United Utilities

Environmental and Social Costs of Water Resources Management Plan 2019 Supply-Demand Options

Revised Final Report (Redacted)

August 2018

Amec Foster Wheeler Environment
& Infrastructure UK Limited

Report for

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Doc Ref. R0109ir

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Document revisions

No.	Details	Date
1	Draft Report	17/11/2017
2	Final Draft Report	29/11/2017
3	Final Report	30/11/2017
4	Updated Post Consultation (Redacted)	10/08/2018
5	Final Report (Redacted)	16.08.2018
6	Final Report (Redacted) – security review	30.08.2018

Executive Summary

Purpose of this Report

United Utilities is currently finalising its Water Resources Management 2019 (WRMP19). Once approved, the WRMP will set out the strategy for water resource and demand management to ensure supplies of safe, clean drinking water are maintained to customers throughout the company's region over the period 2020 to 2045 and beyond.

As part of the preparation of WRMP19, United Utilities is required to identify and assess feasible water resources management options that could be implemented to maintain a supply-demand balance across its three water resource zones: Carlisle; Strategic; and North Eden[1]. In order to identify the feasible options for WRMP19, United Utilities first considered an 'unconstrained' list of options. These options were deliberately selected to cover as wide a range of measures as possible and represent all of the ways in which United Utilities could manage supply and demand. These unconstrained options were then subject to 'Primary Screening' in order to identify a list of feasible options, i.e. options that could realistically be implemented in the next 25 years. The options identification process is described further in the Revised Draft Water Resources Management Plan (Revised Draft WRMP) and supporting documentation[2].

Options that progressed to the feasible list were assessed by United Utilities in terms of capital and operating costs. As part of this options appraisal process, Amec Foster Wheeler Environment and Infrastructure UK Ltd (Amec Foster Wheeler, now Wood) was appointed to assess the environmental and social impacts of these options. This assessment was documented in a report[3] prepared in support of the Draft WRMP. A further report[4] presenting the environmental and social costs of potential solutions to address risks associated with the regional aqueduct system that supplies water from the Lake District to the Greater Manchester and Pennine areas including parts of Lancashire and south Cumbria (Manchester and Pennine Resilience) was also prepared.

United Utilities published its Draft WRMP for consultation between 2nd March and 25th May 2018. The Draft WRMP set out United Utilities' Preferred Plan for WRMP19, including preferred resource management and demand management options designed to enhance leakage reduction, improve levels of service for drought permits and orders and support water trading. A Revised Draft WRMP has subsequently been prepared and is being submitted to the Secretary of State for approval.

As part of the development of the Revised Draft WRMP, changes to existing options considered as part of the original environmental and social costs assessment, and new feasible options[5], have been identified by United Utilities. As a result, the assessment of environmental and social costs has been updated to reflect these changes.

This report presents the findings of the assessment. It provides a clear explanation and audit trail of the process and data used to assess the environmental and social costs of the feasible options, and the subsequent outputs. Detailed assessment for each option is presented in the appendices to this report. This report does not describe how the outputs generated were used by United Utilities in determining its Preferred

[1] United Utilities' region is currently split into three water resource zones: the Strategic Water Resource Zone covering the major conurbations; North Eden; and Carlisle.
[2] United Utilities (2018) *Revised Draft Water Resources Management Plan 2019 Technical Report – Options identification*.
[3] Amec Foster Wheeler (2017) *Environmental and Social Costs of Water Resources Management Plan 2019 Options Final Report* .
[4] Amec Foster Wheeler (2018) *Environmental and Social Costs of Manchester and Pennines Resilience Solutions Supplementary Information to the Environmental and Social Costs of Water Resources Management Plan 2019 Options*.
[5] Rather than completely new options as such, these are essentially variants of existing options resulting from further work on leakage enhancements and innovations for the revised draft plan, which resulted in further detailed review.

Plan for WRMP19 and selection of composite preferred options. This information is set out in the Revised Draft WRMP and supporting documentation[2,6].

It should be noted that, as there have not been any changes to the Manchester and Pennine Resilience options and solutions, the environmental and social costs assessment in this regard has not been revised and does not feature in this report.

[6] United Utilities (2018) *Revised Draft Water Resources Management Plan 2019 Technical Report – Options appraisal*.

Contents

1. Introduction

1.1 Overview

United Utilities is currently finalising its Water Resources Management Plan 2019 (WRMP19). Once approved, the WRMP will set out the strategy for water resource and demand management to ensure supplies of safe, clean drinking water are maintained to customers throughout the company's region over the period 2020 to 2045 and beyond.

United Utilities has assessed the supply-demand balance in each of its three water resource zones: Carlisle, Strategic and North Eden. United Utilities must address any supply-demand deficits identified over the 25-year period of the WRMP by managing demand for water, improving efficiency and reducing losses from its distribution network, and/or providing new resources where necessary.

A process for assessing and deciding on future options to secure and safeguard public water supplies is presented in Section 6 of the latest Water Resources Planning Guideline (WRPG)[7]. The guidelines include a list of factors and types of options (i.e. resilience options, third party options, options arising from upstream competition) that companies are expected to consider when preparing their long-term WRMPs. The guidelines also recommend that companies compile an 'unconstrained list' of all possible options that could reasonably contribute to a supply-demand balance, and then identify a subset of 'feasible options' for further scrutiny and assessment. United Utilities has completed this process using a two-step 'Primary' and 'Secondary' screening approach which is documented in the Revised Draft WRMP and supporting technical documents[8].

All of the feasible options were assessed in terms of their capital, operating, and social and environmental costs over the long term. United Utilities has assessed these costs over an anticipated 105-year lifetime in order to ensure that both the short and longer term implications of all options are understood and assessed fairly and consistently. As part of this options appraisal process, Amec Foster Wheeler Environment and Infrastructure UK Ltd (Amec Foster Wheeler, now Wood) was appointed to assess the environmental and social costs of the feasible options. This assessment was documented in a report[9] prepared in support of the Draft WRMP. A further report[10] presenting the environmental and social costs of potential solutions to address the risk associated with the regional aqueduct system that supplies water from the Lake District to the Greater Manchester and Pennine areas including parts of Lancashire and south Cumbria (Manchester and Pennine Resilience) was also prepared.

United Utilities published its Draft WRMP for consultation between 2nd March and 25th May 2018. The Draft WRMP set out United Utilities' Preferred Plan for WRMP19, including preferred resource management and demand management options designed to enhance leakage reduction, improve levels of service for drought permits and orders and support water trading. These were based on a number of strategic choices for consultation on the plan.

Subsequently, a Revised Draft WRMP has been prepared and is being submitted to the Secretary of State for approval. This includes further increases to the leakage reductions contained within the plan. However, potential importing companies have not selected imports from the North West in their preferred plans within the core 25-year period of the planning horizon (which defines the 'needs' in the United Utilities plan, albeit

[7] Environment Agency (2018) *Water Resources Planning Guideline*. July 2018. Environment Agency. Bristol.
[8] United Utilities (2018) *Revised Draft Water Resources Management Plan 2019 Technical Report – Options identification.*
[9] Amec Foster Wheeler (2017) *Environmental and Social Costs of Water Resources Management Plan 2019 Options Final Report* .
[10] Amec Foster Wheeler (2018) *Environmental and Social Costs of Manchester and Pennines Resilience Solutions Supplementary Information to the Environmental and Social Costs of Water Resources Management Plan 2019 Options*.

the plans are tested out to the 2080s). Therefore, to align the plan with others, water trading no longer forms part of United Utilities' Preferred Plan, even though it remains the company's preference to continue to work with others on water trading beyond WRMP19 towards the WRMP24 planning round. The strategy to facilitate a potential future trade has therefore been retained within an adaptive pathway, which could form a future preferred plan if water trading was subsequently required in future.

As part of the development of the Revised Draft WRMP, changes to existing options considered as part of the original environmental and social costs assessment, and new feasible options[11], have been identified by United Utilities. As a result, the assessment of environmental and social costs has been updated to reflect these changes.

1.2 Purpose of this Report

This report presents the revised environmental and social costs of United Utilities' updated feasible list of water resources options, cataloguing the key assumptions made to derive the costs for each option. Carbon is a key element that is included but distinguished as cost component in its own right. The carbon cost was calculated for all the feasible options in terms of construction and operational carbon, and within those two categories has been disaggregated into traded and non-traded carbon. This was to enable appropriate monetisation of the carbon costs.

Environmental and social costs were also assessed in terms of the impacts during construction and operation on the following:

- informal recreation activities (e.g. walking, cycling and bird watching);
- recreational angling;
- in-stream recreational activities such as boating, canoeing or rowing;
- other water abstractors;
- heritage, archaeology and landscape;
- biodiversity and non-use values;
- noise, dust and odour associated with construction and operation;
- inconvenience (e.g. congestion caused by option related vehicles, excavations to lay pipelines delaying people's journeys, water supply interruptions caused by the option etc.).

The appendices to this report set out the details, per feasible option, of the components that were identified as significant and the impact assessments made.

1.3 United Utilities' Revised Draft Water Resources Management Plan 2019

Draft Water Resources Management Plan 2019

In developing the Draft WRMP, United Utilities forecast the future demand for water and available supply (the supply-demand balance) for the 25 year period to 2045. The baseline demand forecast was calculated using the latest data, tools and methods including the current population and local authority growth forecasts, and accounted for the potential impacts of climate change. Taking into account this baseline demand

[11] Rather than completely new options as such, these are essentially variants of existing options resulting from further work on leakage enhancements and innovations for the revised draft plan, which resulted in further detailed review.

forecast, alongside water availability, dry weather demand and target headroom, United Utilities determined that there would be a surplus in all three of the company's water resource zones (WRZs) in a dry year over the planning horizon of WRMP19 (the Strategic Zone, North Eden Zone, and Carlisle Zone).

Whilst there was forecast to be enough water to meet demand over the period of WRMP19, following the Water Resources Planning Guidelines[12], consideration was given to using the forecast surplus, with possible new source or demand management investment, to explore strategic choices for the WRMP.

United Utilities' Preferred Plan for WRMP19 set out in the Draft WRMP incorporated four strategic choices, as follows:

- Enhance leakage reduction by a total of 80 megalitres per day (Ml/d) over the planning period;
- Improve levels of service for drought permits and orders from 1 in 20 years to 1 in 40 years (moving from 5% to 2.5% annual risk);
- Increase resilience, through the Manchester and Pennine Resilience solution; and
- Commitment to continue to explore national water trading.

The Draft WRMP Preferred Plan comprised a combination of resource management and demand management options designed to achieve these four strategic choices and maintain and enhance the supply-demand balance. To identify these measures, United Utilities first considered an unconstrained list of options. These options were deliberately selected to cover as wide a range of option types as possible and represented all of the ways in which United Utilities could manage supply and demand. These unconstrained options were subject to preliminary (Primary) screening to identify a list of feasible options, i.e. options that could realistically be implemented in the next 25 years. The feasible options were then assessed in terms of their financial, environmental and social costs. These costs were compared using a standard water industry method that allows quantified information about environmental and social effects of options to be compared with financial data. The feasible options were then ranked based on their combined costs. Informed by this assessment, ongoing discussion with stakeholders, and the outcomes of the Strategic Environmental Assessment (SEA), Habitats Regulations Assessment (HRA) and Water Framework Directive (WFD) Assessment, this list was refined through an additional round of (secondary) screening from which the Preferred Plan options were identified.

Revised Draft Water Resources Management Plan 2019

Following consultation on the Draft WRMP, United Utilities has reviewed its Preferred Plan for WRMP19 in light of consultation responses, ongoing stakeholder engagement (including with other water companies), an update to the supply-demand balance and the findings of the environmental assessments; as a result, the Preferred Plan contained in the Draft WRMP has been modified. In particular, in response to consultation responses, additional customer research, further exploration of leakage options and innovations, and a tightening of the supply-demand balance (showing a very small deficit forecast in the Strategic Resources Zone at the end of the planning horizon), United Utilities has further enhanced its leakage reduction aspirations. United Utilities has also confirmed the proposed solution for water supply resilience to non-drought hazards.

The revised Preferred Plan includes the following strategic choices:

- Adopt an enhanced leakage reduction comprising a total of 190 Ml/d over the planning period, a reduction of just over 40% from the baseline position of 448Ml/d. By the end of 2024/25 United Utilities plan to reduce leakage by at least 67 Ml/d, or 15%;

[12] Environment Agency and Natural Resources Wales (2018) *Water Resources Planning Guideline*. Available at: https://cdn.naturalresources.wales/media/686174/interim-wrpg-update-july18-final-changes-highlighted.pdf [Accessed August 2018].

- Improve level of service for drought permits and orders to augment supply from 1 in 20 years to 1 in 40 years (moving from 5% to 2.5% annual average risk); and
- Increase resilience to other hazards, specifically for the regional aqueduct system associated with the Manchester and Pennine Resilience scheme. This involves completing Solution D, which involves rebuilding all single line sections of the relevant aqueduct.

It should be noted that the revised Preferred Plan does not include a water trading component. This is because a water trade from the North West is not included in the preferred plans of other water companies at this stage. However, water trading remains United Utilities' preference and the company will continue to work with others on water trading beyond WRMP19 towards the WRMP24 planning round.

As highlighted in **Section 1.1**, as part of the development of the Revised Draft WRMP, changes to existing options considered as part of the original environmental and social costs assessment, and new feasible options, have been identified by United Utilities. As a result, the assessment of environmental and social costs has been updated to reflect these changes; this report considers the environmental and social costs element of the options appraisal process.

1.4 Overview of Approach

Since the publication of the 2014 round of WRMPs, the UK water industry has explored alternative methods to assess the environmental and social impacts of options including calculating Natural Capital and undertaking Ecosystem Services valuations (which build on the Water Appraisal Guidance[13]). In this context, Amec Foster Wheeler completed a literature review and comparison of different approaches to environmental and social impact assessment, namely: a) traditional environmental and social costing; b) an Ecosystem Services approach; and c) a Natural Capital approach. This was in order to identify gaps, complementarities and overlaps as well as potential benefits and limitations of adopting a Natural Capital/Ecosystem Services approach for WRMP19 and for future planning rounds.

In light of the recommendations in that review, United Utilities considered the feasibility of applying these approaches to assess options for WRMP19. At this point, there is insufficient guidance and data available in the region to enable rigorous and auditable assessments using these methods; however, United Utilities recognises the benefits to this approach and aims to use natural capital to guide subsequent water resources planning development for the WRMP24 planning round. For WRMP19, United Utilities has continued with the Benefits Assessment Guidance (BAG)[14] approach that was used to assess environmental and social costs for WRMP14. **Section 2.1** of this report sets out the documents constituting the guidance.

The BAG, initially produced by the Environment Agency in 2003 and updated to include a User Guide in 2012, allows a desktop analysis of environmental and social costs and benefits. It requires impacts to be described qualitatively and, where appropriate, monetary values attributed to those potential impacts. The BAG uses a benefit transfer approach, whereby information on environmental and social costs are taken from published data (for example, from willingness to pay studies) and applied to the option under consideration.

Options submitted by the United Utilities resource team and by third parties were assessed using the same methodology, by consultants Amec Foster Wheeler. However, due to the large number of options submitted by United Utilities and third parties, a risk based approach was taken to identify those options for which a smaller number of components would be assessed (based on dominant cost categories), and to undertake

[13] Environment Agency (2014) *Water Appraisal Guidance; Assessing Costs and Benefits for River Basin Management Planning*. October 2014.
[14] Environment Agency (2003) *Guidance. Assessment of Benefits for Water Quality and Water Resources Schemes in the PR05 Environment Programme*.

cost assessment across the wider range of BAG categories only for those options where costs are more evenly distributed across categories. This process divided the list of feasible options into two groups, 'Lite' and 'Full'. These terms are used in this report.

1.5 Structure of this Report

This report is structured as follows:

- **Section 1** describes the background and purpose of this report and provides an overview of the approach adopted to environmental and social costings for WRMP19;
- **Section 2** describes the method used to assess the feasible options and the key assumptions adopted in the assessments;
- **Section 3** presents the outputs of the carbon assessment for each of the feasible options;
- **Section 4** presents a summary of the environmental and social impacts as costed for each of the feasible options.

A series of appendices provide details of the assessment and assumptions made for each option. These are ordered as follows:

- **Appendix A** - Resource management options assessment details;
- **Appendix B** - Metering options assessment details;
- **Appendix C** - Water efficiency options assessment details;
- **Appendix D** – Distribution-side options assessment details.

2. Methodology

2.1 Guidance Documents Used in this Assessment

The Water Resources Planning Guideline requires companies to assess the environmental and social impacts of feasible options using a 'method that is proportionate to the size of the problem'. Component based environmental and social costing remains a valid method, along with new approaches such as Ecosystem Services assessment. **Section 1.4** sets out United Utilities' rationale for continuing with the component based method. To undertake component based environmental and social impact assessment, the 2012 update to the BAG remains the valid source of guidance and information.

The Benefits Assessment Guidance (BAG)[15]

The BAG was initially developed for Environment Agency and water company planners to assess schemes being put forward to the PR04 Environment Programme as part of WRMP04. Although there are limitations to the approach set out in the BAG, following a review and update in 2012, it remains the key guidance for component based assessment.

The BAG allows a desktop analysis of environmental and social costs and benefits. It requires impacts to be described qualitatively and, where appropriate, monetary values attributed to those potential costs and benefits. The BAG uses 'benefit transfer', whereby information on environmental and social costs is taken from published data (for example, from willingness to pay studies) and applied to the option under consideration. One of the key 2012 BAG updates was a recommendation that users focus on the most relevant parts of the BAG for water resource planning purposes. The work undertaken to categorise United Utilities' resource management options into 'Lite' versus 'Full' is in line with this principle (see **Section 2.3**).

Since the 2012 BAG update, there have been further updates with respect to the methodology and data to use to value (cost) carbon emissions[16], and guidance from the Treasury on discounting future costs and benefits (Green Book supplementary guidance: valuation of energy use and greenhouse gas (GHG) emissions for appraisal)[17]. The assessments undertaken and reported here have adopted these new requirements.

Sustainable Economic Level of Leakage Guidance

In October 2008, Ofwat published a revised set of Guidance for the incorporation of environmental and social externalities into water companies' leakage cost assessments, enabling water companies to derive a Sustainable Economic Level of Leakage (SELL)[18]. The SELL approach taken by water companies at the 2009 Periodic Review was reviewed in 2012 by Strategic Management Consultants (SMC)[19] on behalf of the Environment Agency, Ofwat and the Department for Environment, Food and Rural Affairs (Defra).

[15] Environment Agency (2003) *Guidance. Assessment of Benefits for Water Quality and Water Resources Schemes in the PR05 Environment Programme*.
[16] See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/602657/5._Data_tables_1-19_supporting_the_toolkit_and_the_guidance_2016.xlsx [Accessed July 2017].
[17] Department for Business, Energy & Industrial Strategy (2017) *Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal*.
[18] Water Services Regulation Authority (2008) *Providing Best Practice Guidance on the Inclusion of Externalities in the ELL Calculation*. Birmingham. Ofwat. Dated September 2008.
[19] Strategic Management Consultants (2012) *Review of the calculation of sustainable economic level of leakage and its integration with water resource management planning Contract 26777*. Report for Environment Agency, Ofwat, Defra. Available from http://www.ofwat.gov.uk/sustainability/waterresources/leakage/rpt_com121012smcsell.pdf [Accessed August 2017].

The SELL Guidance built on pre-existing assessment approaches, drawing heavily on the BAG. The SELL Guidance does, however, provide more detail with regard to how to assess leakage related externalities, such as the social cost of delays to pedestrian journeys or temporary losses of water pressure in the distribution system as a result of leakage repairs. The approach taken to assess distribution options identified for WRMP19 draws on information presented in the SELL Guidance.

2.2 Sources of Data Used to Assess Environmental and Social Impacts

Following Primary Screening, United Utilities identified a list of feasible options for WRMP19 and provided relevant information and data to enable both United Utilities' and third party options to be assessed by the consultant in a robust and consistent manner. Where additional information was requested by the consultant on United Utilities' or third party options to inform the assessment, this was made available and taken into account as appropriate. For some options, there was deemed to be insufficient available information to support an assessment and in these cases, options were removed from the assessment process. The information provided to support the assessment included (inter alia):

- Option specific details:
  - Information on expected yields (including any decay – or yield maintenance);
  - Information on existing or proposed assets and infrastructure requirements (including any temporary requirements during the implementation phase);
  - Information on locations and/or waterbodies affected by abstractions, transfers or infrastructure;
  - Information on known environmental risks and vulnerabilities, and capacities to withstand interventions. This included information from United Utilities and the Environment Agency that was made available at the Primary Screening stage;
  - Full disclosure of third party option submissions, and any subsequent follow up information obtained during meetings/calls etc. between United Utilities and the third parties; and
  - Scopes for all demand-side options including third party demand options. This included population and property numbers data; numbers of devices; roll-out periods; expected uptake rates etc.
- Supplementary water company data:
  - Baseline power requirements per mega litre (Ml) put into supply per resource zone.

Information on the specific costs was assessed in the context of publicly available datasets, including:

- County/local authority population data;
- Angling club locations and Environment Agency data on angling rod licence sales by area;
- Best estimate data in the BAG such as angling numbers per type of angling, vehicles per hour per road type etc.;
- Transfer values within the BAG such as the economic cost of delays (£/kilometre (km), river and coastal environment transfer values, leisure and travel time transfer values; and landscape impact transfer values;
- Embodied carbon in materials taken from the Inventory of Carbon and Energy (ICE database)[20];

[20] See http://www.circularecology.com/embodied-energy-and-carbon-footprint-database.html#.WgsUdlVI_cs [Accessed July 2017].

- Thermal energy relationships (to calculate energy and carbon associated with customer hot water use);
- Energy to carbon conversion factors; and
- The carbon costing tables supporting the Treasury Green Book supplementary appraisal guidance on valuing energy use and GHG emissions[21].

A number of the feasible options were considered in the development of WRMP14 and/or WRMP09 and as such, the environmental and social costs of these options were previously assessed. The scope of these options was reviewed by United Utilities' engineering team and updated where appropriate. The assessment of environmental and social costs was also reviewed in entirety.

2.3 Key Assumptions Used in the Assessment

The methodology set out in the BAG necessitates a number of assumptions to be made when assessing the feasible options. These assumptions are set out below by option type.

Resource management Options

Option scopes

The scopes of the resource management options considered in this report were developed by United Utilities for the purpose of assessment in the Draft WRMP, or submitted by third parties for the purpose of inclusion and consideration within the WRMP process. The sites and locations identified in the option descriptions were provisional 'assumed' sites for the purpose of the assessment. Sites and transfer routes would be subject to appropriate site selection assessment at the project stage should they be taken forward as a preferred option.

Risk-based assessment

Due to the large number of options submitted by United Utilities and third parties, a risk based approach was taken to identify those options for which a smaller number of components would be assessed (based on dominant cost categories), and to undertake cost assessment across the wider range of BAG categories only for those options where (2012) costs were more evenly distributed across categories. This process divided the list of feasible options into two groups, 'Lite' and 'Full'.

All of the feasible resource management options were grouped into the following four option types; within each group, individual options are expected to impact on the BAG categories in similar ways:

- River abstraction dominated;
- Groundwater dominated;
- Reservoir dominated;
- Infrastructure (i.e. networks/distribution) dominated.

Information from the 2012 WRMP environmental and social costs assessment (undertaken by Amec Foster Wheeler) was interrogated to establish which BAG categories dominated the environmental and social costs of options. **Table 2.1** sets out which BAG categories dominated the costs per option type, and which categories contributed to a lesser extent. Data from the 2012 assessment was used to isolate the most likely dominant BAG cost category for each option group. A "Lite" assessment was carried out for all feasible

[21] See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/602657/5._Data_tables_1-19_supporting_the_toolkit_and_the_guidance_2016.xlsx [Accessed July 2017].

options. United Utilities used the results of this to support a secondary screening process which then created a refined list of 81 feasible options that were to be subjected to more detailed "Full" assessment.

Table 2.1 Dominant and additional BAG categories per the four main option groups

Option type	Dominant BAG categories ('Lite' assessment)	Additional BAG categories ('Full' assessment)
River abstraction dominated options	Carbon (construction & operation) Traffic (during construction)	Informal recreation Angling Biodiversity (rivers)
Groundwater dominated options	Carbon (construction & operation)	Traffic (construction)
Reservoir dominated options	Carbon (construction & operation) Formal recreation (reservoirs)	Informal recreation Angling Biodiversity (rivers) Traffic
Infrastructure dominated options	Carbon (construction & operation) Traffic (during construction)	Informal recreation Landscape (construction) Biodiversity (rivers) Angling

Table 2.2 lists the options for which only a 'Lite' assessment was undertaken. In addition to their dominant cost categories, all of these options were also assessed in terms of the carbon and traffic related impacts during the construction stage. These 57 options were not subject to further detailed "Full" assessment.

Table 2.2 'Lite' resource management options

Option	Option type	Dominant cost categories (not sufficiently significant to quantify)
WR005 Ditton Brook	River abstraction	Informal recreation, angling, river biodiversity
WR026b River Ribble Clitheroe	River abstraction	Informal recreation, angling, river biodiversity
WR029 River Mite	River abstraction	Informal recreation, angling, river biodiversity
WR030 River Esk	River abstraction	Informal recreation, angling, river biodiversity
WR031 River Annas	River abstraction	Informal recreation, angling, river biodiversity
WR032_WR80 Rivers Weaver, Dane, Wheelock	River abstraction	Informal recreation, angling, river biodiversity
WR036 River Caldew	River abstraction	Informal recreation, angling, river biodiversity
WR039b River Eden to Demmings Moss SR	River abstraction	Informal recreation, angling, river biodiversity
WR042 River ESK to Cumwhinton	River abstraction	Informal recreation, angling, river biodiversity
WR043 River Petteril to Cumwhinton	River abstraction	Informal recreation, angling, river biodiversity
WR044 Waver to Church Hill	River abstraction	Informal recreation, angling, river biodiversity
WR045 River Wampool to High Brownelson SR	River abstraction	Informal recreation, angling, river biodiversity
WR056a River Eden (Cumwhinton) to Watchgate	River abstraction	Informal recreation, angling, river biodiversity
WR056b River Eden (Cumwhinton) to Haweswater	River abstraction	Informal recreation, angling, river biodiversity
WR063 River Yarrow and River Lostock	River abstraction	Informal recreation, angling, river biodiversity

Option	Option type	Dominant cost categories (not sufficiently significant to quantify)
WR064 Entwistle Reservoir	Reservoir	Informal recreation, angling, river biodiversity, formal recreation
WR065a Watergrove Reservoir	Reservoir	Informal recreation, angling, river biodiversity, formal recreation
WR065b Whiteholme Reservoir	Reservoir	Informal recreation, angling, river biodiversity, formal recreation
WR066 River Medlock	River abstraction	Informal recreation, angling, river biodiversity
WR075 Stocks Reservoir	Reservoir	Informal recreation, angling, river biodiversity, formal recreation
WR077a Dovestone Reservoir	Reservoir	Informal recreation, angling, river biodiversity, formal recreation
WR077b Errwood Reservoir	Reservoir	Informal recreation, angling, river biodiversity, formal recreation
WR077c Fernilee Reservoir	Reservoir	Informal recreation, angling, river biodiversity, formal recreation
WR079a Appleton IR (3 ML/D)	Reservoir	Informal recreation, angling, river biodiversity
WR088 Alsager Boreholes	Groundwater	-
WR092_WR126 High Brownelson Borehole	Groundwater	-
WR096 Durdar Borehole to High Brownelson SR	Groundwater	-
WR097 Kirklinton Boreholes	Groundwater	-
WR098 Threapwood Boreholes	Groundwater	-
WR103 Croft Boreholes	Groundwater	-
WR108 Mow Cop Borehole	Groundwater	-
WR117 Grindleton and Waddington Springs	Groundwater	-
WR123 Helsby and Foxhill Boreholes	Groundwater	-
WR124 Ashton Boreholes	Groundwater	-
WR130 Carlisle Desalination	Desalination	Landscape (construction and operation), coastal biodiversity
WR131 Wirral Desalination	Desalination	Landscape (construction and operation), coastal biodiversity
WR132 Liverpool Desalination	Desalination	Landscape (construction and operation), coastal biodiversity
WR133 Workington Desalination	Desalination	Landscape (construction and operation), coastal biodiversity
WR138 Ellesmere Port EFR	River abstraction	Informal recreation, angling, river biodiversity
WR139 Castle Carrock EFR	River abstraction	Informal recreation, angling, river biodiversity
WR145 Whitehaven and Workington EFR	River abstraction	Informal recreation, angling, river biodiversity
WR149 Lightshaw increased WTW capacity	Groundwater	-

Option	Option type	Dominant cost categories (not sufficiently significant to quantify)
WR166 Penrith Boreholes to Demmings Moss SR	Groundwater	-
WR801 Third Party abstraction (Lune catchment)	Infrastructure	Informal recreation, angling, river and coastal biodiversity, landscape (construction and operation).
WR802 Third Party abstraction licence trade (Bromborough)	Infrastructure	Informal recreation, angling, river and coastal biodiversity, landscape (construction and operation).
WR811 Cow Green IR to River Eden	Reservoir	Informal recreation, angling, river biodiversity, formal recreation.
WR815 Third party abstraction (Lancaster Canal)	Infrastructure	Informal recreation, angling, river biodiversity, landscape (construction and operation).
WR823 Third party abstraction (minewater)	Infrastructure	Informal recreation, angling, river biodiversity, landscape (construction and operation).
WR825 Third party abstraction (minewater)	Infrastructure	Informal recreation, angling, river biodiversity, landscape (construction and operation).
WR826 Third party abstraction (minewater)	Infrastructure	Informal recreation, angling, river biodiversity, landscape (construction and operation).
WR831 Third party abstraction (minewater)	Infrastructure	Informal recreation, angling, river biodiversity, landscape (construction and operation).
WR833 Third party abstraction (minewater)	Infrastructure	Informal recreation, angling, river biodiversity, landscape (construction and operation).
WR845 Third party abstraction to High Brownelson SR	Infrastructure	Informal recreation, angling, river biodiversity, landscape (construction and operation).
WR008 Arrowe Brook/Birket (Wirral)	River abstraction	Informal recreation, angling, river biodiversity
WR049a River Ribble at Salmesbury	River abstraction	Informal recreation, angling, river biodiversity
WR165 Maximise pumping from Windermere and Ullswater	Reservoir	Informal recreation, angling, river biodiversity, formal recreation.
WR162 Reduction in outages by refurbishment of raw water infrastructure	Infrastructure	Informal recreation, angling, river biodiversity, landscape (construction and operation).

