Section 9

Environmental appraisal

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Environmental appraisal

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A. Introduction to environmental appraisal

Methodology overview

9.1 The Water Resources Planning Guideline (WRPG)[1], Defra guiding principles[2] and UK Water Industry Research Ltd (UKWIR) guidance[3] advises that water companies should consider the environmental and social effects (beneficial and adverse) of the options considered for balancing supply and demand, the preferred programme for each Water Resource Zone (WRZ) and the WRMP19 overall. Additionally, the Environmental Assessment of Plans and Programmes Regulations 2004 (the SEA Regulations)[4] and guidance on Strategic Environmental Assessment (SEA) require assessment of the environmental and social effects of the reasonable alternative programmes considered as part of developing WRMP19.

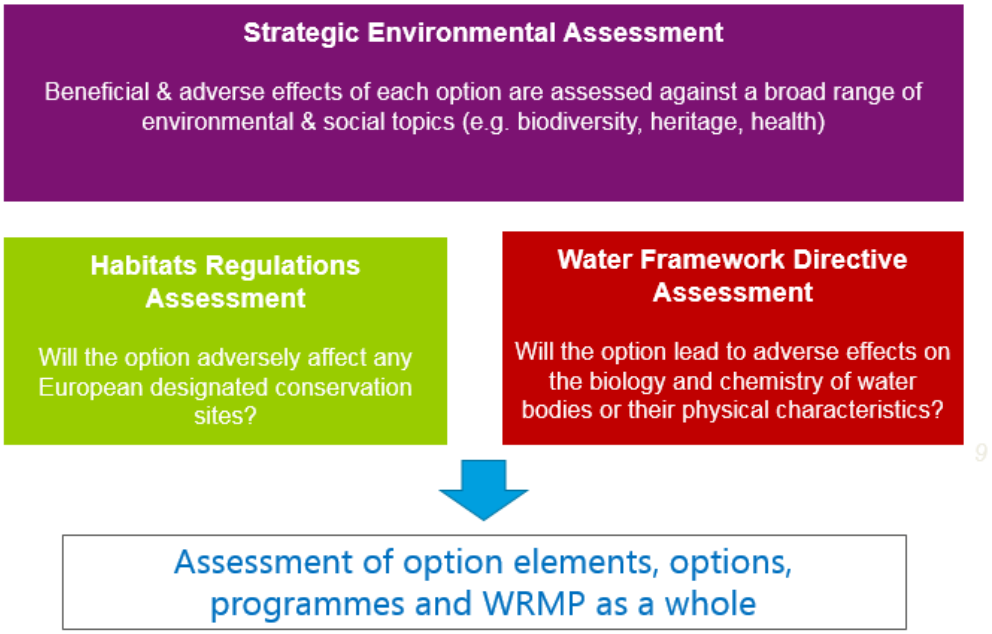
9.2 Ofwat also expects companies to improve water supply resilience, while taking full account of what their customers tell them about priorities for investment and maintaining sustainable water services.

9.3 Knowledge of the environmental and social effects is used to help to identify the preferred (or 'best value') programme of options to achieve a supply-demand balance in each WRZ to ensure a balance is maintained between available water supplies and demand for water.

9.4 An integrated environmental and social assessment approach for the development of our WRMP19 has been adopted as summarised in Figure 9-1, which has been implemented from the very outset of our planning.

[1] Environment Agency and Natural Resources Wales, Water Resources Planning Guideline: Interim Update April 2017
[2] Defra, Guiding principles for water resources planning for water companies operating wholly or mainly in England, May 2016
[3] UKWIR, Strategic Environmental Assessment and Habitats Regulations Assessment - Guidance for Water Resources Management Plans and Drought Plans, 2012
[4] 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

Figure 9-1: The environmental assessment approach within the WRMP



Statutory framework to environmental appraisal

9.5 In line with the WRPG, water companies in England must assess whether a SEA is required of its WRMP to comply with the SEA Regulations[5]. A SEA became a statutory requirement in England 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 SEA Directive was transposed into national legislation by the SEA Regulations. The Government has produced national SEA guidance - the "Practical Guide"[6] - which sets out the stages of the SEA process and the key requirements at each stage. The Practical Guide is supported by water industry specific guidance for undertaking SEA of WRMPs[7]. We have also consulted other national SEA guidance, including Scottish and European Union (EU) guidance, in carrying out the SEA.

[5] 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
[6] Office of the Deputy Prime Minister, A Practical Guide to the Strategic Environmental Assessment Directive, 2005
[7] UKWIR, Strategic Environmental Assessment and Habitats Regulations Assessment - Guidance for Water Resources Management Plans and Drought Plans, 2012

9.6 SEA incorporates the following generic stages:

- **Stage A:** Setting the context, identifying objectives, problems and opportunities, and establishing the environmental 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 (seeking consensus)
- **Stage E:** Monitoring the significant effects of the plan or programme on the environment (verification)

9.7 The SEA provides the overarching structure of the assessment approach but has been integrated with the parallel statutory assessment requirements for the EU Habitats Directive[8] and EU Water Framework Directive (WFD), the results of which inform the SEA.

9.8 The Habitats Directive establishes the requirement for assessment of plans or projects (Articles 6(3) and 6(4)). The Habitats Directive is transposed into national legislation by the Conservation of Habitats and Species Regulations 2017. Under Regulations 63 and 105, any plan or project which falls within a potential zone of influence of a European site must be subject to a Habitats Regulations Assessment (HRA). If the plan or project is likely to have a significant effect on a European site (either alone or in-combination with other plans or projects) and is not directly connected with, or necessary for the management of the site, it must be subject to an Appropriate Assessment to determine the implications for the site in view of its conservation objectives.

9.9 Both the WRPG and the UKWIR SEA and HRA guidance recommend that all WRMPs should be subject to the first stage of the HRA process, i.e. screening for likely significant effects (LSE). The WRPG additionally states that an Appropriate Assessment (the second stage of the HRA process) is required if an option included in the WRMP could affect any designated European site and that companies must clearly test their plans using HRA where applicable.

9.10 A 2018 European Court of Justice ruling[9] 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 Appropriate Assessment 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 being considered at Stage 2 Appropriate Assessment. We have considered this ruling in the WRMP19 and HRA assessment report contained in Appendix C: HRA – stage 1 screening.

9.11 We have applied the HRA process to all of the options considered for our WRMP19, from initial screening through to detailed assessment of the option elements, options and programmes. Details of the HRA can be found in paragraph 9.32 and Appendix C of the WRMP.

[8] Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora
[9] Case C-323/17 (*People Over Wind*).

9.12 In accordance with the WRPG and Defra's guiding principles, WFD assessments have also been carried out throughout the development of our plan: from the initial screening of options through to detailed assessment of the option elements, options and programmes. Details of the WFD can be found in paragraph 9.35 and Appendix BB of the WRMP.

