010) Making Space for Nature: A Review of England's Wildlife Sites and Ecological Network Cadw, CCW and ICOMOS (UK) (International Council on Monuments and Sites) (2001) - Register of Landscapes of Historic Importance Natural Resources Wales, 2016, The State of Natural Resources Report 2016 Planning (Wales) Act 2015 **Regional/Local:** Natural England - National Character Area (NCA) profiles Cannock Chase Area of Outstanding Natural Beauty Management Plan 2014-2019 Cotswolds AONB Management Plan 2013-2018 South Downs National Park (2013) Partnership Management Plan, Shaping the future of your south downs national park 2014-2019. Chiltern Hills AONB Management Plan 2014-2019The North Wessex Downs AONB Management Plan 2014-2019 HM Government, 2018, A Green Future: Our 25 year Plan to Improve the Environment Kent Downs AONB Management Plan 2014-2019 Malvern Hills Area of Outstanding Natural Beauty Management Plan 2014-2019 Shropshire Hills Area of Outstanding Natural Beauty (2014) Management Plan 2014 to 2019 Snowdonia National Park, Snowdonia National Park Management Plan 2010 – 2015 Surrey Hills AONB Management Plan 2014-2019 Thames Landscape Strategy, 2012. Our Guidance Document: The Thames Landscape Strategy Review 2012

4 Environmental Baseline Review

4.1 Introduction

Annex 1 of the SEA Directive requires, amongst other information, the following specific baseline information to be included within the Environmental Report:

- 'the relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan or programme'
- 'the environmental characteristics of areas likely to be significantly affected'
- 'any existing environmental problems which are relevant to the plan or programme including, in particular, those relating to any areas of a particular environmental importance, such as areas designated pursuant to Directives 79/409/EEC (the 'Birds Directive') and 92/43/EEC (the 'Habitats Directive').'

An essential part of the SEA process is to identify the current baseline conditions and their likely evolution in the absence of the WRMP19. It is only with knowledge of baseline conditions that potential impacts of the WRMP19 and its schemes can be identified, monitored, and if necessary mitigated. However, it is important to note that the future baseline is not a 'do nothing' option with respect to water resources management planning. There will be elements of Thames Water's current WRMP (published in 2014) that will continue in the absence of the new WRMP (e.g. increased water metering, continuing leakage reduction and water efficiency measures to implement Thames Water and/or Government policy), which will act to alter the future baseline.

As discussed in Section 1.4.2, the temporal period covered by the WRMP19 is potentially of long duration (up to 80 years), presenting uncertainties in characterising the future baseline. In this Section, the best available projections for environmental and social characteristics have been considered and summarised, but there is significant uncertainty which increases with time. These will need to be updated as part of the subsequent water resources management plan process leading up to the next WRMP submission in 2024, and subsequent WRMP submissions beyond this date.

In view of the area under consideration for the WRMP, effects from some options for the WRMP could result in environmental effects occurring beyond the Thames Water supply area, for example in the wider River Thames basin and/or in parts of the River Severn basin. Baseline data have been drawn from a variety of sources, including a number of the laws, plans, policies and programmes reviewed and summarised earlier in **Table 3.1**. The baseline data are presented in **Appendix D.** The likely future trends in the environmental and social issues considered (where information is available to do so) are also summarised. The key issues arising from the review of baseline conditions (and of relevant plans, programmes and policies) are summarised in section 4.4.

The spatial extent of the SEA is described in section 1.4.1 and the temporal scope of the SEA is described in section 1.4.2. All data presented in this report were obtained prior to June 2017 unless otherwise stated; data or reports published after this date have not been reviewed, unless otherwise indicated.

4.2 Limitations of the Data and Assumptions Made

The area under consideration for this SEA is substantial, presenting some challenges concerning the extrapolation of information from data collated at different spatial resolution. Relevant spatial data have been obtained for each of the SEA topics and presented as mapped information so far as possible to provide a summary of the extensive datasets involved.

In some instances, reporting cycles mean that the available information is dated (as indicated for each dataset).

The principal data limitations concern the establishment of future social and environmental baseline where there is substantial differences in the availability and temporal resolution of robust projections

across the various SEA topic areas: for example, whilst some water companies are planning up to 80 years ahead and climate change estimates extend to a similar horizon, regional population and housing forecasts rarely go beyond a 40 year horizon and forecasts of how the natural environment may change are very limited.

The Environment Agency has been preparing five future scenarios exploring the implications for water resources and management which it completed in late November 2017[22]. This work concluded that, in the absence of specific policy interventions, the scenarios that are driven by short-term growth and competitiveness could undermine the requirements of current environmental legislation and make the negative impacts of climate change worse. Conversely, scenarios characterised by long-term sustainability may offer substantial environmental improvements, though currently desired environmental outcomes may not be fully achieved. The impacts varied across contrasting types of catchment typical of different parts of England and Wales, and with very different future water management challenges. As recommended by this Environment Agency study, Thames Water has carried out a range of sensitivity scenario testing ('stress-testing') of the WRMP19 to take account of the potential risks to its plan, including in relation to climate change and environmental drivers (see Section 10 of the WRMP19).

4.3 Overview

The majority of options under consideration for the WRMP are principally likely to affect people, society and the environment (both natural and built) within the River Thames basin. However, a number of water supply options are located in other areas as discussed in Section 2. Therefore, baseline data are described for the River Thames basin as well as for these other areas within which options were identified. The water supply options outside of the Thames river basin would only affect the immediate areas surrounding the components forming the water supply scheme option as a result of any necessary construction activity, but the operational impact is likely to extend to downstream water bodies (and possibly upstream too if there are effects on groundwater levels or migratory species, for example) and the environment and social activities that are affected and/or dependent on those waterbodies. The SEA of these supply options clearly sets out these potential effects and the associated spatial extent. The relevant baseline data are presented in **Appendix D**.

A summary of the baseline data and future baseline for both the River Thames basin and the specific areas beyond the Thames basin associated with WRMP supply options for each SEA topic area is provided in **Appendix D**.

4.4 Key Issues

4.4.1 Biodiversity, Fauna and Flora Key Issues

The key sustainability issues arising from the baseline assessment for biodiversity are:

- The need to protect or enhance the region's biodiversity, particularly protected sites designated for nature conservation.
- The need to avoid activities likely to cause irreversible damage to natural habitats.
- The need to take opportunities to improve connectivity between fragmented habitats to create functioning habitat corridors.
- The need to recognise the importance of allowing wildlife to adapt to climate change.
- The need to control the spread of Invasive Non-Native Species (INNS).
- The need to engage more people in biodiversity issues so that they personally value biodiversity and know what they can do to help, including through recognising the value of ecosystem services.
- To seek opportunities for net environmental gain from infrastructure development.

[22] Environment Agency (2017). Plausible future scenarios for the water environment to 2030 and 2050

4.4.2 Population and Human Health Key Issues

The key sustainability issues arising from the baseline assessment for population and human health are:

- The need to ensure water supplies remain affordable especially for deprived or vulnerable communities, reflecting the importance of water and sewerage services for health and wellbeing.
- The need to ensure continued improvements in levels of health across the region, particularly in urban areas and deprived areas.
- The need to ensure continuing safe, reliable and resilient provision of water and sewerage services to maintain the health and wellbeing of the population.
- The need to ensure a balance between different aspects of the built and natural environment that will help to provide opportunities for local residents and tourists, including opportunities for access to protected and enhanced recreation resources, green infrastructure and the natural and historic environment.
- The need to plan water resources management requirements and other essential services to accommodate an increasing population, including ensuring a resilient water supply system to avoid the need for emergency drought orders (rota cuts or severe pressure reduction).
- The need to recognise that sites of nature conservation importance, heritage assets, water resources, important landscapes and public rights of way can all contribute to recreation and tourism opportunities and subsequently health and well-being and the economy.

4.4.3 Material Assets and Resource Use Key Issues

The key sustainability issues arising from the baseline assessment for Material Assets and Resource Use are:

- The need to minimise the consumption of resources, including water and energy.
- The need to reduce the total amount of waste produced in the region, from all sources. The need to recognise waste as a potential resource and reuse waste productively where possible to support development of the circular economy.
- The need to reduce the proportion of waste sent to landfill.
- The need to continue to actively control leakage from the water supply system to help reduce demand for water.
- Daily consumption of water resources is higher than the national average in the Thames Water area and as a water stressed area, there is a need to encourage more efficient water use.

4.4.4 Water Key Issues

The key issues arising from the baseline assessment for water are:

- The need to further improve the quality of the regions' river and estuarine waters taking into account WFD objectives.
- The need to maintain the quantity and quality of groundwater resources taking into account WFD objectives.
- The need to improve the resilience, flexibility and sustainability of water resources in the region, particularly in light of potential climate change impacts on surface water and groundwater.
- The need to ensure sustainable abstraction to protect the water environment and meet society's needs for a resilient water supply.
- The need to reduce and manage flood risk.

- The need to ensure that people understand the value of water as part of driving a step change in water consumption to a much lower level over the coming decades, including through increased household water metering.
- The need for innovation to drive water leakage levels down by 50% by 2050 in a cost-effective manner.

4.4.5 Soil, Geology and Land Use Key Issues

The key sustainability issues arising from the baseline assessment for soil, geology and land use are:

- The need to protect geological features of importance (including geological SSSIs) and maintain and enhance soil function and health.
- The need to manage the land more holistically at the catchment level, benefitting landowners, other stakeholders, the environment and sustainability of natural resources (including water resources).
- The need to make use of previously developed land (brownfield land) and to reduce the prevalence of derelict land in the region.

4.4.6 Air and Climate Key Issues

The key sustainability issues arising from the baseline assessment for air and climate are:

- The need to reduce air pollutant emissions (industrial processes/transport) and limit air emissions to comply with air quality standards.
- The need to reduce greenhouse gas emissions (industrial processes and transport).
- The need to mitigate against climate change through the reduction in greenhouse gas emissions in order to contribute to risk reduction over the long term.
- The need to adapt to the impacts of climate change for example, through sustainable water resource management, water use efficiencies, specific aspects of natural ecosystems (e.g. connectivity) as well as accommodating potential opportunities afforded by climate change.

4.4.7 Archaeology and Cultural Heritage Key Issues

The key sustainability issue arising from the baseline assessment for archaeology and cultural heritage is:

- The need to conserve or enhance sites of archaeological importance and cultural heritage interest, particularly those which are sensitive to the water environment.

4.4.8 Landscape and Visual Amenity Key Issues

The key sustainability issues arising from the baseline assessment for landscape and visual amenity are:

- The need to protect and improve the natural beauty of the region’s AONBs, National Parks and other areas of natural beauty.
- The need to protect and improve the character of landscapes and townscapes.

5 Assessment Methodology

5.1 SEA Objectives

This section outlines the SEA objectives and assessment framework used to identify the significant environmental and social effects of the options identified in Thames Water's WRMP19. This has taken into account the relevant comments from consultees on the SEA scoping report.

The assessment methodology has also taken into account the objective of SEA, provided in Article I of the SEA Directive, which 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.'*

The effects assessment of the WRMP19 options was 'objectives-led': establishing assessment objectives is a recognised way of identifying the likely significant environmental and social effects of a plan and comparing these with the effects of alternatives. SEA objectives are often derived from environmental and social objectives established in law, policy or other plans and programmes, or from a review of baseline information and environmental problems based on the SEA topics.

The identification of assessment objectives was informed by stakeholder comments on proposed objectives in the Scoping Report and taking account of:

- The key policies and social and environmental protection objectives identified in the review of law, policies, other plans and programmes (see Section 3). The assessment took these objectives into account to enable the highlighting of any area where the WRMP19 may help or hinder the achievement of the objectives of other plans (e.g. at local, national and international level).
- The current state of the environment in the area under consideration for the SEA (see **Appendix D**) and the key environmental issues identified (see Section 4.4).

The set of SEA objectives adopted following the Scoping Report consultation are set out in **Table 5.1** alongside the key objectives identified from the review of policies, plans and programmes and the key issues highlighted from the review of baseline information. The following sections describe how Thames Water has used these SEA objectives in the assessment of the environmental effects of the options, programmes and the WRMP19 as a whole. The SEA objectives are intended to promote changes that contribute to sustainability. By assessing each option against the objectives, it becomes apparent where there might be adverse effects and where options within the WRMP19 could be developed to deliver beneficial effects.

As well as the overall SEA objectives, a number of key indicator questions were developed for each SEA topic (see **Table 5.1**). These key questions prompted the assessments and ensured they considered all relevant environmental aspects. The assessment of each option, programme and plan used the following information:

- Details of the options involved: main components, location and/or population affected;
- Likelihood of deployment;
- Construction (where applicable) and operational implementation;
- Amount of water provided or volume of water saved (taking uncertainty into account); and
- Key elements of the baseline and future baseline environment, such as the location of designated sites, local air quality, flood risk areas.

The assessment methodology has also taken into account Regulation 12(2) of the SEA Regulations[23], which requires an environmental report to evaluate the likely significant effects of both the promoted plan/programme and reasonable alternatives as confirmed by case law[24].

Regard has also been given to Regulation 12(3) of the SEA Regulations which only requires such evaluation "as may reasonably be required", taking account among other things of:

> *'(b) the contents and level of detail in the plan or programme;*
> *(c) the stage of the plan or programme in the decision making process; and*
> *(d) the extent to which certain matters are more appropriately assessed at different levels in that process in order to avoid duplication of the assessment.'*

[23] The Environmental Assessment of Plans and Programmes Regulations 2004 (Statutory Instrument 2004 No. 1633) apply to any plan or programme which relates solely or in part to England.
[24] Heard v Broadland District Council [2012] EWHC 344 (Admin); [2012] Env. L.R. 23. The High Court quashed a local plan document for failing to carry out 'an equal examination of the alternatives which it is reasonable to select for examination alongside whatever, even at the outset, may be the preferred option' (see per Ouseley J at paragraph 71).

Table 5.1 SEA objectives and assessment approach

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
Biodiversity, flora and fauna	Conservation and enhancement of the natural environment and of biodiversity, particularly internationally and nationally designated sites, whilst taking into account future climate change and ability to adapt. Promote a catchment-wide approach to water use to ensure better protection of biodiversity. To achieve favourable condition for priority habitats and species. Avoidance of activities likely to cause irreversible damage to natural heritage. Ensure maintenance and/or support provision of fish passage for migratory fish. To seek opportunities for net environmental gain from infrastructure development	The need to protect or enhance the region's biodiversity, particularly protected sites designated for nature conservation. The need to avoid activities likely to cause irreversible damage to natural heritage. The need to take opportunities to improve connectivity between fragmented habitats to create functioning habitat corridors	1.1 To conserve and enhance biodiversity, including designated sites of nature conservation interest and protected habitats and species (with particular regard to avoiding the effects of over-abstraction on sensitive sites, habitats and species).	• Will it protect and enhance the most important sites for nature conservation? • Will it protect and enhance aquatic, transitional and terrestrial species and habitats? • Will it contribute to the sustainable management of natural habitats and ecosystems, i.e. within their limits and capacities taking into account climate change adaptability? • Will it affect WFD compliance e.g. good ecological potential/status? • Will it ensure maintenance or support provision of fish passage with respect to migratory fish functioning habitat connectivity?
Biodiversity, flora and fauna	Support well-functioning ecosystems, respect environmental limits and capacities, and maintain/enhance coherent ecological networks, including		1.2 To protect, conserve and enhance natural capital and the ecosystem services from natural capital that contribute to the economy.	• Will it protect or enhance natural capital and ecosystem services?

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
	provision for fish passage and connectivity for migratory/mobile species. Protection, conservation and enhancement of natural capital. Ecosystem services from natural capital contributes to the economy and therefore should be protected and, where possible, enhanced.			
Biodiversity, flora and fauna	Strengthen the connections between people and nature and realise the value of biodiversity.	The need to engage more people in biodiversity issues so that they personally value biodiversity and know what they can do to help, including through recognising the value of ecosystem services.	1.3 To strengthen the connections between people and nature and realise the value of biodiversity and ecosystem services.	• Will it maintain or enhance access to areas of natural heritage conservation interest? • Will it provide educational or information resources for the public? • Will it create areas of improved biodiversity in urban or deprived areas? • Will it engage more people in biodiversity issues and strengthen their connections with nature?
Biodiversity, flora and fauna	Avoidance of activities likely to cause the spread of Invasive Non-Native species (INNS). A need to protect the green infrastructure network.	The need to recognise the importance of allowing wildlife to adapt to climate change. The need to control the spread of Invasive Non-Native Species (INNS)	1.4 To avoid introducing or spreading INNS	• Will it introduce or allow the spread of Invasive Non-Native Species (INNS)?
Population and human health	To ensure secure, safe, reliable, dependable, sustainable and affordable	The need to ensure continued improvements in levels of health across the	2.1 To protect and enhance health and well-being (including raising awareness of	• Will it help to ensure provision of access to a secure resilient and affordable supply of drinking water

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
	supplies of water are provided for all communities and all business sectors. Increase awareness of sustainability, the true value of water and its efficient use. Promotion of well-being and healthy communities and protection from risks to these. Protection and improvement of drinking water quality.	region, particularly in urban areas and deprived areas. The need to ensure continuing safe, reliable and resilient provision of water and sewerage services to maintain health and wellbeing of the population.	the importance and value of the water environment for health and well-being).	particularly where additional water resources may not be available? • Will it help to protect or improve drinking water quality? • Will it raise awareness of the importance and value of the water environment for health and well-being? • Will it help to promote healthy communities and avoid risks to health and wellbeing (for example through nuisance or resulting from traffic or transport changes, disruption to safe and reliable water/sewerage services)? • Is it located in an area considered to be significantly more deprived than others in the region?
Population and human health	Access to high quality open spaces and opportunities for sport and recreation can make an important contribution to the health and well-being of communities. Water resources play an important role in supporting the health and recreational needs of local communities.	The need to ensure a balance between different aspects of the built and natural environment that will help to provide opportunities for local residents and tourists, including opportunities for access to, protecting and enhancing recreation resources, green infrastructure and the natural and historic environment.	2.2 To protect and enhance the water environment for other users including recreation, tourism and navigation, as well as terrestrial recreational resources (including National Trail's and Public Rights of Way).	• Will it improve access to open spaces, the natural and historic environment? • Does it protect and enhance the green infrastructure network? • Will it protect or enhance opportunities for recreation and tourist activities such as Public Rights of Way, including navigation?

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
		The need to accommodate an increasing population. Sites of nature conservation importance, heritage assets, water resources, important landscapes and public rights of way contribute to recreation and tourism opportunities and subsequently health and well-being and the economy.		
Population and human health	To provide a clean, healthy environment that benefits both people and the economy. Promotion of a sustainable economy supported by universal access to essential utility and infrastructure services. Social and economic consequences of severe droughts.	The need to ensure water supplies remain affordable especially for deprived or vulnerable communities, reflecting the importance of water and sewerage services for health and wellbeing.	2.3 To promote sustainable socio-economic development through provision of access to a resilient, high quality, sustainable and affordable supply of water over the long term.	• Will it assist in ensuring provision of essential infrastructure and services to support health and well-being and a sustainable economy?
Material assets and resource use	Promote sustainable production and consumption whilst seeking to reduce the amount of waste generated by using materials, energy and water more efficiently. Contribute to a resource efficient, green and	The need to minimise the consumption of resources, including water and energy. The need to reduce the total amount of waste produced in the region, from all sources. The need to recognise waste as a potential resource and reuse	3.1 To reduce, and make more efficient, the domestic, industrial and commercial consumption of resources, minimise the generation of waste, encourage its re-use and eliminate waste sent to landfill	• Will it minimise the use of energy and promote energy efficiency? • Will it make use of existing infrastructure? • Will it help to encourage sustainable design or use of sustainable materials (e.g. supplied from local resources)?

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
	competitive low carbon economy. Minimise the production of waste, maximise resource benefits from waste and ensure waste management is in line with the 'waste hierarchy': eliminate waste sent to landfill. Promote the sustainable management of natural resources.	waste productively where possible to support development of the circular economy. The need to reduce the proportion of waste sent to landfill.		• Will it reduce the amount of waste generated and increase the proportion sent to reuse or recycling? • Will it encourage the productive reuse of waste including energy recovery?
Material assets and resource use	Consider issues of water demand, water supply and water quality in the natural environment and ensure a sustainable use of water resources. Government expects water companies to continue reducing overall demand for water particularly in areas designated as water stressed, or where demand is above the national average. Maintain a resilient, reliable public water supply and ensure there is enough water for human uses, as well as providing an improved water environment.	The need to continue to actively control leakage from the water supply system to help reduce demand for water. Daily consumption of water resources is higher than the national average in the area and, as a water stressed area, there is a need to encourage more efficient water use.	3.2 To promote the sustainable management of natural resources including efficient water resource management and to ensure water supply for homes and industry in the area is maintained.	• Will it help to minimise the demand for resources (including water)? • Will it enable efficient water resource management to help maintain a supply-demand balance?

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
Water	Promote sustainable water resource management, including a reduction in water consumption, to meet society's needs and offer opportunities for green growth whilst protecting and enhancing the natural environment. Ensure appropriate management of abstractions and protect flow and level variability across the full range of regimes from low to high conditions.	The need to maintain the quantity and quality of groundwater resources taking into account WFD objectives.	4.1 To avoid adverse impact on surface and groundwater levels and flows, including when this impacts on habitats and/or navigation.	• Will it lead to changes in river flows, wetted width or river level? • Will it alter the flow regime or residence time of surface waters? • Will it lead to changes in groundwater levels and recharge?
Water	Maintain and improve water quality (surface waters, groundwater and bathing water). Expand the scope of water quality protection measures to all waters, surface waters and groundwater. Improve the quality of the water environment and the ecology which it supports, and continue to provide high levels of drinking water quality. Prevent deterioration of waterbody status and contribute to achievement of WFD Good Status.	The need to further improve the quality of the regions' river and estuarine waters taking into account WFD objectives. The need to maintain the quantity and quality of groundwater resources taking into account WFD objectives.	4.2 To protect and enhance surface and groundwater quality and protect and enhance estuarine waterbodies.	• Will it affect WFD compliance e.g. good ecological potential/status, prevent deterioration of WFD status between status classes? • Will it present a risk to water quality of groundwater, surface waters or estuarine waters? • Will it prevent water pollution? • Will it affect water quality compliance

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
Water	Balance the abstraction of water for supply with the other functions and services the water environment performs or provides. Ensure appropriate management of abstractions and protect flow and level variability across the full range of regimes from low to high conditions. Support achievement of River Basin Management Plan objectives.		4.3 To ensure appropriate and sustainable management of abstractions to maintain water supplies whilst protecting ecosystem functions that rely on water resources, including contributing to the achievement of WFD objectives	• Will it ensure sustainable abstractions, taking account of water resources availability status? • Will it affect WFD protected areas? • Will it prevent the introduction of impediments to the attainment of WFD good status or potential? • Will it achieve an appropriate balance of supply with other functions and services (including agriculture)? • Will it contribute to meeting society's needs for a sustainable, resilient water supply?
Water	Develop a resilient and flexible water management approach to cope with changing climate, population and economic conditions. Options for long term water needs include strategic supply options; twin tracking demand management, new resources and regional transfers; increased use of demand management and leakage reduction; and promoting and enabling transfers. Promote measures to enable and sustain long-term improvement in water efficiency.	The need to improve the resilience, flexibility and sustainability of water resources in the region, particularly in light of potential climate change impacts on surface water and groundwater. The need to ensure sustainable abstraction to protect the water environment and meet society's needs for a resilient water supply	4.4 To promote measures to enable and sustain long term improvement in water efficiency.	• Will it promote measures to enable improvements in water efficiency and assist in balancing supply and demand? • Will it contribute towards improving the awareness of water sustainability and its true value?

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
	Ensure a sustainable balance between the supply and demand for water.	The need to ensure that people understand the value of water.		
Water	Steer new development to areas with the lowest probability of flooding and manage any residual flood risk, taking account of the impacts of climate change. Reduce flood risk to people, residential and non-residential properties, community facilities and key transport links, as well as designated nature conservation sites and heritage assets and landscapes of value. Reduce risk of flooding from reservoirs.	The need to reduce and manage flood risk.	4.5 To reduce or manage flood risk.	• Will it avoid reducing flood plain storage, or provide opportunities to improve flood risk management?
Soil, geology and land use	Protect and enhance the quality and diversity of geology (including geological Sites of Special Scientific Interest (SSSIs)) and soils including geomorphology and geomorphological processes, which can be lost or damaged by insensitive development. Promote mixed use developments, and encourage	The need to protect geological features of importance (including geological SSSIs) and maintain and enhance soil function and health. The need to make use of previously developed land (brownfield land) and to reduce the prevalence of derelict land in the region.	5.1 To protect and enhance geology, geomorphology, and the quality and quantity of soils.	• Will it avoid damage to and protect geologically important sites? • Will it protect and enhance geomorphology and geomorphological processes? • Will it protect and enhance the quality of soils? • Will it protect and enhance geological SSSIs or similar nationally protected sites?

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
	multiple benefits from the use of land in urban and rural areas, recognising that some open land can perform many functions. Encourage the effective use of land by reusing land that has been previously developed (brownfield land), provided that it is not of high environmental value. Minimise coastal erosion. Conservation and enhancement of geological SSSIs.			
Soil, geology and land use	Ensure that soils will be protected and managed to optimise the varied ecosystem service functions that soils perform for society (e.g. supporting agriculture and forestry, protecting cultural heritage, carbon sequestration, supporting biodiversity, as a platform for construction), in keeping with the principles of sustainable development.		5.2 To protect and enhance the ecosystem services functions of land, soils and geology, including carbon sequestration, flood attenuation, pollutant filtration and nutrient cycling.	• Will it ensure efficient use of land (e.g. make use of previously developed land)?

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
	Promote catchment-wide approach to land management by relevant stakeholders, in order to benefit natural resources, reduce pollution and develop resilience to climate change.	The need to manage the land more holistically at the catchment level, benefitting landowners, other stakeholders, the environment and sustainability of natural resources (including water resources).	5.3 To promote a catchment-wide approach to catchment land management	• Will it contribute towards a catchment-wide approach to land management?
Air and Climate	Reduce the effects of air pollution on ecosystems. Improve overall air quality. Sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas.	The need to reduce air pollutant emissions (industrial processes/transport) and limit air emissions to comply with air quality standards.	6.1 To reduce air pollutant emissions.	• Will it reduce or minimise air pollutant emissions? • Will it increase emissions to air in an areas sensitive to emissions (e.g. in proximity to an AQMA or to sensitive habitat or more deprived area)? • Will it reduce transport or energy requirements?
Air and Climate	Reduce greenhouse gas emissions. Targets include: reduce the UK's greenhouse gas emissions by at least 80% (relative to 1990 levels) by 2050 and cut London's CO2 emissions by 60% by 2025.In Wales at least an 80% reduction in emissions by 2020. Minimise energy consumption, support the use	The need to reduce greenhouse gas emissions (industrial processes and transport).	6.2 To reduce greenhouse gas emissions.	• Will it reduce or minimise greenhouse gas emissions? • Will it reduce transport or energy requirements?

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
	of sustainable/renewable energy and improve resilience to climate change.			
Air and climate	Build in adaption to climate change to future planning and consider the level of urgency of associated risks of climate change impacts accordingly. Need for adaptive measures to respond to likely climate change impacts on water supply and demand.	The need to mitigate climate change effects through the reduction in greenhouse gas emissions and thereby contribute to risk reduction over the long term. The need to adapt to the impacts of climate change for example through, sustainable water resource management, water use efficiencies, specific aspects of natural ecosystems (e.g. connectivity) as well as accommodating potential opportunities afforded by climate change.	6.3 To adapt and improve resilience to the threats of climate change.	• Will it reduce vulnerability to risks associated with climate change effects (e.g. reduce the adverse effects of droughts and floods)? • Will it improve resilience/adaptability to likely effects of climate change, e.g. by increasing resilience of water supplies? • Will it create opportunities to benefit from potential effects of climate change? • Will it make use of renewable energy?
Archaeology and Cultural Heritage	Built development in the vicinity of historic buildings and Scheduled Monuments could have implications for the setting and/or built fabric and cause damage to any archaeological deposits present on the site.	The need to conserve or enhance sites of archaeological importance and cultural heritage interest, particularly those which are sensitive to the water environment.	7.1 To conserve and enhance the historic environment, heritage assets and their settings, and protect archaeologically important sites.	• Will it avoid damage to and protect the historic environment, heritage assets and their settings, places and spaces that enhance local distinctiveness? • Will it maintain and enhance the historic environment, including palaeo-environmental deposits? • Will the hydrological setting of water-dependent assets be altered, such

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
	Ensure active management of the Region's environmental and cultural assets. Ensure effects resulting from changes to water level (surface or sub-surface) on all historical and cultural assets are avoided. Consider effects on important wetland areas with potential for paleo-environmental deposits. Promote the conservation and enhancement of the historic environment, including the promotion of heritage and landscape as central to the culture of the region and conserve and enhance distinctive characteristics of landscape and settlements. Conserve and enhance the historic environment, heritage assets and their settings. Protect, enhance and manage the character and appearance of historic and cultural assets and their settings including maintaining and strengthening local distinctiveness and sense of place.			as important wetland areas with potential for paleo-environmental deposits? • Will it improve access, value, understanding or enjoyment of heritage assets and culturally/historically important assets in the region?

SEA topic	Policies, plans and programmes - key objectives relevant to the WRMP	Baseline - key issues relevant to WRMP	SEA objective	Key indicator questions
Landscape and Visual Amenity	Protection and enhancement of landscape (including designated landscapes, landscape character, distinctiveness and the countryside) Take account of the distinctive landscape features and character, promoting the vitality of main urban areas, protecting the Green Belts around them, recognising the intrinsic character and beauty of the countryside and supporting thriving rural communities within it. Enhance the value of the countryside by protecting the natural environment for this and future generations. Improve access to valued areas of landscape character in sustainable ways to enhance its enjoyment and value by visitors and stakeholders.	The need to protect and improve the natural beauty of the region's AONBs, National Parks and other areas of natural beauty. The need to protect and improve the character of landscapes and townscapes.	8.1 To protect, enhance the quality of and improve access to designated and undesignated landscapes, townscapes and the countryside.	• Will it avoid adverse effects and enhance designated landscapes? • Will it help to protect and improve non-designated areas of natural beauty and distinctiveness (e.g. woodlands) and avoid the loss of landscape features and local distinctiveness? • Will it improve access to valued areas of landscape character?

5.2 Interactions Between Objectives

Schedule 2, paragraph 6 of the SEA Regulations requires that the inter-relationship between the issues referred to between SEA topics shall be explored. In most cases either no interactions occur, or the interactions are identified as compatible.

A potential conflict is identified between the objective to promote efficient use of water and the objective to improve human health and wellbeing and reduce inequalities. This reflects the potential for strategies such as water metering to exacerbate inequalities by disproportionately impacting low income or vulnerable customers. Thames Water considers metering to be important part of its overall strategy for helping customers to understand the value of water and for incentivising water efficiency. However, Thames Water also recognises the need to protect vulnerable and low income customer groups and has already introduced a programme of measures to protect vulnerable customers in conjunction with its increased metering activities.

The matrix identifies a mixed interaction, with both potential compatibility and incompatibility, between the objectives to reduce and manage flood risk and objectives to maintain landscape quality. Flood risk management infrastructure could be a positive or adverse influence on landscape, depending on the specific management solutions implemented (e.g. concrete walls and straightened river channels or catchment management measures). A similar mixed interaction is identified between the objectives to provide climate change resilience and to maintain landscape quality; some infrastructure developments designed to increase resilience could be considered a positive or negative influence.

5.3 Assessment framework

The SEA assessment framework (see **Table 5.2**) has been used to assess each of the option elements, and subsequently options and programmes against the SEA objectives (as set out in **Table 5.1**). The framework has been applied to test the performance of the option elements, options, alternative programmes, final preferred programmes and the WRMP19 as a whole against the SEA objectives to see how far they meet these objectives. The performance findings were used to inform Thames Water's decision-making and finalisation of the WRMP19. Completed assessment frameworks for each of the option elements are provided in **Appendix E** and completed assessment frameworks for each of the options within the preferred programmes are provided in **Appendix F**.

