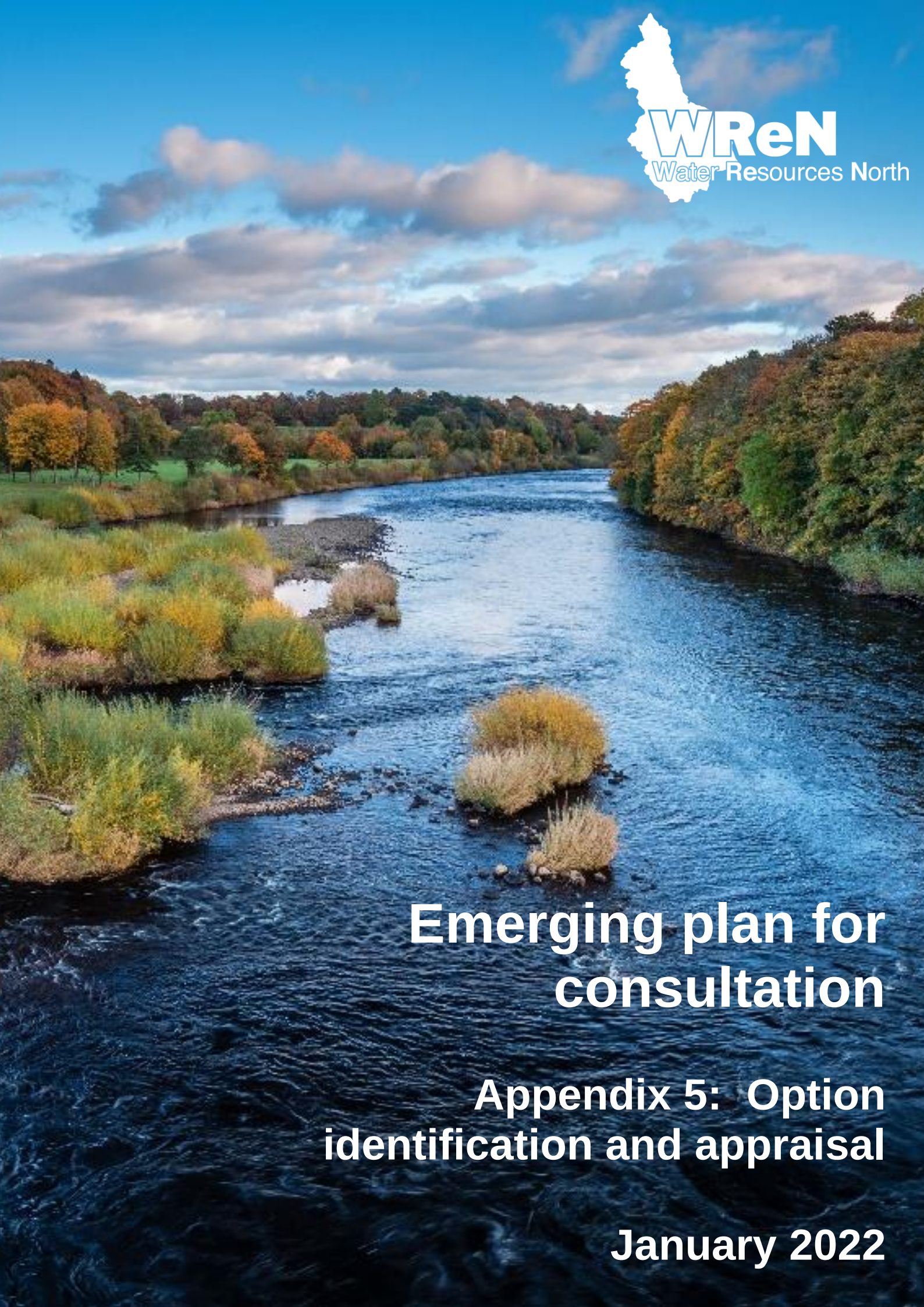


Emerging plan for consultation

Appendix 5: Option identification and appraisal

January 2022

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 for this emerging 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 we developed for the reconciliation process. In Appendix 5.2 we discuss the option appraisal process of our emerging plan.

Appendix 5.1 Option Identification

Background

WReN has identified transfer options for making water available to other regions. There are five feasible options in total. A further four transfer options were originally identified but constrained out as they did not meet the option screening criteria for feasible options (see following section). Four of the feasible options provide exports to other regions and one would reduce or stop an existing import from Water Resources West (WRW). WRW's plan includes a full or partial reduction of the transfer as an option in its plan. The future of the transfer is currently uncertain however, there is also a Strategic Resource Option (SRO) that is being scoped under the RAPID gated process that, if feasible, could allow the transfer to be retained in both regions' plans.

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 WReN supply forecast (e.g., climate change reductions) and in-region needs. Rounds 1 and 2 of the autumn 2021 reconciliation process did not result in another region including a transfer from WReN in its plan. A further round of the reconciliation process is anticipated in spring 2022 following the current consultation period. If, in the future another region did include a transfer in its plan, modelling and stress testing would be carried out to assess the sustainability of the transfer. In some circumstances WReN may be able to facilitate a transfer if additional investment is made in 'WRMP level' options to indirectly support a regional transfer.

Of the four feasible exports identified, three originate from Northumbrian Water Limited (NWL). Although technically feasible, the scale of availability of water is uncertain following the latest deployable output assessments using new stochastics and climate change datasets. Despite this change, we have assessed these options as feasible at this stage, in order to understand if other regions may identify a potential need for the options. Although the impact on the deployable output would be a constraint, this would be reviewed further if any WReN transfers were selected by the other regions[1], noting that the timing and utilisation of the transfer required by neighbouring regions is an important aspect to exploring availability risks in more detail.

We also have an option to transfer water to Severn Trent Water (STW) which would require investment in the Yorkshire Water grid network to make the water available. Due to the uncertainty of the transfer from STW to Yorkshire Water the availability and costs of a Yorkshire Water to STW transfer are uncertain. We have currently identified this as a feasible option, but it may not be available if Yorkshire Water needs to find an alternative supply to substitute the loss of the transfer.

The remaining WReN transfer option is related to the existing transfer from WRW (STW) to WReN (Yorkshire Water). Currently the ability for STW to retain the existing transfer (in the long-term) is uncertain

[1] A key part of the national reconciliation process of regional plans included a capturing of residual risks on transfer options where these were selected during the process, which would have allowed us to identify where further exploration was required had any WReN transfers been selected.

therefore the strategic regional options from the reconciliation process include options for both retaining and reducing/ceasing the transfer. The transfer is from the Derwent Valley reservoirs, operated by Severn Trent Water (STW) in the WRW region, to Yorkshire Water's South Yorkshire supply area. The output of the reconciliation process identified that a WRW solution to future supply-demand risks could include a reduction or cessation of the existing transfer. WReN is aware this is an option in the WRW plan and has investigated options for providing an alternative supply. During the reconciliation process a new option that would allow retention of the transfer emerged. This involves increasing storage in the Derwent Valley (for example by raising reservoir levels) to provide sufficient supply to meet STW's future needs and retain the transfer to Yorkshire Water. The option is under development and to determine its feasibility it has been proposed to RAPID as a new SRO within the gated process. This SRO, if accepted by RAPID, would also allow for more detailed study of YW's in-region 'backfill' option should the existing transfer reduce or cease.

A summary of the inclusion of in-region supply options and inter-company transfers within the region is provided later in this document.

