Technical note:
Habitats Regulations Assessment of the Draft Water Resources Management Plan 2019: Resilience Options Initial Assessment

1. Introduction

1.1 Overview

United Utilities is currently preparing its Water Resources Management 2019 (WRMP19) that 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 currently consulting on a Draft Water Resources Management Plan (Draft WRMP) in order that regulators, stakeholders and the public can comment on United Utilities' proposed strategy and further contribute to the development of the plan.

United Utilities has identified, and included in its Draft WRMP, five potential solutions to address the resilience risks associated with the regional aqueduct system (which transfers water from the Lake District to supply the Manchester and Pennine areas including parts of Lancashire and south Cumbria). At this stage, United Utilities' preferred Manchester and Pennine Resilience solution has not been determined; this work is ongoing and will be informed by consultation responses to the Draft WRMP together with further assessment and appraisal.

In this context, and as part of the process of selecting the preferred Manchester and Pennine Resilience solution, Amec Foster Wheeler Environment and Infrastructure UK Ltd (Amec Foster Wheeler, now Wood) has been commissioned to undertake a Habitats Regulations Assessment (HRA) of the five potential solutions identified by United Utilities and their component resilience options. The HRA is being undertaken to determine whether the solutions could have significant or significant adverse effects on the integrity of any European sites.

This Technical Note presents the findings of an initial review of the resilience options that make up the identified Manchester and Pennine Resilience solutions. It provides an initial review of the resilience options based on the potential to affect European sites within 20km; however, this review does not provide a definitive conclusion on the likely effects of the resilience options (or of the final WRMP, if specific solutions are included), but is intended to inform United Utilities' selection of resilience solutions by identifying:

- those resilience options that would appear to have an unavoidable risk of adverse effects on European sites (and which should therefore be avoided if possible);
- those resilience options where significant or adverse effects would not appear likely, assuming established avoidance and mitigation measures can employed at the scheme level; and
- those resilience options where effects are currently uncertain, which would require additional data or information on operation / construction to support a robust HRA of the WRMP.

1.2 Context

United Utilities' Draft Water Resources Management Plan 2019

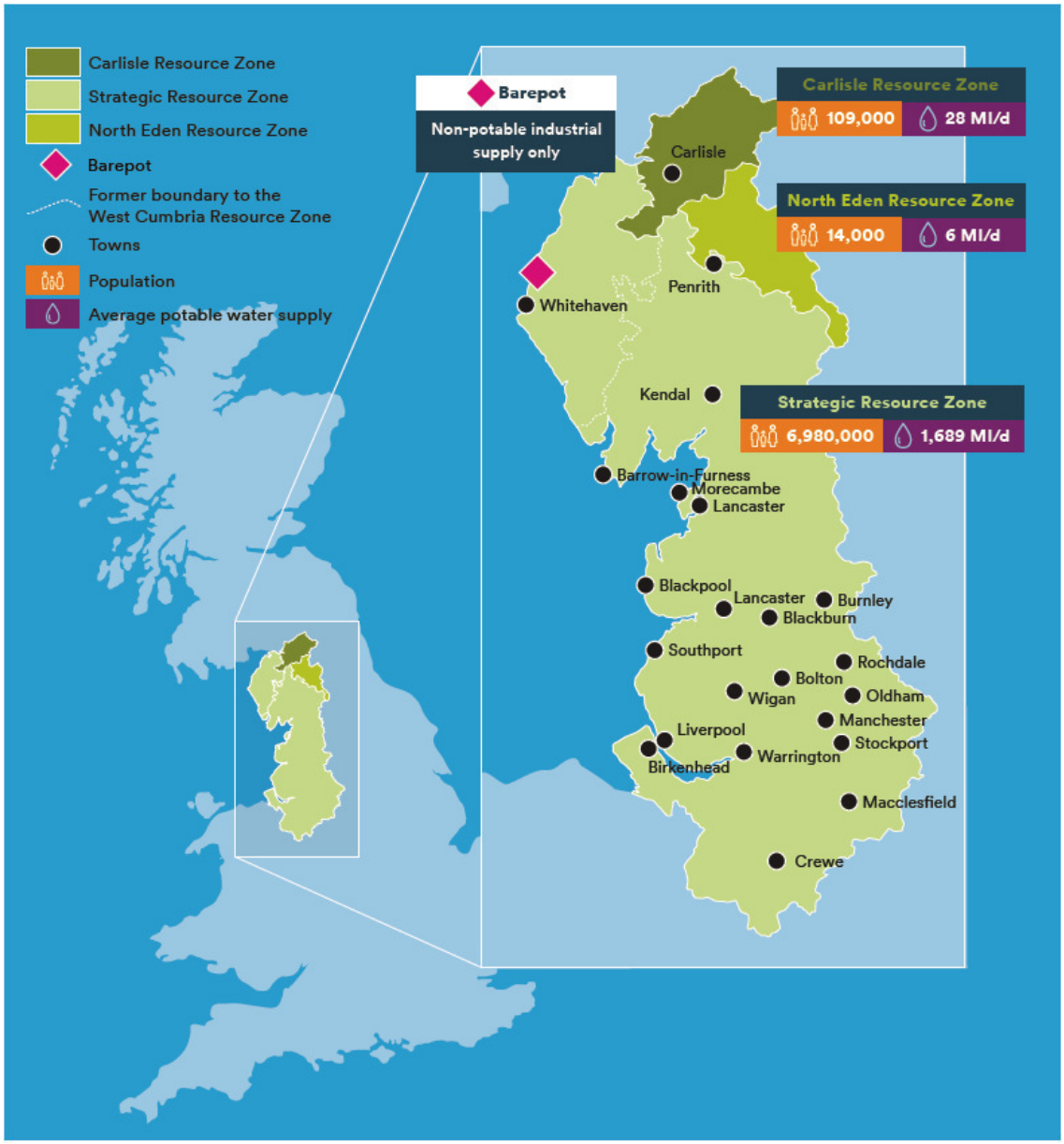
Along with all water companies in England and Wales, there is a statutory requirement for United Utilities to prepare, maintain and publish a WRMP that sets out how the balance between water supply and demand, and security of supply will be maintained over the coming 25 years in a way that is economically, socially and environmentally sustainable. These plans are reviewed on a rolling 5 year basis and United Utilities is currently preparing its WRMP for the period 2020 to 2045 and beyond, which is due to be published in 2019. Once published, WRMP19 will replace the current 2015 WRMP.