9.13 In relation to the WFD, Defra expects that companies should take account of the government's objectives for the environment *"including the appropriate parts of the EU Water Framework Directive"*. Defra also expects that companies will:

- have regard to WFD River Basin Management Plans (RBMPs) and their objectives when making decisions that could affect the condition of the water environment
- ensure that future plans support the achievement of environmental objectives and measures set out in RBMPs
- prevent deterioration in WFD water body status
- support the achievement of protected area and species objectives
- support the achievement of water body status objectives

9.14 Both the WRPG and Defra's guiding principles refer to ensuring 'no deterioration' of water body status. A 2015 European Court of Justice ruling[10] clarified that 'no deterioration' means a deterioration between a whole 'status class' (e.g. 'good', 'moderate', etc.) of one or more of the relevant 'quality elements' (e.g. biological, physico-chemical, etc.). This definition applies equally to Artificial Water Bodies and Heavily Modified Water Bodies in respect of the relevant quality elements that relate to the defined uses of these water bodies. The European Court of Justice ruling further states that if the quality element concerned is already in the lowest class, any deterioration of that element constitutes a deterioration of the status. References to 'no deterioration' in our WRMP19 align to this European Court of Justice ruling.

9.15 Compliance with the statutory requirements of the SEA Directive, the HRA and WFD processes are the key outputs of the assessment process.

9.16 Additionally, the assessment approach takes account of national environmental legislative requirements (for example, those relating to Sites of Special Scientific Interest, Scheduled Monuments, Areas of Outstanding Natural Beauty) and associated relevant national guidance as illustrated in Figure 9-2. This has included consideration of the proposed Marine Conservation Zone in the lower River Thames estuary. The approach to the SEA has been informed by a review of other policies, plans and programmes including the Government's 25 Year Environment Plan (the 25 year plan) to improve the environment, published in 2018.

9.17 Net environmental gain has been included as a principle in the Government's 25 year plan. References to achieving environmental 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 National Planning Policy Framework (NPPF) 2018. The Government states that the 'net environmental gain' principle for development aims to deliver environmental improvements locally and nationally, primarily to "enable housing development

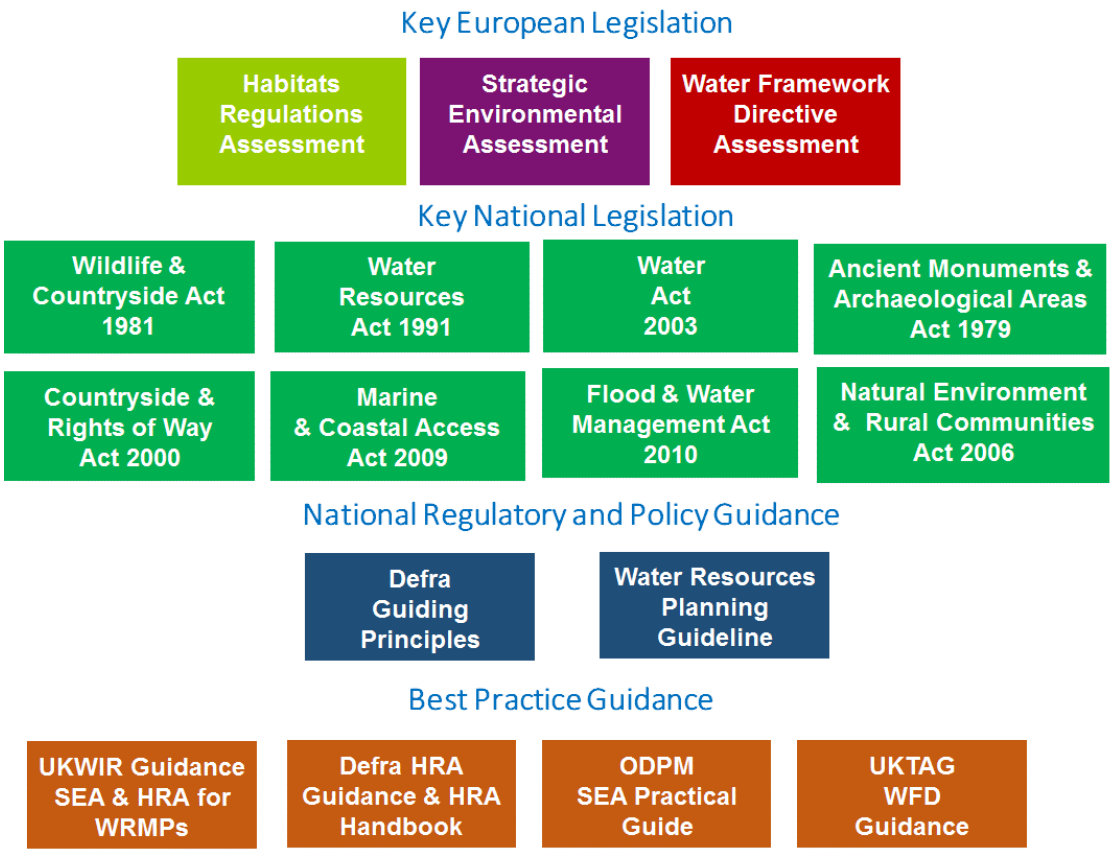
[10] European Court of Justice Case C‑461/13: Bund für Umwelt und Naturschutz Deutschland v Bundesrepublik Deutschland
http://curia.europa.eu/juris/document/document.jsf?docid=178918&mode=req&pageIndex=1&dir=&occ=first&part=1&text=&doclang=EN&cid=175124 [accessed 30.6.16]

without increasing overall burdens on developers". The benefits that are expected to arise as a result of implementing our WRMP and measures aimed at delivering overall net biodiversity and net environmental gain are set out in Sections 10 and 11 of the WRMP19.

9.18 In support of the net environmental gain principle, Thames Water is proposing a regulatory Performance Commitment as part of the 2019 Price Review process to achieving a net gain in biodiversity at its 253 Sites of Biodiversity Interest (SBIs), plus any net change from additional land where specific biodiversity offsetting has been implemented. We are committing to increase the total number of biodiversity units on our SBIs and offsetting sites by 5% during the period 2020-2025, and we expect to continue this commitment over the longer term, subject to customer support. Our proposed Performance Commitment commands strong support from our customers based on our recent customer research evidence.

9.19 Our plan complies with the requirement in the Water Resources Management Plan (England) Direction 2017 to consider the emissions of greenhouse gases (referred to in our plan as "carbon" emissions) that are likely to arise as a result of each measure included in the WRMP. Carbon emissions associated with both construction and operation of measures included in our plan have been assessed and a carbon value calculated in accordance with the latest government guidance and data on carbon pricing.