Options identification process

The overarching WReN option identification process is summarised in **Figure A5.1**, whilst 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

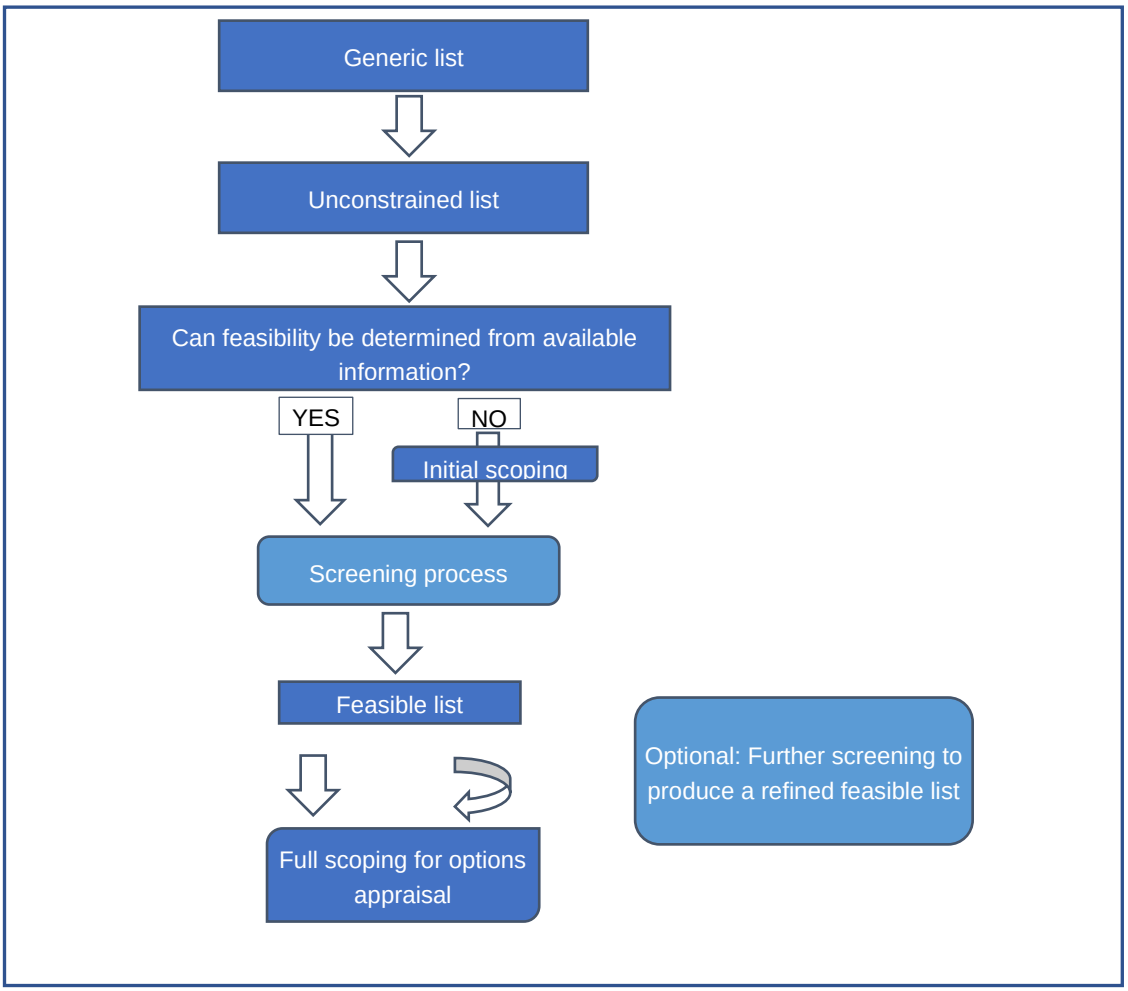


Table A5.1 WReN option feasibility screening criteria

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?
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)?

Screening criteria

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?

Regional Transfer options

Regional transfer options (RTOs)[2] are options which the regional groups can consider in their plans for meeting PWS supply-demand deficits. They include 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. Options that trade resources out of, or into, the region have the potential to become strategic regional options and our feasible RTOs are the WReN options that could become SROs in the future, 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. We have developed the RTOs in order to provide the required level of detail for optimisation in our own regional plan at a pre-gate 1 level, we divided our approach into two phases:

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).

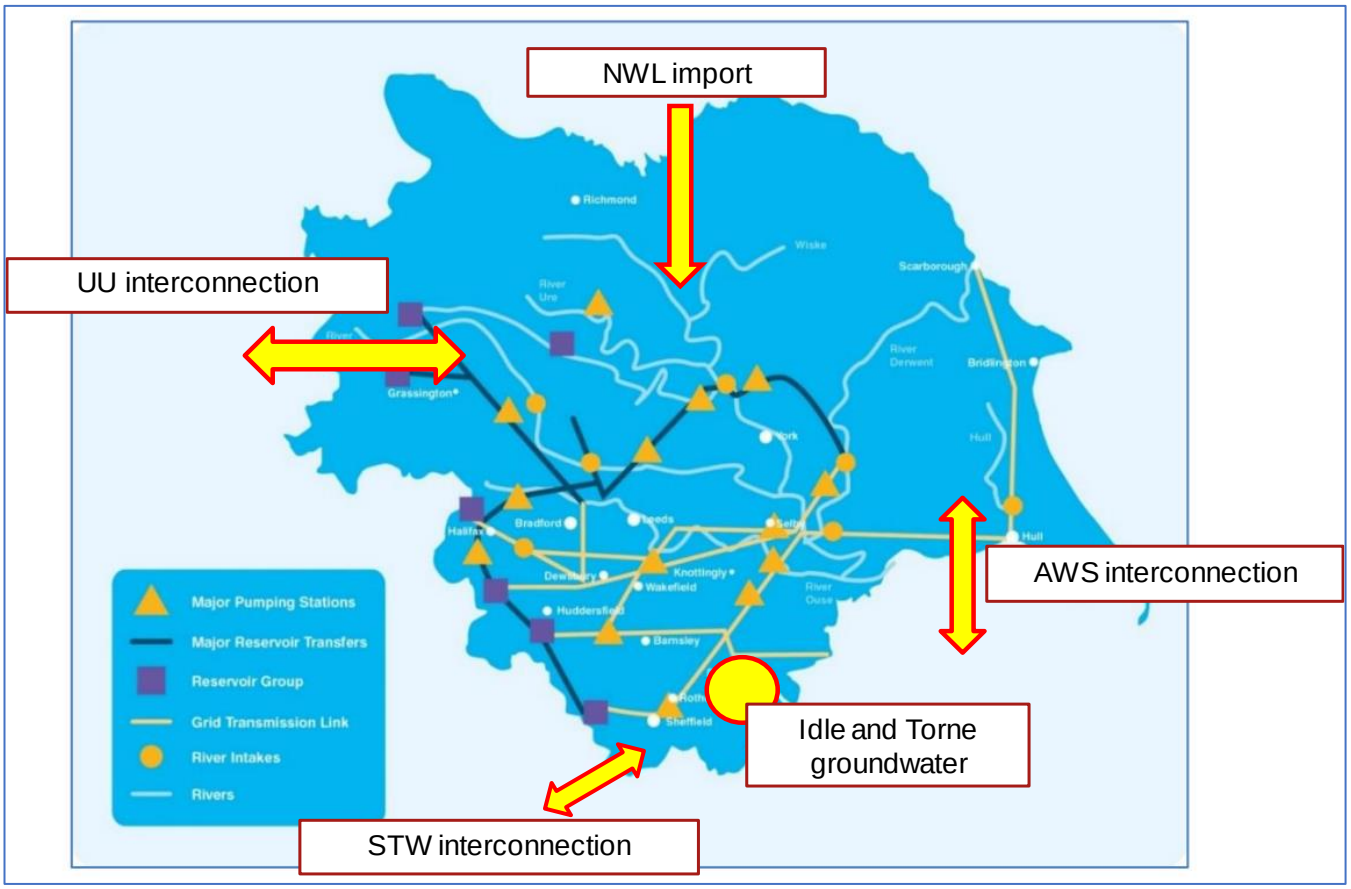
To ensure schemes were proportionate to the need, a de-minimis of 20Ml/d was initially applied to the WRMP19 options. However, further consideration was given to the location of resources and if they could be considered strategically located (close to a boundary). This resulted in a sub-set of options 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 to United Utilities

[2] 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).

3. Scoping opportunities for interconnection: Anglian Water and Yorkshire Water (bi-directional)
4. Scoping opportunities for interconnection: Yorkshire Water to United Utilities
5. Idle and Torne option scoping: Yorkshire Water unused licence capacity.

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



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 is 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. Since producing the February 2021 Position Statement, we have continued to work with other regions and undertaken 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. This has resulted in a number of the initial feasible options being constrained out (further details on this are provided in the option tables below.

The WReN regional transfer options that involve Yorkshire Water either directly (change to existing STW import or new transfer from Yorkshire Water to STW) or indirectly (transfer from NWL to Yorkshire Water) would need to be considered in combination with the company level supply-demand balance and considered in the context of the stress testing scenarios in the Yorkshire Grid zone. This could mean the WReN Regional Plan requires a solution to the Yorkshire Grid zone to be selected from options that enable a transfer. NWL would also need to consider the utilisation and water available from Kielder for specific scenarios related to any transfer requests from the other regions. However, the autumn 2021 reconciliation process concluded there was no emerging need from the other regions for WReN's available transfer options, based on the supply-demand position across the regions and companies.