The WRMP will present management options by water resource zone (WRZ). WRZs are defined in the Water Resources Planning Guideline[1] as "*an area within which the abstraction and distribution of supply to meet demand is largely self-contained (with the exception of agreed bulk transfers)…Within a WRZ all parts of the supply system and demand centres (where water is needed) should be connected so that all customers in the WRZ should experience the same risk of supply failure and the same level of service for demand restrictions*".

United Utilities' region is currently split into four WRZs: the Integrated Water Resource Zone covering the major conurbations; North Eden; Carlisle and West Cumbria. As a long-term 25-year strategic view, WRMP19 is being developed to reflect the merging of the West Cumbria and Integrated Resource Zones in 2022 (following the implementation of the 2015 WRMP) and which together will form the Strategic Resource Zone. A new smaller resource zone, Barepot, has also been established to reflect supplies to commercial customers located in the West Cumbria area (these are not connected into the rest of the public water supply network). As a result, WRMP19 is being developed around the four WRZs that will exist from 2022, as shown in **Figure 1.1.** These are: the Strategic Resource Zone; the Carlisle Resource Zone; the North Eden Resource Zone; and Barepot non potable industrial supply zone.

[1] Environment Agency and Natural Resources Wales (2017) *Water Resources Planning Guideline: Interim Update*. Available at: https://naturalresources.wales/media/681612/interim-wrpg-update-final-april-2017.pdf [Accessed October 2017].

Figure 1.1 United Utilities' Resource Zones (from 2022 onwards)



In preparing the Draft WRMP, United Utilities has forecast the future demand for water and available supply (the supply-demand balance) for the 25 year period to 2045 and has determined that there will be a surplus in all four of the company's WRZs in a dry year over the planning horizon of WRMP19. As there is forecast to be enough water to meet demand over the period of WRMP19, United Utilities does not need to take any further action in this regard. However, consideration has been given to using the forecast surplus, with possible new source or demand management investment, to explore strategic choices for the WRMP.

In this context, United Utilities' Preferred Plan for WRMP19 seeks to deliver the following four 'strategic choices':

- Enhanced leakage reduction by a total of 80 mega litres per day (Ml/d) over the planning period;
- Improved 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);

- Increased resilience to others hazards, including through the Manchester and Pennine Resilience solution; and
- Commitment to continue to explore national water trading.

The Preferred Plan comprises a combination of preferred resource management and demand management (including leakage reduction and network metering) options designed to achieve the four strategic choices outlined above and maintain and enhance the supply-demand balance. These preferred options are presented in the Draft WRMP for public consultation and have been selected following a process of options identification and appraisal. This process initially reviews as many potential solutions as possible (the 'unconstrained list' of options) to identify 'feasible' options. Following an initial round of screening (Primary Screening), the feasible options were then assessed in terms of their financial, environmental and social costs and ranked. Informed by this assessment, ongoing discussion with stakeholders, and the outcomes of the Strategic Environmental Assessment (SEA), HRA and Water Framework Directive (WFD) Assessment, plus some other assessments, this list was further refined through Secondary Screening to identify a list of constrained options, from which the Preferred Plan options were selected.

Manchester and Pennine Resilience

As part of the Preferred Plan, United Utilities will seek to enhance resilience to non-drought hazards; the largest resilience risk identified being that associated with the regional aqueduct system which supplies water from the Lake District to the Manchester and Pennine areas (including parts of south Cumbria and Lancashire). United Utilities has identified that the aqueduct condition is deteriorating over time and presents a risk in terms of both water quality and water supply to Greater Manchester and areas of the Pennines. This risk could, in the future, result in a widespread water quality incident (for example, advice to boil water for drinking purposes for over a million properties) or loss of supply to many thousands of properties for an extended period. United Utilities has identified three indicative events to represent the overall baseline system risk over a future 10 year period:

- 65% probability that 1.2 million properties could be affected by water quality problems for 1 week;
- 35% probability that 120,000 properties could be affected by supply interruptions for up to 3 months;
- 20% probability that 240,000 properties could be affected by supply interruptions for up to 2 weeks.

The development of solutions to address the risks of aqueduct deterioration (and its consequences) to the Strategic Resource Zone is collectively referred to as 'Manchester and Pennine Resilience'.

Resilience Solutions

As set out in **Section 1.1**, five potential Manchester and Pennine Resilience solutions have been identified by United Utilities. These solutions are listed below:

- **Solution A (FM20-SO4)**: New sources and targeted repair of Tunnel 5 and Tunnel 6 (T05 and T06) of the existing aqueduct supported by uprating the West East Link Main (WELM) and construction of a new associated break tank near Bolton in conjunction with a new abstraction from the River Irwell and an associated new water treatment works (WTW) (similar to water resources Option WR141).
- **Solution B (C29)**: New tunnel sections T05 and T06 and partial UV and metals treatment at existing United Utilities facilities along the length of the existing Manchester and Pennine Aqueduct.
- **Solution C (FM15-SO4b)**: Convert the Manchester and Pennine Aqueduct to raw water supply and build new WTWs at Bury and in the Ribble Valley.
- **Solution D (C11)**: New tunnel sections T01, T02, T03, T04, T05 and T06.

- **Solution E (C17)**: New tunnel sections as for Solution D, plus use of new and existing sources requiring WTW and associated pipelines varying in length from 100 m to over 8 km. The new sources are similar to water resources options WR049a/b and WR141.

The five solutions offer varying degrees of risk reduction, are significantly different in terms of technical and geographical scope, and would give rise to varying levels and types of environmental effects.

To support United Utilities' decision making, and to ensure consistency between the assessment of the Manchester and Pennine Resilience solutions and the feasible options contained in the Draft WRMP, the component options that make up each solution as well as the solutions themselves have been subject to Environmental and Social (E&S) Costings, SEA, HRA and WFD Assessment.

The outcomes of these assessments, together with consultees views on the Draft WRMP19, will be used to inform the selection of the preferred Manchester and Pennine Resilience solution.