The first and second columns of the assessment framework set out the SEA topics and objectives. The third column provides commentary and evaluation of the effects of the option on the SEA objectives for each topic, with reference to the key questions (outlined in **Table 5.1**). This commentary includes key details that underpin the assessment against that SEA objective, providing transparency as to how the significance of effects has been assessed. The commentary includes details of any best practice to be applied in implementing the option element, option, programme or plan (e.g. best practice construction methods), together with details of any mitigation included within the design and cost of the activity and how these have reduced any adverse effects. By including planned mitigation in the design, the assessed effects are referred to as "residual effects after planned mitigation".

The eighth column identifies the magnitude of effect. The effect magnitude includes consideration of the scale of the impact, certainty of the effect, duration and permanence (fourth, fifth, sixth and seventh columns of Table) in compliance with criteria for determining the likely significance of effects specified in the SEA Directive Article 3(5) and Annex II of the SEA Regulations Part 2, Regulation 9(2a) and Schedule 1. The value and sensitivity of the receptor(s) is identified in the ninth column. The scale of effect, which might relate to either geographical scale or the size of the population affected is identified in the fourth column. The fifth column addresses certainty of effect. Varying levels of uncertainty are inherent within the assessment process. The assessment has minimised uncertainty through the application of expert judgement. The level of the certainty of effects is identified within the SEA assessment tables. There is a column headed "certainty of effect" which has been assessed on a scale from 'low' to 'high' certainty, and therefore recognises that some effects are more certain than others. In determining the certainty of the effect regard is given to the level of information available having consideration of the need for options to be assessed equally and to avoid duplication of assessments if more appropriately assessed at a different stage of the decision-making process. With respect to duration, short-term effects are those that last up to six months, medium-term effects are those that extend beyond six months to two years, whilst long-term effects are assessed as those that continue for greater than two years. A "significant long term" temporary impact category is used for those temporary effects that continue beyond five years in duration.

The residual adverse and beneficial effects (after application of best practice approaches and any planned mitigation measures) are identified in the tenth and eleventh columns respectively. In line with best practice, the adverse and beneficial effects are assessed and reported separately for all the assessment stages (option element, option, programme and plan level) so that these can clearly be understood and transparency of effects is maintained throughout the WRMP decision-making process.

Where qualitative and/or quantitative information was available (e.g. as identified by the HRA or WFD assessment process, conceptual design information, public domain datasets), this has been used to inform the assessment. Objectives or key questions that are not supported by available data or information have been evaluated using spatial analysis, professional judgement and applicable assessment guidelines relating to that topic/objective.

Table 5.2 SEA assessment framework (column headings) completed for each potential Water Resources Management Plan option / programme

Topic	Objective	Potential residual effect on sensitive receptors (assuming good practice construction methods) Commentary	Scale of effect: geographical &/or population affected (small /medium/ large)	Certainty of effect (low/ moderate/ high)	Short-term/ medium-term/ long-term	Permanence of effect (permanent/ temporary)	Magnitude of effect (low/ medium/ high)	Value/ sensitivity of receptor (low/ medium/ high)	Residual Effect significance (negligible/ minor adverse/ moderate adverse /major adverse)	Residual Effect significance (negligible/ minor beneficial/ moderate beneficial/ major beneficial)

For each SEA objective, a residual effects assessment was determined against a significance of effects matrix (**Figure 5.1**) which takes into account the value/sensitivity of the receptor (e.g. species, air quality, river water quality, landscape value, heritage feature) and the magnitude of the assessed effect. It is important to note that the effects assessment was carried out after consideration of the application of mitigation measures relating to each option and so it is the residual effects that were assessed after the benefits of the mitigation measures.

The significance of effects matrix (**Figure 5.1**) comprises effects on a scale ranging from 'major beneficial' to 'major adverse'. For the box signifying low magnitude and high receptor value/sensitivity, this could result in a greater than 'moderate' effects being assigned dependent on the sensitivity/value of the receptor. This colour coding was used to populate the columns identifying residual effects in the assessment framework.

The resulting significance of effects has been used in enabling Thames Water to consider environmental effects in reaching decisions on which options to include in the WRMP19 and the subsequent timing and phasing of the selected options. Where major adverse effects are predicted, measures envisaged to prevent, reduce (and as far as possible, offset) these effects on the environment (as a result of implementing the option) are outlined where relevant/appropriate.

Figure 5.1 Significance matrix

Significance of Effect		Value/sensitivity of receptor		
		High	Medium	Low
Effect magnitude (includes scale of effect)	High	Major Beneficial / Major Adverse	Major Beneficial / Major Adverse	Moderate Beneficial / Moderate Adverse
	Medium	Major Beneficial / Major Adverse	Moderate Beneficial / Moderate Adverse	Minor Beneficial / Minor Adverse
	Low	= Significance of effect dependent on value/sensitivity of receptor and magnitude	Minor Beneficial / Minor Adverse	Negligible

The definitions for 'significance' ratings as identified in the table above are provided below:

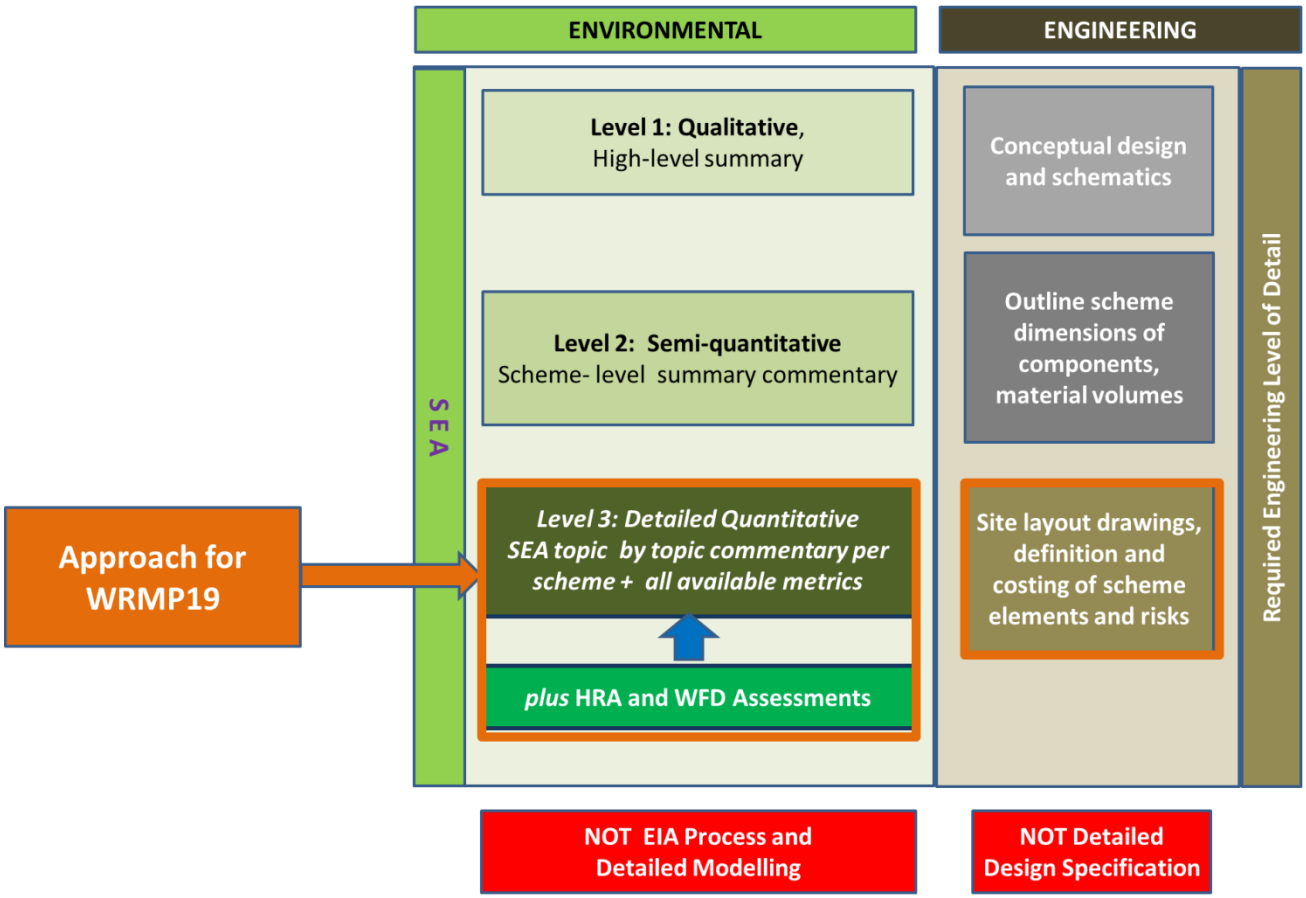
- **Major** - effects constitute key factors in the decision-making process. They are generally associated with sites and features of international, national or regional importance. If adverse, such resources/features affected are generally those which cannot be replaced or relocated.
- **Moderate** - effects are likely to be important considerations at a regional or district scale. If adverse, they are likely to be of potential concern.
- **Minor** - effects are not likely to be decision-making issues. Nevertheless, the cumulative effect of such issues may lead to an increase in the overall effects on a particular area or on a particular resource.
- **Negligible** - effects which are not perceptible, being within normal bounds of variation or the margin of forecasting error.

For the '**high' effect magnitude** (top row), a major effect significance is assigned for both high and medium value receptors to reflect the magnitude of the effect.

For the **'low' effect magnitude and 'high' value receptor** (bottom left box), the significance of effect could be moderate or major dependent on the precise nature of the impact or benefit.

All option elements and options – both supply options and demand management options – are assessed by the SEA and to the same level of detail, in line with the SEA legislative requirements, national SEA guidance and the UKWIR SEA guidance. The level of detail used in the environmental assessment of each option is summarised in **Figure 5.2**, consistent with the strategic nature of SEA. This shows the adoption of an advanced level of qualitative assessment which is informed by detailed quantitative data within the boundaries of the SEA process, but which importantly does not stray into the statutory EIA process. This is consistent with national guidance on the applicability of SEA and EIA.

Figure 5.2 Level of Detail Applied for Assessment of Options and Programmes in SEA for WRMP19



The assessment involved quantitative analysis of environmental and social effects as appropriate, informed by the availability of accepted assessment methods and associated data requirements. The analysis methods used a detailed suite of environmental and social datasets that were available at a consistent quality across the geographical footprint of all the options under consideration.

The assessment relates to information available in order to undertake a strategic level assessment in a consistent manner across the geographical area concerned. For example, assessment of the potential impacts on protected species will be carried out as the option is taken forward for detailed design and environmental surveys are carried out for protected species to inform the assessments. This approach is supported in national guidance[25] and it is noted that in this case it has been

[25] For example the ODPM guidance on SEA.

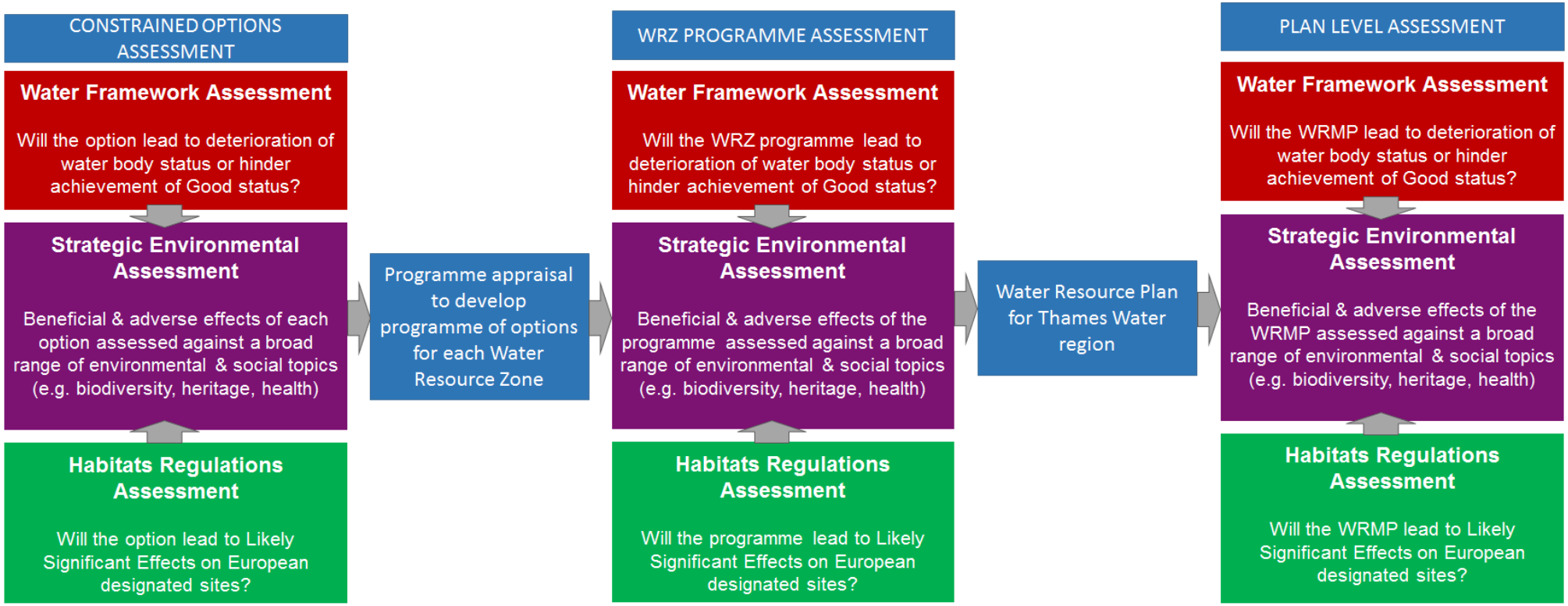
accepted by Natural England. In response to the draft WRMP19[26] Natural England stated that it: "accepts that it is difficult to make a meaningful assessment [on protected species] as part of a strategic plan such as this. However, such assessment will be required as plans for options are taken forwards".

Figure 5.3 confirms that the HRA and WFD assessments also informed the assessments at each key stage of the SEA from the assessment of the Constrained List option elements to the alternative programmes and the preferred programmes making up the WRMP19.

Section 6 provides further details on the overall SEA approach for the WRMP19.

[26] Thames Water (2018). WRMP19: Statement of Response. September 2018.

Figure 5.3 Integrating HRA and WFD into the SEA



In addition to the HRA and WFD assessments, assessment has been carried out and specifically reported within this SEA Environmental Report (in **Appendix H**) as to the effects from the preferred programme on any SSSI as agreed in dialogue with Natural England. This effects assessment takes account of the conservation objectives established for the relevant SSSI in consultation with Natural England. This is in line with the WRPG[27] which states that companies must "ensure compliance with other legally binding environmental objectives (e.g. those for non-Natura 2000 SSSIs)". Effects on other designated sites set out in the WRPG are also specifically reported in the SEA: National Nature Reserves; Local Nature Reserves; local wildlife sites; marine conservation zones; Scheduled Ancient Monuments; World Heritage Sites; National Parks; European Landscape Convention; Areas of Outstanding Natural Beauty.

Effects on Marine Conservation Zones are reported in Section 9 in line with specific advice provided to English water companies by Natural England.

5.3.1 Dealing with the long-term nature of the WRMP19

As previously discussed, the WRMP19 extends over an 80 year planning horizon. This places a challenge to setting out the future baseline against which options are appraised and is further complicated by the fact that the precise timing of option implementation is not known during the option element assessment phase (as this is only determined at the programme appraisal stage). To address this issue, the best currently available information and projections have been used or assumptions made (in the absence of projections) about the likely changes to the social and environmental characteristics of the relevant geographical area over the planning horizon against which option-level assessments are carried out. This includes known or highly likely changes to the water resources baseline linked to Thames Water's existing confirmed plans (e.g. reduction in leakage and increased metering of household customers).

At the programme appraisal stage, the suite of options included in the reasonable alternative programmes assessed under the SEA (and the plan as a whole) have been subject to additional scenario testing to understand how the programme and plan might differ with different demand and/or supply assumptions (for example, WFD-driven reductions to the reliable supply from water sources or changes to assumed bulk supply requirements from neighbouring water companies). Findings from this sensitivity testing are reported in Section 7 of this Environmental Report.

5.3.2 Summarising the effects assessment

The completed assessment framework table for each option element as well as each option identified in the alternative programmes considered in the overall WRMP19 are presented in full in **Appendices E and F**. A summary of the assessments are presented within the main text of this Environmental Report as colour-coded visual evaluation matrices.

The effects (beneficial or adverse) of any interactions between SEA topics are also identified, assessed and reported.

5.4 Secondary, Cumulative and Synergistic Environmental Effects

Schedule 2(6) of the SEA Regulations requires the assessment of "The likely significant effects on the environment, including short, medium and long-term effects, permanent and temporary effects, positive and negative effects, and secondary, cumulative and synergistic effects…." These can be defined as follows:

[27] Defra, Welsh Government, Ofwat, Environment Agency, Natural Resources Wales (2017) Water Resources Planning Guideline: interim update. July 2018

- Secondary or indirect effects are effects that are not a direct result of the plan, (e.g. an abstraction that changes local groundwater levels and thus affects the ecology of a nearby wetland).
- Cumulative effects arise, for instance, where several nearby groundwater sources each has insignificant effects but together they have a measurable effect on river flows; or where several individual effects of a water resource zone programme (e.g. traffic disruption) have a combined effect.
- Synergistic effects interact to produce a total effect greater than the sum of the individual effects. Synergistic effects often happen as habitats, resources or human communities get close to capacity. For instance, a wildlife habitat can become progressively fragmented with limited effects on a particular species until the last fragmentation makes the areas too small to support the species at all.

The term 'cumulative effects' is being adopted as the collective term to include secondary, cumulative and synergistic effects (as suggested by the Practical Guide). The SEA of the WRMP19 includes cumulative effects assessment at the programme level and for the overall draft Plan. It should be noted that some options may be mutually exclusive (i.e. only one of these options can be developed) and this is recognised in the identification of options within the alternative programmes assessed. The cumulative effects include consideration of the environmental effects of other plans, programmes and projects in the context of spatial and/or temporal proximity.

A matrix (**Figure 5.4**) has been used to aid consideration of interactions between options within programmes and details of potential cumulative effects (both during construction and/or operation) between options is provided in **Appendix G**. In assessing these cumulative effects, consideration is given to other factors which may affect the receiving environment in the short, medium and long term.

Figure 5.4 Example Cumulative Effects Assessment Matrix

1					
2					
3					
4					
5					
WRMP Options	1	2	3	4	5

	Potential cumulative construction effects if constructed simultaneously
	Potential cumulative effects in operation
	Potential cumulative construction and operational effects if constructed simultaneously
	No cumulative effects

To meet the requirements of the SEA Directive, the cumulative effects assessment includes determination of the likely significant environmental effects of the WRMP19 in combination with those of other relevant plans, programmes or projects, including Thames Water's revised draft Drought Plan 2018 and neighbouring water companies' WRMPs and Drought Plans.

Cumulative effects with non-water resources related plans, programmes and projects have been assessed where relevant in Section 8 of this Environmental Report, including existing completed projects, approved but uncompleted projects, ongoing activities, plans or projects for which an application has been made and which are under consideration by consenting authorities and plans and projects which are reasonably foreseeable (i.e. projects for which an application has not yet been submitted, but which are likely to progress before completion of the development and for which sufficient information is available to assess the likelihood of cumulative and in-combination effects). Sources of information include the following:

- Land use and development plans to identify major development proposals (those which are likely to generate large scale construction or operational effects e.g. growth points, strategic centres,

infrastructure projects (e.g. HS2 and CrossRail), and other schemes within 10km of each scheme;

- Opportunity areas (e.g. in the London Plan, major areas of 'brown' field land are identified with the capacity to accommodate new housing, commercial and other developments);
- Areas for intensification (e.g. in Greater London areas are identified that can support redevelopment at high densities but at a level below that of Opportunity Areas);
- Other infrastructure projects (e.g. flood risk management schemes and transport schemes).

The following cumulative assessments have been undertaken:

- Within each WRZ programme, assessment of cumulative effects of options that could potentially be implemented at the same time (intra-zone). Mutually exclusive options (e.g. those that draw upon the same resource or use the same site) are also identified.
- Between each WRZ programme, assessment of cumulative effects of options (inter-zonal) that could potentially be implemented at the same time across the entire WRMP19.
- Assessment of cumulative effects of the Thames Water WRMP19 preferred programme with the Thames Water revised draft Drought Plan 2018, other water company Drought Plans and WRMP19s, the Environment Agency National Drought Plan (and any other drought plans prepared by other bodies, such as the Canal & River Trust).
- Assessment of potential cumulative effects of the Thames Water WRMP19 preferred programme with any other identified relevant programmes, plans and projects that may be in place / implemented during the period of the WRMP.

5.5 Environmental metrics

In order to incorporate environmental and social considerations directly into the Thames Water programme appraisal optimisation model – which were used to inform the selection of a short-list of reasonable alternative programmes and scheduling of options –an approach was developed to summarise the environmental and social performance of each option element in the Constrained List in numerical form, as necessary for a mathematical optimisation model. The numerical summaries are called 'environmental and social metrics'. These environmental and social metrics were derived from assessments of all of the individual option elements in the constrained list as presented in **Appendix E**. The metric scores in themselves were generated solely for the programme appraisal modelling and were not used in the SEA of the programme options. The metrics were unable to consider cumulative effects or the effects of options (combinations of elements) and so need to be seen as relative indicators only. However, they provide an important tool to ensure that the environment was not left out of the programme appraisal modelling.

As shown in Figure 5-5, the environmental and social metrics are based on a grading scale of 0 to +10 (for characterising beneficial effects) and 0 to -10 (to characterise adverse effects), with 0 characterising negligible effects. These numerical summary values are not a means of accounting for the SEA in the programme appraisal; however, they inform the relative performance of each of the option elements and are a tool to provide an input to the mathematical optimisation model.

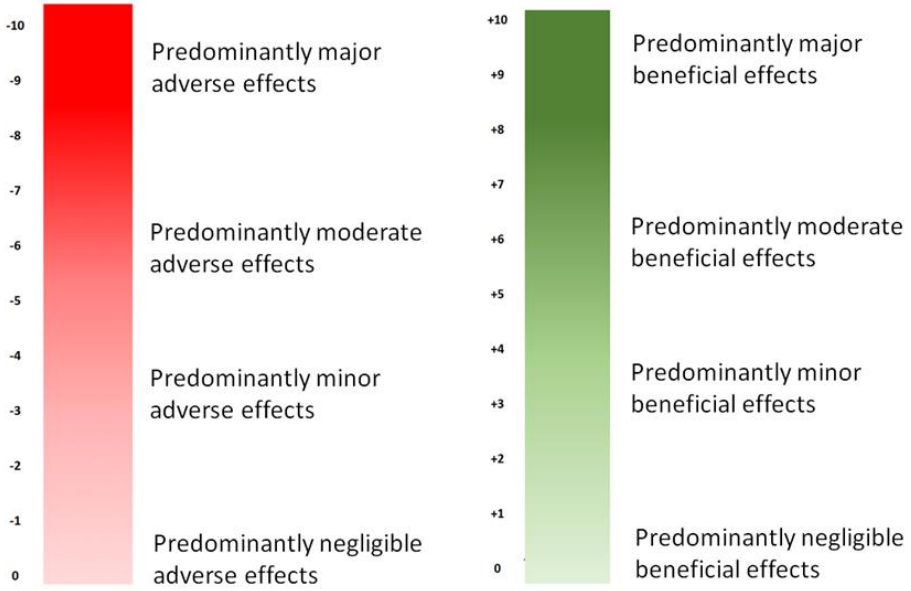
Importantly, the metrics were derived directly from the findings of the SEA, HRA and WFD assessments. As shown in Figure 5-5, the SEA findings of significance of effect (e.g. moderate adverse, minor beneficial) were used to determine the appropriate metric grading.

As with the SEA, the metrics also keep the beneficial and adverse effects separate so as to avoid 'mixing' (or trading) of the beneficial and adverse effects within the model; this also enabled scenarios to be run within the programme appraisal model to investigate reasonable alternative programmes that maximise benefits or minimise adverse effects to inform decision-making. Whilst the initial shortlisting of the reasonable alternative programmes for further consideration had regard to the environmental metrics of each option included the programmes to help identify relative environmental

risks and benefits, the full SEA option element assessments (as discussed in Section 6 of this report and presented in **Appendix E**) were also used to aid decision-making on the selection of the short-list of alternative programmes for further investigation and assessment.

Following this short-listing process, each of the options identified in the reasonable alternative programmes and the programmes themselves were assessed through the SEA process. This enabled the relative performance of each alternative programme against SEA objectives to be considered, with regard being given to potential cumulative and in-combination effects of the components of the options. SEA assessment of the options in the preferred programme as well as the programme itself was also undertaken.

Figure 5-5: Environmental metrics: grading of effects



Options comprise of one or more option elements (e.g. an option might comprise a source option element, a pumping station and pipeline element and a water treatment work element). Section 7 of this Environmental Report provides the findings of these assessments whilst **Appendix F** provides the individual assessments of each of the options.

In response to feedback received on the draft methodology for the use of the environmental metrics as part of the stakeholder consultation on environmental assessment of the WRMP19, it was agreed with stakeholders that in order to reflect the importance of international level environmental protection under EU or international law, major adverse impacts on internationally important sites, habitats or species would be reflected in the grading system of the environmental metrics.

Where the SEA (and HRA and WFD) assessments indicated that an option element would cause intractable issues or would be unmitigable and would likely lead to adverse effects on a European site (after consideration of mitigation measures in an Appropriate Assessment), and/or would lead to likely permanent deterioration of WFD status between status classes, the adverse effects grading was automatically assigned at the grading of -9. The -9 adverse effects grade reflects the fact that these options would be unlikely to be acceptable when compared to other available alternative options and therefore carry a “penalty” grading for the adverse effects metric. Generally, such options were rejected at the Feasibility Assessment stage, but a small number of options are included on the Constrained List of options where uncertainty led to the assignment of the -9 grade, essentially flagging a risk that more detailed investigations may conclude the option element would not be considered suitable for inclusion in the preferred programme.

Where an early assessment of the option elements identified possible risk of adverse effects to European sites or possible WFD status deterioration (after consideration of mitigation measures), a

penalty grading of -7 was applied to the adverse effects metric. This grading of -7 applies where it was recognised that although mitigation is still considered possible there could be significant challenges after mitigation to conclude no adverse effects on European sites or deterioration of WFD status between status classes. With regard to WFD this related to an uncertain finding in the WFD assessment where uncertainties were considered likely and where there could be challenges in ensuring no adverse effects through the application of mitigation measures. This did not include all elements where an uncertain finding in the WFD report was identified, with some uncertain findings recognising a level of uncertainty which would be expected with further evidence to provide mitigation measures that will avoid WFD status deterioration. For the HRA assessment this comprised option elements where, when based on the evidence available at HRA Stage 1 screening, Appropriate Assessment would be required and where there could be challenges in ensuring no adverse effects through the application of mitigation measures.

This approach to compliance with EU or international law as part of the option element assessment process allowed for such issues to be considered and flagged at an early stage, and for the metric grades to flag these issues within the programme appraisal model.

In response to the CJEU judgment on "People Over Wind"[28], and as agreed at a consultation meeting with Natural England held on 13th June 2018, any initial screening that previously relied on mitigation measures to conclude no Likely Significant Effect has been amended in the updated HRA report to recommend Stage 2 Appropriate Assessment if it is included in the preferred programme. However, where mitigation measures had already been identified to ensure no Likely Significant Effect prior to the CJEU judgment for the draft WRMP19, no application of the -7 metric had been applied. The application of a -7 metric was applied where the outcome of the HRA screening had identified a requirement for Appropriate Assessment, for example, due to a lack of current available information the need to undertake further investigations. In these instances, this did not preclude that option element from consideration in the Constrained List, but did flag at an early stage a potential uncertainty or issue that requires further examination of the uncertainties and consideration of additional mitigation measures.

By including the environmental metrics in the programme appraisal model, the relative environmental performance of each option element could be taken explicitly into account within the model optimisation process to select a range of alternative programmes for each WRZ. Further details on the programme appraisal modelling are provided in Section 10 of the WRMP19.

In order to avoid “double-counting” of the carbon effects, the environmental metric excludes consideration of carbon externalities as these were reflected as monetary (£) values in the programme appraisal model in line with government guidance on carbon pricing.

It is important to note that these environmental metrics were only used to inform the programme appraisal model (a numerical model requiring numerical values to represent the environmental effects) and enabled the model to hold information on the environmental effects of each option element alongside other optimisation criteria (e.g. cost, resilience of each option element, etc.). The environmental metrics are not determinative in themselves, rather they were generated to enable inclusion of environmental and social factors into the mathematical model to assist the short-listing of programmes.

The environmental metrics were not a substitute for carrying out full SEA, HRA and WFD assessments on the options determined from the programme modelling that were included in the WRZ reasonable alternative programmes. Indeed, environmental metrics were not derived for the options. Following the short-listing process which included consideration of the full SEA, HRA and WFD option element assessments, each of the short-listed reasonable alternative programmes was assessed through the SEA process. Full SEA, HRA and WFD assessments were undertaken on the options determined from the programme modelling that were included in the short-listed programmes. These detailed assessments informed the decision-making on the “best value” preferred programme

[28] Case C-323/17 (*People Over Wind*).

– not the environmental metric. Further details on the option assessments are provided in Section 6 of this Report.

Regulation 8 of the SEA Regulations requires account to be taken of the Environmental Report for the plan or programme. Schedule 2 of the SEA Regulations requires an Environmental Report to provide information about the way in which environmental protection objectives and any environmental considerations have been taken into account during the preparation of the plan or programme. Further details on how the SEA has influenced the choice of the preferred programme is therefore provided in WRMP19 and Section 7 of this Report. Further details on the programme appraisal modelling and the way in which the choice of the preferred programme was made are provided in Section 10 of the WRMP19.

5.6 Limitations of the study

SEA is a strategic assessment aimed at highlighting potential environmental concerns. The environmental data used in this assessment are based on those that are readily available from existing sources. Limitations in undertaking this SEA included the requirement to rely on conceptual designs appropriate to a strategic plan and which therefore have a lower level of detail to inform assessment of very specific impacts on specific receptors. Assessment of impacts is necessarily limited when, for example, pipeline routes are at the outline conceptual design stage only.

The assessments undertaken do not stray into the statutory EIA process and it is recognised that if schemes are progressed, there would be more detailed assessment work (including EIA where relevant) to support the detailed design as well as any subsequent planning application and that further engagement with stakeholders would be undertaken during this period.