Further detail on the potential WReN transfer options is summarised in each option table below, along with a colour coded status:

Colour code
Feasible
Technically feasible, but the option is dependent on other options being selected and / or scenario analysis of the utilisation by the receiving company.
Constrained out - further details provided in option table

E2	**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:	20Ml/d average, 25Ml/d peak
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. Exact scope and costs would be dependent on the future of the STW import to Yorkshire Water.		
Requirement for other resource option:	An additional raw water source, new connections and treatment capacity likely to be required to support this transfer		
WReN / WRMP 2024 status	Feasible with additional investment in region		

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:	Partially treated	Volume Ml/d:	TBC: 100 Ml/d and 150 Ml/d for 3 months per year
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:	NWL modelling of the 1:500 supply scenario using UKCP18 data shows risk that water is not available in severe drought years. The option presents an INNS risk that would need to be mitigated		
Requirement for other resource option:	n / a		
WReN / WRMP 2024 status	Technically feasible, but WRMP24 deployable output and climate change modelling results in limited water availability depending on utilisation etc. – further context is provided in the section below this group of options tables.		

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:	Partially treated	Volume Ml/d:	TBC: 45 Ml/d
Brief scheme description:	Raw water transfer from NWL Cow Green reservoir to UU. Will require construction of pipeline to recipient reservoir.		
Key constraints and risks:	NWL modelling of the 1:500 supply scenario using UKCP18 data shows risk that water is not available in severe drought years. The option presents an INNS risk that would need to be mitigated. Depending on other potential combinations of transfers may require upgrade of electricity supply to Riding Mill and additional pumps.		
Requirement for other resource option:	n / a		
WReN / WRMP 2024 status	Technically feasible but WRMP24 deployable output and climate change modelling results in limited water availability depending on utilisation		

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:	Partially treated	Volume Ml/d:	TBC: Up to 140 Ml/d
Brief scheme description:	Transfer from NWL Tees abstraction to YW area could be expanded to other regions if a recipient location is identified (STW or AWS). 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:	NWL modelling of the 1:500 supply scenario using UKCP18 data shows risk water not available in drought years. INNS risk and other environmental impacts of pipeline or river transfer. Availability of electricity supply to pump higher volumes from Kielder to support the Tees.		
Requirement for other resource option:	Exact scheme dependent on YW needs and recipient's needs. This option could potentially alter the Yorkshire Water solution.		
WReN / WRMP 2024 status	Technically feasible but dependent on a transfer from NWL to Yorkshire Water to make the water available to STW. This option has not been selected in any or WReN's optimisation runs.		

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:	12 – 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.		
Requirement for other resource option:	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		

E3	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:	Up to 50 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 Sheffield area WTW.		
Requirement for other resource option:	n / a		
WReN / WRMP 2024 status	Constrained out - currently no alternative treated source identified for Yorkshire Water customers.		

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:	12 - 20 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 to be confirmed.		
Requirement for other resource option:	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. Yorkshire Water is investigating if the scheme could be feasible with additional support from its grid network instead of the groundwater supply		

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:	40 – 50 Ml/d
Brief scheme description:	Yorkshire Water resource on the R 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:	This option is subject to YW's supply-demand balance and future needs. UU reviewed potential to transfer via River Aire and Leeds Liverpool Canal based on a suggestion in a RAPID project. Feasibility of the transfer is low as the canal is usually dry during dry weather / drought conditions and the RAPID proposal would require water to flow upstream.		
Requirement for other resource option:	The use of this source is likely to appear in YW's solution scenarios and possibly WReN solutions. An alternative source could be identified but further understanding of the risks is required.		
WReN / WRMP 2024 status	Constrained out - not technically viable		

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 to provide between 25 – 50 Ml/d average and 34 – 68 Ml/d maximum.
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 are being investigated. 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:	The loss of the transfer would increase the Grid SWZ deficit. A number of scenarios will be considered, and options identified. Timescales will be a key constraint depending on when the import might reduce/cease and which options are needed to replace the loss of supply.		
Requirement for other resource option:	This option is only viable by providing an alternative supply to South Yorkshire. WReN is investigating various combinations of options. The timing of when any new assets or infrastructure are needed could be a constraining factor.		
WReN / WRMP 2024 status	***Note*: *This is an option for WRW, but for WReN it will be a SDB scenario with options to replace loss of supply***. Further details are provided below.		

Kielder Water Resource Zone Exports

Kielder reservoir is the largest man-made reservoir in the United Kingdom with a capacity of 200,000Ml (or 200 billion litres). The reservoir was constructed (1975-1981) in response to forecast industrial demand and is used to release compensation discharges into the River North Tyne to support Northumbrian Water abstraction further downstream. It also supports an abstraction at Riding Mill Pumping Station which allows water to be transferred via the Tyne-Tees Transfer into the Rivers Wear and Tees. Kielder reservoir is currently considered to be an under-utilised resource as the full forecast industrial demand in the north east region never materialised and subsequently, industrial demand has also declined over the previous two decades.

Consequently, WReN, WRW and the National Framework have considered exports from the Kielder Water Resource Zone including:

i. Kielder Reservoir (via new abstraction intake and licence) to United Utilities
ii. Cow Green Reservoir (via new abstraction intake and licence) to United Utilities; and
iii. River Tees (as support by Kielder reservoir and the Tyne Tees Transfer) to Yorkshire Water.

<u>Kielder WRZ exports to UU</u>

UU has considered i) above as part of the North West Transfer (NWT) Strategic Resource Option (SRO) which could be an alternative to sources in the North West to support the Severn to Thames Transfer (STT). The Kielder export would transfer ~100Ml/d of raw water into an aqueduct in the Lake District area

for onward treatment and distribution into UU's regional supply system. It would require a new Kielder Water abstraction intake and abstraction licence and ~100km of raw water mains with associated pumping stations.

The Kielder transfer option could offer a reliable source of water into the UU strategic resource zone that would provide resilience benefits to UU customers, through a reduced reliance on Lake District water and facilitate the onward transfer of water to companies in the South of England. However, at present, the relatively high capital costs for the Kielder option make it appear less favourable than other options being considered in the North West and so far, it has not been chosen as part of the regional reconciliation process. Nevertheless, as part of the RAPID SRO gated process, UU has recently submitted its Gate 1 reports and Kielder remains one of 27 potential options carried forward for more detailed assessment for Gate 2. Should the water resources planning process reveal a requirement for continued high transfer volumes in the long term, then the option might become more preferable, especially if other sources are discounted through Gate 2 feasibility.

Some stakeholders were concerned that abstraction charges, and specifically the Kielder Supported Factor (KSF), might have made the Kielder export option's Average Incremental Costs (AIC) more expensive than other options and the reason why the Kielder export options have not been chosen so far. However, this is not the case.

Assessment work for the Kielder export option has been based on the assumption that there is ample water available for transfer now and in the future. However, NWL's latest baseline deployable output modelling and forecasts have shown that Kielder reservoir storage could be drawn down to ~40% when planning for 1 in 500-year drought resilience and the latest climate change projections – an additional 100Ml/d export to UU could draw down Kielder reservoir storage further still.

A further uncertainty is industrial water demand on Teesside from known potential developments. NWL has included the latest forecasts from proposed energy, carbon capture and hydrogen production plants in its baseline demand forecasts although in some cases, these are the developer's early estimates and so are subject to change. Additionally, NWL is proposing to reserve a quantity of raw water for Teesside Industrial raw water demand noting that while it is currently ~90Ml/d, in the early 2000s it was ~215Ml/d. NWL will be undertaking further modelling in Q1 2022 to confirm what quantities of water are available for export while UU will firm up on utilisation.

The Kielder export option could be further developed by UU and NWL with a collaborative programme potentially comprising the following activities:

- Combined water resources modelling to assess source availability further:
- Explore wider benefits including (a) resilience benefits to UU (b) mitigation of environmental or other risks (c) potential to support larger exports and (d) potential benefits to North East through Kielder cost sharing:
- Initial stakeholder management and development of detailed stakeholder plan including research with both NWL and UU customers; and
- Development of operating strategy.

However, significant funding would be required to this work. Additionally, it could not be completed in time for the Gate 2 date of October 2022 and therefore an extended delivery programme would be required. UU, NW, the EA and RAPID will be meeting again in January 2022 to agree a way forward.

<u>River Tees (as supported by Kielder reservoir and the Tyne Tees Transfer) Export to Yorkshire Water.</u>

Like the UU export options, the River Tees export to Yorkshire Water has so far not been chosen through the regional reconciliation process. If it was selected in the future, it would be subject to the same

uncertainties as the potential transfer to UU. In some of the Yorkshire Grid stress test scenarios an import from NWL to Yorkshire Water is selected. However, this is either as a low volume (15Ml/d) and / or in sufficient time for further feasibility assessments to be carried out, including consideration of utilisation.