Options progressing to further qualitative and full BAG assessment

The BAG assessment methodology states that each option should be assessed against different criteria for environmental and works related impacts. In line with the BAG guidance, the first step to assess 'Full' options was to further explore whether their impacts would likely be significant across the wider range of BAG categories. Qualitative assessments were made to inform this process. **Appendix A (Table A1)** summarises the outcome of this first qualitative step for the 'Full' resource management options.

Assessment based on option yield/capacity

The environmental and social costs of the options from existing sources only reflect the costs associated with realising the additional capacity, not the existing baseline costs. For example, in the case of Option WR113 'Tytherington boreholes', the environmental and social costs are those associated with removing the hydraulic restriction to enable an additional 3 Ml/d abstraction. In the case of 'new' options (e.g. new sources, recommissioning disused sources), the environmental and social costs presented in this assessment are for realising the full capacity of those 'new' sources.

Flow change transfer values

The BAG states that for river and groundwater options, the impact on flow changes should be factored into transfer values. This is because many of the transfer values provided in the guidance for the impact on recreation and biodiversity quantify the 'willingness to pay to avoid low flows'. Where an option would not cause low flows, the guidance recommends that the transfer values it provides should be adjusted. However, at this stage very few of the options were developed in sufficient detail to enable specific flow sites to be identified, even less for detailed flow impact assessments to be made. Therefore, in this assessment the flow change transfer value was used. Whilst this may have resulted in some impacts being over-accounted for (e.g. angling, informal recreation, biodiversity), the approach was applied consistently across all options.

Assumptions relating to criteria with significant impacts

For those options where the initial qualitative assessment concluded that impacts could be significant and therefore require quantified/monetised assessment, a range of key assumptions were applied. These assumptions are set out below.

Carbon

Carbon impacts (costs and benefits) were calculated for all resource management options (both "Lite" and "Full"), and all metering, water efficiency and distribution options. The method adopted to assess the carbon cost of options is set out in **Section 3**.

Traffic related impacts

For resource management options where traffic related impacts were identified as potentially significant, this was primarily related to congestion caused by construction activities with the costs being measured as the economic cost of delay to other road users. Information used in these assessments was taken from the option scopes including the length and the type of road expected to be impacted (and hence expected traffic levels) and the duration of that impact. Assumptions were made regarding the length of pipeline construction at any one time and the construction period per km.

Accident risks (to United Utilities) arising from option traffic were not included. This is in line with section 5.4.1 of the BAG which states "*Accident risks should really be considered as second order effects and for most schemes they can be ignored".*

Noise was also excluded on the basis that the BAG (section 5.6.2) states: "*Only if a scheme would lead to fairly long-term increases in noise levels by more than 3 dB(A) for a number of properties should you continue with benefit transfer for noise nuisance (taking into account that this is increases in noise above 55 dB(A)). If there no such change would occur then you should not continue with the assessment." The guidance (section 5.6.1) also states, "Traffic, and in particular HGV movements, are significant sources of noise levels above 55 dB(A). In terms of causing a nuisance, however, NATA (DETR, 1998) noted that a threshold change of 3 dB(A) is necessary for the change in noise levels to become noticeable. Although noise nuisance could arise from increases in the volume of traffic, NATA acknowledged that a large increase in traffic volumes is needed for noise effects to be noticeable (an increase of at least 10% and potentially a 25% increase, if other factors remain unaltered, will only result in a 1dB(A) change). Thus, noise is only likely to be a significant impact for larger construction works, involving high numbers of HGV, or significant increases in passenger car traffic or the dislocation of significant traffic levels on currently quiet roads.*"

Formal recreation

Options, particularly reservoir related options, have the potential to impact on formal recreation activities (such as sailing clubs) either negatively (for example, by disrupting users of recreational facilities) or positively (for example, by creating new or enhanced spaces for sport). A range of definitions were taken from the BAG (part 3, section 2.3.4) which were applied to individual options to recognise the importance of affected sites for formal recreation (and therefore estimated number of annual visitors). For each option involving a reservoir, the local site characteristics were investigated to allocate the correct usage values, as per **Table 2.3**.

Table 2.3 Reservoir characteristics and estimate annual visitor numbers

Reservoir characteristic	Description	Estimated number of annual visitors
Low usage	Small car park, no boating, limited access.	10,000
Medium usage	Few facilities, boating activities limited.	20,000
High usage	Few facilities, close to an urban conurbation.	30,000
Honeypot – low usage	Land and water based activities, including swimming.	60,000
Honeypot – medium usage	Angling from boat or bank, sailing club likely, car parks linked by walks, bridle path, conservation value, picnic areas.	125,000
Honeypot – high usage	Footpaths around most of the shoreline, several car parks, boat hire, cycle hire, visitor centre, food, accommodation available, birdwatching.	250,000

Informal recreation

A list of definitions were used to allocate the importance of option sites for informal recreation. The assumptions adopted are shown in **Table 2.4.**

Table 2.4 Site importance and visitor assumptions

Site importance	Average distance from site for visits (radius) - km	Visits per adult per year
Low importance & limited access - local site	1	17.1
Low importance & good access - local site	1	27.6
Honeypot site with moderate/good access	3	17
Regionally important with moderate access/facilities	10	9
Regionally important with good access/facilities	30	2
Regional/nationally important with good access/facilities	60	2

Angling / coarse fishing

Angling is an activity that can acutely experience the impacts of changes to the water environment from resource management options. The specific impact of options on angling is assessed using a range of factors, such as the type of angling in the area, and thus assumptions regarding the annual number of anglers and frequency of participation. Unlike formal and informal recreation where participation rates are estimated based on quality of site and radius of interest, data on fishing rod licences has been used to

estimate concentrations and proportionate participation as a percentage of county populations (see **Table 2.5**). County population data was obtained from the Office for National Statistics. The location of individual options was then used to estimate angling numbers that could be impacted by an option.

Table 2.5 Angling as proportion of county population

County	% of population with licence
Cheshire	2%
Cumbria	4%
Greater Manchester	0.5%
Lancashire	2.5%
Merseyside	0.0025%

The type of angling likely to be affected by each option was investigated within the categories listed in **Table 2.6**. These data were then used to identify the number of potential alternative sites within a similar radius (i.e. to highlight the importance of a specific site for the activity) and estimated angler numbers.

Table 2.6 Types of angling and estimated activity levels

Type	Number of anglers (per km bank per yr)	Average number of trips
Locally important coarse	2100	24.5
Regionally important salmon	1980	7
Regionally important trout	1250	7
Non-migratory lake trout	280	7
Sea trout	280	7

The BAG (part 2, section 3.3.5) provides the following formulae which were used in this assessment to calculate angling participation and therefore impact:

Number of angling trips = adult population x average number of trips (Table 2.6)

Number of angling trips (to the site in question) = Number of angling trips / number of alternative sites + 1

Biodiversity (rivers and coastal)

The biodiversity impact assessments were guided by information generated by the Strategic Environmental Assessment (SEA) and Habitats Regulations Assessment (HRA) and by reviewing and mapping location information. This process involved a series of questions:

- Are there areas of conservation importance that could potentially be affected by the option (local, regional or national importance)? If no, the assessment was closed.
- Will the option lead to significant change in flows or water levels that could impact on the area of conservation or will construction impact key sites? If no, the assessment was closed.

The costs associated with these impacts reflect generalised estimates of individuals' willingness to pay to conserve/preserve freshwater dependent ecosystems as measured through non-use (where there is no specific intention to use or consume the site/resource being impacted but where there is general interest in its preservation). As for other BAG categories, a range of definitions were used (see **Table 2.7**). The 'importance of the site' (local, regional, national) and the scale of the likely impact (small, moderate, large) is assumed to influence the radius of interest within which people would be 'willing to pay'. All potentially affected sites were investigated in order to select the appropriate 'conservation importance' category. County population data, and willingness to pay transfer values were then applied to each option to complete the assessment.

Table 2.7 Site conservation importance and relative radius of interest

Conservation importance categories	Radius of interest (km)
Local only, small environmental quality change	30
Local only, moderate environmental quality change	40
Local only, large environmental quality change	60
Regional, small to moderate environmental quality change	60
Regional, large environmental quality change	120
National/international, small environmental quality change	60
National/international, large environmental quality change	150

Landscape impacts

The BAG advises that: *"Valuations reported in the original BAG (2003) with respect to landscape impacts are particularly dated (typically 15 plus years old). It is recommended that users do not attempt to value landscape impacts of water resource schemes unless these are expected to be significant and it can be demonstrated that the valuation of this impact does not overlap with assessments that may be made in relation to recreation and/or amenity values. A risk here is double-counting, since valuations can be applied over the same affected population (e.g. visitors, local residents) and it is not necessarily clear that available values in the BAG are additive in this regard.*

Note that the recommendation not to value landscape impacts does not remove the need for a qualitative assessment of the impact, based on either the approach outlined in the BAG or following SEA or EIA outputs. In addition major infrastructure projects that have a significant a landscape impact may require a primary valuation study and it will be appropriate to consult with wider stakeholders to discuss the scope of such an assessment".

Error! Reference source not found. shows that all the options were qualitatively assessed to determine whether either the construction or operational phase would have a significant impact on landscape. The process to review dominant cost categories driving environmental and social costs concluded that landscape was only a dominant category for infrastructure options. In previous assessments, landscape has only contributed very small amounts to the overall cost assessment for other types of options. In this assessment of the options that were costed for across the wider range of BAG categories, three had landscape as a dominant cost category:

- Option WR814c: Increased treatment capacity at Hurleston WTW via pipeline;
- Option WR816: Manchester, Bolton, Bury Canal to Strategic Resource Zone; and

- Option WR820: Shropshire Union Canal to Strategic Resource Zone.

The definitions and assumptions listed in **Table 2.4** were also applied to capture the radius of interest and visitor frequencies associated with landscapes identified as at risk of impact from these options.

Impacts not assessed

For some criteria, it was necessary to make the simplifying assumption that none of the options have a quantifiable impact. These criteria included:

- **Commercial Fisheries and Aquaculture -** Internet searches were undertaken to identify commercial fisheries and very few were found. In all cases, it was assumed that there would be no impact from an option on commercial fisheries and aquaculture;
- **In-stream Recreation -** Internet searches have been undertaken to identify where in-stream recreational activities may take place. The BAG does not identify suitable transfer values for options that may impact on in-stream recreation activities. This assessment has therefore been restricted to a qualitative assessment where impacts may occur;
- **Amenity/Property Prices/Regeneration** - The simplifying assumption has been made that there will be no amenity impacts as a result of the development of any of the options. For all options, it is assumed that changes in flows in watercourses as a result of these options will not be perceptible to the point that they would impact upon property prices;
- **Abstractions** - It has been assumed that none of the options will impact upon other abstractors. Detailed water resource modelling would be required to demonstrate whether increasing or resuming abstraction at existing sources would derogate other abstractors. It is assumed that new abstraction licences would not be granted unless it could be demonstrated that no derogation would occur to other abstractors;
- **Land Take** - The costs of land are assumed to be included within the capital costs of the option (where appropriate) and were not included within this study; and
- **Property Based Dis-amenity Benefits** - The options considered within this study could result in property based dis-amenity benefits such as noise, dust and odour during construction, the excavation of gardens or driveways or short interruptions to supply. In all cases, it has been assumed that the impacts would be of short duration and, although acknowledged as a potential impact of these options, no quantitative assessment has been undertaken.

Other Impacts Not Monetised

Some of the resource management options considered for WRMP19 may, if implemented, result in a change in the sources of supply to groups of customers (for example, where water sources from boreholes are replaced by water from reservoirs or surface waters). This could result in water quality changes to customers, such as hardness, which may result in costs/benefits to customers if hot water consuming appliances do not require descaling or repair more or less frequently. These changes were not considered in the BAG as these are not externality costs (they are a direct cost to the customer).

Demand Management Options

Leakage reduction, water efficiency and metering options reduce demand for water and could therefore result in benefits of reduced abstraction from the environment. This assessment did not monetise the benefits to the water environment of reduced abstraction. It did, however, monetise the benefits of reduced energy use (and therefore carbon) of the utility not putting the water into supply, and where relevant the reductions in customer consumption of energy and carbon of using less hot water.

Assessing environmental and social benefits of demand management options

The BAG proposes two approaches to assessing the environmental and social benefits of demand management options, depending on whether a resource zone is in deficit or not:

> *"In the case of appraising an individual scheme, the benefits of water efficiency savings are framed in terms of the opportunity costs associated with the marginal supply scheme (the 'next best' alternative). The actual estimation of benefits depends on whether the supply-demand balance of the WRZ is in surplus or deficit:*
>
> *Supply-demand balance in surplus: in this case a demand management scheme can typically be assumed to either displace a scheme that currently supplies the WRZ (i.e. it can be decommissioned), or reduce the level of supply required from an existing scheme (e.g. the level of abstraction). The actual outcome will depend on the nature of the 'marginal' scheme (i.e. how much of the water it supplies can be offset by demand management). Assuming it is a resource scheme the benefits associated with the reduction in demand are the (avoided) operational costs of the resource scheme (including operational and environmental and social costs)".*[22]

Environmental and social benefits are the avoided operational costs of the sources from which abstraction would be reduced. The operating costs and the carbon element of environmental and social costs (based on energy use) can be readily monetised. However, the environmental and social costs of operating the current source cannot readily be determined using the BAG as the approach is based on changes in flow from the current flow in the river (it has not been developed to assess the environmental and social costs of current abstraction). To place a value on this could potentially be misleading.

The BAG also states that for deficit zones:

> *"Supply-demand balance in deficit: in this case a demand management scheme can typically be considered as a substitute for a resource development scheme that would otherwise be implemented. The benefits of the demand management scheme can then be estimated as the (avoided) construction and operational costs of the resource development scheme (including environmental and social costs). Again the outcome depends on the nature of the marginal scheme and whether it is an extension of a currently operating scheme, or a completely new resource"*[23].

In this case, the environmental and social benefits of the demand management measure are the avoided environmental and social costs of the next resource management option, as assessed in this report. The next resource management option would be identified by United Utilities through Economics of Balancing Supply and Demand (EBSD) modelling.

The vast majority of demand management options were considered unlikely to result in any benefit to flows in comparison to current abstraction (as perceived by the general public). Even for the largest of schemes, the options do not result in reductions in licence and, during a dry period and at times of peak demand, there may be little benefit to abstraction compared to current operation.

The impact of this simplification is likely to be greatest in the case of the metering and leakage reduction options with larger yields and where there is the potential for substantial reductions in demand (for example, leakage reduction options within the Strategic Resource Zone could result in more than 120 Ml/d of leakage reduction if all were implemented together). In these cases, it is likely that there is some under-accounting of

[22] Eftec (2012) *Benefits Assessment Guidance Annex 2: Worked Example – Demand Management Submitted to the Environment Agency for England and Wales March 2012.* Eftec. London. Page 2-3
[23] Eftec (2012) *Benefits Assessment Guidance Annex 2: Worked Example – Demand Management Submitted to the Environment Agency for England and Wales March 2012.* Eftec. London. Page 3.

the benefits of these options in monetary terms. For other options, particularly the water efficiency options with lower yields, the impact of this simplification is considered to be insignificant.

Traffic related impacts

For demand-side options, particularly metering and water efficiency options where there is a significant element of travel to customer properties, the extent of driving is sufficiently significant to consider accident risks associated with vehicles on the road. In contrast to the resource management options, the congestion aspect of traffic related impacts were not considered significant for metering or water efficiency options. Congestion in the form of disruption to road and pavement users is assessed for distribution options.

Key assumptions applied in this assessment include:

- Percentage of repairs taking place in the road: 37%
- Percentage of repairs taking place in the pavement: 51%
- Daily duration of congestion per repair: 5 hours
- Average pedestrians per hour: 25
- Average time delay per pedestrian: 0.002 hours (12 seconds)
- Pedestrian transfer value: [24]
- Economic cost of delay per vehicle per km: [24]

Supply interruptions and noise

Distribution options were also assessed in terms of the impact of 'fixes' creating low water pressure or supply interruptions. A small amount of impact was assessed for the noise created during leak repairs. Key assumptions applied include:

- Percentage of repairs that cause low water pressure: 80%
- Percentage of repairs that cause supply interruptions: 80%
- Average number of properties affected per repair: 15
- Low pressure cost per property: [24]
- Supply interruption cost per property: [24]
- Noise transfer value: [24]

Transfer values and inflation

Transfer values in the BAG are expressed at 2001 prices. These were inflated to 2016/17 prices using the Consumer Prices Index.

[24] Figures redacted, company confidential information

3. Carbon

The Water Resources Management Plan tables require companies to report the fixed and variable carbon costs per year per option. Carbon costs were applied for all feasible options. The key carbon components included in the assessment were:

- Embodied carbon in materials (typically capex activity, including replacement capex activity);
- Carbon emitted by vehicles involved in the construction/roll-out of options and operational activity (based on the assumption that 50% of United Utilities' fleet involved in both construction and operation is average rigid diesel HGV).
- Carbon emitted (or saved) during the various stages of putting water into supply; and
- Carbon emitted (or saved) by customers heating water.

The Department for Business, Energy, and Industrial Strategy (BEIS) has provided guidance on how to apply the Treasury Green Book supplementary appraisal guidance on valuing energy use and GHG emissions carbon prices[25]. This includes conversion factors to convert property and road fuel types (and quantities) to carbon dioxide equivalent (CO_2e). The assumption of 0.32 kg CO_2e per km is the standard Defra conversion factor for a Class iii Diesel Light Van (1.75 to 3.5 tonnes).

Whilst the components differ between supply and demand options (described further in this section), the carbon for all options was categorised in terms of fixed and variable, and traded and non-traded:

- Carbon covered by traded carbon prices:
  - Emissions derived from grid power use;
  - Embodied carbon
- Carbon covered by non-traded carbon prices:
  - Vehicle emissions

This was necessary in order to apply the carbon prices provided by BEIS to the calculated annual tonnages of carbon.

The remainder of this section describes the approach used to quantify and monetise the carbon impacts of options.

3.1 Resource management Options: Construction Carbon

Resource management options were assessed in terms of the tonnage of embodied carbon in construction materials, tonnes of carbon produced from HGV movements, tonnes of carbon expected to be produced annually during operational use and operational vehicle movements.

United Utilities calculated the embodied carbon per supply option (tonnes CO_2e) together with the estimated number of HGV movements required to construct each resource management option. An average estimate of 50 km per vehicle movement was applied; this reflects the full range of short and long journeys that would be involved:

[25] See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/602657/5._Data_tables_1-19_supporting_the_toolkit_and_the_guidance_2016.xlsx [Accessed July 2017].

- Some materials can be sourced from local suppliers and may therefore only involve vehicle movements of several kilometres;
- Bespoke equipment such as treatment processes may need to be transported from elsewhere in the United Kingdom or further afield.

3.2 Resource management Options: Operational Carbon

Emissions from Energy Use

United Utilities provided estimates of energy usage in kilowatt hours (kWh)/Ml for each option. Energy use per option was determined by using the annual capacity (daily capacity provided by United Utilities multiplied by 365.25) and assuming that the option is utilised 100% of the time. The annual energy consumption in kWh was converted to emissions in CO_2e using updated energy conversion factors from the Treasury Green Book supplementary appraisal guidance. The factor used in 2012 was a single value of 0.59 kg CO_2e per kWh, but the latest guidance provides a projected variable factor, reflecting the expected change in energy mix to more renewable sources over the next 80 years.

Operational Vehicle Movements

United Utilities provided an estimate of the annual number of operational HGV movements required once options have been implemented. The carbon emissions associated with these vehicle movements was assessed using the same approach as described for construction vehicle movements (including the assumed distance travelled).

3.3 Metering Options: Construction Carbon (Implementation)

Embodied Carbon in Water Meters

The embodied carbon in demand management options was assessed by estimating the mass of materials (plastic, brass, concrete and steel) per item and using conversion factors from the University of Bath Inventory of Carbon and Energy[26]. Embodied carbon in a water meter was estimated based on the mass of a water meter and assumptions concerning the constituent materials (see **Table 3.1**). Online information shows that 'Kent' domestic water meters weigh between 1 and 3kg depending on size. It was assumed that a meter weighs 2kg, and that 50% of this is brass and 50% plastic. For a water meter, the embodied carbon per meter is estimated at 5.95 kg CO_2e. The number of water meters installed under a metering programme was multiplied by the embodied carbon to obtain an estimate of the embodied carbon for the option. No allowance was made for additional pipe work or embodied carbon in a meter box.

Table 3.1 Embodied carbon per kg of constituent materials

Material	Embodied Carbon (kg CO_2e per kg material)
Plastic	3.31
Brass	4.80
Concrete	0.11
Steel	2.89

[26]See http://www.circularecology.com/embodied-energy-and-carbon-footprint-database.html#.Wgxo21VI_cs [Accessed July 2017].

Source: Taken from University of Bath Inventory of Carbon and Energy (online version, 2017)

Carbon Emissions from Construction Vehicle Movements

An estimate of the number of vehicle movements required to implement each metering option was made. The assumptions concerning vehicle types and distance travelled are detailed in **Appendix B**. The total distance travelled for each option was converted to a carbon equivalent using the standard Defra conversion factor for a Class iii Diesel Light Van (1.75 to 3.5 tonnes) of 0.32 kg CO_2e/km.

3.4 Metering Options: Operational Carbon

Emissions from Energy Use

In 2012, United Utilities provided estimates of marginal energy use per megalitre supplied in each water resource zone. These remain the same and are shown in **Table 3.2**.

Table 3.2 Marginal energy use to supply 1 Ml/d

Water resource zone	Marginal energy use (kWh/Ml)[27]
Carlisle	
Strategic	
North Eden	

Based on cost of power required to treat a distribute 1 Ml/d. Converted to kWh/Ml using cost per kWh (all Information provided by United Utilities)

Energy savings were determined by using the annual yield (multiplying the daily yield provided by United Utilities by 365.25). The assessments for all of the metering options assume that the option is utilised 100% of the time. The annual reduction in energy consumption in kWh was converted to emissions in CO_2e using the annual profiled energy conversion factors for grid electricity as provided by BEIS[28].

Reduction in energy use associated with hot water use in the home was estimated by assuming that 45% of the water saved is hot water. Carbon savings have been calculated using an approach taken from the Environment Agency and Energy Saving Trust report '*Quantifying the energy and carbon effects of water saving'* (Environment Agency and Energy Saving Trust, 2008). This uses the first law of thermodynamics to calculate the energy required to heat one cubic metre of water, which is multiplied by the assumed annual volume of hot water saved by each option and a standard Defra GHG conversion factor:

$$\text{Carbon saving} = V * \left(\frac{1.6 * \Delta Temp}{BE} \right) * C$$

Where:
V = Volume of hot water saved (m^3/a)
1.6 = Constant
$\Delta Temp$ = Difference in temperature between cold water and hot water, assumed to be 28°C.
BE = Boiler efficiency, assumed to be 90%.

[27] Figures redacted, company confidential information
[28] See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/602657/5._Data_tables_1-19_supporting_the_toolkit_and_the_guidance_2016.xlsx [Accessed July 2017].

C = Conversion factor, 0.23 kg CO_2 per kWh of gas[29].

Operational Vehicle Movements

An estimate of the number of vehicle movements required during operation (for meter reading) was made. The assumptions concerning vehicle types and distance travelled are detailed in the **Appendix B**. The total distance travelled for each option was converted to a carbon equivalent using the standard Defra conversion factor for a Class iii Diesel Light Van (1.75 to 3.5 tonnes) of 0.32 kg CO_2e/km.

3.5 Water Efficiency Options: Construction Carbon (Implementation)

Embodied Carbon in Water Efficiency Materials

The embodied carbon for water efficiency options was assessed using a similar approach to that described for metering options. Estimates of the mass of materials (plastic, brass, concrete and steel) per item were multiplied using conversion factors from the University of Bath Inventory of Carbon and Energy[30] to obtain embodied carbon in kg CO_2e. The number of devices installed per option was multiplied by the embodied carbon per device to obtain an estimate of the embodied carbon for the option. For devices that would be distributed as part of a 'Savers Pack', the embodied carbon was adjusted to reflect percentage uptake of devices. This is summarised in **Table 3.3**.

Table 3.3 Embodied carbon in water efficiency devices

Device	Plastic	Paper	Rubber	Steel	Copper	Lithium	Embodied carbon per device
g carbon per kg of material	***3.31***	***3.73***	***2.85***	***1.46***	***2.71***		***g carbon per device***
Bubblestream	30g			20g			129g
Bathbuoy			75g				214g
Cistern device	25g						82g
Dual flush retrofit device	250g						828g
Toothytimer	57g				0.6g	1.8g	200g
Shower regulator	1.2g		0.3g	28.5g			46g
Showerhead	500g						1655g
Tap inserts (twin pack)	100g						331g
Mail shot/brochure		0.025 kg					93g

Carbon Emissions from Roll-out Vehicle Movements

For each option, an estimate was made regarding the number of vehicle movements required during the roll-out phase. The assumptions concerning vehicle types and distance travelled are detailed in **Appendix C**.

[29] Factor for ALL SCOPES for Natural Gas Consumed (Net Calorific Value) as reported in the 2012 Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting, Version 1, Updated May 2012
[30] See http://www.circularecology.com/embodied-energy-and-carbon-footprint-database.html#.Wgxo21VI_cs [Accessed July 2017].

The total distance travelled for each option was converted to a carbon equivalent using the standard Defra conversion factor for a Class iii Diesel Light Van (1.75 to 3.5 tonnes) of 0.32 kg CO_2e/km.

3.6 Water Efficiency Options: Operational Carbon

Emissions from Energy Use

Energy savings from reduced demand for mains water were estimated based on the approach described for the metering options, using the demand savings calculated for each option. All water efficiency options were assumed to be operational 100% of the time (i.e. the demand reduction is realised 100% of the time). An allowance for reduced hot water use in the home was made where appropriate. The assumptions for each water efficiency option are presented in **Table 3.4**.

Table 3.4 Percentage utilisation and hot water saved for each water efficiency option

Option number	Option name	Utilisation (benefit from the capacity of the scheme in a normal year)	Percentage of water saved assumed to be hot water
WR600 WR601 WR602	Water Efficiency Enabling Activities - offering free water butts to customers	100%	0%
WR603 WR604 WR605	Water Efficiency Enabling Activities - offering subsidised water butts to customers	100%	0%
WR606 WR607 WR608	Existing domestic water saving retrofit products - installation through smart home visits	100%	45%
WR610	Education programme	100%	0%
WR611 WR612 WR613	Partnership projects with public and third sector organisations	100%	45%
WR615 WR616 WR617	Fixing leaking toilets	100%	0%
WR620 WR621 WR622	Provision of free water efficiency goods and advice to all newly metered customers	100%	45%
WR623 WR624 WR625	Offering water efficiency home checks when installing a meter at a customers' property	100%	45%
WR905	Third Party Option - Customer awareness and Smart metering [reduce demand - increase metering]	100%	45%

It should be noted that this table does not list all the duplicate option numbers for the different water resource zones.