Figure 9-2: The statutory framework to environmental appraisal



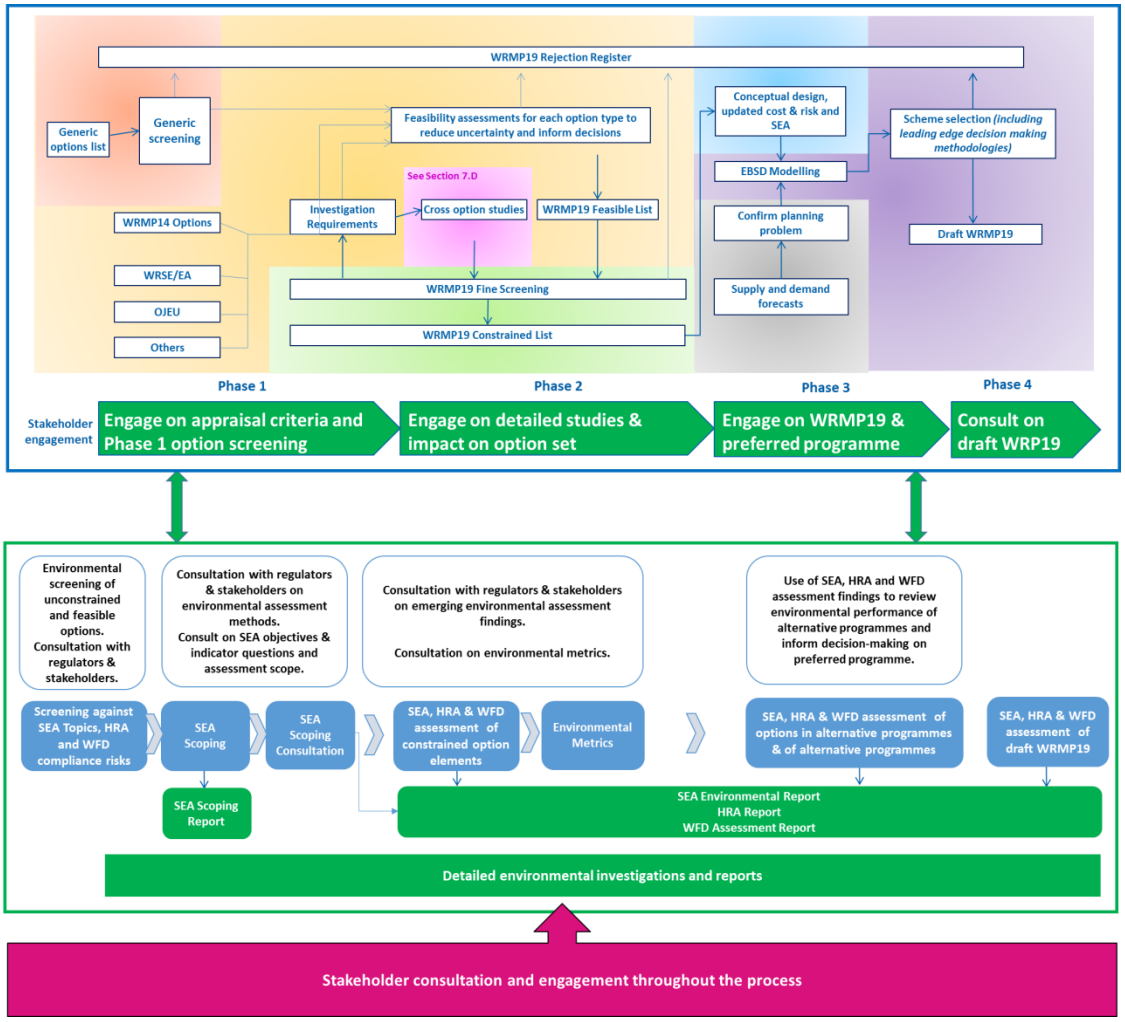
B. Assessment framework

9.20 We consulted extensively on our proposed assessment framework with regulators and stakeholders, supported by written Methodology Statements that were published for comment on our website together with the statutory SEA Scoping Report. Feedback received on our methodologies and SEA Scoping Report was used to inform our assessment framework and this was shared with regulators and stakeholders through a summary report plus presentations at stakeholder meetings[11]. Figure 9-3 summarises the overall framework we adopted and how it linked to the stages of development of the WRMP19. Section 7: Appraisal of water resource options provides details on each of the key stages.

9.21 The approach involved consideration of 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 topics plus HRA and WFD risks were considered as part of the screening of the unconstrained options to help develop a smaller 'feasible' list of options.

[11] Consultation documents available on the Thames Water website: https://corporate.thameswater.co.uk/About-us/Our-strategies-and-plans/Water-resources/Document-library/Assessment-of-environmental-and-social-impacts

Figure 9-3: Integration of environmental assessment within our draft WRMP19 process



9.22 These feasible options were then assessed against a suite of SEA topics and HRA and WFD compliance criteria to determine a constrained list of options for appraisal through SEA, HRA and WFD assessment processes, as described in Section 9.D and in accordance with the approach summarised below.

Strategic Environmental Assessment

9.23 The SEA has been fully integrated with the option appraisal process to help inform decisions on a best value set of options to balance supply and demand over the long-term planning period for both our customers and the environment. Appendix B: Strategic environmental assessment - environmental report accompanying our WRMP19 presents an assessment of the likely social and environmental effects of the Plan (both beneficial and adverse). It also identifies ways in which any adverse effects might be minimised or mitigated and how positive effects might be enhanced. The SEA has informed the consideration of each option element, option and the programme appraisal process, as well as development of the overall WRMP19.

9.24 In order to incorporate the SEA considerations within our programme appraisal model, which is a mathematical model, an approach was developed to summarise the environmental and social performance of each option element in the constrained list in numerical form. These numerical summaries have been termed 'environmental and social metrics', further details of which are provided in Section 9.C. These environmental and social metrics were derived from assessments of all of the option elements in the Constrained List. The metric scores in themselves are relative and provide an important tool to ensure that environmental effects are actively considered within the programme appraisal modelling.

9.25 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 so that the relative performance of each alternative programme against SEA objectives could be considered, with regard being given to potential cumulative and in-combination effects of components of options. SEA assessment of the options in the preferred programme as well as the programme itself was also undertaken. Full details are provided in Sections 7 and 8 of Appendix B: SEA - environmental report.

9.26 As some of our options have the potential for cumulative effects, collaborative work with some of our neighbouring water companies during the development of the WRMP19 has taken place through the Water Resources South East (WRSE) group. Further discussions have taken place separately with individual companies including a review of 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. Environmental assessment of the range of feasible supply options in the WRMPs of these companies has indicated that there may be possible cumulative effects in the North Medway Chalk groundwater body and the Thames wider catchment.

9.27 The findings from this work concluded that no cumulative adverse effects have been identified in relation to other water companies outside of the WRSE group with the WRMP19. The draft 2019 WRMPs for water companies neighbouring our water supply area were still being finalised at the time of carrying out the original SEA; following these other WRMPs being finalised and the specific supply and demand management measures confirmed, the cumulative effects assessment within our SEA has been reviewed.