Resilience Options

Following initial screening in two distinct stages and ranking of over 300 options (consistent with the approach adopted to the identification of feasible (constrained) options for the Draft WRMP), United Utilities has identified a total of 34 resilience options, different combinations of which form the five potential Manchester and Pennine Resilience solutions. These options are listed and described in **Table 1.1** together with the respective solution(s) to which they relate.

Table 1.1 Resilience Options

Ref	Option	Description	Solution(s)
3	Manchester and Pennine Aqueduct to Raw: 2 Stage filtration (Bury)	This option would involve the development of a new 2 stage filtration Water Treatment Works (WTW) at an existing site in the Bury area in order to provide increased resilience. In conjunction with Options 212, 213, 214, 301, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. In addition to the new WTW, the scheme would require new abstraction/ pumping from a Bulk Supply Point (BSP) to the new WTW, pumping from the new WTW to existing treated water storage, and the demolition of the existing connection mains.	▸ Solution C
37-38	Manchester and Pennine Aqueduct section T05 to T06	This option would provide protection against structural failure of an existing single pipe section of the Manchester and Pennine Aqueduct and would be used for the conveyance of treated water. This option would involve the construction of new 2.6m diameter conduits and a 2.85m diameter tunnel for a total length of approximately 19.3km, and new connection chambers and isolating penstocks.	▸ Solution B
37-42	Manchester and Pennine Aqueduct sections T01 to T06	This option would provide protection against structural failure of an existing single pipe section of the Manchester and Pennine Aqueduct and would be used for the conveyance of treated water. This option would involve the construction of new 2.6m diameter conduits and a 2.85m diameter tunnel for a total length of approximately 51.9km, and new connection chambers and isolating penstocks.	▸ Solution D ▸ Solution E
46	WELM Uprate to 150Ml/day	This option would provide additional connectivity for treated water. It would involve the construction of a 3.1Ml break tank and intermediate pumping facilities to enable the transfer of 150 Ml/d.	▸ Solution A ▸ Solution E

Ref	Option	Description	Solution(s)
112	Manchester and Pennine Aqueduct Outage (4 weeks) for installation of connections	This option would involve implementing Manchester and Pennine Aqueduct outage for a period of 4 weeks to facilitate the installation of connections. There would be no new development associated with this option.	▶ Solution B ▶ Solution D
212	Manchester and Pennine Aqueduct to Raw (Newton-in-Bowland)	Under this option, raw water would be taken directly from the Manchester and Pennine Aqueduct (without treatment) for treatment at a new WTW in the Newton-in-Bowland area. In conjunction with Options 3, 213, 214, 301, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The option would involve the construction of a new 2 stage filtration WTW together with a new connection from the Aqueduct to the WTW and pumped supply to an existing aqueduct. The new WTW is expected to treat an average of 41 Ml/d, with a maximum treatment capacity of 60 Ml/d.	▶ Solution C
213	Manchester and Pennine Aqueduct to Raw (Clayton-le-Moors)	Under this option, raw water would be taken directly from the Manchester and Pennine Aqueduct (without treatment) for treatment at a new WTW in the Clayton-le-Moors area. In conjunction with Options 3, 212, 214, 301, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The option would involve the construction of a new 2 stage filtration WTW together with a new connection from the Manchester and Pennine Aqueduct to the WTW inlet, a pumping station and circa 2.8km pipeline from the WTW to two BSPs.	▶ Solution C
214	Manchester and Pennine Aqueduct to Raw (Haslingden)	Under this option, raw water would be taken directly from the Manchester and Pennine Aqueduct (without treatment) for treatment at a new WTW in the Haslingden area. In conjunction with Options 3, 212, 213, 301, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The option would involve the construction of a new 2 stage filtration WTW together with new connections from the Manchester and Pennine Aqueduct to the WTW inlet and from the WTW to an existing pumping station.	▶ Solution C
215	Alternative Supply: Raw water transfer and WTW (Clayton-le-Moors)	This option would provide additional raw water from the River Ribble (under a new abstraction licence) and additional water treatment capacity in the Clayton-le-Moors area. The option, in conjunction with Options 216, 217 and 218, would provide additional abstraction/treatment facilities to facilitate Solution E. The option would require a new abstraction point, circa 9.1km of 800m main to a new 3 stage WTW and a pumping station.	▶ Solution E ▶
216	Alternative Supply: Raw water abstraction and WTW (Haslingden)	This option would provide additional raw water from the River Irwell (under a new abstraction licence) and additional water treatment capacity in the Haslingden area. The option, in conjunction with Options 215, 217 and 218, would provide additional abstraction/treatment facilities to facilitate Solution E. The option would require a new abstraction point and pumping station, circa 1.0km of 450mm main to a new 3 stage WTW and a new connection from the WTW to an existing BSP.	▶ Solution A ▶ Solution E ▶

Ref	Option	Description	Solution(s)
217	Alternative Supply: Raw water transfer and WTW (Newton-in-Bowland)	This option would provide additional raw water from an aqueduct and additional water treatment capacity in the Newton-in-Bowland area. The option, in conjunction with Options 215, 216 and 218, would provide additional abstraction/treatment facilities to facilitate Solution E. The option would require a new connection to the raw water aqueduct, circa 5.3km of 700mm diameter pipeline to transfer water from the connection point and a new 3 stage WTW and pumping station.	▶ Solution E ▶
218	Alternative Supply: Raw water transfer and WTW (Preston)	This option would redirect raw water from the River Wyre to additional water treatment capacity in the Preston area. The option, in conjunction with Options 215, 216 and 217, would provide additional abstraction/treatment facilities to facilitate Solution E. The option would require a connection to the raw water feed from the River Wyre and pumping from the connection point via circa 8.5km of 800mm main to a new 3 stage WTW. A new pumping station would also be constructed at the WTW site to feed water from the WTW into an existing aqueduct via circa 4.4km of 700mm pipeline.	▶ Solution E ▶
238	Metals & UV treatment of BSPs: Bury	This option seeks to provide treatment of metals, cryptosporidium and/or E.Coli to the treated water which is being siphoned off the Manchester and Pennine Aqueduct. The option would require the construction of a new 2 stage WTW in the Bury area.	▶ Solution B
260	Ribblesdale South Well Isolation	This option would enable the isolation of the downstream section T05 for rehabilitation. It would require a new valve chamber constructed around existing siphon pipes in the Clitheroe area and a new valve house over the chamber. The option would also require a new access road.	▶ Solution A ▶
261	Haslingden Well Isolation	This option would enable the isolation of the downstream section T06 for rehabilitation. It would require a new 12.5mID shaft on an existing 2.59mID conduit in the Haslingden area with two isolating penstocks and provision for downstream tunnel access. The option would also require a new control kiosk and access road.	▶ Solution A ▶
296	T05 targeted repair 2025	This option would target section T05 for remedial works (tunnel lining) in order to provide greater structural support to the wider water distribution network. Under the option, approximately 100m of section T05 would undergo tunnel lining which would involve the installation of steel liner. The installation of two new access shafts (5m diameter/110m deep) would be required to facilitate the proposed works. It should be noted that the installation of tunnel liners would subsequently decrease the diameter of the Manchester and Pennine Aqueduct, e.g. reduced water flow, thus further hydraulic analysis is required to confirm the minimum acceptable diameter to support/maintain present operation.	▶ Solution A ▶