Carbon Emissions from Operational Vehicle Movements

An estimate of the number of vehicle movements required during the operation of each water efficiency option was made. The assumptions concerning vehicle types and distance travelled are detailed in the **Appendix C**. The total distance travelled for each option was converted to a carbon equivalent using the standard Defra conversion factor for a Class iii Diesel Light Van (1.75 to 3.5 tonnes) of 0.32 kg CO_2e/km.

3.7 Distribution-Side Options: Construction Carbon (Implementation)

Embodied Carbon in Leak Repair Materials

The embodied carbon involved in distribution options (repairs) was assessed taking the length of repairs as quoted in the option scopes for the mains rehabilitation options, and assuming all other network repairs require an average of 1 metre of pipe (including waste). All pipes were assumed to be High Density Polyethylene (HDPE). Based on information provided by United Utilities at PR09, the mass of HDPE in 1 metre of pipe 1.39 kg/metre was used.

Embodied Carbon in Pressure Management Valves, Network Meters and Noise Loggers

The embodied carbon in equipment used to manage pressure and monitor flows on the distribution network was assessed using the same method as for the water efficiency options. Specification information was investigated to estimate the volumes of materials making up each piece of equipment, and multiplied by the numbers forecast to be installed as per the option definition, including replacements over time. Total masses of materials were converted to carbon equivalents using conversion factors as shown in **Table 3.5.**

Table 3.5 Embodied carbon in leakage management materials

Device	Plastic	Brass	Rubber	Steel	Iron	Polyethylene	Embodied carbon per device (kg)
g carbon per kg of material	***3.31***	***2.64***	***2.85***	***1.46***	***1.91***	***2.59***	
Polythylene pipe						1.39	3.6 kg
Meter*	1 kg	1 kg					5.95 kg
Pressure Management Valve / loggers			1.25 kg	3.15 kg	58.2kg		119.3 kg

*Assumed similar to standard Kent meter.

Carbon Emissions from Construction Vehicle Movements

The assessment estimated the number of vehicle movements required to implement each leakage option. The assumptions concerning vehicle types and distance travelled are detailed in the **Appendix D.** The total distance travelled for each option was converted to a carbon equivalent using the standard Defra conversion factor for a Class iii Diesel Light Van (1.75 to 3.5 tonnes) of 0.32 kg CO_2e/km.

3.8 Distribution-side Options: Operational Carbon

Emissions from Energy to Put Water into Supply

Energy used to put water into supply which is subsequently lost from the network is wasted energy. Energy savings associated with reducing losses were therefore estimated using the approach described for the metering options. All leakage and network metering options were assumed to be operational 100% of the time (i.e. the demand reduction is realised 100% of the time). No allowance for reduced hot water use within buildings was made for any of the leakage and network metering options. These savings were categorised as operational rather than construction related.

Carbon Emissions from Operational Vehicle Movements

The assessment estimated the number of vehicle movements required during the operational leakage activity. United Utilities provided estimates of the number of Active Leakage Control (ALC) surveys and subsequent repairs that would be required to maintain the reduced leakage achieved during the construction/implementation stage. These emissions only begin once the construction phase is complete. The assumptions concerning vehicle types and distance travelled are detailed in **Appendix D.** The total distance travelled for each option was converted to a carbon equivalent using the standard Defra conversion factor for a Class iii Diesel Light Van (1.75 to 3.5 tonnes) of 0.32 kg CO_2e/km.

3.9 Monetisation of Carbon

Carbon emissions have been monetised using the traded and non-traded carbon price per tonne CO_2e as provided by BEIS[31]. The Government guidance on carbon costing stipulates which types of activities should be considered as traded or non-traded carbon:

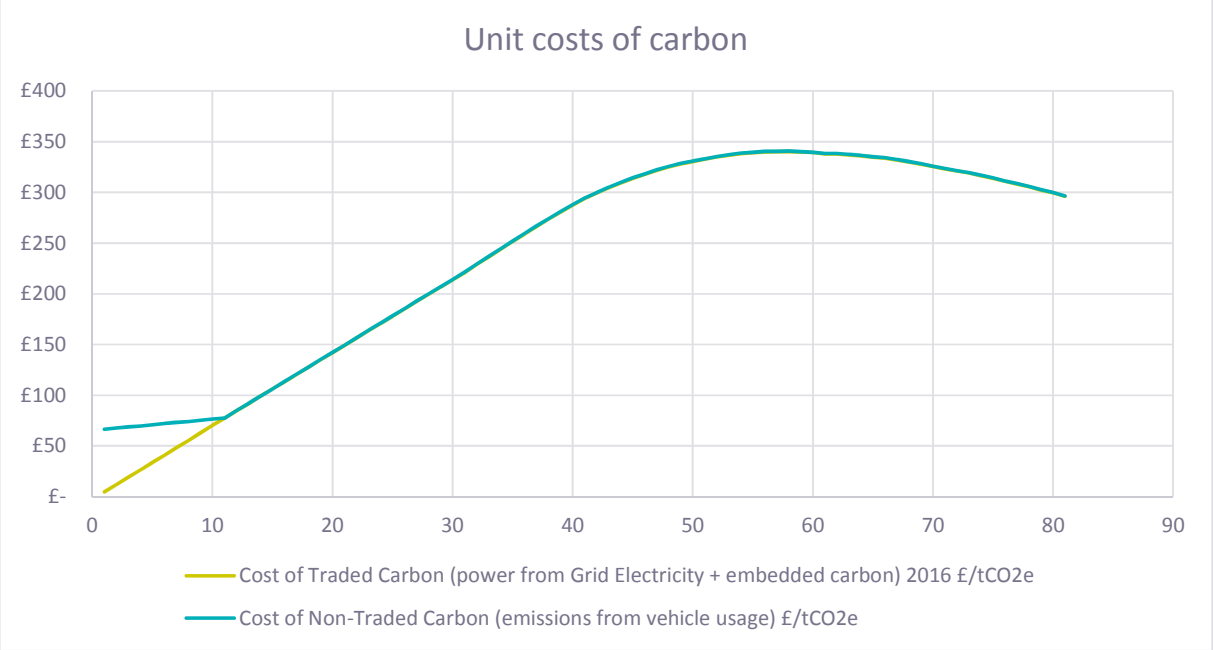
- Carbon covered by traded carbon prices:
  - Emissions derived from grid power use;
  - Embodied carbon;
- Carbon covered by non-traded carbon prices:
  - Vehicle emissions.

The Government carbon data profiles these two datasets up to 2100 (i.e. over an 80 year period). This assessment costed options over an 80 year lifespan. All costs, including carbon, are discounted to a present value at a rate of 3.5% per annum until 2049, 3.0% until 2094, and 2.5% beyond that point.

Initially, the cost of traded carbon is much lower than for non-traded (£4.58 and £66.42 respectively in year 1, 2020) but by year 10 the unit costs are much closer to each other (£70.09 and £76.38 initially). The unit costs of carbon are forecast to increase rapidly (**Figure 3.1**) hence options which have sustained or increasing carbon savings become very favourable.

[31] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/602657/5._Data_tables_1-19_supporting_the_toolkit_and_the_guidance_2016.xlsx [Accessed July 2017].

Figure 3.1 Projected unit costs of carbon



4. Environmental and Social Impacts

This section presents a summary of the environmental and social impacts as costed for each of the feasible options. The data are presented in the following tables in the format required by United Utilities as input data to the EBSD optimiser model. The data presented are as follows:

- **Construction related environmental costs (£m):** total construction environmental and social costs (excluding carbon). These are total construction (capex) over the longer term 80 year period (these are not Net Present Values (NPVs)– NPVs are provided in the WRMP tables);

  Section 2.3 explains which categories of environmental and social costs have been included in the construction and operational phases of the options. Not all options exert significant construction phase environmental and social costs. This is particularly the case for options where costs are dominated by carbon or limited to relatively minor traffic related impacts.

- **Fixed operational environmental and social costs (£m/yr):** annual environmental and social costs (excludes carbon).

  The operational environmental and social costs for all four types of option (river and groundwater abstraction, reservoirs, and infrastructure) are dominated by operational carbon (which is presented as its own cost category) hence many options listed in **Table 4.1** show no fixed operating environmental or social costs.

  For resource management options which were costed against the wider range of BAG categories, the operational impacts were all identified as fixed costs, relating to fixed activities associated with producing a fixed yield.

- **Variable operational environmental costs (£/Ml):** annual environmental and social costs (excludes carbon);

- **Construction related carbon costs initial (£m);**

- **Fixed operational carbon costs (£m/yr)**; and

- **Variable operational carbon costs (£/Ml)**.

It should be noted that due to company commercial confidentiality reasons, the cost figures have been redacted from the tables.

4.1 Resource Management Options Environmental and Social Costs

Table 4.1 presents the environmental and social impacts as costed for the feasible resource management options (the qualitative and quantitative assessments for those options subjected to “Full” assessment can be found in **Table A1** and **Table A2** (**Appendix A)** respectively). It should be noted that these resource management options do not form part of the Preferred Plan for the Revised Draft WRMP on the basis that a water trade from the North West is not included in the preferred plans of other water companies at this stage.

Table 4.1 Environmental and social costs – resource management options[32]

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80-year NPV £m)	Fixed operational carbon costs (8-year NPV £m/yr)	Variable operational carbon costs (£m/Ml for year 1)*
WR001 River Alt to Prescot WTW						
WR003 Fisher Tarn						
WR004 Longsleddale Reservoir						
WR005 Ditton Brook						
WR006 Glaze Brook						
WR007 Sankey Brook						
WR009 River Rawthey to Watchgate WTW						
WR026a River Ribble (Stocks Reservoir)						
WR026b River Ribble Clitheroe						
WR029 River Mite						
WR030 River Esk						
WR031 River Annas						
WR032 - WR80 Rivers Weaver, Dane, Wheelock						
WR036 River Caldew						
WR037a Haweswater IR 0.5m						
WR037b Haweswater IR 1m						
WR038 WR040 River Eamont to North Eden						
WR039a River Eden (Temple Sowerby) to Watchgate						
WR039b River Eden to Demmings Moss SR						
WR041 River Irthing to Cumwhinton						
WR042 River Esk to Cumwhinton						
WR043 River Petteril to Cumwhinton						

[32] Cost figures redacted, company confidential information

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80-year NPV £m)	Fixed operational carbon costs (8-year NPV £m/yr)	Variable operational carbon costs (£m/Ml for year 1)*
WR044 Waver to Church Hill						
WR045 River Wampool to High Brownelson SR						
WR047a Milwr Tunnel Bagillt (River Alyn)						
WR049a - River Ribble (Transfer to Anglezarke IR) 30Ml/d						
WR049b - River Ribble (Transfer to Anglezarke IR) 40Ml/d						
WR056a River Eden (Cumwhinton) to Watchgate						
WR056b River Eden (Cumwhinton) to Haweswater						
WR062a Worthington WTW (Prospect SR)						
WR062b Worthington WTW to Rivington WTW						
WR063 River Yarrow and River Lostock						
WR064 Entwistle Reservoir						
WR065a Watergrove Reservoir						
WR065b Whiteholme Reservoir						
WR066 River Medlock						
WR074 River Darwen						
WR075 Stocks Reservoir						
WR076 River Bollin						
WR077a Dovestone Reservoir						
WR077b Errwood Reservoir						
WR077c Fernilee Reservoir						
WR079a Appleton IR (3 Ml/d)						

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80-year NPV £m)	Fixed operational carbon costs (8-year NPV £m/yr)	Variable operational carbon costs (£m/Ml for year 1)*
WR079b Appleton IR (6 Ml/d)						
WR079c Appleton IR (9 Ml/d)						
WR079d Appleton IR (12.5 Ml/d)						
WR084 Carlisle to North Eden transfer						
WR088 Alsager Boreholes						
WR092 - WR126 High Brownelson Borehole						
WR095 Roughton Gill						
WR096 Durdar Borehole to High Brownelson SR						
WR097 Kirklinton Boreholes						
WR098 - Threapwood Boreholes						
WR099a Worsthorne Borehole (compensation)						
WR099b Worsthorne Borehole (Hurstwood IR)						
WR099c Worsthorne Borehole (WTW)						
WR100 Thorncliffe Road Boreholes, Barrow						
WR101 Franklaw						
WR102ai Widnes Boreholes to Prescot (with softening)						
WR102a Widnes Boreholes to Prescot						
WR102b - Widnes Boreholes to Liverpool and Warrington						
WR102d Eccleston Hill Borehole to Prescot						
WR102e Bold Heath Boreholes to Prescot						
WR103 Croft Boreholes						

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80-year NPV £m)	Fixed operational carbon costs (8-year NPV £m/yr)	Variable operational carbon costs (£m/Ml for year 1)*
WR105ai Lymm Boreholes to Sow Brook (with softening)						
WR105a Lymm Boreholes to Sow Brook (without softening)						
WR105b Lymm Boreholes (Hill Cliffe)						
WR106 Walton and Daresbury Boreholes						
WR107b Randles Bridge Knowsley Primrose Hill						
WR108 Mow Cop Borehole						
WR109 Swineshaw Boreholes						
WR111 Woodford Borehole						
WR112 Bramhall Borehole						
WR113 Tytherington Boreholes						
WR114 Python Mill Borehole PBD						
WR117 Grindleton and Waddington Springs						
WR119a Egremont Boreholes (Existing)						
WR119b Egremont Boreholes (New)						
WR120i Cross Hill Boreholes						
WR121a Eaton Borehole (Hollins Hill)						
WR121b Eaton Boreholes (Mid Cheshire Main)						
WR122 Newton Hollows Boreholes						
WR123 Helsby and Foxhill Boreholes						
WR124 Ashton Boreholes						
WR125 Bearstone Boreholes						

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80-year NPV £m)	Fixed operational carbon costs (8-year NPV £m/yr)	Variable operational carbon costs (£m/Ml for year 1)*
WR127 Fairhill WTW transfer to Highgate SR						
WR128 Tarn Wood (North Eden to Carlisle)						
WR129 North Cumbria Boreholes						
WR130 Carlisle Desalination						
WR131 Wirral Desalination						
WR132 Liverpool Desalination						
WR133 Workington Desalination						
WR138 Ellesmere Port EFR						
WR139 Castle Carrock EFR						
WR140 Horwich EFR						
WR141 Rossendale EFR						
WR142 Hyndburn EFR						
WR144 Saddleworth Mossley Top						
WR145 Whitehaven and Workington EFR						
WR146 Davyhulme EFR						
WR148 Cumwhinton Boreholes Castle Carrock Link						
WR149 Lightshaw increased WTW capacity						
WR150 Castle Carrock Dead water						
WR153 Simmonds Hill						
WR166 Penrith Boreholes to Demmings Moss						
WR800 River Bela to Thirlmere Aqueduct						
WR801 Third Party abstraction (Lune catchment)						

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80-year NPV £m)	Fixed operational carbon costs (8-year NPV £m/yr)	Variable operational carbon costs (£m/Ml for year 1)*
WR802 Third Part abstraction trade (Bromborough)						
WR810 Cow Green IR to Heltondale Aqueduct						
WR811 Cow Green IR to River Eden						
WR812 Keilder Water Transfer						
WR814a Increased treatment capacity at Huntington WTW						
WR814b Increased treatment capacity at Hurleston WTW via Canal						
WR814c Increased treatment capacity at Hurleston WTW via Pipeline						
WR815 Third party abstraction (Lancaster Canal)						
WR816 MBB Canal to Strategic Zone						
WR817 Carr Mill Dam to Strategic Zone						
WR820 Shropshire Union canal to Strategic Zone						
WR821 Shropshire Union canal						
WR823 Third party abstraction (minewater)						
WR824 Third party mine to Carlisle Zone						
WR825 Third party abstraction (minewater)						
WR826 Third party abstraction (minewater)						
WR831 Third party abstraction (minewater)						
WR833 Third party abstraction (minewater)						
WR845 Dalston Borehole to High Brow (Nelson) SR						

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80-year NPV £m)	Fixed operational carbon costs (8-year NPV £m/yr)	Variable operational carbon costs (£m/Ml for year 1)*
WR012 Borrow Beck Reservoir						
WR055 Cumwhinton Enhancement						
WR008 Arrowe Brook/Birket (Wirral)						
WR154 Sandiford Increased WTW Capacity						
WR159 Improved reservoir compensation control group 1 PDB						
WR160 Improved reservoir compensation control group 2 PBD						
WR010 River Greta River Wenning to Lancaster						
WR049a River Ribble at Salmesbury						
WR813 Scammondden IR to Buckton Castle						
WR110 Increased abstraction from Rushton Spencer Boreholes (Congleton)						
WR165 Maximise pumping from Windermere and Ullswater						
WR162 Reduction in outages by refurbishment of raw water infrastructure						
WR167 DPS Delph Reservoir						
WR168 DPOS Dovestone reservoir						
WR169 DPS Jumbles reservoir						
WR170 DPOS Longdendale reservoirs						
WR171 DPS River Lune LCUS abstraction						
WR172 DPS Rivington reservoirs - Brinscall Brook						
WR173 DPS Rivington reservoirs - White Coppice						

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80-year NPV £m)	Fixed operational carbon costs (8-year NPV £m/yr)	Variable operational carbon costs (£m/Ml for year 1)*
WR174 DPS Ullswater						
WR175 DPS Lake Vyrnwy						
WR176 DPS Lake Windermere: Scenario 1						
WR177 DPS Lake Windermere: Scenario 2						
WR178 DPS Swineshaw boreholes						
WR179 DPS Bowscar, Gamblesby, Tarn Wood boreholes						
WR102c Widnes Boreholes to Runcorn						
WR105bi - Lymm Boreholes (Hill Cliffe) (With Softening)						
WR107a Aughton Park & Moss End Boreholes (no Ion exchange)						
WR107ai Aughton Park & Moss End Boreholes (with Ion Exchange)						
WR120 Cross Hill Boreholes (without softening)						
B2 Thames Water Trading enabling works						

*Variable operational carbon (as £/Ml) calculated using total variable components' carbon in year 1, divided by the total annual yield (e.g. 13Ml/d x 365). Actual operational carbon varies according to the projected energy conversion factor. Year 1 is presented for the purposes of displaying a single figure.

4.2 Metering Options Environmental and Social Costs

Table 4.2 presents the overall costs for the metering options (qualitative descriptions of impacts and costs are provided in **Appendix B**). The construction (implementation) social and environmental costs were linked to traffic related costs (accident rather than congestion) involved in installing meters across the zones. No costs were allocated to inconvenience to individual customers as the disruption involved in installing a water meter is considered minimal (unlike leak repairs which are more disruptive).

There are OPEX costs associated with collating and processing meter readings but these activities do not drive operational environmental or social costs (fixed or variable), i.e. traffic impacts are costed as part of the carbon calculation, and there are no disamenity impacts. None of the other BAG categories were applicable.

The construction/ implementation related carbon is composed of embodied carbon in the meters (a fixed component) and the emissions relating to roll-out (this is also considered fixed as it is also based on assumptions of fixed numbers of meters being installed). After the initial roll-out period, annual net carbon costs rapidly turn in to savings. There is no single operational 'variable' £/Ml as this changes annually. However, **Table 4.2** presents the average as based on the total operational carbon (calculated over an 80 year period) and the total associated yield.

Operational carbon is dominated by savings: reduced water being put into supply and reduced volumes of customer hot water usage. This is illustrated as negative costs (savings in **Table 4.2**).

Table 4.2 Environmental and social costs – metering options[33]

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (£m)	Fixed operational carbon costs (£m yr)	Variable operational carbon costs (lifetime 80-year £/Ml)
WR700a Metering on change of occupancy (AMR)-5 years						
WR701a Metering on change of occupancy (AMR)-5 years						
WR702a Metering on change of occupancy (AMR)-5 years						
WR700b Metering on change of occupancy (AMR)-10 years						
WR701b Metering on change of occupancy (AMR)-10 years						
WR702b Metering on change of occupancy (AMR)-10 years						
WR703a Refer a friend meter installation scheme-5 years						

[33] Cost figures redacted, company confidential information

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (£m)	Fixed operational carbon costs (£m yr)	Variable operational carbon costs (lifetime 80-year £/Ml)
WR703b Refer a friend meter installation scheme-10 years						
WR707a Enhanced blanket FMO promotion 5yrs						
WR707b Enhanced blanket FMO promotion 10yrs						
WR708b Enhanced blanket FMO promotion 10yrs						
WR710 Target customers with financial savings 5yrs						
WR711 Target customers with financial savings 5yrs						
WR716a Promote to customers who had service renewal 5yrs						
WR716b Promote to customers who had service renewal 10yrs						

4.3 Water Efficiency Options Environmental and Social Costs

Table 4.3 presents the overall costs for the water efficiency options (qualitative descriptions of impacts and costs are provided in **Appendix C**). Implementation related environmental and social impacts are similar in nature to metering, i.e. they relate to the traffic related impacts component, and even within this category, impacts are limited to accident risks associated with the number of United Utilities vehicle journeys being made, rather than any kind of congestion or other inconvenience that affect supply options.

There are no operational activities associated with these options. Whilst customers will operate the measures and generate operational carbon savings, once the measures have been rolled out no further option specific activity from United Utilities is assumed.

Water efficiency options that involve distributing water efficiency devices inevitably have higher levels of carbon per water saving than metering options. Whilst both types of option include embodied carbon in devices and equipment, water efficiency measures with relatively lower annual average water savings (e.g. water butts provided to a relatively small proportion of the population) drive up the carbon cost per Ml. Conversely, options that enable customers to save more water, including hot water, rapidly become more economical from a carbon perspective.

The results listed in **Table 4.3** show all options for the zones and with differing roll-out periods; this is why some options appear to have the same name.

Table 4.3 Environmental and social costs – water efficiency options[34]

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80 year £m)	Fixed operational carbon costs (£m/yr)	Variable operational carbon costs (£/Ml over 80 years)
WR600a - offering free water butts to customers						
WR601a - offering free water butts to customers						
WR602a - offering free water butts to customers						
WR600b - offering free water butts to customers						
WR601b - offering free water butts to customers						
WR602b - offering free water butts to customers						
WR603a - offering subsidised water butts to customers						
WR604a - offering subsidised water butts to customers						
WR605a - offering subsidised water butts to customers						
WR603b - offering subsidised water butts to customers						
WR604b - offering subsidised water butts to customers						
WR605b - offering subsidised water butts to customers						
WR606a Existing domestic water saving retrofit products - installation through smart home visits						
WR607a Existing domestic water saving retrofit products - installation through smart home visits						
WR608a Existing domestic water saving retrofit products - installation through smart home visits						
WR606b Existing domestic water saving retrofit						

[34] Cost figures redacted, company confidential information

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80 year £m)	Fixed operational carbon costs (£m/yr)	Variable operational carbon costs (£/Ml over 80 years)
products - installation through smart home visits						
WR607b Existing domestic water saving retrofit products - installation through smart home visits						
WR608b Existing domestic water saving retrofit products - installation through smart home visits						
WR610a Education programme						
WR610b Education programme						
WR611a Partnership projects with public and third sector organisations						
WR612a Partnership projects with public and third sector organisations						
WR613a Partnership projects with public and third sector organisations						
WR611b Partnership projects with public and third sector organisations						
WR612b Partnership projects with public and third sector organisations						
WR613b Partnership projects with public and third sector organisations						
WR615a Fixing leaking toilets						
WR616a Fixing leaking toilets						
WR617a Fixing leaking toilets						
WR615b Fixing leaking toilets						
WR616b Fixing leaking toilets						
WR617b Fixing leaking toilets						
WR620a Provision of free water efficiency goods						

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80 year £m)	Fixed operational carbon costs (£m/yr)	Variable operational carbon costs (£/Ml over 80 years)
and advice to all newly metered customers						
WR621a Provision of free water efficiency goods and advice to all newly metered customers						
WR622a Provision of free water efficiency goods and advice to all newly metered customers						
WR620b Provision of free water efficiency goods and advice to all newly metered customers						
WR621b Provision of free water efficiency goods and advice to all newly metered customers						
WR622b Provision of free water efficiency goods and advice to all newly metered customers						
WR623a Offering water efficiency home checks when installing a meter at a customer's property						
WR624a Offering water efficiency home checks when installing a meter at a customer's property						
WR625a Offering water efficiency home checks when installing a meter at a customer's property						
WR623b Offering water efficiency home checks when installing a meter at a customer's property						
WR624b Offering water efficiency home checks when installing a meter at a customer's property						
WR625b Offering water efficiency home checks when installing a meter at a customer's property						
WR905 Third Party - Customer awareness and Smart metering [reduce demand - increase metering]						

4.4 Distribution Options Environmental and Social Costs

Table 4.4 presents the overall costs for the distribution options (qualitative descriptions of impacts and costs are provided in **Appendix D**). Distribution options have greater environmental and social impacts during 'construction' than other demand management options; this is due to the disruption associated with fixing leaks. For the purpose of costing, construction impacts relate to the repairs made during the initial 'capital or transitional' period when the company will instigate enhanced ALC beyond baseline leakage management. Leakage activity that is ongoing after the option 'yields' have been achieved are considered operational. The operational costs only include the additional costs to maintain the yields, i.e. baseline leakage efforts that would contribute to maintaining these savings are not included. Typically, this translates into operational levels being lower (per year) than the initial capital level of activity.

Distribution options do generate carbon savings by reducing the volume of water put into supply. However, unlike water efficiency and metering options which include carbon emission savings associated with reduced hot water use, the embodied carbon in leakage repair materials and vehicle emissions are not offset and. hence distribution options do not result in net operational carbon savings.

The very high carbon costs associated with Option WR511 is driven by the input value; this option would involve installation of 6,650 modified PMVs, meters, or network loggers, in addition to the embodied carbon associated with the number of additional repairs identified by enhanced network monitoring.