9.28 The SEA process and emerging findings helped facilitate consultation and engagement during the development of our plan with customers, government, regulators and stakeholders on environmental and social considerations, in particular through our regular meetings with regulators and stakeholders at our Water Resources Forum and Technical Stakeholder Meetings.

9.29 The SEA was informed by the parallel assessment processes of the HRA and WFD assessments.

9.30 The SEA topics indicated by the SEA Directive and adopted in our environmental appraisal of the WRMP19 are:

- Biodiversity, flora and fauna
- Population and human health
- Material assets and resource use
- Water
- Soils, geology and land use
- Air and climate
- Archaeology and cultural heritage
- Landscape and visual amenity

9.31 We followed an objectives-led approach to the SEA. Section 5.A.12 of the Practical Guide explains that whilst SEA objectives are not specifically required by the SEA Directive, they are a 'recognised way of considering the environmental effects of a plan or programme and comparing the effects of alternatives'. The objectives-led approach is also recommended in the UKWIR Guidance on SEA of WRMPs. The objectives for each SEA topic were developed and informed by the key messages identified following a review of relevant policies, and other plans and programmes, along with stakeholder engagement through the SEA Scoping Report consultation in summer 2016 and regulatory and stakeholder meetings. Alongside each SEA objective a series of indicator questions were developed to ensure that the assessments were both comprehensive and consistent.

Habitats Regulations Assessment

9.32 We carried out HRA screening throughout the development of our plan to assess the potential effects on European sites (also known as Natura 2000 sites) of each of the option elements, options, programmes and the WRMP19 as a whole. European sites include those sites designated as Special Areas of Conservation (SAC) under the EU Habitats Directive, Special Protection Areas under the Birds Directive, and Ramsar sites under the international Ramsar Convention, as well as candidate or proposed sites.

9.33 We undertook screening assessment of the constrained list of options considered in developing the draft WRMP, which have been updated in the revised draft WRMP19 to have regard to the 2018 European Court of Justice ruling[12], and discussed the outcomes with Natural England and the Environment Agency, as well as stakeholders at our engagement meetings. The process and full assessment findings are summarised later in this section and fully documented in Appendix C: HRA stage 1 screening, which is published alongside our WRMP19. Outcomes of the HRA screening assessments informed the SEA, and in turn, helped inform our decision-making at each stage of developing the WRMP19.

9.34 For those options included in our preferred programmes for each WRZ, we carried out additional HRA screening to assess likely significant effects on any European sites either alone or in combination with other options within the programme, during both construction and

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

operation. In light of the 2018 European Court of Justice ruling, a number of the screening assessments in the WRMP19 identified the need to undertake Appropriate Assessment. The findings of the HRA assessments are presented in detail in Appendix C: HRA stage 1 screening.

Water Framework Directive assessment

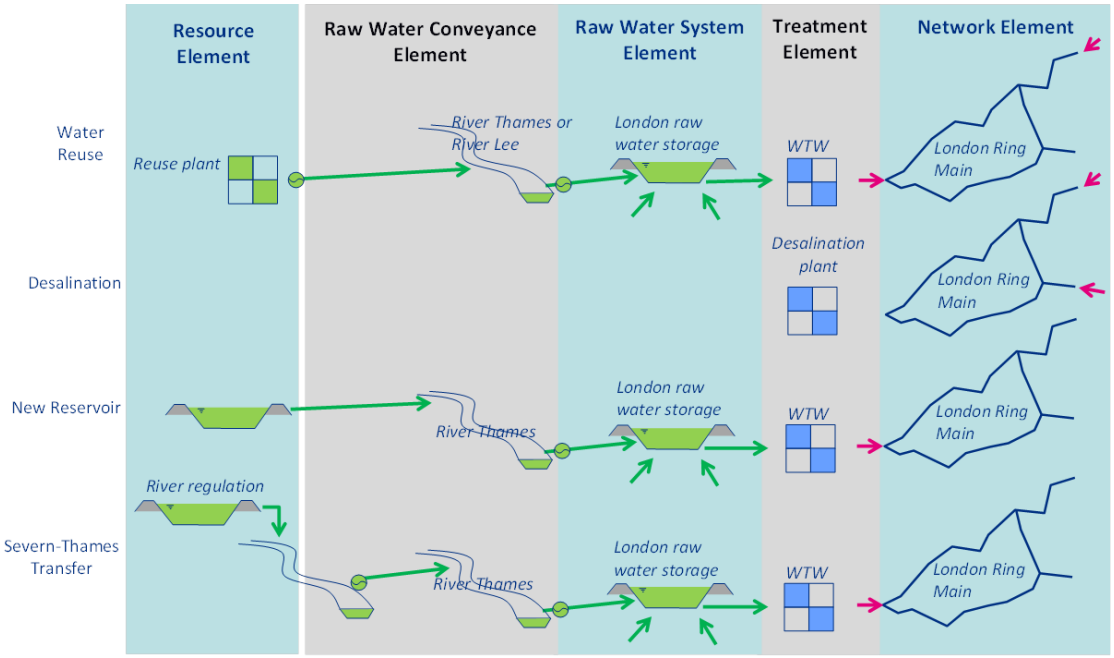
9.35 WFD assessments were carried out in a similar manner to the HRA at each stage of the plan development to assess the potential effects of implementing the WRMP19 on designated WFD water bodies, River Basin Management Plan objectives and measures, as well as on WFD Protected Areas. In particular, for each option element, option and programme we assessed whether there was a risk of deterioration in the status class of any WFD water body. For those options included in our preferred programme for each WRZ, we carried out additional WFD assessments of the residual effects of the options both alone and in combination with other options within the programme, both during construction and operation.

9.36 The findings of the WFD assessments are summarised later in this section and presented in detail in Appendix BB: WFD assessment.

C. Approach to environmental assessment

9.37 The assessment approach covered all stages of the development of the WRMP, commencing from the coarse screening of the very broad unconstrained list of options, through to the fine screening process which identified those option elements (e.g. new water sources, pipelines, pumping stations, water treatment works) to include in our Constrained List of options for more detailed assessment and consideration within our programme appraisal process. Figure 9-4 shows some examples of these option elements. This process ensured end-to-end consistency of the approach to environmental assessment throughout the plan development.

