Draft Regional Plan

for consultation

Appendix 5: Option identification and appraisal

November 2022

WReN

Water Resources North

Appendix 5. Option Identification and Appraisal Process

This appendix provides additional information on Water Resources North's (WReN) option identification and option appraisal work carried out to support our draft regional plan:

- Appendix 5.1 provides an overview of the screening process used to develop the WReN feasible options, with a specific focus on the inter-regional transfer options considered through development of the plan.

- Appendix 5.2 discusses the option appraisal process leading to development of our draft regional plan to meet the significant deficits with the Yorkshire Grid zone (building on Section 7 of the main report).

Appendix 5.1 Option Identification

General approach to option identification

We identified and developed a range of public water supply (PWS) options for appraisal within the regional plan where a deficit, or where a material risk of a deficit, exists. We took a 'twin-track' approach which considered both reducing demand through demand-side options (e.g. increased water efficiency, leakage reductions), and increasing supply through supply options (e.g. new or enhancement of existing supplies, transfers of water from other zones with suitable water availability).

In line with customer and stakeholder preferences, we have a preference to deliver demand-side options in the first instance and have included options in the plans to achieve ambitious government policy targets by 2050 for both reducing per capita consumption (PCC) and leakage. However, through the planning process it was found that we cannot rely on demand options alone in the Yorkshire Grid zone, and therefore we needed to identify new and sustainable options for increasing supply.

The options identification process started by reviewing the potential choices available and identifying an initial set of options called 'the unconstrained list'. The regional plan focus was on exploration of strategic options, in particular transfer options between neighbouring regions, or between companies in our own region. Regional plan activity is therefore 'pooled' with activity at WRMP level across all options, and the reader should refer to the Yorkshire Water draft WRMP24 for more details. Approaches to identifying the unconstrained list of options included the following:

- review of WRMP19 list of options
- review of the options suggested in the WR27 Water Resources Planning Tools, UKWIR 2012 report.
- *consideration of transfer opportunities in consultation with other water companies including both intra-region and inter-region transfers* (in alignment with the reconciliation process)
- consultation with third parties to review existing third-party options and identify new options
- consultation within the water companies with staff who have knowledge of the supply system and operations, water production planning and service delivery
- review of the specific system constraints and associated risks to the network e.g. learning from the dry period of 2018 and investigating which areas of the Yorkshire Grid network were under stress (links to the critical period scenario)
- review of new and existing techniques and network improvements for driving leakage down.

The unconstrained options were then assessed to understand which were suitable for addressing the plan needs and risks that have been identified to produce 'the constrained list'. Any constrained option which was then considered as 'infeasible' was excluded from the constrained list to determine the 'feasible list' of options for further

development. An option may have been considered infeasible if there are technical limitations that make it undeliverable, or if a risk to the delivery of the option is judged too high to proceed.

The overarching WReN option identification process is summarised in **Figure A5.1**. and the associated screening criteria for assessing options feasibility is provided in **Table A5.1**. The process follows the same principles of options identification as applied in WRMPs and is compatible with the planning guidelines and associated UKWIR WR27 methodology.

Figure A5.1. Options identification process

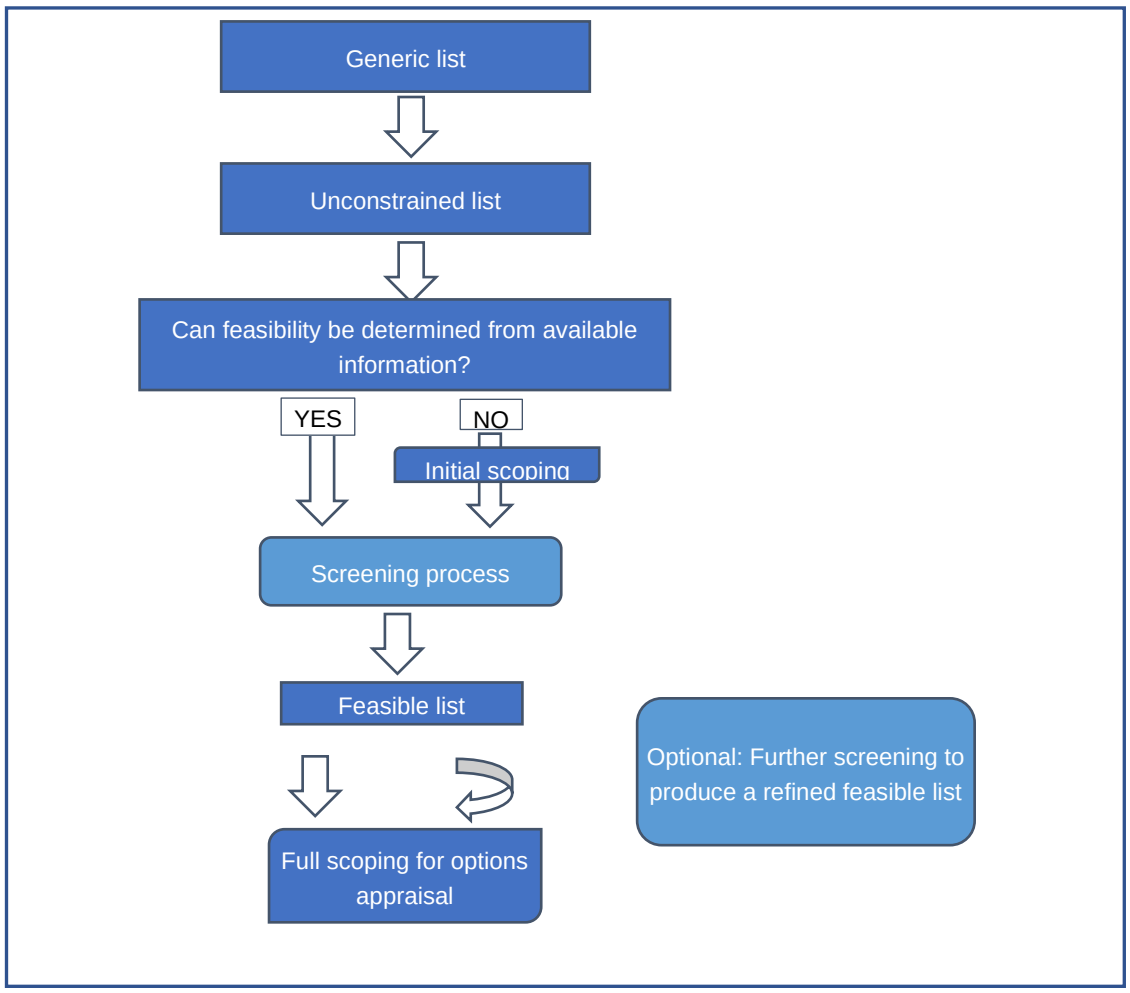


Table A5.1. WReN option feasibility screening criteria

Screening criteria	
1. Benefit	**Does the scheme provide a regional benefit? For example, does it:** • Provide a direct or indirect means of transferring resources from WReN to another region, or meet identified public water supply (PWS) or non-PWS need? • Does it provide a non-drought resilience benefit, e.g., water quality improvement, flood mitigation, mitigate a sustainability reduction / environmental risk or other? • Does the option meet any constraints agreed by the WReN option identification workstream e.g., de-minimus value for PWS? • Will the option have a moderate to high likelihood of providing the stated benefit to offer to other regions? • Will the option have a high likelihood of being able to mitigate against future resource loss due to climate change impacts or licence changes to existing sources?

Screening criteria	
2. Environmental acceptability	**Does the option avoid breaching any unalterable constraints that makes it unsuitable for promotion e.g., unacceptable environmental impacts that cannot be overcome or options which have a failure?** • Is the option likely to be acceptable in terms of planning and statutory environmental constraints relevant to the scheme (e.g., internationally, or nationally designated sites) subject to any reasonable mitigation measures? • Does the scheme avoid causing CAMS units to become over-abstracted (and/or avoid WFD status deterioration, where known)?
3. Regulatory acceptability	**Is the option promotable / does it meet regulatory and stakeholder expectations?** • Is the scheme likely to be acceptable to customers fed off this supply? • Is the scheme compatible with other parts of the WReN regional plan, other sectors, other regions, or national ambition? • Does the scheme provide any non-PWS benefits or additional regional benefits? • Is the scheme likely to be acceptable to (non-statutory) stakeholder groups, subject to reasonable mitigation? • Does the scheme avoid major carbon impacts, e.g., operational carbon effects and asset construction/replacement costs? • Is the option a favourable development options for this source of water (e.g., a specific river)? • Are the option costs acceptable (based on available cost data)?
4. Risk of failure	**Is the risk of the option failing acceptable?** • Is the scale of the option proportionate? Can the option be scaled up or down? • Is there a high level of confidence that the scheme will be technically feasible? • Does the option have sufficient flexibility to still deliver a benefit under a range of external future scenarios different to the baseline? • Does the option avoid a disproportionately high level of up-front feasibility costs relative to the benefit it could deliver? • Are the necessary permissions likely to be granted? i.e., if a new abstraction permit (licence) is needed, is it likely Environment Agency will approve the application?

Options appraisal second screening

During the options appraisal process a number of the Yorkshire Water options that were classed as feasible were constrained out during a second screening phase. Options were screened out at this stage for the following reasons:

1. Any supply options below 5Ml/d de-minimis as disproportionate to need. In most cases there were additional reasons for excluding – biodiversity assessment was defined as unacceptable, disrupting a built-up area and locations not strategically beneficial. One option that is below the 5Ml/d (R3a with a DYAA benefit of 0.3Ml/d) was retained as the benefit would be higher for the critical period (15Ml/d) and it provides a resilience benefit in short peak demands of 2 to 3 days.

2. The de-minimis is not applied to demand options as they provide wider benefits can be combined with other demand reduction options to achieve a greater benefit.
3. Groundwater options where the licence is under a WINEP investigation – water companies are not permitted to plan growth in these areas.
4. Options where a risk has been identified (e.g. water quality) and there is an alternative option utilising the same source that is considered to have lower risk.

Approach to identifying Regional Transfer Options (RTOs)

Regional transfer options (RTOs)[1] are options for water companies within a region to trade resources, or for two or more regions to trade across borders and increase water resources resilience on a national level. We have used the term to describe strategic transfer options explored in a regional planning context. Separately, options that trade resources between regions or companies within regions have the potential to become Strategic Resource Options (SROs), subject to RAPID approval and the gated process.

The exploration of RTOs is designed to meet the needs under the Water Resources National Framework (WRNF) to offer feasible options to the other regions. WReN identified RTOs via a two-phased approach:

Phase 1: regional transfer options identification studies
Phase 1 was carried out in 2019 to understand which resources in our region could potentially provide a strategic transfer volume and where opportunities for connections with our neighbouring regions could be realised. This provided an initial view of the potential cross border connections and allowed us to start detailed discussions with neighbouring water companies and regional groups. The approach to Phase 1 was to first review water company WRMP19 feasible options and then investigate the opportunities they provided for interconnection between WReN and its neighbouring water companies, which are United Utilities (UU), Severn Trent Water (STW) and Anglian Water (AWS).