Ref	Option	Description	Solution(s)
297	T06 targeted repair 2025	This option would target section T06 for remedial works (tunnel lining and conduit lining) in order to provide greater structural support to the wider water distribution network. It is proposed that an approximate 200m of section T06 would undergo conduit lining which would involve the installation of steel reinforcement cages sprayed with concrete lining whilst 200m of the tunnel would receive tunnel lining. The installation of four new access shaft/chambers (5m diameter/110m deep) would be required. Additionally, there is a risk that it may be necessary to rebuild a cracked conduit bridge (approx 30m) in addition to implementing a new settled conduit configuration as additional ancillary works. It should be noted that the installation of conduit/tunnel liners would subsequently decrease the diameter of the Manchester and Pennine Aqueduct, e.g. reduced water flow, thus further hydraulic analysis is required to confirm the minimum acceptable diameter to support/maintain present operation.	▶ Solution A ▶
301	Lunesdale Siphon BSPs North	This option seeks to provide additional connectivity for treated water via existing pipework to a treated water storage facility in the Kendal area and onwards to the north end of the Lunesdale Siphon where it would be intercepted by a proposed new pipeline connecting to existing BSPs. In conjunction with Options 3, 212, 213, 214, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The option would require pipelines from the treated water storage facility to the Manchester and Pennine Aqueduct in the vicinity of the BSPs in the Kirkby Lonsdale area in addition to increased storage provision at the existing treated water storage facility (from 0.75Ml to 9.0Ml).	▶ Solution C
303	Lunesdale Siphon BSPs South	This option would increase connectivity for treated water through Manchester and Pennine Aqueduct outage on a permanent basis. In conjunction with Options 3, 212, 213, 214, 301, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The options would require new sections of pipeline between BSPs in the Bentham area. The option would also require: a new pumping station in the Bentham area; additional 9Ml storage at an existing treated water storage facility near Lancaster; modification to a pumping station in the Morecambe area to accommodate permanent usage; and the abandonment of existing facilities.	▶ Solution C
306	Ribblesdale Siphon BSPs North	This option would adapt the connectivity of the treated water network with BSPs in the Clitheroe area being permanently supplied via an existing aqueduct and pumping stations using existing network infrastructure. In conjunction with Options 3, 212, 213, 214, 301, 303 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The option would require a new circa 2.9km reinforcing pipe (250mm diameter) to support the new configuration between the BSPs and the aqueduct. Some existing pipelines would be abandoned.	▶ Solution C

Ref	Option	Description	Solution(s)
348	Metals & UV Treatment of BSPs: Lunesdale Siphon (1)	This option would involve the construction of a new WTW with second stage rapid gravity filters (RGF) for metals removal and UV treatment in the Kirkby Lonsdale area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat 2.48 Ml/d.	▶ Solution B
349	Metals & UV Treatment of BSPs: Lunesdale Siphon (2)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Kirkby Lonsdale area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat 2.9 Ml/d.	▶ Solution B
350	Metals & UV Treatment of BSPs: Lunesdale Siphon (3)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Kirkby Lonsdale area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 0.36 Ml/d, with a maximum treatment capacity of 0.57 Ml/d.	▶ Solution B
351	Metals & UV Treatment of BSPs: Lunesdale Siphon (4)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Wrayton area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 5.59 Ml/d, with a maximum treatment capacity of 6.04 Ml/d.	▶ Solution B
352	Metals & UV Treatment of BSPs: Lunesdale Siphon (5)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Bentham area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat 0.01 Ml/d.	▶ Solution B
353	Metals & UV Treatment of BSPs: Lunesdale Siphon (6)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Bentham area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat 0.01 Ml/d.	▶ Solution B
354	Metals & UV Treatment of BSPs: Hodder Siphon	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Newton-in-Bowland area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 40.86 Ml/d, with a maximum treatment capacity of 45.28 Ml/d.	▶ Solution B
355	Metals & UV Treatment of BSPs: Ribblesdale Siphon (1)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Clitheroe area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 0.02 Ml/d, with a maximum treatment capacity of 0.03 Ml/d.	▶ Solution B