Option to cease or reduce existing Derwent Valley transfer

We have investigated options to replace the existing STW to Yorkshire Water raw water transfer from the Derwent Valley reservoirs. 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. WRW's feasible options include an option to reduce/stop the transfer. The SRO to raise the Derwent Valley reservoirs could enable the transfer to be retained in the future. However, we must ensure we have explored options to prepare for a reduction or cessation of the transfer, and not assume that raising the reservoirs will be the final solution. We have investigated alternative supply options for either a full or partial loss of the transfer. This was part of the Phase 2 investigations noted above and built on 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*. Should the SRO be accepted by RAPID into the gated process, further detailed work on this in-region 'backfill' option would be carried out.

In line with the options identification process outlined in **Figure A5.1** we identified an unconstrained list of options and assessed them against the screening criteria listed in **Table A5.1** to determine a feasible list of options. The unconstrained list is shown in **Table A5.2.**

Table A5.2 Unconstrained list of alternative options to the STW transfer

Option Ref.	Option name	Outcome
DV1 & DV2a	Increase / expand South Yorkshire reservoir existing supply	**Low benefit (below 5Ml/d de-minimis)**
DV2b	Additional storage at or near South Yorkshire WTW	**Low benefit (below 5Ml/d de-minimis)**
DV3	Magnesium Limestone (Sheffield) new GW supply	Feasible but limited resource available (5Ml/d)
DV4	Barnsley BH	**Low benefit (below 5Ml/d de-minimis)**
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
DV7a	NWL import from R Tees transfer via grid	Feasible provided pre-treatment installed at source to address INNS risk
DV8*	Grid to South Yorkshire - improve connectivity by construction of a new main that would need to be implemented in conjunction with other options that provide a source of supply either directly or by displacing existing sources to feed the transfer.	Feasible but is an option to enable internal transfers and would require investment in a new source of supply also
DV9a & DV9b	Doncaster supply to South Yorkshire – treated or raw	**Source of supply is under WINEP investigation**

Option Ref.	Option name	Outcome
DV9c	Doncaster supply to STW	**Source of supply is under WINEP investigation**
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**
DV11a	Increase grid supplies to South Yorkshire - treated	Feasible if implemented in conjunction with DV8
DV11b	Increase grid supplies to South Yorkshire - raw	**INNS risk**
DV11c/d	Increase grid supplies to South Yorkshire – raw river/canal/pipeline	**INNS risk**
DV12	Sheffield WTW new local sources	**Low benefit (below 5Ml/d de-minimis)**
DV12a	River Trent	Initial investigations have not identified a feasible option but further work required
DV12b	River Don	Water only available at low reliability
DV13	River Aire and Calder	Scheme under development but not complete in time for this report

* Options to feed the new main include Yorkshire Grid resource zone WRMP level options

We identified a total of 18 unconstrained options, although it should be noted that some presented alternative uses of the same source and are mutually exclusive. A number of the options investigated could provide an alternative raw water source to the water treatment works that treats the Derwent Valley import. However, to address INNS risks if the alternative raw water source is within a different catchment to the receiving works pre-treatment is required before transferring. There were no feasible options identified in the same catchment as the works that treats the import.

WReN resource zone supply options

Of the five WReN zones the Yorkshire Grid zone is the only zone to include supply-side options in the regional plan. 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. The Kielder zone borders Yorkshire Water and United Utilities, and has the benefit of surplus resources and the Kielder operating agreement. Historically, the Kielder zone supply-demand balance has not forecast a deficit and WRMP level supply-side options therefore have not been developed. The storage in Kielder Water and the existing infrastructure theoretically creates opportunities for transfers out of the Northumbrian Water supply area, although the availability of significant surplus from Kielder is now in doubt given the impact of new supply data as referenced elsewhere. However, notwithstanding that doubt, the Kielder zone supply-side options are currently included as transfer options to export to United Utilities (included in the reconciliation transfers) or Yorkshire Water (included in the Yorkshire Grid options).

The Yorkshire Grid WRMP level options identified as feasible options in the WReN Regional Plan are those that have the potential to facilitate or support a regional transfer or a change to the STW import to Yorkshire Water. These options are listed in **Table A5.3** and will be included in the Yorkshire Water WRMP24 list of feasible options. The options are a combination of those included in WRMP19, new options that have been identified for WRMP24, or existing options that have been adapted to meet specific requirements (e.g., INNS risks) or to enable the regional transfers. The full list of WRMP24 options is still being developed and further options will be investigated and scoped if determined as feasible. The WRMP options were subject to the same high-level screening process as the regional transfer options (**Table A5.1**) to determine feasibility. Further screening of the feasible WRMP options was undertaken to constrain out any options with no potential to support the regional decision making. This screening was based on the following:

- A de-minimis benefit of 5Ml/d was applied as any options below this volume would provide insufficient benefit to enable or support regional transfers. There was one exception to this which is an option to transfer existing licence capacity further upstream. The annual average benefit for this option is below the de-minimis but would be above during certain times of the year and the option was considered strategically significant.
- Location – some areas of the WReN region are a significant distance from regional boundaries and any options in these zones to meet local deficits would not be feasible regional transfer options. This includes the Berwick, Hartlepool, and Yorkshire East zones. Parts of the Yorkshire Grid zone are also too remote to support a regional transfer directly. However, options may be able to provide a benefit through displacement.

Table A5.3 Feasible WReN options in the Yorkshire Grid zone

Option reference	Option Name	Benefit
R1a	R. Ouse WTW extension	22.0
R2	River Ouse raw water transfer	60.0
R3	Increase River Ouse pumping capacity.	10.0
R3a	Acomb Landing to Moor Monkton licence transfer	0.3
R5	Aquifer Storage and Recovery Scheme 1	6.6
R6	Doncaster Wellfield link to Grid	12.0
R8b	Sherwood Sandstone and Magnesian Limestone Boreholes Option 2	5.0
R8c	Sherwood Sandstone and Magnesian Limestone Boreholes Option 3	5.0
R12	East Yorkshire Groundwater Option 1	8.0
R13	East Yorkshire Groundwater Option 2	6.0
R29	Reservoir De-silting	11.0
R34	River Calder Abstraction option 1	9.3
R35	River Aire Abstraction option 1	9.3
R37b	River Aire Abstraction option 4	TBC
R51	Supply Dales from the Tees - treated	15.0
R61	East Yorkshire coast desalination	20.0
DV6(iv)	Tees to South Yorkshire - NWL import 50Ml/d	50.0
DV6(v)	Tees to South Yorkshire - NWL import 80Ml/d	80.0
DV6(vi)	Tees to South Yorkshire - NWL import 140Ml/d	140.0
DV7a(iv)	Tees to York - NWL import 50 Ml/d	50.0
DV7a(v)	Tees to York - NWL import 80 Ml/d	80.0
DV7a(vi)	Tees to York - NWL import 140 Ml/d	140.0
DV8(iv)	York WTW to South Yorkshire treated water transfer	15+ (with supporting options)
DV8(v)	Increase York WTW capacity (a variation to R2)	50.0
DV3	DV3 Magnesium Limestone	5.0

WReN inter-company transfer options

In addition to the regional transfer options WReN has considered transfer options between the water companies within the region as part of the supply options. This section provides further specific information on this type of supply option; the feasible transfer options are shown in **Table A5.** 4 below.

Those that rely on an import from NWL are subject to the same uncertainty as the regional transfer options, as described above. The options that are above the regional de-minimis of 5Ml/d and located in a regional strategic location are included as supporting options to the regional transfers.

Table A5. 4 WReN intra-water company transfer options

Ref.	Exporter WC	Importer WC	Scheme Name	Volume Ml/d	Brief Scheme Description	Feasibility status	Regional plan option
R49	NWL	YW	Tees to Dales - raw import from NWL	TBC	Import 15Ml/d of raw water to the Yorkshire Dales from NWL's existing abstraction point on the River Tees. This is an alternative to the treated water R51 scheme.	Constrained out – INNS risk of transferring raw water between catchments	No - infeasible
R51	NWL	YW	Tees to Dales - treated import	TBC (estimated 15)	Import 15Ml/d of treated water to the Yorkshire Dales from NWL's existing WTW on the River Tees. This is an alternative to the raw water resource R49 scheme.	Feasible	Yes
R53	NWL	YW	Tees to Swale River Transfer - NWL import	TBC - Up to 140	Import up to 140Ml/d of raw water from NWL's existing abstraction point on the River Tees to York WTW via river courses. This scheme is an alternative to D6 and DV7.	Constrained out – INNS risk of transferring raw water between catchments	No - infeasible
DV6	NWL	YW	Tees to South Yorkshire - NWL import	TBC - Up to 140	Import up to 140Ml/d from NWL's existing abstraction point on the River Tees via a direct pipeline to a South Yorkshire WTW. Scheme has 3 alternatives DV6(iv) (50Ml/d), DV6(v) (80Ml/d) and DV6(vi) (140Ml/d).	Feasible – mutually exclusive with DV7a	Yes – same option as WReNE3 but would be used in WReN area only
DV7a	NWL	YW	Tees to York Pipeline - NWL import	TBC - Up to 140	Import up to 140Ml/d of raw water from NWL's existing abstraction point on the River Tees to York WTW via a new pipeline. Scheme has 3 alternatives DV7a(iv) (50Ml/d), DV7a(v) (80Ml/d) and DV7a(vi) (140Ml/d).	Feasible – mutually exclusive with DV6	Yes
R57	UU	YW	Transfer from United Utilities 1	2.3	Raw water transfer from a UU reservoir to YW reservoir in the West Yorkshire area	Feasible but uncertainty over availability in	No – below de-minimis