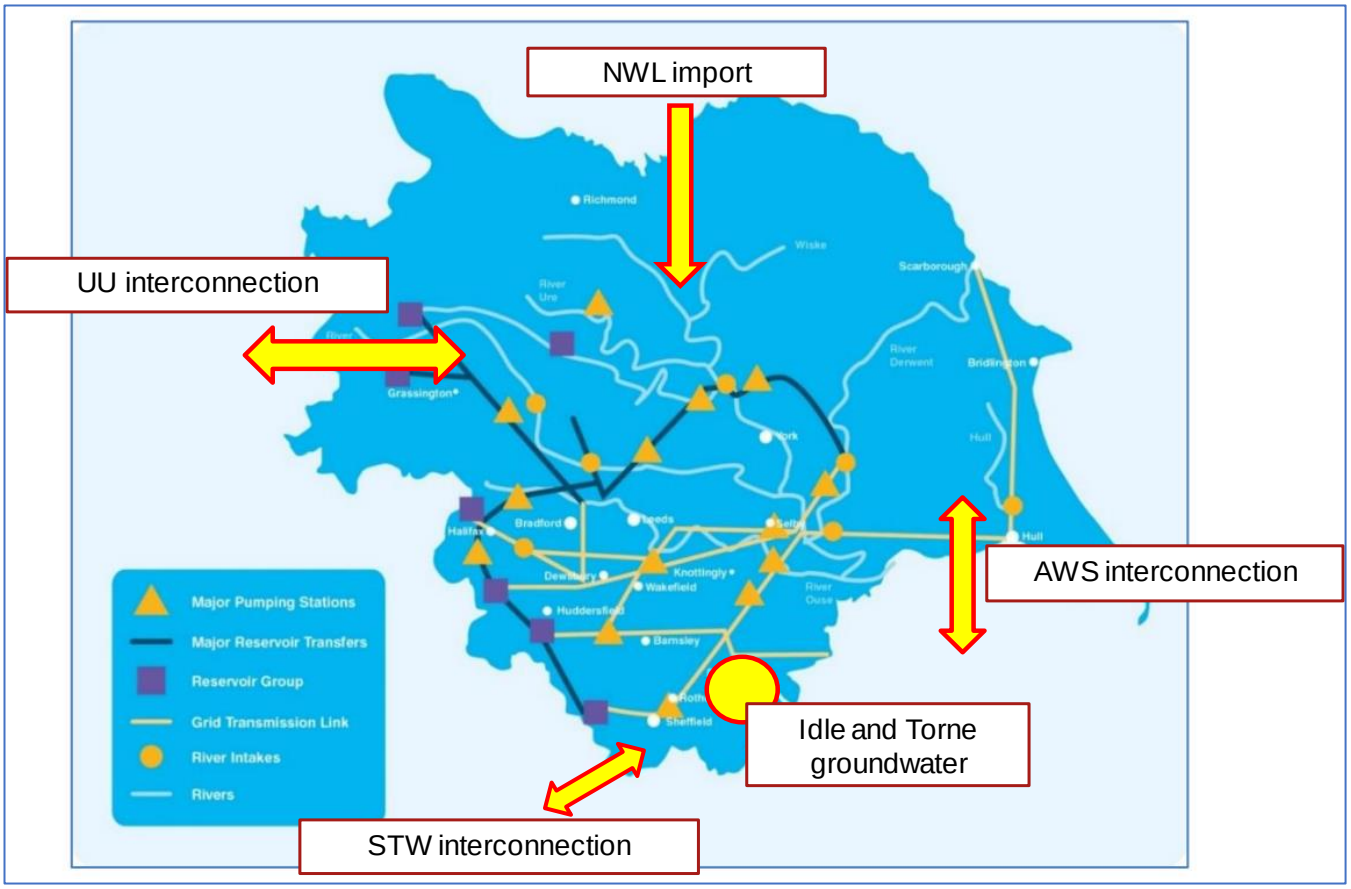
To ensure schemes were proportionate to the need, a de-minimis of 20Ml/d was initially applied to the WRMP19 options. However, further consideration was given to the location of resources and if they could be considered strategically located (close to a boundary). This resulted in a sub-set of options for consideration in five Phase 1 studies, which are listed below and shown on **Figure A5.2.**

1. Future options for the South Yorkshire and Derwent area transfer: substitute resources that could enable the existing STW import to reduce / cease.
2. Scoping opportunities for interconnection: Northumbrian Water (NWL) to UU
3. Scoping opportunities for interconnection: Yorkshire Water (YW) and AWS (bi-directional)
4. Scoping opportunities for interconnection: YW to UU
5. Idle and Torne option scoping: YW unused licence capacity.

Phase 2: Regional option development
Phase 2 investigated the potential cross border connections identified in Phase 1 in collaboration with the relevant neighbouring water companies / regions. The output was a feasible list of export options for our region to offer other regions. An initial list of feasible options was presented in our Revised Water Resources Position Statement in February 2021. A number of the initial feasible options have since been constrained out following further work with other regions and further assessment and scoping associated with potential transfer options that may be required to facilitate a trade and contribute to national or in-region needs. Further details on this are provided in the option details.

[1] These should not be confused with Strategic Resource Options (SROs), which are transfer schemes provided with specific funding via Ofwat and PR19, and subject to the RAPID gated process. WReN is involved in the development of one SRO that is being investigated in collaboration with WRW (the SRO status of this option has only recently been confirmed).

Figure A5.2. WReN Phase 1 regional transfer options scoping studies



The import and export options that supported inter-regional decision-making were considered in the regional reconciliation process in autumn 2021 and spring 2022, along with the in-region supply-demand balance considerations and in the context of stress testing scenarios (with a focus on addressing the deficit in the Yorkshire Grid zone). The reconciliation position is also briefly summarised for these options in the following section.

Option details

WReN supply options

Of the five WReN zones, the Yorkshire Grid zone is the only zone to include supply-side options in the regional plan. Risks and local deficits in other zones are addressed through demand management options alone. The feasible supply options identified are listed in **Table A5.2.** The options are a combination of those included in WRMP19, new options that have been identified through the WRMP/RP process, or existing options that have been adapted to meet specific requirements (e.g. INNS risks) or to enable the regional transfers.

Table A5.2. Feasible WReN options in the Yorkshire Grid zone (preferred options in green)

Option reference	Option Name	Benefit * (Ml/d)[2]
DV3	Magnesium Limestone	5.00
DV6(iv)	Tees to South Yorkshire - 50Mld	50.00
DV6(v)	Tees to South Yorkshire - 80Mld	80.00
DV6(vi)	Tees to South Yorkshire - 140Mld	140.00

[2] Gains in WAFU / Savings in Demand on full implementation in Ml/d

Option reference	Option Name	Benefit * (Ml/d)[2]
DV7a(iv)	Tees to York Pipeline - 50Mld	50.00
DV7a(v)	Tees to York Pipeline - 80Mld	80.00
DV7a(vi)	Tees to York Pipeline - 140Mld	140.00
DV8(iv)	New north to south internal transfer connection - 50 Ml/d capacity*	0.00
DV8(v)	New WTW (York) supplied by the River Ouse	50.00
R1c	Grid network enhancement: New River Ouse WTW to York - 30 Ml/d cap*	0.00
R1c(i)	Grid network enhancement: New River Ouse WTW to York - up to 60 Ml/d*	0.00
R1d	Grid network enhancement: New River Ouse WTW to North Yorkshire 1	15.00
R1d(i)	Grid network enhancement: New River Ouse WTW to North Yorkshire 2*	0.00
R1e	Grid network enhancement: New River Ouse WTW to North Yorkshire 3	5.00
R1f	Grid network enhancement: New River Ouse WTW to North Yorkshire 4	10.00
R1g	Grid network enhancement: New River Ouse WTW to York	25.00
R2	River Ouse to York WTW	60.00
R3	Increased River Ouse pumping capacity	10.00
R3a	River Ouse licence transfer (15Ml/d in peak use)	0.30
R5	Aquifer Storage and Recovery Scheme 1	6.58
R6	South Yorkshire Groundwater Option 1	12.00
R6b	South Yorkshire Groundwater Option 2	20.00
R6c	South Yorkshire Groundwater Option 3	10.00
R6d	South Yorkshire Groundwater Option 4	20.00
R8b	Sherwood Sandstone and Magnesian Limestone Boreholes option 2	5.00
R8c	Sherwood Sandstone and Magnesian Limestone Boreholes option 3	5.00
R8f	Sherwood Sandstone and Magnesian Limestone Boreholes option 6	20.00
R8g	Sherwood Sandstone Boreholes support to North Yorkshire	15.00
R8h	New groundwater (Sherwood Sandstone) supply to existing North Yorkshire WTW	5.50
R12	East Yorkshire Groundwater Option 1	8.00
R13	East Yorkshire Groundwater Option 2	6.00
R29	Reservoir De-silting	11.00
R31a	Additional bankside storage at York WTW	10.60
R34	River Calder Abstraction option 1	9.29
R35	River Aire Abstraction option 1	9.29
R37b(ii)	River Aire Abstraction option 4	33.50
R49	Supply Dales from the Tees - raw import and new WTW	15.00
R51	Supply Dales from the Tees - treated	15.00
R61	East Yorkshire coast desalination	20.00
R78	Tidal Abstraction Reservoir	20.00
R85	Rebuild KirkleesWTW	8.00
R86	West Yorkshire new WTW	50.00

*** Options with zero benefit will provide a benefit when linked to options and are represented in the optimiser this was to allow flexibility on which options are combined to realise the benefit.**

There are 42 feasible supply options in total (5Ml/d de-minimis), 11 of which are preferred plan options (in green). The exports to other regions are not included in the table, as they are options for other regions to explore within their own options appraisals, and as such are not included in the feasible list above.

Options investigated to replace the loss of existing STW import

We have investigated options to replace the potential loss of the existing STW to Yorkshire Water raw water transfer. Under the terms of the existing contract the supply could either reduce or cease in the future (2035 or later) if either STW or Yorkshire Water gave notice to the other party by no later than 2030. Ceasing the transfer is a feasible option

for WRW (STW) because of the impacts of abstraction licence capping to prevent environmental deterioration in the WRW/STW area and, due to lack of feasible alternatives, has been selected in their preferred plan. A potential future alternative option is to increase the capacity of the Derwent Valley reservoirs in the STW area, and this has informed the scope of a RAPID Upper Derwent Valley Reservoir Expansion Strategic Resource Option (UDVRE SRO) scheme. The SRO project is exploring a range of different reservoir enlargement options, which, if delivered, could protect Yorkshire Water's import whilst also addressing supply-demand deficits within the WRW region. However, the final position on this scheme will only be known later in the regional planning process from further ongoing work via the RAPID gated process. We have therefore taken a pathway approach in relation to this option and considered two pathways in the plan; one where the transfer is maintained, and one where the transfer is stopped.

Supply options to offset lost supplies in the event that the STW transfer is stopped (our 'preferred' pathway[3]) were explored as part of the Phase 2 investigations noted above and built upon the findings of the Phase 1 study *Future options for the South Yorkshire and Derwent area transfer: substitute resources that could enable the existing STW import to reduce / cease*.

In line with the options identification process outlined in **Figure A5.1,** we identified an initial list of (unconstrained) options and assessed them against the screening criteria listed in **Table A5.1** to determine a feasible list of options to address the loss of the STW. The unconstrained list is shown in **Table A5.3.**

Table A5.3. List of options investigated to replace the existing STW transfer

Option Ref.	Option name	Outcome *(Red = not feasible, Green = feasible, Blue = SRO)*
DV1 & DV2a	Increase / expand South Yorkshire reservoir existing supply	**Low benefit (below 5Ml/d)**
DV2b	Additional storage at or near South Yorkshire WTW	**Low benefit (below 5Ml/d)**
DV3	Magnesium Limestone (Sheffield) new GW supply	**Feasible but limited resource available (5Ml/d)**
DV4	Barnsley BH	**Low benefit (below 5Ml/d)**
DV5	Expand Derwent Valley reservoirs	**SRO**
DV6	NWL import from R Tees to South Yorkshire (direct)	**Feasible provided pre-treatment installed at source to address INNS risk**
DV7	NWL import from R Tees transfer via grid	**Feasible provided pre-treatment installed at source to address INNS risk**
DV8	Yorkshire Grid to South Yorkshire – conjunctive use option to improve connectivity	**Feasible but is an option to enable internal transfers and would require investment in a new source of supply also**
DV9	Doncaster supply to South Yorkshire – treated or raw	**Source of supply is under WINEP investigation (see also RTOs section)**
DV10	Transfer existing South Yorkshire Reservoir supplies to Sheffield WTW receiving the Derwent Valley import	**This does not provide a new resource and although could provide a resilience benefit it would not close the deficit**
DV11	Increase grid supplies to South Yorkshire - raw	**INNS risk**
DV12	Sheffield WTW new local sources	**Low benefit (below 5Ml/d)**

[3] This is the formal terminology used in WRMPs for the plan, however, in practice, loss of the transfer is determined by WRW's resource position and lack of feasible alternatives; inclusion in the preferred plan is not a best-value plan choice as such.

Option Ref.	Option name	Outcome *(Red = not feasible, Green = feasible, Blue = SRO)*
DV12b	River Don	**Water only available at low reliability**

The initial unconstrained list was identified and assessed including potential variants noting that:

- options involving alternative uses of the same source are mutually exclusive
- options providing alternative raw water source to the water treatment works that treats the Derwent Valley import require pre-treatment to address INNS risks before transfers of water can take place, where the alternative raw water source is within a different catchment to the receiving works
- a number of options offer marginal benefit (below 5 Ml/d) by comparison to the engineering challenges and cost.

A number of Derwent Valley (DV) variants initially identified in the above table were constrained out, but nine variants were taken forward to the feasible list:

- Two variants of the conjunctive use Yorkshire Grid to Yorkshire South (DV8) - involving implementation of a new transfer connection (DV8iv) and a new water treatment works (DV8v)
- Three variants of the Tees to South Yorkshire option (DV6) - involving NWL imports of 50 Ml/d (DV6iv), 80Ml/d (DV6v) and 140 Ml/d (DV6vi)
- Magnesium Limestone new GW supply option (DV3)
- Three variants of the Tees to York pipeline option (DV7) – involving NWL imports of 50 Ml/d (DV7iv), 80Ml/d (DV7v) and 140 Ml/d (DV7vi)

Both DV8 conjunctive use variants and DV7vi (140Mld raw water import from NWL) have been selected as preferred options.