Ref	Option	Description	Solution(s)
356	Metals & UV Treatment of BSPs: Ribblesdale Siphon (2)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Clitheroe area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 4.09 Ml/d, with a maximum treatment capacity of 5.05 Ml/d.	▶ Solution B
357	Metals & UV Treatment of BSPs: Ribblesdale Siphon (3)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Clitheroe area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 2.10 Ml/d, with a maximum treatment capacity of 2.17 Ml/d.	▶ Solution B
358	Metals & UV Treatment of BSPs: Ribblesdale Siphon (4)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Clayton-le-Moors area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 33.51 Ml/d, with a maximum treatment capacity of 43.05 Ml/d.	▶ Solution B
359	Metals & UV Treatment of BSPs: Ribblesdale Siphon (5)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Accrington area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 5.23 Ml/d, with a maximum treatment capacity of 6.83 Ml/d.	▶ Solution B
360	Metals & UV Treatment of BSPs: Haslingden	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Haslingden area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 8.97 Ml/d, with a maximum treatment capacity of 9.96 Ml/d.	▶ Solution B
382	Manchester and Pennine Aqueduct to Raw: WTW reduced flow	This option would reduce the flow of a WTW in the Kendal area from 570 Ml/d to 80 Ml/d whilst continuing to provide treated water to existing BSPs. In conjunction with Options 3, 212, 213, 214, 301, 303 and 306, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The option would require: modifications and refurbishment of the existing WTW to maintain the existing process but at a reduced flow of 80 Ml/d; new connections to a new inlet tank (total length circa 8km); new UV disinfection process; new final water chemical dosing and storage in bunded area – replaced existing due to new outlet position; sodium bisulphite dosing and storage for de-chlorination of start up to waste line and pre UV disinfection (prevention of fouling); dual process streaming of works to minimise plant shut-downs and ensure 50% of max flow can be maintained at all times; and a new valve chamber and new twin outlet pipelines from the WTW to supply existing BSPs.	▶ Solution C

Abbreviations:
BSP: Bulk Supply Point
DMA: District Metered Area
RGF: Rapid Gravity Filters
WTW: Water Treatment Works

2. Approach

Each of the 34 resilience options have been assessed using the same assessment methodology as that which has been employed for the Draft WRMP19 feasible options, as set out in detail in Section 3 of the HRA Report. The results of the assessment are presented in **Appendix A**. This provides a short description of each option and a narrative assessment of its likely effects, with those European sites within 20km that are most vulnerable (i.e. both exposed and sensitive) to the delivery or operation of the scheme[2] noted in the text. It then provides broad 'recommendations' regarding progressing the option as a preferred option, based on the anticipated construction and operational effects; the criteria for these recommendations are as follows (colour coded for clarity):

Table 2.1 Summary of criteria for considering feasible options as potential

Recommend as preferred option?	Notes
Yes	Option appears unlikely to have any effects on European sites as features are either not exposed or not sensitive to the likely outcomes (i.e. no or no reasonable impact pathways – for example, operational effects for a 'construction only' network solution; 'dry' habitats over (say) 2km from an option; sites in different surface water catchments; upstream sites; etc. (being mindful of mobile species)). In these instances, the recommendation is 'Yes', i.e. no reason not to pursue as preferred option.
Yes	Options where pathways for effects are clearly identifiable (such that HRA would probably be required at the scheme level) but where the potential effects can obviously be avoided or mitigated using established measures that are known to be effective, for example: ▸ construction near a European site (effects avoidable with normal project planning and best-practice); ▸ minor works within European sites (e.g. works to existing assets where effects unlikely to be adverse due to absence of features); ▸ major works near / within European sites that can be completed without adverse effects (e.g. crossings of SAC rivers using existing roads or directional drilling); ▸ operational effects that are avoidable with established operational mitigation (e.g. licence controls, although at this stage potential operational effects will usually lead to an 'uncertain' recommendation to flag the need for additional information). In these instances the generic measures outlined in Appendix B can be relied on if these are included within the WRMP package, although the final plan may need to include specific measures for potential 'high-impact' options (e.g. commitments to non-invasive river crossings or timing works to avoid sensitive periods).
Uncertain	Options where a potential effect is conceivable and cannot be discounted, and the likely effects are therefore uncertain at the feasible options stage. This is typically due to limitations on the information available, either in terms of the operation of the scheme, the mitigation that might be employed, or the data available on the interest features of the sites. These options, if pursued as preferred options, may require ▸ additional investigation to determine their effects, and there may be a risk that the risk of effects cannot be quantified satisfactorily at the strategic level (for example, substantial additional modelling or site-specific investigation may be required). ▸ the identification of specific measures or requirements for scheme delivery for inclusion with the WRMP. This category is therefore intended as a flag to identify those options where there is potentially additional 'cost' associated with their inclusion (either related to the data required to support a robust HRA and hence the option, or the need for specific mitigation commitments) which UU should consider when selecting the preferred options.
No	Options where significant effects (i.e. not negligible or inconsequential) on a European site are very likely or certain due to the scale/ nature/location of the option proposals, or the vulnerability and distribution of the interest features within /near the European site. Although a full appropriate assessment is not undertaken at this stage, adverse effects may be more likely (or even certain) if the scheme is taken forward as a preferred option and it is likely that extensive or unproven mitigation will be required following scheme-level investigations. Feasible options in this category are not recommended for consideration as preferred options (although additional information may allow a re-assessment).

Appendix A also includes a summary of the potential for 'in combination' effects on European sites as the result of Solutions A – E (i.e. whether any of the options that make up the solutions have the potential to significantly affect the same European site). Note that this assessment does not consider potential effects with the preferred options that have been previously assessed; due to the number of options and complexity

[2] For clarity, the summary tables do not explicitly identify or assess every European site within 20km; this will be set out in more comprehensive 'screening proformas' that will accompany the final HRA which will be used to transparently document the screening process.

of this, this assessment cannot be completed until the preferred solution is selected. However, a preliminary examination of the options suggests that 'in combination' effects between the resilience solutions and the preferred options are unlikely to occur at any European sites, assuming normal best-practice (particularly at the planning stage, to minimise the risks of simultaneous construction), although there may be a risk of 'in combination' effects on the Bowland Fells SPA, which is potentially exposed to effects from Solution C and from preferred option WR159. However, all potential 'in combination' effects are likely to be avoidable through scheme design.

3. Summary and Next Steps

The review indicates that most resilience solutions and their composite options are unlikely to have significant effects on European sites (alone, or in combination with each other), assuming normal scheme planning and best-practice measures are employed. Some options are likely to require additional environmental investigation and, potentially, HRA at the project-level, although there is nothing to suggest that effects on European sites would be an unavoidable outcome of the resilience options/solutions.