Ref.	Exporter WC	Importer WC	Scheme Name	Volume Ml/d	Brief Scheme Description	Feasibility status	Regional plan option
						drought scenarios	
R58	UU	YW	Transfer from United Utilities 3	1	Treated water transfer from UU network into YW's network in the Calderdale area	Feasible but uncertainty over availability in drought scenarios	No – below de-minimis
R59	UU	YW	Transfer from United Utilities 4	1	Treated water transfer from UU into YW's network on the Lancashire/North Yorkshire boundary	Feasible but uncertainty over availability in drought scenarios	No – below de-minimis
WReNE5	NWL	HW	NWL Service Reservoir to Hartlepool Water	5 average / 10 peak	Treated water transfer from NWL's WTW on the River Tees to HW	Feasible but uncertainty over availability in drought scenarios	No – uses same resource as DV6 and DV7 (WReNE3)

Appendix 5.2 Option Appraisal

The WReN optimisation model has been run for the Yorkshire Grid zone dry year annual average scenarios that resulted in a risk of a deficit. A summary of all the scenarios is presented in **Table A5.5**. The optimiser provides a least cost solution (EBSD) for the scenarios in deficit. If the initial solutions include options that have high uncertainty (e.g., under WINEP investigation) or create additional risks (e.g., resilience concerns) the optimiser is rerun with these options constrained out to identify an alternative option selection that can be considered more favourable (no regrets). This provides a range of solution programmes and the options that are selected most frequently can then be considered in more detail, and potentially included in a portfolio programme that can be presented as the best value plan.

Table A5.5 Yorkshire Grid zone baseline and stress testing scenario summary

Scenario ref.	Description	Baseline surplus / deficit Ml/d			
		2025	2030	2050	2085
Reconciliation baseline	*Reconciliation baseline SDB – incorporates demand reduction policy requirements (leakage reduction linear profile); 1:500 DO; RCP 6.0 climate change DO impacts; WReN view of BAU environmental destination*	*-1.20*	*26.69*	*106.06*	*6.09*
Regional plan (RP) reference scenario[3]	2025-2039 = 1 in 200 level of service >2039 = 1 in 500 level of service Environmental destination BAU 2030 - 2050 (linear profile, unadjusted WRNF impacts) 50% leakage by 2050 (linear profile) 110 l/p/d by 2050 Climate change RCP6.0	55.81	83.41	75.56	-26.01
Scenario 1a (National RP stress test adverse scenario)[3]	As reconciliation baseline, but with: Half of policy leakage and PCC aspirations achieved by 2050 (delivery uncertainty) Climate change RCP8.5	-41.39	-30.70	-17.92	-169.82
Scenario 1b (National RP stress test adverse scenario – 1:200 LoS applied)	Half of policy leakage and PCC aspirations achieved by 2050 (delivery uncertainty) Climate change RCP8.5 1:200 deployable output to 2039	-4.65**	2.33	-17.92	-169.82
Scenario 2	Reconciliation baseline SDB + high demand growth	-16.75	3.44	62.02	-40.72
Scenario 3	Reconciliation baseline SDB + enhanced environmental destination	-1.20	26.69	-103.94	-203.91
Scenario 4	Reconciliation baseline SDB + High climate change	-39.26**	-17.89*	35.45	-116.45
Scenario 5	Reconciliation baseline SDB + cease Derwent valley transfer	0.00	0.00	-39.77	-39.77
Scenario 6	Reconciliation baseline SDB + half Derwent valley transfer	0.00	0.00	-20.90	-20.90

[3] These scenarios were applied by all regions nationally as part of the reconciliation process.

Scenario ref.	Description	Baseline surplus / deficit Ml/d			
		2025	2030	2050	2085
Scenario 7	Reconciliation baseline SDB + Low demand growth	14.35	49.94	150.09	52.89
Scenario 8	Reconciliation baseline SDB with a 1:200 level of service	55.81	83.41	106.06	55.81
Scenario 9	Initial baseline SDB (no policy demand reductions incorporated)	-23.70	-17.07**	-18.44	-23.70

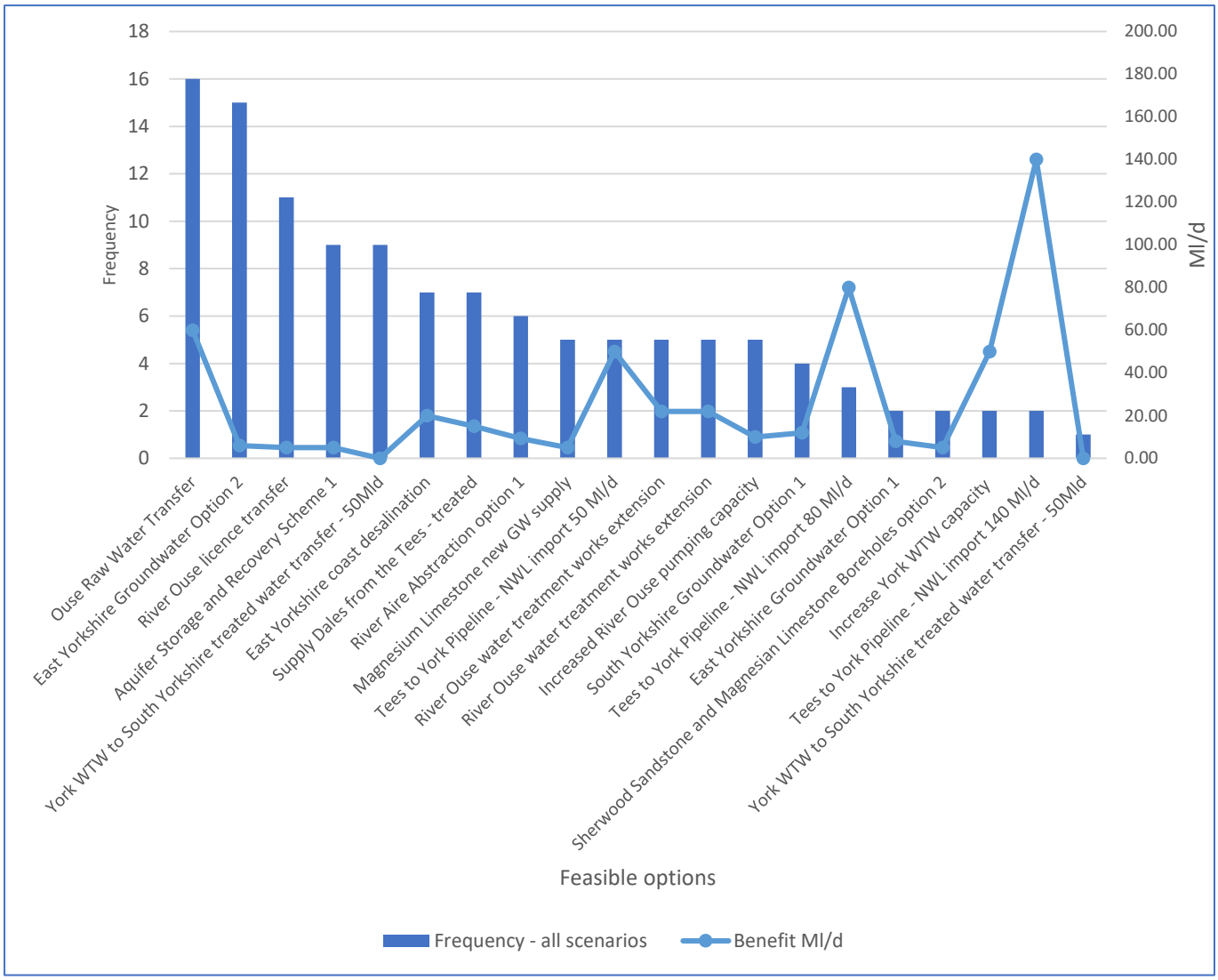
*** Scenario 4 is the same as Scenario 1a, but assumes the full leakage policy reduction is achieved. This deficit would therefore be met by planning to a 1:200 level of service.**
****Scenario 1b shows that the high climate change risk is still present in the 1:200 scenario in the early part of the planning period, but closed by 2030 even if only half the leakage reduction is achieved.**
***** This deficit is met in the reconciliation baseline scenario through incorporating the leakage policy requirements (Baseline). The uncertainty of achieving the leakage reduction can be addressed in the early part of the planning period by a 1:200 level of service until 2039.**

The reconciliation baseline scenario incorporates the benefit of achieving the leakage policy reduction in line with the regional reconciliation process (the PCC policy requirement is achieved in the baseline[4]). The scenarios have been created to stress test against this baseline position and, unless stated otherwise, include the leakage policy reduction benefit as presented in the reconciliation baseline supply-demand balance. For the purposes of the regional plan stress testing the scenarios have been optimised with only supply options included. This provides additional information on the frequency of individual option selection as part of the stress testing. It does not represent any decision criteria to exclude demand reduction options when the final planning solution will be presented in the draft WReN Regional Plan and Yorkshire Water's WRMP24 due to be published later this year.