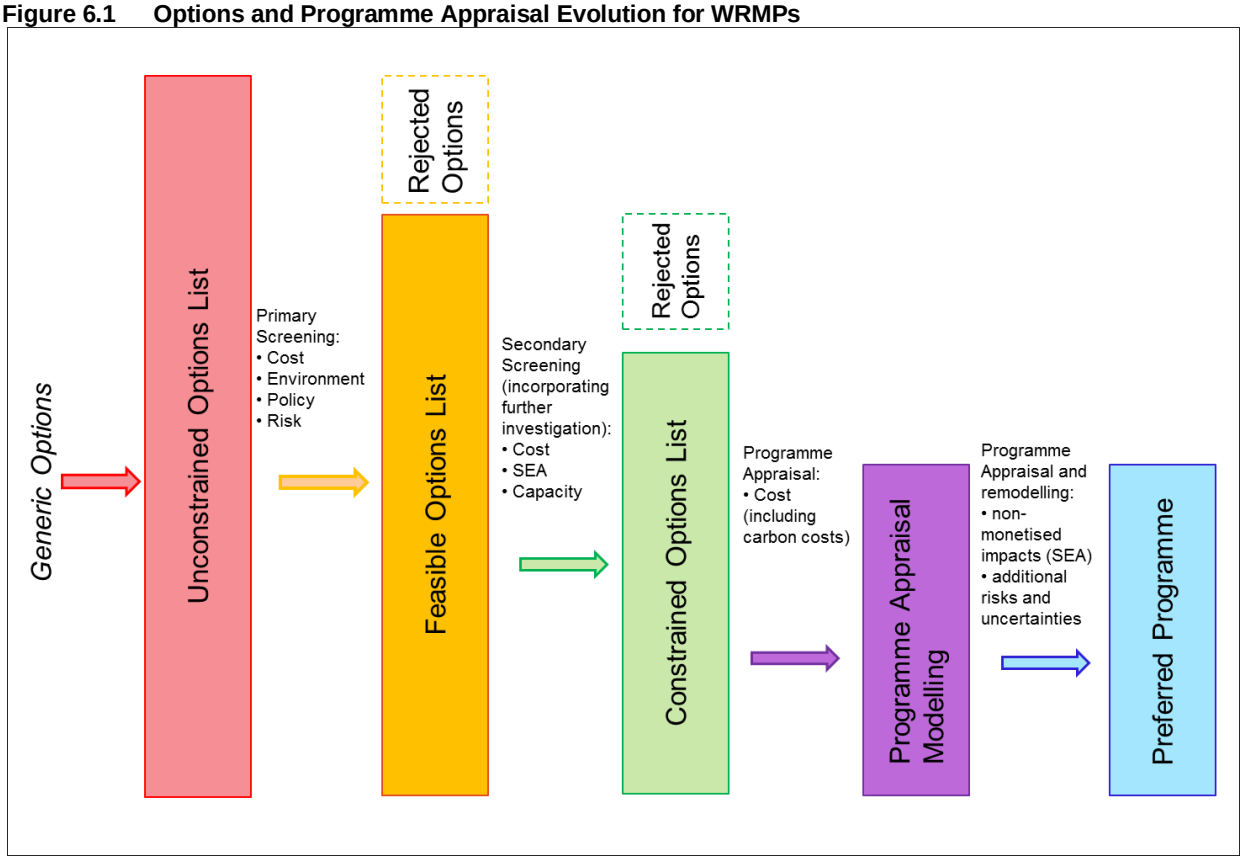
Where particular limitations or outstanding issues are known, these are described in the SEA appraisal tables for the relevant option concerned.

6 SEA of Options

6.1 Introduction

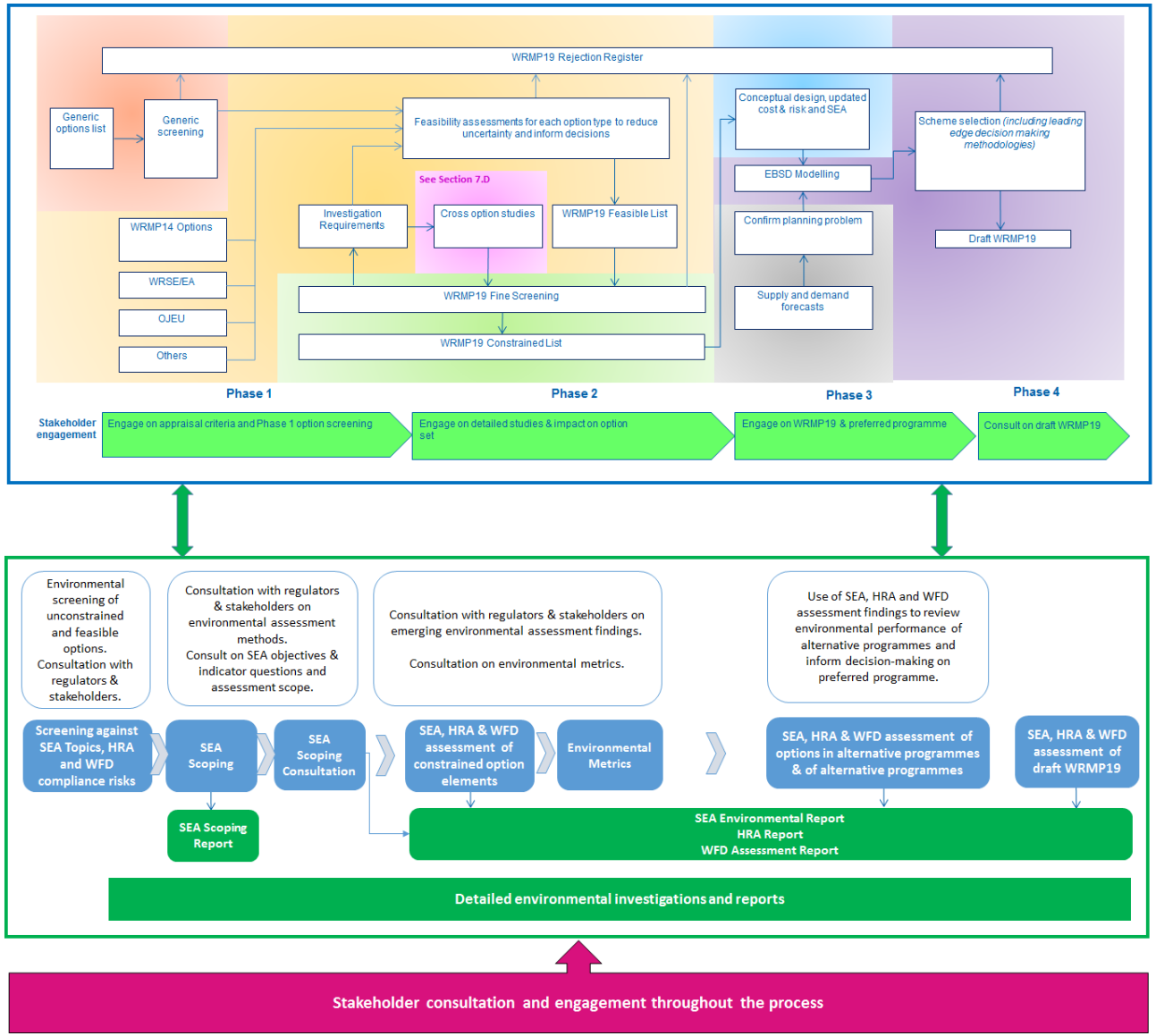
The UKWIR Guidance on integrating SEA into WRMPs provides clear directions as to how SEA outputs should be used in options and programme appraisal. **Figure 6.1** summarises the overall approach to the evolution of the WRMP from initial "unconstrained" list of options through to the preferred programme for each WRZ and the WRMP19 as whole.

Figure 6.1 Options and Programme Appraisal Evolution for WRMPs



Options appraisal is an overarching term for the specification and assessment of options under consideration for the development of the WRMP19. SEA has played an important role in options appraisal; Thames Water considered SEA topics (and HRA and WFD compliance criteria) from the very outset of the development of the WRMP19, starting with the initial screening assessment of a large number of 'unconstrained' options. SEA, HRA and WFD screening of these options was used to help develop a smaller 'feasible' list of options and, through further SEA criteria (and HRA and WFD compliance criteria), options which were found to have unacceptable adverse effects were rejected from the options "pool". **Figure 6.2** summarises these key initial stages of assessment prior to the assessment of the Constrained Options list reported in this Environmental Report.

Figure 6.2 Overall environmental assessment approach: from the Unconstrained Options list to the Constrained Options list



Remaining 'constrained' list of options were subject to detailed SEA (and HRA and WFD assessment) and included within the Thames Water programme appraisal model (see Section 7). An option rejection register has been compiled by Thames Water to explain why options were removed from further evaluation at each of these option assessment stages.

Table 6.1 summarises the broad range of option types considered for inclusion in the WRMP19.

Table 6.1 Generic Options Considered by Thames Water for the WRMP19

Generic option	Sub-option
Raw water transfers	Transfer of partially treated water to the River Thames catchment from the River Severn catchment or other catchments, including options with reservoir storage (existing or new). Transfer options to River Thames include use of canals or new pipelines/tunnels.
	Other raw water bulk supply transfers offered by other water companies (including companies operating wholly or mainly in Wales)
New River Regulation and/or Direct Supply Storage Reservoirs	Range of sites were considered in the Thames Valley
Artificial Recharge (AR) Aquifer Storage and Recovery (ASR)	Range of sites in the River Thames basin
Development of groundwater resources or increased abstraction from existing groundwater sources	Range of sites in the River Thames basin
Development of surface water sources	Several sites including the River Lower Lee and middle reaches of the River Thames
Indirect water reuse	Options to indirectly reuse treated sewage effluent from sewage treatment works or from the sewer network, with additional treatment prior to discharge to river or reservoir for subsequent abstraction
Desalination	Options to use estuarine water in the Thames Estuary
Release of network/treatment constraints or optimising use of resources within WRZs	Within Thames Water WRZs
Treated water transfers and licence trading/transfers	Inter-WRZ transfers
	Imports of treated water from other water companies or licence trading with other abstractors
	Amend export agreements with other water companies

Generic option	Sub-option
Surface water and rainwater recycling for non-potable uses	Range of measures to use surface water and rainwater recycling to provide alternative water supplies for non-potable uses
Catchment management	Options to use catchment management measures to enhance supply resilience or augment water supplies (e.g. by addressing diffuse pollution risks to water sources such as pesticides and nitrate). Also includes in-river measures to help address adverse effects of abstraction.
Reduction of Operational Water Use and Leakage	Range of measures to reduce water leakage and minimise operational water use
Water tariffs linked to metering of customers	Water tariffs to encourage water efficiency by customers linked to the Thames Water strategy for increasing water metering of household customers
Water efficiency measures	Measures to promote efficient use of water including education and advice, provision of water audits and/or water saving devices and working with others to ensure water efficiency of new developments.

6.2 SEA of unconstrained and feasible list options

The initial stages of the SEA involved the screening of a large number of options in an 'Unconstrained' list. The environmental performance of each option in respect of SEA principles, HRA and WFD were considered and this information used to help decide which options should be rejected and not taken further in the planning process. At this stage, several options were rejected on environmental grounds (and often alongside other factors such as planning or engineering feasibility), mainly due to their likely major adverse effects on international environmental designations (for example, on European conservation sites or UNESCO World Heritage Sites).

Remaining options were then considered in more detail as part of a Feasible List of options through a Feasibility Assessment process (as described and summarised in the Feasibility Assessment Reports accompanying the WRMP19). This process included assessment of each Feasible option against key SEA topics, HRA screening and WFD screening criteria. This process also involved engagement with regulators and stakeholders. The environmental assessments formed part of a wider set of assessments of each option, including appraisal against economic, engineering, resilience and planning considerations. From these assessments, decisions were made about which options should be taken forward to the Fine Screening process.

The Fine Screening process included comparing options of the same option type (e.g. reservoirs, desalination schemes, water reuse schemes) against SEA, HRA and WFD criteria and considering potential cumulative effects with other options, projects, plans or existing schemes. Those options that performed best against all of the Fine Screening assessment 'dimensions' and criteria were taken forward to the Constrained List of options for further evaluation, including development of environmental mitigation measures where required as part of the conceptual design of each option.

The Fine Screening process was subject to extensive consultation with regulators and stakeholders, including discussions at specific technical meetings with relevant parties, through the Water Resources Forum and associated open Technical Stakeholder Meetings, as well as through written submissions. Feedback from this engagement activity helped to refine and finalise the final decisions on which options were taken forward to the Constrained list of options for further development and detailed SEA, HRA and WFD assessment. Further details are provided in the Fine Screening Report accompanying the WRMP19 and published on the Thames Water website. A number of options were added to, updated or removed from the list following submission of the draft WRMP19 as part of the development of the WRMP19, as detailed in Section 1.8.

6.3 SEA of Constrained List Option Elements

For those options taken forward to the Constrained list, the options were disaggregated into their key component 'elements' and a conceptual design was developed for each of these 'option elements' (e.g. water source, raw water conveyance pipeline, water treatment works). Consideration of mitigation measures was a key component of the development of the conceptual designs, assessing the potential adverse effects and beneficial effects of each option element and identifying mitigation measures to reduce adverse effects or, where feasible, to enhance beneficial effects. There were two key mitigation considerations:

- **Modifying scheme design to eliminate or reduce adverse effects (or provide or enhanced beneficial effects).** For example, this included moving the location of pipelines or adopting tunnelling for water conveyance rather than laying a pipeline through a sensitive terrestrial landscape, or selecting treatment processes which minimise waste and carbon consumption. Particular attention was paid to optimising long-distance pipeline routes to avoid sensitive environmental or social receptors wherever feasible. Enhancement opportunities included consideration of providing biodiversity betterment following construction activities and provision of recreational amenity as part of the option element development.
- **Mitigating where feasible the effects of the modified scheme design**. For example, this included consideration of additional measures (over and above standard mitigation methods) to minimise noise, dust or vibration effects on sensitive natural or human receptors in close proximity during construction work, such as ceasing noisy work during the bird breeding season or during the evenings to minimise effects on local residents. For operational effects, mitigation measures included consideration of landscaping and natural screening of new structures to minimise impacts on visual amenity. Mitigation also included additional water treatment processes to minimise impacts of water discharges to rivers and estuaries for reuse, desalination and some raw water transfer option elements.

The final conceptual designs for each option element were then assessed through the SEA (and HRA and WFD assessments) based on the **residual** effects after application of the mitigation measures developed as part of the conceptual design of each option element. These were developed in an iterative manner between the design engineers and the environmental assessment team. The assessment was undertaken in accordance with the methodology set out in Section 5.

The detailed assessment of the likely significant effects for each option element is provided in **Appendix E**, including a colour-coded visual evaluation summary matrix. The assessment of the option elements included the effects of any interactions between topics where applicable. The assessment also included production of the environmental metrics, as described in section 5.5, for both beneficial and adverse effects as summarised below.

The SEA findings of the Constrained list option elements presented in detail at **Appendix E** can be summarised as follows:

- **demand management (including leakage reduction) measures** generally cause few significant adverse effects. The main adverse effects relate mainly to disruption and traffic congestion effects during the construction phase, water pipe repair or replacement activities or equipment installation. These measures provide benefits by reducing the volume of water that needs to be abstracted, treated and put into supply. The magnitude of the benefit varies widely from negligible to major, depending on the implementation scale of the measure and consequent volume of water savings delivered.
- effects from **water transfer schemes** vary considerably according to the scale of the scheme and the associated transfer and water treatment infrastructure required. The larger scale schemes, such as those considered for transferring water from the River Severn to the River Thames, can have many potential adverse effects during both construction and operation. However, the larger schemes and the schemes designed to reduce abstraction from

environmentally sensitive watercourses can bring beneficial effects by improving water supply resilience and helping to adapt to the risks presented by climate change.

- the **removal of resource and network constraints and treatment** capacity upgrades may have adverse impacts on the physical environment if there is potential for increasing abstraction above recent levels to have an adverse environmental impact, even though this may be within the abstraction licence limits. However, this could assist with ensuring the optimal use of existing water resources, maintenance of the water supply system and contributing to the protection of health, well-being and socio-economic development.
- smaller **inter-zone and inter-company** treated water transfers generally have fewer environmental effects, but this is dependent on the precise location of the construction activities relative to natural, built and human receptors.
- **groundwater (including artificial storage and recovery – ASR)** schemes generally have few impacts, although there can sometimes be consequences of the abstractions for recharge on the WFD status of the source water bodies.
- **new reservoir schemes** can have significant adverse effects during a prolonged construction period. Both adverse and beneficial effects can arise during operation: from potential adverse effects on visual amenity in the medium to long term before the reservoir landscaping is fully established, to beneficial effects from the recreational resources and compensatory habitat provision.
- **the water reuse** schemes make use of water which would otherwise be lost to the sea as a useable resource and provide increased resilience to the effects of climate change. However, the schemes can remove “freshwater” inputs to estuarine environments such as the Thames Tideway. The schemes have a high energy demand arising from intensive water treatment processes, with adverse effects on carbon emissions. For some of the schemes, construction of the water conveyance pipelines or tunnels may temporarily adversely affect natural, built or human receptors.
- **desalination schemes** using estuarine water also have high energy demands due to intensive water treatment processes, with consequent effects on carbon emissions. For some of the schemes, construction of the water conveyance pipelines or tunnels may temporarily adversely affect natural, built or human receptors. Desalination schemes are more resilient to climate change but elevated salinity concentrations can arise in the estuarine water body due to the discharge of the treatment process wastewater which can contain a high saline content.
- **raw water purchase** options have very limited environmental effects but provide a range of beneficial outcomes whilst maintaining a neutral effect on the overall volume abstracted from the environment.

Overall, the SEA of the option elements concluded that, as would generally be expected, larger scale water source, conveyance and water treatment option elements have greater adverse and beneficial effects than those associated with the smaller scale options. The precise significance of adverse effects for the same option element type (e.g. desalination plant elements on the River Thames Tideway or large diameter conveyance tunnel elements in London) does however vary markedly between minor and major adverse effects as the impact significance is highly dependent on the specific geographical setting of the element and its proximity (or otherwise) to sensitive environmental, human and built environment receptors.

The significance of the beneficial effects of the larger scale option elements also exhibit a wide range, reflecting several key factors:

- the resilience to climate change and water supply reliability afforded
- the opportunity for provision of co-benefits, for example enhanced biodiversity value, recreational and/or educational benefits
- the contribution to a more sustainable water resources management system

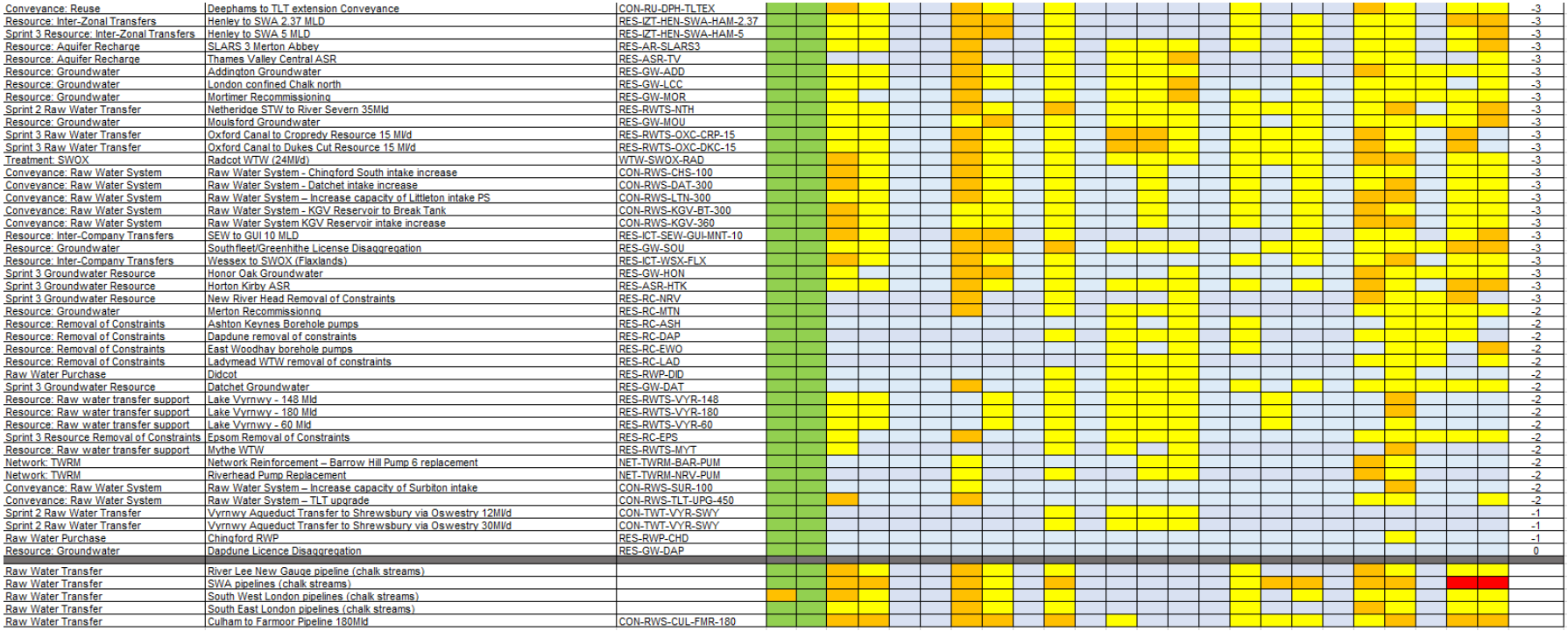
An overall summary assessment matrix, ranked according to the significance of SEA effects (adverse or beneficial) and the assessed environmental metric grading was produced as presented at **Figure 6.3** (for adverse effects) and **Figure 6.4** (for beneficial effects), and also included the risk assessment for WFD and HRA (from green to red; green reflects no or limited risks where further evidence may be required to confirm mitigation measures identified, amber a risk where mitigation is considered possible but challenging to implement and red reflects a risk that mitigation measures may not be able to reduce the adverse effects to an acceptable level for WFD or HRA compliance).

The detailed findings were discussed and presented to regulators and stakeholders, including at specific technical meetings with regulators and at various Technical Stakeholder Meetings. The draft option element assessments were made available to regulators and stakeholders via the Thames Water website: comments and challenges provided through this consultation activity helped to refine and finalise the assessments for use in the programme appraisal model. Feedback on the draft WRMP19 SEA Environmental Report from the public consultation process has also been considered and assessments have been revised, where appropriate, in light of the comments received as described in the Statement of Response available on the Thames Water website.

In conclusion, the earlier stages of the SEA (and HRA and WFD assessment processes) had largely ensured that the constrained list of option elements for selection within the programme appraisal process did not include options that would have unacceptable environmental or social impacts, particularly where there may have been implications for internationally designated sites (e.g. European sites, landscapes or heritage sites) or high risks of WFD status deterioration. No Constrained List option elements were therefore excluded from the draft WRMP19 and from the subsequent programme appraisal process which is described in Section 7 due to unacceptable environmental or social impacts. However, following representations on the draft WRMP19, in particular from the Environment Agency, the Teddington DRA option was excluded from the Constrained List and programme selection for the Final WRMP19 on account of the WFD challenges as described earlier in Section 1.8. A number of options were added to, updated or removed from the list following submission of the draft WRMP19 as part of the development of the Final WRMP19, as detailed in Section 1.8.

Figure 6.3 SEA, HRA and WFD assessment summary matrix for adverse effects of all option elements

Option type & sub-type	Element name	Element Ref	HRA	WFD	SEA objectives																						Adverse effects metric
					1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
Treatment: London	Coppermills WTW extension (100Ml/d)	WTW-LON-COP-100																									-7
Treatment: London	Coppermills WTW extension (150Ml/d)	WTW-LON-COP-150																									-7
Network: TWRM	Hampton WTW to Battersea Extension	NET-TWRM-HAM-BAT																									-7
Treatment: London	Kempton WTW expansion (100Ml/d)	WTW-LON-KEM-100																									-7
Treatment: London	Kempton WTW expansion (150Ml/d)	WTW-LON-KEM-150																									-7
Treatment: London	Kempton WTW expansion (300Ml/d)	WTW-LON-KEM-300																									-7
Sprint 2 Raw Water Transfer	Minworth STW to River Avon 115 Ml/d	RES-RWTS-MIN																									-7
Network: TWRM	Network Reinforcement – Kempton WTW New shaft	NET-TWRM-KEM																									-7
Network: TWRM	Network Reinforcement New Header tank at Coppermills WTW	NET-TWRM-COP-HEA																									-7
Conveyance: Raw Water System	Raw Water System Conveyance from Break Tank to Coppermills	CON-RWS-BT-COP-800																									-7
Sprint 3 Resource: Removal of	Britwell Removal of Constraints	RES-RC-BTW																									-7
Conveyance: Reuse	Beckton to Lockwood Conveyance (300 MLD)	CON-RU-BEC-LCK																									-6
Network: TWRM	Coppermills WTW to New Honor Oak Service Reservoir TWRM Extension	NET-TWRM-COP-HON																									-6
Resource: Desalination	Crossness Desal Treatment Plant 3 phases of 100Mld	RES-DES-CRO-100																									-6
Resource: Reservoir	South East Strategic Reservoir Option 100Mm3	RES-RRR-ABI-100Mm3																									-6
Resource: Reservoir	South East Strategic Reservoir Option 125Mm3	RES-RRR-ABI-125Mm3																									-6
Resource: Reservoir	South East Strategic Reservoir Option 150Mm3	RES-RRR-ABI-150Mm3																									-6
Resource: Reservoir	South East Strategic Reservoir Option 30+100Mm3 Phase 1	RES-RRR-ABI-30+100Mm3-P1																									-6
Resource: Reservoir	South East Strategic Reservoir Option 30+100Mm3 Phase 2	RES-RRR-ABI-30+100Mm3-P2																									-6
Resource: Reservoir	South East Strategic Reservoir Option 75Mm3	RES-RRR-ABI-75Mm3																									-6
Resource: Reservoir	South East Strategic Reservoir Option 80+42Mm3 Phase 1	RES-RRR-ABI-80+42Mm3-P1																									-6
Resource: Reservoir	South East Strategic Reservoir Option 80+42Mm3 Phase 2	RES-RRR-ABI-80+42Mm3-P2																									-6
Raw Water Transfer	Severn Thames Transfer – Deerhurst to Culham (300Ml/d) pipeline	CON-RWT-DEH-CLM-300																									-6
Raw Water Transfer	Severn Thames Transfer – Deerhurst to Culham (400Ml/d) pipeline	CON-RWT-DEH-CLM-400																									-6
Raw Water Transfer	Severn Thames Transfer – Deerhurst to Culham (500Ml/d) pipeline	CON-RWT-DEH-CLM-500																									-6
Resource: Desalination	Beckton Desalination treatment plant 150Ml/d	RES-DES-BEC-150																									-5
Resource: Reuse	Beckton Reuse 100 MLD	RES-RU-BEC-100																									-5
Resource: Reuse	Beckton Reuse 150 MLD	RES-RU-BEC-150																									-5
Resource: Reuse	Deephams Reuse 45Ml/d	RES-RU-DPH																									-5
Network: Desalination	Desalination – Crossness to Beckton tunnel	NET-DES-CRO-BEC																									-5
Network: Desalination	Desalination Beckton to Coppermills tunnel	NET-DES-BEC-COP																									-5
Conveyance: Raw Water System	Desalination – Beckton to Crossness tunnel	CON-RWS-BEC-CRO-300																									-5
Conveyance: Raw Water System	Raw Water System – Lockwood PS to KGV Reservoir Intake	CON-RWS-LCK-KGV-800																									-5
Conveyance: Raw Water System	Raw Water System – Queen Mary Reservoir to Kempton WTW site	CON-RWS-QMR-KEM-800																									-5
Sprint 3 SWA North	SWOX to SWA (48 Ml/d)	NET-IZT-AB-LC-48																									-5
Raw Water Transfer	SWOX to SWA (72 Ml/d)	NET-IZT-AB-LC-72																									-5
Sprint 3 Raw Water Systems	Abingdon to Farmoor	CON-RWS-ABI-FMR																									-4
Conveyance: Reuse	Deephams to KGV Conveyance	CON-RU-DPH-KGV																									-4
Resource: Inter-Zonal Transfers	Henley to SWOX 2.37 MLD	RES-IZT-HEN-SWX-NET-2.37																									-4
Sprint 3 Resource: Inter-Zonal Transfers	Henley to SWOX 5 MLD	RES-IZT-HEN-SWX-NET-5																									-4
Resource: Inter-Zonal Transfers	Kennet Valley to SWOX 2.3 MLD	RES-IZT-KEN-SWX-CLV-2.3																									-4
Resource: Inter-Zonal Transfers	Kennet Valley to SWOX 6.7 MLD	RES-IZT-KEN-SWX-CLV-6.7																									-4
Sprint 3 SWA South	Medmenham Intake-53	CON-RWS-MMM-53																									-4
Sprint 3 SWA South	Medmenham Intake-80	CON-RWS-MMM-80																									-4
Raw Water Transfer	Medmenham WTW (24Ml/d)	WTW-SWA-MMM																									-4
Sprint 3 Raw Water Transfer	Oxford Canal_Duke's Cut to Farmoor 15Ml/d Pipeline	CON-RWS-DKC-FRM																									-4
Sprint 3 Network Reinforcement	Shalford to Netley Mill	NET-GUI-SFD-NML																									-4
Sprint 2 Raw Water Transfer	Wye to Deerhurst 60.3Ml/d	CON-RWT-ROW-DEH-60.3																									-4
Resource: Aquifer Recharge	ASR SE Lon Addington	RES-ASR-SEL																									-3
Treatment: SWOX	Abingdon WTW (24Ml/d)	WTW-SWOX-ABI																									-3
Treatment: SWOX	SWA North: Abingdon WTW (24Ml/d)	WTW-SWOX-ABI-SWA																									-3
Resource: Aquifer Recharge	SLARS 1 Kidbrooke	RES-AR-SLARS1-7																									-3
Resource: Aquifer Recharge	SLARS 2 Streatham	RES-AR-SLARS2																									-3



Conveyance: Reuse	Deephams to TLT extension Conveyance	CON-RU-DPH-TLTEX	-3
Resource: Inter-Zonal Transfers	Henley to SWA 2.37 MLD	RES-IZT-HEN-SWA-HAM-2.37	-3
Sprint 3 Resource: Inter-Zonal Transfers	Henley to SWA 5 MLD	RES-IZT-HEN-SWA-HAM-5	-3
Resource: Aquifer Recharge	SLARS 3 Merton Abbey	RES-AR-SLARS3	-3
Resource: Aquifer Recharge	Thames Valley Central ASR	RES-ASR-TV	-3
Resource: Groundwater	Addington Groundwater	RES-GW-ADD	-3
Resource: Groundwater	London confined Chalk north	RES-GW-LCC	-3
Resource: Groundwater	Mortimer Recommissioning	RES-GW-MOR	-3
Sprint 2 Raw Water Transfer	Netheridge STW to River Severn 35Mld	RES-RWTS-NTH	-3
Resource: Groundwater	Moulsford Groundwater	RES-GW-MOU	-3
Sprint 3 Raw Water Transfer	Oxford Canal to Cropredy Resource 15 Ml/d	RES-RWTS-OXC-CRP-15	-3
Sprint 3 Raw Water Transfer	Oxford Canal to Dukes Cut Resource 15 Ml/d	RES-RWTS-OXC-DKC-15	-3
Treatment: SWOX	Radcot WTW (24Ml/d)	WTW-SWOX-RAD	-3
Conveyance: Raw Water System	Raw Water System - Chingford South intake increase	CON-RWS-CHS-100	-3
Conveyance: Raw Water System	Raw Water System - Datchet intake increase	CON-RWS-DAT-300	-3
Conveyance: Raw Water System	Raw Water System – Increase capacity of Littleton intake PS	CON-RWS-LTN-300	-3
Conveyance: Raw Water System	Raw Water System - KGV Reservoir to Break Tank	CON-RWS-KGV-BT-300	-3
Conveyance: Raw Water System	Raw Water System KGV Reservoir intake increase	CON-RWS-KGV-360	-3
Resource: Inter-Company Transfers	SEW to GUI 10 MLD	RES-ICT-SEW-GUI-MNT-10	-3
Resource: Groundwater	Southfleet/Greenhithe License Disaggregation	RES-GW-SOU	-3
Resource: Inter-Company Transfers	Wessex to SWOX (Flaxlands)	RES-ICT-WSX-FLX	-3
Sprint 3 Groundwater Resource	Honor Oak Groundwater	RES-GW-HON	-3
Sprint 3 Groundwater Resource	Horton Kirby ASR	RES-ASR-HTK	-3
Sprint 3 Groundwater Resource	New River Head Removal of Constraints	RES-RC-NRV	-3
Resource: Groundwater	Merton Recommissionng	RES-RC-MTN	-2
Resource: Removal of Constraints	Ashton Keynes Borehole pumps	RES-RC-ASH	-2
Resource: Removal of Constraints	Dapdune removal of constraints	RES-RC-DAP	-2
Resource: Removal of Constraints	East Woodhay borehole pumps	RES-RC-EWO	-2
Resource: Removal of Constraints	Ladymead WTW removal of constraints	RES-RC-LAD	-2
Raw Water Purchase	Didcot	RES-RWP-DID	-2
Sprint 3 Groundwater Resource	Datchet Groundwater	RES-GW-DAT	-2
Resource: Raw water transfer support	Lake Vyrnwy - 148 Mld	RES-RWTS-VYR-148	-2
Resource: Raw water transfer support	Lake Vyrnwy - 180 Mld	RES-RWTS-VYR-180	-2
Resource: Raw water transfer support	Lake Vyrnwy - 60 Mld	RES-RWTS-VYR-60	-2
Sprint 3 Resource Removal of Constraints	Epsom Removal of Constraints	RES-RC-EPS	-2
Resource: Raw water transfer support	Mythe WTW	RES-RWTS-MYT	-2
Network: TWRM	Network Reinforcement – Barrow Hill Pump 6 replacement	NET-TWRM-BAR-PUM	-2
Network: TWRM	Riverhead Pump Replacement	NET-TWRM-NRV-PUM	-2
Conveyance: Raw Water System	Raw Water System – Increase capacity of Surbiton intake	CON-RWS-SUR-100	-2
Conveyance: Raw Water System	Raw Water System – TLT upgrade	CON-RWS-TLT-UPG-450	-2
Sprint 2 Raw Water Transfer	Vyrnwy Aqueduct Transfer to Shrewsbury via Oswestry 12Ml/d	CON-TWT-VYR-SWY	-1
Sprint 2 Raw Water Transfer	Vyrnwy Aqueduct Transfer to Shrewsbury via Oswestry 30Ml/d	CON-TWT-VYR-SWY	-1
Raw Water Purchase	Chingford RWP	RES-RWP-CHD	-1
Resource: Groundwater	Dapdune Licence Disaggregation	RES-GW-DAP	0
Raw Water Transfer	River Lee New Gauge pipeline (chalk streams)		
Raw Water Transfer	SWA pipelines (chalk streams)		
Raw Water Transfer	South West London pipelines (chalk streams)		
Raw Water Transfer	South East London pipelines (chalk streams)		
Raw Water Transfer	Culham to Farmoor Pipeline 180Mld	CON-RWS-CUL-FMR-180	