The resilience options that are more likely to require additional scheme information or commitment to specific mitigation or avoidance measures are as follows:

- **Option 37 – 42**: Under this option, works are likely to be required within a few hundred metres of the River Kent SAC. Normal best-practice is likely to be sufficient to avoid impacts on the SAC, but confirmation of construction requirements would be required and commitments regards timing of works (i.e. to avoid possible noise / vibration effects on migrating fish) may be appropriate. This option may also require construction works near to the Bowland Fells SPA (this site would not be affected directly, but interest features will use habitats outside the site boundary and therefore the option may require bespoke mitigation or avoidance of construction during the breeding period.
- **Option 215**: This option requires abstraction from the River Ribble, which is upstream of the Ribble and Alt Estuaries SPA. Effects on this site are unlikely given the distance (>30km) but confirmation that water is available for abstraction would be appropriate.
- **Option 217**: This option requires construction near to the Bowland Fells SPA. This site will not be affected directly, but the interest features will use habitats outside the site boundary and therefore the option may require bespoke mitigation or avoidance of construction during the breeding period.
- **Option 382**: This option would require a pipeline crossing of the River Mint, which is part of the River Kent SAC. This will require non-invasive crossing methods and bespoke mitigation plans, and may require the avoidance of key migration periods for salmon (note, although salmon are not a feature of the site the freshwater pearl mussel is, and is dependent on salmon for part of its life-cycle).

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Appendix A

Summary of review of Resilience Options

Option Number	Name	Option Summary	General Assessment	Recommend option? (Construction)	Recommend option? (Operation)
3	Manchester and Pennine Aqueduct to Raw: 2 Stage filtration (Bury)	This option would involve the development of a new 2 stage filtration Water Treatment Works (WTW) at an existing site in the Bury area in order to provide increased resilience. In conjunction with Options 212, 213, 214, 301, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. In addition to the new WTW, the scheme would require new abstraction/ pumping from a Bulk Supply Point (BSP) to the new WTW, pumping from the new WTW to existing treated water storage facilities, and the demolition of the existing connection mains.	This option would involve construction of a new WTW on or near an existing operational site near Bury, with associated connections to the aqueduct. The site is a greenfield area but is a substantial distance from the nearest European sites and no construction effects effects would be expected. It is assumed that no 'new water' is required for this option and so there will be no operational effects.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
37-38	Manchester and Pennine Aqueduct section T05 to T06	This option would provide protection against structural failure of an existing single pipe section of the Manchester and Pennine Aqueduct and would be used for the conveyance of treated water. This option would involve the construction of new 2.6m diameter conduits and a 2.85m diameter tunnel for a total length of approximately 19.3km, and new connection chambers and isolating penstocks.	This scheme is a fairly substantial construction project although there are no European sites in particularly close proximity to the likely construction areas, and no downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
37-42	Manchester and Pennine Aqueduct sections T01 to T06	This option would provide protection against structural failure of an existing single pipe section of the Manchester and Pennine Aqueduct and would be used for the conveyance of treated water. This option would involve the construction of new 2.6m diameter conduits and a 2.85m diameter tunnel for a total length of approximately 51.9km, and new connection chambers and isolating penstocks.	This would be a substantial construction scheme although most of the works would be some distance from the nearest European sites. However, two sites are likely to be particularly vulnerable to construction effects. (1) The River Kent SAC is within 600m of the proposed works, although effects are likely to be avoidable with normal best-practice. (2) The route for the new aqueduct runs beneath the Bowland Fells SPA for approximately 7km; it is understood that this section would be completed with non-invasive tunneling or drilling techniques, with any receptor pits (etc.) sited outside the SPA boundary, and so effects on the SPA as a result of construction are likely to be nil (assuming all normal best-practice). There is a theoretical risk of groundwater bodies being affected by the pipeline, which may then have indirect effects on any groundwater dependent ecosystems that may be associated with European sites, although geological investigations have indicated that this risk is minimal due to the dominance of low-permeability geological formations and the depth of the pipeline. In addition, any potential effects can be avoided through pipeline design to prevent water ingress. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - effects possible but significant or significant adverse effects clearly avoidable with established scheme-level avoidance or mitigation measures	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)

Option Number	Name	Option Summary	General Assessment	Recommend option? (Construction)	Recommend option? (Operation)
46	WELM Uprate to 150Ml/day	This option would provide additional connectivity for treated water. It would involve the construction of a 3.1Ml break tank and intermediate pumping facilities to enable the transfer of 150 Ml/d.	This option would involve construction on or near an existing operational site near Bury, with associated connections. The site is a greenfield area but is a substantial distance from the nearest European sites and no construction effects effects would be expected. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
112	Manchester and Pennine Aqueduct Outage (4 weeks) for installation of connections	This option would involve implementing Manchester and Pennine Aqueduct outage for a period of 4 weeks to facilitate the installation of connections. There would be no new development associated with this option.	No construction with option and therefore no significant effects. No significant effects due to no long term operational changes.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
212	Manchester and Pennine Aqueduct to Raw (Newton-in-Bowland)	Under this option, raw water would be taken directly from the Manchester and Pennine Aqueduct (without treatment) for treatment at a new WTW in the Newton-in-Bowland area. In conjunction with Options 3, 213, 214, 301, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The option would involve the construction of a new 2 stage filtration WTW together with a new connection from the Aqueduct to the WTW and pumped supply to an existing aqueduct. The new WTW is expected to treat an average of 41 Ml/d, with a maximum treatment capacity of 60 Ml/d.	This option would involve construction of a new WTW on a greenfield site adjacent to the River Hodder (which ultimately flows to the River Ribble). The nearest sites (Bowland Fells SPA and North Pennine Dales Meadows SAC) are 'upstream' of the proposed development and unlikely to be affected; mobile species associated with the SPA are unlikely to be reliant on habitats affected by the proposals. Significant effects would not be expected assuming normal construction best-practice. It is assumed that no 'new water' is required for this option and so there will be no operational effects.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)