The outputs of the stress test optimisation runs have been accumulated to assess which options appear most frequently in the runs. The frequencies are shown in **Figure A5.3**. This information can be used to develop portfolio programmes that could be put forward in place of scenario solution programmes or to assess if an option is beneficial to multiple scenarios and support a 'no regrets' approach.

[4] This is an initial baseline position which could change for the formal daft WReN regional plan to be submitted in 2022.

Figure A5.3 Option selection frequency from all optimisation runs



Metric scores

Metric scores have been calculated for the solution programmes produced for the following WReN scenarios:

- Reconciliation baseline: incorporates demand reduction policy requirements to halve leakage compared to 2017 actual leakage by 2050 (a leakage reduction linear profile has been assumed)
- Scenario 3: Enhanced environmental destination
- Scenario 5: Cease the Derwent valley transfer and achieve the demand reduction policy requirements
- Scenario 6: Half the Derwent valley transfer and achieve the demand reduction policy requirements
- Scenario 9: Initial baseline supply-demand balance (SDB), no policy demand reductions incorporated (supply options only), to articulate the benefits of demand reductions included in our plan baseline

Scenarios 3, 5 and 6 present alternative pathways to the reconciliation baseline. Both scenario 4 and 5 are dependent on the uncertainty of the existing transfer from WRW and will influence the final plan. Scenario 3 provides a comparison to the reconciliation baseline, but fails the leakage strategic option therefore it would not be taken forward. Scenario 9 is for stress testing only and represents the enhanced environmental destination. It has been included as, of all the WReN scenarios, it is this one that presents the highest potential deficit in the Yorkshire Grid zone.

The main document (Section 8) compares the scenarios to the reconciliation baseline using a scale based on positive, negative and equal signs to represent the impact each scenario has on the metric scores (beneficial and detrimental impacts respectively). This has been developed for ease of communication of the relative change of scenarios to the less technical stakeholder.

Table A5.6 provides a key to the signs used in numeric terms relative to the underpinning normalised scores. The 0-100 normalised score has been used to compare metric values as the metrics represent impacts that are measured using a variety of units which are not comparable (an approach used by the regions in reconciliation). For all metrics the range is from 0, which is least optimal, to 100, which is most optimal. By converting to the normalised score then using the '+, -, =' scoring scale presented in **Table A5.6** we aim to provide a simple comparison between scenarios. In Figure A5.4 and A5.5 the normalised scores have been presented.

Table A5.6 Metric scoring comparison (normalised score to relative change scale)

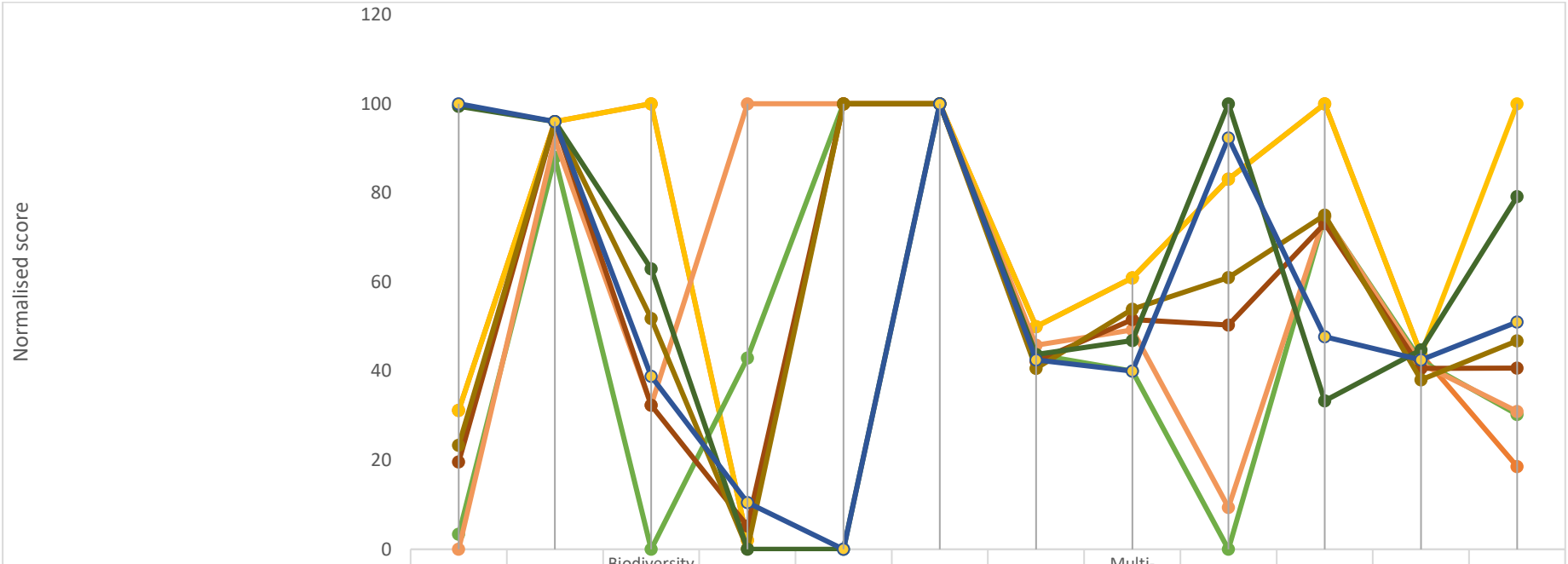
Difference to regional baseline metric normalised score	Scoring scale
76 to 100	++++
51 to 75	+++
26 to 50	++
1 to 25	+
0	=
-1 to -25	-
-26 to -50	--
-51 to -75	---
-76 to -100	----

Figure A5.4 presents the normalised scores of optimised solutions to a number of the stress testing scenarios listed in **Table A5.5.** The actual metric scores for the scenarios presented in **Figure A5.4** are provided in **Table A5.7**. The reconciliation baseline represents the regional plan which includes the leakage activity to achieve the leakage policy requirements. With the exception of scenario 9 (least cost supply only), all other scenarios assume the leakage policy requirement is met. As the PCC policy requirement is achieved in the Yorkshire Grid baseline demand forecast, all scenarios score the maximum value for this metric.

The 'retain import as existing' scenario assumes the import could continue with no additional investment. This was the WReN position in round 1 of the reconciliation process, however, the WRW reconciliation output raised a risk the transfer could not be retained without investment in an SRO, which has now entered the RAPID gated process. Therefore, in the formal draft this scenario may include the SRO metric values.

Figure A5.4 shows which metrics score relatively evenly across all scenarios and which show a range of scores. It is the metrics with the range of scores where trade-offs will be required (e.g., carbon, biodiversity and natural capital). Although it should be noted that mitigation, such as carbon offsetting, would also impact on the final solution and a biodiversity net gain strategy is likely to be required in accordance with legislation under the Environment Bill. Cost and option deliverability also demonstrate a range. The highest performing scenarios on cost are the least cost scenario solutions programmes, but these would fail the leakage strategic objective. It should also be noted that the option deliverability for all sensitivity scenarios, except the least cost, is skewed as they are assuming the leakage reduction in the reconciliation baseline will be achieved.