Figure 9-4: Illustration of the option elements approach



9.38 We carried out detailed environmental assessment for:

- each option element included in the Constrained List
- each of the options selected for inclusion in the reasonable alternative programmes under consideration
- each of the reasonable alternative programmes under consideration
- the overall 'best value' programme for each WRZ
- the WRMP19 as a whole (i.e. considering the cumulative environmental effects across our six WRZs)
- each of the supply-demand scenarios used to carry out sensitivity testing of the WRMP19

9.39 Cumulative effects with other programmes, plans and projects were also considered in relation to each of the reasonable alternative programmes and the preferred programme. This included assessing the potential for cumulative effects with:

- Thames Water revised Draft Drought Plan 2018
- Other water company WRMPs and Drought Plans, including information from the WRSE group
- Environment Agency Drought Plan and the Canal & River Trust Drought Plan
- Thames River Basin Management Plan (RBMP) 2015 and the Severn RBMP 2015
- Local development and land use plans
- Major planned infrastructure schemes, for example High Speed 2 and Crossrail 2

9.40 We are confident that the SEA, as updated, addresses at a strategic level, the full range of impacts from all options brought forward into the preferred programme and reasonable alternative programmes.

9.41 All option elements, options and programmes were assessed to the same level of detail involving an advanced level of qualitative assessment informed by detailed quantitative data within the boundaries of the SEA process. Importantly the level of detail and assessments undertaken did not stray into the statutory Environmental Impact Assessment (EIA) process. This is consistent with national guidance on SEA and EIA. Where required, detailed EIAs that will entail more detailed assessment work may be necessary for some of the options included in our WRMP19 as part of any development consent process at a later date.

9.42 It is important to note that the detailed SEA, HRA and WFD assessments we undertook were of the residual environmental and social effects of each option element, option and programme, after consideration of the mitigation measures and opportunities for environmental enhancement that have been included in the conceptual designs and costs for each option element/option.

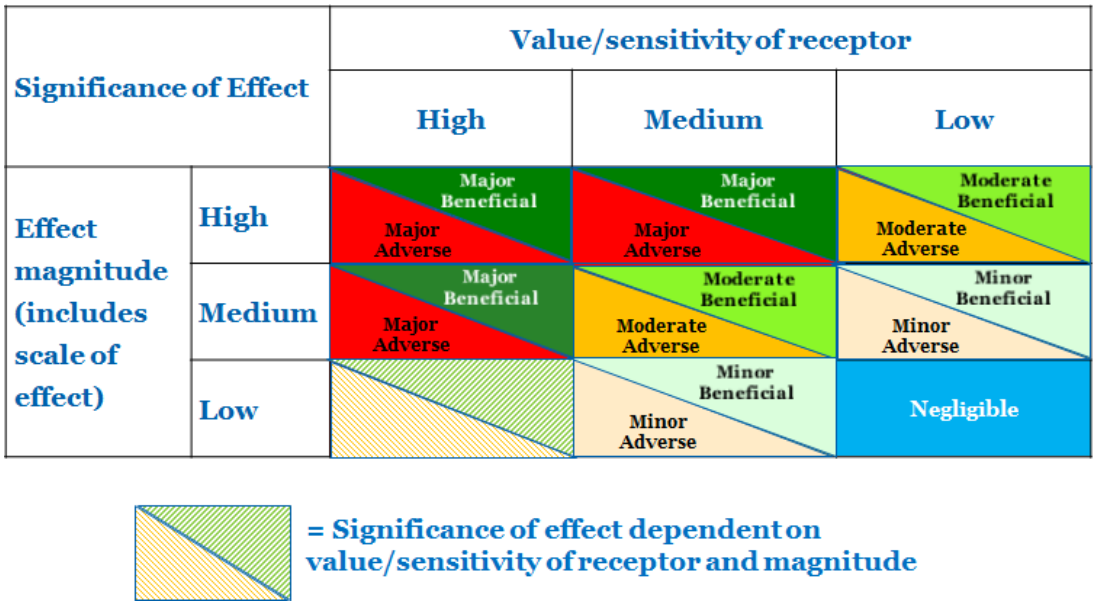
9.43 For the SEA, the residual adverse and beneficial effects have been identified separately to avoid mixing (or trading) of adverse and beneficial effects, in line with SEA best practice. This enables adverse and beneficial impacts to be independently assessed, maintaining transparency throughout the WRMP decision-making process.

9.44 The findings from the HRA and WFD assessments informed the SEA and were actively considered alongside the SEA findings in the decision-making process, reflecting the statutory requirements and expectations of Government and regulators to carefully consider the effects of the WRMP19 on European sites and WFD water bodies.

9.45 The SEA of the Constrained List of option elements, options, alternative WRZ programmes and the overall WRMP19 were carried out using the effects assessment matrix shown in Figure 9-5, as well as taking account of, for both adverse and beneficial effects, the scale of effect (geographical and/or population affected) (small/medium/large), certainty of the effect, whether the effects arise in the short, medium or long term, and whether the effects are permanent or temporary.

9.46 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 as summarised within the Appendix E and Appendix F assessment tables of Appendix B: Strategic environmental assessment – environmental report. 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. The definitions for the significance of the effects are explained in Figure 9-5.

Figure 9-5: Significance of effects matrix



- **Major** - effects represent 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 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

9.47 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.

9.48 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.

9.49 The colour coding shown in Figure 9-5 has been used to signify the residual effects in the summary assessment tables presented later in this section. These effects were considered in the selection of options and programmes of options, alongside the HRA and WFD assessment findings, for which the following colour coding system has been adopted in the summary assessment tables later in this section:

- Green (no adverse effects)
- Amber (potential risk of adverse effects but further mitigation is possible to reduce the effects to acceptable levels)
- Red (adverse effects cannot be ruled out and further mitigation unlikely to reduce effects to acceptable levels)

9.50 Further details of the assessment methodologies are provided in the accompanying Appendix B: SEA - environmental report, Appendix C: HRA – stage 1 screening and Appendix BB: WFD assessment.

Environmental valuation

9.51 In line with the WRPG, we have carefully considered the role of environmental valuation in supporting the development of the WRMP19. In dialogue with the Environment Agency and stakeholders, we concluded that there would be little benefit to the decision-making process in calculating environmental and social costs for identified environmental and social effects of the alternative options for balancing supply and demand.

9.52 A current key limitation is that only certain effects of options can be valued through the benefits-transfer approach to environmental and social costing. As a consequence, many of the effects (both beneficial and adverse) identified through the SEA process cannot be assigned a monetary value, thereby hindering comparative assessment of alternative options. This risks the programme appraisal modelling being skewed and results in a mixed approach to how environmental and social effects are represented in the optimisation process: some options will have no monetised environmental and social costs whilst others will have material environmental and social costs assigned despite both options having the same overall significance of effect in the SEA. Adopting a partial valuation of the effects could lead to transparency issues due to the need to amend the SEA findings to address any double-counting of effects at the programme appraisal stage.

9.53 We consulted with stakeholders on the application of environmental and social costs for the WRMP19. The majority of stakeholders felt that monetisation of environmental and social effects would not materially improve the option assessment and programme appraisal process. Those who favoured monetisation of effects mostly expressed a view that a Natural Capital Accounting (NCA) and/or Ecosystems Services approach would likely be more appropriate. This is further discussed in paras 9.56 to 9.57.