Table 4.4 Environmental and social costs – distribution options[35]

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80 year £m)	Fixed operational carbon costs (£m/yr)	Variable operational carbon costs (£/Ml) 80-year lifetime costs
WR500a Leakage reduction stage 1						
WR500b Leakage reduction stage 2						
WR500c Leakage reduction stage 3						
WR500d Leakage reduction stage 4						
WR500e Leakage reduction stage 5						
WR500f Leakage reduction stage 6						
WR500g Leakage reduction stage 7						
WR500h Leakage reduction stage 8						
WR500i Leakage reduction stage 9						
WR500j Leakage reduction stage 10						

[35] Cost figures redacted, company confidential information

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80 year £m)	Fixed operational carbon costs (£m/yr)	Variable operational carbon costs (£/Ml) 80-year lifetime costs
WR500k Leakage reduction stage 1						
WR501a Leakage reduction stage 1						
WR501b Leakage reduction stage 2						
WR501c Leakage reduction stage 3						
WR501d Leakage reduction stage 4						
WR501e Leakage reduction stage 5						
WR502a Leakage reduction stage 1						
WR502b Leakage reduction stage 2						
WR502c Leakage reduction stage 3						
WR502d Leakage reduction stage 4						
WR502e Leakage reduction stage 5						
WR503 Monitoring of HH meters to identify and fix SPL						
WR506 Free SPL repair to NHH						
WR508a Mains Rehab Scheme 1						
WR508b Mains Rehab Scheme 2						
WR508c Mains Rehab Scheme 3						
WR508d Mains Rehab Scheme 4						
WR508e Mains Rehab Scheme 5						
WR511 Network metering enhancements						
WR512 Network metering enhancements						
WR513 Network metering enhancements						

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80 year £m)	Fixed operational carbon costs (£m/yr)	Variable operational carbon costs (£/Ml) 80-year lifetime costs
WR514 Logging of large customers						
WR515 Splitting DMAs						
WR516 Splitting DMAs						
WR517 Upstream tiles enhancements						
WR518 Upstream tiles enhancements						
WR519 Upstream tiles enhancements						
WR520 Set up hydraulic WSZs for analysis and reporting						
WR151 Reduce Raw Water Losses from u/s of the 5 WTW with the largest u/s RWLs. Replacement and renewal of 25% of the total length.						
WR903a Crowder Consulting - Proactive Leakage Reduction Service						
WR903b Third party - Proactive Leakage Reduction Service						
WR903c Third party - Proactive Leakage Reduction Service						
WR907a Third party						
WR907b Third party						
WR907c Third party						
WR907d Third party						
WR907e Third party						
WR907f Third party						
WR907g Third party						
WR911a Third party Leakage reduction						
WR911b Third party Leakage reduction						
WR912 Third party Advice and information on						

Option	Construction related environmental costs (£m)	Fixed operational environmental costs (£m/yr)	Variable operational environmental costs (£/Ml)	Construction carbon costs (80 year £m)	Fixed operational carbon costs (£m/yr)	Variable operational carbon costs (£/Ml) 80-year lifetime costs
leakage detection and fixing techniques						
WR914 Third party Cello 4S and Regulo						

Appendix A
Resource Management Options Assessment Details

Table A1 Qualitative assessment of options requiring full BAG assessment

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
WR001 River Alt to Prescot WTW	✓	✓		✓		✓		This option comprises a new abstraction on the River Alt and the transfer of raw water to Prescot WTW for treatment and storage. The raw water transfer/treatment would utilise circa 18km of pipeline and a new WTW at Prescot, or alternatively, modifications to the existing Prescot WTW if new development is not seen as viable. There is no current abstraction licence associated with this option. Traffic: Pipeline route includes 1 major road crossing and 1 rail line crossing with 50% in rural area. Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: Near to Trans Pennine Trail and other footpaths. Relatively poor/restricted access (limited parking and no facilities). No angling clubs on this part of the Alt. Day tickets available downstream towards Formby. Biodiversity (rivers): The option may lead to significant change in flows or water levels that could impact on areas of conservation. The River Alt flows c.11km from the proposed abstraction point into the Sefton Coast SSSI/SAC and Ribble and Alt Estuaries SPA. Landscape (construction): not applicable for review of river abstraction dominated options.
WR003 Fisher Tarn	✓	✓	✓	✓	✓			This option would involve the reinstatement of Fisher Tarn Reservoir in order to abstract and transfer a maximum of 5 Ml/d via a new 1.8km raw water main to the Mint South Well (Thirlmere Aqueduct) for treatment at Lostock WTW. Ancillary development may be required to facilitate the operation of this option such as a new pumping station and modification to the Mint South Well. Traffic: New pipeline is primarily expected to be off-road, but will involve several road crossings likely to cause some disruption. Formal recreation: Fisher Tarn reservoir is used for angling only (fly fishing) and has limited access and no dedicated car park. Informal recreation: Fisher Tarn reservoir is noted in several local walks. Angling: Fly fishing day tickets are available. The extent of potential impact is not known. Biodiversity (rivers): This option is not expected to significantly affect downstream watercourses. Landscape (construction): not applicable for review for reservoir dominated options.
WR004 Longsleddale Reservoir	✓	✓		✓		✓		This option would involve the development of a new impounding reservoir across the River Sprint with a capacity of 1,897Ml. The proposed dam would be 370m long with a new access road 1.4km in

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								length. Additionally, a new pumping station would be installed on an off-road site near Garnett Bridge. Raw water from the reservoir would be transferred to Watchgate WTW via a new raw water main (circa 10km in length). Traffic:10 minor road crossings with limited convenient diversions. Congestion impacts may be felt by a small number of road users. Formal recreation: This is a new reservoir and so impacts on existing recreational reservoir use are not an issue. Informal recreation: This area forms part of the Lake District National Park and the Eastern Fells. Known walks up the valley but access poor (limited parking and no facilities). Angling: No angling clubs found on the Upper River Sprint. There is fishing downstream towards the confluence with the River Kent but the impacts on this are not expected to be significant. Biodiversity (rivers): Creation of a new impounding reservoir may lead to significant change in flows or water levels that could impact on the area of conservation. Loss of the valley by creation of the reservoir will result in loss of the amenity. Landscape (construction): not applicable for review for reservoir dominated options.
WR006 Glaze Brook	✓	✓		✓		✓		This option would involve the provision of a new lowland river raw water abstraction on Glaze Brook and construction of a pumping station. A new circa11km raw water main to Lightshaw WTW would be required together with a new WTW process for river water. Treated water would be transferred to Lightshaw SR. Traffic: New raw water main involves approximately 200m of open cut in unclassified roads and several road crossings which may lead to congestion impacts. Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: The Glaze Brook Trail is a recognised long-distance trail and borders the river on the east side. Access to this immediate reach is limited. Angling: No angling clubs found on the Glaze Brook. Biodiversity (rivers): The Glaze Brook is not widely known for high quality habitat, but this option may lead to significant change in flows or water levels downstream that could impact on the general area of conservation. Landscape (construction): not applicable for review of river abstraction dominated options.
WR007 Sankey Brook	✓	✓		✓		✓		This option would involve the development of a new abstraction from Sankey Brook that would transfer 10 Ml/d of raw water to a new WTW at Hill Cliffe SR via a new circa 5.5km main. Following water treatment, output from Hill Cliffe WTW would be transferred to Hill Cliffe SR. Traffic: New pipeline routes potentially impacting A roads along length. Formal recreation: not applicable for review of non-reservoir dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Informal recreation: Walkers along the canal system and users of the adjacent Sankey Valley Park may perceive an impact as a result of this option. This may be a local impact. Angling: No angling clubs found on the Sankey Brook. Biodiversity (rivers): Abstraction from the Sankey Brook may lead to significant change in flows or water levels downstream that could impact on the general area of conservation. The Mersey Estuary SSSI, however, is approximately 9.2km downstream from the Sankey Brook abstraction point via the Mersey River which could potentially be impacted by the abstraction of 10 Ml/d or more depending on the development of the option. Landscape (construction): not applicable for review of river abstraction dominated options.
WR009 - River Rawthey to Watchgate WTW	✓	✓		✓	✓	✓		This option would involve the development of a new abstraction/intake point on the River Rawthey near Sedbergh in order to abstract and transfer an average of 15 Ml/d to Watchgate WTW via a new raw water main (circa15.5km in length). Ancillary infrastructure including two new pumping stations would also be delivered to facilitate the transfer of water to the Watchgate WTW. Modifications to the Watchgate WTW would be necessary to accommodate the increased raw water input from this option. Traffic: Construction works along pipeline route may result in congestion where road crossings are needed. Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: River Rawthey close to tourism centre of Sedberg. Within Yorkshire Dales National Park and 5 miles from M6. Dales Way Long Distance footpath runs along north bank and a golf course lies on south bank. Many local facilities and good access. Used by canoers downstream. Angling: Fishing covered by Sedberg Anglers. Day tickets available. Fishing for brown trout, sea trout and salmon. Biodiversity (rivers): Abstraction from the River Rawthey may lead to significant change in flows or water levels downstream that could impact on the general area of conservation. Landscape (construction): not applicable for review of river abstraction dominated options.
WR026a River Ribble (Stocks Reservoir)	✓	✓		✓	✓	✓		This option would involve the development of a new abstraction/intake point on the River Ribble near Clitheroe in order to abstract and transfer an average of 6.67 Ml/d to Stocks IR via a new raw water main (circa 15km in length). Ancillary infrastructure would also be installed to facilitate the transfer of water to Stocks IR including a new pumping station and a new break pressure tank. Traffic: New raw water main route requires several road crossings which may cause local congestion impacts. Formal recreation: not applicable for review of non-reservoir dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Informal recreation: Excavation could impact the visual amenity of the site for visitors during construction whilst new above ground infrastructure could impact enjoyment during operation. Angling: Salmon fishing is found on the River Ribble which may be impacts by this option. Biodiversity (rivers): During construction proposed pipeline directly traverses a SSSI which may affect its integrity. SAC impacts are deemed to be minimal with appropriate mitigation. Operational impact on biodiversity uncertain. Perhaps constrained to local River Ribble. Downstream SPA/Ramsar are less likely to be impacted due to other tributaries feeding in along route, masking the impact. Landscape (construction): not applicable for review of river abstraction dominated options.
WR037a Haweswater IR 0.5m	✓			✓		✓		This option would involve the raising of Haweswater IR dam by 0.5m to increase water storage. Ancillary refurbishments and structural modifications would be required to accommodate the increased storage capacity of the reservoir including: raising of the reservoir's inlet tower and access bridge; installation of a new steelwork platform at the spillway; increase in the size of the existing stilling pools downstream of the dam; a new road bridge; minor perimeter works to the reservoir (7.5km); and remedial works to the proposed site compound. Traffic: Traffic impacts deemed to be negligible due to an absence of works directly affecting roads. Formal recreation: No impact on formal water based recreation considered likely as a result of raising water level. Informal recreation: It is expected that there will be a temporary restriction of use/access for recreational activities such as walking or fishing during the construction period. Angling: No effect on angling aside from temporary restriction on access during construction. Biodiversity (rivers): Impacts arising during construction may affect Naddle Forest SSSI and white clawed crayfish downstream of the scheme. Landscape (construction): not applicable for review for reservoir dominated options.
WR037b Haweswater IR 1m	✓			✓		✓		This option would involve the raising of Haweswater IR dam by 1.0m to increase water storage. Ancillary refurbishments and structural modifications would be required to accommodate the increased storage capacity of the reservoir including: raising of the reservoir's inlet tower and access bridge; installation of a new steelwork platform at the spillway; increase in the size of the existing stilling pools downstream of the dam; a new road bridge; minor perimeter works to the reservoir (7.5km); and remedial works to the proposed site compound. Traffic: Traffic impacts deemed to be negligible due to an absence of works directly affecting roads. Formal recreation: No impact on formal water based recreation considered likely as a result of raising water level.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Informal recreation: It is expected that there will be a temporary restriction of use/access for recreational activities such as walking or fishing during the construction period. Angling: No effect on angling aside from temporary restriction on access during construction. Biodiversity (rivers): Impacts arising during construction may affect Naddle Forest SSSI and white clawed crayfish downstream of the scheme. Landscape (construction): not applicable for review for reservoir dominated options.
WR039a River Eden (Temple Sowerby) to Watchgate	✓	✓			✓	✓		This option would involve the development of a new abstraction/intake point and pumping station on the River Eden within the vicinity of Temple Sowerby in order to abstract and transfer up to 50 Ml/d of water to a new upfront WTW situated on the existing Watchgate WTW site via a new 47km raw water main. Traffic: Numerous crossings of minor unclassified roads (30 noted within the option scope) and 5 B-roads may cause congestion impacts. Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: Impacts expected to be small and limited to the construction phase only. Angling: A decrease in water volume in the River Eden may impact angling. Brown Trout, Salmon, Sea Trout, Grayling. Biodiversity (rivers): The River Eden SSSI/SAC supports a diverse range aquatic European designated species which may be adversely impacted by reduced flows in addition to local river fish and flora, riverine macrophytes, and in-river habitats. Landscape (construction): not applicable for review of river abstraction dominated options.
WR041 River Irthing to Cumwhinton	✓	✓		✓	✓	✓		This option would involve the development of a new abstraction/intake point and pumping station on the River Irthing at Newby East in order to abstract and transfer 6.5 Ml/d of water to Cumwhinton WTW via a new 9.59km raw water main. Modifications to Cumwhinton WTW may be necessary to accommodate the increased raw water input from the River Irthing. Treated output from Cumwhinton WTW would subsequently be transferred to Castle Carrock SR via a new 10.1km treated water main and pumping station. Modifications to Castle Carrock SR (a secondary disinfection process at its outlet in order to maintain water quality compliance) would most likely be required. Traffic: Minor traffic impacts arising from road crossings. Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: Proximate recreational users of the River Irthing may perceive abstraction as an adverse alteration to the river's setting and visual amenity. Angling: Trout fishing along the River Irthing and downstream on the River Eden may be affected by new abstraction.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Biodiversity (rivers): It is currently unknown whether the abstraction of 6.5 Ml/d of water from the River Irthing would have an adverse effect on the river's ability to support its local populations of aquatic flora and fauna, and furthermore, whether abstraction would adversely affect the River Eden and Tributaries SSSI/SAC's designated flora and fauna features. Landscape (construction): not applicable for review of river abstraction dominated options.
WR047a Milwr Tunnel Bagillt (River Alyn)	✓	✓						This option would involve the development of a new abstraction/intake point on the Milwr Tunnel at Bagillt in order to abstract and transfer 70 Ml/d for treatment at Huntington WTW via a new 31km raw water main and ancillary pumping stations. Huntington WTW would require modifications and structural enlargement in order to accommodate the increased raw water input. Traffic: 13 minor road crossings are noted within the option scope, which may give rise to minor congestion impacts during a short period in construction. Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: The option is not expected to significantly affect recreation or visitors. Angling: There are no angling clubs in the vicinity of the site. Biodiversity (rivers): It is not expected that the option would impact any designated or non-designated environments. Landscape (construction): not applicable for review of river abstraction dominated options.
WR049b - River Ribble (Transfer to Anglezarke IR) 40ML/D	✓	✓			✓	✓		This option would involve the provision of a new river intake, screen and pumping station on the River Ribble at Samlesbury. Subject to obtaining an abstraction licence, the scheme would abstract 30 - 40 Ml/d of raw water from the River Ribble to transfer to the Anglezarke IR for primary treatment at Rivington WTW via 15.5km of pipeline. Traffic: 4 A-road crossings are noted which may result on congestion impacts. Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: This area is considered a reduced quality urban environment. No significant impacts on recreation are expected as a result of this option. Angling: There are local course fishing clubs in the vicinity of the proposed abstraction point which may be impacted by a new operation on the River Ribble. Biodiversity (rivers): The new discharge point at the Anglezarke IR is directly adjacent to the West Pennine Moors SSSI although it is uncertain whether the additional influx of raw water within the reservoir will have any adverse impacts on habitats or wildlife within the SSSI site. Landscape (construction): not applicable for review of river abstraction dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
WR062a Worthington WTW (Prospect SR)	✓		✓	✓				This option would involve the recommissioning of the Worthington WTW in order to treat up to 12 Ml/d of raw water. The proposed scheme would utilise existing infrastructure and treatment processes to abstract and treat the raw water. Treated water output from the WTW would be transferred to Prospect SR via existing treated water mains. Traffic: It is not expected that there would be significant impacts on traffic congestion during the construction period. - work is for upgrading the WTW within the existing footprint and resumption of abstraction. Formal recreation: Reservoir levels may be affected by this option and is used for walking and fishing. Informal recreation: Local interest for walking may be disrupted as a result of changed operations in the reservoir. Angling: Impacts on angling are unclear. Biodiversity (rivers): Possible change to characteristics for reservoir due to renewed abstraction, however, this is uncertain. Landscape (construction): not applicable for review for reservoir dominated options.
WR062b Worthington WTW to Rivington WTW	✓	✓	✓	✓				This option would utilise existing intake infrastructure to transfer up to 12 Ml/d of raw and/or partially treated water from Worthington IR to Rivington WTW via a new 6.5km water main. Traffic: It is expected that there would be impacts on traffic congestion during the construction period (particularly on the A6, M61, and A673). Formal recreation: Reservoir levels may be affected by this option and is used for walking and fishing. Informal recreation: No significant effect on informal recreation other than possible temporary effect on Liverpool-Leeds canal towpath and Wigan Golf course Angling: Impacts on angling are unclear. Biodiversity (rivers): Significant biodiversity impacts are not expected from this option. Landscape (construction): not applicable for review for reservoir dominated options.
WR074- River Darwen	✓	✓				✓		This option would involve the development of a new abstraction/intake point on the River Darwen near Roach Bridge in order to abstract and transfer 10 Ml/d to Fishmoor IR via a new raw water main (14.7km in length). Ancillary infrastructure would also be installed to facilitate the operation of this option including a new pumping station and intake screens on the abstraction site. Traffic: Large portions of the new raw water main are expected to involve works with a likelihood of temporarily disrupting traffic. Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: The scheme is not expected to significantly affect recreational visitors.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Angling: No angling clubs within the vicinity of the site. Biodiversity (rivers): It is unknown whether abstraction will impact statutory conservation sites further downstream such as the Ribble Estuary SSSI (16.5km) or habitats adjacent to the river such as Beeston Wood, Rass Wood, and Holland Wood which may support wildlife dependent upon the river. Landscape (construction): not applicable for review of river abstraction dominated options.
WR076 River Bollin	✓	✓			✓	✓		This option would involve the provision of a new river abstraction and intake on the River Bollin in the vicinity of Lymm. In addition, a new WTW facility at the same location would be required together with a pumping station and treated water main (circa 6.5km in length) to transfer water to Dunham SR. Traffic: Very minor impacts on congestion expected as a result of pipeline construction. Majority of route away from roads or on disused railway/cycle track. Formal recreation: Informal recreation: No effect on recreational activities expected. Angling: Bay Malton Angling Club may be affected by reduced river flows. Coarse fishing. Biodiversity (rivers): There may be effects on biodiversity downstream as a result of reduced river flow. Landscape (construction): not applicable for review of river abstraction dominated options.
WR079b - Appleton IR (6 ML/D)	✓	✓	✓		✓			This option would involve the reinstatement of Appleton Reservoir comprising a new or refurbished abstraction point at the draw-off tower on its northern embankment and a new raw water pumping station. A new raw water main would be constructed to connect Appleton Reservoir to a new WTW at Hill Cliffe SR. Traffic: New raw water main route primarily off-road. Direct impacts to roads (other than general construction vehicle movements) appears limited to 1 minor road crossing. Formal recreation: Changes to abstraction from reservoir may affect recreational users, although it is not clear if the site is used beyond anglers. Informal recreation: Beyond some potential temporary impact during construction on two footpaths and a gold course close to the new pipeline route, operational impacts on informal recreation are not expected. Angling: Appleton reservoir is used by a private member angling club. Of the three similar options presented here WR079b has the lowest proposed abstraction. However, there may yet be some impact on angling activity as a result of renewed abstraction from the reservoir. Biodiversity (rivers): Links between the reservoir and downstream watercourses is not clear. Some impact on downstream biodiversity may therefore be possible but it is not thought to be significant. Landscape (construction): not applicable for review for reservoir dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
WR079c - Appleton IR (9 ML/D)	✓	✓	✓		✓			This option would involve the reinstatement of Appleton Reservoir comprising a new or refurbished abstraction point at the draw-off tower on its northern embankment and a new raw water pumping station. A new raw water main would be constructed to connect Appleton Reservoir to a new WTW at Hill Cliffe SR. Traffic: New raw water main route primarily off-road. Direct impacts to roads (other than general construction vehicle movements) appears limited to 1 minor road crossing. Formal recreation: Changes to abstraction from reservoir may affect recreational users, although it is not clear if the site is used beyond anglers. Informal recreation: Beyond some potential temporary impact during construction on two footpaths and a gold course close to the new pipeline route, operational impacts on informal recreation are not expected. Angling: Appleton reservoir is used by a private member angling club. Of the three similar options presented here WR079b has the lowest proposed abstraction. However, there may yet be some impact on angling activity as a result of renewed abstraction from the reservoir. Biodiversity (rivers): Links between the reservoir and downstream watercourses is not clear. Some impact on downstream biodiversity may therefore be possible but it is not thought to be significant. Landscape (construction): not applicable for review for reservoir dominated options.
WR079d - Appleton IR (12.5 ML/D)	✓	✓	✓		✓			This option would involve the reinstatement of Appleton Reservoir comprising a new or refurbished abstraction point at the draw-off tower on its northern embankment and a new raw water pumping station. A new raw water main would be constructed to connect Appleton Reservoir to a new WTW at Hill Cliffe SR. Traffic: New raw water main route primarily off-road. Direct impacts to roads (other than general construction vehicle movements) appears limited to 1 minor road crossing. Formal recreation: Changes to abstraction from reservoir may affect recreational users, although it is not clear if the site is used beyond anglers. Informal recreation: Beyond some potential temporary impact during construction on two footpaths and a gold course close to the new pipeline route, operational impacts on informal recreation are not expected. Angling: Appleton reservoir is used by a private member angling club. Of the three similar options presented here WR079b has the lowest proposed abstraction. However, there may yet be some impact on angling activity as a result of renewed abstraction from the reservoir. Biodiversity (rivers): Links between the reservoir and downstream watercourses is not clear. Some impact on downstream biodiversity may therefore be possible but it is not thought to be significant. Landscape (construction): not applicable for review for reservoir dominated options.
WR095 Roughton Gill	✓	✓						This option would involve the reinstatement of the Roughton Gill mine abstraction source in order to abstract and transfer 1.5 Ml/d to a new

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								WTW situated at Caldbeck SR via the existing raw water main network (310m of new pipeline would additionally be required). Treated output would subsequently be transferred to Caldbeck SR (on-site) and Roundhills SR via a new 4.5km treated water main. Traffic: works involved in the construction of a new treater water main involve a number of road crossing which may cause congestion impacts. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR099a Worsthorne Borehole (compensation)	✓							This option comprises the recommissioning and refurbishment of Worsthorne borehole providing a yield of up to 4 Ml/d. Refurbishments would include a new pump, new/improved headworks, and the construction of a new 400m extension of the existing raw water main to divert flow into the River Brun as a compensation flow. Traffic: Laying of 375m of new pipework during construction could generate temporary disruption of the local road network but impacts are not expected to be significant. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR099b Worsthorne Borehole (Hurstwood IR)	✓							This option comprises the recommissioning and refurbishment of Worsthorne borehole in order to abstract a maximum capacity of 4 Ml/d. Refurbishments would include a new pump, new/improved headworks and mechanical and electrical systems (M & E) together with the construction of a new 1.1km main to transfer water to Hurstwood IR. Traffic: Infrastructure route entirely off road. Length of road impacted is zero. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR099c Worsthorne Borehole (WTW)	✓							This option comprises the recommissioning and refurbishment of Worsthorne borehole. Refurbishments would include a new pump, new/improved headworks and M & E. The option would utilise the existing raw water mains to Worsthorne WTW where treatment processes would be modified to accommodate up to 4 Ml/d of water from the borehole. Traffic: Works associated are contained on site. No traffic impacts expected. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR100 Thorncliffe Road Boreholes, Barrow	✓	✓						This option would involve the development of a new duplicate borehole at the Thorncliffe Road WTW site in addition to a new WTW. A new inlet to Thorncliffe Road SR would be developed to facilitate the transfer of a cumulative 9 Ml/d of treated water from the new and existing boreholes. Once operational, the new borehole/WTW would abstract, treat, and transfer 4.5 Ml/d to Thorncliffe SR via a new 92m treated water main. In conjunction with this scheme, abstraction from the Schneider Road boreholes would be reduced in order to ensure no deterioration in WFD objectives for the Furness aquifer. Traffic: Construction of new treated water main involves limited road works which may cause traffic disruption. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR101 Franklaw	✓							This option would involve the reinstatement and refurbishment of two existing boreholes at the Franklaw Z site in order to abstract and transfer a maximum of 18 Ml/d of raw groundwater to the existing Franklaw WTW via an existing raw water pipeline. Additionally, new borehole pumps would be installed at 10 other existing/utilised

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Franklaw/Broughton boreholes in order to abstract an additional 12 Ml/d and the capacity of Franklaw WTW would be increased. Traffic: Congestion impacts likely to be limited only to works vehicles' presence on the roads. No direct works taking place on road network. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR102ai - Widnes Boreholes to Prescot (with softening)	✓	✓						This option comprises the refurbishment of Belle Vale, Netherley, Greensbridge Lane, Water Lane, Stockswell and Pex Hill borehole sites, which are currently out of service. Additional refurbishment at Pex Hill would introduce a new break tank and pumping station, refurbishment of Cronton Booster pumping station to permit required flow transfer to Pex Hill, and two new watermains: one pipeline connecting Pex Hill to the Prescot WTW (7.2km) and the other from Pex Hill to DMA 127-1 (6.1km). New WTW plant at Prescot would be developed to treat the blended water from the open reservoirs and boreholes. Traffic: This option utilises public highways for the Pex Hill to Prescot WTW pipeline route. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR102a Widnes Boreholes to Prescot	✓	✓						This option comprises the refurbishment of Belle Vale, Netherley, Greensbridge Lane, Water Lane, Stockswell and Pex Hill borehole sites, which are currently out of service. Additional refurbishment at Pex Hill would introduce a new break tank and pumping station, refurbishment of Cronton Booster pumping station to permit required flow transfer to Pex Hill, and two new water mains: one pipeline connecting Pex Hill to Prescot WTW (7.2km) and the other from Pex Hill to District Metered Area (DMA) 127-1 (6.1km). New WTW plant at Prescot would be developed to treat the blended water from the open reservoirs and boreholes. Traffic: This option utilises public highways for the Pex Hill to Prescot WTW pipeline route. Formal recreation: not applicable for review of groundwater dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR102b - Widnes Boreholes to Liverpool and Warrington	✓	✓						This option comprises the refurbishment of Belle Vale, Netherley, Greensbridge Lane, Water Lane, Stockswell and Pex Hill borehole sites. Development within the Liverpool District Metred Zone (DMZ) would include an upgrade to Netherley WTW in order to treat the combined raw water transfer from Belle Vale, Netherley, Water Lane, and Greensbridge Lane, a new pumping station at Netherley, and new treated water mains between Netherley WTW and Woolton Hill SR and Speke SR (approx. 4.4km) and Pex Hill to DMA 127-1 (6.1km). Development within the Warrington DMZ would include the refurbishment of Stockswell WTW, a new WTW at Pex Hill, slip lining of the existing treated water main between the Stockswell WTW and Pex Hill, and the abandonment of the Cronton Booster pumping station. Traffic: No specific information on pipeline routes available. However, the route does follow the routes of several B-roads and crosses several roads in suburban areas which may involve works causing temporary traffic disruption. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR102d Eccleston Hill Borehole to Prescot	✓							This option comprises the refurbishment of Eccleston Hill boreholes and the construction of a new 1.5km raw water main to the Prescot open reservoirs. Traffic: It is not expected that there would be significant impacts on traffic congestion during the construction period. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Landscape (construction): not applicable for review of groundwater dominated options.
WR102e Bold Heath Boreholes to Prescot	✓	✓						This option comprises the recommissioning of Bold Heath boreholes and the construction of a new 9km raw water main to Prescot WTW. Traffic: The laying of 9km of new pipework during construction could adversely impact ease of access to the local transportation networks Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR105ai - Lymm Boreholes to Sow Brook (with softening)	✓							This option would involve the decommissioning of Lymm WTW while intensifying the operation of the Quarry and Dingle boreholes. Utilising existing raw water mains and pumping infrastructure, the 9.1 Ml/d from the Lymm boreholes would be transferred and treated at a new WTW at Sow Brook. Output from the new WTW would be pumped into an existing treated water main and transferred to the Manchester DMZ. This option would include water softening within the treatment process. Traffic: No direct works affecting roads are seen within the scope of this option. Congestion impacts likely to be limited only to works vehicles' presence on the roads. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR105a - Lymm Boreholes to Sow Brook (without softening)	✓							This option would involve the decommissioning of Lymm WTW while intensifying the operation of the Quarry and Dingle boreholes. Utilising existing raw water mains and pumping infrastructure, the 9.1 Ml/d from the Lymm boreholes would be transferred and treated at a new WTW at Sow Brook. Output from the new WTW would be pumped into an existing treated water main and transferred to the Manchester DMZ. Traffic: No direct works affecting roads are seen within the scope of this option. Congestion impacts likely to be limited only to works vehicles' presence on the roads. Formal recreation: not applicable for review of groundwater dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR105b - Lymm Boreholes (Hill Cliffe)	✓	✓						It is expected that there would be impacts on traffic congestion during the construction period (particularly on segments of the A56, A50, A49 and local roads such as Weaste Lane, Broad Lane, Witherwin Avenue, Broom Avenue, and Windmill Lane), the transportation of equipment/material and the excavation of pipeline under segments of the local road network could temporarily increase congestion and disruption/driver delay. In the absence of detailed route information in the engineering scopes, assumed that 5% of the length of the pipeline route could potentially impact on congestion.
WR106 Walton and Daresbury Boreholes	✓	✓						This option would involve the reinstatement and refurbishment of existing boreholes at Walton and Daresbury. A new raw water main (approximately 3.6km in length) would be constructed between the Walton and Daresbury borehole sites as well as a new 500m main between Hill Cliffe SR and a new WTW at Hill Cliffe. Traffic: works involved in the construction of a new water main involve a number of road crossing which may cause congestion impacts. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR107b Randles Bridge Knowsley Primrose Hill	✓	✓						This option would involve the recommissioning of the Randles Bridge boreholes, Knowsley boreholes, and the Primrose Hill borehole. A cumulative 12 Ml/d of raw water would be abstracted and transferred to Royal Oak WTW via new raw water mains: Randles Bridge/Knowsley main (14.2km) and Primrose Hill main (8.9km). Royal Oak WTW's treatment processes would be modified to accommodate the increased 12 Ml/d input (54 Ml/d to 65 Ml/d). Additional modifications to Royal Oak WTW's output and distribution network would occur as appropriate to permit the WTW's increased capacity to function within the Southport and Liverpool DMZs. Traffic: Pipeline excavation in addition to the transportation of equipment/material could temporarily increase congestion and disruption/driver delay on the regional and local road networks Formal recreation: not applicable for review of groundwater dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR109 Swineshaw Boreholes	✓							This option involves the recommissioning and refurbishment of three existing boreholes located on the Swineshaw Brook catchment and the transfer of up to 4 Ml/d (1.33 Ml/d per borehole) of raw water to Buckton Castle WTW via existing raw water transfer infrastructure. Traffic: Any traffic congestion associated with transferring material/equipment to the sites would be localised and short term-negligible. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR111 Woodford Borehole	✓	✓						This option would involve increasing the capacity of Woodford borehole from 9 Ml/d to 12 Ml/d. The option would also require a new WTW at Hazel Grove SR and (potentially) circa 7.8km of upgraded pipeline. Traffic: Engineering scope for this option suggests that sections of the upgraded pipeline would require direct road works. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR112 Bramhall Borehole	✓	✓						This option would involve the development of a new borehole and pumping stations within the Bramhall area in order to abstract an average of 5 Ml/d. A new 5.3km raw water main, partially following the existing Woodford – Hazel Grove SR main, would transfer raw water from the Bramhall borehole to a new WTW adjacent to Hazel Grove SR.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Traffic: Engineering scope for this option suggests that sections of the upgraded pipeline would require direct road works. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR113 Tytherington Boreholes	✓	✓						This option would involve the replacement of an existing treated water main between Tytherington WTW and Hurdsfield SR to permit an additional 3 Ml/d treated water transfer to existing storage. It would also comprise the replacement of existing borehole pumps at Tytherington and modifications to the WTW. Traffic: Engineering scope for this option suggests that sections of the upgraded pipeline would require direct road works in urban areas. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR114 Python Mill Borehole PBD	✓	✓						This option comprises the reinstatement and refurbishment of Python Mill borehole and the transfer of raw water to Rochdale Canal, offsetting compensation from the Chelburn system. It would also require 3km of new transfer pipeline along a road from Python Mill to Rochdale Canal. A new discharge scour into the canal and new sewer connection at Python Mill would also be required. Traffic: Excavation works for new transfer pipeline are expected to cause traffic disruption. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
WR119a Egremont Boreholes (Existing)	✓	✓						This option would involve the continued use of the South Egremont boreholes (Merry Hill, Kellhead, Gulley Flatts, and Black Ling) and associated pipeline network to abstract and transfer 11 Ml/d to Ennerdale WTW and Nannycatch SR. This option proposes a new WTW at Nannycatch and a new treated water main between the Nannycatch WTW and High Leys SR. Traffic (construction) - no detailed information in the scope concerning the route. However, a new transfer pipeline linking Nannycatch and High Leys WTWs is said to cross 1 road (and another by tunnelling). It is not clear how much of the pipeline route will require direct in-road works. Much of the route appears to cross rural land. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR119b Egremont Boreholes (New)	✓	✓						This option would involve the continued use of the South Egremont boreholes (Merry Hill, Kellhead, Gulley Flatts, and Black Ling) as well as the development of three new boreholes located at Sandwith, Rottington and Moor Platts. The Catgill borehole would also be refurbished. A new raw water main would transfer water from the new and refurbished boreholes to the Catgill site, and then subsequently to the Nannycatch SR. A new WTW at Nannycatch and a new treated water main between the Nannycatch WTW and High Leys SR would be developed to treat and transfer a combined 21 Ml/d from the new and existing boreholes. Traffic (construction) - no detailed information in the scope concerning the route. However, a new transfer pipeline linking Nannycatch and High Leys WTWs is said to cross 1 road (and another by tunnelling) (as for WR019a). In addition, this option requires new transfer from 3 other Boreholes. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR120i Cross Hill Boreholes	✓							This option would involve the construction of three new boreholes and a new WTW at Cross Hill SR, located at Thingwall on the Wirral, in order to abstract/transfer 15 Ml/d. Additionally, the revocation of existing abstraction licences at Hooton, Gorston, and Springhill would be included within the abstraction licence proposal. It should be noted