Figure 6.4 SEA assessment summary matrix for beneficial effects of all option elements

Option type & sub-type	Element name	Element Ref	SEA objectives																						Benefic effects metric
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
Resource: Reservoir	South East Strategic Reservoir Option 100Mm3	RES-RRR-ABI-100Mm3																							6
Resource: Reservoir	South East Strategic Reservoir Option 125Mm3	RES-RRR-ABI-125Mm3																							6
Resource: Reservoir	South East Strategic Reservoir Option 150Mm3	RES-RRR-ABI-150Mm3																							6
Resource: Reservoir	South East Strategic Reservoir Option 30+100Mm3 Phase 1	RES-RRR-ABI-30+100Mm3-P1																							6
Resource: Reservoir	South East Strategic Reservoir Option 75Mm3	RES-RRR-ABI-75Mm3																							6
Resource: Reservoir	South East Strategic Reservoir Option 80+42Mm3 Phase 1	RES-RRR-ABI-80+42Mm3-P1																							6
Resource: Desalination	Beckton Desal Treatment Plant 150Mld	RES-DES-BEC-150																							5
Resource: Reuse	Beckton Reuse 100 Mld	RES-RU-BEC-100																							5
Resource: Reuse	Beckton Reuse 150 Mld	RES-RU-BEC-150																							5
Treatment: London	Coppermills WTW extension (100Ml/d)	WTW-LON-COP-100																							5
Treatment: London	Coppermills WTW extension (150Ml/d)	WTW-LON-COP-150																							5
Resource: Desalination	Crossness Desal Treatment Plant 3 phases of 100Mld	RES-DES-CRO-100																							5
Treatment: London	Kempton WTW expansion (100Ml/d)	WTW-LON-KEM-100																							5
Treatment: London	Kempton WTW expansion (150Ml/d)	WTW-LON-KEM-150																							5
Treatment: London	Kempton WTW expansion (300Ml/d)	WTW-LON-KEM-300																							5
Sprint 2 Raw Water Transfer	Minworth STW to River Avon 115Mld	RES-RWTS-MIN																							5
Resource: Reservoir	South East Strategic Reservoir Option 30+100Mm3 Phase 2	RES-RRR-ABI-30+100Mm3-P2																							5
Resource: Reservoir	South East Strategic Reservoir Option 80+42Mm3 Phase 2	RES-RRR-ABI-80+42Mm3-P2																							5
Raw Water Transfer	Severn Thames Transfer – Deerhurst to Culham (300Ml/d) pipeline	CON-RWT-DEH-CLM-300																							5
Raw Water Transfer	Severn Thames Transfer – Deerhurst to Culham (400Ml/d) pipeline	CON-RWT-DEH-CLM-400																							5
Raw Water Transfer	Severn Thames Transfer – Deerhurst to Culham (500Ml/d) pipeline	CON-RWT-DEH-CLM-500																							5
Sprint 2 Raw Water Transfer	Wye to Deerhurst 60.3Mld	CON-RWT-ROW-DEH-60.3																							5
Resource: Reuse	Deephams Reuse 45Mld	RES-RU-DPH																							4
Resource: Raw water transfer support	Lake Vyrnwy 148Mld	RES-RWTS-VYR-148																							4
Resource: Raw water transfer support	Lake Vyrnwy 180Mld	RES-RWTS-VYR-180																							4
Resource: Raw water transfer support	Lake Vyrnwy 60Mld	RES-RWTS-VYR-60																							4
Sprint 2 Raw Water Transfer	Netheridge STW to River Severn 35Mld	RES-RWTS-NTH																							4
Sprint 2 Raw Water Transfer	Vyrnwy Aqueduct Transfer to Shrewsbury via Oswestry 30Ml/d	CON-TWT-VYR-SWY																							4
Treatment: SWOX	Abingdon WTW (24Ml/d)	WTW-SWOX-ABI																							3
Treatment: SWOX	SWA North: Abingdon WTW (24Ml/d)	WTW-SWOX-ABI-SWA																							3
Raw Water Purchase	Didcot	RES-RWP-DID																							3
Raw Water Transfer	Medmenham WTW (24Ml/d)	WTW-SWA-MMM																							3
Sprint 3 Raw Water Transfer	Oxford Canal to Cropredy Resource 15 Ml/d	RES-RWTS-OXC-CRP-15																							3
Sprint 3 Raw Water Transfer	Oxford Canal to Dukes Cut Resource 15 Ml/d	RES-RWTS-OXC-DKC-15																							3
Treatment: SWOX	Radcot WTW (24Ml/d)	WTW-SWOX-RAD																							3
Sprint 2 Raw Water Transfer	Vyrnwy Aqueduct Transfer to Shrewsbury via Oswestry 12Ml/d	CON-TWT-VYR-SWY																							3
Sprint 3 Raw Water Systems	Abingdon to Farmoor	CON-RWS-ABI-FMR																							2
Resource: Groundwater	Addington Groundwater	RES-GW-ADD																							2
Resource: Removal of Constraints	Ashton Keynes Borehole pumps	RES-RC-ASH																							2
Resource: Aquifer Recharge	ASR SE Lon Addington	RES-ASR-SEL																							2
Conveyance: Reuse	Beckton to Lockwood Conveyance (300 MLD)	CON-RU-BEC-LCK																							2
Sprint 3 Resource: Removal of Constraints	Britwell Removal of Constraints	RES-RC-BTW																							2
Raw Water Purchase	Chingford RWP	RES-RWP-CHD																							2
Network: TWRM	Coppermills WTW to New Honor Oak Service Reservoir TWRM Extension	NET-TWRM-COP-HON																							2
Resource: Groundwater	Dapdune Licence Disaggregation	RES-GW-DAP																							2
Resource: Removal of Constraints	Dapdune removal of constraints	RES-RC-DAP																							2
Sprint 3 Groundwater Resource	Datchet Groundwater	RES-GW-DAT																							2
Conveyance: Reuse	Deephams to TLT extension Conveyance	CON-RU-DPH-TLTEX																							2
Conveyance: Reuse	Deephams to KGV Conveyance	CON-RU-DPH-KGV																							2
Network: Desalination	Desalination – Crossness to Beckton tunnel	NET-DES-CRO-BEC																							2
Network: Desalination:	Desalination Beckton to Coppermills tunnel	NET-DES-BEC-COP																							2
Conveyance: Raw Water System	Desalination – Beckton to Crossness tunnel	CON-RWS-BEC-CRO-300																							2
Resource: Removal of Constraints	East Woodhay borehole pumps	RES-RC-EWO																							2

Sprint 3 Resource Removal of Constraints	Epsom Removal of Constraints	RES-RC-EPS																						2
Network: TWRM	Hampton WTW to Battersea Extension	NET-TWRM-HAM-BAT																						2
Resource: Inter-Zonal Transfers	Henley to SWA 2.37 MLD	RES-IZT-HEN-SWA-HAM-2.37																						2
Sprint 3 Resource: Inter-Zonal Transfers	Henley to SWA 5 MLD	RES-IZT-HEN-SWA-HAM-5																						2
Resource: Inter-Zonal Transfers	Henley to SWOX 2.37 MLD	RES-IZT-HEN-SWX-NET-2.37																						2
Sprint 3 Resource: Inter-Zonal Transfers	Henley to SWOX 5MLD	RES-IZT-HEN-SWX-NET-5																						2
Sprint 3 Groundwater Resource	Honor Oak Groundwater	RES-GW-HON																						2
Sprint 3 Groundwater Resource	Horton Kirby ASR	RES-ASR-HTK																						2
Resource: Inter-Zonal Transfers	Kennet Valley to SWOX 2.3 MLD	RES-IZT-KEN-SWX-CLV-2.3																						2
Resource: Inter-Zonal Transfers	Kennet Valley to SWOX 6.7 MLD	RES-IZT-KEN-SWX-CLV-6.7																						2
Resource: Removal of Constraints	Ladymead WTW removal of constraints	RES-RC-LAD																						2
Resource: Groundwater	London confined Chalk north	RES-GW-LCC																						2
Sprint 3 SWA South	Medmenham Intake-53	CON-RWS-MMM-53																						2
Sprint 3 SWA South	Medmenham Intake-80	CON-RWS-MMM-80																						2
Resource: Groundwater	Merton Recommissionng	RES-RC-MTN																						2
Resource: Groundwater	Mortimer Recommissioning	RES-GW-MOR																						2
Resource: Groundwater	Moulsford Groundwater	RES-GW-MOU																						2
Resource: Raw water transfer support	Mythe WTW	RES-RWTS-MYT																						2
Network: TWRM	Network Reinforcement – Barrow Hill Pump 6 replacement	NET-TWRM-BAR-PUM																						2
Network: TWRM	Riverhead Pump Replacement	NET-TWRM-NRV-PUM																						2
Sprint 3 Groundwater Resource	New River Head Removal of Constraints	RES-RC-NRV																						2
Sprint 3 Raw Water Transfer	Oxford Canal - Duke's Cut to Farmoor 15Ml/d Pipeline	CON-RWS-DKC-FRM																						2
Conveyance: Raw Water System	Raw Water System - Chingford South intake increase	CON-RWS-CHS-100																						2
Conveyance: Raw Water System	Raw Water System - Datchet intake increase	CON-RWS-DAT-300																						2
Conveyance: Raw Water System	Raw Water System – Increase capacity of Littleton intake PS	CON-RWS-LTN-300																						2
Conveyance: Raw Water System	Raw Water System – Increase capacity of Surbiton intake	CON-RWS-SUR-100																						2
Conveyance: Raw Water System	Raw Water System - KGV Reservoir to Break Tank	CON-RWS-KGV-BT-300																						2
Conveyance: Raw Water System	Raw Water System – Lockwood PS to KGV Reservoir Intake	CON-RWS-LCK-KGV-800																						2
Conveyance: Raw Water System	Raw Water System – Queen Mary Reservoir to Kempton WTW site	CON-RWS-QMR-KEM-800																						2
Conveyance: Raw Water System	Raw Water System – TLT upgrade	CON-RWS-TLT-UPG-450																						2
Conveyance: Raw Water System	Raw Water System Conveyance from Break Tank to Coppermills	CON-RWS-BT-COP-800																						2
Conveyance: Raw Water System	Raw Water System KGV Reservoir intake increase	CON-RWS-KGV-360																						2
Resource: Inter-Company Transfers	SEW to GUI 10Mld	RES-ICT-SEW-GUI-MNT-10																						2
Resource: Aquifer Recharge	SLARS 1 Kidbrooke	RES-AR-SLARS1-7																						2
Resource: Aquifer Recharge	SLARS 2 Streatham	RES-AR-SLARS2																						2
Resource: Aquifer Recharge	SLARS 3 Merton Abbey	RES-AR-SLARS3																						2
Resource: Groundwater	Southfleet/Greenhithe License Disaggregation	RES-GW-SOU																						2
Raw Water Transfer	SWOX to SWA (48 Ml/d)	NET-IZT-AB-LC-48																						2
Sprint 3 SWA North	SWOX to SWA (72 Ml/d)	NET-IZT-AB-LC-72																						2
Resource: Aquifer Recharge	Thames Valley Central ASR	RES-ASR-TV																						2
Resource: Inter-Company Transfers	Wessex to SWOX (Flaxlands)	RES-ICT-WSX-FLX																						2
Network: TWRM	Network Reinforcement – Kempton WTW New shaft	NET-TWRM-KEM																						1
Network: TWRM	Network Reinforcement New Header tank at Coppermills WTW	NET-TWRM-COP-HEA																						1
Sprint 3 Network Reinforcement	Shalford to Netley Mill	NET-GUI-SFD-NML																						1
Raw Water Transfer	River Lee New Gauge pipeline (chalk streams)																							
Raw Water Transfer	SWA pipelines (chalk streams)																							
Raw Water Transfer	South West London pipelines (chalk streams)																							
Raw Water Transfer	South East London pipelines (chalk streams)																							
Raw Water Transfer	Culham to Farmoor Pipeline 180Mld	CON-RWS-CUL-FMR-180																						

7 SEA of Alternatives Programmes and WRMP19 Decision-Making

7.1 Role of SEA in Programme Appraisal and WRMP19 Decision-Making

The primary aim of the WRMP19 programme appraisal process is to find the 'best value' programme of supply and/or demand management options to secure a supply-demand balance across the Thames Water supply area.

The process is particularly, but not exclusively, facilitated through Thames Water's programme appraisal modelling tools which produced a wide range of different programmes optimised on a range of key selection criteria including whole-life cost, customer acceptability, resilience and environmental and social effects (represented by the environmental metrics described in Sections 5 and 6). These programmes were then reviewed for their relative performance against key decision-making criteria, including environmental and social performance. A short-list of reasonable alternative programmes was then selected for detailed environmental assessment.

The SEA process was used to assess the short-list of alternative programmes using the assessment methodology set out in Section 5 of this Report so as to provide the Thames Water decision-makers with a detailed appraisal of the relative environmental and social performance of each programme. The SEA assessment of the reasonable alternative programmes identified a number of environmental and social issues, related to particular options as well as combinations of options. The SEA assessments also identified that there were viable alternative options, with comparable environmental and social effects, available for each of these different alternative programmes, This information was used by Thames Water to help inform a final decision on the most appropriate programme of measures to include in the WRMP19.

Carbon consumption for each option has been monetised and included as a monetary value in the programme appraisal model. To avoid double-counting of the carbon impact, the environmental metric inputs derived from the SEA, HRA and WFD assessments for input to the programme appraisal model excluded consideration of the carbon impact of each option element. It should be noted that this is applicable only to effects from carbon emissions – the broader implications for longer-term climate change have not be monetised and have been addressed through the climate change SEA objective, as described earlier, and taking account of guidance on integrating climate change into SEA[29].

7.2 SEA of Reasonable Alternative Programmes for the WRMP19

In accordance with Regulation 12 and Schedule 2 Paragraph 8 of the SEA Regulations, reasonable alternative programmes have been assessed through SEA to evaluate their environmental and social performance against the SEA objectives.

A wide range of alternative programmes were generated from the Thames Water programme appraisal model for consideration. Thames Water commissioned an online visualisation tool (PolyVis) to help them to analyse the performance of the programmes across seven defined metrics. Trade-offs could be identified and programmes filtered and selected based on their performance across all the metrics and their likelihood of providing reasonable alternative solutions. For example, higher cost programmes could be removed as unaffordable and the remainder tested against key drivers, such as the most sustainable, the highest resilience, or increased environmental benefits. This is described further in Section 10 the WRMP19.

[29] European Commission (2013) Guidance on Integrating Climate Change and Biodiversity into Strategic Environmental Assessment

A short-list of six reasonable alternative programmes was selected by Thames Water, taking into account of the SEA of the option elements that make up each of the potential alternative programmes, for detailed consideration through the SEA process (including HRA and WFD assessment), as detailed in Section 10 of the WRMP19. The non-shortlisted programmes offered either no material improvement compared to the short-listed programmes or marginal improvements in some of the assessment criteria metrics and significant detriment to others.

The six alternative programmes short-listed for SEA (and HRA and WFD assessments) were:

- Favouring intergenerational equity (Min_IGEQ) [30]
- Favouring resilience and cost equally (Multi-obj_RES)
- Favouring customer preference for the frequency of restrictions and cost equally (Multi-obj_FP)
- Favouring resilience with a programme cost restriction of 120% of least cost (NearO_RES)
- Favouring customer preference for type of options with a programme cost restriction of 120% of least cost (NearO_TP)[31]
- Least cost programme (Phased_LC)

For each of these short-listed reasonable alternative programmes, environmental assessments were carried out for each of the options (schemes) within the programme, both individually and then cumulatively across all of the WRZs in the Thames Water supply area. Importantly, the assessments were based on the **residual** effects after application of mitigation measures included in the conceptual design (and cost) of each scheme.

The SEA findings of the six reasonable alternative programmes are summarised below (and described by the summary visual evaluation tables in **Figures 7-1 to 7-6**). The findings were used by Thames Water to help inform its decision-making to develop its final preferred programmes for each WRZ and the WRMP19.

Initially, each option (scheme) included in the programme was assessed in isolation (taking account of the various option elements that make up each of these options which had been previously assessed through the SEA, HRA and WFD process), and then in-combination with the other options included in the same programme (both construction and operational effects, as applicable). Full details of the option (scheme) assessments are provided in **Appendix F**.

Figures 7-1 to 7-6 summarise the schemes included in each of the reasonable alternative programmes and **Appendix G** sets out the delivery schedules showing the timescales over which different schemes would be implemented.

7.2.1 SEA of Favouring intergenerational equity (Min_IGEQ) programme

Each scheme within this programme (see **Appendix F**) has been subject to rigorous environmental and social assessment (SEA, HRA and WFD). Cumulative effects of the full programme during operation were also assessed as discussed below and no construction-related cumulative effects were identified as the timing of construction/development of the different options do not overlap in spatial proximity (see **Appendix G**).

[30] Min_IGEQ = (Minimum Intergenerational Equity) An optimisation run that uses a 1% discount rate instead of 3.5% in order to decrease the incentive to defer spend to the future. Lower IGEQ values represent better performance in the modelling outputs

[31] NearO_TP = (Near optimal type preference) An optimisation run that meets customer preferences for option type, constrained to within 120% of the Least Cost

The options selected for this programme vary in size, location and scale; consequently the environmental and social effects also vary between the different options (**Figure 7.1**).

A summary of the key environmental social effects of the programme are provided below. Carbon effects have been monetised (£ values) and were included in the programme appraisal model as a financial dis-benefit (or benefit where carbon savings identified): consequently, carbon effects were not considered in defining the environmental metric gradings for each option element included in the programme appraisal model in order to avoid 'double counting' of carbon effects.

The **South East Strategic Reservoir** 150Mm^3 option has several significant adverse and beneficial effects. Major adverse effects include:

- Temporary but extended impacts on communities during construction of the reservoir
- Significant consumption of resources and materials
- Impacts on local air quality and a rise in greenhouse gas (GHG) emissions due to increased HGV movements and other activities associated with construction
- Impacts on archaeological and heritage assets during construction and operation, including Listed Buildings and Registered Parks in close proximity to the land acquisition area
- Permanent landscape impacts on surrounding area and scheme visible from the North Wessex Downs AONB

Moderate adverse effects include:

- Weir pools in the River Thames may also be affected due to the potential change in their level and flow regime from operation of the reservoir discharges to regulate flows in the River Thames.
- Potential for temporary but extended construction effects on natural capital and ecosystem services.
- Moderate adverse effects related to socio-economic development in local area due to a loss of some local employment facilities
- Disruption to recreational activities as large areas of land and public rights of way become permanently inaccessible
- Impacts on watercourses
- Impacts on soil, geology and land use during construction including removal of land from agricultural use

Major beneficial effects are identified in respect of the long-term provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. The scheme also reduces the impact of additional abstraction from the River Thames at times of low river flows to meet demand growth in both London and SWOX. Furthermore, there are likely to be opportunities to provide numerous recreational benefits over the long term through water-based activities, provision for rehabilitation of part of the Wiltshire and Berks Canal and new footpaths around the reservoir area. Construction will bring employment opportunities for residents in the local area, with the potential for longer term job opportunities once the reservoir is operational.

Construction works to expand the capacity of the **Kempton and Coppermills Water Treatment Works** will require the application of a series of mitigation measures as set out in the HRA Report. These measures are necessary during the construction period to protect designated bird species associated with nearby Special Protection Areas and Ramsar sites (these are internationally important conservation sites designated for the protection of important bird species and their habitats).

The **Beckton Desalination** option includes development, including a tunnel and new header tank, close to Coppermills Water Treatment Works, which will require the application of a series of mitigation measures as set out in the HRA Report. These measures are necessary during the construction period to protect designated bird species associated with nearby Special Protection

Areas and Ramsar sites. The development of this option would have major adverse effects for biodiversity, health and wellbeing, material assets and air quality. There would be moderate adverse effects for the protection of natural capital and ecosystem services, health and wellbeing for recreation, greenhouse gas emissions, heritage and landscape. There would be four major beneficial effects for health and wellbeing associated with the provision of reliable water supplies and reducing reliance on freshwater resources, climate change resilience and adaptability.

For the **Deephams reuse** scheme, there are three major adverse effects associated with population and health (local nuisance and emissions during construction) and for air quality (construction effects) and greenhouse gas emissions (during construction and operation) related to embodied and operational carbon consumption from energy intensive processes required to treat wastewater effluent at the site and pump it to the discharge location on the River Lee, upstream of Thames Water's abstraction intakes for the Lee Valley Reservoirs. Three moderate adverse effects are identified associated with biodiversity, impacts on recreational amenity and use of material during construction. Remaining effects are assessed as predominately minor adverse. The HRA screening concluded that the option would require an Appropriate Assessment and consideration of mitigation measures to avoid construction effects (particularly noise and visual disturbance) on designated bird species to avoid adverse effects on the integrity of nearby European sites. The HRA assessment concluded that having regard to the identified mitigation measures would mean that the option would not lead to adverse effects on the integrity of nearby European sites or the ability of these sites to meet their conservation objectives. The WFD assessment concluded that the option would not lead to any risk of deterioration in WFD status.

Two major beneficial effects associated with population and health arise due to the provision of a reliable and robust water supply and infrastructure to support socio-economic activity. Two moderate beneficial effects are identified associated with sustainable management of water abstraction and provision of water supply resilience to climate change risks. The remaining effects are predominately assessed as minor or negligible.

There are a substantial number of relatively small **groundwater schemes** included in this programme (**Figure 7.1**) including options to optimise the use of existing groundwater sources and several artificial recharge (AR) and artificial storage and recovery (ASR) groundwater schemes. The residual effects of these schemes are mostly characterised by negligible to minor effect significance, although there is one major adverse effect for the **Britwell groundwater source** associated with the risk of WFD status deterioration for which there is uncertainty about the impacts and the potential need to mitigate the effects. Mitigation measures may be necessary to secure WFD compliance in respect of the Ashton Keynes and Epsom groundwater options following the conclusion of planned site specific investigations and options appraisal. Beneficial effects for these schemes are mostly negligible to minor.

The **Chingford and Didcot raw water purchase schemes** involve no net change in current abstraction from the Lee Valley Reservoirs and River Thames, respectively, and optimise use of existing water resources. The residual effects of these schemes are mostly characterised by negligible to minor effect significance.

For the **Wessex to SWOX transfer** scheme, three moderate adverse effects are identified in relation to biodiversity, health and well-being and greenhouse gas emissions as a result of construction activities. The HRA Assessment shows that there would be no likely significant effects on any European sites. The WFD assessment concludes no overall likely risk to WFD status. Two moderate beneficial effects are associated with the provision of a secure resilient supply of drinking water and providing essential water supply infrastructure to help support a sustainable socio-economy.

For the **Oxford Canal transfer** scheme, there are five moderate adverse effects relating to population and human health, water quality, air quality and cultural heritage. The HRA Assessment shows that there would be no likely significant effects on European sites. The WFD assessment concludes no overall likely risk to WFD status. Three moderate beneficial effects are identified with respect to population and human health, material assets use and optimising use of existing water sources.

The **Medmenham intake to SWA** option would have two major adverse effects, on biodiversity with some of the development being adjacent to a SSSI and landscape effects with works being undertaken in the Chilterns AONB. There would also be five moderate adverse effects on health and wellbeing, soil, air quality and heritage.

The **demand management programmes** provide moderate to major beneficial environmental effects but there are some moderate and minor adverse effects associated principally with leakage control activities in urban areas (for example traffic congestion from road closures and associated effects on air quality), but most adverse effects are assessed as negligible.

Cumulative effects

No construction-related cumulative effects were identified between options included in this programme as the timing of construction/development of the different options do not overlap (see **Appendix G**).

Cumulative operational adverse effects (**Appendix G**) principally would arise in relation to concurrent operation of the Beckton desalination scheme with the Deephams reuse scheme, but the overall effect on the Thames Tideway is assessed as minor with the cumulative volumetric impact remaining below the threshold at which salinity changes might arise to lead to WFD compliance risks or risks to the recommended Thames Estuary Marine Conservation Zone. Negligible cumulative effects are anticipated between operation of the South East Strategic Reservoir and the Oxford Canal transfer scheme given the small additional volume of river flow support to the Middle River Thames from the canal transfer (15 Ml/d).

Negligible cumulative operational effects are assessed in relation to the South East Strategic Reservoir scheme operating concurrently with the Didcot and Medmenham options further downstream on the River Thames. Concurrent operation of the Didcot and Medmenham options would have only negligible adverse cumulative effects.

Assessment Conclusions

The schemes forming this programme are, with the application of mitigation measures, compliant with Habitats Regulations and WFD objectives, but there remains uncertainty as to whether mitigation measures for the Britwell option would remove the uncertain risks of WFD status deterioration. The programme presents some environmental challenges, mainly during the construction phase, but most major effects can be mitigated such that, overall, the environmental and social effects of this programme are predominately of a **minor to moderate** significance (both adverse and beneficial effects).

Some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the South East Strategic Reservoir Option and Beckton desalination scheme) or may be permanent in nature.

This environmental performance of this programme is relatively less challenging compared to most of the other reasonable alternative programmes considered with the exception of the NearO_TP programme.

Figure 7.1 SEA of Favouring intergenerational equity (Min_IGEQ) SEA Summary

Option	HRA	WFD	SEA OBJECTIVES																					
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
London Demand Management																									Minor Adverse
																									Major Beneficial
New River Head Removal of Constraints																									Minor Adverse
																									Minor Beneficial
AR Merton (SLARS3)																									Minor Adverse
																									Minor Beneficial
ASR Horton Kirby																									Minor Adverse
																									Minor Beneficial
Groundwater Addington																									Minor Adverse
																									Minor Beneficial
Deephams Reuse																									Moderate Adverse
																									Moderate Beneficial
RC Epsom																									Minor Adverse
																									Minor Beneficial
Oxford Canal to Cropredy 15Ml/d																									Minor Adverse
																									Minor Beneficial
Groundwater Southfleet																									Minor Adverse
																									Minor Beneficial
Chingford RWP																									Negligible Adverse
																									Minor Beneficial
South East Straetgic Reservoir Option 150Mm³																									Major Adverse
																									Moderate Beneficial
Groundwater London confined Chalk (north) - 2 MLD																									Minor adverse
																									Minor beneficial
AR Streatham (SLARS2) - 5 MLD																									Minor adverse
																									Minor beneficial
Merton recommissioning																									Minor adverse
																									Minor beneficial
ASR Thames Valley/Thames Central																									Minor adverse
																									Minor beneficial

Option	HRA	WFD	SEA OBJECTIVES																						
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
Beckton Desalinisation 150																									Moderate Adverse
																									Moderate Beneficial
Honor Oak																									Minor adverse
																									Minor beneficial
Coppermills WTW Extension 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Kempton WTW new 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Didcot RWP																									Negligible Adverse
																									Minor Beneficial
Groundwater Datchet																									Minor adverse
																									Minor beneficial
SWA Demand Management																									Minor adverse
																									Moderate beneficial
SWOX Demand Management																									Minor adverse
																									Moderate beneficial
Groundwater - Moulsford 1 - 3.5 MLD																									Minor adverse
																									Minor beneficial
RC Ashton Keynes borehole pumps - 2.5 MLD																									Minor adverse
																									Minor beneficial
RC Britwell - 1.31 MLD																									Moderate Adverse
																									Minor beneficial
Wessex to SWOX (Flaxlands)																									Minor adverse
																									Minor beneficial
Medmenham raw water intake and transfer 80 Ml/d																									Moderate Adverse
																									Moderate Beneficial

Overall Programme Assessment:

Minor to Moderate Adverse Effects

Minor to Moderate Beneficial Effects

7.2.2 SEA of Favouring resilience and cost equally (Multi-obj_RES)

Each scheme within this programme (see **Appendix F**) has been subject to rigorous environmental and social assessment (SEA, HRA and WFD). Cumulative effects of the programme during operation were also assessed as discussed below, but no construction-related cumulative effects were identified as the timing of construction/development of the different options do not overlap in spatial proximity (see **Appendix G**).

The options selected for this programme vary in size, location and scale; consequently the environmental and social effects also vary between the different options (**Figure 7.2**).

A summary of the key environmental social effects of the programme are provided below. Carbon effects have been monetised (£ values) and were included in the programme appraisal model as a financial dis-benefit (or benefit where carbon savings identified): consequently, carbon effects were not considered in defining the environmental metric gradings for each option element included in the programme appraisal model in order to avoid 'double counting' of carbon effects.

The **South East Strategic Reservoir** 150Mm^3 option has several significant adverse and beneficial effects. Major adverse effects include:

- Temporary but extended impacts on communities during construction of the reservoir
- Significant consumption of resources and materials
- Impacts on local air quality and a rise in GHG emissions due to increased HGV movements and other activities associated with construction
- Impacts on archaeological and heritage assets during construction and operation, including Listed Buildings and Registered Parks in close proximity to the land acquisition area
- Permanent landscape impacts on surrounding area and scheme visible from the North Wessex Downs AONB

Moderate adverse effects include:

- Weir pools in the River Thames may also be affected due to the potential change in their level and flow regime from operation of the reservoir.
- Potential for temporary but extended construction effects on natural capital and ecosystem services.
- Moderate adverse effects related to socio-economic development in local area due to a loss of some local employment facilities
- Disruption to recreational activities as large areas of land and public rights of way become permanently inaccessible
- Impacts on watercourses
- Impacts on soil, geology and land use during construction including removal of land from agricultural use

Major beneficial effects are identified in respect of the long-term provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. The scheme also reduces the impact of additional abstraction from the River Thames at times of low river flows to meet demand growth in both London and SWOX. Furthermore, there are likely to be opportunities to provide numerous recreational benefits over the long term through water-based activities, provision for rehabilitation of part of the Wiltshire and Berks Canal and new footpaths around the reservoir area. Construction will bring employment opportunities for residents in the local area, with the potential for longer term job opportunities once the reservoir is operational.

Construction works to expand the capacity of the **Kempton and Coppermills Water Treatment Works** will require the application of a series of mitigation measures as set out in the HRA Report.