9.54 We have therefore followed the "building blocks" approach to the assessment of environmental and social impacts advocated in the WRPG. The SEA (informed by the HRA and WFD assessments) provide qualitative and semi-quantitative assessments of the environmental and social effects at a detailed level. SEA has been used as the primary vehicle for assessing the effects at the option, programme and plan level, with the effects reported in the SEA Environmental Report.

9.55 Carbon consumption impacts of each option have been monetised using national UKWIR guidance and HM Treasury carbon prices. Valuation of carbon effects is being carried out because all of the effects can be valued using internationally recognised approaches and backed up by a strong methodology and Government carbon pricing data. The carbon costs were added to the AIC for each option and used in the programme appraisal modelling. The environmental metrics therefore do not reflect any carbon impacts to avoid double counting of the effects.

9.56 Defra’s guiding principles for water resource planning (2016) state that water companies should demonstrate how they value natural capital in decision-making and report on environmental and social costs and benefits. Thames Water has been piloting the use of

Natural Capital Accounting and associated ecosystem services assessment for application to water resource planning and our wider business planning processes. Currently, the available methods and evidence are not sufficiently robust to apply them to all of the options considered in the WRMP19 on a consistent basis to enable objective comparison to inform decision-making. We appointed consultants to trial applying a NCA assessment approach to our supply side options. We found that whilst it was possible to generate natural capital valuations for some of the options, the absence of an agreed methodology and a lack of data meant that we felt the results were not sufficiently robust to ensure consistency in our decision making. Thames Water has however considered potential effects on natural capital in a qualitative manner in the SEA and we have therefore focussed on using the SEA, WFD and HRA to ensure that environmental and social impacts and benefits are considered.

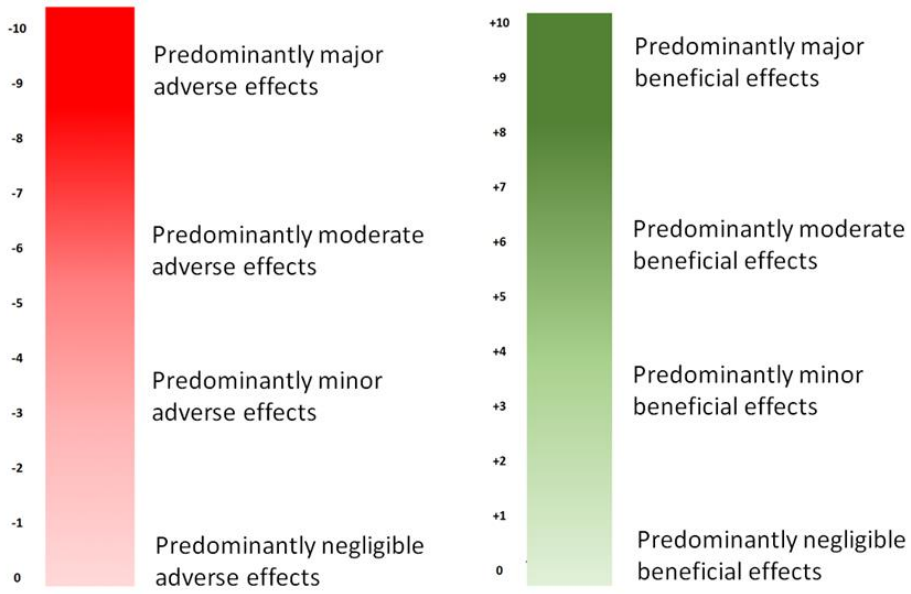
9.57 As members of the Natural Capital Coalition, we are keen to support the development of the NCA approach and will work with the sector to progress this, including through the current collaborative water industry research programme into the application of NCA for long-term planning. We have also examined the relationships between the SEA findings and ecosystem services as part of our investigations into how to integrate ecosystem services into the assessment of future water resources management plans. We will continue to develop our approach to NCA, working in partnership with the water sector, regulators and stakeholders. Once robust methodologies for applying NCA approaches to our long-term plans are available we will work with regulators and other stakeholders to embed them into our future planning activities.

9.58 Our approach to environmental assessment for WRMP19 has therefore been based on broad support from stakeholders and regulators, with a simple, clear and understandable assessment framework based on SEA, WFD and HRA processes that are familiar to both our regulators and stakeholders.

Environmental metrics

9.59 In order to incorporate environmental and social considerations directly into our appraisal optimisation model – which we used in short-listing reasonable alternative programmes and scheduling of options - we developed an approach 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. We called these numerical summaries ‘environmental and social metrics’. These environmental and social metrics were derived from assessments of all of the option elements in the Constrained List. The metric scores in themselves are relative and provide an important tool to ensure that the environment was actively considered within the programme appraisal modelling.

Figure 9-6: Environmental metrics: grading of effects



9.60 As shown in Figure 9-6, our environmental and social metrics were 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.

9.61 Importantly, the metrics were derived directly from the findings of the SEA, HRA and WFD assessments. As shown in Figure 9-6, the SEA findings of significance of effect (e.g. moderate adverse, minor beneficial) were used to determine the appropriate metric grading. The metric scores in themselves are relative and provide an important tool to ensure that the environment was actively considered within the programme appraisal modelling.

9.62 As with the SEA, the metrics kept the beneficial and adverse effects separate 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. To help identify relative environmental risks and benefits the initial shortlisting of reasonable alternative programmes for further consideration had regard to the environmental metrics of each option element.

9.63 Following the shortlisting process, each of the options in the reasonable alternative programmes and the programmes themselves were assessed through the SEA process. The relative performance of each was assessed against SEA objectives with regard given to potential cumulative and in-combination effects of components of options. SEA assessment of the options in the preferred programme as well as the programme itself was also undertaken.

9.64 Options comprise 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 works

element). Section 7 of Appendix B of our WRMP (SEA Environmental Report) provides the findings of these assessments. Environmental metrics were not derived for the options.

9.65 In response to stakeholder feedback on the draft methodology, it was agreed 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.

9.66 Where the SEA (and HRA and WFD) assessments indicated that an option element would cause intractable issues or could not be mitigated and would therefore likely lead to adverse effects on a European site (after consideration of mitigation measures in an Appropriate Assessment), and/or lead to likely permanent deterioration of WFD status between status classes, the adverse effects grading was automatically assigned at the grading of -9 for adverse effects. The -9 adverse effects grade reflects the fact that these options would be unlikely to be acceptable 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. This was done to flag potential risks and more detailed investigations may conclude that the option element would not be considered suitable for inclusion in the preferred programme.

9.67 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 it was considered, based on the evidence available at HRA Stage 1 screening, that Appropriate Assessment would be required and where there could be challenges in ensuring no adverse effects through the application of mitigation measures.

9.68 This approach to compliance with EU or international law as part of the option element assessment process provided 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.

9.69 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.

9.70 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: Programme appraisal and scenario testing.

9.71 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.