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								that water softening (ion exchange) is included within the treatment process for this option. Traffic (construction): No significant impact expected due to there being limited pipeline requirements beyond existing sites. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR121a Eaton Borehole (Hollins Hill)	✓							This option would involve the reinstatement and refurbishment of the two Eaton boreholes and development of a new WTW at the site. Once operational, up to 6.7 Ml/d of treated water would be transferred to Hollins Hill SR via an existing main, sections of which may need to be replaced. Traffic (construction): Uncertainty around the level of work required to replace existing mains mean that traffic impacts are not clear. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR121b - Eaton Borehole (mid Cheshire main)	✓							This option would involve the reinstatement and refurbishment of the two Eaton boreholes and development of a new WTW at the site. Once operational, up to 6.7 Ml/d of treated water would be transferred to the Mid Cheshire Main via an existing main, sections of which may need to be replaced. Traffic (construction): Uncertainty around the level of work required to replace existing mains mean that traffic impacts are not clear. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Landscape (construction): not applicable for review of groundwater dominated options.
WR122 - Newton Hollows Boreholes	✓							This option would involve reinstating and refurbishing three boreholes at Newton Hollows. A new WTW within the existing WTW site would be required together with three new borehole pumps, rising main and headworks on the new boreholes. An existing main between the WTW and Harrol Edge SR would be recommissioned as part of the scheme. Traffic (construction): Works contained on site and utilising existing mains. No significant impact. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR125 Bearstone Boreholes	✓							This option would involve the reinstatement and refurbishment of two of the three Bearstone boreholes. Bearstone WTW's treatment processes would be modified to accommodate the increased abstraction output. The cumulative output from Bearstone WTW would be transferred to Woore Ash SR via an existing 3.4km treated main though pipeline modification may be required. Similarly, a new outlet booster pumping station may be included within the scheme if required. Traffic (construction): Majority of works contained on site and utilising existing mains. No significant impact. Uncertainty around the level of work required modify existing mains mean that traffic impacts are not clear. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR128 Tarn Wood (North Eden to Carlisle)	✓	✓						This option would involve the installation of new borehole pumps at Tarn Wood WTW to augment the current maximum flow of 2.3 Ml/d to 4 Ml/d, an increase of 1.7 Ml/d. The scheme would require a new pumping station at Tarn Wood and a new circa 14km main to Cumwhinton WTW. Traffic (construction): In the absence of detailed route information in the engineering scopes, assumed that 10% of the length of the pipeline route could potentially impact on congestion.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR129 North Cumbria Boreholes	✓	✓						This option would involve the continued abstraction and transfer of 6 Ml/d from the three Scales boreholes to Quarry Hill WTW. Additionally, new boreholes would be developed at Waverton and Thursby with each borehole producing 2 Ml/d. New raw water mains (15.8km combined) would transfer water from both boreholes to a new blending tank and then to Quarry Hill WTW which would be refurbished to treat the combined 10 Ml/d from all five boreholes. Treated water would then be transferred to Moota Hill SR via a new treated water main (9.8km). Traffic (construction): Engineering scope sets out lengths of pipe laying in-road: Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR140 Horwich EFR	✓					✓		This option would involve the development of a new abstraction/intake point on Pearl Brook/the River Douglas in order to abstract and transfer final effluent from Horwich WwTW to Rivington WTW via a new 2km raw water main and pumping station. Rivington WTW would be modified in order to provide new operational processes required to treat raw river water/effluent to potable water quality standards. Treated water (5 Ml/d) would then be transferred into an existing distribution system from Rivington WTW. Traffic: One crossing of Anderton Lane during pipeline construction not expected to cause congestion impacts Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: No effect on recreational activities expected. Angling: No angling clubs in the vicinity. Biodiversity (rivers): It is unknown whether the abstraction will have an adverse effect on the rivers ability to support its population of aquatic flora and fauna. Further investigation is required.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Landscape (construction): not applicable for review of non-infrastructure dominated options.
WR141 Rossendale EFR	✓	✓		✓		✓		This option would involve the development of a new abstraction/intake point on the River Irwell in order to abstract and transfer final effluent from Rossendale WwTW to Townsend Fold WTW via a new 2.2km raw water main and pumping station. Townsend Fold WTW would be modified in order to provide new operational processes required to treat raw river water/effluent to potable water quality standards. Treated water would then be transferred into an existing distribution system. Traffic: Construction of new water main is noted to require some road works. 565m on open cut along Irwell Rd and B6527 Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: Temporary disruption or loss of amenity to grounds local to construction vicinity which may host recreational walking and sport. Angling: No angling clubs in close proximity. Although, water levels may affect trout numbers in River Douglas. Biodiversity (rivers): It is currently unknown whether the abstraction of 10 Ml/d of water from the River Irwell could have an adverse effect on the river's ability to support its populations of aquatic flora and fauna or to proximate downstream habitats and wildlife dependent upon the river. Landscape (construction): not applicable for review of non-infrastructure dominated options.
WR142 Hyndburn EFR	✓	✓				✓		This option would involve the development of a new abstraction/intake point on the River Calder in order to abstract and transfer final effluent from Hyndburn WwTW to Martholme WTW via a new 2.1km raw water main and pumping station. Martholme WTW would be modified in order to provide new operational processes required to treat raw river water/effluent to potable water quality standards. Treated water would then be transferred into the existing distribution system. Traffic: The majority of new pipeline route is off-road. Limited congestion impact only for 1 unclassified road crossing Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: No affect on recreational activities expected. Angling: No angling clubs in close proximity. Biodiversity (rivers): Downstream from the River Calder abstraction point could potentially be impacted by the abstraction of 10 Ml/d, however, the various intervening tributaries which feed into the wider water system and the relative distance between these sites may help mitigate any adverse impacts on water volume. Landscape (construction): not applicable for review of non-infrastructure dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
WR144 Saddleworth Mossley Top	✓	✓		✓		✓		This option would involve the development of a new abstraction/intake point on the River Tame in order to abstract and transfer final effluent from Mossley Top WwTW and Saddleworth WwTW to Buckton Castle WTW via a new 2.9km raw water main and pumping station. Buckton Castle WTW would be modified in order to accommodate the increased raw water input as well as to provide new operational processes required to treat raw river water/effluent to potable water quality standards. Treated water would then be transferred into the existing distribution system from Buckton Castle WTW. Traffic: New pipeline route is noted to require direct road works, potentially leading to minor congestion impact. Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: Mapping indicates there are several recreational walking paths along the river tame, although it is uncertain whether walkers would perceive the proposed abstraction of 5Ml/d. Angling: No angling clubs in close proximity. Biodiversity (rivers): It is currently unknown whether the abstraction of 5 Ml/d of water from the River Irwell could have an adverse effect on the Tame's ability to support its populations of aquatic flora and fauna or to proximate downstream habitats and wildlife dependent upon the river. Landscape (construction): not applicable for review of non-infrastructure dominated options.
WR146 Davyhulme EFR	✓			✓		✓		This option would involve the development of a new storage tank and pumping station within the vicinity of the Davyhulme WwTW facility in order to abstract and transfer 159 Ml of final effluent to a new WTW and SR on-site via a new 400m raw water main. The new WTW would be required to treat final effluent to potable water quality standards. Treated water would then be transferred into an existing treated water network for Manchester. Traffic: This is effectively a direct effluent reuse scheme with no offsite impacts arising from pipeline developments that might otherwise affect traffic. Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: Temporary disruption and loss of amenity to the grounds local to construction. Davyhulme nature reserve, Salteye walking path and Ship canal towpath. Angling: No angling clubs in close proximity. Biodiversity (rivers): Mersey Estuary Ramsar/SSSI/SPA, approx. 29km downstream from the scheme, is classified as an internationally significant feeding/roosting site for local wildfowl and waders thus a reduction in water quality and any subsequent impact on food resources could interfere with conservation efforts. Unlikely impact on European designations based on available info, but would require further investigation. The proposed works, construction could potentially result in minor temporary impacts on the habitats and wildlife supported by the Nature Reserve such as air pollution (dust), noise disturbance, and disruption of wildlife movement in/out of the site.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Landscape (construction): not applicable for review of non-infrastructure dominated options.
WR148 Cumwhinton Boreholes Castle Carrock Link	✓							This option would involve the development of 2 new boreholes at Cumwhinton WTW in order to abstract a cumulative 6.5 Ml/d (3.25 Ml/d per borehole). Output from these boreholes would be transferred to Cumwhinton WTW via an existing raw water main. It should be noted that Cumwhinton WTW may need further modification to accommodate the increased raw water input from the new boreholes. Treated output from Cumwhinton WTW would subsequently be transferred to Castle Carrock SR via a new 10.5km treated water main and pumping station. Modifications to Castle Carrock SR (a secondary disinfection process at its outlet in order to maintain water quality compliance) would most likely be required. Traffic: works involved in the construction of a new treated water main are not expected to affect traffic significantly. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR150 Castle Carrock Dead water	✓			✓	✓	✓		This option would involve modification to the Castle Carrock impounding reservoir (IR) draw-off tower in order to abstract and transfer an additional 6 Ml/d to Castle Carrock WTW via a new dead water abstraction process and associated pipeline works. Traffic: Works that might otherwise generate traffic impacts are to take place on existing site only. Formal recreation: not applicable for review of non-reservoir dominated options. Informal recreation: OS mapping indicates there are several recreational walking paths around the reservoir, although it is uncertain whether walkers would perceive the proposed abstraction of 6Ml/d. Angling: Angling within Castle Carrock reservoir may be impacted but this depends on the scale of effect arising from the abstraction of an additional 6 Ml/d. Biodiversity (rivers): A permanent reduction in water level of both Castle Carrock Reservoir and Castle Carrock Beck could potentially impact local ecosystems in addition to designated avifauna associated with the River Eden and Tributaries SSSI/SAC and Geltsdale & Glendue Fells SSSI – North Pennine Moors SAC/SPA which may use the reservoir as a secondary habitat. Landscape (construction): not applicable for review of non-infrastructure dominated options.
WR153 Simmonds Hill	✓	✓						This option would involve the reinstatement and refurbishment of the Helsby boreholes in order to abstract and transfer 3 Ml/d to the Foxhill

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								WTW via a new 1.6km raw main between the Helsby SR and the Foxhill facility. Foxhill borehole would also be reinstated. Foxhill WTW's disinfection process would be modified with water transferred from the WTW to Simmonds Hill WTW via an existing treated water main. Additionally, Mouldsworth, Manley Common, Manley Quarry, and Five Crosses boreholes would be refurbished to abstract an additional 5 Ml/d of water which would also be transferred to Simmonds Hill WTW via existing water infrastructure. Simmonds Hill WTW would be modified to increase its existing capacity. Traffic: It is expected that there would be impacts from traffic congestion during the construction period. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR800 River Bela to Thirlmere Aqueduct	✓	✓			✓	✓		This option would involve an abstraction trade from an existing non-water industry abstraction licence holder abstracting from the River Bela. It would require the development of a new abstraction/intake point on the River Bela at Bela Mill in order to abstract and transfer 4.5 Ml/d of water to Thirlmere Aqueduct (Lupton North Well) via a new pumping station and 8.5km raw water main. Traffic: Construction of new raw water main has a route that may create traffic impact. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: Some local amenity/visual value but limited public access to site. No significant impact expected. Angling: Angling controlled by Bela Anglers. Upstream also managed fishery by Milnthorpe Anglers. Biodiversity (rivers): River has some local biodiversity interest that could be affected by changes in flow due to the new abstraction. Landscape (construction): None expected.
WR810 Cow Green IR to Heltondale Aqueduct	✓	✓	✓	✓	✓	✓		This option would involve the development of new abstraction infrastructure and screens at Cow Green Reservoir in order to abstract and transfer 40 Ml/d to the Heltondale Aqueduct via a new pumping station at Cow Green, a new 44.6km raw water main, and 8 new break pressure tanks situated along the route. Abstracted water would then be discharged from the Heltondale Aqueduct into the Haweswater Reservoir. Traffic: A number of road crossings are required as part of the new water main construction which may create traffic impacts.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Formal recreation: Cow Green reservoir is a regional recreation site and the scale of works proposed under this option may impact upon its recreational uses. Informal recreation: Significant construction stage impact on informal recreation due to scale of works. Impacts once operational are likely to be minimal. Angling: Angling takes place at Cow Green Reservoir. Potential for significant impacts on River Tees/Eden/Lyvenet also as a result of downstream release effects. During construction the potential for contamination or pollution of waters is also a risk. Biodiversity (rivers): Risks posed by potential transfer of invasive non-native species (sensitive rivers)/change in flow regime, in particular on R. Tees downstream of reservoir. Landscape (construction): not applicable for review of reservoir dominated options.
WR812 Kielder Water Transfer	✓	✓	✓	✓	✓	✓		This option comprises the transfer of water from Kielder Water in the Northumbrian Water supply region to the United Utilities supply region. Under this option, a new intake structure and screening equipment would be constructed at Kielder Water. A new 40km raw water main with three pumping stations would be constructed from Kielder to transfer water into Heltondale Aqueduct. Traffic: There is limited information provided regarding road crossings or in-road works as part of raw water main construction. The new main traverses many greenfield and natural sites, and appears to cross and involve works on many roads of varying type too. Formal recreation: Kielder Water is a major honeypot site with arrange of activities. The scale of works proposed under this option may impact upon its recreational uses. Informal recreation: Significant construction stage impact on informal recreation due to scale of works. Impacts once operational are likely to be minimal. Angling: Angling takes place at Kielder Reservoir. Potential for significant impacts on River Eden/Irthing/Tyne etc. - significant angling resource Biodiversity (rivers): Risks posed by potential transfer of invasive non-native species (sensitive rivers)/change in flow regime, in particular on North Tyne downstream of reservoir. Landscape (construction): not applicable for review of reservoir dominated options.
WR814a Increased treatment capacity at Huntington WTW	✓							This option would involve a reduction in industrial supply from Heronbridge pumping station on the River Dee, releasing additional capacity for abstraction and treatment at Huntington WTW. The option would require modifications to/expansion of Huntington WTW. Traffic: Traffic congestion impacts not expected to be significant. Works contained. Formal recreation: not applicable for review non-reservoir dominated options. Informal recreation: There are walking route along the River Dee, but the scheme is unlikely to affect them. No significant impact expected.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Angling: No angling clubs in the vicinity. Biodiversity (rivers): May affect nearby Meadow House farm and Heronbridge Roman Site but biodiversity impacts not likely Landscape (construction): None expected.
WR814b Increased treatment capacity at Hurleston WTW via Canal	✓							This option would involve a reduction in industrial supply from Heronbridge pumping station on the River Dee, releasing additional capacity for abstraction and treatment at Hurleston WTW via Llangollen Canal. Treated output would be transferred to the Mid-Cheshire Main located near Nanney's Bridge via existing infrastructure. The option would require modifications to/expansion of Hurleston WTW. Traffic: Traffic congestion impacts not expected to be significant. Works contained. Formal recreation: not applicable for review non-reservoir dominated options. Informal recreation: The operation of a second WTW could be perceived as a minor alteration of the local setting by recreational users of the canal and passing receptors on the A51 although this would depend on the facility's scale and proximity to the existing site. No significant effects likely. Angling: could potentially impact recreational activities on the Llangollen/Shropshire Canal such as angling if abstraction adversely impacts local fish populations (currently unknown). No angling clubs in the vicinity. Biodiversity (rivers): No significant effects expected due to the relative distance from this operation of important sites. Landscape (construction): None expected.
WR814c Increased treatment capacity at Hurleston WTW via Pipeline	✓	✓		✓	✓		✓	This option would involve a reduction in industrial supply from Heronbridge pumping station on the River Dee, releasing additional capacity for abstraction and treatment at Hurleston WTW. Water would be abstracted from the Dee/Llangollen Canal confluence and transferred via a new circa 44km raw water main to the WTW. Treated output would then be transferred to the Mid-Cheshire Main located near Nanney's Bridge via existing infrastructure. The option would require modifications to/expansion of Hurleston WTW and new pumping infrastructure. Traffic: Traffic congestion related to pipeline construction limited to only parts of the route. Engineering workbook suggests 80% off road routes. 5 A-road crossings. Formal recreation: not applicable for review non-reservoir dominated options. Informal recreation: Construction only impacts on local users of river. Angling: could potentially impact recreational activities on the Llangollen/Shropshire Canal such as angling if abstraction adversely impacts local fish populations (currently unknown). No angling clubs in the vicinity. Biodiversity (rivers): During operation, there are uncertain impacts on River Dee and Bala SAC (including protected species (Atlantic Salmon

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								etc). Construction of and modification to abstraction equipment and potential WTW expansion, including direct excavation crossing of River Dee could impact local ecosystem (downstream includes River Dee SSSI, River Dee Bala SAC etc.). Excavation route would impact directly on several SSSIs and Berwyn and S.Clwyd SAC. Landscape (construction): Modification of WTW and potential construction of a new WTW could impact semi-rural greenfield setting and intensified use of area. Approx. 6km of pipe route is within the AONB which could alter the landscape character.
WR816 MBB Canal to Strategic Zone	✓	✓	✓				✓	This option would involve the development of a new abstraction/intake point and pumping station at Elton Reservoir in order to abstract and transfer 10 Ml/d from Manchester, Bolton and Bury Canal to a new WTW on-site via a new 300m raw water main. Treated output from the new WTW would then be transferred to Woodgate Hill SR via a new 4.8km treated water main. Traffic: Traffic congestion related to pipeline construction. Formal recreation: included here due to current use of reservoir for angling/sailing etc. and uncertain impact of new abstraction regime. Informal recreation: Construction only impacts on local users of river. Angling: angling not included so as not to double count since impacted angling likely only to be in the reservoir itself. Biodiversity (rivers): Uncertain impact on reservoir or downstream arising from abstraction. Landscape (construction): potential disruption to visual amenity for recreation users of Elton reservoir (sailing/angling uses) and surrounds.
WR817 Carr Mill Dam to Strategic Zone	✓		✓					This option would involve the development of a new abstraction/intake point and pumping station on Carr Mill dam in order to abstract and transfer 23 Ml/d of water from St. Helens Canal to a new WTW via a new 900m raw water main. Treated output from the new WTW would then be transferred to Montrey SR via a new 1km treated water main. Traffic: No significant traffic impacts expected through route of new water mains. Formal recreation: Temporary disruption to reservoir users (sailing, angling etc.) during implementation. Uncertain impacts on reservoir users during operation, but thought to be minor. . Informal recreation: Not expected to be significant. Angling: angling not included so as not to double count since impacted angling likely only to be in the reservoir itself. Biodiversity (rivers): Uncertain impact on reservoir or downstream arising from abstraction. Landscape (construction): Landscape impacts not deemed to be significant or related to any particular landscape features. Much of the work will enjoy woodland buffer.
WR820 Shropshire Union canal to Strategic Zone	✓			✓	✓	✓	✓	This option would involve increased abstraction from the Shropshire Union Canal for treatment to potable standards at Hurleston WTW and transfer to the Mid-Cheshire Main located near Nanney's Bridge. It

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								would require additional abstraction infrastructure, a new/expanded WTW at Hurleston and a 6.9km treated water main. Traffic: No significant traffic impacts expected through route of new water mains. Formal recreation: Not applicable to non-reservoir dominated options. . Informal recreation: Disturbance during construction only. Angling: risk of impact during construction. Biodiversity (rivers): Risks during construction to designated sites (e.g. River Dee and Bala SAC). Direct crossing of Shropshire Union Canal, Llangollen Canal and two tributaries of the Weaver. During operation, uncertain impacts on River Dee and Bala SAC (including protected species (Atlantic Salmon etc.). Landscape (construction): modification to Hurleston WTW and possible second WTW construction could impact visual amenity of setting.
WR821 Shropshire Union canal	✓					✓		This option would involve increased abstraction from the Shropshire Union Canal for treatment to potable standards at Hurleston WTW and transfer to the Mid-Cheshire Main located near Nanney's Bridge. It would require additional abstraction infrastructure, a new/expanded WTW at Hurleston and a 6.9km treated water main. Traffic: No significant traffic impacts expected through route of new water mains. Formal recreation: Not applicable to non-reservoir dominated options. . Informal recreation: No significant effect expected. Angling: No angling clubs in the vicinity. Biodiversity (rivers): Abstraction may adversely affect the regional water network which could result in indirect impacts on the River Dee SSSI – River Dee and Bala SAC and its interest features; particularly, its local and protected migratory species such Atlantic salmon, trout, and lamprey which could be vulnerable to alterations of water level regarding established migratory routes. Furthermore, abstraction could potentially impact the biodiversity of Shropshire Union Canal and other local wildlife dependent upon the canal. Landscape (construction): No significant effects expected.
WR824 – Third party mine to Carlisle Zone	✓	✓				✓		This option would involve the new abstraction and transfer of 2.2 Ml/d of raw water from the Blenkinsopp Mine to the existing Castle Carrock WTW via a new pumping station and 21km raw water main. Treated output from Castle Carrock WTW would subsequently be transferred to an existing potable storage system. Traffic: Some traffic disruption may result from the construction of a new water main involving road crossings. Formal recreation: Not applicable to non-reservoir dominated options. . Informal recreation: No significant effect expected. Angling: No angling clubs in the vicinity.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Biodiversity (rivers): Uncertainties over the potential impact on a range of national and internationally designated sites in the area as well as local impacts on any mine-water dependent ecosystems. Landscape (construction): No significant effects expected.
WR012 Borrow Beck Reservoir	✓	✓		✓		✓		This option would involve the development of a new impounding reservoir in Borrow Beck between Shooter Howe and Belt Howe. A new pumping station would be installed to facilitate the transfer of raw water to the inlet at Watchgate WTW via a new raw water main (circa 6.5km in length). Traffic: Some traffic disruption may result from the construction of a new water main involving road crossings. Formal recreation: Not applicable to non-reservoir dominated options. . Informal recreation: Flooding of the valley in an area of walking and recreational use is likely to have an impact. Less certain impacts on the downstream River Lune. Angling: No angling clubs in the vicinity. Biodiversity (rivers): Uncertainties over the potential impact on a range of national and internationally designated sites in the area as well as local impacts on any mine-water dependent ecosystems. Landscape (construction): Not applicable to this type of option in line with BAG guidance. However it should be noted that the new impounding reservoir will flood land of interest to conservation groups in the Lake District.
WR154 Sandiford WTW Increased Capacity	✓							This option would involve the refurbishment of the existing Organsdale, Delamere, Delamere, Eddisbury, Cotebrook, Cotebrook, and Sandiford boreholes in order to increase raw water production (within existing licence constraints). Delamere WTW and Sandiford WTW would require modification to increase treatment capacity. Output from Sandiford WTW would be transferred to Hollins Hill SR for wider distribution. Traffic: No significant impacts on traffic are expected. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR159 Improved reservoir compensation control group 1 PDB	✓							This option would involve the construction of new automated penstock arrangements at 76 reservoirs (Group 1) in order to provide compensation control in line with licence requirements. The proposed development scope would also include a new kiosk at each targeted reservoir.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								E&S costs assumed to be negligible since activity during implementation will be contained and relatively small scale. As the operation of this option is intended simply to give more accurate control over compensation releases, impacts on the recreational use of the reservoir and on downstream uses is not expected to be high.
WR160 Improved reservoir compensation control group 2 PBD	✓							This option would involve the construction of new automated penstock arrangements at four reservoirs (Group 2: Lake Vyrnwy, Rivington, Thirlmere and Haweswater) in order to provide compensation control in line with licence requirements. The proposed development scope would also include a new kiosk at each targeted reservoir. E&S costs assumed to be negligible since activity during implementation will be contained and relatively small scale. As the operation of this option is intended simply to give more accurate control over compensation releases, impacts on the recreational use of the reservoir and on downstream uses is not expected to be high.
WR813 Scammondden IR to Buckton Castle	✓	✓	✓			✓		This option would involve the development of a new abstraction point and pumping station at Scammodden IR in order to abstract and transfer 5 Ml/d to Huddersfield Narrow Canal via a new 4.23km raw water main and break pressure tank. A second new abstraction point and pumping station would be installed on the Huddersfield Narrow Canal near Mossley in order to abstract and transfer 5 Ml/d to Buckton Castle WTW via a new 700m raw water main for treatment and distribution. Traffic: Limited road works may be required. Formal recreation: Scammodden reservoir is used for boating and as a scouts' water sports centre. Abstraction or changes to water levels within the reservoir may impact on these uses. Informal recreation: No further recreational impacts expected. Angling: Impacts on angling within the reservoir expected to be minimal as the site is already operational, and with appropriate screening impacts on the Huddersfield canal are expected to be mitigated. Biodiversity (rivers): Localised temporary disturbance during construction only. Operational impacts not expected to be large, but there are risks to changing flow regimes in the canal. Landscape (construction): not applicable to the review of reservoir dominated options.
WR110 Increased abstraction from Rushton Spencer Boreholes (Congleton)	✓							This option would involve increasing the licenced abstraction rate of the two existing Rushton Spencer boreholes in order to abstract and transfer an additional 2 Ml/d to Hug Bridge WTW via an existing raw water main. Neither the Rushton Spencer boreholes nor Hug Bridge WTW are expected to require any modifications to accommodate the increased abstraction, transference, and treatment of raw water. Traffic: It is not expected that there would be significant impacts on traffic congestion during the construction period. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR102c Widnes Boreholes to Runcorn	✓							This option would involve the recommissioning and refurbishment of the existing Belle Vale, Netherley, Greensbridge Lane, Water Lane, Stockswell, and Pex Hill boreholes. Development within the Runcorn DMZ would consist of installing a new raw water main connecting Belle Vale, Netherley, Water Lane, and Stockswell boreholes to the Greensbridge Lane borehole site to facilitate the transfer of 30 Ml/d – 48 Ml/d of raw water to a new WTW at Hale Bank. Output from the Hale Bank WTW would subsequently be transferred to the Runcorn SRs via a new pumping station and treated water main for distribution as required by demand. Development within the Warrington DMZ would consist of a new WTW situated within the existing Pex Hill SR site to treat and transfer 5.8Ml/d – 9.1 Ml/d to customers within DMA 127-1 via a new treated water. Because the cumulative abstraction amount of 57.1 Ml/d is greater than the existing conjunctive licence of 55 Ml/d, maximum capacities of Runcorn SR and Pex Hill SR would be reduced to 47 Ml/d and 8 Ml/d, respectively, to maintain a total scheme capacity of 55 Ml/d. Traffic: Engineering scope for option suggests that where pipe routes are illustrated as in-road works, it is possible to route them off the road. Also, the scope states that all road crossings (motorway and A road) would be achieved without open cut (over/bridges or tunnelling). As such, traffic impacts directly from pipe laying are considered potentially minimal. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR105bi - Lymm Boreholes (Hill Cliffe) (With Softening)	✓	✓						This option would involve the decommissioning of Lymm WTW while intensifying the operation of the Quarry and Dingle boreholes. Utilising a new pumping main (8.4km), the 9.1 Ml/d from the Lymm boreholes would be transferred and treated at a new WTW at Hill Cliffe SR. It should be noted that this option includes water softening within the treatment process. Traffic: In the absence of detailed route information in the engineering scopes, assumed that 5% of the length of the pipeline route could potentially impact on congestion. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR107a Aughton Park & Moss End Boreholes No Ion exchange	✓							This option would involve fully commissioning two existing boreholes located at Aughton Park and Moss End. A new raw water main would transfer water from the two sites to the existing Royal Oak WTW which would be modified to allow the additional water to be treated. Traffic: It is not expected that there would be significant impacts on traffic congestion during the construction period. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR107ai Aughton Park & Moss End Boreholes with Ion Exchange	✓							This option would involve fully commissioning two existing boreholes located at Aughton Park and Moss End. A new raw water main would transfer water from the two sites to the existing Royal Oak WTW which would be modified to allow the additional water to be treated. It should be noted that water softening (ion exchange) is included within the treatment process. Traffic: as for option WR107a, this option is not expected to generate significant traffic issues. Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
WR120 Cross Hill Boreholes (without softening)	✓							This option would involve the construction of three new boreholes and a new WTW at Cross Hill SR, located at Thingwall on the Wirral, in order to abstract/transfer 15 Ml/d. Additionally, the revocation of existing abstraction licences at Hooton, Gorston, and Springhill would be included within the abstraction licence proposal. Traffic: is not expected that there would be significant impacts on traffic congestion during the construction period.