NWL has taken account of the 140Ml/d raw water transfer to Yorkshire Water within their plan. This has been possible due to the sizeable supply-demand surplus in the Kielder WRZ (once demand reduction measures are in place) which has been enabled by the historical investment in Kielder reservoir and the Tyne Tees Transfer (TTT).

For the 140 Ml/d transfer to YW, raw water would be abstracted from the River Tees which is a regulated river with flows maintained by releases from Cow Green reservoir. When Cow Green reservoir storage falls below an agreed level, Cow Green releases are reduced and River Tees flows are supported with additional transfers from Kielder reservoir via the TTT system. However, the capacity of a key TTT Pumping Station will need to be increased to deliver the full 140Ml/d export to YW in some drought years. This would involve installing an additional pump, and may require a new incoming electricity supply although this cannot be confirmed until an application for the new connection has been made and granted.

NWL modelling confirmed that the full 140Ml/d of raw water is available with the TTT pumping station upgrade. However, this assumes that the out-of-region transfers from Kielder Reservoir to UU do not proceed (see Regional Transfer Options section below) which is currently the case (the option does not feature in either UU or WRW's best value plans). The Kielder WRZ demand forecast allowed for all known new household and non-household demand including an additional 25 Ml/d for future unknown industrial demand on Teesside. However, if new, currently unknown industrial demand exceeds 25Ml/d over the next 5 to 10 years, then this could reduce the size of the export to YW.

In addition to the above Derwent Valley (DV) options listed in **Table A5.3**, a number of other treated and raw water NWL and UU import options have also been considered to address the Yorkshire Grid WRZ supply deficit forecast. These are presented in **Table A5.24** below along with their feasibility status in relation to the regional plan.

Table A5.4. WReN intra-water company transfer options

Ref.	Exporter WC	Importer WC	Scheme Name	Volume Ml/d	Feasibility status	Regional plan option
R49	NWL	YW	Tees to Dales raw import and new WTW	15	Feasible	Yes
R50	NWL	YW	Tees to Dales – raw 2	15	Constrained out - need can be met by NWL existing licence	No
R51	NWL	YW	Tees to Dales - treated	15	Feasible	Yes
R52	NWL	YW	Tees-Wiske Transfer Scheme	50	Constrained out environmental impact / INNS risk and volume too high for receiving watercourse	No
R53	NWL	YW	Tees - Swale River Transfer Option 1	50 to 140	Constrained out – INNS risk of transferring raw water between catchments	No
R55	NWL	YW	Tees – Swale River Transfer Option 2	50 to 140	Constrained out as the environmental impact - INNS risk	No
R56	NWL	YW	Tees - Ouse Pipeline Option 2	50 to 140	Constrained out as the environmental impact - INNS risk	No
R57 / R57i	UU	YW	Transfer from United Utilities Option 1 / 2	2.3	Constrained out - uncertainty over availability in	No

Ref.	Exporter WC	Importer WC	Scheme Name	Volume Ml/d	Feasibility status	Regional plan option
					dry years when needed	
R58	UU	YW	Transfer from United Utilities Option 3	1	Constrained out - technically feasible but the benefit is disproportionately low relative to the need	No
R59	UU	YW	Transfer from United Utilities Option 4	1	Constrained out - technically feasible but the benefit is disproportionately low relative to the need	No

The majority of options have been constrained out with only two Tees to Dales options (R49 and R51) carried forward to the feasible list. Neither have been selected as preferred plan options. The R56 option has been rescoped to include pre-treatment to address the INNS risk and is represented in the plan as DV7 and the largest option DV7a(vi) is included in the preferred plan.

Regional Transfer Options

Regional transfer exports (out-of-region transfers)

The Yorkshire East, Berwick and Hartlepool zones serve small populations and are not located near regional boundaries, and therefore do not have the capacity to provide regionally strategic options. Parts of the Yorkshire Grid zone are also too remote to support a regional transfer directly.

The Kielder zone borders Yorkshire Water and United Utilities, and as previously discussed has the benefit of surplus resources (with implementation of demand management options) and the Kielder operating agreement. Historically, the Kielder zone supply-demand balance has not forecast a deficit and WRMP level supply-side options have therefore not been developed. However, the storage in Kielder Water and the existing infrastructure has created the opportunity for transfers out of the Northumbrian Water supply area, and these are currently included as transfer options to export to United Utilities (included in the regional reconciliation review process) or Yorkshire Water (included in the Yorkshire Grid options and discussed in the previous section).

The volumes available for transfer out of our region and the associated infrastructure/new asset requirements for making the water available are dependent on other factors, including the WReN supply-demand forecast and in-region needs (which at the draft plan stage have increased significantly).

The following eight inter-regional exports were explored:

Table A5.5. Inter-regional exports explored

Reference	Scheme name	Status

WReNE1	Kielder to UU transfer	Technically feasible
WReNE2	Cow Green to UU transfer	Technically feasible
WReNE3	Tees to STW via YW	Constrained out
WReNE4	York to UU transfer	Constrained out
WReNB1	Bi-directional Doncaster to AWS	Constrained out
E02	Yorkshire Grid network to STW	Technically feasible but significantly resource constrained
E03	Sheffield (YW) to Peak District (STW)	Constrained out
DV9c	Doncaster supply to South Yorkshire	Constrained out (see **Table A5.3**)

Of the above options, five have been constrained out, two are considered feasible (Kielder and Cow Green to UU transfers) and one is feasible but resource constrained (the Yorkshire Grid network to STW).

The option to transfer water from Yorkshire Grid to STW (E02) was initially identified as feasible with investment in the Yorkshire Water grid network being needed to make the water available. However, through the planning process we now know that the Yorkshire Grid has a significant underlying deficit that would require further supply options to be developed to facilitate an export and that the future availability of the existing STW import is uncertain. Therefore, although this option is technically feasible, the extent of further supply options required and associated cost along with uncertainty of the STW import means that the resource position constrains the practical application compared to our position earlier in the planning process. Further dialogue with STW around this option will continue towards the final WRMP and in future planning cycles, so that the cost and availability position can be reconsidered to take into account changes to the YW resource position.

Working with UU, we have undertaken a more detailed assessment of the range of potential exports from Kielder reservoir to UU (WReNE1 to 3), either to support resilience within UU's own supply area or to facilitate a transfer of water south into serious water stressed areas with a supply deficit. New UU assets would include a new abstraction licence, reservoir intake and pumping station and a raw water strategic pipeline. In the case of WReNE1 and WReNE2, availability has also been explored further within a collaborative, coordinated inter-company water resources modelling exercise associated with the Severn Thames Transfer SRO (STT). The potential for export to WRW was considered as part of the inter-regional reconciliation process in Spring 2022. Currently, these Kielder exports have not been included in either UU's or WRWs best value plans mainly on the basis of cost and carbon impacts and hence, they have not been included in WReN's plan. There is a significant unit cost (i.e. £/Ml) difference at this time between the assets needed to facilitate a transfer from Kielder or other alternative supply options. However, WReN / NWL and WRW / UU will continue to appraise WReNE1 and WReNE2, which still remain as potential options for consideration as part of the RAPID gated process.

In the case of the Tees to STW transfer via YW (WReNE3), the feasibility of this option for export is also impacted by our own plan position (i.e. Yorkshire Grid deficit, uncertainty around STW import and the extent/cost of required supply options). It should be noted that modelling has confirmed that when providing a 1 in 500 level of supply resilience to our customers, the surplus of water in Kielder reservoir means NWL can only provide a raw water export (at full capacity) to one of the companies (YW or UU). As things stand, this will be to Yorkshire Water based on the respective draft plan positions. As such, given use of the Tees transfer in our own regional plan, it has been excluded as a feasible option at this stage by WReN and WRW.

Inter-regional transfers from WReN to AWS / Water Resources East (WRE) have been explored to address deficits in WRE resource zones. However, the WRE zones in surplus are geographically much closer to the WRE zones in deficit than the WReN zones, and therefore are not justified or included within any plans (as detailed in Section 7.3 of our main report based on the Spring 2022 reconciliation review with WRE).

The remaining out-of-region transfer option is (DV9c) which is constrained out and discussed previously as part of the sections detailing options investigated to replace the potential loss of the existing STW import (see also Table A5.2).

Further detail on the WReN regional transfer options is summarised in each option table below, along with a colour coded status. It should be noted that the only transfer *into* the region considered as an RTO in the regional reconciliation process is the reduction of the STW import and a table for this is also presented below.

Colour code
Technically feasible
Technically feasible, but resource significantly constrained
Constrained out - further details provided in option table
Import

Table A5.6. Kielder to UU transfer

WReNE1	**Kielder to UU transfer**		
Plan origin:	WReN	Type of transfer:	Trade - transfer
Resource zone providing the water:	Kielder	Potential receiving water company (and region):	United Utilities (WRW)
Raw or potable transfer:	Raw but will need INNS treatment	Volume Ml/d:	100 Ml/d
Brief scheme description:	Raw water transfer from Kielder Water to UU. Will require construction of pumping station at Kielder and pipeline to recipient reservoir.		
Key constraints and risks:	Reduces drought resilience, but still compliant with 1 in 500 level of supply resilience in modelling (central scenario) The option presents an INNS risk that would need to be mitigated Kielder resource required to address in-region deficit (Yorkshire Grid)		
WReN / WRMP 2024 status	Technically feasible. Currently not in any plans mainly due to cost compared to other alternative options and carbon impacts but remains as a potential option for consideration as part of the RAPID gated process.		

Table A5.7. Cow Green to UU transfer

WReNE2	Cow Green to UU transfer		
Plan origin:	WReN	Type of transfer:	Trade - transfer
Resource zone providing the water:	Kielder	Potential receiving water company (and region):	United Utilities (WRW)
Raw or potable transfer:	Raw but will need INNS treatment	Volume Ml/d:	40 Ml/d
Brief scheme description:	Raw water transfer from Cow Green to UU. Will require construction of pipeline.		
Key constraints and risks:	Reduces drought resilience, but still compliant with 1 in 500 level of supply resilience in modelling (central scenario) The option presents an INNS risk that would need to be mitigated Kielder resource required to address in-region deficit (Yorkshire Grid)		
WReN / WRMP 2024 status	Technically feasible. Currently not in any plans mainly due to cost compared to other alternative options, but remains as a potential option for consideration as part of the RAPID gated process.		

Table A5.8. Tees to Severn Trent Water via Yorkshire Water

WReNE3	Tees to Severn Trent Water via Yorkshire Water		
Plan origin:	WReN	Type of transfer:	Trade - transfer
Resource zone providing the water:	Kielder via Yorkshire Grid SWZ	Potential receiving water company (and region):	Severn Trent Water (WRW)
Raw or potable transfer:	Raw but will need INNS treatment	Volume Ml/d:	Up to 140 Ml/d
Brief scheme description:	Transfer from NWL Tees to YW area could be expanded to STW. This could be transferred via either South Yorkshire or York before transfer to other regions. Variations on transfer route being considered including full pipeline or combination of river transfers and pipelines.		
Key constraints and risks:	Reduces drought resilience, but still compliant with 1 in 500 level of supply resilience in modelling (central scenario) The option presents an INNS risk that would need to be mitigated Kielder resource required to address in-region deficit (Yorkshire Grid) Availability of electricity supply to pump higher volumes from Kielder to support the Tees.		
WReN / WRMP 2024 status	Constrained out - not technically viable		

Table A5.9. River Ouse to United Utilities (UU) transfer

WReNE4	River Ouse to United Utilities (UU) transfer		
Plan origin:	WReN	Type of transfer:	Trade - transfer
Resource zone providing the water:	Yorkshire Grid SWZ	Potential receiving water company (and region):	United Utilities (WRW)
Raw or potable transfer:	Raw	Volume Ml/d:	50 Ml/d
Brief scheme description:	Yorkshire Water resource on the River Ouse creates a potential trading opportunity with UU for a transfer via a combination of new infrastructure, rivers and canal networks.		
Key constraints and risks:	Resource required to address in-region deficit (Yorkshire Grid) Viability - the canal is usually dry during dry weather / drought conditions and the RAPID proposal would require water to flow upstream.		
WReN / WRMP 2024 status	Constrained out - not technically viable and source required for Yorkshire Grid		

Table A5.10. Bi-directional Doncaster to Anglian Water transfer

WReNB1	Bi-directional Doncaster to Anglian Water transfer		
Plan origin:	WReN	Type of transfer:	Trade - transfer
Resource zone providing the water:	Yorkshire Grid SWZ / Anglian Water	Potential receiving water company (and region):	Anglian Water (WRE) / Yorkshire Water (WReN)
Raw or potable transfer:	Treated	Volume Ml/d:	10 Ml/d
Brief scheme description:	This option would provide a treated water transfer to AWS from YW existing groundwater licences and water treatment works in the Doncaster area. It is mutually exclusive with option DV9c. The pipeline connecting the two companies could be bi-directional. This would be for use in extreme drought events (1:200 and 1:500) dependent on water availability.		
Key constraints and risks:	Future local demand needs could limit the volume available. Additional treatment capacity would be required as well as the connecting pipeline. Benefit dependent on WINEP investigation to be complete 2025. Availability in drought years. Due to local growth in the area additional options would be required to support this option for water to be available to Anglian Water.		
WReN / WRMP 2024 status	Constrained out initially as resource under WINEP investigation.		