Figure A5.4 Metric normalisation comparison for solution programmes



	Cost of the plan £M NPV	PWS Drought resilience	Biodiversity (supply options only)	Natural Capital £ NPV	Leakage reduction Ml/d	PCC reduction l/h/d	Flood risk management	Multi-abstractor benefit (SEA)	Carbon 000s tCO2	Customer preferred option type	Human and social well-being	Option Deliverability
Reconciliation baseline	31	96	100	2	100	100	50	61	83	100	44	19
Retain import as existing	31	96	100	2	100	100	50	61	83	100	44	100
Scenario 3 (enhanced ED)	3	88	0	43	100	100	44	40	0	75	42	30
Scenario 3 (enhanced ED 60 years)	0	92	32	100	100	100	46	49	9	75	42	31
Scenario 5 (stop transfer)	20	96	32	5	100	100	42	52	50	73	41	41
Scenario 6 (half transfer)	23	96	52	0	100	100	41	54	61	75	38	47
Scenario 9 Least cost (supply only)	99	96	63	0	0	100	44	47	100	33	45	79
Scenario 9 Least cost (supply only) 60 years	100	96	39	10	0	100	43	40	92	48	43	51

NB. All scenarios run to meet a 25-year deficit except where noted.

Table A5.7 Actual metric scores comparison

	Cost of the plan £M NVP	PWS Drought resilience	Biodiversity (supply option only)	Natural Capital £ NPV	Leakage reduction Ml/d	PCC reduction l/h/d	Flood risk management	Multi- abstractor bene-fit (SEA)	Carbon 000stCO2	Customer preferred option type	Human and social well-being	Option Deliverability
Reconciliation baseline	1627	24	0	0	122	110	0	1	1276	3	-1	2
Retain import as existing	1627	24	0	0	122	110	0	1	1276	3	-1	5
Scenario 3 (enhanced ED)	2236	22	-1688	-51330454	122	110	-1	-1	3693	2	-1	2
Scenario 3 (enhanced ED) 60 years	2310	23	-1143	-122914647	122	110	0	0	3419	2	-1	2
Scenario 5 (stop transfer)	1880	24	-1143	-3960030	122	110	-1	0	2228	2	-1	3
Scenario 6 (half transfer)	1799	24	-814	2426518	122	110	-1	0	1919	3	-1	3
Scenario 9 Least cost (supply only)	132	24	-626	2581850	0	110	-1	0	784	2	0	4
Scenario 9 Least cost (supply only) 60 years	119	24	-1032	-10577809	0	110	-1	-1	1007	2	-1	3

NB. All scenarios run to meet a 25-year deficit except where noted.

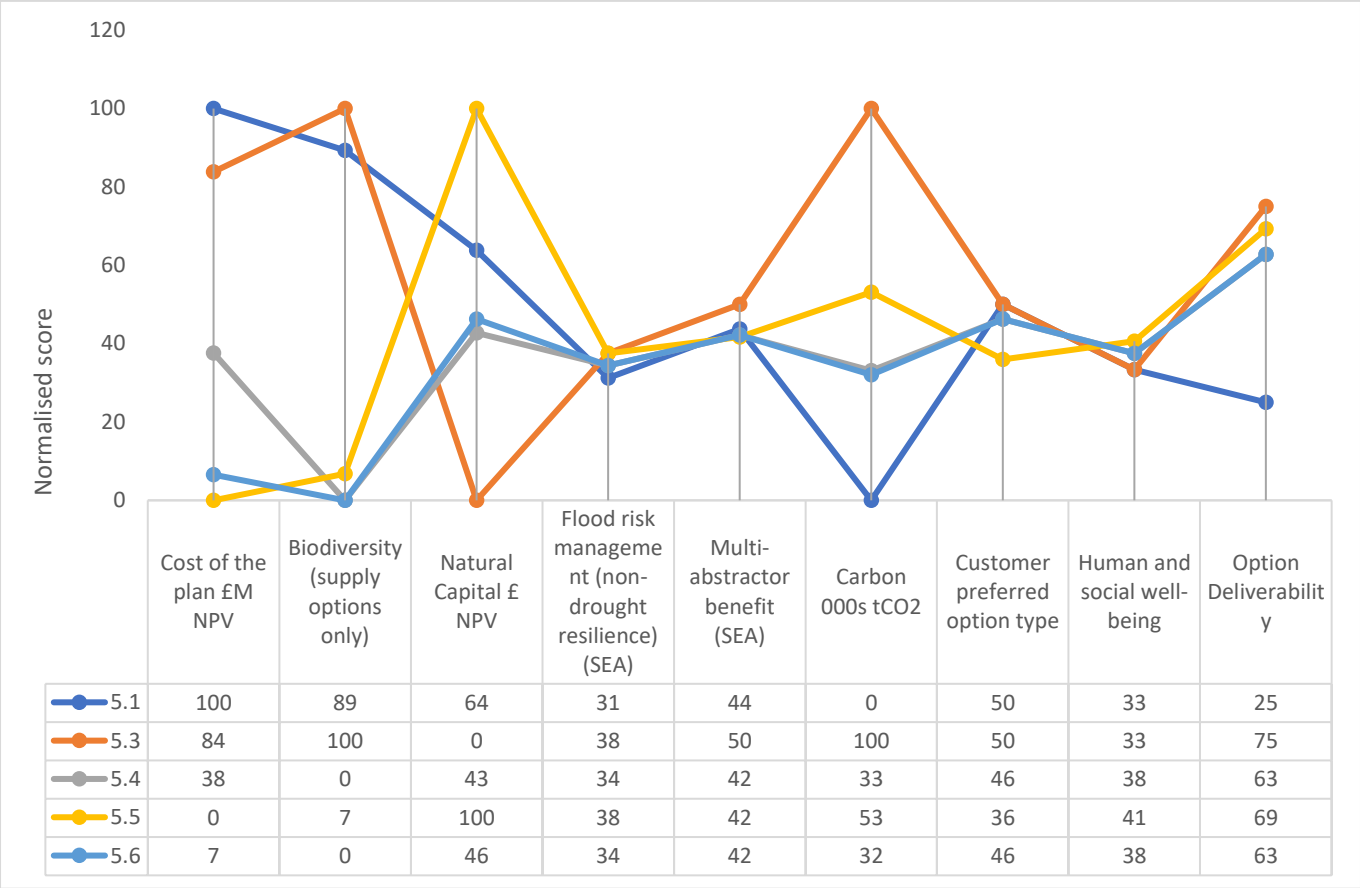
Derwent Valley uncertainty / alternative pathway

Several solution programmes have been produced for Scenarios 5 and 6, which address the risk that the existing Derwent Valley transfer may not be available as currently operated in the future. Although the WRW-WReN SRO to enlarge reservoir storage could enable the transfer to be retained, there is insufficient information at present to assess if the SRO provides a best value solution. We have therefore investigated alternatives to the transfer as discussed above and in the main document; should the SRO be accepted into the gated process then further development of these alternatives would form part of the SRO's programme. The solution programmes for scenarios 5 and 6 are summarised in **Table A5.8**.

The solution programmes used for comparison in **Figure A5.5** all meet the Scenario 5 deficit, which we would need to meet if the Derwent Valley transfer ceased in 2035 (they represent alternative solutions to the same need). These allow us to compare alternative solution programmes and identify where trade-offs would need to be made if the transfer ceased. These have not been used to select a final plan as the future of the transfer is still uncertain and further work on the options is needed. They do show the emerging results, subject to further investigations, to enable stakeholders to comment on the potential solutions should they wish. Further work includes consideration of options still under development for the Yorkshire Water WRMP, simulation modelling of the selected options, further

assessment of the resilience risks within the zone and Yorkshire Water company level sign-off as part of its detailed WRMP assurance process.

Figure A5.5 Normalised metric scores for candidate solutions to a loss or reduction in the Derwent valley transfer



	Cost of the plan £M NPV	Biodiversity (supply options only)	Natural Capital £ NPV	Flood risk management (non-drought resilience) (SEA)	Multi-abstractor benefit (SEA)	Carbon 000s tCO2	Customer preferred option type	Human and social well-being	Option Deliverability
5.1	100	89	64	31	44	0	50	33	25
5.3	84	100	0	38	50	100	50	33	75
5.4	38	0	43	34	42	33	46	38	63
5.5	0	7	100	38	42	53	36	41	69
5.6	7	0	46	34	42	32	46	38	63

NB. Leakage, PCC and LoS metrics not included as score same values for all scenarios

We shall continue to develop solution programmes for addressing the risk to the future of the Derwent Valley and the SRO. Once metric information is available for the SRO it will need to be considered in the metric comparison.

Table A5.8 compares the selected options for solution programmes to meet the scenario 5 (cease transfer) and scenario 6 (half transfer). All scenarios require an additional internal transfer main. The decisions that would need to be made if the transfer could not be retained, is which combination of options would provide best value. Solution programmes 5.1 to 5.3 and 6.1 would increase the output from an existing water treatment works to feed the internal main. However, this would make the Yorkshire Water area over reliant on a single water treatment works and from a resilience perspective these solutions are not best value for customers. Yorkshire Water will consider resilience further in its WRMP24.