These measures are necessary during the construction period to protect designated bird species associated with nearby Special Protection Areas and Ramsar sites (these are internationally important conservation sites designated for the protection of important bird species and their habitats).

The **Beckton reuse scheme** (phased 100 Ml/d) has several significant adverse and beneficial effects. Major adverse effects include:

- Effects on biodiversity during construction, although application mitigation measures would mitigate all adverse effects on any European sites.
- Effects on population due to construction and HGV activities.
- Significant materials use.
- Air and greenhouse gas emissions

Moderate effects include:

- Effects during construction on recreational facilities such as Public Rights of Way and King George V reservoir.
- Effects on material assets associated with use of energy and chemicals during operation.
- Heritage effects due to the proximity to a number of heritage assets. Close liaison with Historic England and local conservation groups would be required for this scheme, prior to works commencing.
- Effects on landscape due to construction activities.

Major beneficial effects are identified in respect of the provision of a substantial volume of reliable water supplies, improved resilience to the water supply system and reduced vulnerability to climate change effects.

For the **Oxford Canal transfer** scheme, there are five moderate adverse effects relating to population and human health, water quality, air quality and cultural heritage. The HRA assessment shows that there would be no likely significant effects on European sites. The WFD assessment concludes no overall likely risk to WFD status. Three moderate beneficial effects are identified with respect to population and human health, material assets use and optimising use of existing water sources.

The **Severn-Thames Transfer 2** option (which includes Mythe, Netheridge, Minworth and River Vyrnwy support elements) has several significant adverse and beneficial effects. Major adverse effects include:

- Effects on population and health during construction.
- Material assets and resource use due to resource requirements.
- Effects on sustainable abstractions including potential WFD effects.
- Effects on heritage due to the large number of heritage assets within close proximity to the pipeline route.
- Effects on landscape with large parts of the scheme located within the Cotswolds AONB.

Moderate effects include:

- Effects on biodiversity as the scheme is in proximity to a number of designated sites and effects on ecosystem services and natural capital.
- Effects on recreation associated with areas of AONB and Public Rights of Way
- Water flows and water quality. For example, the use of the Minworth support element could increase low flows in the River Avon, potentially changing the normal pattern of flows.
- Soil, geology and land use during construction including loss of agricultural land as well as some permanent loss of land

- Impacts on local air quality in and a rise in GHG emissions due to increased HGV movements and other activities associated with construction.

There is a minor adverse effect in relation to the **Vyrnwy Reservoir flow support** (60 Ml/d) element of the Severn-Thames transfer scheme due to possible risks to WFD status deterioration but with mitigation measures this risk is assessed as low. Conversely, the **Minworth effluent flow support** element (115 Ml/d) of the transfer scheme carries a higher WFD compliance risk. This would require further consideration of the effect on sanitary, nutrient and chemical water quality, as well as water temperature. The impact on aquatic ecology from mixing tertiary treated effluent into the River Avon downstream of Warwick particularly under low river flow conditions in the River Avon also requires further consideration. At present, the ability to secure WFD compliance for this option remains a challenge and requires more extensive site environmental investigations to assess the risk in more detail and, if necessary, develop additional mitigation measures to secure WFD compliance.

Major beneficial effects are identified in respect of the provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. Also the flow support elements of the scheme would reduce the vulnerability to climate change effects and consequently improve resilience to such effects.

There are a substantial number of relatively small **groundwater schemes** included in this programme (**Figure 7.2**) including options to optimise the use of existing groundwater sources and several artificial recharge (AR) and artificial storage and recovery (ASR) groundwater schemes. The residual effects of these schemes are mostly characterised by negligible to minor effect significance, although there is one major adverse effect for the **Britwell groundwater source** associated with the risk of WFD status deterioration for which there is uncertainty about the impacts and the potential need to mitigate the effects. Mitigation measures may be necessary to secure WFD compliance in respect of the Ashton Keynes and Epsom groundwater options following the conclusion of planned site specific investigations and options appraisal. Beneficial effects for these schemes are mostly negligible to minor.

The **Chingford and Didcot raw water purchase schemes** involve no net change in current abstraction from the Lee Valley Reservoirs and River Thames, respectively, and optimise use of existing water resources. The residual effects of these schemes are mostly characterised by negligible to minor effect significance.

For the **Wessex to SWOX transfer** scheme, three moderate adverse effects are identified in relation to biodiversity, health and well-being and greenhouse gas emissions as a result of construction activities. The HRA Assessment shows that there would be no likely significant effects on any European sites. The WFD assessment concludes no overall likely risk to WFD status. Two moderate beneficial effects are associated with the provision of a secure resilient supply of drinking water and providing essential water supply infrastructure to help support a sustainable socio-economy.

The **North SWX to SWA 72 Ml/d** option would have three major adverse effects, on health and well-being, on recreational assets including a national trail and on local air quality with a rise in GHG emissions, due to increased HGV movements and other activities associated with construction. There would also be nine moderate adverse effects on biodiversity, material assets, soil, air quality, heritage and landscape.

The **demand management programmes** provide moderate to major beneficial environmental effects but there are some moderate and minor adverse effects associated principally with leakage control activities in urban areas (for example traffic congestion from road closures and associated effects on air quality), but most adverse effects are assessed as negligible.

Cumulative effects

No construction-related cumulative effects were identified between options included in this programme as the timing of construction/development of the different options do not overlap (see **Appendix G**).

Major cumulative operational adverse effects (**Appendix G**) would arise in relation to this programme. Concurrent operation of the South East Strategic Reservoir with the Severn-Thames transfer scheme and Oxford Canal transfer scheme would lead to cumulative flow support discharges to the Middle River Thames exceeding the identified 500 Ml/d cumulative threshold flow volume downstream of Culham above which there are risks of WFD status deterioration due to the change to the low flow regime of the river.

Negligible cumulative operational effects are assessed in relation to the South East Strategic Reservoir and Severn-Thames transfer schemes operating concurrently with the Didcot option further downstream on the River Thames.

Assessment Conclusions

The schemes forming this programme are compliant with Habitats Regulations with delivery of specified mitigation measures for Beckton reuse, Coppermills WTW and Kempton Park WTW.

The programme presents several WFD challenges. There remains uncertainty as to whether mitigation measures for the Britwell option would remove the uncertain risks of WFD status deterioration. The Minworth effluent transfer element of a supported Severn-Thames Transfer option carries a greater level of WFD compliance risk and currently presents a challenge to develop additional mitigation measures to secure WFD compliance. The Vyrnwy support element of a Severn-Thames Transfer option requires the collection and consideration of further evidence prior to confirming WFD compliance or implementing mitigation measures. Concurrent operation of the Severn-Thames transfer scheme with discharges from the South East Strategic Reservoir presents WFD risks to the Middle River Thames.

Overall, the environmental and social effects of this programme are predominately of **minor to moderate** significance (both adverse and beneficial effects). However, some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the South East Strategic Reservoir Option, Severn-Thames transfer scheme pipeline and Beckton reuse scheme) or may be permanent in nature.

This programme would be challenging to promote from a planning and environmental perspective, requiring agreement of extensive mitigation measures for various strategic schemes to avoid adverse effects in relation to European environmental legislation. The environmental performance of this programme is adverse when compared to most of the other reasonable alternative programmes considered, with the exception of the programme favouring customer preference for the frequency of restrictions and cost equally (Multi-obj_FP). It is of a similar scale of challenge as the Near_O RES programme, but with issues focused on the Middle Thames rather than the Thames Tideway.

Figure 7.2 SEA of Favouring resilience and cost equally (Multi-obj_RES) SEA Summary

Option	HRA	WFD	SEA OBJECTIVES																					
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
London Demand Management																									Minor Adverse
																									Major Beneficial
New River Head Removal of Constraints																									Minor Adverse
																									Minor Beneficial
AR Merton (SLARS3)																									Minor Adverse
																									Minor Beneficial
ASR Horton Kirby																									Minor Adverse
																									Minor Beneficial
Groundwater Addington																									Minor Adverse
																									Minor Beneficial
RC Epsom																									Minor Adverse
																									Minor Beneficial
Oxford Canal to Cropredy 15Ml/d																									Minor Adverse
																									Minor Beneficial
Groundwater Southfleet																									Minor Adverse
																									Minor Beneficial
Chingford RWP																									Negligible Adverse
																									Minor Beneficial
South East Straetgic Reservoir Option 150Mm³																									Major Adverse
																									Moderate Beneficial
AR Streatham (SLARS2) - 5 MLD																									Minor adverse
																									Minor beneficial
ASR_South East London (Addington)																									Minor adverse
																									Minor beneficial
Merton recommissioning																									Minor adverse
																									Minor beneficial

Option	HRA	WFD	SEA OBJECTIVES																						
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
ASR Thames Valley/Thames Central																									Minor adverse
																									Minor beneficial
AR SLARS Kidbrooke (SLARS1)																									Minor adverse
																									Minor beneficial
Honor Oak																									Minor adverse
																									Minor beneficial
Beckton Reuse 200 MLD (phased 100)																									Major Adverse
																									Moderate Beneficial
Severn Thames Transfer 2																									Major Adverse
																									Moderate Beneficial
Coppermills WTW Extension 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Kempton WTW New 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Didcot RWP																									Negligible Adverse
																									Minor Beneficial
Groundwater Datchet																									Minor adverse
																									Minor beneficial
SWA Demand Management																									Minor adverse
																									Moderate beneficial
SWOX Demand Management																									Minor adverse
																									Moderate beneficial
Groundwater - Moulsford 1 - 3.5 MLD																									Minor adverse
																									Minor beneficial
RC Ashton Keynes borehole pumps - 2.5 MLD																									Minor adverse
																									Minor beneficial
RC Britwell - 1.31 MLD																									Moderate Adverse
																									Minor beneficial
Wessex to SWOX (Flaxlands)																									Minor adverse
																									Minor beneficial
ITZ_North SWX to SWA 72																									Moderate Adverse
																									Minor beneficial

Overall Programme Assessment:

Minor to Moderate Adverse Effects

Minor to Moderate Beneficial Effects

7.2.3 SEA of Favouring customer preference for the frequency of restrictions and cost equally (Multi-obj_FP)

Each scheme within this programme (see **Appendix F**) has been subject to rigorous environmental and social assessment (SEA, HRA and WFD). Cumulative effects of the programme during operation were also assessed as discussed below, but no construction-related cumulative effects were identified as the timing of construction/development of the different options do not overlap in spatial proximity (see **Appendix G**).

The options selected for this programme vary in size, location and scale; consequently the environmental and social effects also vary between the different options (**Figure 7.3**).

A summary of the key environmental social effects of the programme are provided below. Carbon effects have been monetised (£ values) and were included in the programme appraisal model as a financial dis-benefit (or benefit where carbon savings identified): consequently, carbon effects were not considered in defining the environmental metric gradings for each option element included in the programme appraisal model in order to avoid 'double counting' of carbon effects.

The **South East Strategic Reservoir** 125Mm^3 option has several significant adverse and beneficial effects. Major adverse effects include:

- Temporary but extended impacts on communities during construction of the reservoir
- Significant consumption of resources and materials
- Impacts on local air quality and a rise in GHG emissions due to increased HGV movements and other activities associated with construction
- Impacts on archaeological and heritage assets during construction and operation, including Listed Buildings and Registered Parks in close proximity to the land acquisition area
- Permanent landscape impacts on surrounding area and scheme visible from the North Wessex Downs AONB

Moderate adverse effects include:

- Weir pools in the River Thames may also be affected due to the potential change in their level and flow regime from operation of the reservoir.
- Potential for temporary but extended construction effects on natural capital and ecosystem services.
- Moderate adverse effects related to socio-economic development in local area due to a loss of some local employment facilities
- Disruption to recreational activities as large areas of land and public rights of way become permanently inaccessible
- Impacts on watercourses
- Impacts on soil, geology and land use during construction including removal of land from agricultural use

Major beneficial effects are identified in respect of the long-term provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. The scheme also reduces the impact of additional abstraction from the River Thames at times of low river flows to meet demand growth in both London and SWOX. Furthermore, there are likely to be opportunities to provide numerous recreational benefits over the long term through water-based activities, provision for rehabilitation of part of the Wiltshire and Berks Canal and new footpaths around the reservoir area. Construction will bring employment opportunities for residents in the local area, with the potential for longer term job opportunities once the reservoir is operational.

Construction works to expand the capacity of the **Kempton and Coppermills Water Treatment Works** will require the application of a series of mitigation measures as set out in the HRA Report. These measures are necessary during the construction period to protect designated bird species associated with nearby Special Protection Areas and Ramsar sites (these are internationally important conservation sites designated for the protection of important bird species and their habitats).

The Beckton reuse 300 Ml/d scheme has several significant adverse and beneficial effects. Major adverse effects include:

- Effects on biodiversity during construction, although application mitigation measures would mitigate all adverse effects on any European sites.
- Effects on biodiversity in operation as the scheme capacity exceeds the precautionary lower threshold value of 275 Ml/d, above which there may be an increase in the salinity regime in the Thames Tideway with possible risks to saline-sensitive species (WFD compliance risk) and the Recommended Thames Estuary Marine Conservation Zone.
- Effects on population due to construction and HGV activities.
- Substantial materials use.
- Significant air and greenhouse gas emissions

Moderate effects include:

- Effects during construction on recreational facilities such as Public Rights of Way and water based use on the King George V reservoir.
- Effects on material assets, associated with use of energy and chemicals during operation.
- Heritage effects due to the proximity to a number of heritage assets. Close liaison with Historic England and local conservation groups would be required for this scheme, prior to works commencing.
- Effects on landscape due to construction activities.

Major beneficial effects are identified in respect of the provision of a substantial volume of reliable water supplies, improved resilience to the water supply system and reduced vulnerability to climate change effects.

For the **Deephams reuse** scheme, there are three major adverse effects associated with population and health (local nuisance and emissions during construction) and for air quality (construction effects) and greenhouse gas emissions (during construction and operation) related to embodied and operational carbon consumption from energy intensive processes required to treat wastewater effluent at the site and pump it to the discharge location on the River Lee, upstream of Thames Water's abstraction intakes for the Lee Valley Reservoirs. Three moderate adverse effects are identified associated with biodiversity, impacts on recreational amenity and material assets use. Remaining effects are assessed as predominately minor adverse. The HRA screening concluded that the option would require an Appropriate Assessment and consideration of mitigation measures to avoid construction effects (particularly noise and visual disturbance) on designated bird species to avoid adverse effects on the integrity of nearby European sites. The HRA assessment concluded that having regard to the identified mitigation measures would mean that the option would not lead to adverse effects on the integrity of nearby European sites or the ability of these sites to meet their conservation objectives. The WFD assessment concluded that the option would not lead to any risk of deterioration in WFD status.

Two major beneficial effects associated with population and health arise due to the provision of a reliable and robust water supply and infrastructure to support socio-economic activity. Two moderate beneficial effects are identified associated with sustainable management of water abstraction and provision of water supply resilience to climate change risks. The remaining effects are predominately assessed as minor or negligible.

The **Beckton Desalination** option includes development, including a tunnel and new header tank, close to Coppermills Water Treatment Works, which will require the application of a series of mitigation measures as set out in the HRA Report. These measures are necessary during the construction period to protect designated bird species associated with nearby Special Protection Areas and Ramsar sites. The development of this option would have major adverse effects for biodiversity, health and wellbeing, material assets and air quality. There would be moderate adverse effects for the protection of natural capital and ecosystem services, health and wellbeing for recreation, greenhouse gas emissions, heritage and landscape. There would be four major beneficial effects for health and wellbeing associated with the provision of reliable water supplies and reducing reliance on freshwater resources, climate change resilience and adaptability.

For the **Oxford Canal transfer** scheme, there are five moderate adverse effects relating to population and human health, water quality, air quality and cultural heritage. The HRA Assessment shows that there would be no likely significant effects on European sites. The WFD assessment concludes no overall likely risk to WFD status. Three moderate beneficial effects are identified with respect to population and human health, material assets use and optimising use of existing water sources.

The **Severn-Thames Transfer 3** scheme (which includes Mythe, Netheridge, Minworth, River Wye, Vyrnwy transfer to Severn Trent and the River Vyrnwy support elements) has several significant adverse and beneficial effects.

Major adverse effects include:

- Effects on population and health during construction.
- Material assets and resource use due to resource requirements.
- Effects on sustainable abstractions including potential WFD effects.
- Effects on heritage due to the large number of heritage assets within close proximity to the pipeline route.
- Effects on landscape with large parts of the scheme located within the Cotswolds AONB.

Moderate effects include:

- Effects on biodiversity as the scheme is in proximity to a number of designated sites and effects on ecosystem services and natural capital.
- Effects on recreation associated with areas of AONB and Public Rights of Way
- Water flows and water quality. For example, the use of the Minworth support element could increase low flows in the River Avon, potentially changing the normal pattern of flows.
- Soil, geology and land use during construction including loss of agricultural land as well as some permanent loss of land
- Impacts on local air quality in and a rise in GHG emissions due to increased HGV movements and other activities associated with construction.

There is a minor adverse effect in relation to the **Vyrnwy Reservoir flow support** (60 Ml/d) element of the Severn-Thames transfer scheme due to possible risks to WFD status deterioration but with mitigation measures this risk is assessed as low. Conversely, the **Minworth effluent flow support** element (115 Ml/d) of the transfer scheme carries a higher WFD compliance risk. This would require further consideration of the effect on sanitary, nutrient and chemical water quality, as well as water temperature. The impact on aquatic ecology from mixing tertiary treated effluent into the River Avon downstream of Warwick particularly under low river flow conditions in the River Avon also requires further consideration. At present, the ability to secure WFD compliance for this option remains a challenge and requires more extensive site environmental investigations to assess the risk in more detail and, if necessary, develop additional mitigation measures to secure WFD compliance.

The **River Wye transfer element** (raw water supply direct to the Deerhurst to Culham pipeline) is assessed as WFD compliant subject to appropriate abstraction licence conditions being in place to protect downstream ecology.

Major beneficial effects are identified in respect of the provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. Also the flow support elements of the scheme would reduce the vulnerability to climate change effects and consequently improve resilience to such effects.

There are a substantial number of relatively small **groundwater schemes** included in this programme (**Figure 7.3**) including options to optimise the use of existing groundwater sources and several artificial recharge (AR) and artificial storage and recovery (ASR) groundwater schemes. The residual effects of these schemes are mostly characterised by negligible to minor effect significance, although there is one major adverse effect for the **Britwell groundwater source** associated with the risk of WFD status deterioration for which there is uncertainty about the impacts and the potential need to mitigate the effects. Mitigation measures may be necessary to secure WFD compliance in respect of the Ashton Keynes and Epsom groundwater options following the conclusion of planned site specific investigations and options appraisal. Beneficial effects for these schemes are mostly negligible to minor.

The **Chingford and Didcot raw water purchase schemes** involve no net change in current abstraction from the Lee Valley Reservoirs and River Thames, respectively, and optimise use of existing water resources. The residual effects of these schemes are mostly characterised by negligible to minor effect significance.

The **North SWX to SWA 48 Ml/d** option would have three major adverse effects, on health and well-being, on recreational assets including a national trail and on local air quality with a rise in GHG emissions, due to increased HGV movements and other activities associated with construction. There would also be nine moderate adverse effects on biodiversity, material assets, soil, air quality, heritage and landscape.

The **demand management programmes** provide moderate to major beneficial environmental effects but there are some moderate and minor adverse effects associated principally with leakage control activities in urban areas (for example traffic congestion from road closures and associated effects on air quality), but most adverse effects are assessed as negligible.

Cumulative effects

No construction-related cumulative effects were identified as the timing of construction/development of the different options do not overlap (see **Appendix G**).

Major cumulative operational adverse effects (**Appendix G**) would arise in relation to this programme. Concurrent operation of the South East Strategic Reservoir with a large Severn-Thames transfer scheme and the Oxford Canal transfer scheme would lead to cumulative flow support discharges to the Middle River Thames exceeding the identified 500 Ml/d cumulative threshold flow volume downstream of Culham. Above this threshold there are risks of WFD status deterioration due to the change to the low flow regime of the river.

Concurrent operation of the Beckton reuse scheme, Beckton desalination scheme and the Deephams reuse scheme, substantially exceeds the precautionary lower threshold value of 275 Ml/d above which there may be an increase in the salinity regime in the Thames Tideway, with possible cumulative operational risks to saline-sensitive species (WFD compliance risk) and the Recommended Thames Estuary Marine Conservation Zone. The Multi-obj_FP programme may not comply with WFD objectives for the ecology of the transitional water body. Further baseline understanding of the salinity regime of the middle Tideway would be required to better understand these patterns.

Negligible cumulative operational effects are assessed in relation to the South East Strategic Reservoir and Severn-Thames transfer schemes operating concurrently with the Didcot option further downstream on the River Thames.

Assessment Conclusions

The schemes forming this programme are compliant with Habitats Regulations with delivery of specified mitigation measures for Beckton desalination scheme, Beckton and Deephams reuse schemes, Coppermills WTW and Kempton Park WTW.

This programme presents multiple WFD compliance challenges on the River Avon, River Thames and Thames Tideway.

Overall, the environmental and social effects of this programme are predominately of a **minor to moderate** significance (both adverse and beneficial effects).

Some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the South East Strategic Reservoir Option, Severn-Thames Transfer, Beckton reuse and Beckton desalination schemes) or may be permanent in nature.

This programme would be very challenging to promote from a planning and environmental perspective, requiring agreement of extensive mitigation measures for various strategic schemes to avoid adverse effects in relation to European environmental legislation. The environmental performance of this programme is the most adverse relative to all of the other five reasonable alternative programmes considered.

Figure 7.3 Favouring customer preference for the frequency of restrictions and cost equally (Multi-obj_FP) SEA summary

Option	HRA	WFD	SEA OBJECTIVES																						
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
London Demand Management																									Minor Adverse
																									Major Beneficial
New River Head Removal of Constraints																									Minor Adverse
																									Minor Beneficial
AR Merton (SLARS3)																									Minor Adverse
																									Minor Beneficial
ASR Horton Kirby																									Minor Adverse
																									Minor Beneficial
Groundwater Addington																									Minor Adverse
																									Minor Beneficial
Deephams Reuse																									Moderate Adverse
																									Moderate Beneficial
RC Epsom																									Minor Adverse
																									Minor Beneficial
Oxford Canal to Cropredy 15Ml/d																									Minor Adverse
																									Minor Beneficial
Groundwater Southfleet																									Minor Adverse
																									Minor Beneficial
Chingford RWP																									Negligible Adverse
																									Minor Beneficial
South East Strategic Reservoir Option 125Mm³																									Major Adverse
																									Moderate Beneficial
Groundwater London confined Chalk (north) - 2 MLD																									Minor adverse
																									Minor beneficial
AR Streatham (SLARS2) - 5 MLD																									Minor adverse
																									Minor beneficial
ASR_South East London (Addington)																									Minor adverse
																									Minor beneficial
Merton recommissioning																									Minor adverse
																									Minor beneficial

Option	HRA	WFD	SEA OBJECTIVES																						
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
ASR Thames Valley/Thames Central																									Minor adverse
																									Minor beneficial
Beckton Desalinisation 150																									Moderate Adverse
																									Moderate Beneficial
AR SLARS Kidbrooke (SLARS1)																									Minor adverse
																									Minor beneficial
Beckton Reuse 300 MLD (phased 150)																									Major Adverse
																									Moderate Beneficial
Severn Thames Transfer 3																									Major Adverse
																									Moderate Beneficial
Coppermills WTW Extension 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Kempton WTW New 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Didcot RWP																									Negligible Adverse
																									Minor Beneficial
Groundwater Datchet																									Minor adverse
																									Minor beneficial
SWA Demand Management																									Minor adverse
																									Moderate beneficial
SWOX Demand Management																									Minor adverse
																									Moderate beneficial
Groundwater - Moulsford 1 - 3.5 MLD																									Minor adverse
																									Minor beneficial
RC Ashton Keynes borehole pumps - 2.5 MLD																									Minor adverse
																									Minor beneficial
RC Britwell - 1.31 MLD																									Moderate Adverse
																									Minor beneficial
ITZ_North SWX to SWA 48																									Moderate Adverse
																									Minor beneficial

Overall Programme Assessment:

Minor to Moderate Adverse Effects

Minor to Moderate Beneficial Effects

7.2.4 SEA of Favouring resilience with a programme cost restriction of 120% of least cost (NearO_RES)

Each scheme within this programme (see **Appendix F**) has been subject to rigorous environmental and social assessment (SEA, HRA and WFD). Cumulative effects of the programme during operation were also assessed as discussed below, one construction-related cumulative effect was identified as the timing of construction/development of different options overlapped in spatial proximity (see **Appendix G**).

The options selected for this programme vary in size, location and scale (**Figure 7.4**); consequently, the environmental and social effects also vary between the different options. Given the scale of the long-term supply deficit over the 80-year planning period, some major water supply schemes and a comprehensive Demand Management Programme are required to secure a supply-demand balance, with some smaller scale groundwater schemes needed in the very short term to address immediate deficits.

The **Severn-Thames Transfer** scheme (which includes Mythe, Netheridge, Minworth, Vyrnwy transfer to Severn Trent and the River Vyrnwy support elements with the capacity of the pipeline being 400Mld) has several significant adverse and beneficial effects.
Major adverse effects include:

- Effects on population and health during construction.
- Material assets and resource use due to resource requirements.
- Effects on sustainable abstractions including potential WFD effects.
- Effects on heritage due to the large number of heritage assets within close proximity to the pipeline route.
- Effects on landscape with large parts of the scheme located within the Cotswolds AONB.

Moderate effects include:

- Effects on biodiversity as the scheme is in proximity to a number of designated sites and effects on ecosystem services and natural capital.
- Effects on recreation associated with areas of AONB and Public Rights of Way
- Water flows and water quality. For example, the use of the Minworth support element could increase low flows in the River Avon, potentially changing the normal pattern of flows.
- Soil, geology and land use during construction including loss of agricultural land as well as some permanent loss of land
- Impacts on local air quality in and a rise in GHG emissions due to increased HGV movements and other activities associated with construction.

There is a minor adverse effect in relation to the **Vyrnwy Reservoir flow support** (60 Ml/d) element of the Severn-Thames transfer scheme due to possible risks to WFD status deterioration but with mitigation measures this risk is assessed as low. Conversely, the **Minworth effluent flow support** element (115 Ml/d) of the transfer scheme carries a higher WFD compliance risk. This would require further consideration of the effect on sanitary, nutrient and chemical water quality, as well as water temperature. The impact on aquatic ecology from mixing tertiary treated effluent into the River Avon downstream of Warwick particularly under low river flow conditions in the River Avon also requires further consideration. At present, the ability to secure WFD compliance for this option remains a challenge and requires more extensive site environmental investigations to assess the risk in more detail and, if necessary, develop additional mitigation measures to secure WFD compliance.

Major beneficial effects are identified in respect of the provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. Also the flow support elements of the scheme would reduce the vulnerability to climate change effects and consequently improve resilience to such effects.

The **Beckton Desalination** option includes development, including a tunnel and new header tank, close to Coppermills Water Treatment Works, which will require the application of a series of mitigation measures as set out in the HRA Report. These measures are necessary during the construction period to protect designated bird species associated with nearby Special Protection Areas and Ramsar sites. The development of this option would have major adverse effects for biodiversity, health and wellbeing, material assets and air quality. There would be moderate adverse effects for the protection of natural capital and ecosystem services, health and wellbeing for recreation, greenhouse gas emissions, heritage and landscape.

There would be four major beneficial effects for health and wellbeing associated with the provision of reliable water supplies and reducing reliance on freshwater resources, climate change resilience and adaptability.

The **Beckton reuse** 200 Ml/d scheme has several significant adverse and beneficial effects. Major adverse effects include:

- Effects on biodiversity during construction, although application mitigation measures would mitigate all adverse effects on any European sites.
- Effects on population due to construction and HGV activities.
- Significant materials use.
- Air and greenhouse gas emissions

Moderate effects include:

- Effects during construction on recreational facilities such as Public Rights of Way and water based use on the King George V reservoir.
- Effects on material assets, associated with use of energy and chemicals during operation.
- Heritage effects due to the proximity to a number of heritage assets. Close liaison with Historic England and local conservation groups would be required for this scheme, prior to works commencing.
- Effects on landscape due to construction activities.

Major beneficial effects are identified in respect of the provision of a substantial volume of reliable water supplies, improved resilience to the water supply system and reduced vulnerability to climate change effects.

The **Deephams Reuse** scheme has predominantly minor to moderate adverse impacts. However, major impacts include:

- Temporary construction activity effects on air quality associated with vehicle movements to deliver materials to construction site.
- Impacts on local air quality due to increased HGV movements and other activities associated with construction.
- Embodied and operational carbon consumption from energy intensive processes required to treat wastewater effluent at the site and pump it to the discharge location on the River Lee, upstream of Thames Water's abstraction intakes for the Lee Valley Reservoirs.

Major beneficial effects are identified in respect of the provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. Moderate effects relate to sustainable management of water abstraction and provision of water supply resilience to climate change risks.

Construction works to expand the capacity of the **Kempton and Coppermills Water Treatment Works** will require the application of a series of mitigation measures as set out in the HRA Report. These measures are necessary during the construction period to protect designated bird species

associated with nearby Special Protection Areas and Ramsar sites (these are internationally important conservation sites designated for the protection of important bird species and their habitats).

For the **Oxford Canal transfer** scheme, there are five moderate adverse effects relating to population and human health, water quality, air quality and cultural heritage. The HRA Assessment shows that there would be no likely significant effects on European sites. The WFD assessment concludes no overall likely risk to WFD status. Three moderate beneficial effects are identified with respect to population and human health, material assets use and optimising use of existing water sources.

The **Medmenham intake to SWA** option would have two major adverse effects, on biodiversity with some of the development being adjacent to a SSSI and landscape effects with works being undertaken in the Chilterns AONB. There would also be five moderate adverse effects on health and wellbeing, soil, air quality and heritage.

There are a substantial number of relatively small **groundwater schemes** included in this programme (**Figure 7.4**) including options to optimise the use of existing groundwater sources and several artificial recharge (AR) and artificial storage and recovery (ASR) groundwater schemes. The residual effects of these schemes are mostly characterised by negligible to minor effect significance, although there is one major adverse effect for the **Britwell groundwater source** associated with the risk of WFD status deterioration for which there is uncertainty about the impacts and the potential need to mitigate the effects. Mitigation measures may be necessary to secure WFD compliance in respect of the Ashton Keynes and Epsom groundwater options following the conclusion of planned site specific investigations and options appraisal. Beneficial effects for these schemes are mostly negligible to minor.

The **Chingford and Didcot raw water purchase schemes** involve no net change in current abstraction from the Lee Valley Reservoirs and River Thames, respectively, and optimise use of existing water resources. The residual effects of these schemes are mostly characterised by negligible to minor effect significance.

The **demand management programmes** provide moderate to major beneficial environmental effects but there are some moderate and minor adverse effects associated principally with leakage control activities in urban areas (for example traffic congestion from road closures and associated effects on air quality), but most adverse effects are assessed as negligible.

Cumulative effects

Moderate construction-related cumulative effects were identified in relation to the concurrent construction of parts of the ASR Thames Valley/Thames Central groundwater scheme and Kempton WTW in west London (**Appendix G**). Mitigation measures will be required to minimise disturbance on both the local community in a densely populated area as well as on sensitive, internationally designated bird species during construction.

Major cumulative operational adverse effects would arise in relation to concurrent operation of the Beckton desalination scheme, Beckton reuse scheme and the Deephams reuse scheme (**Appendix G**), presenting a challenge to WFD compliance in the Thames Tideway and the Recommended Thames Estuary Marine Conservation Zone. These options directly influence freshwater flow in the middle Thames Tideway: the cumulative effect of these two options would be a reduction in freshwater flows to the middle Tideway of around 395Ml/d which exceeds the indicative impact threshold on salinity in Tideway of 275-365 Ml/d. This could have inherent effects on water quality and supported (saline-sensitive) ecology. The threshold is indicative only and requires further study and analysis to confirm its validity. It is considered that this scale of freshwater reduction could lead to salinity regime changes in the middle Tideway and may not comply with WFD objectives for the ecology of the transitional water body and the Recommended Thames Estuary Marine Conservation Zone.