Table A5.11. Yorkshire grid network to Severn Trent Water

E02	Yorkshire grid network to Severn Trent Water		
Plan origin:	WRMP	Type of transfer:	Trade - transfer
Resource zone providing the water:	Yorkshire Grid SWZ	Potential receiving water company (and region):	Severn Trent Water (WRW)
Raw or potable transfer:	Treated	Volume Ml/d:	20 Ml/d
Brief scheme description:	Treated water transfer to STW from Yorkshire grid network. YW's current conjunctive system could provide water to STW through duplication of an existing pipeline to South Yorkshire then additional main to STW.		
Key constraints and risks:	Water would not be available in the 1:500 scenario without additional resources and infrastructure. An additional raw water source and potentially new connections and treatment capacity required to support this transfer Exact scope and costs would be dependent on the future of the STW import to Yorkshire Water.		
WReN / WRMP 2024 status	Technically feasible but resource constrained		

Table A5.12. Sheffield to Peak District

E03	Sheffield to Peak District		
Plan origin:	WRMP	Type of transfer:	Trade - transfer
Resource zone providing the water:	Yorkshire Water	Potential receiving water company (and region):	Severn Trent Water (WRW)
Raw or potable transfer:	Treated	Volume Ml/d:	20 Ml/d
Brief scheme description:	Treated water transfer from a YW WTW in South Yorkshire to the Peak District in STW's area. This scheme has previously been considered, but for resilience only and not as a permanent transfer.		
Key constraints and risks:	Would be dependent on Yorkshire Water providing alternative supply to the South Yorkshire area that did not require use of the WTW. However, status could change depending on the future of the Derwent Valley import.		
WReN / WRMP 2024 status	Constrained out - currently no alternative treated source identified for Yorkshire Water customers.		

Table A5.13. Doncaster to Severn Trent Water

DV9c	Doncaster to Severn Trent Water		
Plan origin:	WRMP	Type of transfer:	Trade - transfer
Resource zone providing the water:	Yorkshire Grid SWZ	Potential receiving water company (and region):	Severn Trent Water (WRW)
Raw or potable transfer:	Treated	Volume Ml/d:	up to 20 Ml/d
Brief scheme description:	Transfer of treated water to STW from YW existing groundwater licences and water treatment works in the Doncaster area. Mutually exclusive with WReNB1. A new pipeline and additional treatment capacity would be required.		
Key constraints and risks:	Future local demand needs could limit the volume available. Additional treatment capacity would be required as well as the connecting pipeline. Benefit dependent on WINEP investigation to be complete 2025. Availability in drought years to be confirmed through modelling. Due to local growth in the area additional options would be required to support this option for water to be available to AWS.		
WReN / WRMP 2024 status	Constrained out - resource under WINEP investigation		

Table A5.14. Reduce Severn Trent Water import to Yorkshire

WReNI1	Reduce Severn Trent Water import to Yorkshire		
Plan origin:	WReN	Type of transfer:	Reduce import
Resource zone providing the water:	Severn Trent Water	Potential receiving water company (and region):	Yorkshire Grid SWZ (WReN)
Raw or potable transfer:	Raw	Volume Ml/d:	Investigating a range of options see previous sections
Brief scheme description:	South Yorkshire PWS is currently met by an import to YW from STW. STW may reduce or terminate the import in 2035 within the terms of the contract. Alternative means of meeting the demand have been explored and included as an adaptive pathway (the preferred plan – discussed in above WReN supply options section). These include re-routing existing supplies and installing new connections to transfer existing and new supplies to the South Yorkshire area.		
Key constraints and risks:	This option is only viable by providing an alternative supply to South Yorkshire. Dependent on the final position of the new RAPID Upper Derwent Valley Reservoir Expansion Strategic Resource Option (UDVRE SRO) scheme which is exploring a range of different reservoir enlargement options (if delivered, could protect the import). Final position on (UDVRE SRO) will only be known later in the regional planning process from further ongoing work via the RAPID gated process.		
WReN / WRMP 2024 status	***This is an option for WRW, but for WReN is included in the 'preferred plan' with options to replace loss of supply***. This is discussed in previous sections.		

Appendix 5.2 Option Appraisal

Section 5.5 of the WReN draft regional plan main report explains the options appraisal and decision-making approach used to develop our best-value plan, whilst Section 7 explains the choices and position for our best-value plan along with key alternatives and pathways. This section of Appendix 5 provides further details for the interested stakeholder on the outcomes of options appraisal in defining our best-value plan; it closely reflects the outcome of the YW draft WRMP24 submission (Section 9), where further justification and detail on specific WRMP level options may be found if of interest to the reader.

Decision-making approach

The assessment of future needs in our region has highlighted a significant PWS deficit in the Yorkshire Grid zone. For other areas, any deficits can be addressed via demand management and drought measures, however, for the Yorkshire Grid, supply-side solutions are also required. To select an appropriate solution to the deficit, we considered the types of options available and determine which are feasible for the risks we need to address; this option identification process has already been described above in the first part of this Appendix. We then carried out a best value plan decision-making assessment to determine the combination of feasible options to include in YW's draft WRMP as the best value solution to the deficit.

The WReN decision-making process is based upon the options appraisal of individual water companies where there is a supply-demand need to address. This has complemented company level activity by facilitating the effective consideration of in-region and inter-regional transfer options, where appropriate. The WReN best value plan therefore aims to meet the region's objectives and that of the constituent water companies, and which aligns with other regions and supports the national goals. The emerging plan consultation confirmed that the WReN decision making approach and support tools for the regional plan development are seen as appropriate to the scale of the problem faced in the region.

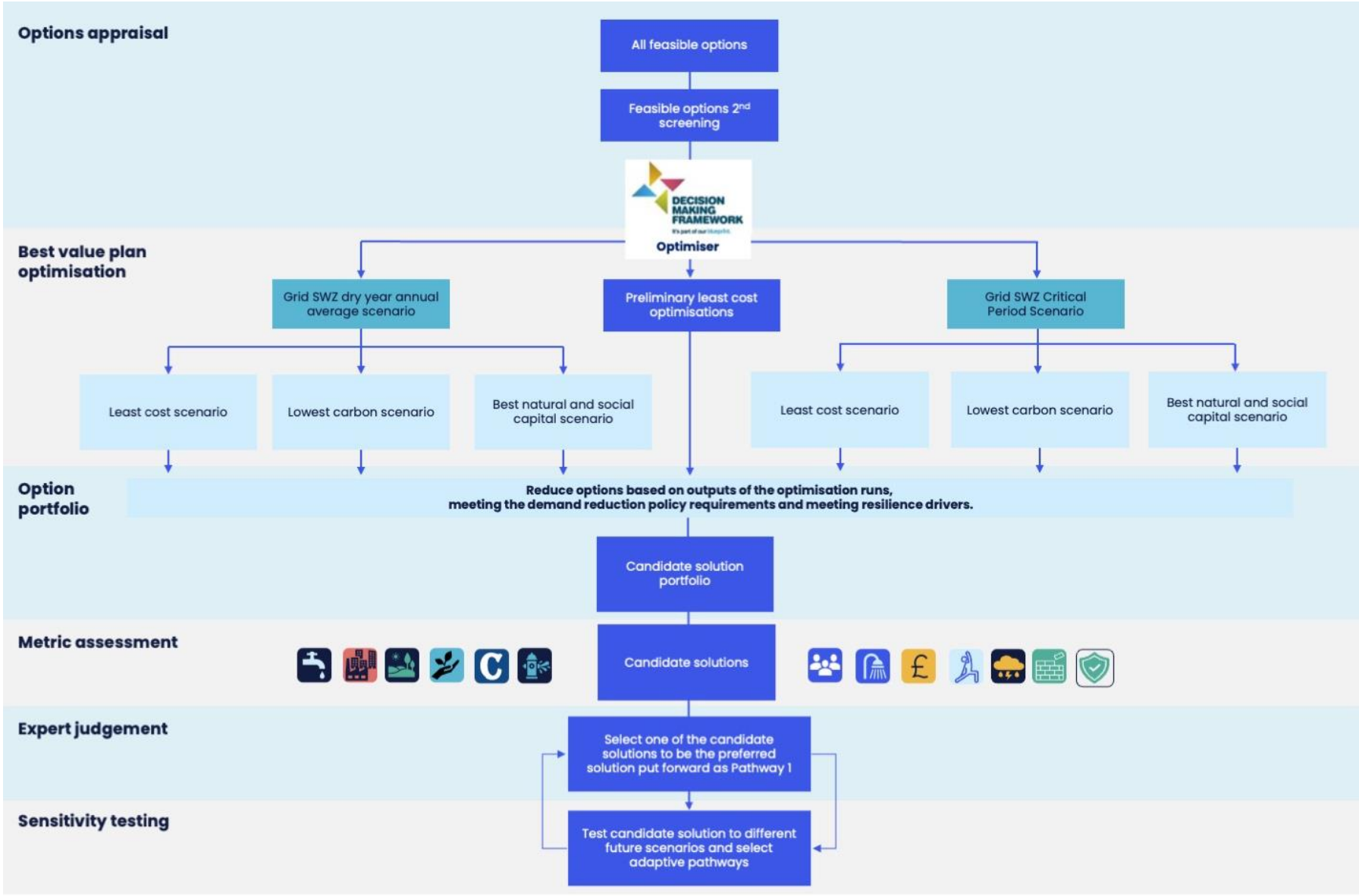
We reviewed the possible methods we could use to determine the best value solution to the deficit and developed our approach using the following guidelines:

- WRMP24 WRPGL;
- The economics of balancing supply and demand (UKWIR, 2002);
- UKWIR WRMP 2019 methods - Decision Making Process: Guidance; and
- UKWIR WRMP 2019 methods - Risk Based Planning: Guidance.
- UKWIR Deriving a Best Value Water Resources Management Plan (HR Wallingford 2020).

We chose to use the EBSD approach extended to include multi-criteria analysis (MCA) to determine a best value solution. The MCA approach allows us to compare both monetised and non-monetised costs and impacts to develop a best value plan as opposed to a least cost plan using the traditional EBSD approach. Our best value plan process is summarised in **Figure A5.3**.

The Enterprise Decision Analysis (EDA) is the software that YW used to build its best value plan. All feasible options and the associated assets, infrastructure and operating elements were entered into the WRMP24 optimiser model. The model then uses the above information entered for individual options to identify a solution that ensures supply can meet demand plus target headroom for each year of the 60-year planning scenario. It optimally schedules investment to meet the projected deficit, optimising for one or more of the capitals as defined by the model parameters. For the least cost solution optimisation is based on the minimum net present cost (NPC).

Figure A5.3. Best Value Planning process



Metrics and trade-offs

Metrics describe the performance of the alternative optimised solutions and selected portfolios (at a programme level) considered in determining our plan. As part of the process, we have attributed how each metric would influence the optimisation. For example, metrics may be defined by whether they should be achieved, optimised (to minimise or maximise), or for the purpose of a specific options appraisal, set as a scenario constraint (where a particular objective outcome may be constrained into the plan to compare to alternative programmes). These concepts are explained further in Appendix 4, with additional detail on the development and definition of our objectives and metrics, including taking into account associated engagement.

Our current metric areas included in our options appraisal[4] are shown in **Figure A5.4**, with further details on the metric in Appendix 4 – Objective and metric development.