9.72 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. Following the short-listing process, each of the short-listed 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" programme of options – not the environmental metric. 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 provided in Section 10: Programme appraisal and Section 11: Preferred plan.

Cumulative environmental effects assessment

9.73 As explained earlier, the SEA, HRA and WFD assessments included consideration of any potential cumulative effects (adverse and beneficial) at key stages of WRMP19 development: feasible options assessment; fine screening process; assessment of the options included in the reasonable alternative WRZ programmes; assessment of the reasonable alternative programmes and the preferred programme; and for the overall plan.

D. Unconstrained to Constrained List Options: environmental assessment

9.74 The initial stages of the environmental assessment approach involved screening of a large number of options in the 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, European sites or UNESCO World Heritage Sites). Remaining options were then considered in more detail as part of the Feasible List of options through the Feasibility Assessment process (as described and summarised in our Feasibility Assessment Reports).

9.75 The Feasibility Assessment process included the assessment of each Feasible option against key SEA topics, HRA screening and WFD screening criteria. This process involved engagement with regulators and stakeholders through presentation and publication of the draft Feasibility Assessments, and we used the feedback from this engagement activity to help finalise our 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, we made decisions about which options should be taken forward to the Fine Screening process.

9.76 The environmental assessments contributed to a range of options being rejected due either solely, or more often in part, to adverse environmental effects – when compared with other alternative options which performed much better against the environmental assessment criteria. For example, we evaluated 55 potential large reservoir options as part of the Reservoir Feasibility Assessment, but only three options (with sub-options reflecting different potential storage capacities) were taken forward to the Fine Screening assessment. Of the 52 options rejected, 34 options were rejected partly as a result of substantive adverse environmental effects (such as destruction to Ancient Woodland, and damage to a European site).

9.77 Options passing through the Feasibility Assessment stage were considered further as part of the Fine Screening stage, which 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. The assessment approach is summarised in the Fine Screening Report, with the magnitude of the benefits or disbenefits for SEA (and disbenefits only for HRA and WFD) based on a scale from neutral to substantial. These assessments built on the findings of the Feasibility Assessment reports.

9.78 As denoted in Table 9-1 by the red letter ‘r’, the Fine Screening assessment considered whether disbenefits could be reduced through mitigation (as identified as part of the final stage of the Feasibility Assessment process).

9.79 Those options that performed best against all of the Fine Screening assessment criteria (i.e. not just environmental and social factors, but others such as cost and resilience) 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.

9.80 In view of the preceding environmental assessment processes, in particular the Feasibility Assessments, no options were rejected solely in relation to adverse environmental issues at the Fine Screening stage. Some options were identified as performing less well environmentally compared with other options in the same option type, and these findings formed part of the reasoning for the option being rejected. Full details are provided in the Fine Screening Report[13].

9.81 The Fine Screening process was subject to extensive consultation with regulators and stakeholders, through the Water Resources Forum and associated open Technical

[13] Fine Screening Report, Mott MacDonald, January 2018

Stakeholder Meetings, as well as through written submissions on draft versions of the Fine Screening Report made available on our website. Feedback from this engagement activity helped to refine and finalise our decisions on which options to take forward to the Constrained List of options for further development and detailed environmental assessment. A number of options were added to, updated or removed from the list following submission of the draft WRMP19 and development of the final WRMP19, as detailed below.

Table 9-1: Fine screening environmental assessment: example

Environmental & social screening of Option X	
SEA	◎ ●
HRA	○
WFD	◑r
Cumulative effects	◉

Key to symbols:

- ● Substantial disbenefit
- ◐ Material disbenefit
- ○ Neutral
- ◎ Material benefit
- ◉ Substantial benefit
- r Disbenefit reducible through mitigation

Changes since the draft WRMP

9.82 Thames Water published the draft WRMP19 for public consultation in February 2018. The public consultation ran from 9 February to 29 April 2018.

9.83 Work has continued to develop the water resource options identified in the draft WRMP19 in parallel with the public consultation. As a result, some of the options on the Constrained List of options have been 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)

9.84 Due to the above, new options have been identified, which have been assessed and included in WRMP19, and subject to SEA, HRA and WFD assessment using the same methodologies as 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 WRMP19.

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

9.86 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 WRMP19, reflective of customer, regulatory and government expectations.

9.87 The following new water resource options have been identified:

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

9.88 The following existing water resource options have been updated:

- Raw Water Transfers
    a. River Wye to Deerhurst (60.3 Ml/d) (previously listed as South-East Wales Resource)
    b. Great Spring (previously listed as South-East Wales Resource)
    c. Netheridge STW to River Severn 35 Ml/d
    d. Minworth STW to River Avon 115 Ml/d
    e. Minworth Canal Transfer 75 Ml/d
- Direct River Abstractions
    f. Teddington DRA
- Reuse
    g. Mogden Reuse
- Groundwater
    h. Groundwater Datchet
    i. Ashton Keynes removal of constraints to DO
    j. North London Licence Trading

- Inter Zonal Transfers
    k. Henley to SWOX 5 Ml/d – Inter-zonal transfer
    l. Henley to SWA 5 Ml/d – Inter-zonal transfer
- Conveyance: Raw Water System
    m. Medmenham Intake – 53 Ml/d
    n. Abingdon to Farmoor pipeline
- Network Reinforcement
    o. SWOX to SWA (48 Ml/d)

9.89 The following elements have been removed:

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

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

9.91 Both the Hayden STW to River Severn and Draycote Reservoir Extension Severn to 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 and the option was also reviewed by Thames Water and discussed with the Environment Agency. This ultimately led to these two options being withdrawn.

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

9.93 Further work on the Teddington Direct River Abstraction (DRA) option was undertaken since 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 a Teddington DRA option cannot be considered a feasible option in a proposed WRMP programme at this time.

E. Constrained List Options: environmental assessment

9.94 A number of options were added to, updated or removed from the list following submission of the draft WRMP19 and development of the final WRMP19, as detailed above. For those options taken forward from the Fine Screening stage to the Constrained List, the options were disaggregated into key component elements (see Figure 9-4) and a conceptual design developed for each of these 'option elements'.

9.95 Findings from our preceding environmental assessment work, together with the initial findings of our detailed SEA, HRA and WFD assessments of each option element, were discussed with our design engineers to examine the requirements for specific mitigation measures as well as to identify opportunities for environmental enhancement and potential environmental gain.

9.96 Consideration of mitigation measures was a key component of the development of the conceptual designs, assessing the potential adverse effects and beneficial effects of the option element and identifying mitigation measures to reduce adverse effects or, where feasible, to enhance beneficial effects. There were two key elements of the mitigation considerations:

- **Modifying scheme design to eliminate or reduce adverse effects** (or provide enhanced beneficial effects). For example, this included measures such as moving the location of pipelines or adopting tunnelling for water conveyance rather than laying a pipeline through a sensitive terrestrial landscape. Particular attention was paid to optimising long-distance pipeline routes to avoid sensitive environmental or social receptors wherever feasible. Enhancement opportunities included consideration of improving biodiversity 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. We 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.