Negligible cumulative operational effects are assessed in relation to the Severn-Thames transfer scheme operating concurrently with the Didcot and Medmenham options further downstream on the

River Thames. Concurrent operation of the Didcot and Medmenham options would have only negligible adverse cumulative effects.

Assessment Conclusions

The schemes forming this programme are compliant with Habitats Regulations with delivery of specified mitigation measures for Beckton desalination scheme, the Beckton and Deephams reuse schemes, Coppermills WTW and Kempton Park WTW.

The programme presents several WFD challenges, principally in respect of concurrent operation of the Beckton reuse scheme, Beckton desalination scheme and Deephams reuse scheme on the Thames Tideway (and risks to the Recommended Thames Estuary Marine Conservation Zone). There remains uncertainty as to whether mitigation measures for the Britwell option would remove the uncertain risks of WFD status deterioration. The Minworth effluent transfer element of a supported Severn-Thames Transfer option carries a greater level of WFD compliance risk and currently presents a challenge to develop additional mitigation measures to secure WFD compliance.

Overall, the environmental and social effects of this programme are predominately of **minor to moderate** significance (both adverse and beneficial effects). However, some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the Severn-Thames transfer scheme pipeline, Beckton reuse scheme and Beckton desalination scheme) or may be permanent in nature.

This programme would be challenging to promote from a planning and environmental perspective, requiring agreement of extensive mitigation measures for various strategic schemes to avoid adverse effects in relation to European environmental legislation. The environmental performance of this programme is adverse when compared to most of the other reasonable alternative programmes considered, with the exception of the programme favouring customer preference for the frequency of restrictions and cost equally (Multi-obj_FP). It is of a similar scale of challenge as the Multi_Obj_RES programme, but with issues focused on the Thames Tideway rather than the Middle Thames (as this programme does not include both the Severn-Thames Transfer and the South East Strategic Reservoir options).

Figure 7.4 Favouring resilience with a programme cost restriction of 120% of least cost (NearO_RES) SEA Summary

Option	HRA	WFD	SEA OBJECTIVES																							
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
London Demand Management																									Minor Adverse
																									Major Beneficial
New River Head Removal of Constraints																									Minor Adverse
																									Minor Beneficial
AR Merton (SLARS3)																									Minor Adverse
																									Minor Beneficial
ASR Horton Kirby																									Minor Adverse
																									Minor Beneficial
Groundwater Addington																									Minor Adverse
																									Minor Beneficial
Deephams Reuse																									Moderate Adverse
																									Moderate Beneficial
RC Epsom																									Minor Adverse
																									Minor Beneficial
Oxford Canal to Cropredy 15Ml/d																									Minor Adverse
																									Minor Beneficial
Groundwater Southfleet																									Minor Adverse
																									Minor Beneficial
Chingford RWP																									Negligible Adverse
																									Minor Beneficial
Groundwater London confined Chalk (north) - 2 MLD																									Minor adverse
																									Minor beneficial
ASR_South East London (Addington)																									Minor adverse
																									Minor beneficial
ASR Thames Valley/Thames Central																									Minor adverse
																									Minor beneficial
Beckton Desalination 150																									Moderate Adverse
																									Moderate Beneficial
Beckton Reuse 200 MLD (phased 100)																									Major Adverse
																									Moderate Beneficial

Option	HRA	WFD	SEA OBJECTIVES																						
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
Severn Thames Transfer																									Major Adverse
																									Moderate Beneficial
Coppermills WTW Extension 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Kempton WTW New 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Didcot RWP																									Negligible Adverse
																									Minor Beneficial
Groundwater Datchet																									Minor adverse
																									Minor beneficial
SWA Demand Management																									Minor adverse
																									Moderate beneficial
SWOX Demand Management																									Minor adverse
																									Moderate beneficial
Groundwater - Moulsford 1 - 3.5 MLD																									Minor adverse
																									Minor beneficial
RC Ashton Keynes borehole pumps - 2.5 MLD																									Minor adverse
																									Minor beneficial
RC Britwell - 1.31 MLD																									Moderate Adverse
																									Minor beneficial
Medmenham raw water intake and transfer 80 Ml/d																									Moderate Adverse
																									Moderate Beneficial

Overall Programme Assessment:
Minor to Moderate Adverse Effects
Minor to Moderate Beneficial Effects

7.2.5 SEA of Favouring customer preference for type of options with a programme cost restriction of 120% of least cost (NearO_TP)

Each scheme within this programme (see **Appendix F**) has been subject to rigorous environmental and social assessment (SEA, HRA and WFD). Cumulative effects of the programme during operation were also assessed as discussed below, but no construction-related cumulative effects were identified as the timing of construction/development of the different options do not overlap in spatial proximity (see **Appendix G**).

The options selected for this programme vary in size, location and scale; consequently the environmental and social effects also vary between the different options (**Figure 7.5**).

A summary of the key environmental social effects of the programme are provided below. Carbon effects have been monetised (£ values) and were included in the programme appraisal model as a financial dis-benefit (or benefit where carbon savings identified): consequently, carbon effects were not considered in defining the environmental metric gradings for each option element included in the programme appraisal model in order to avoid 'double counting' of carbon effects.

The **South East Strategic Reservoir** 150Mm^3 option has several significant adverse and beneficial effects. Major adverse effects include:

- Temporary but extended impacts on communities during construction of the reservoir
- Significant consumption of resources and materials
- Impacts on local air quality and a rise in GHG emissions due to increased HGV movements and other activities associated with construction
- Impacts on archaeological and heritage assets during construction and operation, including Listed Buildings and Registered Parks in close proximity to the land acquisition area
- Permanent landscape impacts on surrounding area and scheme visible from the North Wessex Downs AONB

Moderate adverse effects include:

- Weir pools in the River Thames may also be affected due to the potential change in their level and flow regime from operation of the reservoir.
- Potential for temporary but extended construction effects on natural capital and ecosystem services.
- Moderate adverse effects related to socio-economic development in local area due to a loss of some local employment facilities
- Disruption to recreational activities as large areas of land and public rights of way become permanently inaccessible
- Impacts on watercourses
- Impacts on soil, geology and land use during construction including removal of land from agricultural use

Major beneficial effects are identified in respect of the long-term provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. The scheme also reduces the impact of additional abstraction from the River Thames at times of low river flows to meet demand growth in both London and SWOX. Furthermore, there are likely to be opportunities to provide numerous recreational benefits over the long term through water-based activities, provision for rehabilitation of part of the Wiltshire and Berks Canal and new footpaths around the reservoir area. Construction will bring employment opportunities for residents in the local area, with the potential for longer term job opportunities once the reservoir is operational.

Construction works to expand the capacity of the **Kempton and Coppermills Water Treatment Works** will require the application of a series of mitigation measures as set out in the HRA Report. These measures are necessary during the construction period to protect designated bird species associated with nearby Special Protection Areas and Ramsar sites (these are internationally important conservation sites designated for the protection of important bird species and their habitats).

The **Beckton Desalination** option includes development, including a tunnel and new header tank, close to Coppermills Water Treatment Works, which will require the application of a series of mitigation measures as set out in the HRA Report. These measures are necessary during the construction period to protect designated bird species associated with nearby Special Protection Areas and Ramsar sites. The development of this option would have major adverse effects for biodiversity, health and wellbeing, material assets and air quality. There would be moderate adverse effects for the protection of natural capital and ecosystem services, health and wellbeing for recreation, greenhouse gas emissions, heritage and landscape.

There would be four major beneficial effects for health and wellbeing associated with the provision of reliable water supplies and reducing reliance on freshwater resources, climate change resilience and adaptability.

The **Medmenham intake to SWA** option would have two major adverse effects, on biodiversity with some of the development being adjacent to a SSSI and landscape effects with works being undertaken in the Chilterns AONB. There would also be five moderate adverse effects on health and wellbeing, soil, air quality and heritage.

The **Chingford and Didcot raw water purchase schemes** involve no net change in current abstraction from the Lee Valley Reservoirs or the River Thames, respectively, and optimised use of existing water resources. The residual adverse effects of these schemes are mostly characterised by negligible to minor effect significance, with minor to moderate beneficial effects associated with optimising use of existing water resources and enhancing water supply resilience.

The **demand management programmes** provide moderate to major beneficial environmental effects but there are some moderate and minor adverse effects associated principally with leakage control activities in urban areas (for example traffic congestion from road closures and associated effects on air quality), but most adverse effects are assessed as negligible.

Cumulative operational effects

No construction-related cumulative effects were identified as the timing of construction/development of the different options do not overlap (see **Appendix G**).

No material operational cumulative effects have been identified (**Appendix G**): there are negligible cumulative effects between operation of the South East Strategic Reservoir flow releases to the River Thames, the Didcot raw water purchase option and the Medmenham option.

Assessment Conclusions

The schemes forming this programme are compliant with Habitats Regulations with the inclusion of mitigation measures for the Beckton desalination scheme and the Coppermills and Kempton water treatment works. The programme is also compliant with WFD objectives.

Overall, the environmental and social effects of this programme are considered of a **moderate** significance (both adverse and beneficial effects).

Some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the South East Strategic Reservoir Option and the Beckton desalination schemes) or may be permanent in nature.

This programme has the fewest number of strategic schemes. It is noted that small schemes (less than 50 Ml/d), with the exception of the Britwell groundwater scheme, have fewer adverse environmental effects than the larger strategic schemes, both individually and cumulatively. However, it is equally recognised that larger strategic schemes are essential to address the future supply deficit. This programme presents the fewest environmental challenges relative to the other reasonable alternative programmes considered.

Figure 7.5 Favouring customer preference for type of options with a programme cost restriction of 120% of least cost (NearO_TP) SEA Summary

Option	HRA	WFD	SEA OBJECTIVES																							
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
London Demand Management																									Minor Adverse
																									Major Beneficial
Chingford RWP																									Negligible Adverse
																									Minor Beneficial
South East Straetgic Reservoir Option 150Mm³																									Major Adverse
																									Moderate Beneficial
Beckton Desalination 150																									Moderate Adverse
																									Moderate Beneficial
Coppermills WTW Extension 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Kempton WTW New 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Didcot RWP																									Negligible Adverse
																									Minor Beneficial
Medmenham raw water intake and transfer 80 Ml/d																									Moderate Adverse
																									Moderate Beneficial
SWA Demand Management																									Minor adverse
																									Moderate beneficial
SWOX Demand Management																									Minor adverse
																									Moderate beneficial

Overall Programme Assessment:
Moderate Adverse Effects
Moderate Beneficial Effects

7.2.6 SEA of Least cost programme (Phased_LC)

Each scheme within this least-cost programme (see **Appendix F**) has been subject to rigorous environmental and social assessment (SEA, HRA and WFD). Cumulative effects of the programme during operation were also assessed as discussed below, but no construction-related cumulative effects were identified as the timing of construction/development of the different options do not overlap (see **Appendix G**).

The options selected for this least-cost programme vary in size, location and scale; consequently the environmental and social effects also vary between the different options (**Figure 7.6**). Given the scale of the long-term supply deficit over the 80 year planning period, some major water supply schemes and a comprehensive Demand Management Programme are required to secure a supply-demand balance, with some smaller scale groundwater schemes needed in the very short term to address immediate deficits.

A summary of the key environmental social effects of the programme are provided below. Carbon effects have been monetised (£ values) and were included in the programme appraisal model as a financial dis-benefit (or benefit where carbon savings identified): consequently, carbon effects were not considered in defining the environmental metric gradings for each option element included in the programme appraisal model in order to avoid 'double counting' of carbon effects.

The **Beckton Desalination** option includes development, including a tunnel and new header tank, close to Coppermills Water Treatment Works, which will require the application of a series of mitigation measures as set out in the HRA Report. These measures are necessary during the construction period to protect designated bird species associated with nearby Special Protection Areas and Ramsar sites. The development of this option would have major adverse effects for biodiversity, health and wellbeing, material assets and air quality. There would be moderate adverse effects for the protection of natural capital and ecosystem services, health and wellbeing for recreation, greenhouse gas emissions, heritage and landscape.

There would be four major beneficial effects for health and wellbeing associated with the provision of reliable water supplies and reducing reliance on freshwater resources, climate change resilience and adaptability.

The **South East Strategic Reservoir** 125Mm^3 option has several significant adverse and beneficial effects. Major adverse effects include:

- Temporary but extended impacts on communities during construction of the reservoir
- Significant consumption of resources and materials
- Impacts on local air quality and a rise in GHG emissions due to increased HGV movements and other activities associated with construction
- Impacts on archaeological and heritage assets during construction and operation, including Listed Buildings and Registered Parks in close proximity to the land acquisition area
- Permanent landscape impacts on surrounding area and scheme visible from the North Wessex Downs AONB

Moderate adverse effects include:

- Weir pools in the River Thames may also be affected due to the potential change in their level and flow regime from operation of the reservoir.
- Potential for temporary but extended construction effects on natural capital and ecosystem services.
- Moderate adverse effects related to socio-economic development in local area due to a loss of some local employment facilities
- Disruption to recreational activities as large areas of land and public rights of way become permanently inaccessible

- Impacts on watercourses
- Impacts on soil, geology and land use during construction including removal of land from agricultural use

Major beneficial effects are identified in respect of the long-term provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. The scheme also reduces the impact of additional abstraction from the River Thames at times of low river flows to meet demand growth in both London and SWOX. Furthermore, there are likely to be opportunities to provide numerous recreational benefits over the long term through water-based activities, provision for rehabilitation of part of the Wiltshire and Berks Canal and new footpaths around the reservoir area. Construction will bring employment opportunities for residents in the local area, with the potential for longer term job opportunities once the reservoir is operational.

For the **Oxford Canal transfer** scheme, there are five moderate adverse effects relating to population and human health, water quality, air quality and cultural heritage. The HRA Assessment shows that there would be no likely significant effects on European sites. The WFD assessment concludes no overall likely risk to WFD status. Three moderate beneficial effects are identified with respect to population and human health, material assets use and optimising use of existing water sources.

The **Deephams Reuse** scheme has predominantly minor to moderate adverse impacts. However, major impacts include:

- Temporary construction activity effects on air quality associated with vehicle movements to deliver materials to construction site.
- Impacts on local air quality due to increased HGV movements and other activities associated with construction.
- Embodied and operational carbon consumption from energy intensive processes required to treat wastewater effluent at the site and pump it to the discharge location on the River Lee, upstream of Thames Water's abstraction intakes for the Lee Valley Reservoirs.

Major beneficial effects are identified in respect of the provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. Moderate effects relate to sustainable management of water abstraction and provision of water supply resilience to climate change risks.

Construction works to expand the capacity of the **Kempton and Coppermills Water Treatment Works** will require the application of a series of mitigation measures as set out in the HRA Report. These measures are necessary during the construction period to protect designated bird species associated with nearby Special Protection Areas and Ramsar sites (these are internationally important conservation sites designated for the protection of important bird species and their habitats).

There are a substantial number of relatively small **groundwater schemes** included in this programme (**Figure 7.6**) including options to optimise the use of existing groundwater sources and several artificial recharge (AR) and artificial storage and recovery (ASR) groundwater schemes. The residual effects of these schemes are mostly characterised by negligible to minor effect significance, although there is one major adverse effect for the **Britwell groundwater source** associated with the risk of WFD status deterioration for which there is uncertainty about the impacts and the potential need to mitigate the effects. Mitigation measures may be necessary to secure WFD compliance in respect of the Ashton Keynes and Epsom groundwater options following the conclusion of planned site specific investigations and options appraisal. Beneficial effects for these schemes are mostly negligible to minor.

The **Chingford and Didcot raw water purchase schemes** involve no net change in current abstraction from the Lee Valley Reservoirs and River Thames, respectively, and optimise use of

existing water resources. The residual effects of these schemes are mostly characterised by negligible to minor effect significance.

For the **Wessex to SWOX transfer** scheme, three moderate adverse effects are identified in relation to biodiversity, health and well-being and greenhouse gas emissions as a result of construction activities. The HRA Assessment shows that there would be no likely significant effects on any European sites. The WFD assessment concludes no overall likely risk to WFD status. Two moderate beneficial effects are associated with the provision of a secure resilient supply of drinking water and providing essential water supply infrastructure to help support a sustainable socio-economy.

The **Medmenham intake to SWA** option would have two major adverse effects, on biodiversity with some of the development being adjacent to a SSSI and landscape effects with works being undertaken in the Chilterns AONB. There would also be five moderate adverse effects on health and wellbeing, soil, air quality and heritage.

The **demand management programmes** provide moderate to major beneficial environmental effects but there are some moderate and minor adverse effects associated principally with leakage control activities in urban areas (for example traffic congestion from road closures and associated effects on air quality), but most adverse effects are assessed as negligible.

Cumulative effects

No construction-related cumulative effects were identified as the timing of construction/development of the different options do not overlap (see **Appendix G**).

Negligible cumulative effects are anticipated between operation of the South East Strategic Reservoir and the Oxford Canal transfer scheme given the small additional volume of river flow support to the Middle River Thames from the canal transfer (15 Ml/d).

Cumulative operational adverse effects due to concurrent operation of the Beckton desalination scheme and the Deephams reuse scheme would be of moderate magnitude but the combined impact on freshwater flows in the Thames Tideway would remain well below the threshold of 275 Ml/d above which there are WFD compliance risks and potential effects on the Recommended Thames Estuary Marine Conservation Zone.

Negligible cumulative operational effects are assessed in relation to the South East Strategic Reservoir scheme operating concurrently with the Didcot and Medmenham options further downstream on the River Thames. Concurrent operation of the Didcot and Medmenham options would have only negligible adverse cumulative effects.

Assessment Conclusions

The schemes forming this programme are, with the application of mitigation measures, compliant with Habitats Regulations and WFD objectives, but there remains uncertainty as to whether mitigation measures for the Britwell option would remove the uncertain risks of WFD status deterioration. The programme presents some environmental challenges, mainly during the construction phase, but most major effects can be mitigated such that, overall, the environmental and social effects of this programme are predominately of a **minor to moderate** significance (both adverse and beneficial effects).

Some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the South East Strategic Reservoir Option and Beckton desalination scheme) or may be permanent in nature.

This environmental performance of this programme is relatively less challenging compared to most of the other reasonable alternative programmes considered with the exception of the NearO_TP and Min_IGEQ programmes.

Figure 7.6 Least Cost Programme (Phased_LC) SEA Summary

Option	HRA	WFD	SEA OBJECTIVES																					
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
London Demand Management																									Minor Adverse
																									Major Beneficial
New River Head Removal of Constraints																									Minor Adverse
																									Minor Beneficial
AR Merton (SLARS3)																									Minor Adverse
																									Minor Beneficial
ASR Horton Kirby																									Minor Adverse
																									Minor Beneficial
Groundwater Addington																									Minor Adverse
																									Minor Beneficial
Deephams Reuse																									Moderate Adverse
																									Moderate Beneficial
RC Epsom																									Minor Adverse
																									Minor Beneficial
Oxford Canal to Cropredy 15Ml/d																									Minor Adverse
																									Minor Beneficial
Groundwater Southfleet																									Minor Adverse
																									Minor Beneficial
Chingford RWP																									Negligible Adverse
																									Minor Beneficial
South East Straetgic Reservoir Option 125Mm³																									Major Adverse
																									Moderate Beneficial
Groundwater London confined Chalk (north) - 2 MLD																									Minor adverse
																									Minor beneficial
AR Streatham (SLARS2) - 5 MLD																									Minor adverse
																									Minor beneficial
ASR_South East London (Addington)																									Minor adverse
																									Minor beneficial
Merton recommissioning																									Minor adverse
																									Minor beneficial

Option	HRA	WFD	SEA OBJECTIVES																						
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
ASR Thames Valley/Thames Central																									Minor adverse
																									Minor beneficial
Beckton Desalinisation 150																									Moderate adverse
																									Moderate Beneficial
Coppermills WTW Extension 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Kempton WTW New 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Didcot RWP																									Negligible Adverse
																									Minor Beneficial
Groundwater Datchet																									Minor adverse
																									Minor beneficial
SWA Demand Management																									Minor adverse
																									Moderate beneficial
SWOX Demand Management																									Minor adverse
																									Moderate beneficial
Groundwater - Moulsford 1 - 3.5 MLD																									Minor adverse
																									Minor beneficial
RC Ashton Keynes borehole pumps - 2.5 MLD																									Minor adverse
																									Minor beneficial
RC Britwell - 1.31 MLD																									Moderate Adverse
																									Minor beneficial
Wessex to SWOX (Flaxlands)																									Minor adverse
																									Minor beneficial
Medmenham raw water intake and transfer 80 Ml/d																									Moderate Adverse
																									Moderate Beneficial

Overall Programme Assessment:
Minor to Moderate Adverse Effects
Minor to Moderate Beneficial Effects

7.2.7 Reasonable alternative programme assessment conclusions

The SEA of each of the reasonable alternative programmes has highlighted that:

- Given the scale of the supply deficit faced over the next 80 years, it is not considered feasible to develop a programme that would lead to only minor adverse cumulative effects. Some major adverse effects from options are therefore inevitable, albeit that they can be mitigated such that, overall, the environmental and social effects of the programmes are predominately of a **minor to moderate** significance (both adverse and beneficial effects).Three of the six programmes (Multi_Obj_RES, Multi_Obj_FP and NearO_RES) are assessed as having potential for some cumulative major adverse effects, with the Multi_Obj_FP programme having the greatest magnitude of cumulative adverse effects. All of these programmes have several WFD cumulative compliance risks. They would present significant challenges for promotion and obtaining required permissions and approvals.
- The other three programmes are assessed as having the potential for cumulative moderate adverse effects. These are broadly similar in overall scale of effects with little to choose between them, but a relative ranking shows that the NearO_TP has the fewest environmental challenges due to a much smaller programme of schemes. For these programmes, WFD risks can be addressed if the Britwell groundwater option is removed from relevant programmes and mitigation measures are applied where identified for specific other options in the WFD assessments.
- Effects are geographically spread across the Thames river basin: some programmes lead to greater effects in the Thames Tideway whilst some others result in the concentration of effects in the Middle Thames. Some programmes also affect the Severn river basin, increasing the overall magnitude of cumulative effects (mainly due to inclusion of the Minworth flow support option for programmes that include the Severn-Thames Transfer) which brings WFD compliance risks.
- Programmes that involve both the South East Strategic Reservoir and the Severn-Thames Transfer give rise to WFD cumulative compliance risks in the Middle River Thames as discharges to the river would exceed the approximate 500 Ml/d threshold above which changes to the low flow regime may start to adversely affect aquatic ecology and geomorphology of the river reach downstream of Culham.
- Programmes that involve both desalination and reuse schemes at a cumulative capacity above 275 Ml/d give rise to possible WFD compliance risks in the Thames Tideway due to potential effects on saline-sensitive aquatic species, and may also affect the Recommended Thames Estuary Marine Conservation Zone.

Table 7.1 summarises the overall relative environmental performance of each of the programmes taking account of the SEA findings set out above. A relative ranking of the programmes is shown.

These assessments also demonstrated that there are viable alternative options available to each of the different programmes at comparable levels of environmental effects.

Table 7.1 Relative comparative summary of the six reasonable alternative options considered in the SEA (and associated HRA and WFD assessments)

Multi_Obj RES	Phased_LC	Multi_Obj_FP	NearO_ RES	NearO_TP	Min_IGEQ	
Several WFD Risks	One small WFD Risk	Several WFD Risks	Several WFD Risks	No WFD Risks	One small WFD Risk	
Multiple material planning risks	Single material planning risk	Multiple material planning risks	Single material planning risk	Single material planning risk	Single material planning risk	
Impacts mostly fall in Thames Valley and River Severn catchment	Impacts mostly fall in Thames Valley and Thames Tideway	Impacts mostly fall in Thames Valley, Thames Tideway and River Severn	Impacts mostly fall in Thames Valley, Thames Tideway and River Severn	Impacts fall in Thames Valley and Thames Tideway	Impacts fall in Thames Valley and Thames Tideway	
Major Adverse	Moderate Adverse	Major Adverse	Major Adverse	Moderate Adverse	Moderate Adverse	Cumulative Programme SEA
5	3	6	4	1	2	Indicative Ranking
"Challenging"	"Some difficulties"	"Extremely challenging"	"Fairly challenging"	"A few difficulties"	"A few difficulties"	

7.3 SEA of Preferred Programme for WRMP19

7.3.1 Role of SEA in developing the preferred programme

Development of the preferred programme for the WRMP19 was informed by the above SEA considerations of the short-listed reasonable alternative programmes. Given the fact that all of the alternative programmes are characterised by at least moderate adverse cumulative environmental effects, consideration was given as to how each of these alternative programmes might be improved to improve the environmental performance. This process helped to further identify those features of each programme that present the greatest environmental challenges and which should be avoided in developing the preferred programme.

Discussions on the selection of a preferred programme also explored the potential additional measures that could be incorporated into the preferred programme to improve the overall environmental outcomes of the plan. Such considerations also reflected the strong stakeholder feedback on the draft WRMP19 that Thames Water needed to secure greater environmental benefits from delivery of its WRMP19 given the environmental dis-benefits associated with development of major new water sources.

The following key findings from the SEA of the reasonable alternative programmes and the subsequent review of opportunities for reducing programme cumulative adverse effects and increasing cumulative beneficial effects were taken into consideration in making decisions on the preferred programme:

• Demand Management Programmes provide material benefit to the environment and should be delivered early in the planning period. It would be very challenging to increase the scale of demand management savings much further with reasonable certainty of delivery.
• There are several residual WFD uncertainties/risks included in most of the reasonable alternative programmes that should be avoided unless it can be demonstrated there are no reasonable alternatives:
  - Britwell groundwater option due to uncertainty over impacts and any mitigation measures to avoid WFD deterioration risks
  - Minworth effluent support for the Severn-Thames Transfer due to challenges in securing acceptable mitigation measures to ensure no WFD deterioration risks.

- Scheme capacities that lead to potential cumulative WFD risks if combined flow support discharges to the Middle River Thames exceed a threshold value of approximately 500 Ml/d
- Scheme capacities that lead to the potential for cumulative WFD risks and Marine Conservation Zone (MCZ) risks to the Thames Tideway if water reuse and/or desalination schemes exceed a cumulative size in excess of 275 Ml/d due to potential adverse effects on the salinity regime of the Tideway and consequent effects on saline-sensitive species

• Small schemes (less than 50 Ml/d) – except the Britwell groundwater scheme – have fewer adverse environmental effects than the larger strategic schemes, both individually and cumulatively. Environmentally, these should be preferred to larger schemes but it is equally recognised that larger strategic schemes are essential to address the future supply deficit.
• Water reuse options are marginally preferable to desalination options – construction effects are similar but operational effects are marginally worse for the desalination options. Non environmental factors will be more important in deciding which of these options to include in the preferred programme.
• Options that can deliver environmental benefits with overall minor adverse effects are preferable if there are real choices to be made between options.
• Consider opportunities for net environmental gain in developing the preferred programme given Defra's 25 Year Environment Plan policy objectives, the policies included in the revised National Planning Policy Framework 2018 and stakeholder feedback on the draft WRMP19. This could include, for example, considering measures to reduce abstraction from those chalk streams in the Thames river basin assessed as being sensitive to existing Thames Water abstractions.
• The material planning and/or public inquiry (or DCO process under the NSIP regime) risks that could arise in respect of the Severn-Thames Transfer scheme and South East Strategic Reservoir option
• In terms of phasing of options, the SEA conclusions only influence consideration of minimising cumulative construction effects. The SEA of the reasonable alternative programmes indicated that, if at all possible, overlapping construction periods should be avoided in respect of:

- South East Strategic Reservoir with the Severn-Thames Transfer conveyance pipeline
- Beckton reuse and Beckton desalination schemes

• In relation to environmental considerations at key decision points over the planning period, having regard to projected need as set out in Section 10 of the WRMP19, the results of the SEA assessments would suggest:

- **Up to 2030** - SEA would favour development of smaller schemes rather than a larger scheme (for example, desalination or water reuse) to address the identified need on the basis that smaller schemes have generally been found to have fewer adverse environmental effects and therefore should be developed first as part of the longer term plan.
- **2037** – as set out in Section 10 of the WRMP19 further need is identified at around this time to allow for future regional supply requirements. The South East Strategic Reservoir option has a lower level of adverse environmental effects compared to the Severn-Thames Transfer option. Thames Water has proposed the largest (150 Mm^3) South East Strategic Reservoir option in 2037, timed with the need from Affinity Water. Thames Water considers that if a reservoir is selected it should be built to maximise its potential benefit to the supply demand balance. The delivery of largest South East Strategic Reservoir option creates sufficient surplus in the supply demand balance which can be used to facilitate a reduction in some of Thames Water's abstractions that are perceived to have an adverse impact on vulnerable chalk streams and water courses. Thames Water's groundwater abstractions at Pann Mill (River Wye), Waddon (River Wandle) and North Orpington (River Cray) have previously been examined for environmental impact but the investigations concluded that it was not cost beneficial to reduce abstraction at these sites. The South East Strategic Reservoir option with its low annual operating costs will help to reduce abstraction at these sites and thereby address the concerns voiced by environmental groups.
- **2080s** – any remaining small schemes are favoured, but otherwise water reuse schemes are marginally preferable to desalination schemes. The Severn-Thames Transfer is the least favoured option environmentally, mainly due to large scale effects of the pipeline construction on the Cotswolds AONB and also the WFD deterioration risks associated with the Minworth flow support element (if selected as part of the supported transfer scheme). However, given that additional water resources are likely to be required in the west of the Thames Water

supply area by this time, it will be important to avoid cumulative WFD risks by keeping the cumulative flow discharges to the Middle River Thames at or less than approximately 500 Ml/d from a Severn-Thames Transfer scheme when operating in conjunction with discharges from the South East Strategic Reservoir.

Further details on how these SEA considerations were taken into account alongside other decision-making criteria in the development of the preferred programme are provided in Section 10 of the WRMP19.

7.3.2 SEA of the Preferred Programme

Overview of the preferred programme
The options finally selected for the preferred programme are shown in **Figure 7.7** and **Table 7.2** and vary in size, location and scale; consequently, the environmental and social effects also vary between the different options. Given the scale of the long-term supply deficit over the 80 year planning period, some major water supply schemes and a comprehensive Demand Management Programme are required to secure a supply-demand balance, with some smaller scale groundwater schemes needed in the very short term to address immediate deficits.

Details of the preferred programme delivery schedule are provided in **Appendix G** and the SEA of each of the individual options making up this programme are to be found in **Appendix F**. Each option within the preferred programme has been subject to the same environmental and social assessment process as set out in Section 7.2 above, and the findings are summarised in **Figure 7.7** below.

A summary of the key environmental social effects of the programme are provided below. Carbon effects have been monetised (£ values) and were included in the programme appraisal model as a financial dis-benefit (or benefit where carbon savings identified): consequently, carbon effects were not considered in defining the environmental metric gradings for each option element included in the programme appraisal model in order to avoid 'double counting' of carbon effects.

In developing the preferred programme, Thames Water has sought, where possible, to take account of the key conclusions of the SEA of the reasonable alternative programmes and minimise cumulative adverse effects as a first priority and secondly to assess where further environmental benefits could be realised from delivery of the plan as a whole. The major cumulative adverse effects highlighted in the SEA of the reasonable alternative programmes (and particularly in respect of WFD cumulative compliance risks) have been avoided.

Additionally, Thames Water has included the largest (150 Mm^3) South East Strategic Reservoir option in 2037, timed with the need from Affinity Water. Thames Water considers that if a reservoir is selected it should be built to maximise its potential benefit to the supply demand balance. The delivery of largest South East Strategic Reservoir option creates sufficient surplus in the supply demand balance which can be used to facilitate a reduction in some of Thames Water's abstractions that are perceived to have an adverse impact on vulnerable chalk streams and water courses. Thames Water's groundwater abstractions at Pann Mill (River Wye), Waddon (River Wandle) and North Orpington (River Cray) have previously been examined for environmental impact but the investigations concluded that it was not cost beneficial to reduce abstraction at these sites. The South East Strategic Reservoir option with its low annual operating costs will help to reduce abstraction at these sites and thereby address the concerns voiced by environmental groups. Delivering this environmental improvement will also require a number of new pipelines and pumping stations to be constructed to ensure that customers continue to receive a resilient water supply. These additional "chalk stream assets" have been assessed as part of the SEA of the preferred programme (see below).