Option	Carbon	Traffic	Formal recreation	Informal recreation	Angling	Biodiversity (rivers)	Landscape (construction)	Initial qualitative review
								Formal recreation: not applicable for review of groundwater dominated options. Informal recreation: not applicable for review of groundwater dominated options. Angling: not applicable for review of groundwater dominated options. Biodiversity (rivers): not applicable for review of groundwater dominated options. Landscape (construction): not applicable for review of groundwater dominated options.
B2 Thames Water Trading enabling works	✓			✓				In order to maintain supplies to United Utilities' own customers and environmental standards when exporting water from Lake Vyrnwy to the Thames Water region, Dee Aqueduct water would be diverted on the Vyrnwy Aqueduct using existing aqueduct connections and would then be pumped up Line 3 of the Vyrnwy Aqueduct for additional treatment at Oswestry. The option would require modifications to Oswestry WTW, 4 booster stations and pipeline replacement. Traffic: Pipeline works could temporarily result in increased congestion and driver delay along the A495, A41, A534, A54, A556, A49. Without detail of the works and programme, it is assumed that there would be disruption is to A roads in rural areas linking small towns. Informal recreation: This option is not expected to significantly affect opportunities for recreation and activity during construction or operation, but may result in temporary disruption to playing fields at Park Hill, Lake Vyrnwy, Delamere Forest and footpaths along the Shropshire Way. It should be noted that the calculated recreation impact for this may be overestimated due to the population density. Biodiversity (rivers): No net changes to abstraction from Vyrnwy. Impacts on River Severn to be assessed by Thames Water. Impacts on nearby designated sites are not expected to be significant or long lasting with appropriate site mitigation. Landscape: No landscape designations expected to be impacted. Works would be relatively small in scale and temporary.

Table A2 Detail of quantified Environmental and Social Costs[36]

Option	Description of quantified Environmental and Social Costs (including key assumptions) *Note descriptions are limited to those BAG categories to be monetised (those found to be significant in the qualitative assessment (see Table A1))*	Operational cost (£/year)	Construction cost (£)
WR001 River Alt to Prescot WTW	Traffic: Duration of congestion impact estimated at 500 days during construction affecting A roads in non-built up areas connecting small towns. Informal recreation: Impacts on informal recreation during operation based on local value for walkers. The area impacted is deemed to be a site of low importance and limited access – local site, affecting a population in a 1km radius. Biodiversity (rivers): Potential operational impact on downstream SSSI/SAC/SPA monetised. Small environmental change affecting the population within a radius of interest of 60km.		
WR003 Fisher Tarn	Traffic: Duration of congestion impact estimated at 8 days in total due to 4 road crossings, affecting C roads in non-built up areas. Formal recreation: Fisher Tarn reservoir deems to be a medium usage site attracting no more than 20,000 visitors per year. Impacts potentially during operation. Informal recreation: Impacts during operation based on local value for walkers. The area impacted is deemed to be a site of low importance – local site, affecting a population in a 1km radius. Angling: Potential impact during operation on non-migratory lake trout fishing. 300m of reservoir bank assumed accessible for fishing affecting 84 anglers per year.		
WR004 Longsleddale Reservoir	Traffic: Limited impact during construction on minor unclassified roads over an estimated duration of 40 days. Informal recreation: The area is within the wider national park and is known for walks up the valley. However, access and facilities are limited. Monetised costs are based therefore on a local site with limited access, affecting a population within a 1km radius. Biodiversity (rivers): Potential operational impact from new reservoir on downstream habitats – locally important site, large environmental change affecting the population within a radius of interest of 60km.		
WR006 Glaze Brook	Traffic: Potential congestion impact arising from open cut in approximately 300m of unclassified and B roads. Duration of impact estimated at 38 days. Informal recreation: Users of adjacent walking trails with limited access may experience dis-benefit. This section of the trail and the more likely localised impacts led to the selection of a low importance site with limited access to monetise cots. This therefore affects a population within a 1km radius. Sensitivity testing of a greater radius of interest was observed to over-estimate costs due to the relatively high population density of the county. Biodiversity (rivers): Potential impacts on locally site experiencing a small environmental change were monetised – affecting the population within a radius of 30km.		
WR007 Sankey Brook	Traffic: Potential congestion impacts during construction of pipeline on A roads (non-central urban area). Duration of impact estimated at 464 days.		

[36] Cost figures redacted, company confidential information

Option	Description of quantified Environmental and Social Costs (including key assumptions) *Note descriptions are limited to those BAG categories to be monetised (those found to be significant in the qualitative assessment (see Table A1))*	Operational cost (£/year)	Construction cost (£)
	Informal recreation: Potential impact on recreational users of adjacent park and footpaths (a local site with good access), coming from a radius of 1km. Biodiversity (rivers): The potential for a small environmental change in the downstream SSSIs has been monetised (regionally important site). Costs are based on the affected population within a radius of interest of 60km. Note that owing to the high population density of Warrington, this results in a high cost.		
WR009 - River Rawthey to Watchgate WTW	Traffic: Mapped pipeline route primarily runs off-road with one major road/rail crossing (100m), and 1 other major road crossing (50m). Total length of pipeline likely to impact road congestion is approximately 1km (resulting in an estimated duration of impact of approximately 100 days). Note that a range of road types are potentially impacted, however a significant proportion of impacted length is to rural B-roads and as such this road type is use for cost monetisation. Informal recreation: The River Rawthey is part of a regionally important area for recreation benefitting from good access and facilities. Visitors may be expected to travel from a radius of 30km twice per year. Angling: Regionally important trout fishing. 4km of river potentially affected by abstraction (River Rawthey to the confluence with the River Lune). 3 alternative fishing sites of equivalent quality were found within a radius of 30km mean that the cost of the potential angling impact is reduced. Biodiversity (rivers): Potential impact on area of conservation of regional importance with a small to moderate environmental quality change is monetised. This affects a population within a radius of interest of 60km.		
WR026a River Ribble (Stocks Reservoir)	Traffic: Pipeline construction potentially impacting congestion on unclassified roads is estimated to be 2,250m. The duration of these works is estimated at 225 days. Informal recreation: Impacts on informal recreation are monetised based on a site of local site of low importance and relatively limited access, affecting a population within a radius of 1km, but with each adult visiting up to 17 times per year. Angling: Regionally important salmon fishing is found which may be affected along an accessible river bank of 10km in length. 3 alternative sites of a similar quality are found within a 30km radius. Biodiversity (rivers): Potential impacts on local conservation and a SSSI during construction are monetised based on a regionally important site exposed to a small to moderate environmental quality change – affecting a population within a 60km radius.		
WR037a Haweswater IR 0.5m	Informal recreation: Haweswater reservoir is deemed to be a regionally important recreation site with moderate access and facilities, attracting visitors from a distance of 10km (each adult within that radius visiting up to 9 times per year). Disturbance to informal recreation is only expected during the construction phase. Biodiversity (rivers): Encroachment on Naddle Forest SSSI and disturbance of species within it (and downstream white clawed crayfish) during construction are monetised according to the population within a radius of interest of 120km (regionally important site, large environmental quality change).		

Option	Description of quantified Environmental and Social Costs (including key assumptions) *Note descriptions are limited to those BAG categories to be monetised (those found to be significant in the qualitative assessment (see Table A1))*	Operational cost (£/year)	Construction cost (£)
WR037b Haweswater IR 1m	Informal recreation: Haweswater reservoir is deemed to be a regionally important recreation site with moderate access and facilities, attracting visitors from a distance of 10km (each adult within that radius visiting up to 9 times per year). Disturbance to informal recreation is only expected during the construction phase. Biodiversity (rivers): Encroachment on Naddle Forest SSSI and disturbance of species within it (and downstream white clawed crayfish) during construction are monetised according to the population within a radius of interest of 120km (regionally important site, large environmental quality change).		
WR039a River Eden (Temple Sowerby) to Watchgate	Traffic: 30 unclassified road crossings and 5 B-road crossings. Duration of road works estimated at just 15 days. Angling: Regionally important trout fishing attracting visitors within a 30km radius up to 7 times per year. 6 alternative equivalent quality sites within this radius reduce the costs of impact. Biodiversity (rivers): Potential impacts on international designations on the River Eden. Deemed to be an internationally important site, but exposed to small environmental change. Monetised costs based on population within a radius of interest of 60km.		
WR041 River Irthing to Cumwhinton	Traffic: Several B-road crossings with a construction period estimated at 12 days result in a small cost. Informal recreation: Local recreational visitors to the River Irting may perceive a change to their enjoyment of the area. This is deemed to be a local site of relatively low importance attracting locals from a 1km radius. Angling: Game fishing may be impacted by new abstraction operations, bringing a potential dis-benefit to the angling population within a 30km radius. 5 alternative equivalent angling sites are found within this radius, which reduces the overall cost. Biodiversity (rivers): Uncertainty remains over the potential for this new abstraction to impact the downstream River Eden designations. As such the potential impact has been monetised based on a moderate environmental quality change to a locally important site, attracting interest from a population within a 40km radius.		
WR047a Milwr Tunnel Bagillt (River Alyn)	Traffic: 13 minor road crossings stated in scope give possibility of limited road works which may affect journeys for residents of local settlements. Duration of works estimated to be just 26 days.		
WR049b - River Ribble (Transfer to Anglezarke IR) 40ML/D	Traffic: 4 A-road crossing may result in congestion impacts for an estimated duration of 12 days in a non-central urban area. Angling: Local course fishing may be affected over a 5km length of accessible river bank. 5 alternative equivalent sites are present within a 30km radius which reduces the final cost of this dis-benefit. Biodiversity (rivers): Impacts on local biodiversity are expected to be limited to locally important sites only with small levels of environmental quality change – driving an interest from a population within a 30km radius.		
WR062a Worthington WTW (Prospect SR)	Formal recreation: Monetised impacts on reservoir are based on BAG guidance rule of thumb for a medium usage reservoir with few facilities and limited boating activity. Up to 20,000 annual visitors. Informal recreation: Informal recreation impacts assume the site is a local site of relatively low importance but with good access – attracting local residents from a distance of 1km up to 28 times per year.		

Option	Description of quantified Environmental and Social Costs (including key assumptions) *Note descriptions are limited to those BAG categories to be monetised (those found to be significant in the qualitative assessment (see Table A1))*	Operational cost (£/year)	Construction cost (£)
WR062b Worthington WTW to Rivington WTW	Traffic: Potential congestion impact cost based on construction of new pipeline. Approximately 2.6km of pipeline construction deemed to potentially impact roads through crossings and open cut. Monetised according to A-roads in built-up areas lasting for 264 days. Formal recreation: Monetised impacts on reservoir are based on BAG guidance rule of thumb for a medium usage reservoir with few facilities and limited boating activity. Up to 20,000 annual visitors. Informal recreation: Informal recreation impacts assume the site is a local site of relatively low importance but with good access – attracting local residents from a distance of 1km up to 28 times per year.		
WR074- River Darwen	Traffic: Approximately 2.5km of pipeline construction relates to road crossings or open cut along A and B-roads. The various road types, the length of each affected (and hence the likely duration of works) and communities using those roads dictated the final cost. Biodiversity (rivers): A conservative approach was taken to the uncertain impacts on downstream designated SSSIs. These were considered to be regionally important sites exposed to a small to moderate environmental quality change - driving an interest from a population within a 30km radius.		
WR076 River Bollin	Traffic: Only one B-road crossing is expected to cause minor traffic disruption close to a non-central urban area, expected to last just 3 days. Angling: Locally important course fishing may be slightly affected over a river length of 1km. 1 alternative equivalent angling site is found within a 30km radius. Biodiversity (rivers): Impacts are monetised according to moderate environmental quality change on a locally important site – potentially driving an interest from a population within a 40km radius. Due to local population density, this results in a high cost.		
WR079b - Appleton IR (6 ML/D)	Traffic: One short C-road crossing is expected to require construction activity lasting 2 days only. Formal recreation: It is not clear whether Appleton reservoir hosts formal water-based recreational activities beyond angling. However, a conservative approach has been adopted. Potential impacts are therefore monetised based on BAG guidance rule of thumb for a low usage reservoir with limited access and no boating. Up to 10,000 annual visitors. Angling: Approximately 200m of accessible reservoir bank available to anglers to take part in locally important coarse fishing may be impacted. This means that up to 420 anglers may be impacted per year. It should be noted that without more detailed review and detailed assessment of option variants, the methods set out in the BAG guidance do not allow for subtle changes to monetised costs that might arise from the different option yields proposed in options WR079b-d.		
WR079c - Appleton IR (9 ML/D)	Traffic: One short C-road crossing is expected to require construction activity lasting 2 days only. Formal recreation: It is not clear whether Appleton reservoir hosts formal water-based recreational activities beyond angling. However, a conservative approach has been adopted. Potential impacts are therefore monetised based on BAG guidance rule of thumb for a low usage reservoir with limited access and no boating. Up to 10,000 annual visitors.		

Option	Description of quantified Environmental and Social Costs (including key assumptions) *Note descriptions are limited to those BAG categories to be monetised (those found to be significant in the qualitative assessment (see Table A1))*	Operational cost (£/year)	Construction cost (£)
	Angling: Approximately 200m of accessible reservoir bank available to anglers to take part in locally important coarse fishing may be impacted. This means that up to 420 anglers may be impacted per year. It should be noted that without more detailed review and detailed assessment of option variants, the methods set out in the BAG guidance do not allow for subtle changes to monetised costs that might arise from the different option yields proposed in options WR079b-d.		
WR079d - Appleton IR (12.5 ML/D)	Traffic: One short C-road crossing is expected to require construction activity lasting 2 days only. Formal recreation: It is not clear whether Appleton reservoir hosts formal water-based recreational activities beyond angling. However, a conservative approach has been adopted. Potential impacts are therefore monetised based on BAG guidance rule of thumb for a low usage reservoir with limited access and no boating. Up to 10,000 annual visitors. Angling: Approximately 200m of accessible reservoir bank available to anglers to take part in locally important coarse fishing may be impacted. This means that up to 420 anglers may be impacted per year. It should be noted that without more detailed review and detailed assessment of option variants, the methods set out in the BAG guidance do not allow for subtle changes to monetised costs that might arise from the different option yields proposed in options WR079b-d.		
WR095 Roughton Gill	Traffic: 4 B-road crossings along the new pipeline route involving road works estimated to take 8 days.		
WR099a Worsthorne Borehole (compensation)	No social and environmental costs monetised.		
WR099b Worsthorne Borehole (Hurstwood IR)	No social and environmental costs monetised.		
WR099c Worsthorne Borehole (WTW)	No social and environmental costs monetised.		
WR100 Thorncliffe Road Boreholes, Barrow	Traffic: 40m of road works on A-Roads affecting small town traffic are estimated to last 4 days.		
WR101 Franklaw	No social and environmental costs monetised.		
WR102ai - Widnes Boreholes to Prescot (with softening)	Traffic: No engineering route specific detail available with which to determine length of road directly impacted by works. As a very rough estimate in the absence of other information, assumed 10% of the pipe length will affect congestion on roads (A-roads in built up areas). This is estimated to have a duration of 155 days.		
WR102a Widnes Boreholes to Prescot	Traffic: No engineering route specific detail available with which to determine length of road directly impacted by works. As a very rough estimate in the absence of other information, assumed 10% of the pipe length will affect congestion on roads (A-roads in built up areas). This is estimated to have a duration of 148 days.		

Option	Description of quantified Environmental and Social Costs (including key assumptions) *Note descriptions are limited to those BAG categories to be monetised (those found to be significant in the qualitative assessment (see Table A1))*	Operational cost (£/year)	Construction cost (£)
WR102b - Widnes Boreholes to Liverpool and Warrington	Traffic: From visual check of route map in engineering scope, estimated 5km of B-roads in built up areas potentially directly impacted by works. Duration of this work estimated to be up to 500 days.		
WR102d Eccleston Hill Borehole to Prescot	No social and environmental costs monetised.		
WR102e Bold Heath Boreholes to Prescot	Traffic: Of the 9km of new pipework, only 220m is seen to directly require road works within the engineering scope. Affecting A-roads on well-used routes, these works are estimated to last 22 days.		
WR105ai - Lymm Boreholes to Sow Brook (with softening)	No social and environmental costs monetised.		
WR105a - Lymm Boreholes to Sow Brook (without softening)	No social and environmental costs monetised.		
WR106 Walton and Daresbury Boreholes	Traffic: Option scope indicates that direct road works will be required on 50m of B-roads in non-urban areas. This is estimated to cause disruption to traffic for a period of 5 days.		
WR107b Randles Bridge Knowsley Primrose Hill	Traffic: Construction of new pipelines is shown in the scope to potentially direct road works estimated to last 144 days, largely in built-up areas.		
WR109 Swineshaw Boreholes	No social and environmental costs monetised.		
WR111 Woodford Borehole	Traffic: Pipeline excavation in a mixture of unclassified and A-roads shown within the engineering scope are estimated to have a duration of 20 days.		
WR112 Bramhall Borehole	Traffic: Engineering scope indicates that open cut in roads for pipeline works is limited to 140m of road crossings within urban areas. This is estimated to last 14 days.		
WR113 Tytherington Boreholes	Traffic: Engineering scope indicates that open cut in roads for pipeline works is limited to 120m of road crossings within central urban areas. This is estimated to last 12 days.		
WR114 Python Mill Borehole PBD	Traffic: Approximately 3km of open cut pipeline works in urban B-roads is expected to take 307 days.		
WR119a Egremont Boreholes (Existing)	Traffic: Impacts arising from pipeline road works at one A-road crossing are monetised. These are estimated to last 4 days.		
WR119b Egremont Boreholes (New)	Traffic: Engineering scope assumed 5% of route for new transfer pipelines accounts for minor road crossings: Sandwich to Catgill 5% of 6591m; Rottington to Catgill 5% of 5826m; Moor Platts to Catgill 5% of 2424m. Costs associated with the single A road crossing are also accounted for.		

Option	Description of quantified Environmental and Social Costs (including key assumptions) *Note descriptions are limited to those BAG categories to be monetised (those found to be significant in the qualitative assessment (see Table A1))*	Operational cost (£/year)	Construction cost (£)
WR120i Cross Hill Boreholes	No social and environmental costs monetised.		
WR121a Eaton Borehole (Hollins Hill)	No social and environmental costs monetised.		
WR121b - Eaton Borehole (mid Cheshire main)	No social and environmental costs monetised.		
WR122 - Newton Hollows Boreholes	No social and environmental costs monetised.		
WR125 Bearstone Boreholes	No social and environmental costs monetised.		
WR128 Tarn Wood (North Eden to Carlisle)	Traffic: In the absence of detailed route information in the engineering scopes, assumed that 10% of the length of the pipeline route could potentially impact on congestion. This is deemed to be impacting on A roads and is estimated to last 146 days.		
WR129 North Cumbria Boreholes	Traffic: Engineering scope sets out lengths of pipe laying in-road: Quarry Hill to Moota Hill 2866m, Waverton to blending tank 4323m, Thursby to blending tank 11424m, Blending tank to Quarry Hill, 3902m. = total 22,515m Road type - mix of A and minor roads, within rural areas. Type ""B-built up"" selected as a mid-range value to encompass uncertainty in impact.		
WR140 Horwich EFR	Biodiversity (rivers): A conservative approach is adopted and potential biodiversity impacts are monetised despite uncertainty. Potentially impacted river environments are deemed to be only locally important and exposed to a small environmental quality change – driving interest from a population within a 30km radius.		
WR141 Rossendale EFR	Traffic: New main construction requires 565m on open cut along Irwell Rd and B6527, estimated to take 57 days. Informal recreation: Potential impacts are monetised according to the local population within a 1km radius visiting impacted sites up to 17 times per year (low importance site with limited access). However, the presence of 2 alternative equivalent sites close by reduce the final cost. Biodiversity (rivers): A conservative approach is adopted and potential biodiversity impacts are monetised despite uncertainty. Potentially impacted river environments are deemed to be only locally important and exposed to a small environmental quality change – driving interest from a population within a 30km radius.		
WR142 Hyndburn EFR	Traffic: Very minor impacts on traffic flow arising from a single unclassified road crossing estimated to last just 2 days. Biodiversity (rivers): A conservative approach is adopted and potential biodiversity impacts are monetised despite uncertainty. Potentially impacted river environments are deemed to be only locally important and exposed to a small environmental quality change – driving interest from a population within a 30km radius.		
WR144 Saddleworth Mossley Top	Traffic: 350m of open cut in B-road in built up areas is estimated to affect traffic flow for 35 days. Informal recreation: Potential impacts on recreational walkers adjacent to the river are monetised according to the local population within a 1km		

Option	Description of quantified Environmental and Social Costs (including key assumptions) *Note descriptions are limited to those BAG categories to be monetised (those found to be significant in the qualitative assessment (see Table A1))*	Operational cost (£/year)	Construction cost (£)
	radius visiting impacted sites up to 28 times per year (low importance site with good access). However, the presence of 5 alternative recreation sites nearby reduce the overall cost of the impact. Biodiversity (rivers): A conservative approach is adopted and potential biodiversity impacts are monetised despite uncertainty. Potentially impacted river environments are deemed to be only locally important and exposed to a moderate environmental quality change – driving interest from a population within a 40km radius.		
WR146 Davyhulme EFR	Informal recreation: Potential impacts on recreational walkers adjacent to the river during construction are monetised according to the local population within a 1km radius visiting impacted sites up to 28 times per year (low importance site with good access). The relatively high population density of Greater Manchester results in a high cost. Biodiversity (rivers): There is some uncertainty as to the extent of potential impact under this category. It was deemed overly-precautionary to monetise potential impacts on downstream international designations, but some local impacts are more likely during both construction and potentially during operation. Potentially impacted environments are deemed to be only locally important and exposed to a moderate environmental quality change – driving interest from a population within a 40km radius.		
WR148 Cumwhinton Boreholes Castle Carrock Link	No social and environmental costs monetised.		
WR150 Castle Carrock Dead water	Informal recreation: Potential impacts on recreational walkers adjacent to the reservoir are monetised according to the local population within a 1km radius visiting impacted sites up to 28 times per year (low importance site with good access). Angling: Locally important coarse fishing (with no other similar sites within close proximity) may be impacted, however there is significant uncertainty around this. Biodiversity (rivers): Potentially impacted environments are deemed to be only locally important and exposed to a moderate environmental quality change – driving interest from a population within a 40km radius. Impacts on higher level designations further downstream are deemed to be less likely and monetisation of these impacts would be viewed as an over-estimation.		
WR153 Simmonds Hill	Traffic: The engineering scope for this option indicates that 10% of the new pipeline construction will involve road crossings. These are deemed to potentially impact congestion. An assumption is made that these roads are B-roads in non-built up areas and impacts are estimated to last for 26 days.		
WR800 River Bela to Thirlmere Aqueduct	Traffic: Engineering scope states assumption of 20% route in urban environment. For conservative approach, this is taken to be entirely in road (B-road) causing potential traffic disruption. (20% of 8,458m) . This is estimated to last for 169 days. Angling: Despite the presence of angling clubs, the location of the proposed intake close to the tidal limit of the river is less likely to cause a significant impact. Due to this uncertainty, the impact is not monetised here. Biodiversity: Potentially impacted environments are deemed to be only locally important and exposed to a small environmental quality change – driving interest from a population within a 30km radius.		

Option	Description of quantified Environmental and Social Costs (including key assumptions) *Note descriptions are limited to those BAG categories to be monetised (those found to be significant in the qualitative assessment (see Table A1))*	Operational cost (£/year)	Construction cost (£)
WR810 Cow Green IR to Heltondale Aqueduct	Traffic: The route of the new water main is expected to involve a number of open-cut unclassified road crossings (totalling 440m) which may require diversions and interrupt traffic flow. These are estimated to take 44 days but have a limited impact due to their location. Formal recreation: Cow Green reservoir is deemed to be a honeypot site for visitors (low usage category of honeypot site), which using the BAG guidance might receive 60,000 visitors annually. Informal recreation: Informal recreational impacts (such as those perceived by walkers etc) are monetised here by assessing the site as regionally important with good access and facilities (attracting on average 2 visits per year from a population within a radius of 30km). Angling: Potential angling impacts assessed against regionally important salmon fishing. 10 alternative equivalent value sites found within a 30km reduce the final cost of this impact. Biodiversity (rivers): Potential impacts to downstream designations is assessed as a small environmental quality change to an international/national site – driving a monetised cost from a population within a radius of interest of 60km.		
WR812 Kielder Water Transfer	Traffic: There is limited information provided regarding road crossings or in-road works as part of raw water main construction. The new main traverses many greenfield and natural sites, and appears to cross and involve works on many roads of varying type too. Assume 5% of route would involve direct congestion impact on road network. As a broad assumption (in an attempt to capture the range of traffic congestion impacts along the route), the road type has been assumed to be B (built up), and cost based on non-central peak - these are central values. These works are estimated to have a duration of 500 days. Formal recreation: Kielder Water is deemed to be a honeypot site for visitors (high usage category of honeypot site), which using the BAG guidance might receive 250,000 visitors annually. Informal recreation: Informal recreational impacts (such as those perceived by walkers etc) are monetised here by assessing the site as regionally important with good access and facilities (attracting on average 2 visits per year from a population within a radius of 30km). 5 alternative sites are found within this radius and this acts to reduce the final cost to informal recreation. Angling: Potential angling impacts assessed against regionally important salmon fishing. 10 alternative equivalent value sites found within a 30km reduce the final cost of this impact. Biodiversity (rivers): Potential impacts to downstream designations is assessed as a small environmental quality change to an international/national site – driving a monetised cost from a population within a radius of interest of 60km.		
WR814a Increased treatment capacity at Huntington WTW	No social and environmental costs monetised.		
WR814b Increased treatment capacity at Hurleston WTW via Canal	No social and environmental costs monetised.		