Figure A5.4. Decision-making metrics summary

Metric areas	Planning status	Metric areas	Planning status
PWS Drought resilience	Achieve or enhance	Multi-abstractor benefit	Optimise
Biodiversity	Optimise	Carbon	Optimise
Natural Capital	Optimise	Customer preferred option type	Optimise
Leakage reduction	Achieve or enhance	Human and social well-being	Optimise
PCC reduction	Achieve or enhance	Financial Cost	Optimise
Flood risk management	Optimise	Option Deliverability	Optimise

Building the best value plan

Preliminary optimisation runs

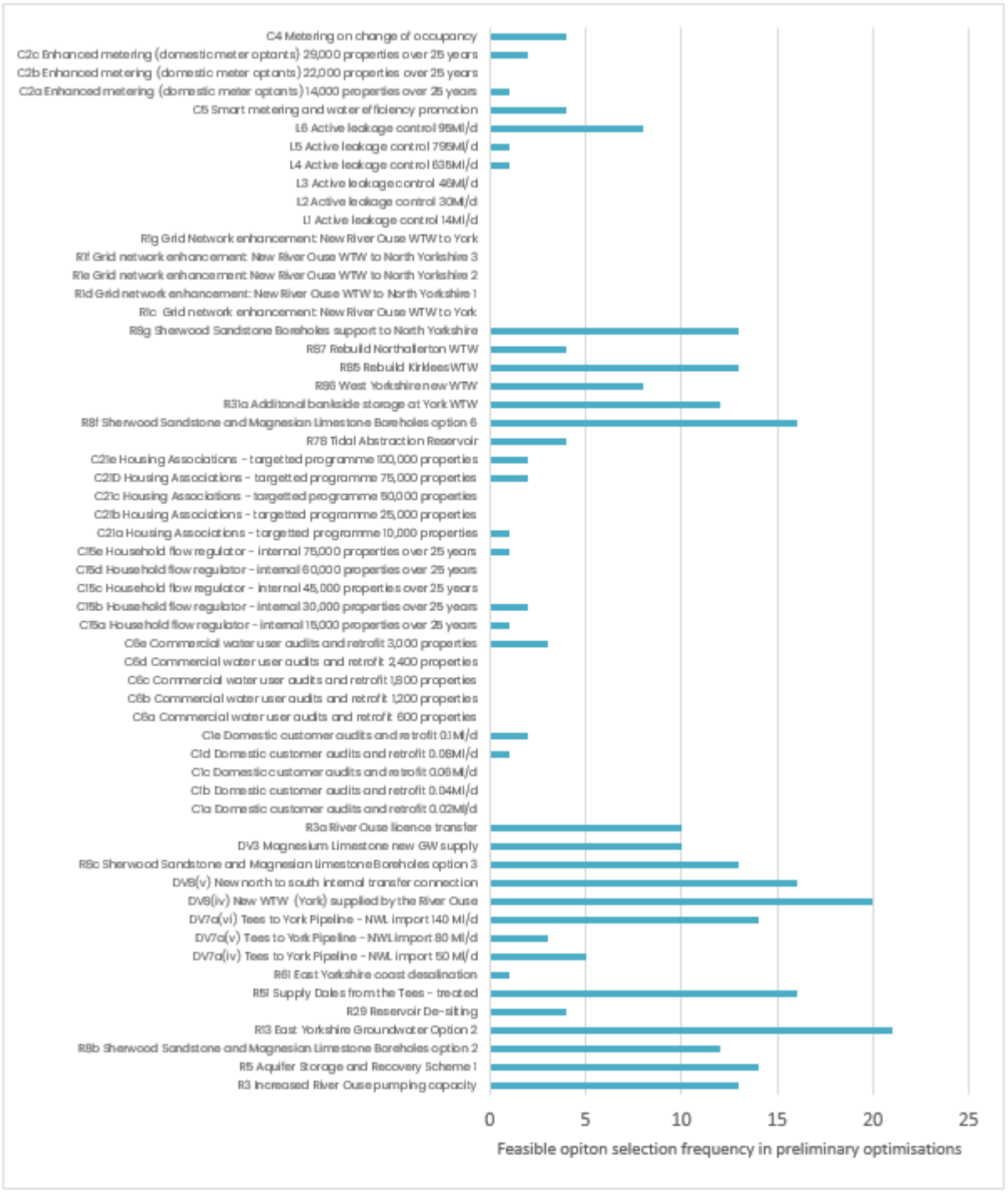
The optimiser was run with all feasible options that had passed the second screening step available for selection, as described in the option identification process. We also created least cost runs where we assumed demand policy requirements for leakage and PCC would be met. For the scenarios with the policy requirement reductions built into the supply-demand balance, we optimised on supply options only to close the remaining deficit. We created preliminary solution programmes by using the optimiser to meet scenarios including the Grid SWZ DYAA baseline and the Ofwat common reference scenarios that resulted in a deficit materially different to the baseline deficit. These preliminary runs, optimised on cost, provided information on which options were selected most frequently and should be included in a portfolio of options for consideration when creating the best value plan.

Figure A5.5 shows the number of times the feasible options were selected during the preliminary least cost runs. In total we produced 26 optimised runs with the options available following the second screening. If any options were not selected, we considered excluding them from future runs. Similarly, options that were selected most frequently

[4] The loss of the existing STW transfer from the WRW area to WReN would fundamentally change the configuration of the Yorkshire Grid, which leads to specific additional resilience considerations as part of options and solutions development. This has been accounted for as part of exploring the impacts and candidate solutions to address a loss of the import (Section 7 of the WReN main report). In the development of the Yorkshire Water draft WRMP24, a specific resilience metric was also introduced to help facilitate the identification of the preferred plan and support company level resilience objectives.

were considered better value than the others. However, as these runs were optimised on cost alone, further analysis was needed to identify if any of the options not selected in the least cost runs should be included in the candidate solution portfolio.

Figure A5.5. Option selection frequency based on cost optimisation runs



Best value optimisation and common reference scenarios

In addition to the least cost runs we produced further optimisation runs using other metrics including scenarios that optimise to minimise carbon[5] and to maximise the environmental and social benefits[6] of the options. We refer to these runs as "best value optimisations". Whilst they do not provide the final preferred best value plan, they provide optimisations based on factors other than financial costs that we considered in formulating our best value plan.

To ensure the best value plan is flexible to alternative futures and that it presents a no or least regrets solution, we considered the common reference scenarios that could alter the baseline DYAA scenario, and the impacts and benefits of planning to a 1 in 200 baseline DYAA level of service and assuming benefits of drought measures. Table A5.15. lists the key scenarios and optimisation runs completed for this stage of the process. All scenarios are based on a 60-year planning period from 2025/26 to 2084/85, derived from a baseline of 2019/20. Each solution produces a programme of options scheduled to be delivered in specified years during the planning period (a solution programme). The solution programmes differ as each scenario aims to meet a different deficit or has been optimised on different criteria.

Table A5.15. Grid SWZ key scenario optimisation runs – all options available

Scenario	Optimisation	Deficit (Ml/d)
Baseline dry year annual average 1 in 500 level of service	Minimise financial cost	2025/26 - 106 2049/50 - 299 2084/85 - 403
	Minimise carbon cost	
	Maximise natural capital and social benefits	
Baseline dry year annual average 1 in 200 level of service	Minimise financial cost	2025/26 – 62 2049/50 - 192 2084/85 - 327
Enhanced environmental destination dry year annual average 1 in 500 level of service	Minimise financial cost	2025/26 - 106 2049/50 - 347 2084/85 -446
High climate change dry year annual average 1 in 500 level of service	Minimise financial cost	2025/26 - 125 2049/50 - 336 2084/85 - 465
Enhanced environmental destination and high climate change dry year annual average 1 in 500 level of service	Minimise financial cost	2025/26 - 125 2049/50 - 383 2084/85 - 465
Baseline critical period	Minimise financial cost	2025/26 - 107 2049/50 - 325 2084/85 - 428
	Minimise carbon cost	
	Maximise natural capital and social benefits	
	Maximise six capital benefits	

[5] The minimum carbon run is based on minimising the carbon costs associated with emissions from capital and operational expenditure of WRMP options to meet supply-demand balance requirements.
[6] A maximised environmental and social benefit run is based on maximising the monetised Natural and Social Capital values due to the yield benefit and other impacts from the WRMP options (e.g. change in land use) to meet supply-demand balance requirements. There may be cases where the Natural and Social Capital impact represents a 'cost' rather than a benefit (e.g. due a loss of a habitat type from building the option). Due to this, the maximisation of a benefit is also associated with minimising a negative Natural and Social Capital impact.

We used the outputs of the least cost and best value optimisation runs to create a portfolio of supply options for consideration in the preferred plan. The portfolio was used to create candidate solution programmes to be considered as the best value plan.

Candidate best value solution programmes

The aim of the candidate solution programmes was to improve on the metric values compared to the least cost solution and create a best value plan. As our preferred plan is to meet the demand reduction policy requirements (in line with the plan strategic choices described in Section 6.1 of our main report), the L6 Leakage reduction 95Ml/d and the C5 Smart Metering and Water Efficiency options were included in the portfolio. At this stage we also considered the level of service reduction option, and the assumed benefits of drought measures. All options included in the portfolio and a high-level SEA assessment summary for these is shown in **Table A5.16.** below. The options included in the portfolio were assessed to identify any risks that would make the option benefit unsustainable over the longer term or any environmental impacts that made the option less favourable than the alternatives. A number of risks were highlighted by the SEA assessment and further investigation of the supply options would be needed if they were to be included in the final solution. This information was considered when formulating the candidate solutions.

Table A5.16. Portfolio of options

Option Ref	Feasible options	SEA high level assessment
-	Demand side and supply side drought measures	n/a
R48	Level of service reduced to 1 in 200 from 2025 to 2039	n/a
L6	Active Leakage Control 95 Ml/d	n/a
C5	Smart Metering and Water Efficiency	n/a
DV8(iv)	New north to south internal transfer connection	Mitigation measures will need to be identified and agreed with Natural England. Detailed scheme design will need to consider risks which have been identified in relation to permitted waste sites and historic landfills, air quality impacts on local populations, heritage assets and the Peak District National Park.
R3	Increased River Ouse pumping capacity	Potential construction phase impacts to a range of heritage assets have been identified which would need consideration during the detailed scheme design; scope of investigations would need to be agreed with Historic England.
R8b	Sherwood Sandstone and Magnesian Limestone Boreholes Option 2	Further investigation to understand the current flows in the catchment, as well as the potential impact on river flows associated with the proposed groundwater source, is required in order to understand whether there is the potential for deterioration in the biological status elements of associated WFD water bodies.
R13	East Yorkshire Groundwater Option 2	Further investigations are needed to assess the impact on water quality in the WFD groundwater body and potential impacts of the abstraction on the associated surface water bodies.

Option Ref	Feasible options	SEA high level assessment
DV7a(iv)	Tees to York Pipeline - NWL import 50 Ml/d	Mitigation measures will need to be identified and agreed with Natural England. Detailed scheme design will also need to consider risks which have been identified in relation to historic landfills, heritage assets and an AONB.
DV7a(v)	Tees to York Pipeline - NWL import 80 Ml/d	Mitigation measures will need to be identified and agreed with Natural England. Detailed scheme design will also need to consider risks which have been identified in relation to historic landfills, heritage assets and an AONB.
DV7a(vi)	Tees to York Pipeline - NWL import 140 Ml/d	Further investigation is required in order to determine whether this option would be WFD compliant. Mitigation measures will also need to be identified and agreed with Natural England. Detailed scheme design will also need to consider risks which have been identified in relation to historic landfills, heritage assets and an AONB.
DV8(v)	New north to south internal transfer connection	Potential construction phase impacts on designated biodiversity sites and further surveys/studies may be required to better understand likely impacts and to identify mitigation measures.
R8c	Sherwood Sandstone and Magnesian Limestone Boreholes option 3	This site is a WFD groundwater body and further investigation is required to assess the potential impacts and river connectivity. During construction, impacts on heritage assets would need consideration and scope of investigations agreed with Historic England.
DV3	Magnesium Limestone new GW supply	The assessment identified issues of minor significance only.
R3a	River Ouse licence transfer	Potential impacts on marine sites have been identified and while these are not anticipated to be significant, further investigation is required.
R37b(ii)	River Aire Abstraction option 4	A water-dependent SSSI is downstream of the proposed abstraction and may be influenced by reduction in flows during operation of the scheme, further investigation is needed.
R78	Tidal Abstraction Reservoir	Likely significant effects associated with both construction and operational phases have been identified in relation to marine sites. A number of investigations would be required to provide sufficient evidence of no adverse effects on these sites (e.g. hydrodynamic modelling, water quality modelling, habitat surveys).
R8f	Sherwood Sandstone and Magnesian Limestone Boreholes option 6	There are a number of chemical pressures in the relevant WFD groundwater body that may be increased as a result of additional abstraction and further investigation is required. Rerouting of proposed pipeline and agreement of mitigation measures in consultation with Natural England would be required to be informed by further surveys and investigations. Potential construction phase impacts to a range of

Option Ref	Feasible options	SEA high level assessment
		heritage assets have been identified which would need consideration during the detailed scheme design; scope of investigations would need to be agreed with Historic England.
R86	West Yorkshire new WTW	A new abstraction licence would need to be agreed with the EA. Further investigation is required to assess the impact of the new abstraction on lamprey. Bird and habitat surveys would also be required to better understand likely impacts, and inform mitigation measures to be agreed with Natural England.
R85	Rebuild Kirklees WTW	The assessment identified issues of minor significance only.
R8g	Sherwood Sandstone Boreholes support to North Yorkshire	Further investigation is required to understand the impact of the proposed abstraction on the associated watercourses.
R31a	Additional bankside storage at York WTW	Bird surveys are required to better understand likely impacts and inform mitigation measures to be agreed with Natural England.
R88	Convert Wensleydale springs to boreholes	The assessment identified issues of minor significance only.