9.97 The conceptual designs, including details on construction and operational requirements and the mitigation measures for each option element were developed in an iterative manner between the design engineers and the environmental assessment team. These were then used to inform the SEA, HRA and WFD assessment of each option element based on the residual effects after application of the mitigation measures and or inclusion of enhancement opportunities.

9.98 The residual effects of each option element were assessed in accordance with the stated methodologies for SEA, HRA and WFD. The appraisals drew on the Feasibility Reports, the Conceptual Design Reports, public domain environmental datasets and, in most cases, more detailed, option specific environmental assessment reports prepared as part of the development of WRMP19.

9.99 In some cases, the residual effects assessment as well as consultation responses from consultees highlighted the requirement for additional mitigation requirements or enhancement opportunities beyond those included in the conceptual design of the option element. Such additional mitigation or enhancement measures were reviewed and agreed and costed for within the appraisal of each option. Further details on the mitigation measures included for within the SEA assessments of the option elements are contained in Appendix I of Appendix B: Strategic environmental assessment - environmental report. Where mitigation or enhancement measures have been identified as being required in the options identified within the preferred programme we will continue to work closely with the Environment Agency, Historic England, Natural England and other key stakeholders to develop and finalise the details of these measures.

9.100 Further assessment work and development of mitigation and enhancement opportunities will be also carried out as part of the detailed design and refinement of all of the other schemes in the WRMP19 preferred programme as they are brought forward for more detailed planning. This will be in order to seek opportunities to further reduce the identified adverse residual effects and increase beneficial residual effects. Further details are provided in Sections 7 and 10 of Appendix B: SEA environmental report.

9.101 The SEA, HRA and WFD assessment findings were set out in detailed assessment tables for each option element (for a wide range of options considered for the plan including demand management option elements), as presented in the accompanying Appendix B: SEA - environmental report, Appendix C: HRA – stage 1 screening and Appendix BB: WFD assessment.

9.102 An overall summary assessment matrix, ranked according to the magnitude of effects (adverse or beneficial) and the assessed environmental metric grading was produced as presented in Table 9-2 (for adverse effects) and Table 9-3 (for beneficial effects). For a small number of option elements, where they were identified after the programme appraisal modelling had been undertaken, no environmental metrics were produced. These option elements relate to measures decided during the programme appraisal stage to enable reduced abstraction from various vulnerable chalk streams and water courses (see Section 10). These option elements were however assessed through the same detailed SEA option element assessment process as all other option elements and the SEA findings are summarised at the bottom of Table 9-2 and Table 9-3. The detailed SEA findings for all of the option elements (rather than the environmental metrics) were used to aid decision-making on the selection of options within the preferred programme.

9.103 The key conclusions from these detailed assessments of the option elements are summarised in the following sub-sections.

HRA

9.104 The HRA provided in Appendix C: HRA stage 1 screening has been updated since the draft WRMP19 report to take account of the 2018 European Court of Justice "People over Wind" judgement[14] which held that mitigation measures should not be considered as part of the HRA screening assessment. The consequence of this judgement and as agreed at the meeting with Natural England held on 13th June 2018, any screening that previously at draft WRMP19 stage relied on mitigation measures to conclude no Likely Significant Effects has been declared a Likely Significant Effect and Stage 2 Appropriate Assessment recommended if it is included in the preferred programme.

9.105 In light of the revised approach to HRA screening and exclusion of consideration of mitigation measures at Stage 1 screening, a total of 44 option elements were identified at the option element level as having potential Likely Significant Effects. The HRA assessments are discussed as part of the programme appraisal assessment in Appendix B: SEA - environmental report, with full details provided in Appendix C: HRA stage 1 screening.

9.106 HRA assessments at option level (which includes combinations of option elements) are discussed as part of the programme appraisal assessment in Appendix B: SEA environmental report, with full details provided in Appendix C: HRA stage 1 screening.

WFD

9.107 Six of the option elements were found to have uncertain risks to WFD objectives when considered in isolation and at the individual operational capacities. Full details of the WFD findings are provided in Appendix BB: WFD assessment.

9.108 WFD assessments at option level (which includes combinations of option elements) are discussed as part of the programme appraisal assessment in Appendix B: SEA environmental report, with full details provided in Appendix BB: WFD assessment.

SEA

9.109 As would generally be expected, the adverse and beneficial effects of larger scale water source, conveyance and water treatment option elements are greater than for smaller scale options. The precise significance of adverse effects for the same option element type (e.g. desalination plant on the River Thames Tideway or large diameter tunnel 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.

9.110 SEA assessments at the option level (which includes combinations of option elements) are discussed as part of the programme appraisal assessment in Appendix B: SEA - environmental report, with full details provided in Appendix F of Appendix B: SEA - environmental report.

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

[14] Case C-23/17 People Over Wind and Sweetman. Ruling of CJEU

- 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

Conclusions

9.112 The draft conclusions of the detailed option element SEA, HRA and WFD assessments were discussed and presented to regulators and stakeholders, through the Water Resources Forum and at an open workshop as part of the June 2017 Technical Stakeholder Meeting. The draft option element assessments were made available to regulators and stakeholders via our website: comments and challenges provided through this consultation activity helped to refine and finalise our assessments and the option element environmental metric gradings for use in the appraisal optimisation model. We have also considered the comments received from stakeholders to the consultation undertaken on the draft WRMP19 in updating the assessments contained within the final WRMP19.

9.113 In conclusion, the earlier stages of the 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 led to unacceptable environmental or social impacts. No option elements from the Constrained List of option elements were therefore excluded from the programme appraisal process.

9.114 Some option elements for which the outcome of the HRA screening had identified a requirement for Appropriate Assessment and / or the outcome of the WFD assessment was uncertain, either because of a lack of available information or due to insufficient time being available to design adequate mitigation measures, were taken forward into the programme appraisal process. In these instances, where the option elements were selected as part of the reasonable alternative programmes and/or the preferred programme, the SEA, WFD and HRA processes involved further examination of the uncertainties and consideration of additional mitigation measures.

9.115 The contribution of the environmental assessment processes to the programme appraisal process and decision-making for the WRMP19 is described in Section 10: Programme appraisal and in Appendix B: SEA - environmental report.

9.116 Further detail from the SEA, HRA and WFD assessments are set out for a wide range of options considered for both the reasonable alternative programmes as well as for the preferred programme, as presented in the accompanying Appendix B: SEA environmental report, Appendix C: HRA – stage 1 screening and Appendix BB: WFD assessment.

Table 9-2: 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																									

Table 9-3: SEA, HRA and WFD assessment summary matrix for beneficial effects of all option elements

Option type & sub-type	Element name	Element Ref	SEA objectives																							Beneficial 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																						