Option	Description of quantified Environmental and Social Costs (including key assumptions) *Note descriptions are limited to those BAG categories to be monetised (those found to be significant in the qualitative assessment (see Table A1))*	Operational cost (£/year)	Construction cost (£)
WR814c Increased treatment capacity at Hurleston WTW via Pipeline	Traffic: Engineering workbook suggests 80% off new pipeline route is off-road. 5 A-road crossings in expected to take 20 days to complete. Informal recreation: Informal recreational impacts during construction are monetised here by assessing the site as regionally important with good access and facilities (attracting on average 2 visits per year from a population within a radius of 30km). 5 alternative sites are found within this radius and this acts to reduce the final cost to informal recreation. Angling: Potential angling impacts assessed against regionally important salmon fishing. 5 alternative equivalent value sites found within a 30km reduce the final cost of this impact. Biodiversity (rivers): Potential impacts to downstream designations is assessed as a small to moderate environmental quality change to a regionally important site – driving a monetised cost from a population within a radius of interest of 60km. Landscape (construction): Landscape impacts during construction are assessed against a regional site (low importance) – driving a monetised cost from a population within a radius of interest of 10km.		
WR816 MBB Canal to Strategic Zone	Traffic: Engineering workbook states 4,776m of pipeline construction for treated water transfer. Not clear how much of this will be directly in-road activity, so for conservative approach, it is all assumed to be in-road (B-roads) and therefore having potential to disrupt traffic. This is estimated to take 468 days. Formal recreation: Elton Reservoir is deemed to be a low usage site for visitors, which using the BAG guidance might receive 10,000 visitors annually. Landscape (construction): Landscape impacts during construction are assessed against a local honeypot site – driving a monetised cost from a population within a radius of interest of 3km.		
WR817 Carr Mill Dam to Strategic Zone	Formal recreation: Carr Mill dam is deemed to be a low usage honeypot site for visitors, which using the BAG guidance might receive 60,000 visitors annually.		
WR820 Shropshire Union canal to Strategic Zone	Informal recreation: Informal recreational impacts during construction are monetised here by assessing the site as regionally important with good access and facilities (attracting on average 2 visits per year from a population within a radius of 30km). 5 alternative sites are found within this radius and this acts to reduce the final cost to informal recreation. Angling: Potential angling impacts assessed against regionally important salmon fishing. Affecting up to 15km. Biodiversity (rivers): Potential impacts to downstream designations is assessed as a small to moderate environmental quality change to a regionally important site – driving a monetised cost from a population within a radius of interest of 60km. Landscape (construction): Landscape impacts during construction are assessed against a local park site – driving a monetised cost from a population within a radius of interest of 1km.		
WR821 Shropshire Union canal	Biodiversity: Potential impacts to downstream designations is assessed as a small environmental quality change to a locally important site – driving a monetised cost from a population within a radius of interest of 30km.		

Option	Description of quantified Environmental and Social Costs (including key assumptions) *Note descriptions are limited to those BAG categories to be monetised (those found to be significant in the qualitative assessment (see Table A1))*	Operational cost (£/year)	Construction cost (£)
WR824 – Third party mine to Carlisle Zone	Traffic: Engineering workbooks states assumption of 10% of 21,181m involved in road crossings. This is estimated to take 212 days to complete affecting unclassified roads. Biodiversity: Potential impacts limited to locally important sites, rather than extending impacts with a high degree of uncertainty to internationally designated sites (which would increase costs dramatically with little evidence in support). A small environmental quality change to local sites is monetised - driving a monetised cost from a population within a radius of interest of 30km.		
WR012 Borrow Beck Reservoir	Traffic: An estimated 16 days of works affecting road traffic on unclassified roads as a result of several open-cut road crossings along the pipeline route. Impact limited. Informal recreation: Informal recreational impacts during construction are monetised here by assessing the site as low importance with limited access and facilities (attracting on average 17 visits per year from a population within a radius of 1km). Biodiversity: Potential impacts are assessed as a moderate environmental quality change to a local site – driving a monetised cost from a population within a radius of interest of 40km.		
WR154 Sandiford WTW Increased Capacity	No social and environmental costs monetised.		
WR159 Improved reservoir compensation control group 1 PDB	No social and environmental costs monetised.		
WR160 Improved reservoir compensation control group 2 PBD	No social and environmental costs monetised.		
WR813 Scammondden IR to Buckton Castle	Traffic: 250m of open cut road works possible affecting unclassified roads for a period of 25 days (estimated). Formal recreation: Formal recreation impacts in the reservoir assessed as a high usage site with up to 30,000 visits per year. Biodiversity: Potential impacts are assessed as a small environmental quality change to a local site – driving a monetised cost from a population within a radius of interest of 30km.		
WR110 Increased abstraction from Rushton Spencer Boreholes (Congleton)	No social and environmental costs monetised.		
WR102c Widnes Boreholes to Runcorn	No social and environmental costs monetised.		
WR105bi - Lymm Boreholes (Hill Cliffe) (With Softening)	Traffic: In the absence of detailed route information in the engineering scopes, assumed that 5% of the length of the pipeline route could potentially impact on congestion and is assumed to affect A roads in non-built up areas. This totals 430m taking place over an estimated 43 days.		

Option	Description of quantified Environmental and Social Costs (including key assumptions) *Note descriptions are limited to those BAG categories to be monetised (those found to be significant in the qualitative assessment (see Table A1))*	Operational cost (£/year)	Construction cost (£)
WR107a Aughton Park & Moss End Boreholes No Ion exchange	No social and environmental costs monetised.		
WR107ai Aughton Park & Moss End Boreholes with Ion Exchange	No social and environmental costs monetised.		
WR120 Cross Hill Boreholes (without softening)	No social and environmental costs monetised.		
B2 Thames Water Trading enabling works	Traffic: Without detail of the works and programme, it is assumed that there would be disruption is to A roads in rural areas linking small towns. The engineering scope assumes 20% of length is in suburban ground, so it is assumed that 20% of the pipe length of construction is disruptive to traffic. Informal recreation: Informal recreational impacts during construction are monetised here by assessing the site as locally important with good access and facilities (attracting on average up to 28 visits per year from a population within a radius of 1km). 5 alternative sites are found within this radius and this acts to reduce the final cost to informal recreation.		

Appendix B
Metering Options Assessment Details

Table B1 Summary table: Qualitative description of metering options

Category	Monetised	Qualitative description
Works related impacts		
Land take	No	Metering options do not require land take. It has not been necessary to quantify and monetise this impact category.
Landscape impacts	No	Metering is not expected to exert any type of landscape impacts, either during roll-out or operation. Metering assets are typically small and located within existing buildings.
Property based disamenity effects	No	Property disamenity essentially relates to impacts on any aspect of property value, such as changes in aesthetic, surrounding environment, access etc. The BAG recommends disamenity only be quantified where: "*there is a net increase in the number of minor interruptions to domestic water supplies, where there is an increase in the number of domestic properties with excavations in driveways or gardens, an increase in odours or additional properties being impacted by odours from wastewater treatment works or siting of plant where gives rise to significant increase in background noise levels*". The meter installation process would likely increase the number of minor interruptions to domestic water supplies. Customers may experience a short disruption (maximum approximately 2 hours, but generally much less) and there may ancillary disruptions (noise, dust, minor excavation on property) depending on the work required to access the metering point and connect the meter. These disruptions would be very short and do not meet the BAG definition of impacts warranting quantification.
Traffic related impacts	Yes	BAG sub-divides Traffic related impacts into multiple components: congestion, accident risk, Heavy Goods Vehicles (HGVs) movements, Noise impacts, community severance (e.g. schemes that disrupt pedestrians' and cyclist's journey patterns, cause delays etc). This type of disruption occurs when utilities are required to close or dig up roads, and is only considered significant for the purpose of social and environmental costing if this is sustained for more than a few weeks. Metering options do not fall into this category. Installations involve a small amount of very temporary disruption, usually on private property. Any excavations that do encroach onto public areas (pavements etc) will also be small in scale and duration. However, the installation period and subsequent meter reading (unless Smart meters are installed) would generate additional light vehicle movements (vans). Accident risk has been quantified and monetised. This has been quantified as described in Tables B2a and B2b.
Energy and global warming potential	No	Carbon impacts assessed separately.
Operational impacts		
Informal recreation	No	Metering options do not trigger impacts on informal recreation. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.
Angling	No	Metering options do not trigger impacts on angling. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.
Commercial fisheries	No	Metering options do not trigger impacts on commercial fisheries. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.
In stream recreation	No	Metering options do not trigger impacts on in-stream recreation. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.
Amenity	No	Metering options do not trigger impacts on amenity. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.

Category	Monetised	Qualitative description
Abstractions	No	Metering options do not trigger impacts on abstractions. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.
Heritage, archaeology and landscape	No	Metering options do not trigger impacts on heritage, archaeology, or landscape. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.
Traffic related impacts	No	Installing domestic water meters will increase the workload to take meter readings, and in turn increase the number of vehicle journeys. This could be minimised if metering is concentrated in an area - but without compulsory metering (which is not an applicable option to United Utilities) systematic collation of meter readings will be difficult to achieve. Vehicles covering more mileage, particularly on urban roads to access domestic meters will increase the accident risk. This has been quantified in Tables B2a and B2b.
Biodiversity and non-use	No	Metering options do not trigger impacts on biodiversity and non-use. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.

The traffic related social and environmental impacts have been assessed on a yearly basis (80 year period). To summarise the results, Table B2 shows the total distances, vehicle movements, and kilometres travelled over the course of option implementation, and subsequent replacement.

Table B2a Quantified and monetised traffic related impacts of metering options (accident risk): Options WR700a to WR702b[37]

Category	Unit	WR700a	WR701a	WR702a	WR700b	WR701b	WR702b
Works related impacts							
Traffic related impacts:							
- Accident Risk							
o Urban road distance (round trip per installation)	km	10	10	10	10	10	10
o Total number of installations	Nbr	225,724	4,416	461	374,224	7,612	802
o Total number of van movements (yr)*	Nbr	1,541,841	30,138	3,145	2,432,840	49,314	5,193
o Total km travelled	Km	1,583,7787	309,580	32,309	24,990,137	506,551	53,342
o Accident risk cost per km	£ / km						
Total environmental and social cost over the implementation and replacement period (£)	Total £						
Total environmental and social cost during the initial implementation period (£)	Initial £						
Option duration (years)	Years	5	5	5	10	10	10
Total environmental and social cost during the initial implementation period (average per year of implementation)	£/Yr						

[37] Cost figures redacted, company confidential information

Table B2b Quantified and monetised traffic related impacts of metering options (accident risk): Options WR703a to WR716b[38]

Category	Unit	WR703a	WR703b	WR707a	WR707b	WR708b	WR710	WR711	WR716a	WR716b
Works related impacts										
Traffic related impacts:										
- Accident Risk										
o Urban road distance (round trip per installation)	km	10	10	10	10	10	10	10	10	10
o Total number of installations	Nbr	8,253	15,839	9,865	18,480	326	13,809	246	1,685	4,506
o Total number of van movements)*	Nbr	56,165	101,683	67,185	118,875	2,097	93,905	1,672	11,366	28,290
o Total km travelled	Km	576,923	1,044,492	690,121	1,221,084	21,542	964,587	17,178	116,749	290,600
o Accident risk cost per km	£ / km									
Total environmental and social cost over the implementation and replacement period	Total £									
Total environmental and social cost during the initial implementation period	Initial £									
Option duration	Years	5	10	5	10	10	10	5	5	10
Total environmental and social cost during the initial implementation period (average per year of implementation)	£/Yr									

*Number of van movements is based on the annual number of meters to be installed (a variable parameter based on uptake), the number of trips anticipated to each property per installation (set to one), and the number of vehicles per trip (also assumed to be one).

[38] Cost figures redacted, company confidential information

Appendix C
Water Efficiency Options Assessment Details

Table C1 Summary table: Qualitative description of water efficiency options

Category	Monetised	Qualitative description
Works related impacts		
Land take	No	Water efficiency options do not require land take. Unnecessary to quantify and monetise this impact category.
Landscape impacts	No	Water efficiency is not expected to exert any type of landscape impacts, either during roll-out or operation. Water efficiency measures are typically very small will be implemented within-property and no landscape impacts expected. Unnecessary to quantify and monetise this impact category.
Property based disamenity effects	No	Property disamenity essentially relates to impacts on any aspect of property value, such as changes in aesthetic, surrounding environment, access etc. The BAG recommends disamenity only be quantified where: "*there is a net increase in the number of minor interruptions to domestic water supplies, where there is an increase in the number of domestic properties with excavations in driveways or gardens, an increase in odours or additional properties being impacted by odours from wastewater treatment works or siting of plant where gives rise to significant increase in background noise levels*". Some of the water efficiency options, would involve entering a property to undertake an audit and provide advice, make plumbing repairs, install water efficiency devices. This could disrupt householders temporarily, e.g, making plans to be at home for the visit. However, these minor inconveniences do not constitute property disamenity.
Traffic related impacts	Yes	Guidance suggests that this element is only significant if disruption from closing or digging up roads is over a period of more than a few weeks. As described above, metering options are anticipated to involve a few hours work at any one property. Excavations for meter installation are normally in pavements and do not result in road closure or traffic diversion. No monetisation of traffic disruption has been included. The installation and reading of a large number of meters, or the installation of water efficiency measures, can result in a large number of van movements, which will in turn result in increased accident risk. This has been quantified as described in Table B1b. BAG sub-divides Traffic related impacts into multiple components: congestion, accident risk, Heavy Goods Vehicles (HGVs) movements, Noise impacts, community severance (e.g. schemes that disrupt pedestrians' and cyclist's journey patterns, cause delays etc). This type of disruption occurs when utilities are required to close or dig up roads, and is only considered significant for the purpose of social and environmental costing if this is sustained for more than a few weeks. However, those options which involve home visits would generate additional light vehicle movements (vans). Therefore, accident risk has been quantified and monetised. This has been quantified as described in Table C2. Other traffic related impacts are not considered significant enough to require quantification or monetisation.
Energy and global warming potential	No	Carbon impacts assessed separately.
Operational impacts		
Informal recreation	No	Water efficiency options do not trigger impacts on informal recreation. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.
Angling	No	Water efficiency options do not trigger impacts on angling. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.
Commercial fisheries	No	Water efficiency options do not trigger impacts on commercial fisheries. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.

Category	Monetised	Qualitative description
In stream recreation	No	Water efficiency options do not trigger impacts on in-stream recreation. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.
Amenity	No	Water efficiency options do not trigger impacts on amenity. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.
Abstractions	No	Water efficiency options do not trigger impacts on abstractions. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.
Heritage, archaeology and landscape	No	The water butts options could be perceived as impacting on the urban residential landscape but many would be located in private gardens, and customers already have the ability to access and install water butts without issue. Visual impacts of water butts is considered minimal. Not necessary to quantify and monetise this impact category. No impacts from these option options on heritage, archaeology and landscape.
Traffic related impacts	No	Whilst there is significant mileage activity associated with rolling-out water efficiency options there is no longer-term ongoing 'household' visit operational activity. Subsequent re-engagement initiatives would be considered either as new options at a future point, or part of on-going general baseline customer engagement activity. Specific properties targeted under these WRMP19 options would not be routinely re-visited. No impacts to quantify or monetise.
Biodiversity and non-use	No	Water efficiency options do not trigger impacts on biodiversity and non-use. Whilst reductions in demand would reduce pressure on abstraction it is not possible to allocate those savings to specific sources or associated waterbodies. Impacts not quantified or monetised.

Table C2a Quantified and monetised traffic related impacts of water efficiency options (accident risk): Options WR600a to WR605a[39]

Category	Unit	WR600a	WR601a	WR602a	WR600b	WR601b	WR602b	WR603a	WR604a	WR605a
Works related impacts										
Traffic related impacts:										
- Accident risk:										
○ Urban road distance (round trip per installation)	km	44	76	76	44	76	76	44	76	76
○ Total number of installations	Nbr	49,079	826	95	196,284	3,334	382	19,631	337	38
○ Total number of van movements (yr)*	Nbr	98,157	1,652	190	392,567	6,668	765	39,263	673	76
○ Total km travelled	Km	4,320,101	125,605	14,481	17,277,697	506,896	58,125	1,728,040	51,171	5,792
○ Accident risk cost per km	£ / km									
Total environmental and social cost over the implementation period (£)	Total £									
Option duration (years)	Years	5	5	5	10	10	10	5	5	5
Total environmental and social cost during the initial implementation period (average per year of implementation)	£/Yr									

[39] Cost figures redacted, company confidential information

Table C2b Quantified and monetised traffic related impacts of water efficiency options (accident risk): Options WR603b to WR608b[40]

Category	Unit	WR603b	WR604b	WR605b	WR606a	WR607a	WR608a	WR606b	WR607b	WR608b
Works related impacts										
Traffic related impacts:										
Accident risk:										
○ Urban road distance (round trip per installation)	km	44	76	76	44	76	76	44	76	76
○ Total number of installations	Nbr	78,513	1,385	153	39,263	673	78	157,027	2,771	318
○ Total number of van movements (yr)*	Nbr	157,027	2,771	306	78,526	1,346	155	314,054	5,542	635
○ Total km travelled	Km	6,911,079	210,624	23,250	3,456,081	102,343	11,798	13,822,158	421,247	48,297
○ Accident risk cost per km	£ / km									
Total environmental and social cost over the implementation period (£)	Total £									
Option duration (years)	Years	10	10	10	5	5	5	10	10	10
Total environmental and social cost during the initial implementation period (average per year of implementation)	£/Yr									

[40] Cost figures redacted, company confidential information

Table C2c Quantified and monetised traffic related impacts of water efficiency options (accident risk): Options WR610a to WR615a[41]

Category	Unit	WR610a	WR610b	WR611a	WR612a	WR613a	WR611b	WR612b	WR613b	WR615a
Works related impacts										
Traffic related impacts:										
Accident risk:										
○ Urban road distance (round trip per installation)	km	44	44	44	76	76	44	76	76	44
○ Total number of installations	Nbr	750	3,000	227,486	3,900	450	909,802	16,054	1,841	3,068
○ Total number of van movements (yr)*	Nbr	1,500	6,000	454,973	7,800	899	1,819,605	32,107	3,681	6,136
○ Total km travelled	Km	66,018	264,072	20,024,287	592,965	68,359	80,084,598	2,440,676	279,830	270,048
○ Accident risk cost per km	£ / km									
Total environmental and social cost over the implementation period (£)	Total £									
Option duration (years)	Years	5	10	5	5	5	10	10	10	5
Total environmental and social cost during the initial implementation period (average per year of implementation)	£/Yr									

[41] Cost figures redacted, company confidential information

Table C2d Quantified and monetised traffic related impacts of water efficiency options (accident risk): Options WR616a to WR620b[42]

Category	Unit	WR616a	WR617a	WR615b	WR616b	WR617b	WR620a	WR621a	WR622a	WR620b
Works related impacts										
Traffic related impacts:										
Accident risk:										
○ Urban road distance (round trip per installation)	km	76	76	44	76	76	44	76	76	44
○ Total number of installations	Nbr	51	6	12,272	205	24	222,831	1,837	152	853,813
○ Total number of van movements (yr)*	Nbr	102	12	24,543	409	47	445,662	3,674	304	1,707,626
○ Total km travelled	Km	7,782	902	1,080,191	31,127	3,608	19,614,515	279,249	23,088	75,156,177
○ Accident risk cost per km	£ / km									
Total environmental and social cost over the implementation period (£)	Total £									
Option duration (years)	Years	5	5	10	10	10	5	5	5	10
Total environmental and social cost during the initial implementation period (average per year of implementation)	£/Yr									

[42] Cost figures redacted, company confidential information

Table C2e Quantified and monetised traffic related impacts of water efficiency options (accident risk): Options WR621b to WR905[43]

Category	Unit	WR621b	WR622b	WR623a	WR624a	WR625a	WR623b	WR624b	WR625b	WR905
Works related impacts										
Traffic related impacts:										
Accident risk:										
○ Urban road distance (round trip per installation)	km	76	76	44	76	76	44	76	76	44
○ Total number of installations	Nbr	7,347	607	222,831	1,837	152	853,813	7,347	607	4,025,000
○ Total number of van movements (yr)*	Nbr	14,694	1,215	445,662	3,674	304	1,707,626	14,694	1,215	120,750
○ Total km travelled	Km	1,116,995	92,353	19,614,515	279,249	23,088	75,156,177	1,116,995	92,353	5,314,459
○ Accident risk cost per km	£ / km									
Total environmental and social cost over the implementation period (£)	Total £									
Option duration (years)	Years	10	10	5	5	5	10	10	10	7
Total environmental and social cost during the initial implementation period (average per year of implementation)	£/Yr									

Number of van movements is based on the annual number of visits to properties (a variable parameter based on uptake), the number of trips anticipated to each property per installation (set to two), and the number of vehicles per trip (also assumed to be one). The number of trips to a property is more than for metering because of options typically involving audit or other form of pre-visit in advance of delivery and installation.

[43] Cost figures redacted, company confidential information

Appendix D
Distribution-side Options Assessment Details

Table D1 Summary table: Qualitative description of distribution options

Category	Monetised	Qualitative description
Works related impacts		
Land take	No	Leakage surveys / repairs / replacement do not require land-take. No valuation undertaken.
Landscape impacts	No	Leakage surveys / repairs / replacement can impact on the landscape, particularly the urban landscape. However, the short duration of impacts in urban areas does not trigger the need for valuation in the way that major infrastructure in a landscape sensitive area would. The main concerns in the urban area relate to Traffic. No valuation undertaken.
Property based disamenity effects	Yes	Property disamenity essentially relates to impacts on any aspect of property value, such as changes in aesthetic, surrounding environment, access etc. The BAG recommends disamenity only be quantified where: "*there is a net increase in the number of minor interruptions to domestic water supplies, where there is an increase in the number of domestic properties with excavations in driveways or gardens, an increase in odours or additional properties being impacted by odours from wastewater treatment works or siting of plant where gives rise to significant increase in background noise levels*". Leakage activity whilst necessary does inevitably increase the number of minor interruptions to domestic water supplies. Fixing leaks (large or small) may require temporary supply-cut off to a range of properties whilst the pipes are under repair (or being replaced). In some cases repairs can be undertaken without cutting-off supply, but some properties may experience reductions in water pressure or temporary colouration issues. BAG recommends distinguishing between planned and unplanned interruptions and allocating cost rates accordingly. For the leak related ALC options it is assumed that any interruptions would be unplanned, i.e. reactive to customer leak reports, or ALC surveys. For the mains rehabilitation options it is assumed that United Utilities will be able to anticipate potential interruption/pressure issues for customers most directly affected by those works and will take necessary preventative measures to mitigate those impacts. These impacts have been quantified and monetised in **Tables D2 (a to f).**
Traffic related impacts	Yes	Guidance suggests that this element is only significant if disruption from closing or digging up roads is over a period of more than a few weeks. BAG sub-divides Traffic related impacts into multiple components: congestion, accident risk, Heavy Goods Vehicles (HGVs) movements, Noise impacts, community severance (e.g. schemes that disrupt pedestrians' and cyclist's journey patterns, cause delays etc). This type of disruption occurs when utilities are required to close or dig up roads, and is only considered significant for the purpose of social and environmental costing if this is sustained for more than a few weeks. However, those options which involve home visits would generate additional light vehicle movements (vans). Whilst individual leakage activities are generally concluded in a much shorter timescale than a few weeks (typically days rather than weeks) this impact has been quantified to reflect the potential cumulative impact of increased leakage action in urban areas. With the exception of HGV movements (it is assumed that the majority of smaller scale leakage projects require light vehicle vans rather than HGVs) all of the traffic related impact sub-categories have been assessed and quantified in **Tables D2 (a to f).** The works related impacts 'Traffic' assessment relates to the 'capex' element of leakage: i.e. the leakage activity to initially fix leaks, install pressure reduction valves etc, and to **subsequently replace** equipment. Works to undertake **transitional repairs** (that is the repair work required to achieve the yield) is covered in the operational impacts section.
Energy and global warming potential	No	Carbon impacts assessed separately.
Operational impacts		
Informal recreation	No	Leakage surveys / repairs / replacement do not require land-take. No valuation undertaken.

Category	Monetised	Qualitative description
Angling	No	Leakage surveys / repairs / replacement do not directly impact on flow rates for angling. By reducing losses the company would be able to reduce abstraction from sources but it is not possible to apportion leakage savings back to specific sources or related waterbodies. No valuation undertaken.
Commercial fisheries	No	Leakage surveys / repairs / replacement do not directly impact on flow rates for commercial fisheries. By reducing losses the company would be able to reduce abstraction from sources but it is not possible to apportion leakage savings back to specific sources or related waterbodies. No valuation undertaken.
In stream recreation	No	Leakage surveys / repairs / replacement do not directly impact on flow rates and therefore in-stream recreation. By reducing losses the company would be able to reduce abstraction from sources but it is not possible to apportion leakage savings back to specific sources or related waterbodies. No valuation undertaken.
Amenity	No	Leakage surveys / repairs / replacement do not impact on amenity. No valuation undertaken.
Abstractions	No	By reducing losses the company would be able to reduce abstraction from sources but it is not possible to apportion leakage savings back to specific sources or related waterbodies. No valuation undertaken.
Heritage, archaeology and landscape	No	Short-term (and typically shallow excavations to access infrastructure that has already been in position for many years) will not impact on any local heritage or archaeology. No valuation undertaken.
Property based dis-amenity	Yes	Once leaks have been identified repairs can require temporary supply cut-off or can lead to localised low pressure. These impacts have been monetised in **Tables D2 (a to f)** in terms of low pressure and supply interruptions.
Traffic related impacts	Yes	This category focuses on the 'opex' element of leakage, i.e. to undertake **transitional repairs** (that is the repair work required to achieve the yield). These impacts have been quantified and monetised as shown in **Tables D2 (a to f).** Costs cover leakage activity to undertake operational surveys, and **steady-state repairs**, those required to maintain the reduced leakage achieved in the capex phase. Once leaks have been identified there can be considerable disruption to either traffic (consequence of in-road excavations) and / or pedestrians (pavement excavations). These impacts have been monetised in terms of congestion, pedestrian delays, low pressure, supply interruptions, and noise pollution.
Biodiversity and non-use	No	Leakage surveys / repairs / replacement do not require land-take. No valuation undertaken.