The candidate solution programmes were created by selecting different combinations of options from the portfolio and manually creating programmes to address wider risks and objectives, including YW WRMP24 objectives. *It should be noted that these objectives are for the options appraisal optimisation process itself, and so are different from the WReN objectives (although there are evident overlaps and alignment) accounted for through exploration of the best-value plan metrics later in this section).* **Table A5.17** shows the WRMP24 objectives mapped to the candidate solutions.

Once the options to meet objectives 1, 2, 3, 7 and 8 were mandated into the preferred plan we selected additional supply options from the portfolio to implement in the near term (AMP8) and help to address the immediate deficit. We produced four candidate solution programmes to close the baseline critical period deficit. The candidate solution programmes included supply-side options from the portfolio of options that were selected in the least cost and the best value optimisation runs for both the critical period and the DYAA scenarios. The candidate solutions were made up from different combinations of these options. The options included in the candidate solution programmes are listed in **Table A5.18** alongside the critical period least cost (benchmark) solution programme.

Table A5.17. YW WRMP24 public water supply objectives (needs) and high-level solutions

Objective		Benefit delivery year(s)	Solution	Justification of need
1.	Objective: Close the supply-demand deficit (25 years minimum)	2025-2035	• Plan to 1 in 200 level of service (DYAA scenario) and rely on drought measures until no later than 2039 • Invest in new supplies that close the WRMP deficit and provide additional resilience to the Grid SWZ conjunctive use system.	Both the 1 in 500 LoS DYAA baseline scenario and the critical period scenario show an immediate risk of deficit. Early interventions are needed to mitigate this risk in the short term and ensure the zone is in surplus in the final plan.
2.	Objective: Reduce leakage by 50% compared to 2017/18 levels by 2050	2025-2050	• L6 Leakage reduction 95Ml/d	Policy requirement and reduces water taken from the environment
3.	Objective: Achieve an average PCC of 110 l/h/d by 2050	2025-2050	• Smart metering and water saving initiatives • Water labelling	Policy requirement and reduces water taken from the environment
4.	Objective: Become resilient to 1 in 500 drought events without reliance on drought measures	2025-2039	• This should be achieved once objectives 1, 2 and 3 are met but careful monitoring is required and an alternative pathway could be triggered in the future.	Policy requirement: resilience to a 1 in 500 drought event no later than 2039 and reduce reliance on drought measures
5.	Objective: Increase resilience in the Grid SWZ and localised growth hot spots	2025-2035	• Invest in new supplies that meet objectives 1 and 4 and provide additional resilience to the Grid SWZ conjunctive use system.	We have identified areas of the Grid SWZ that would benefit from new supplies to meet short term resilience risks or offset the impact of growth in localised areas.
6.	Objective: Offset the ED BAU+ Groundwater loss	2035	• Met by combined benefits of demand reduction and new supplies delivered to achieve objectives 1 to 4.	Environmental Destination BAU+: risk of reduced licence availability from groundwater sources by 2035 (11Ml/d in total)
7.	Objective: Offset the STW transfer termination	2035	• Invest in DV8(iv) New north to south internal transfer connection • Invest in DV8(v) New WTW in York supplied by the River Ouse	The internal transfer is required to connect new supplies to the South Yorkshire demand area that is currently supplied by the STW transfer. The York WTW option will provide an additional source of water to substitute the loss of the transfer.
8.	Objective: Offset the ED BAU+ Surface water loss on the River Derwent	2050	• Invest in option DV7a(vi) Tees to York Pipeline - NWL import 140 Ml/d	Environmental Destination BAU+: licence reduction on the River Derwent by 2050 to meet a CSMG target.

Table A5.18. Candidate solutions for the DYAA critical period scenario

Option	DV3 Magnesium Limestone	DV7a(v) – Tees to York Pipeline - 80Mld	DV7a(vi) - Tees to York Pipeline - 140Mld	DV8(iv) - New north to south internal transfer connection - 50 Ml/d capacity 0 Ml/d benefit	DV8(v) - New WTW (York) supplied by the River Ouse	Household Flow Regulators A	Increased River Ouse pumping capacity	L6 Active Leakage Control 94.5 Ml/d	R13 East Yorkshire Groundwater Option	R29 Reservoir De-silting	R31a Additional bankside storage at York WTW	R3a River Ouse licence transfer	R5 Aquifer Storage and Recovery Scheme 1	R51 Supply Dales from the Tees - treated	R85 Rebuild Kirklees WTW	R86 West Yorkshire new WTW	R8b Sherwood Sandstone and Magnesian Limestone Boreholes option 2	R8c Sherwood Sandstone and Magnesian Limestone Boreholes option 3	R8f Sherwood Sandstone and Magnesian Limestone Boreholes option 6	R8g Sherwood Sandstone Boreholes support to North Yorkshire	C5 Smart Metering and Water Efficiency	R37b (ii) River Aire Abstraction option 4	R6d South Yorkshire Groundwater Option 4	R85 CP Rebuild Kirklees WTW
Critical period least cost	✓		✓	✓	✓	✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓				
Candidate solution 01	✓		✓	✓			✓	✓	✓		✓	✓				✓	✓	✓	✓	✓	✓		✓	✓
Candidate solution 03	✓		✓	✓	✓			✓	✓		✓	✓				✓	✓		✓	✓	✓		✓	
Candidate solution 04	✓		✓	✓	✓			✓	✓		✓	✓					✓			✓	✓	✓		
Candidate solution 04.01	✓		✓	✓	✓			✓	✓		✓	✓			✓		✓			✓	✓	✓		

Candidate solutions metric assessment

The candidate solutions, which included variations on the options presented in **Table A5.15**, resulted in similar combinations. The description of the options that made up every candidate solution is presented in **Table A5.19.** The candidate solution programmes were then compared against each other and against the critical period least cost solution using the MCA approach of comparing metric values at a programme level.

The metrics represent a range of criteria each measured by a qualitative unit or a quantitative scale that is appropriate for that particular criterion. However, this makes it difficult to compare programme metric scores using the measured values as they are not consistent, therefore we have normalised the values to a scale from 0 to 100 to provide consistent units. A score of 100 is the most optimal value for all metrics. All other programmes are applied a normalised score that is relative to the optimum programme for that metric. The normalised metric scores for all candidate solutions is presented in **Table A5.20** (normalised scores) and **Table A5.21** (actual values). A summary of the results from comparing the candidate solutions' performance across all metrics is provided in **Table A5.22.**

Table A5.19. Description of candidate solution programmes

Solution programme reference	Description
Candidate solution 01 – partial-optimisation	Options were mandated into the programme to: • meet the policy demand reduction requirements • address the loss of the transfer • address the River Derwent environmental destination risk • address resilience needs - R8b Sherwood Sandstone and Magnesian Limestone Boreholes Option 2, R8g Sherwood Sandstone Boreholes support to North Yorkshire, R3a River Ouse licence transfer and R86 West Yorkshire new WTW The optimiser could then select based on cost from the remaining options in the portfolio.
Candidate solution 02	This solution was a variation of solution 01, but was not assessed any further as the results were no different.
Candidate solution 03- maximise resilience benefits	This solution programme included the same mandated options as candidate solution 01 plus the following additional options were mandated to increase the resilience benefits: • R13 East Yorkshire Groundwater Option 2 • DV3 Magnesium Limestone • R8f Sherwood Sandstone and Magnesian Limestone Boreholes Option 6 • R31a Additional bankside storage at York WTW The optimiser had limited scope to optimise and selected one additional option which was a new interconnecting pipeline.
Candidate solution 04 – fully mandated	This solution programme was a variation on candidate solution 03 with fewer groundwater options mandated and the R86 West Yorkshire new WTW replaced with a R37b(ii) River Aire Abstraction Option 4. As a result the total new supply benefit was reduced.
Candidate solution 04.01– fully mandated	This solution programme was the same as candidate solution 04 except that an additional option, R85 Rebuild Kirklees WTW, was mandated into the programme to treat existing reservoir supplies and to remove a risk of deficit in the longer term (2060s).

Table A5.20. Comparison of metric normalised scores[7] between WReN candidate solutions to address Grid deficit metrics compared to a least cost (with supply options only) scenario

Solution programme	Cost of the plan (Totex)	Carbon 000s tCO2	PWS Drought resilience	Natural Capital £ NPV	Biodiversity (supply options only)	Leakage reduction Ml/d	PCC reduction 2050 l/h/d	Flood risk management (non-drought resilience) (SEA)	Multi-abstractor benefit (SEA)	Human and social well-being	Customer preferred option type	Option Deliverability	Programme resilience score	Total normalised score
Best Value Plan (Candidate solution 04.01)	72	74	78	88	88	100	100	100	100	100	82	71	78	**1131**
Candidate solution 03	63	78	86	100	72	100	100	87.5	86	86.8	81	72	88	**1100**
Candidate solution 04	73	75	78	88	88	100	100	85.7	86	89.6	82	71	70	**1086**
Candidate solution 01	65	78	81	100	62	100	100	80	62	79.7	81	72	78	**1039**
Least cost	100	92	86	85	100	100	50	50	43	56.7	75	72	50	**960**

[7] *Values are normalised not absolute values, with 0 representing the worst performance and 100 representing the best performance.

Table A5.21. Comparison of metric actual scores between candidate solutions to address Grid deficit metrics compared to a least cost (with supply options only) scenario

Solution programme	Cost of the plan (Totex)	Carbon 000s tCO2	PWS Drought resilience	Natural Capital £ NPV	Biodiversity (supply options only)	Leakage reduction Ml/d	PCC reduction l/h/d	Flood risk management (non-drought resilience) (SEA)	Multi-abstractor benefit (SEA)	Human and social well-being	Customer preferred option type	Option Deliverability	Programme resilience
Best Value Plan (Candidate solution 04.01)	2126	2490	18	-286,025,838	-2392	95	2.65	-0.50	-0.21	-0.55	2.35	2.96	5
Candidate solution 01	2358	2355	19	-333,393,397	-3426	95	2.65	-0.63	-0.34	-0.69	2.29	3.05	5
Candidate solution 03	2426	2345	21	-332,920,251	-2920	95	2.65	-0.57	-0.25	-0.63	2.29	3.05	6
Candidate solution 04	2113	2440	18	-286,050,497	-2392	95	2.65	-0.58	-0.25	-0.61	2.36	2.92	4
Least cost	1685	2308	21	-285,781,973	-3437	95	0.01	-0.57	-0.45	-0.68	2.26	2.90	5

Table A5.22. Description of candidate solution best value metric scores

Best value metric	Candidate solution comparison
PWS Drought resilience	The scores range from 58 to 68 and none of the solutions were able to close the immediate deficit. The best performing were the least cost and candidate solution 3.
Biodiversity	This metric is only applied to the supply options and by assuming the PCC policy requirement and reducing the number of supply side options the least cost score of 15 is raised slightly but the highest scoring is only 20. When delivering schemes requiring planning permission, we shall plan to achieve a 10% biodiversity net gain[8].
Natural Capital	The scores range from 88 to 100 with candidate solution 01 the best performing.
Leakage reduction	All programmes score 100 on leakage as the least cost selected the 50% reduction option and it was mandated into the candidate solution programmes.
PCC reduction	The policy PCC reduction was mandated into the candidate solutions which all scored the maximum value of 100. The least cost performed poorly in comparison with a score of 50.
Flood risk management (non-drought resilience)	The scores range from 62 to 73 with the least cost solution preforming lowest and candidate solution 04.01 the highest.
Multi-abstractor benefit	The scores range from 20 to 42 with the least cost preforming lowest and candidate solution 04.01 the highest.

[8] To be an egal requirement when Environment Act 2021 is implemented and legal requirement of the Natural Environment and Rural Communities Act 2006 (Section 40).