Option Number	Name	Option Summary	General Assessment	Recommend option? (Construction)	Recommend option? (Operation)
213	Manchester and Pennine Aqueduct to Raw (Clayton-le-Moors)	Under this option, raw water would be taken directly from the Manchester and Pennine Aqueduct (without treatment) for treatment at a new WTW in the Clayton-le-Moors area. In conjunction with Options 3, 212, 214, 301, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The option would involve the construction of a new 2 stage filtration WTW together with a new connection from the Manchester and Pennine Aqueduct to the WTW inlet, a pumping station and circa 2.8km pipeline from the WTW to two BSPs.	This option would involve construction of a new WTW on or near an existing operational site near Clayton-le-Moors. The site is a substantial distance from the nearest European sites and no effects would be expected. It is assumed that no 'new water' is required for this option and so there will be no operational effects.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
214	Manchester and Pennine Aqueduct to Raw (Haslingden)	Under this option, raw water would be taken directly from the Manchester and Pennine Aqueduct (without treatment) for treatment at a new WTW in the Haslingden area. In conjunction with Options 3, 212, 213, 301, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The option would involve the construction of a new 2 stage filtration WTW together with new connections from the Manchester and Pennine Aqueduct to the WTW inlet and from the WTW to an existing pumping station.	This option would involve construction of a new WTW on or near an existing operational site near Haslingden. The site is in an urban area a substantial distance from the nearest European sites and no effects would be expected. It is assumed that no 'new water' is required for this option and so there will be no operational effects.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
215	Alternative Supply: Raw water transfer and WTW (Clayton-le-Moors)	This option would provide additional raw water from the River Ribble (under a new abstraction licence) and additional water treatment capacity in the Clayton-le-Moors area. The option, in conjunction with Options 216, 217 and 218, would provide additional abstraction/treatment facilities to facilitate Solution E. The option would require a new abstraction point, circa 9.1km of 800m main to a new 3 stage WTW and a pumping station.	This option would require construction works near the River Ribble and a new abstraction from this watercourse. There are no European sites in close proximity to the likely working areas and construction effects can be avoided with established best-practice. With regard to operational effects, the abstraction is over 30km upstream of the Ribble and Alt Estuaries SPA, and significant effects as a result of this abstraction would not be expected due to distance and natural attenuation, although it will be necessary to confirm that water is available for use.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - effects possible but significant or significant adverse effects avoidable with established operational mitigation (e.g. licence controls)

Option Number	Name	Option Summary	General Assessment	Recommend option? (Construction)	Recommend option? (Operation)
216	Alternative Supply: Raw water abstraction and WTW (Haslingden)	This option would provide additional raw water from the River Irwell (under a new abstraction licence) and additional water treatment capacity in the Haslingden area. The option, in conjunction with Options 215, 217 and 218, would provide additional abstraction/treatment facilities to facilitate Solution E. The option would require a new abstraction point and pumping station, circa 1.0km of 450mm main to a new 3 stage WTW and a new connection from the WTW to an existing BSP.	This option would require construction works near the River Irwell and a new abstraction from this river. There are no European sites in close proximity, and no downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. Operational effects will not occur (no sites exposed to effects of scheme).	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
217	Alternative Supply: Raw water transfer and WTW (Newton-in-Bowland)	This option would provide additional raw water from an aqueduct and additional water treatment capacity in the Newton-in-Bowland area. The option, in conjunction with Options 215, 216 and 218, would provide additional abstraction/treatment facilities to facilitate Solution E. The option would require a new connection to the raw water aqueduct, circa 5.3km of 700mm diameter pipeline to transfer water from the connection point and a new 3 stage WTW and pumping station.	This option would require construction works within 500m of the Bowland Fells SPA; disturbance from construction may occur although this can be avoided / mitigated with normal measures (e.g. avoiding construction near the SPA during the breeding season). Construction effects for the other designated sites within 20km can likely be avoided through established measures. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - effects possible but significant or significant adverse effects clearly avoidable with established scheme-level avoidance or mitigation measures	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
218	Alternative Supply: Raw water transfer and WTW (Preston)	This option would redirect raw water from the River Wyre to additional water treatment capacity in the Preston area. The option, in conjunction with Options 215, 216 and 217, would provide additional abstraction/treatment facilities to facilitate Solution E. The option would require a connection to the raw water feed from the River Wyre and pumping from the connection point via circa 8.5km of 800mm main to a new 3 stage WTW. A new pumping station would also be constructed at the WTW site to feed water from the WTW into an existing aqueduct via circa 4.4km of 700mm pipeline.	This option would require new pipelines and associated infrastructure, although none of the proposed works are likely to be in close proximity to any European sites. The Morecambe Bay sites are downstream of the Wyre, although construction effects can be avoided with established best-practice. It is assumed that the raw water abstraction is within the terms of a current abstraction licence and so significant operational effects would not be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)

Option Number	Name	Option Summary	General Assessment	Recommend option? (Construction)	Recommend option? (Operation)
238	Metals & UV treatment of BSPs: Bury	This option seeks to provide treatment of metals, cryptosporidium and/or E.Coli to the treated water which is being siphoned off the Manchester and Pennine Aqueduct. The option would require the construction of a new 2 stage WTW in the Bury area.	This option would involve construction of a new WTW on or near an existing operational site near Bury, with associated connections to the aqueduct. The site is a greenfield area but is a substantial distance from the nearest European sites and no construction effects effects would be expected. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
260	Ribblesdale South Well Isolation	ThiThis option would enable the isolation of the downstream section T05 for rehabilitation. It would require a new valve chamber constructed around existing siphon pipes in the Clitheroe area and a new valve house over the chamber. The option would also require a new access road.	This option would involve minor works near Accrington. Surface works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
261	Haslingden Well Isolation	This option would enable the isolation of the downstream section T06 for rehabilitation. It would require a new 12.5mID shaft on an existing 2.59mID conduit in the Haslingden area with two isolating penstocks and provision for downstream tunnel access. The option would also require a new control kiosk and access road.	This option would require construction works near the River Irwell. There are no European sites in close proximity, and no downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
296	T05 targeted repair 2025	This option would target section T05 for remedial works (tunnel lining) in order to provide greater structural support to the wider water distribution network. Under the option, approximately 100m of section T05 would undergo tunnel lining which would involve the installation of steel liner. The installation of two new access shafts (5m diameter/110m deep) would be required to facilitate the proposed works. It should be noted that the installation of tunnel liners would subsequently decrease the diameter of the Manchester and Pennine Aqueduct, e.g. reduced water flow, thus further hydraulic analysis is required to confirm the minimum acceptable diameter to support/maintain present operation.	This option would involve re-lining an existing tunnel. Surface works (new access shafts) would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)