Table D2a Quantified and monetised traffic related impacts of distribution options: Options WR500a to WR501c[44]

Category	Unit	WR500a	WR500b	WR500c	WR500d	WR500e	WR500f	WR500g	WR500h
Works related impacts									
Traffic related impacts:									
Accident risk:									
Total number of transitional ALC surveys	Nbr	276	339	332	520	692	85	104	225
Total number of transitional repairs	Nbr	510	510	408	510	510	511	625	1350
Total number of PRV installations	Nbr	10	13	12	19	26	4424	8148	20083
[subsequent steady state surveys]	Nbr/yr	276	339	332	520	692	85	104	225
- Number of journeys per leak detection survey (one vehicle)	Nbr/survey	8	8	8	8	8	1	1	1
- Number of journeys per leak repair	Nbr/repair	2	2	2	2	2	2	2	2
- Number of vehicles per leak repair journey	Nbr/repair	2	2	2	2	2	2	2	2
- Number of journeys per DMA verification	Nbr/verif	0	0	0	0	0	1	1	1
<u>Congestion:</u>									
o Total number of repairs/verifications during operation in the road	Nbr	192	193	155	196	198	189	231	500
o km of road affected per road repair	Km/repair	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
o Total km of road affected	km	38	39	31	39	40	38	46	100
o Road Type for vehicles data	Text	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads
o Number of vehicles per hour	Nbr/hr	1,259	1,259	1,259	1,259	1,259	1,259	1,259	1,259
o Number of congestion hours	Hrs/day	5	5	5	5	5	5	5	5
o Cost per vehicle per km	£/km								
o Total cost per km	Total £/km								
o Total cost of congestion	Total £								
<u>Accident risk:</u>									
o Road distance (round trip)	km	44	44	44	44	44	44	44	44
o Total number of van movements (yr)*	Nbr								

[44] Cost figures redacted, company confidential information

Category	Unit	WR500a	WR500b	WR500c	WR500d	WR500e	WR500f	WR500g	WR500h
○ Total km travelled	Km	187,049	209,026	188,543	272,913	333,393	108,430	141,743	314,443
○ Accident risk cost per km	£ / km								
○ Total accident risk cost	£								
○ Pedestrian flow	Ped/hr	25	25	25	25	25	25	25	25
○ Repair duration	Hrs/day	5	5	5	5	5	5	5	5
○ Pedestrians affected	Ped/repair	125	125	125	125	125	125	125	125
○ No of repairs/verifications affecting pavement	Nbr	260	260	208	260	260	260	318	688
○ Total pedestrians affected	Nbr	32,459	32,459	25,967	32,460	32,459	32,544	39,805	85,978
○ Time delayed	Hrs/ped	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
○ Transfer value	£								
○ Total pedestrian cost	£								
Noise pollution:									
○ Duration of equipment use	Hrs/day	2	2	2	2	2	2	2	2
○ Pedestrians affected	Nbr	50	50	50	50	50	50	50	50
○ Number of repairs	Nbr	520	522	420	529	535	511	625	1,350
○ Days of 'road' related rehab works - construction	Days	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
○ Pedestrians affected	Nbr	25,996	26,111	21,001	26,446	26,762	25,550	31,250	67,500
○ Exposure time	Hrs/day	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
○ Total person hours affected	Nbr	25,996	26,111	21,001	26,446	26,762	25,550	31,250	67,500
○ Cost per person	£ /person								
○ Total noise cost	£								
Disamenity impacts:									
Supply interruptions:									
○ % leaks causing supply interruptions	%	80%	80%	80%	80%	80%	80%	80%	80%
○ Properties affected (per leak)	Nbr	15	15	15	15	15	15	15	15
○ Properties affected (total)	Nbr	6,239	6,267	5,040	6,347	6,423	6,132	7,500	16,200
○ Cost per property	£/property								
○ Total interruptions cost	£								
Low pressure:									
○ % leaks causing low pressure	%	80%	80%	80%	80%	80%	80%	80%	80%
○ Properties affected (per leak)	Nbr	15	15	15	15	15	15	15	15
○ Properties affected (total)	Nbr	6,239	6,267	5,040	6,347	6,423	6,132	7,500	16,200
○ Cost per property	£/property								

Category	Unit	WR500a	WR500b	WR500c	WR500d	WR500e	WR500f	WR500g	WR500h
○ Total low pressure cost	£								
Total variable environmental and social cost	Total £								
Total fixed 'construction' costs									
Option duration (years)	Years	3	3	3	3	3	1	1	1
Total variable environmental and social costs (average per year of implementation)	£/Yr								

Table D2b Quantified and monetised traffic related impacts of distribution options: Options WR500i to WR501c[45]

Category	Unit	WR500i	WR500j	WR500k	WR501a	WR501b	WR501c
Works related impacts							
Traffic related impacts:							
Accident risk:							
Total number of transitional ALC surveys	Nbr	231	257	112	6	8	9
Total number of transitional repairs	Nbr	1388	1542	671	7	7	7
Total number of PRV installations	Nbr	25575	29235	17098	0	0	1
[subsequent steady state surveys]	Nbr/yr	231	257	112	6	8	9
- Number of journeys per leak detection survey (one vehicle)	Nbr/survey	1	1	1	8	8	8
- Number of journeys per leak repair	Nbr/repair	2	2	2	2	2	2
- Number of vehicles per leak repair journey	Nbr/repair	2	2	2	2	2	2
- Number of journeys per DMA verification	Nbr/verif	1	1	1	0	0	0
Congestion:							
o Total number of repairs/verifications during operation in the road	Nbr	514	570	248	3	4	4
o km of road affected per road repair	Km/repair	0.20	0.20	0.20	0.20	0.20	0.20
o Total km of road affected	km	103	114	50	1	1	1
o Road Type for vehicles data	Text	Main Roads	Main Roads	Main Roads	Main roads	Main roads	Main roads
o Number of vehicles per hour	Nbr/hr	1,259	1,259	1,259	1,259	1,259	1,259
o Number of congestion hours	Hrs/day	5	5	5	5	5	5
o Cost per vehicle per km	£/km						
o Total cost per km	Total £/km						
o Total cost of congestion	Total £						
Accident risk:							
o Road distance (round trip)	km	44	44	44	76	76	76
o Total number of van movements (yr)*	Nbr						

[45] Cost figures redacted, company confidential information

Category	Unit	WR500i	WR500j	WR500k	WR501a	WR501b	WR501c
○ Total km travelled	Km	339,782	380,113	180,010	5,922	6,623	7,502
○ Accident risk cost per km	£ / km						
○ Total accident risk cost	£						
Pedestrian delays:							
○ Pedestrian flow	Ped/hr	25	25	25	25	25	25
○ Repair duration	Hrs/day	5	5	5	5	5	5
○ Pedestrians affected	Ped/repair	125	125	125	125	125	125
○ No of repairs/verifications affecting pavement	Nbr	707	786	342	3	3	3
○ Total pedestrians affected	Nbr	88,421	98,193	42,734	427	427	428
○ Time delayed	Hrs/ped	0.002	0.002	0.002	0.002	0.002	0.002
○ Transfer value	£						
○ Total pedestrian cost	£						
Noise pollution:							
○ Duration of equipment use	Hrs/day	2	2	2	2	2	2
○ Pedestrians affected	Nbr	50	50	50	50	50	50
○ Number of repairs	Nbr	1,388	1,542	671	9	10	11
○ Days of 'road' related rehab works - construction	Days				n/a	n/a	n/a
○ Pedestrians affected	Nbr	69,418	77,090	33,550	464	487	548
○ Exposure time	Hrs/day	1.00	1.00	1.00	1.00	1.00	1.00
○ Total person hours affected	Nbr	69,418	77,090	33,550	464	487	548
○ Cost per person	£ /person						
○ Total noise cost	£						
Disamenity impacts:							
Supply interruptions:							
○ % leaks causing supply interruptions	%	80%	80%	80%	80%	80%	80%
○ Properties affected (per leak)	Nbr	15	15	15	15	15	15
○ Properties affected (total)	Nbr	16,660	18,502	8,052	111	117	131
○ Cost per property	£/property						
○ Total interruptions cost	£						
Low pressure:							
○ % leaks causing low pressure	%	80%	80%	80%	80%	80%	80%
○ Properties affected (per leak)	Nbr	15	15	15	15	15	15
○ Properties affected (total)	Nbr	16,660	18,502	8,052	111	117	131
○ Cost per property	£/property						

Category	Unit	WR500i	WR500j	WR500k	WR501a	WR501b	WR501c
○ Total low pressure cost	£						
Total variable environmental and social cost	Total £						
Total fixed 'construction' costs					£0	£0	£0
Option duration (years)	Years	2	2	1	3	3	3
Total variable environmental and social costs (average per year of implementation)	£/Yr						

Table D2c Quantified and monetised traffic related impacts of distribution options: Options WR501d to WR503[46]

Category	Unit	WR501d	WR501e	WR502a	WR502b	WR502c	WR502d	WR502e	WR503*
Works related impacts									
Traffic related impacts:									
Accident risk:									
Total number of transitional ALC surveys	Nbr	0	0	0	0	0	0	0	0
Total number of transitional repairs	Nbr	4,762	0	0	0	0	0	0	0
Total number of PRV installations	Nbr	0	0	0	0	0	0	6,650	164
[subsequent steady state surveys]	Nbr/yr	0	0	0	0	0	0	0	0
- Number of journeys per leak detection survey (one vehicle)	Nbr/survey	0	0	0	0	0	0	0	0
- Number of journeys per leak repair	Nbr/repair	2	0	0	0	0	0	2	2
- Number of vehicles per leak repair journey	Nbr/repair	2	5	5	5	5	5	1	1
- Number of journeys per DMA verification	Nbr/verif	0	0	0	0	0	0	2	2
Congestion:									
o Total number of repairs/verifications during operation in the road	Nbr	5	5	1	1	1	1	1	-
o km of road affected per road repair	Km/repair	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
o Total km of road affected	km	1	1	0	0	0	0	0	-
o Road Type for vehicles data	Text	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads
o Number of vehicles per hour	Nbr/hr	1,259	1,259	1,259	1,259	1,259	1,259	1,259	1,259
o Number of congestion hours	Hrs/day	5	5	5	5	5	5	5	5
o Cost per vehicle per km	£/km								
o Total cost per km	Total £/km								
o Total cost of congestion	Total £								
Accident risk:									
o Road distance (round trip)	km	76	76	76	76	76	76	76	0
o Total number of van movements (yr)*	Nbr	114	134	82	118	194	375	1,085	0

[46] Cost figures redacted, company confidential information

Category	Unit	WR501d	WR501e	WR502a	WR502b	WR502c	WR502d	WR502e	WR503*
○ Total km travelled	Km	8,636	10,195	6,239	8,990	14,733	28,492	82,512	-
○ Accident risk cost per km	£ / km								
○ Total accident risk cost	£								
Pedestrian delays:									
○ Pedestrian flow	Ped/hr	25	25	25	25	25	25	25	25
○ Repair duration	Hrs/day	5	5	5	5	5	5	5	5
○ Pedestrians affected	Ped/repair	125	125	125	125	125	125	125	125
○ No of repairs/verifications affecting pavement	Nbr	3	3	1	1	1	1	1	-
○ Total pedestrians affected	Nbr	426	425	123	122	124	123	123	-
○ Time delayed	Hrs/ped	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
○ Transfer value	£								
○ Total pedestrian cost	£								
Noise pollution:									
○ Duration of equipment use	Hrs/day	2	2	2	2	2	2	2	2
○ Pedestrians affected	Nbr	50	50	50	50	50	50	50	50
○ Number of repairs	Nbr	12	13	2	2	2	2	2	-
○ Days of 'road' related rehab works - construction	Days	-	-	-	-	-	-	-	-
○ Pedestrians affected	Nbr	610	674	96	96	98	97	97	-
○ Exposure time	Hrs/day	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
○ Total person hours affected	Nbr	610	674	96	96	98	97	97	-
○ Cost per person	£ /person								
○ Total noise cost	£								
Disamenity impacts:									
Supply interruptions:									
○ % leaks causing supply interruptions	%	80%	80%	80%	80%	80%	80%	80%	80%
○ Properties affected (per leak)	Nbr	15	15	15	15	15	15	15	15
○ Properties affected (total)	Nbr	146	162	23	23	23	23	23	-
○ Cost per property	£/property								
○ Total interruptions cost	£								
Low pressure:									
○ % leaks causing low pressure	%	80%	80%	80%	80%	80%	80%	80%	80%
○ Properties affected (per leak)	Nbr	15	15	15	15	15	15	15	15
○ Properties affected (total)	Nbr	146	162	23	23	23	23	23	-
○ Cost per property	£/property								

Category	Unit	WR501d	WR501e	WR502a	WR502b	WR502c	WR502d	WR502e	WR503*
○ Total low pressure cost	£								
Total variable environmental and social cost	Total £								
Total fixed 'construction' costs									
Option duration (years)	Years	3	3	3	3	3	3	3	5
Total variable environmental and social costs (average per year of implementation)	£/Yr								

*WR503 is a desktop exercise option

Table D2d Quantified and monetised traffic related impacts of distribution options: Options WR506 to WR512[47]

		Mains rehabilitation schemes							
Category	**Unit**	**WR506***	**WR508a**	**WR508b**	**WR508c**	**WR508d**	**WR508e**	**WR511**	**WR512**
Works related impacts									
Traffic related impacts:									
Accident risk:									
Total number of transitional ALC surveys	Nbr	0	n/a	n/a	n/a	n/a	n/a	0	0
Total number of transitional repairs	Nbr	4,762	n/a	n/a	n/a	n/a	n/a	0	0
Total number of PRV installations	Nbr	0	n/a	n/a	n/a	n/a	n/a	6,650	164
[subsequent steady state surveys]	Nbr/yr	0	n/a	n/a	n/a	n/a	n/a	0	0
- Number of journeys per leak detection survey (one vehicle)	Nbr/survey	0	n/a	n/a	n/a	n/a	n/a	0	0
- Number of journeys per leak repair	Nbr/repair	2	0	0	0	0	0	2	2
- Number of vehicles per leak repair journey	Nbr/repair	2	5	5	5	5	5	1	1
- Number of journeys per DMA verification	Nbr/verif	0	0	0	0	0	0	2	2
Congestion:									
o Total number of repairs/verifications during operation in the road	Nbr	-	n/a	n/a	n/a	n/a	n/a	2,461	61
o km of road affected per road repair	Km/repair	0.20	0.10	0.10	0.10	0.10	0.10	0.20	0.20
o Total km of road affected	km	-	6.47	13.38	6.23	7.21	12.54	492	12
o Road Type for vehicles data	Text	Main roads	Main roads	Main roads	Main roads	Main roads	Main roads	Main roads	Main roads
o Number of vehicles per hour	Nbr/hr	1,259	1,259	1,259	1,259	1,259	1,259	1,259	1,259
o Number of congestion hours	Hrs/day	5	5	5	5	5	5	5	5
o Cost per vehicle per km	£/km								
o Total cost per km	Total £/km								
o Total cost of congestion	Total £								

[47] Cost figures redacted, company confidential information

		Mains rehabilitation schemes							
Category	**Unit**	**WR506***	**WR508a**	**WR508b**	**WR508c**	**WR508d**	**WR508e**	**WR511**	**WR512**
Accident risk:									
○ Road distance (round trip)	km	44	0	0	0	0	0	44	76
○ Total number of van movements (yr)*	Nbr	19,048	0	0	0	0	0	13,300	329
○ Total km travelled	Km	838,342	38,495	79,591	37,047	42,903	74,568	585,368	24,972
○ Accident risk cost per km	£ / km								
○ Total accident risk cost	£								
Pedestrian delays:									
○ Pedestrian flow	Ped/hr	25	-	-	-	-	-	25	25
○ Repair duration	Hrs/day	5	15	15	15	15	15	5	5
○ Pedestrians affected	Ped/repair	125	-	-	-	-	-	125	125
○ No of repairs/verifications affecting pavement	Nbr	-	-	-	-	-	-	3,388	84
○ Total pedestrians affected	Nbr	-	-	-	-	-	-	423,527	10,461
○ Time delayed	Hrs/ped	0.002	0.100	5.00	5.00	5.00	5.00	0.002	0.002
○ Transfer value	£								
○ Total pedestrian cost	£								
Noise pollution:									
○ Duration of equipment use	Hrs/day	2	100 (total)	100	100	100	100	2	2
○ Pedestrians affected	Nbr	50	-	-	-	-	-	50	50
○ Number of repairs	Nbr	4,762	-	-	-	-	-	6,650	164
○ Days of 'road' related rehab works - construction	Days	-	2,660.36	5,500.54	2,560.32	2,965.03	5,153.38	-	-
○ Pedestrians affected	Nbr	238,100	-	-	-	-	-	332,504	8,213
○ Exposure time	Hrs/day	1.00	-	-	-	-	-	1.00	1.00
○ Total person hours affected	Nbr	238,100	-	-	-	-	-	332,504	8,213
○ Cost per person	£ /person								
○ Total noise cost	£								
Disamenity impacts:									
Supply interruptions:									
○ % leaks causing supply interruptions	%	80%	6%	6%	6%	6%	6%	80%	80%
○ Properties affected (per leak)	Nbr	15	10	10	10	10	10	15	15
○ Properties affected (total)	Nbr	57,144	-	-	-	-	-	79,801	1,971
○ Cost per property	£/property								

		Mains rehabilitation schemes							
Category	**Unit**	**WR506***	**WR508a**	**WR508b**	**WR508c**	**WR508d**	**WR508e**	**WR511**	**WR512**
○ Total interruptions cost	£								
Low pressure:									
○ % leaks causing low pressure	%	80%	80%	80%	80%	80%	80%	80%	80%
○ Properties affected (per leak)	Nbr	15	100	100	100	100	100	15	15
○ Properties affected (total)	Nbr	57,144	-	-	-	-	-	79,801	1,971
○ Cost per property	£/property								
○ Total low pressure cost	£								
Total variable environmental and social cost	Total £								
Total fixed 'construction' costs									
Option duration (years)	Years	5	1	2	1	1	1	5	5
Total environmental and social costs (average per year of implementation)									

*WR506 Free SPL repair – this option does not create congestion or other 'external' impacts
Mains rehabilitation schemes: impacts are different to the ongoing smaller 'per leak' actions of other leakage options.

Table D2e Quantified and monetised traffic related impacts of distribution options: Options WR513 to WR520[48]

Category	Unit	WR513	WR514	WR515	WR516	WR517	WR518	WR519	WR520
Works related impacts									
Traffic related impacts:									
Accident risk:									
Total number of transitional ALC surveys	Nbr	0	0	0	0	0	0	0	0
Total number of transitional repairs	Nbr	0	0	0	0	0	0	0	0
Total number of PRV installations	Nbr	85	0	0	0	0	0	0	220
[subsequent steady state surveys]	Nbr/yr	0	0	0	0	0	0	0	0
- Number of journeys per leak detection survey (one vehicle)	Nbr/survey	0	0	0	0	0	0	0	0
- Number of journeys per leak repair	Nbr/repair	2	2	2	2	2	2	2	2
- Number of vehicles per leak repair journey	Nbr/repair	1	1	1	1	1	1	1	1
- Number of journeys per DMA verification	Nbr/verif	2	2	2	2	2	2	2	2
Congestion:									
o Total number of repairs/verifications during operation in the road	Nbr	31	-	36	0	165	4	-	-
o km of road affected per road repair	Km/repair	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
o Total km of road affected	km	6	-	7	0	33	1	-	-
o Road Type for vehicles data	Text	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads
o Number of vehicles per hour	Nbr/hr	1,259	1,259	1,259	1,259	1,259	1,259	1,259	1,259
o Number of congestion hours	Hrs/day	5	5	5	5	5	5	5	5
o Cost per vehicle per km	£/km								
o Total cost per km	Total £/km								
o Total cost of congestion	Total £								
Accident risk:									
o Road distance (round trip)	km	76	44	44	76	44	76	76	44
o Total number of van movements (yr)*	Nbr	170	1,080	196	2	894	24	0	440

[48] Cost figures redacted, company confidential information

Category	Unit	WR513	WR514	WR515	WR516	WR517	WR518	WR519	WR520
○ Total km travelled	Km	12,891	47,533	8,626	152	39,347	1,824	-	19,365
○ Accident risk cost per km	£ / km								
○ Total accident risk cost	£								
Pedestrian delays:									
○ Pedestrian flow	Ped/hr	25	25	25	25	25	25	25	25
○ Repair duration	Hrs/day	5	5	5	5	5	5	5	5
○ Pedestrians affected	Ped/repair	125	125	125	125	125	125	125	125
○ No of repairs/verifications affecting pavement	Nbr	43	275	50	1	228	6	-	112
○ Total pedestrians affected	Nbr	5,400	34,391	6,241	64	28,468	764	-	14,011
○ Time delayed	Hrs/ped	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
○ Transfer value	£								
○ Total pedestrian cost	£								
Noise pollution:									
○ Duration of equipment use	Hrs/day	2	2	2	2	2	2	2	2
○ Pedestrians affected	Nbr	50	50	50	50	50	50	50	50
○ Number of repairs	Nbr	85	540	98	1	447	12	-	220
○ Days of 'road' related rehab works - construction	Days	-	-	-	-	-	-	-	-
○ Pedestrians affected	Nbr	4,240	27,000	4,900	50	22,350	600	-	11,000
○ Exposure time	Hrs/day	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
○ Total person hours affected	Nbr	4,240	27,000	4,900	50	22,350	600	-	11,000
○ Cost per person	£ /person								
○ Total noise cost	£								
Disamenity impacts:									
Supply interruptions:									
○ % leaks causing supply interruptions	%	80%	80%	80%	80%	80%	80%	80%	80%
○ Properties affected (per leak)	Nbr	15	15	15	15	15	15	15	15
○ Properties affected (total)	Nbr	1,018	6,480	1,176	12	5,364	144	-	2,640
○ Cost per property	£/property								
○ Total interruptions cost	£								
Low pressure:									
○ % leaks causing low pressure	%	80%	80%	80%	80%	80%	80%	80%	80%
○ Properties affected (per leak)	Nbr	15	15	15	15	15	15	15	15
○ Properties affected (total)	Nbr	1,018	6,480	1,176	12	5,364	144	-	2,640
○ Cost per property	£/property								

Category	Unit	WR513	WR514	WR515	WR516	WR517	WR518	WR519	WR520
○ Total low pressure cost	£								
Total variable environmental and social cost	Total £								
Total fixed 'construction' costs									
Option duration (years)	Years	5	5	5	5	5	5	5	5
Total environmental and social costs (<u>average per year of implementation</u>)	£/Yr								

Table D2f Quantified and monetised traffic related impacts of distribution options: Options WR151 to WR907d[49]

Category	Unit	WR151	WR903a	WR903b	WR903c	WR907a	WR907b	WR907c	WR907d
Works related impacts									
Traffic related impacts:									
Accident risk:									
Total number of transitional ALC surveys	Nbr	0	1,523	37	14	8,000	3,800	5,000	3,200
Total number of transitional repairs	Nbr	0	245	3	1	9,000	5,400	9,000	9,000
Total number of PRV installations	Nbr	220	0	0	0	0	0	0	0
[subsequent steady state surveys]	Nbr/yr	0	0	0	0	0	0	0	0
- Number of journeys per leak detection survey (one vehicle)	Nbr/survey	0	2	2	2	1	1	1	1
- Number of journeys per leak repair	Nbr/repair	2	1	1	1	1	1	1	1
- Number of vehicles per leak repair journey	Nbr/repair	2	1	1	1	1	1	1	1
- Number of journeys per DMA verification	Nbr/verif	2	0	0	0	0	0	0	0
Congestion:									
o Total number of repairs/verifications during operation in the road	Nbr	-	91	1	0	-	-	-	-
o km of road affected per road repair	Km/repair	0.41	0.20	0.20	0.20	-	-	-	-
o Total km of road affected	km	29.23	18	0.24	0.04	-	-	-	-
o Road Type for vehicles data	Text	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads	Main Roads
o Number of vehicles per hour	Nbr/hr	1,259	1,259	1,259	1,259	1,259	1,259	1,259	1,259
o Number of congestion hours	Hrs/day	5	5	5	5	5	5	5	5
o Cost per vehicle per km	£/km					-	-	-	-
o Total cost per km	Total £/km					-	-	-	-
o Total cost of congestion	Total £					**-**	**-**	**-**	**-**
Accident risk:									
o Road distance (round trip)	km	0	113	113	113	45	57	68	83
o Total number of van movements (yr)*	Nbr	440	4,271	90	31	26,000	14,600	23,000	21,200

[49] Cost figures redacted, company confidential information

Category	Unit	WR151	WR903a	WR903b	WR903c	WR907a	WR907b	WR907c	WR907d
○ Total km travelled	Km	173,848	481,447	10,156	3,472	360,000	218,000	340,000	264,000
○ Accident risk cost per km	£ / km								
○ Total accident risk cost	£								
Pedestrian delays:									
○ Pedestrian flow	Ped/hr	0	25	25	25	25	25	25	25
○ Repair duration	Hrs/day	15	5	5	5	5	5	5	5
○ Pedestrians affected	Ped/repair	1	125	125	125	125	125	125	125
○ No of repairs/verifications affecting pavement	Nbr	-	125	2	0	450	270	450	450
○ Total pedestrians affected	Nbr	90	15,605	205	36	56,250	33,750	56,250	56,250
○ Time delayed	Hrs/ped	5.00	0.002	0.002	0.002	0.002	0.002	0.002	0.002
○ Transfer value	£								
○ Total pedestrian cost	£								
Noise pollution:									
○ Duration of equipment use	Hrs/day	5	2	2	2	2	2	2	2
○ Pedestrians affected	Nbr	0	50	50	50	50	50	50	50
○ Number of repairs	Nbr	-	245	3	1	9,000	5,400	9,000	9,000
○ Days of 'road' related rehab works - construction	Days	564.69	-	-	-	-	-	-	-
○ Pedestrians affected	Nbr	141	12,251	161	28	450,000	270,000	450,000	450,000
○ Exposure time	Hrs/day	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
○ Total person hours affected	Nbr	141	12,251	161	28	450,000	270,000	450,000	450,000
○ Cost per person	£ /person								
○ Total noise cost	£								
Disamenity impacts:									
Supply interruptions:									
○ % leaks causing supply interruptions	%	0%	80%	80%	80%	100%	100%	100%	100%
○ Properties affected (per leak)	Nbr	-	15	15	15	1	1	1	1
○ Properties affected (total)	Nbr	-	2,940	39	7	9,000	5,400	9,000	9,000
○ Cost per property	£/property								
○ Total interruptions cost	£								
Low pressure:									
○ % leaks causing low pressure	%	80%	80%	80%	80%	0%	0%	0%	0%
○ Properties affected (per leak)	Nbr	100	15	15	15	-	-	-	-
○ Properties affected (total)	Nbr	-	2,940	39	7	-	-	-	-
○ Cost per property	£/property					-	-	-	-

Category	Unit	WR151	WR903a	WR903b	WR903c	WR907a	WR907b	WR907c	WR907d
○ Total low pressure cost	£					-	-	-	-
Total variable environmental and social cost	Total £								
Total fixed 'construction' costs									
Option duration (years)	Years	3	5	5	5	10	5	10	5
Total environmental and social costs (<u>average per year of implementation</u>)	£/Yr								

Table D2g Quantified and monetised traffic related impacts of distribution options: Options WR907e to WR914[50]

Category	Unit	WR907e*	WR907f*	WR907g*	WR911a*	WR911b*	WR912*	WR914
Works related impacts								
Traffic related impacts:								
Accident risk:								
Total number of transitional ALC surveys	Nbr	90	450	450	60	120	60	104
Total number of transitional repairs	Nbr	248	1,238	1,238	0	60	60	0
Total number of PRV installations	Nbr	0	0	0	0	0	0	0
[subsequent steady state surveys]	Nbr/yr	0	0	0	0	0	0	0
- Number of journeys per leak detection survey (one vehicle)	Nbr/survey	1	1	1	1	1	1	2
- Number of journeys per leak repair	Nbr/repair	1	1	1	0	0	0	0
- Number of vehicles per leak repair journey	Nbr/repair	2	2	2	0	0	0	0
- Number of journeys per DMA verification	Nbr/verif	0	0	0	0	0	0	1
Congestion:								
o Total number of repairs/verifications during operation in the road	Nbr	n/a	n/a	n/a	n/a	n/a	n/a	44
o km of road affected per road repair	Km/repair	n/a	n/a	n/a	n/a	n/a	n/a	0.2
o Total km of road affected	km	n/a	n/a	n/a	n/a	n/a	n/a	9
o Road Type for vehicles data	Text	n/a	n/a	n/a	n/a	n/a	n/a	Main roads
o Number of vehicles per hour	Nbr/hr	n/a	n/a	n/a	n/a	n/a	n/a	1,259
o Number of congestion hours	Hrs/day	n/a	n/a	n/a	n/a	n/a	n/a	5
o Cost per vehicle per km	£/km							
o Total cost per km	Total £/km							
o Total cost of congestion	Total £							
Accident risk:								

[50] Cost figures redacted, company confidential information

Category	Unit	WR907e*	WR907f*	WR907g*	WR911a*	WR911b*	WR912*	WR914
○ Road distance (round trip)	km	70	70	70	71	71	71	48
○ Total number of van movements (yr)*	Nbr	585	2,925	2,925	60	120	60	328
○ Total km travelled	Km	40,950	204,750	204,750	4,290	8,580	4,290	15,845
○ Accident risk cost per km	£ / km							
○ Total accident risk cost	£							
Pedestrian delays:								
○ Pedestrian flow	Ped/hr	25	25	25	-	-	-	25
○ Repair duration	Hrs/day	5	5	5	-	-	-	-
○ Pedestrians affected	Ped/repair	125	125	125	-	-	-	-
○ No of repairs/verifications affecting pavement	Nbr	12	62	62	-	-	-	6
○ Total pedestrians affected	Nbr	1,547	7,734	7,734	-	-	-	-
○ Time delayed	Hrs/ped	0.002	0.002	0.002	0.000	0.000	0.000	0.002
○ Transfer value	£							
○ Total pedestrian cost	£							
Noise pollution:								
○ Duration of equipment use	Hrs/day	2	2	2	2	2	2	2
○ Pedestrians affected	Nbr	50	50	50	-	-	-	50
○ Number of repairs	Nbr	248	1,238	1,238	60	120	60	120
○ Days of 'road' related rehab works - construction	Days	-	-	-	-	-	-	-
○ Pedestrians affected	Nbr	12,375	61,875	61,875	-	-	-	6,000
○ Exposure time	Hrs/day	1.00	1.00	1.00	1.00	1.00	1.00	1.00
○ Total person hours affected	Nbr	12,375	61,875	61,875	-	-	-	6,000
○ Cost per person	£ /person							
○ Total noise cost	£							
Disamenity impacts:								
Supply interruptions:								
○ % leaks causing supply interruptions	%	100%	100%	100%	100%	100%	100%	80%
○ Properties affected (per leak)	Nbr	1	1	1	1	1	1	15
○ Properties affected (total)	Nbr	248	1,238	1,238	60	120	60	1,440
○ Cost per property	£/property							
○ Total interruptions cost	£							
Low pressure:								
○ % leaks causing low pressure	%	0%	0%	0%	0%	0%	0%	80%
○ Properties affected (per leak)	Nbr	-	-	-	-	-	-	15

Category	Unit	WR907e*	WR907f*	WR907g*	WR911a*	WR911b*	WR912*	WR914
○ Properties affected (total)	Nbr	-	-	-	-	-	-	1,440
○ Cost per property	£/property							
○ Total low pressure cost	£							
Total variable environmental and social cost	Total £							
Total fixed 'construction' costs		0						
Option duration (years)	Years	5	5	5	5	5	5	5
Total environmental and social costs (<u>average per year of implementation</u>)	£/Yr							

*Options target leaks on privately owned non-household sites. Therefore whilst there will be vehicle movements to site (and so accident risk), these options do not trigger the congestion impact. It is assumed that they still could require pavement disruption (identifying supply pipes and connections to mains).