Best value metric	Candidate solution comparison
Carbon	The metric scores showed little variation from 72 (candidate solution 04.01) to 78 (least cost solution).
Customer preferred option type	There was virtually no variation on this metric with all scores just over 80.
Human and social well-being	The metric scores show a small range from 46 (least cost) to 55 (candidate solution 04.01).
Financial Cost	The least cost plan scores best at 63 and the lowest scoring is 58, candidate solution 03.
Option Deliverability	There is little variation in this metric with all programmes scoring around 70.
Resilience	The scores range from 70 to 88 with candidate solution 04 scoring lowest and 01 scoring highest. The rest were even scoring 78. Candidate solution 03 was designed to maximise resilience benefits

Our assessment concludes Candidate Solution 04.01 is best value. This is because Candidate solution 04.01:

- has the highest normalised score for five of the 13 best value metrics (customer preference, human and social wellbeing, biodiversity, multi abstractor benefit and flood risk management) and has been identified as the best value plan.
- presents the lowest cost solution of the candidate solutions.
- scores mid-way between the highest and lowest programme resilience scores, and scores lowest on public water supply drought resilience (but is broadly comparable given the basis of the metric being “number of years” the 1:500 drought resilience level is met)^.
- selects a reduced number of Sherwood Sandstone options and we will review in the next plan once investigations are complete if more of the options can be developed in this area.
- does not have the lowest natural capital score - it is equal to all, but candidate solution 03, and scores highest of all programmes on biodiversity. The carbon results of all solution programmes show a very small range (72 to 78) and this is not considered material.

^ *To offset the public water supply drought resilience risk, we shall plan to a lower level of service in the short term (a drought return period of 1 in 200) and will be resilient to 1 in 500 drought events no later than 2039. Although the alternatives to candidate solution 04.01 improve the public water supply drought resilience score, they do not score 100, and we would still be required to plan to a 1 in 200 return period in the short term. Our preferred programme reduces the number of new supply options at the start of the planning period, which makes it more deliverable overall. It also reduces the risk of investing in supplies that may not be needed in the future once the benefit of the demand reduction options accumulates.*

Stress testing

Candidate solution 04.01 has been selected as the best value plan for closing the DYAA and critical period baseline deficits. The plan has been adjusted to bring forward five supply options to meet the risk at the start of the planning period. However, before we finalised our preferred plan, we considered several alternative scenarios. The deficit presented in our baseline scenarios is driven by three key risks:

- Climate change impact on future supply
- The loss of the STW transfer
- Environmental destination.

Our forecasts are based on the most up to date information we have at the time of producing our plan. However, forecasts are inherently subject to uncertainty and factors that we cannot control; therefore, we must plan for alternative futures. To do this, we stress tested our plan to the known risks that could trigger a material change to our plan. This helps us see how the plan should change in response to various changes, if these were to occur in the future.

Our stress tests are based on the Common Reference Scenarios, which simulate a greater deficit than the baseline due to high climate change and the enhanced environmental destination. We also tested the plan against the Ofwat Core Scenario which simulates a lower deficit based on the minimum investment needs across all scenarios, and created a scenario that includes the combined risk of the enhanced environmental destination and the high climate change scenario. The stress testing scenarios have also been adjusted to incorporate the benefit of planning to a 1 in 200 drought return period and the assumed benefit from drought measures until 2038/39. From 2039/40 onwards the deficit represents a DYAA 1 in 500 level of service and no assumed benefit from drought measures.

Figure A5.6 shows the needs (in Ml/d) under each scenario in the Grid SWZ (represented by the trendlines on the graph) and the extent to which preferred plan options can bridge that deficit (colourful bars in the background linked to the legend). As seen in the first graph, there is a marginal surplus in 2025 in both the DYAA high climate change and high environmental destination scenarios. This surplus increases as more option benefits take effect until 2035 when the STW transfer terminates. This reduces the headroom in the Grid zone, but it does not create a deficit in either scenario, therefore no further supply options are brought in at this point. From 2035 the surplus increases again due to the benefit of demand reduction options until in 2039 when we move to a 1 in 500 level of service. Again, the loss does not create a deficit in either the high climate change or high environmental destination scenarios. In 2050, the River Derwent CSMG target is applied, and the loss is offset by the DV7a(vi) - Tees to York Pipeline option. The climate change and high environmental destination scenarios remain in surplus until the mid to late 2070s, but without the benefit of water labelling they would be in deficit in the early 2060s.

The combined high climate change and enhanced environment destination scenario can be met by the best value solution in the first 25 years of the planning period. With the assumed benefit of water labelling it has a marginal surplus from 2050 to 2060 and without any benefit from labelling it would be in deficit from 2050 onwards.

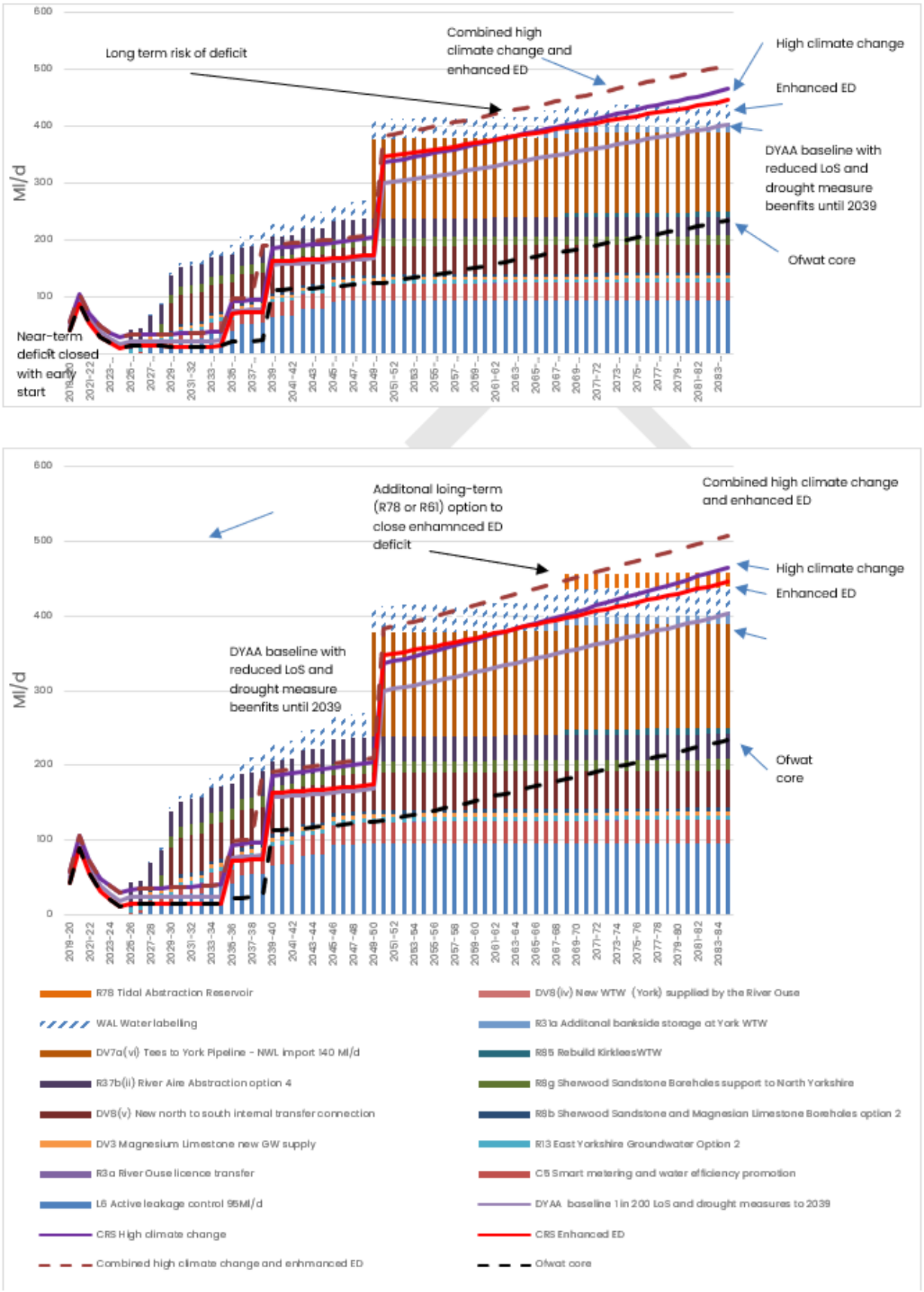
The Ofwat Core scenario represents a lower deficit future which could occur if the STW transfer is maintained, and we do not lose any of our River Derwent licence through the environmental destination (CSMG target). Under this scenario the internal transfer main from York to South Yorkshire (DV8(iv)) would not be required in 2035/36, the Tees transfer (DV7a(vi)) option would not be required in 2049/50 and the R31a Bankside storage at York WTW option would not be required in 2066/67.

As the high stress test scenarios risks are beyond the first 25 years of the planning period there would be time to monitor the impacts of climate change and to plan for the enhanced environmental destination outcome. However, to demonstrate mitigation of the risks we are including an additional option as an alternative scenario to our best value plan. This alterative would include the tidal abstraction reservoir (R78) option to abstract when the water quality is less saline. We have selected this option as it appears in three of our best value runs, including the maximise six capitals run. It is located in East Yorkshire, an area that would be impacted by a reduction in the River Derwent licence, and it could connect to existing networks.

The second chart in **Figure A5.6** incorporates the 20Mld benefit of the R78 tidal abstraction reservoir into the best value solution. The enhanced environment destination scenario deficit is closed by including this option and the high climate change deficit is closed until 2084. The option does not remove the long-term risk of the combined high climate change and enhanced environment destination scenario. As the impact of climate change in our baseline scenario is already representative of an extreme climate change scenario, our alternative pathways (see section below) include an enhanced environmental destination pathway as we consider this a more likely scenario than the high climate change scenario. The R78 tidal abstraction reservoir would require significant investigations and its possible the tidal abstraction would not achieve the assumed benefit (20Ml/d) and instead we would require a desalination plant at the same location. We consider 20Ml/d to be a conservative estimate of the benefit of desalination and depending on the outcome of investigations, it is possible we could achieve a greater benefit from

both options. By adding this option to our plan to address the longer-term risks it gives us time to complete the investigations before the risks emerge.

Figure A5.6. Grid SWZ best value plan stress testing to alternative DYAA scenarios

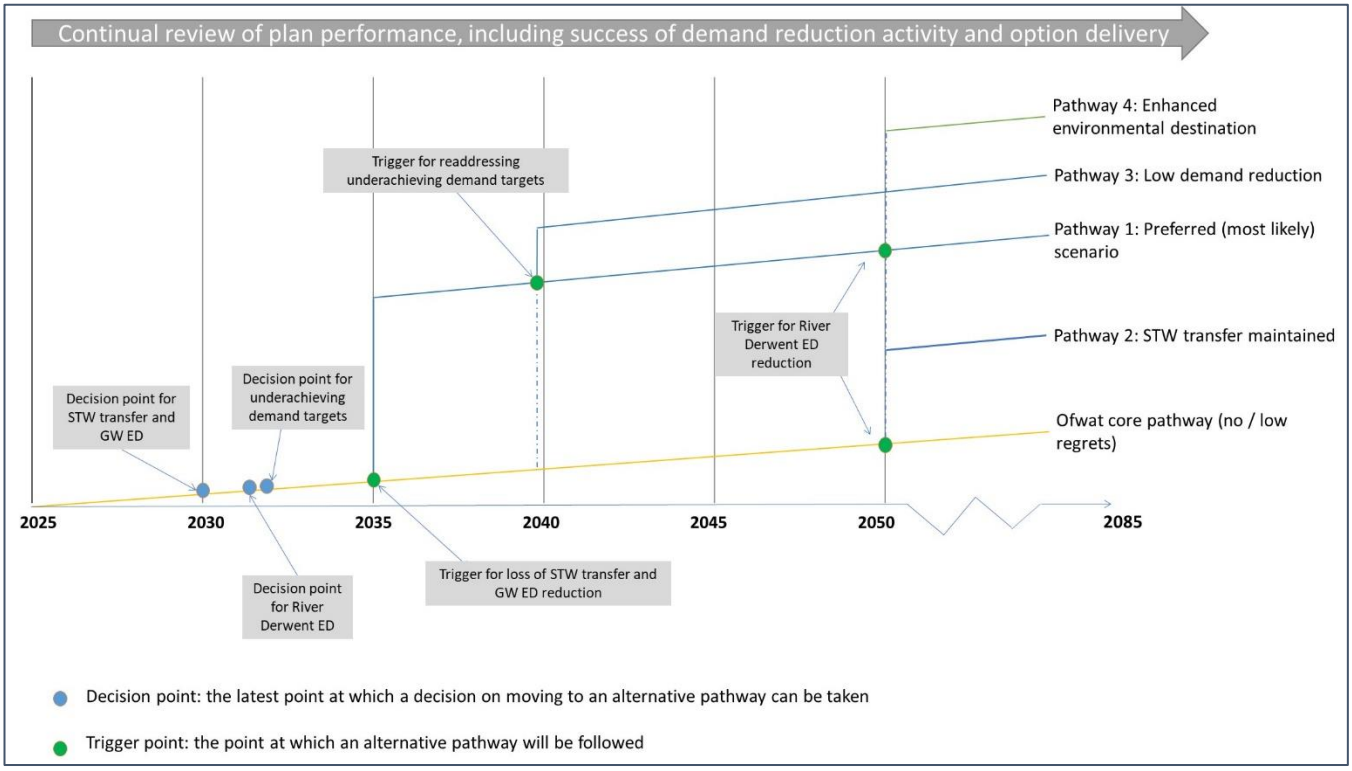


Alternative pathways

Our preferred (or most likely) draft plan is a twin track approach, which invests in both supply and demand reduction options. The solution has been selected through our decision-making approach for determining a best value plan and candidate solution 04.01 performed best against our best value plan metrics. The final step in formulating our preferred plan is to create an adaptive plan that enables it to be flexible to the uncertainties. However, not all risk and uncertainty can be quantified accurately and, although our forecasts incorporate the most up to date information available to us, our plans are still based on estimates, and we must consider this in our final preferred plan. The known risks in our plan allow us to incorporate an appropriate level of flexibility and divert to an alternative future if required.