The development of these additional "chalk stream assets" along with the new strategic water sources will enable Thames Water to deliver the environmental improvements to vulnerable chalk streams and water courses through the reduction and re-location of abstraction. This responds to a number of stakeholder concerns raised during the consultation process about the draft WRMP19 delivering

environmental improvement alongside enhanced water supply resilience. Further details are provided in Section 10 of the WRMP19 but **Table 7.3** below summarises the vulnerable chalk streams and water courses where existing abstractions will be reduced or modified, and outlines how this will be achieved.

Table 7.2 Options included in the Preferred Programme of the WRMP19

Aquifer Storage and Recovery (ASR) Horton Kirby	Groundwater Southfleet/Greenhithe (new WTW) 8 Ml/d
AR SLARS Kidbrooke (SLARS1) 7 Ml/d	Kempton WTW new 100 Ml/d
AR Merton (SLARS3) 5 Ml/d	Medmenham intake to SWA
ASR South East London (Addington) 3 Ml/d	Merton Recommissioning
Chingford Raw Water Purchase	New River Head - Removal of Constraints
Coppermills WTW extension 100 Ml/d	Oxford Canal to Cropredy Resource 15 Ml/d
Culham to Farmoor 180 Ml/d (Chalk Streams)	RC Epsom borehole pumps - 2.13Ml/d (groundwater scheme)
Deephams Reuse	Severn-Thames Transfer 1
Dapdune Removal of Constraints	South East Strategic Reservoir Option 150Mm^3
Didcot Raw Water Purchase	NTC Ladymead + Shelford to Albury transfer main
Groundwater Addington 1 Ml/d	SWA Pipelines (Chalk Streams)
Groundwater Datchet 6Ml/d	South East London Pipelines (Chalk Streams)
Groundwater Dapdune	South West London Pipelines (Chalk Streams)
River Lee New Gauge pipeline (Chalk Streams)	Demand Management Programmes for each WRZ

Table 7.3 Vulnerable chalk streams and watercourses

Source	Waterbody	WRZ	Reduction		Scheme
			Average (Ml/d)	Peak (Ml/d)	
Farmoor	Thames	SWX	0	0	Re-location of abstraction point at low flows to downstream of Oxford at Culham to improve flow regime in the Oxford Watercourses
New Gauge	Lee (Amwell Magna Loop)	LON	0	0	Relocation of abstraction at low flows to improve flow regime in Amwell Magna Loop
Pann Mill	Wye	SWA	9.8	9.8	Reduce abstraction facilitated by new strategic sources and new intra-zonal pipelines and pumping stations in SE London, SW London and in the SWA water resource zone.
Waddon	Wandle	LON	7.2	15.1	
North Orpington	Cray	LON	8.8	8.8	

Assessment of the preferred programme

The preferred programme includes development of the South East Strategic Reservoir at the maximum 150Mm3 capacity by 2037. The **South East Strategic Reservoir** 150Mm^3 option has several significant adverse and beneficial effects. Major adverse effects include:

- Temporary but extended impacts on communities during construction of the reservoir
- Significant consumption of resources and materials
- Impacts on local air quality and a rise in GHG emissions due to increased HGV movements and other activities associated with construction

- Impacts on archaeological and heritage assets during construction and operation, including Listed Buildings and Registered Parks in close proximity to the land acquisition area
- Permanent landscape impacts on surrounding area and scheme visible from the North Wessex Downs AONB

Moderate adverse effects include:

- Weir pools in the River Thames may also be affected due to the potential change in their level and flow regime from operation of the reservoir.
- Potential for temporary but extended construction effects on natural capital and ecosystem services.
- Moderate adverse effects related to socio-economic development in local area due to a loss of some local employment facilities
- Disruption to recreational activities as large areas of land and public rights of way become permanently inaccessible
- Impacts on watercourses
- Impacts on soil, geology and land use during construction including removal of land from agricultural use

Major beneficial effects are identified in respect of the long-term provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. The scheme also reduces the impact of additional abstraction from the River Thames at times of low river flows to meet demand growth in both London and SWOX. Furthermore, there are likely to be opportunities to provide numerous recreational benefits over the long term through water-based activities, provision for rehabilitation of part of the Wiltshire and Berks Canal and new footpaths around the reservoir area. Construction will bring employment opportunities for residents in the local area, with the potential for longer term job opportunities once the reservoir is operational. Additionally, as described above, the development of the 150 Mm3 capacity reservoir provides supply headroom from 2037 to reduce abstraction from vulnerable chalk streams and water courses as summarised earlier in **Table 7.3.**

A moderately sized supported **Severn-Thames Transfer** scheme (**Severn-Thames Transfer** 1 sized up to a maximum capacity of 300 Ml/d to allow substantial abstraction when river flows in the lower Severn are high) is included in the preferred programme, with flow support options selected (Mythe, Netheridge, Vyrnwy transfer to Severn Trent and transfer from Vyrnwy reservoir support elements) to minimise WFD risks to the River Severn catchment.

Major adverse effects of the Severn -Thames transfer scheme identified arise due to:

- Temporary but long-term effects on local communities during construction of the water pipeline to move the water from the River Severn to the River Thames and other new infrastructure, including the Netheridge to Deerhurst pipeline which is a supporting element in the option.
- Significant resource consumption associated with the scale of the construction works required and the operational treatment of water.
- Potential construction risks to a range of Listed Buildings, Scheduled Monuments, Registered Parks and Gardens and other heritage assets around Deerhurst and along the pipeline route.
- Effects on landscape with large parts of the scheme located within the Cotswolds AONB . In the short to medium term (approximately 5 years) after construction, fields affected by the construction works would return to their original condition. In the longer term (approximately 15 years) after initial construction, re-planting along the pipeline route would mature and hedgerow connections re-established, aiding integration into the landscape and setting of the AONB.

Moderate adverse effects have been identified in respect of:

- Embodied and operational carbon consumption
- Temporary construction activity effects on air quality associated with vehicle movements to deliver materials to construction sites.
- Temporary effects on soils and land-use during construction work over a wide area.
- Changes to the river flow regime in the River (Afon) Vyrnwy by increasing river flow releases by up to 60 Ml/d from Lake Vyrnwy reservoir at times of low flow conditions when the transfer is required to operate during low flows in the River Severn are of no greater than of moderate effect. The 60 Ml/d flow releases are not considered likely to lead to a deterioration of WFD status in the Afon Vyrnwy subject to application of mitigation measures to protect fish and geomorphological processes.
- Temporary construction effects on recreational amenities.
- Potential for temporary but extended construction effects on natural capital and ecosystem services.
- Construction effects on non-Ancient Woodland trees, some sections of hedgerows and associated vegetation along the Deerhurst to Culham and Netheridge to Deerhurst pipeline routes.

Major beneficial effects are identified in respect of the provision of a substantial volume of reliable water supplies and improved resilience to the water supply system, with use of surplus water resources to support the provision of the additional supplies.

The scheme enables access to a significant raw water storage at Vyrnwy Reservoir, providing greater resilience of the Thames Water supply system to the potential effects of climate change. The scheme reduces the impact of additional abstraction from the River Thames at times of low river flows to meet demand growth in both London and SWOX. The provision of up to 300 Ml/d of additional water supplies to London and SWOX will help safeguard the health and wellbeing of a significant population, as well as supporting socio-economic improvements.

Moderate beneficial effects of the transfer scheme relate to a more sustainable water resource management regime, bringing water resources from the wetter north-west to the drier south-east of England.

For the **Oxford Canal transfer** scheme, there are five moderate adverse effects relating to population and human health, water quality, air quality and cultural heritage. The HRA Assessment shows that there would be no likely significant effects on European sites. The WFD assessment concludes no overall likely risk to WFD status. Three moderate beneficial effects are identified with respect to population and human health, material assets use and optimising use of existing water sources.

The **Deephams Reuse** scheme has predominantly minor to moderate adverse impacts. However, major impacts include:

- Temporary construction activity effects on air quality associated with vehicle movements to deliver materials to construction site.
- Impacts on local air quality due to increased HGV movements and other activities associated with construction.
- Embodied and operational carbon consumption from energy intensive processes required to treat wastewater effluent at the site and pump it to the discharge location on the River Lee, upstream of Thames Water's abstraction intakes for the Lee Valley Reservoirs.

Major beneficial effects are identified in respect of the provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. Moderate effects relate to, sustainable management of water abstraction and provision of water supply resilience to climate change risks.

Construction works to expand the capacity of the **Kempton and Coppermills Water Treatment Works** will require the application of a series of mitigation measures as set out in the HRA Report. These measures are necessary during the construction period to protect designated bird species associated with nearby Special Protection Areas and Ramsar sites (these are internationally important conservation sites designated for the protection of important bird species and their habitats).

There are several relatively small **groundwater schemes** included in this programme (**Figure 7.7**) including options to optimise the use of existing groundwater sources and several artificial recharge (AR) and artificial storage and recovery (ASR) groundwater schemes. The residual effects of these schemes are mostly characterised by negligible to minor effect significance. Following options appraisal, mitigation measures may be necessary to avoid WFD deterioration risks in respect of the Epsom groundwater option once more detailed investigations of the effects of increasing abstraction within existing licence limits are completed in dialogue with the Environment Agency. In the event that such mitigation measures are not resolved with stakeholders other groundwater schemes could be utilised. Beneficial effects for these schemes are mostly negligible to minor.

The **Chingford and Didcot raw water purchase schemes** involve no net change in current abstraction from the Lee Valley Reservoirs and River Thames, respectively, and optimise use of existing water resources. The residual effects of these schemes are mostly characterised by negligible to minor effect significance.

The **Medmenham intake to SWA** option would have two major adverse effects, on biodiversity with some of the development being adjacent to a SSSI and landscape effects with works being undertaken in the Chilterns AONB. There would also be five moderate adverse effects on health and wellbeing, soil, air quality and heritage.

Construction of the **"chalk stream" pipelines** (SWA, Culham to Farmoor, River Lee New Gauge, SW and SE London) and associated pumping stations give rise to mostly negligible to minor adverse effects during construction with the application of mitigation measures to protect the environment. There are two major adverse effects identified associated with the SWA pipelines options associated with development being partially located within a registered park and garden as well as works being undertaken within the North Wessex Downs AONB and Chilterns AONB. Mitigation measures will include consultations with key stakeholders to review route realignments and use of pipe-jacking during the construction of the option. The SWA pipelines option would have eight moderate adverse effects related to: biodiversity and the potential for temporary but extended construction effects on natural capital and ecosystem services; resource use; soils; and air quality. The Culham to Farmoor pipeline would have a number of moderate adverse related to construction impacts on biodiversity; natural capital and ecosystem services; health and wellbeing; recreational assets; material use air quality; heritage and landscape. Moderate adverse effects related to the River Lee New Gauge pipeline construction activities due to air quality, health and well-being and proximity to European sites, SSSIs and Ancient Woodland. The SW London pipeline has two moderate adverse effects related to health and well-being and biodiversity due to the proximity of construction works to the Bessborough Reservoir which is a constituent part of the South West London Waterbodies SPA and Ramsar site. However, with the application of best practice construction mitigation measures to reduce noise, screen workings and avoid light pollution no adverse effects on site integrity or the ability of the site to achieve its conservation objectives are predicted. The SE London pipeline has two moderate adverse effects related to health and well-being and air quality. There are negligible adverse effects during operation of the pipelines. Development of these chalk stream assets will secure the delivery of moderate environmental benefits to various vulnerable chalk streams and water courses as set out above in **Table 7.3**.

The **demand management programmes** provide moderate to major beneficial environmental effects but there are some moderate and minor adverse effects associated principally with leakage control activities in urban areas (for example traffic congestion from road closures and associated effects on air quality), but most adverse effects are assessed as negligible.

Figure 7.7 Environmental and social assessment findings for the preferred programme

Option	HRA	WFD	SEA OBJECTIVES																							
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
London Demand Management																									Minor Adverse
																									Major Beneficial
Culham to Farmoor Pipeline																									Moderate Adverse
																									Minor Beneficial
River Lee New Gauge pipeline (chalk streams)																									Minor Adverse
																									Minor Beneficial
SWA pipelines (chalk streams)																									Moderate Adverse
																									Minor Beneficial
South West London pipelines (chalk streams)																									Moderate Adverse
																									Minor Beneficial
South East London pipelines (chalk streams)																									Minor Adverse
																									Minor Beneficial
New River Head Removal of Constraints																									Minor Adverse
																									Minor Beneficial
AR Merton (SLARS3)																									Minor Adverse
																									Minor Beneficial
ASR Horton Kirby																									Minor Adverse
																									Minor Beneficial
Groundwater Addington																									Minor Adverse
																									Minor Beneficial
Deephams Reuse																									Moderate Adverse
																									Moderate Beneficial
RC Epsom																									Minor Adverse
																									Minor Beneficial
Oxford Canal to Cropredy 15Ml/d																									Minor Adverse
																									Minor Beneficial
Groundwater Southfleet																									Minor Adverse
																									Minor Beneficial

Option	HRA	WFD	SEA OBJECTIVES																					
			1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	3.2	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	6.1	6.2	6.3	7.1	8.1	
Chingford RWP																									Negligible Adverse
																									Minor Beneficial
South East Straetgic Reservoir Option 150Mm³																									Major Adverse
																									Moderate Beneficial
ASR_South East London (Addington)																									Minor adverse
																									Minor beneficial
Merton recommissioning																									Minor adverse
																									Minor beneficial
AR SLARS Kidbrooke (SLARS1)																									Minor adverse
																									Minor beneficial
Severn Thames Transfer 1																									Major Adverse
																									Moderate Beneficial
Coppermills WTW Extension 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Kempton WTW New 100 MLD																									Moderate Adverse
																									Moderate Beneficial
Didcot RWP																									Negligible Adverse
																									Minor Beneficial
Groundwater Datchet																									Minor adverse
																									Minor beneficial
Medmenham intake to SWA																									Moderate Adverse
																									Moderate Beneficial
SWA Demand Management																									Minor adverse
																									Moderate beneficial
SWOX Demand Management																									Minor adverse
																									Moderate beneficial
Demand Management Kennet Valley																									Minor adverse
																									Minor beneficial
Demand Management Guildford																									Minor adverse
																									Minor beneficial
NTC Ladymead + Shalford to Albury transfer main)																									Moderate adverse
																									Minor beneficial
NTC Dapdune																									Minor adverse
																									Minor beneficial
GW Dapdune																									Negligible Adverse
																									Minor beneficial
Demand Management Henley																									Minor adverse
																									Minor beneficial

Overall Programme Assessment:

Minor to Moderate Adverse Effects

Minor to Moderate Beneficial Effects

Cumulative effects

Moderate construction-related cumulative effects were identified in relation to the concurrent construction of the Culham to Farmoor pipeline and the South East Strategic Reservoir scheme This will require careful planning and scheduling as part of the construction mitigation programme to minimise both temporary environmental effects, such as impacts on the landscape and effects on local communities, in dialogue with environmental regulators, local authority planners, AONB committees, local residents and local stakeholder groups. More detailed assessments including landscape assessments would be undertaken to inform the detailed design as well as the construction management plans for these options. Such assessments would also be prepared to support any application for development consent.

No other construction-related cumulative effects were identified as the timing of construction and development of the different options do not overlap (see **Appendix G**).

Moderate cumulative operational adverse effects would arise in relation to concurrent operation of the Severn-Thames transfer scheme, Oxford Canal scheme, Culham to Farmoor "chalk stream" pipeline transfer and the South East Strategic Reservoir scheme. However, the cumulative volume of flow discharges to the Middle Thames will remain below the cumulative flow discharge threshold value of approximately 500 Ml/d at Culham above which risks to WFD status deterioration start to develop due to the change to the low flow regime of the river in the reach downstream of Culham. As discussed in the WFD assessment report, concurrent operation of the South East Strategic Reservoir, the Culham to Farmoor pipeline transfer and a supported Severn-Thames Transfer scheme will all modulate flow in the River Thames locally at Culham and downstream. For these options, a combined detailed operating strategy will be developed with environmental regulators and other stakeholders to manage these flow modulation effects a set of through operating rules to ensure WFD compliance in terms of the potential ecological impacts on the River Thames locally and downstream. Negligible cumulative operational effects are assessed in relation to these three schemes operating concurrently with the Didcot and Medmenham options further downstream on the River Thames.

Concurrent operation of the Didcot and Medmenham options would have only negligible adverse cumulative effects.

Assessment Conclusions

The schemes forming this programme are compliant with Habitats Regulations with delivery of specified construction mitigation measures identified in the HRA report.

The schemes forming this programme are compliant with the WFD objectives, with no risk of WFD status deterioration. Following options appraisal, mitigation measures may be necessary to be implemented in the form of additional flow augmentation support and/or abstraction licence controls to avoid WFD deterioration risks in respect of the Epsom groundwater option once more detailed investigations of the effects of increasing abstraction within existing licence limits are completed in dialogue with the Environment Agency. In the event that such mitigation measures are not resolved with stakeholders other groundwater schemes could be utilised.

Overall, the environmental and social effects of this programme are predominately of **minor to moderate** significance (both adverse and beneficial effects). Some major adverse effects have been identified, which is to be expected given the scale of the schemes necessary to address a very large supply deficit. Many of these major effects are temporary in nature and largely unavoidable while construction works take place. However, some of the major effects are related to extended construction periods over a number of years (in respect of the Severn-Thames transfer scheme pipeline and the South East Strategic Reservoir) or may be permanent in nature. Major beneficial effects are identified in respect of the long-term provision of a substantial volume of reliable water supplies and improved resilience to the water supply system. The scheme also reduces the impact of additional abstraction from the River Thames at times of low river flows to meet demand growth in both London and SWOX. There are likely to be opportunities to provide numerous recreational benefits over the long term and construction will bring employment opportunities for residents in the local area, with the potential for longer term job opportunities once the reservoir is operational.

Additionally, the development of the 150 Mm3 capacity reservoir provides supply headroom from 2037 to reduce abstraction from vulnerable chalk streams and water courses as summarised earlier.

This programme presents several challenges in delivery and operation from a planning and environmental perspective, requiring agreement of extensive mitigation measures for several schemes to avoid adverse effects in relation to European Sites and national environmental designations (including SSSIs, AONBs and heritage designations). The environmental performance of this programme is characterised by moderate adverse effects but has the advantage over the reasonable alternative programmes considered by:

- Removing schemes with WFD compliance risks (Minworth and Britwell options)
- Reducing the scale of the cumulative effects of the Severn Thames transfer and South East Strategic Reservoir at Culham to an acceptable level that avoids cumulative WFD compliance risks
- Avoids cumulative WFD and Recommended MCZ compliance risks for the Thames Tideway by only developing the Deephams reuse scheme
- Provides for a material reduction in abstraction by Thames Water in low flow conditions from various vulnerable chalk streams and water courses by creating sufficient supply headroom and developing additional water supply transfer infrastructure from 2037. This measure materially improves the overall environmental performance of the WRMP19.

7.3.3 Sensitivity testing

Details on the sensitivity and scenario testing undertaken as part of the programme appraisal are provided in Section 10 of the WRMP19.

7.3.4 Consideration of reasonable alternatives

Through the assessment of several alternative programmes as described above, the SEA has identified that feasible alternative schemes exist that could be developed with acceptable environmental and social effects that are comparable to those schemes included in the preferred programme of the WRMP19. Substitute schemes are therefore available for consideration if it becomes necessary to adapt to changing conditions over the long-term implementation of the WRMP19.

8 Cumulative Effects of the WRMP19 Preferred Programme with other Plans, Programmes and Projects

As set out in Section 5.4, the term 'cumulative effects' is adopted as the collective term to include secondary, cumulative and synergistic effects (as indicated by the Practical Guide). The cumulative effects include consideration of other plans, programmes and projects in the context of spatial and/or temporal proximity, including the following:

- Thames Water's revised draft Drought Plan 2018
- Neighbouring water companies' WRMPs and Drought Plans
- Environment Agency Drought Plans
- River Basin Management Plans
- Local development and land use plans
- Other major infrastructure projects

8.1 Thames Water's Revised Draft Drought Plan 2018

Thames Water's revised draft Drought Plan 2018[32] (covering the period to 2023) sets out the range of demand management and supply augmentation measures that the company may need to implement during drought conditions to maintain essential water supplies to its customers. The measures include water use restrictions (Temporary Use Bans and Drought Orders to further restrict non-essential water use) as well as Drought Permit or Drought Order options to temporarily authorise amendments to abstraction licence conditions to enable more water to be abstracted during drought from water sources.

The WRMP19 and the revised draft Drought Plan 2018 are fundamentally linked, with the measures contained in each plan acting in combination to provide a resilient water supply to customers in the Thames Water region and safeguard the provision of essential water supplies in drought conditions. In particular, the WRMP19 includes schemes to provide greater resilience to severe drought conditions by ensuring that, despite significant growth in demand for water, there are sufficient water supplies reliably available to sustain essential water supplies during a severe drought that may only occur on average once in every 200 years. The supply schemes are complemented by a very substantial programme of demand management measures to reduce the scale of future growth in demand.

The demand management measures in the revised draft Drought Plan 2018 have **moderate beneficial** effects on the water environment in combination with the extensive demand management programmes included in the WRMP by reducing the pressure on water resources in periods of prolonged dry weather when river flows and groundwater levels are well below normal.

In terms of geographic location, a review of the Thames Water's revised draft Drought Plan 2018 supply augmentation options identified the following possible cumulative effects with the WRMP19 supply augmentation schemes and/or drought order/drought permit options for the period up to end 2023:

- The Horton Kirby ASR option is common to both the WRMP19 and the revised draft Drought Plan 2018. After the planned operational date of the WRMP option in 2022, the option would no longer be considered as a drought management option for the Drought Plan.

[32] Thames Water (2018). Revised Draft Drought Plan. September 2018.

- The WRMP19 includes a groundwater removal of constraints option at Southfleet/Greenhithe in the River Darent catchment, with construction commencing in 2021, which would be operational after the end of the period covered by the revised draft Drought Plan 2018. The potential for cumulative effects between this WRMP option and groundwater options in the revised draft Drought Plan 2018 which potentially affect surface flows in the River Darent catchment (Sundridge, Eynsford, Wansunt, Crayford) will be screened in the next Drought Plan.
- No cumulative effects are anticipated to arise from the Waddon groundwater drought permit and the ASR South East London scheme in the WRMP19.

8.2 Neighbouring water companies' 2019 WRMPs and Drought Plans

8.2.1 Other water company 2019 WRMPs

The 2019 WRMPs of the other water companies include significant demand management components. Improved water efficiency, additional water metering coverage and leakage reduction measures across the southern half of England and Wales will give rise to cumulative **major beneficial** effects in terms of the overall reduction in the growth of water abstraction from the water environment, as well as lower energy use and carbon emissions from reduced water pumping and treatment.

As referenced above, the WRMP19 programmes do include for the additional demands on the Thames Water supply system from some of the neighbouring water companies for additional bulk water supply exports. These extra supplies provide cumulative **major beneficial** effects by using sustainable water resource developments to secure reliable and resilient water supplies to the wider South East of England.

A report has been produced 'Environmental Information to Inform Water Company SEAs - Identification of potential for cumulative effects between water companies for WRMP19 SEAs, December 2017' and completes a region wide cumulative effects assessment. This assessment was updated in 2018 using the current preferred programme as at 13 August 2018. This assessment indicates that there is the potential for cumulative operational effects in the North Medway Chalk groundwater body and the Thames wider catchment from concurrent operation of new water source schemes across different water companies. However, having considered the nature of the schemes included by the other companies, cumulative effects are assessed as negligible with the Southfleet/Greenhithe groundwater option included in the preferred programme. No cumulative construction effects on the North Wessex Downs AONB have been identified between the South East Strategic Reservoir and a small number of relatively small-scale schemes included in Southern Water's and South East Water's WRMPs due to different timing of construction activities. The nature of any residual operational effects on the setting of this AONB arising from these other water company schemes alongside the South East Strategic Reservoir leads to an assessment of cumulative negligible adverse effects after consideration of mitigation measures. No other cumulative construction or operational effects have been identified.

We have reviewed the Thames Water preferred programme against the potential for cumulative effects with the Affinity Water WRMP19.

The HRA report considered potential in-combination effects of two Affinity Water WRMP19 schemes AFF-RTR-WRZ1-4010 (Abingdon Reservoir to Harefield Transfer 50Ml/d) and AFF-RTR-WRZ4-4011 (Abingdon to Iver 2 50Ml/d) with Kempton Park WTW, Datchet Groundwater scheme and South West London Pipelines (Chalk Streams) on the South West London Waterbodies SPA and Ramsar site.

The HRA concludes no in-combination adverse effects with Kempton WTW as there is no overlap in construction period. No in-combination effects are likely between Datchet Groundwater scheme and the Affinity Water schemes as the Affinity WRMP19 indicates that construction of the Abingdon Reservoir transfer schemes will take place after construction of the Datchet scheme (2036-2038).

Even if construction was to be concurrent, the HRA concludes that there will be no in-combination adverse effects with the Datchet scheme due to a combination of distance from the SPA waterbodies, existing disturbance levels to closer water bodies and visual screening from tree lines and high reservoir embankments.

The Appropriate Assessment for South West London Pipelines identified potential in-combination effects with the Affinity Water schemes. However, as the South West London pipelines (Chalk Streams) scheme will be constructed between 2033-2037 and the two Affinity Water Abingdon Reservoir transfer schemes will be constructed after 2038, then no adverse cumulative effects will arise. Even if construction was to occur simultaneously, by implementing appropriate mitigation measures, no in-combination adverse effects will arise. Therefore, no cumulative adverse effects are anticipated between the Thames Water preferred programme and Affinity Water's WRMP19 preferred programme."

No cumulative adverse effects have been identified in relation to other water companies outside of the WRSE group with the Thames Water WRMP19. This review included the WRMP19 preferred programmes of United Utilities, Severn Trent Water, Welsh Water and Bristol Water in the context of the Severn-Thames Transfer option set out in Thames Water's WRMP19.

8.2.2 Drought Plans

Cumulative effects have also been assessed in respect of the current published Drought Plans of neighbouring water companies. The SEA has concluded that:

- the demand management measures in the WRMP19 have a moderate beneficial cumulative effect on the water environment in combination with the demand management measures contained in the Drought Plans of the other companies, reducing the pressure on water resources in the River Thames catchment during periods of prolonged dry weather when river flows and groundwater levels are well below normal.
- by increasing the drought resilience of the Thames Water supply system to withstand a severe drought that may occur on average only once in every 200 years, the draft WRMP19 will have moderate beneficial cumulative effects with those neighbouring water companies that are reliant on bulk water supply exports from Thames Water during drought.
- no cumulative effects are anticipated between the Thames Water Waddon groundwater drought permit, the Addington groundwater scheme and ASR South East London scheme in the WRMP19 and the potential drought permit option in SES Water's Drought Plan relating to three groundwater abstraction sites in the same vicinity.
- no other cumulative effects between the WRMP19 and other water company current published Drought Plans are anticipated.

Drought Plans are required to be updated every five years by water companies. The cumulative effects assessments will need to be updated over time to reflect any changes to the Drought Plans.

8.3 Environment Agency Drought Plan and Canal & River Trust Drought Plan

8.3.1 Environment Agency National Drought Plan

Assessment of the potential for cumulative effects of the WRMP19 with the drought management options listed in the Environment Agency National Drought Plan[33] has been undertaken.

Part of the Environment Agency's role is to reduce the impact of drought on the natural environment by taking specific actions. The Environment Agency can apply for environmental drought orders if the environment is suffering serious damage because of abstraction during a drought. The plan says that

[33] Environment Agency (2015). Drought response: our framework for England. June 2015.

the Environment Agency would work with stakeholders including water companies to identify where and when it would be necessary and its potential effects on any essential public supplies or infrastructure.

The Environment Agency can also restrict spray irrigation during periods of drought to help reduce the effects of drought on the water environment. Such restrictions would have cumulative **moderate beneficial** effects with the demand management programmes included in the WRMP19.

Given that the Environment Agency drought actions will have a positive effect on river flows and lake levels and, therefore, the natural environment and ecology, there will be no cumulative adverse effects with the WRMP19.

8.3.2 Canal & River Trust Drought Plan

No cumulative adverse effects are anticipated in respect of the Canal & River Trust's (CRT) drought management plan. The Oxford Canal scheme utilises surplus resources available to the canal and no adverse effects should arise. No other WRMP19 scheme is likely to have cumulative effects with water resources required for the CRT canal system.

The information used to carry out these cumulative assessments is considered to be the most up to date information available at the time of writing, but the assessments may need to be reviewed at the time of drought option implementation.

8.4 River Basin Management Plans

The WRMP19 may have cumulative effects with the Thames River Basin Management Plan (RBMP) 2015[34] and the Severn RBMP 2015[35], the Humber RBMP 2015[36]".The RBMPs acknowledge that, to support economic growth and development, significant or large scale infrastructure projects will occasionally take place within the river basin district. In line with the RBMP expectations, the SEA, HRA and WFD assessments of the WRMP19 supply augmentation schemes have taken account of the environmental objectives within the RBMPs, with specific assessment objectives included to evaluate the effects on RBMP measures.

In accordance with the RBMPs, the WRMP19 includes measures to maintain a supply-demand balance while addressing the need to deliver sustainable abstraction from water bodies. The WFD assessment of the WRMP19 demonstrates that there will be no deterioration in water body status subject to implementing relevant mitigation measures. The WRMP19 includes measures to maximise the use of existing water resources in a sustainable manner and to develop a major water reuse scheme to reduce the need for additional abstraction from freshwater resources in the Thames basin. Overall, the SEA has concluded there may be cumulative **minor adverse** effects with the RBMPs due to the need to increase the overall volume of water being abstracted from the Thames and Humber and Severn basins to meet future demand growth for water. However, the WRMP19 also includes a very substantial programme of demand management activities that have been assessed in the SEA as having cumulative **major beneficial** effects with the Thames RBMP measures targeted at implementing and encouraging water efficiency measures.

Additionally, the WRMP19 includes commitments by Thames Water to carry out further investigations in consultation with the Environment Agency of some existing water sources to assess whether abstraction licence conditions should be modified to ensure a long-term sustainable water environment.

[34] Defra and Environment Agency (2016). Water for life and livelihoods: Thames river basin district River Basin Management Plan 2015. Updated December 2015.
[35] Defra and Environment Agency (2016). Water for life and livelihoods: Severn river basin district River Basin Management Plan 2015. Updated December 2015.
[36] Defra and the Environment Agency (2016): Water for life and livelihoods: Humber river basin district River basin management plan. Updated December 2015.

8.5 Local development and land use plans

8.5.1 Greater London

Opportunity areas identified in the London Plan are described as major pools of brownfield land with capacity to accommodate new housing, commercial and other developments. All of the WRMP19 schemes located within Greater London are within 10km of at least one opportunity area. Areas for Intensification can support redevelopment at high densities but at a level below that of Opportunity Areas. As with Opportunity Areas, all of the WRMP19 schemes within Greater London are located with 10km of one or more of these areas. With careful planning and dialogue with the GLA and relevant London Boroughs, no material adverse effects are anticipated on the aims and objectives of these Opportunity or Intensification Areas; there may be opportunities for the WRMP schemes to support these aims and objectives and these will be explored as appropriate as WRMP schemes are brought forward for development. It should be noted that some schemes will not be developed for many decades and therefore the cumulative effects assessment will need to be updated in the future to take account of the prevailing London Plan or equivalent strategic plan.