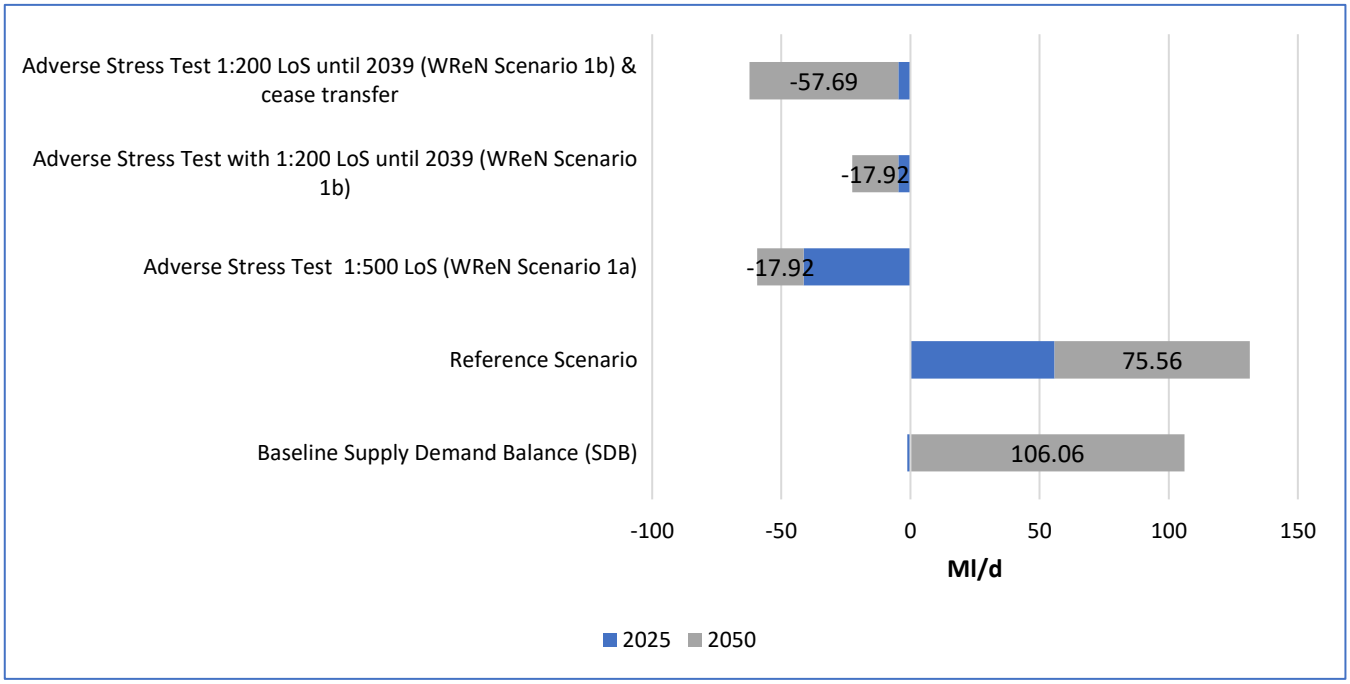
Table A5.8 Initial optimisation outputs for the Derwent Valley scenarios

		Scenario 5: Cease existing Derwent Valley transfer						Scenario 6: Half existing Derwent Valley transfer		
		5.1	**5.2**	**5.3**	**5.4**	**5.5**	**5.6**	**6.1**	**6.2**	**6.3**
Screening		All supply	R2 constrained out	York WTW 1 direct feed options	York WTW 1 demand displacement options			All supply	York WTW 1 demand displacement options	York WTW 1 demand displacement options
Optimisation criteria		Cost	Cost	Cost	Cost	6 Capitals	Carbon	Cost	Cost	Cost
Option Ref	**Solution programme description**									
DV8(iv)	New main from York to South Yorkshire	✓	✓	✓	✓	✓	✓	✓	✓	✓
DV8(v)	New supply and treatment capacity for existing York WTW 1		✓	✓						
R1a	Increased capacity at York WTW 2 to displace demand on York WTW 2				✓	✓	✓	✓	✓	
R13	New groundwater abstraction in East Yorkshire				✓	✓	✓			✓
R2	New supply but no treatment capacity for existing York WTW 1	✓								
R35	New abstraction on the R Aire					✓				✓
R3a	Increased R Ouse pumping capacity					✓				
R5	Aquifer Storage and Recovery Scheme 1					✓				✓
R51	Treated water import from NWL				✓		✓			
	Benefit Ml/d	**60**	**50**	**50**	**43**	**48**	**43**	**22**	**22**	**21**

Regional reconciliation common stress testing scenarios

The WReN stress testing scenarios include scenarios all regions agreed to consider as part of the regional reconciliation process. These are listed in **Table A5.5** as Regional plan (RP) reference scenario, Scenario 1a (RP stress test adverse scenario) and Scenario 1b (RP stress test adverse scenario). **Figure A5.6** illustrates the deficit in the Yorkshire Grid zone for the regional stress test scenarios. We have created additional scenarios to represent the adverse stress test as a 1:200 level of service instead of 1:500 (linked to our strategy to adopt a 1:200 if a deficit occurs before 2040), and to aggregate the 1:200 adverse stress test scenario (Scenario 1b) with the risk that the Derwent Valley transfer could cease (Scenario 5).

Figure A5.6 Regional reconciliation common scenarios



NB: Our baseline August submission included our best estimate of business as usual environmental destination (BAU) at 0 Ml/d. This position remains our view, however, for demonstrating resilience as part of the national stress tests, the BAU value in the reference scenario presents the full Water Resources National Framework loss, to demonstrate how this does not impact our strategic supply-demand position within the core 25-year horizon of the plan.

The regional plan reference stress test does not result in a deficit in the first 25 years of the planning period, but over a 60-year planning period there is a risk of deficit. The regional plan BAU scenario (Scenario 1a) could result in a deficit at the start of the planning period, which increases over the 60-year period. Due to the early deficit, we will plan to a 1:200 level of service in the early years of the planning period but plan to a 1:500 no later than 2039 (Scenario 1b), however, there is still a risk of deficit under this scenario at the start of the planning period and from 2039 onwards. The uncertainty over the future of the Derwent Valley reservoir transfer poses an additional risk to the zone. The aggregated scenario of the 1:200 adverse stress test scenario (Scenario 1b) with the cease Derwent Valley transfer scenario shows the increased risk in the medium and longer term.

Table A5.9 summarises the 25-year deficit position of each of the common regional reconciliation scenarios and our emerging plans. These plans address the risk over the 25-year period, except for the deficit in the early years of the adverse 1:200 scenario shown in **Figure A5.6**. This will be given further consideration by Yorkshire Water as it develops its WRMP24. As the risk is under an extreme climate change scenario and the planned leakage reduction and 1:200 level of service addresses the deficit in the medium term, any additional investment in the early years of the plan to address a short-term extreme scenario risk must be balanced with the impacts of any potential solution and it may not be best value to invest to meet this short-term deficit. An allowance for climate change is also included

in the headroom assessment therefore investment in this scenario could be inappropriate as the risk is being double counted.

Table A5.9 Regional stress test common scenario solution summary

Scenario	Scenario description	2025 baseline surplus/deficit (Ml/d)	2050 baseline surplus/deficit (Ml/d)	Emerging solution summary description	2050 post solution surplus/deficit (Ml/d)
Reconciliation baseline 1:500	Initial SDB with demand reduction policy requirements met: 1:500 LoS 50% leakage by 2050 110 l/p/d by 2050 Climate change RCP6.0	-1	106	Early deficit met through planning to a 1:200 LoS. Uncertainty over Derwent Valley import.	106
RP Reference scenario	2025-2039 = 1 in 200 >2039 = 1 in 500 BAU 2030 - 2050 (linear profile) 50% leakage by 2050 110 l/p/d by 2050 Climate change RCP6.0	56	76	Scenario results in surplus therefore no solution required	76
RP Stress test scenario 1:500	Half of policy leakage and PCC* aspirations achieved by 2050 (delivery uncertainty) Climate change RCP8.5	-41	-18	Early deficit largely met through planning to a 1:200 LoS. To meet the longer-term deficit, invest in new infrastructure and new sources of supply	25
RP Stress test scenario + cease Derwent Valley transfer	As above aggregated with full loss of STW import	-5	-58	As above plan to 1:200 until 2039 + invest in new supplies. These would be in addition a new main from York to South Yorkshire and additional supplies to displace existing sources of supply to the works.	27

* As the Yorkshire Grid zone achieves the PCC policy requirement in the baseline without intervention no adjustment has been made as there is no uncertainty associated with interventions to be considered. Yorkshire Water will consider PCC scenarios for its WRMP24.

How to find out more

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