We have created five alternative pathways by stress testing our best value plan to the common reference scenarios, as shown in **Figure A5.7** below.

Figure A5.7. WReN core adaptive pathways to meet Yorkshire Grid deficits



To ensure we are prepared for diverting to an alternative plan, we identify decision points in advance of the pathway diverging, as illustrated in the figure above. The decision points are to ensure a solution for mitigating a risk is implemented in advance of the risk occurring.

The options included in each of the alternative pathways are presented in **Table A5.23**.

Table A5.23. Adaptive pathway options

Option Name	Preferred (Most Likely) Programme	Least Cost CP Programme	Least Cost DYAA	Ofwat Core Programme	Alternative 1 - STW transfer maintained	Alternative Programme 2 - Pathway 3 Low demand reduction	Alternative 3 - enhanced environmental destination
C5 Smart Metering and Water Efficiency	✓	×	×	✓	✓	✓	✓
DV3 Magnesium Limestone	✓	✓	✓	✓	✓	✓	✓
DV7a(vi) - Tees to York Pipeline - 140Mld	✓	✓	✓	×	✓	✓	✓
DV8(iv) - New north to south internal transfer connection - 50 Ml/d capacity 0 Ml/d benefit	✓	✓	✓	×	×	✓	✓
DV8(v) - New WTW (York) supplied by the River Ouse	✓	✓	✓	✓	✓	✓	✓
L6 Active Leakage Control 95 Ml/d	✓	✓	✓	✓	✓	✓	✓
R3a Increased River Ouse pumping capacity	✓	×	×	✓	✓	✓	✓
R8b Sherwood Sandstone and Magnesian Limestone Boreholes Option 2	✓	✓	×	✓	✓	✓	✓
R8g Sherwood Sandstone Boreholes support to North Yorkshire	✓	✓	✓	✓	✓	✓	✓
R13 East Yorkshire Groundwater Option 2	✓	✓	✓	✓	✓	✓	✓
R31a Additional bankside storage at York WTW	✓	✓	✓	×	×	✓	✓
R37b (ii) River. Aire abstraction Option 4	✓	×	×	✓	✓	✓	✓
R85 Rebuild Kirklees WTW	✓	×	×	✓	✓	✓	✓
R78 Tidal abstraction	×	×	×	×	×	×	✓

Pathway 1: Preferred plan (most likely) scenario: This is the most likely pathway represented by the baseline supply-demand balance in the YWSEST and YWSGRD WRP tables. The best value plan has been selected to close the deficit in the Grid SWZ DYAA and critical period baseline scenarios. The options included are listed in **Table A5.24**.

Table A5.24. Preferred plan solution programme

Option	First year of benefit	Benefit (Ml/d) on full implementation
Plan to a 1 in 200 level of service until 2039	Immediate effect	52 (reduces slightly each year due to climate change impacts)
Drought measures until 2039	Immediate effect	Assumed benefits circa 40
L6 Active Leakage Control 95 Ml/d (halving leakage by 2050)	2025/26	95
C5 Smart Metering and water efficiency	2025/26	32**
Labelling of water use appliances*	2027/28	39**
R13 East Yorkshire Groundwater Option 2	2025/26	6 (8 maximum)
R37b(ii) River Aire Abstraction option 4	2025/26	34
R3a River Ouse licence transfer	2027/28	0.3 (15 maximum)
DV3 Magnesium Limestone new GW supply	2027/28	5
R8b Sherwood Sandstone and Magnesian Limestone Boreholes option 2	2027/28	5
R8g Sherwood Sandstone Boreholes support to North Yorkshire	2028/29	15
DV8(v) New WTW (York) supplied by the River Ouse	2029/30	50
DV8(iv) New north to south internal transfer connection	2035/36	n/a – required to transfer new source of supply to South Yorkshire
DV7a(vi) Tees to York Pipeline - 140Mld	2049/50	140
R31a Additional bankside storage at York WTW	2066/67	11
R85 Rebuild Kirklees WTW	2068/69	8

Pathway 2: STW transfer maintained: This pathway assumes the STW transfer could be maintained in the future. Under this scenario there are two options included in the preferred plan we would not implement. These are the internal transfer main from York to South Yorkshire (DV8(iv)) and the additional bankside storage (R31a). The decision would be made in 2030 and the pathway triggered in 2035.

Pathway 3: Low demand reduction: This pathway recognises the success of our planned demand reduction activity cannot be guaranteed and assumes the year-on-year combined benefits of leakage reduction and PCC reduction will be half that assumed in our preferred plan pathway. This pathway would bring forward the Tees transfer option and leave us vulnerable in the longer term. We have not identified the longer-term solution in this pathway as our draft regional plan to build on our available options and understand alternatives to the Tees transfer will be incorporated into the next round of planning (WRMP29 cycle) when we will readdress this risk.

We have included a decision point in 2032 and a trigger in 2038 for this pathway. However, the uncertainty cannot be defined to a single year, and we will monitor our progress each year and review in each iteration of our regional plan and alter our plan accordingly.

Pathway 4: Enhanced environmental destination: This pathway represents the enhanced environmental destination and the risk of additional deficit if the outcome of the River Derwent investigations is more severe than assumed in our preferred pathway. Under this scenario we would be required to invest in additional option in 2060s. We have selected a new abstraction that would be stored in a tidal abstraction (R78) reservoir or used at a desalination plant in East Yorkshire (R61). This would require environmental investigations in advance to ensure the water was available and further scoping to understand which of the two options would be implemented.

The trigger for the pathway is 2049 when the CSMG target will be applied. The decision point is well in advance of this date in 2032. The time between the decision and the trigger allows for the complexities of this pathway to be resolved. Currently the scale of the loss is unknown but could be high (130Ml/d or more). This reduction in our available supply would have a significant impact particularly if we were also following the low demand pathway. We have allowed time for understanding the impact and ensuing we have sufficient options implemented that can reliably secure supply to our customers.

Ofwat core pathway: This pathway represents the minimum interventions required to ensure the future risks are mitigated and we are resilient to future drought events. It assumes all options planned for AMP8 and 9 will be implemented. However, as in Pathway 2, there is potential that the STW transfer could continue if STW's plan diverts to a different pathway. There is also a possible outcome from the River Derwent environmental destination investigations that the licence is not reduced. This alternative outcome would negate the need for three options included in the preferred pathway. These options are - internal transfer main from York to South Yorkshire (DV8(iv)), the Tees to York transfer from NWL (DV7a(vi)) and the additional bankside storage (R31a).

Decisions to divert from the preferred pathway to an alternative pathway will be based on evidence collated over time as we monitor both our own progress and the external factors that influence our plan. It is most likely our plan will change in the future. It is reviewed every five years and with each iteration we assess new data and integrate new approaches and objectives that alter our supply and demand scenarios. The critical period risks become apparent during drought events such as 2018 and 2022, and this provides more data on which we can assess water availability and demand increases due to hot, dry weather. YW will carry out investigations on needs, such as the environmental destination requirements, and we shall be implementing the preferred solution. Any risks will be monitored and progress to Defra will be reported as part of annual WRMP reviews.

Preferred plan benefits

The benefits of the preferred plan have been summarised in **Table A5.25** against the plan objectives.

Table A5.25. Preferred plan actions

Yorkshire Water WRMP24 Objectives (Needs) linked to WReN	Preferred plan actions
1. Close the supply-demand balance deficit	The DYAA baseline deficit from 2025 to 2085 has been met but is dependent on options R13 East Yorkshire Groundwater Option 2 being delivered by 2025. The critical period deficit could not be met in the early years, and we will be operating to reduced headroom until 2027. We shall consider these risks further for our final plan.
2. Reduce leakage by 50% compared to 2017/18 levels by 2050	A year-on year target from 2025 to 2050 has been built into our preferred plan. The uncertainty of achieving this target will increase over time and may require us to divert to the low demand pathway. We will monitor our progress.
3. Achieve an average PCC of 110 l/h/d by 2050	Meeting the PCC policy target has been built into our plan to achieve 106 l/h/d by 2050. We shall monitor progress towards this target and whether we divert to the low demand pathway in the future. The success of this objective is partly dependent on the government's water labelling initiative.
4. Become resilient to 1 in 500 drought events without reliance on drought measures	Our plan aims to meet this objective by 2039. We could achieve this earlier in the mid-2030s, however our sensitivity assessment and risk of diverting to an alternative pathway has concluded the 2039 target is most representative of the risks. We shall review this for the final WRMP24.
5. Increase resilience in the Grid SWZ and localised growth hot spots	Our preferred plan includes investment in the North Yorkshire (R8g), South Yorkshire (R8b), Bradford (R37b(ii)) and York (DV8(v)) areas that will mitigate some of the risks identified by our WSSS as well as closing the supply-demand balance gap. There is a future risk to the York area once the supply is required to support South Yorkshire. At this stage we have chosen to delay the decision on this additional investment and develop further options for the WRMP29 planning round and monitor our demand reduction.
6. Offset the ED BAU+ Groundwater loss	Assuming we achieve our demand and supply option benefits we should meet this objective through our AMP8 investment. We shall review in the WRMP29 planning round if additional interconnections are needed to support the areas directly supplied to the groundwater supplies.
7. Offset the STW transfer termination	This will be met through investment in: DV8(v) - new WTW (York) supplied by the River Ouse. It will require DV8(iv) - new north to south internal transfer connection to provide the supply to South Yorkshire
8. Offset the ED BAU+ Surface water loss on the River Derwent	We have included the Tees transfer option to offset the baseline loss. However, there is significant further work to do to understand both the scale of the loss and the true cost of the option. We shall be developing our understanding of these during AMP8. The loss of the supply is not triggered until 2049 to allow time to develop the Tees solution or a better value alternative – which we will investigate in AMP8. If we are following our low demand pathway the Tees transfer could be triggered sooner and we would need to find an alternative in the longer term.

A best-value plan for the region

As described earlier, as the key supply-demand challenge occurs in the Yorkshire Grid zone, the options appraisal process is driven by the Yorkshire Water WRMP24. However, through WReN, the potential for export from Northumbrian Water has been undertaken in a collaborative manner, allowing areas of surplus to support those in deficit within our region. YW has ensured that the selected export does not impinge on Northumbrian Water's plan position and broader regional impacts have been taken into account. In line with customer feedback, Yorkshire Water are undertaking significant demand-side action in addition to drawing on new supply-side schemes. Our approach to metrics has ensured that the costs and impacts cover assets in the Northumbrian Water area developed by/for Yorkshire Water to facilitate the transfer (e.g. carbon, environmental impacts).

Northumbrian Water has sufficient raw water within its Kielder WRZ to meet its own forecast customer demand over the planning period, forecast demand on Industrial Teesside and to provide a 140 Ml/d raw water transfer to Yorkshire Water from 2040. The 1:500-year drought resilience standard is not impacted by the transfer of water for Northumbrian Water, whilst helping to deliver improved resilience in the Yorkshire Grid. Operationally any impacts of the scheme are modest, given the regulated nature of the export from existing Northumbrian Water sources, whilst supporting significant environmental improvements to be delivered elsewhere in the region. Northumbrian Water and its customers receive some financial benefit from the export, reflecting a fair transfer of 'value' within the region for the use of available surplus water.

How to find out more

More information about Water Resources North, including our publications and how you can contact us, is available on our website, www.waterresourcesnorth.org.

WReN
Water Resources North