8.5.2 Other local authority areas in the Thames Water supply area

Outside of Greater London, no specific cumulative effects with land use and development plans have been identified, noting that the planning horizon of the WRMP19 extends well beyond the planning periods of the land use and development plans (early 2030s generally). All local authorities Local Plans (adopted or in development) are particularly focused on delivering government targets for new house building. Cumulative **minor adverse** effects may arise at any location of new housing developments if the construction were to coincide spatially and temporally with construction of WRMP19 schemes; due to the uncertainties relating to the housing developments, it is not possible to identify specific risks at this strategic plan stage and these will need to be assessed with local planning authorities as and when schemes are brought forward for detailed development and planning permissions.

Minor beneficial cumulative effects may arise in conjunction with the local housing development schemes in respect of the Demand Management Programme, in particular engaging with developers to build water efficient homes and consider use of rainwater harvesting and local water recycling processes to reduce the growth in demand for water.

The cumulative effects assessment with local development plans will need to be updated to take account of the prevailing plans as schemes are brought forward for development.

It should be noted that Defra has recently (November 2017) issued a consultation on the government's proposals for new large, 'nationally-significant' water resources infrastructure developments to be included in a National Policy Statement (NPS) on Water Resources. This will streamline the process of gaining planning consents for large water infrastructure projects in line with the provisions for a NPS set out in the Planning Act 2008. This means that for any WRMP scheme that is defined as a nationally significant infrastructure project, Thames Water will be required to obtain a Development Consent Order (DCO) granted by the Secretary of State.

Defra has subsequently held an additional consultation in April 2018 to amend the definitions of nationally significant water resources infrastructure projects within the Planning Act 2008 so they are appropriate and representative of nationally significant water resources infrastructure. The result of this confirmed that a consistent deployable output threshold of 80 million litres will be used.

8.5.3 Abingdon reservoir: local planning authority safeguarding policy

In respect of the South East Strategic Reservoir Option, Thames Water has actively engaged with the local planning authority (Vale of White Horse District Council) and its latest Local Plan (Part 1, adopted in December 2016 and setting planning policy out to 2031) includes a policy ("CP14") to safeguard the land required for the reservoir site for Thames Water. The Vale of White Horse District

Council Local Plan 2031 Part 2: Detailed Policies and Additional Sites was adopted on 9 October 2019 and includes Policy 14a and Appendix C that safeguards land for a reservoir and ancillary works between the settlements of Drayton, East Hanney and Steventon.

8.6 Other major infrastructure projects and plans

The potential for cumulative effects with other major projects has been considered. These include existing completed projects, approved but uncompleted projects, ongoing activities, plans or projects for which an application has been made and which are under consideration by consenting authorities and plans and projects which are reasonably foreseeable (i.e. projects for which an application has not yet been submitted, but which are likely to progress before completion of the development and for which sufficient information is available to assess the likelihood of cumulative and in-combination effects).

Most of the confirmed or well-developed plans for significant infrastructure schemes are scheduled to be constructed and commissioned within the next 5-10 years. Relevant schemes have been reviewed in relation to spatial and temporal proximity to the WRMP19 schemes to assess whether any cumulative effects might arise. Key schemes reviewed included:

- River Thames Flood Alleviation Scheme (Datchet to Teddington)
- Oxford Flood Alleviation Scheme
- Abingdon Flood Alleviation Scheme
- Thames Tideway Tunnel Project
- Crossrail 1: construction (2013-2020) and the westerly extension (post-2020)
- Crossrail 2
- London Underground Northern Line Extension
- High Speed Two Rail Network (HS2): Construction of Phase 1 of the HS2 network from Euston station to Birmingham.
- North London Heat and Power Project.
- North London (Electricity Line) Reinforcement.
- A2 Bean and Ebbsfleet Junction Improvements

Most of the confirmed or well-developed plans for significant infrastructure schemes are scheduled to be constructed and commissioned within the next 5-10 years. Relevant schemes have been reviewed in relation to spatial and temporal proximity to the WRMP19 schemes to assess whether any cumulative effects might arise.

Some temporary cumulative moderate adverse effects are anticipated in relation to the flood alleviation schemes for the main River Thames referenced above during construction depending on the precise timing of the construction. There may be potential for cumulative moderate beneficial effects as part of operational mitigation measures for both the flood alleviation schemes and the WRMP19 schemes. Thames Water will liaise closely with the Environment Agency on these schemes over the next few years as they are progressed.

Thames Water and the Environment Agency have been in close liaison regarding whether there is any impact of the potential South East Strategic Reservoir Option on the Abingdon Flood Alleviation Scheme. The Flood Alleviation Scheme is expected to be constructed in the early 2020s.

Mitigation measures are built into the Reservoir Option design to ensure that there is no increase in flood risk. These mitigation measures will be reviewed, and updated if necessary, once the Abingdon Flood Alleviation Scheme design is finalised to ensure that there remains no increase in flood risk, as part of the ongoing dialogue between Thames Water and the Environment Agency that has been taking place over recent years.

No cumulative adverse construction effects will arise in connection with the Thames Tideway Tunnel project (construction due to be completed by 2023) as construction programmes do not overlap. No cumulative adverse operational effects are anticipated.

Crossrail 2 has been developed to the stage of an outline strategy with an indicative route and stations, but no firm decisions have yet been reached on the funding of the line. Should Crossrail 2 gain approval in the next few years, there is a possible risk of some temporal and spatial overlaps of construction activities with some of the new conveyance routes in south-west London and Merton groundwater scheme is in a similar area. To the north of London there are potential overlaps with parts of the Beckton Reuse and Deephams Reuse. No operational cumulative effects are anticipated. Thames Water will need to liaise closely with the Department for Transport and Transport for London to assess the potential risks of construction cumulative effects.

No specific cumulative effects were identified in relation to HS2 Phase 1 (no spatial proximity) and Crossrail 1 (works due to be complete before 2020). Thames Water will need to take account of the new underground infrastructure of the Northern Line extension routes where these overlap with the proposed WRMP19 new water conveyance routes. Thames Water will need to liaise closely with Transport for London and the relevant railway authorities as planning for these conveyance routes progresses.

There are no likely cumulative construction effects associated with the Deephams Reuse scheme together with the North London Heat and Power Project and the North London (Electricity Line) Reinforcement as both are anticipated to be operational before construction for the Deephams Reuse starts in 2026.

The construction periods for the A2 Bean and Ebbsfleet Junction Improvements and the Southfleet/Greenhithe option are close and there is potential for overlap and therefore potential cumulative construction effects.

There are no known other confirmed or well-developed plans for significant infrastructure scheme, and particularly none beyond 2030, although a number of significant developments are probable (for example, further expansion of Heathrow airport). The cumulative effects assessment will therefore need to be updated in the future to take account of the prevailing plans for such schemes as Thames Water brings forward its WRMP19 schemes for development over the coming decades.

9 Summary of HRA, WFD and other Designated Sites Assessments

9.1 Habitats Regulations Assessment

The HRA of the WRMP19 has concluded that the preferred programme is compliant with the Habitats Directive. A Stage 2 Appropriate Assessment was required for seven options for which likely significant effects on European sites could not be ruled out without mitigation. For all of these seven options, no adverse effects on the European sites or their ability to achieve their conservation objectives were anticipated, subject to appropriate mitigation measures. In particular, three schemes (Deephams reuse, Coppermills WTW and Kempton WTW) will require particular careful planning and design of the proposed mitigation measures to protect Special Protection Areas and Ramsar sites (designated to protect internationally important bird species) during construction activities.

9.2 Water Framework Directive

The WFD compliance assessment of the WRMP19 has concluded that the preferred programme is considered compliant with the WFD objectives of the relevant water bodies, now and in the future, as no WFD non-compliance has been confirmed. There is currently one compliance uncertainty in respect of the Epsom groundwater (removal of constraints) option. That option alone requires further investigation and assessment to confirm there is no WFD deterioration risk to the surface water linked to the groundwater abstraction from the aquifer. The option involves abstraction within the existing abstraction licence conditions which will be subject to review of its sustainability under the Water Industry National Environment Programme (WINEP) in AMP7. Currently impacts are mitigated by 3rd party flow augmentation. The proposed increase in abstraction at Epsom (but within current licence) may be mitigated through an increase in flow augmentation, however this is subject to the planned investigation and would need to be agreed with the Environment Agency following an options appraisal if required. With any required mitigation in place the scheme would be considered WFD compliant. Should the planned investigation identify the option as non-sustainable, or where the incorporating mitigation measures are considered not to be appropriate or effective, then the option programmed for operation in 2030 would be replaced in the 2024 WRMP by another option.

The Environment Agency and Natural Resources Wales require the collection and consideration of further evidence for three of the options within the preferred programme to either confirm the provisional assessment of WFD compliance, or to identify appropriate mitigation actions to ensure this. These options are:

- The Vyrnwy support element of a Severn-Thames Transfer requires the collection and consideration of further evidence, and if necessary the provision of additional mitigation measures, prior to confirming WFD compliance in the Afon Vyrnwy WFD water bodies downstream of Vyrnwy Reservoir.
- The Deephams Reuse option requires the collection and consideration of further evidence, and if necessary the provision of additional mitigation measures, prior to confirming the assessment of WFD compliance in the lowest freshwater water body of the River Lee and the potential for interaction with tidal Middle Thames estuary.
- The Oxford Canal Transfer to Cropredy option requires the collection and consideration of further evidence, and if necessary the provision of additional mitigation measures, prior to confirming the assessment of WFD compliance local to the source waters in the Birmingham groundwater (both groundwater and linked surface waters) and in the River Cherwell from the point it would receive transferred water and downstream.

In-combination, a South East Strategic Reservoir Option, a Culham to Farmoor transfer and a supported Severn-Thames Transfer modulate flow in the River Thames locally at Culham and downstream may adversely affect several River Thames water bodies. For these options a combined operating strategy would be developed with regulators and other stakeholders to manage these

effects as WFD compliant in terms of the potential ecological impacts on the River Thames locally and downstream.

There are no in-combination WFD compliance effects from Thames Water's WRMP19 preferred programme with the WRMP preferred programmes of any other water companies.

9.3 Sites of Special Scientific Interest

Appendix H provides a review of the potential effects of the WRMP19 on Sites of Special Scientific Interest (SSSI) after consideration of the mitigation measures included in the scheme conceptual design. Key findings of this review are:

- Effects on most SSSIs are negligible due to the distance from any of the draft WRMP19 schemes and/or there is no hydrological and/or environmental connectivity to the SSSI to give rise to any adverse effects.
- Where schemes are located close to or within the boundary of SSSIs, there are risks of indirect or direct impacts to the SSSI features during construction activities (for example, due to noise and visual disturbance, air quality impacts from construction traffic and impacts on habitat used by species within the SSSI designations). In these circumstances, mitigation has been proposed to minimise the adverse effect, for example by use of screening measures, using plant silencers and careful location of the works to avoid key habitats. In a small number of cases, the SEA (and HRA where relevant) has concluded that further mitigation may be required to avoid significant adverse effects, particularly in relation to potential noise and vibration impacts on bird populations. Further detailed assessment will be carried out into potential construction effects on relevant SSSIs as detailed in Appendix H. Thames Water will work with Natural England and the SSSI managers during the detailed design phase to agree any additional mitigation measures to minimise the impact of construction at these sites. Any agreed mitigation measures are expected to form part of planning conditions and/or conditions of relevant environmental permits, and these would be managed through contractual obligations with supervision from an Environmental Clerk of Works appointed by Thames Water.
- The risk of effects on groundwater have been mostly eliminated based on the design of the construction works and associated mitigation measures to protect physical aquifer properties and minimise the effects on groundwater-dependent features. Uncertainty of the magnitude of effects at a small number of groundwater-dependent SSSIs is however recognised and this would require a more detailed assessment.
- SSSIs relying on water levels in the freshwater River Thames are unlikely to be impacted due to the heavily regulated nature of the river.
- The impacts on SSSIs from the WRMP19 Raw Water Transfers on the Rivers Vyrnwy and Severn are predominantly negligible as most SSSI features do not rely upon river water levels or impacts on water levels are negligible. Only Coed Copi'r Graig SSSI, situated within the Upper Vyrnwy was assessed as potentially impacted by changes in water level, although the level of impact is at present uncertain. A more detailed assessment to understand the potential impacts from the scheme's operation would need to be undertaken before mitigation measures could be settled. If required, appropriate additional mitigation measures would be developed in consultation with NRW. As identified in the WFD report should it not be possible to adequately mitigate adverse effects the scheme could be amended to discharge water directly to the River Severn rather than to the Afon Vyrnwy.

Where further additional mitigation is required, this will be developed as the schemes are taken forward for promotion in close dialogue with Natural England and site managers/owners. Subsequent assessments, including where relevant site specific assessments to support an EIA, will also be expected to be undertaken in support of consenting applications for specific schemes as and when these schemes are brought forward for development.

9.4 Marine Conservation Zones

The Marine and Coastal Access Act 2009 allows for the creation of Marine Conservation Zones (MCZs). MCZs protect a range of nationally important marine wildlife, habitats, geology and geomorphology, and can be designated anywhere in English and Welsh territorial and UK offshore waters.

The SEA has concluded that the WRMP19 would have negligible effect on the Thames Estuary (Recommended) MCZ. The proposed programme includes only one scheme, Deephams reuse, that was considered for potential effect on the estuarine Thames Tideway. A Deephams reuse scheme would reduce freshwater input from the River Lee into the estuarine Tidal Lee and thence into the estuarine middle Thames Tideway at a point upstream of the MCZ boundary located downstream of the Beckton reuse scheme. A desktop assessment of potential effects has been carried out of the effects of the scheme and other potential WRMP19 options affecting the salinity regime of the estuarine Thames Tideway and potential ecological consequences, including for the MCZ, taking account of Natural England's advice note[37] issued in July 2017.

As identified in Sections 7 and 8 of this Environmental Report, there is a negligible potential for upstream salinity changes in the estuarine middle Thames Tideway from a Deephams reuse scheme and consequently negligible potential for adverse effects in the future to this Recommended MCZ. This assessment is made as an in-combination assessment with Thames Water's Thames Gateway desalination plant at Beckton, which operates under licence at times of reduced London reservoir storage and lower River Thames freshwater flows to the upper estuarine Thames Tideway at Teddington.

Table 9.2 provides a summary of the desktop assessment of the potential sensitivity to any changes to salinity on key estuarine features and designations that has informed the SEA.

The desktop assessment concluded that the possible adverse effects on the estuarine middle Thames Tideway from a Deephams 46.5 Ml/d reuse scheme would include the following:

- Negligible salinity effects locally in the estuarine Tidal Lee (outside the MCZ boundary);
- Negligible longer term spatial effect on salinity in the wider Thames Tideway including within the MCZ boundary; and
- Negligible changes in tidal level locally in the estuarine Tidal Lee (outside the MCZ boundary).

[37] Natural England (2017). Tips and advice on how to assess potential impacts of water company statutory plans on the marine environment – Focussing on Marine Conservation Zones (MCZ). Natural England (v2 July 2017).

Table 9.2 Summary of potential adverse effects on the estuarine middle Thames Tideway

Feature	Sensitivity to salinity changes	Adverse effects significance assessment
Recommended Thames Estuary Marine Conservation Zone designation	Minor	Negligible
Tidal Thames Site of Metropolitan Importance to Nature Conservation (SMINC)	Negligible	Negligible
Intertidal mudflat habitats in the Middle Thames Tideway	Negligible	Negligible
Saltmarsh habitat	Minor	Negligible
Populations of the brackish water shrimp (a common species and an important food source for fish and birds)	Negligible	Negligible
Populations of the swollen spire snail (NERC Section 41 species)	Uncertain	Negligible
Populations of common macroalgae	Negligible	Negligible
Phytoplankton community in the Thames Tideway	Minor	Negligible
Populations of European Smelt in the Middle Thames Tideway (NERC Section 41 species)	Minor	Negligible
Populations of Cod, Dover Sole, Herring and Whiting recorded in the Thames Tideway (NERC Section 41 species)	Negligible	Negligible
European Eel (NERC Section 41 species, IUCN 'Endangered')	Negligible	Negligible
Populations of common estuarine fish species recorded in the Thames Tideway	Minor	Negligible

10 Mitigation and Enhancement of Significant Effects

10.1 Approach to mitigation measures for the WRMP19

A key stage in any SEA process is having regard to measures that might mitigate the adverse effects of a plan or programme. This section describes how Thames Water intends to ensure that mitigation measures are implemented for any adverse effects that are identified. Section 11 additionally describes the way in which the environmental performance of the WRMP19 will be assessed and any modifications made to the mitigation measures as may be necessary.

Consideration of mitigation measures has been an integral part of the SEA (and associated HRA and WFD assessment) process in development of the WRMP19 from the very outset. An iterative approach has been followed, with the initial screening assessments identifying potential adverse effects and mitigation measures being explored to reduce their magnitude. As more detailed assessments of the feasible options were carried out and consultees provided feedback on the options, the mitigation measures were further refined and incorporated into the conceptual design (and costs) of the option elements included in the programme appraisal model. Following the development of the preferred programmes for each WRZ, the SEA, HRA and WFD assessments have, in some cases, identified additional mitigation measures to address adverse effects as described in Sections 8 and 9. In a similar way, opportunities for enhancing identified beneficial effects have also been considered throughout the SEA, HRA and WFD assessment process.

A wide range of mitigation and enhancement measures have been incorporated into the option element conceptual design to address both construction-related effects and operational effects, including:

- best practice construction methods to protect the environment, built environment and local communities and ensure adherence to all relevant regulatory requirements (including development of formal Construction Environmental Management Plans)
- provision of flood storage compensation measures and use of sustainable drainage approaches to ensure no net change in fluvial, estuarine or surface water flood risk
- runoff from construction sites would be attenuated and the quality managed to prevent flooding or pollution
- in-river and riparian improvement measures
- a wide variety of landscaping measures to address landscape and visual amenity effects, as well as enhance biodiversity
- screening around the perimeter of works during construction
- appropriate pipeline laying techniques regarding river crossings (such as directional drilling)
- operational and regulatory control measures to avoid adverse effects on the environment
- seeking opportunities for use of, or generation of, renewable energy to help offset additional operational carbon emissions
- opportunities for educating the public and/or providing improved access to the environment
- enhanced water and wastewater treatment processes to protect water bodies
- temporary diversion or temporary provision of alternative of Public Rights of Way during construction activities
- noise, vibration and dust abatement measures to protect people and the environment during construction activities
- archaeological investigations and asset ‘watching briefs’ etc during excavation activities to identify any opportunities for new heritage asset discoveries and ensure no damage to such assets

- ‘watching briefs’ for invasive non-native species and removal in accordance with regulations
- maximising reuse of spoil locally and sourcing raw construction materials as locally as possible
- preventing construction and/or HGV movements during certain times of the day or particular seasons to avoid adverse effects on people or particular species
- routing and timing of HGV deliveries where possible to avoid impacts on local communities and Air Quality Management Areas
- using barges and railway lines to deliver heavy construction materials to minimise impacts on traffic and air quality effects on local communities

Mitigation measures have been incorporated into the conceptual design of all the schemes included in the preferred programme of the WRMP19.

The assessments presented in this Environmental Report have assumed the implementation of these mitigation measures as well as the specific mitigation and enhancement measures identified in Sections 6 and 7 plus **Appendices E and F**. Appendix I is a compilation of mitigation measures on which the SEA has taken into account in assessing residual effects after consideration of these mitigation measures, in line with the SEA methodology. As explained earlier in this Report, the significance of effects identified by the SEA relate to the **residual** effects after the application of the defined mitigation or enhancement measures. Subsequent assessments, including where relevant site specific assessments to support an EIA, will also be expected to be undertaken in support of consenting applications for specific schemes as and when these schemes are brought forward for development.

10.2 Mitigation measures for significant residual effects

Several specific additional mitigation measures have been identified by the options and programme SEA, HRA and WFD assessment process as set out in this Environmental Report for the WRMP19 preferred programme and as summarised in Appendix I. In particular, several schemes included in the preferred programme include some significant residual effects requiring the application of specific mitigation measures.

Construction works necessary to expand the capacity of Thames Water’s Kempton and Coppermills Water Treatment Works, as well as construction of the Deephams Reuse scheme, South West London Pipelines and River Lee New Gauge Pipeline schemes will require mitigation measures as set out in the HRA Report and this Report.. These measures are necessary during the construction period to protect designated bird species associated with nearby Special Protection Areas and Ramsar sites (these are internationally important conservation sites designated for the protection of important bird species and their habitats). Thames Water will work with Natural England to confirm the mitigation measures as planning for these works progresses.

Any construction works that take place within 1 km could potentially disturb the wintering bird population (bittern, gadwall and shoveler). In order to avoid such impacts to the qualifying features of the SPA (wintering birds) from this option, potentially disturbing construction activities will take place outside of the winter period (October to March inclusive). This would avoid adverse impacts to site integrity (as has been demonstrated previously in relation to construction works at the nearby Deephams sewage treatment works). Other construction activities will be subject to mitigation measures such as visual and noise screening, sensitive lighting design and the use of plant silencers to ensure no likely significant effects (in consultation with Natural England and SPA/Ramsar landowner/operator). Detailed noise abatement and visual disturbance mitigation measures will be developed in co-ordination with Natural England, taking account of local site knowledge from the site managers and following professional mitigation guidance. Studies will also be conducted to identify the key flight paths of the wintering birds that use the designated site (and associated functional habitat), and an assessment will be made of the impact of the construction activities on these key flight paths. Good practice construction mitigation measures should avoid the potential for any dust impacts to the Ramsar/SPA site – i.e. by damping down the construction site.

Close liaison with Historic England and local conservation groups will be required during design development to agree mitigation measures for heritage value. Where possible the tunnels will be aligned so that historic assets are outside the zone of influence. Where this is not possible, due to constraints on the alignment, detailed settlement analysis will be undertaken to demonstrate how best to minimise the impacts during construction. This will include stringent control and monitoring requirements during tunnelling, to limit settlement.

Mitigation will also include good construction practice, good design of permanent above ground features, review of previous desk based and field studies, further targeted archaeological investigations and a watching brief during site preparation works where archaeology has been identified. Further specific additional mitigation measures may be required for some of these cultural heritage assets to further reduce the potential residual effects.

Construction works necessary to provide a new fully bunded **South East Strategic Reservoir**, the associated conveyance tunnel and intake / discharge structure at Culham on the River Thames and enabling structures including temporary railway siding, contractor's area and access and haul roads.

In addition to construction best practice, further construction mitigation measures in the form of extensive vegetation planting around the reservoir margin as well as compensatory measures to enhance lower quality habitat in the vicinity of the reservoir to replace lost habitat will be developed in close dialogue with regulatory bodies, planning authorities, interested stakeholders and local communities. Where applicable (and depending on updated bird surveys to be carried out as part of the detailed design of the scheme), these measures may be developed in advance of reservoir construction so as to minimise effects on identified bird species.

The scheme will involve the removal and rerouting of several small watercourses, mitigation measures will be set out in a Flood Risk Assessment (FRA) in support of an application for a flood risk activity permit where required.

Results from previous surveys and excavations of the reservoir site identifies moderate archaeological potential (prehistoric and roman). Archaeological remains will be impacted by the construction of the reservoir. Mitigation includes siting of temporary works to minimise impacts on settings. Further meetings will be held with Historic England and Oxfordshire County Council to confirm mitigation measures as part of the detailed design process. Mitigation measures will include review of previous desk based and field studies, further targeted field evaluations and targeted excavations alongside watching briefs during overburden stripping where archaeology has been identified. As part of any future application for consent further studies would be commissioned including landscape and visual impact assessments that could help inform the detail of mitigation measures such as landscape proposals.

Further work and assessments, including where relevant site specific assessments to support an EIA, will be also carried out as part of the detailed design and refinement of all of the other schemes in the WRMP19 as they are brought forward for more detailed planning to seek opportunities to further reduce the identified adverse residual effects and increase beneficial residual effects.

10.3 Enhancement measures

The development of additional "chalk stream assets" along with the new strategic water sources will enable Thames Water to cost effectively deliver environmental improvements to vulnerable chalk streams and water courses through the reduction and re-location of abstraction. This responds to a number of stakeholder concerns raised during the consultation process about the WRMP19 delivering environmental improvement alongside enhanced water supply resilience. Further details are provided in Section 10 of the WRMP19.

11 Monitoring Proposals

Key stages of the SEA process include Task B6: proposing measures to monitor the environmental effects of plan or programme implementation. Monitoring is required to track the assessed environmental effects set out in this Environmental Report to show whether they arise as predicted, and to help identify any adverse impacts and trigger deployment of mitigation measures.

The SEA Regulations require the responsible authority to:

'monitor the significant environmental effects of the implementation of each plan or programme with the purpose of identifying unforeseen adverse effects at an early stage and being able to undertake appropriate remedial action.'

Key monitoring parameters are those relating to the abstraction of water and the effects this may have on water bodies, their WFD waterbody status, and their functions as habitats. The WRMP19 may also cause more direct potential impacts on people living in urban areas, due for example to construction works and associated disturbance. This Environmental Report has also highlighted risks of adverse effects on landscapes and townscapes, visual and recreational amenity, as well as heritage assets. Higher level potential impacts such as those on water resources, groundwater and river levels are monitored and reported routinely by the Environment Agency. Many company level impacts, such as transport emissions and fair treatment of customers, are also already monitored and reported annually by Thames Water. However, additional monitoring is recommended to address the objectives of high level environmental protection in line with the SEA Directive. Mitigation and monitoring plans have been revised as appropriate for strategic level of assessment. Protected species monitoring has also been recommended using site-specific surveys as part of the detailed design of options.

The natural, built and human SEA receptors potentially affected by the WRMP19 have been set out in Table 11.1 with monitoring indicators alongside. These will enable Thames Water to develop and implement a monitoring programme to establish whether the WRMP is performing as expected over the coming years as anticipated by the SEA findings. The monitoring programme will be refined as schemes progress through the detailed planning and environmental approvals stage. The plan will include:

- Scheme-specific monitoring requirements and targets that focus on scheme-specific risks, habitats, species and sites; and
- Strategic, regional and local monitoring requirements and targets to ensure that monitoring is conducted at a suitable spatial scale that reflects the scale and risks of each scheme and the overall programme.

The monitoring plan will be owned and implemented by Thames Water and will be developed to reflect the phasing of the preferred programme. The monitoring plan will be further developed beyond this report during the implementation of this plan in consultation with Natural England and the Environment Agency to make best use of available data, to share existing monitoring locations and, where possible, locate new monitoring sites in locations that not only meet scheme-specific requirements but provide additional value to Natural England and the Environment Agency's own monitoring programmes.

Table 11.1 Proposed receptors and indicators for the SEA monitoring programme

Impacted Receptor	Monitoring Indicators
Water resources, water quality, biodiversity	Changes in WFD condition status (both adverse and positive) of surface waters and groundwater waterbodies.

Impacted Receptor	Monitoring Indicators
	Changes in WFD condition status (both adverse and positive) of surface waters and groundwater waterbodies and number of water bodies where no deterioration to current WFD status has arisen Site-specific Protected Species and habitats surveys Condition of European Sites and SSSIs according to Natural England condition assessments Progress against the Thames Water publication: Our Biodiversity Policy
Climate Factors	Net greenhouse gas emissions per Ml (million litres) of treated water (kg CO2 equivalent emissions per Ml) reported annually by Thames Water
Transport	Transport fleet fuel consumption, emissions and mileage, as monitored routinely by Thames Water Scheme level traffic disruption due to construction works / during operation (where applicable) would be monitored through appropriate Environmental Management Plan's agreed as part of the planning permission process which would establish agreed traffic routes and traffic levels and timings
Nuisance/ Community Amenity Effects	Scheme level community disruption due to construction works / during operation (where applicable) would be monitored through Environmental Management Plan's such as a Construction Environmental Management Plan (CEMP) and Transport Logistics Plans agreed as part of the planning permission process Complaints logged with Thames Water and Local Authority Environmental Health Officers or equivalent Responses gauged through customer satisfaction surveys and reported in Thames Water's annual performance processes Surveys of recreational and other amenities likely to be affected, including assessment of the success of agreed mitigation measures.
Air Quality	Scheme-specific monitoring during construction works / during operation (where applicable) would be monitored through an Environmental Management Plan agreed as part of the planning permission process Changes in air quality as monitored by the Defra Automatic Urban and Rural Network (for example nitrogen oxides), including using these data to establish the baseline conditions.
Landscape and visual amenity	Baseline, construction phase and operational phase Landscape and Visual Impact Assessments or equivalent assessment techniques of sensitive landscapes (including townscapes where applicable) and visual amenity identified in the SEA (and subsequent planning application submissions) as being at a major or moderate adverse effect. Assessments to be carried out in consultation with appropriate bodies, such as the relevant AONB committees and Natural England. These surveys will aid planning and evaluation of the success of proposed mitigation measures to reduce adverse effects on the landscape and visual amenity.

Impacted Receptor	Monitoring Indicators
Cultural Heritage	Condition of buried archaeology would be monitored during construction works as part of a Watching Brief and associated response measures as set out in the Environmental Management Plan agreed as part of the planning permission process Consultation with Historic England, heritage asset owners and other relevant stakeholders to ensure adverse impacts are minimised and opportunities sought for heritage discovery and/or maintenance. Reference to Historic England's monitoring of heritage assets such as Listed Buildings and Scheduled Monuments, Registered Battlefields, Registered Parks and Gardens, in particular the 'Heritage at risk' register.

These proposed indicators would form the core component of the monitoring programme to assess whether the identified effects in the SEA are occurring as anticipated, or whether it is giving rise to greater or lesser effects (adverse or beneficial). In turn, the monitoring may identify changes to the mitigation measures necessary to minimise adverse effects and/or modifications to scheme design or operation to further augment beneficial effects.

In the period to 2022/23 Thames Water has set out a continuing programme of ongoing studies to be undertaken with regulators, other water companies and third party organisations to continue to examine the feasibility of a number of options, namely further investigations of the Deephams reuse scheme, Beckton reuse scheme, Oxford Canal Transfer, Severn Thames transfer, and South East Strategic Reservoir scheme. These studies are in addition to those associated with the delivery of groundwater schemes which are planned in the period 2020-2030. Further details of the studies are set out in Appendix XX.

As options are brought forward for development, further specific monitoring requirements may be incorporated in detailed designs and plans accompanying scheme development (including, where applicable, formal applications for any required environmental permits or abstraction licences, planning permission, as well as any scheme-specific HRA and WFD assessments). These will be discussed with relevant regulatory and statutory bodies and stakeholders to agree the appropriate scale and duration of such scheme-specific monitoring activities proportionate to the assessed environmental risks.

12 Conclusions and Next Steps

12.1 SEA Conclusions

The environmental assessment of the WRMP19 indicates an overall minor to moderate adverse effect and minor to moderate beneficial effect of the plan and programme on the environment and society.

The WRMP19 is compliant with the Habitats Directive and associated national Habitats Regulations with the undertaking of appropriate mitigation measures.

The plan also meets the WFD Regulations and associated objectives subject to agreeing and implementing appropriate site-specific investigations and, if necessary, following options appraisal, mitigation measures through ongoing dialogue with the Environment Agency and Natural Resources Wales.

In line with the requirements of the Water Resources Planning Guideline, the SEA has also demonstrated that there are viable alternative options available at comparable levels of environmental effects.

12.2 Next Steps

Once the WRMP19 has been published and adopted, Thames Water will publish a SEA Post Adoption Statement, describing how the SEA and the responses to consultation have been taken into account during the preparation of the WRMP19. This statement will describe how environmental considerations have been integrated into the WRMP19 and explain any changes made or alternatives rejected. Information will also be provided on the environmental monitoring to be carried out during the implementation of the WRMP19 to track the environmental effects of implementation of the Plan and to trigger appropriate responses where effects are identified.

Appendices

Appendix A Statutory Consultee responses to the SEA Scoping Report

Appendix B SEA Quality Assurance Checklist

Appendix C Review of Law, Policy, Plans and Programmes

Appendix D Environmental Baseline Review

Appendix E Option Element Assessments

Appendix F Option Assessments

Appendix G Programme Delivery Schedules

Appendix H Review of Potential Effects of the Preferred Programme on Sites of Special Scientific Interest

Appendix I Mitigation assumed in SEA element matrices

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