Option Number	Name	Option Summary	General Assessment	Recommend option? (Construction)	Recommend option? (Operation)
297	T06 targeted repair 2025	This option would target section T06 for remedial works (tunnel lining and conduit lining) in order to provide greater structural support to the wider water distribution network. It is proposed that an approximate 200m of section T06 would undergo conduit lining which would involve the installation of steel reinforcement cages sprayed with concrete lining whilst 200m of the tunnel would receive tunnel lining. The installation of four new access shaft/chambers (5m diameter/110m deep) would be required. Additionally, there is a risk that it may be necessary to rebuild a cracked conduit bridge (approx 30m) in addition to implementing a new settled conduit configuration as additional ancillary works. It should be noted that the installation of conduit/tunnel liners would subsequently decrease the diameter of the Manchester and Pennine Aqueduct, e.g. reduced water flow, thus further hydraulic analysis is required to confirm the minimum acceptable diameter to support/maintain present operation.	This option would involve re-lining an existing tunnel. Surface works (new access shafts) would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
301	Lunesdale Siphon BSPs North	This option seeks to provide additional connectivity for treated water via existing pipework to a treated water storage facility in the Kendal area and onwards to the north end of the Lunesdale Siphon where it would be intercepted by a proposed new pipeline connecting to existing BSPs. In conjunction with Options 3, 212, 213, 214, 303, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The option would require pipelines from the treated water storage facility to the Manchester and Pennine Aqueduct in the vicinity of the BSPs in the Kirkby Lonsdale area in addition to increased storage provision at the existing treated water storage facility (from 0.75Ml to 9.0Ml).	This option requires the construction of several new pipelines near the existing aqueduct, together with alterations to existing assets locally. The works would be approximately 3.4km from the nearest European site (Morecambe Bay Pavements SAC) although this site would not be exposed to the construction proposals (upland / upstream site; no reasonable pathways). Other sites are downstream of the construction area (e.g. Morecambe Bay SAC) but effects on these sites can be avoided through normal construction best practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)

Option Number	Name	Option Summary	General Assessment	Recommend option? (Construction)	Recommend option? (Operation)
303	Lunesdale Siphon BSPs South	This option would increase connectivity for treated water through Manchester and Pennine Aqueduct outage on a permanent basis. In conjunction with Options 3, 212, 213, 214, 301, 306 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The options would require new sections of pipeline between BSPs in the Bentham area. The option would also require: a new pumping station in the Bentham area; additional 9Ml storage at an existing treated water storage facility near Lancaster; modification to a pumping station in the Morecambe area to accommodate permanent usage; and the abandonment of existing facilities.	This option would require pipeline construction near and across the River Hindburn, which flows to the River Lune and hence Morcambe Bay SAC; however, effects on downstream sites can clearly be avoided with normal best-practice at the scheme level. The site is approximately 2.4km from the Bowland Fells SPA although the mobile features of this site are unlikely to be dependent on the habitats temporarily affected by the scheme, and the site is too far for disturbance effects to be realistically possible. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
306	Ribblesdale Siphon BSPs North	This option would adapt the connectivity of the treated water network with BSPs in the Clitheroe area being permanently supplied via an existing aqueduct and pumping stations using existing network infrastructure. In conjunction with Options 3, 212, 213, 214, 301, 303 and 382, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The option would require a new circa 2.9km reinforcing pipe (250mm diameter) to support the new configuration between the BSPs and the aqueduct. Some existing pipelines would be abandoned.	This option would require construction works near the River Calder. There are no European sites in close proximity, and no downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
348	Metals & UV Treatment of BSPs: Lunesdale Siphon (1)	This option would involve the construction of a new WTW with second stage rapid gravity filters (RGF) for metals removal and UV treatment in the Kirkby Lonsdale area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat 2.48 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)

Option Number	Name	Option Summary	General Assessment	Recommend option? (Construction)	Recommend option? (Operation)
349	Metals & UV Treatment of BSPs: Lunesdale Siphon (2)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Kirkby Lonsdale area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat 2.9 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
350	Metals & UV Treatment of BSPs: Lunesdale Siphon (3)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Kirkby Lonsdale area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 0.36 Ml/d, with a maximum treatment capacity of 0.57 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
351	Metals & UV Treatment of BSPs: Lunesdale Siphon (4)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Wrayton area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 5.59 Ml/d, with a maximum treatment capacity of 6.04 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
352	Metals & UV Treatment of BSPs: Lunesdale Siphon (5)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Bentham area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat 0.01 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
353	Metals & UV Treatment of BSPs: Lunesdale Siphon (6)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Bentham area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat 0.01 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)

Option Number	Name	Option Summary	General Assessment	Recommend option? (Construction)	Recommend option? (Operation)
354	Metals & UV Treatment of BSPs: Hodder Siphon	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Newton-in-Bowland area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 40.86 Ml/d, with a maximum treatment capacity of 45.28 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
355	Metals & UV Treatment of BSPs: Ribblesdale Siphon (1)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Clitheroe area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 0.02 Ml/d, with a maximum treatment capacity of 0.03 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
356	Metals & UV Treatment of BSPs: Ribblesdale Siphon (2)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Clitheroe area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 4.09 Ml/d, with a maximum treatment capacity of 5.05 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
357	Metals & UV Treatment of BSPs: Ribblesdale Siphon (3)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Clitheroe area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 2.10 Ml/d, with a maximum treatment capacity of 2.17 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
358	Metals & UV Treatment of BSPs: Ribblesdale Siphon (4)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Clayton-le-Moors area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 33.51 Ml/d, with a maximum treatment capacity of 43.05 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)

Option Number	Name	Option Summary	General Assessment	Recommend option? (Construction)	Recommend option? (Operation)
359	Metals & UV Treatment of BSPs: Ribblesdale Siphon (5)	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Accrington area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 5.23 Ml/d, with a maximum treatment capacity of 6.83 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
360	Metals & UV Treatment of BSPs: Haslingden	This option would involve the construction of a new WTW with second stage RGF for metals removal and UV treatment in the Haslingden area in order to treat water siphoned off the Manchester and Pennine Aqueduct. This would also involve associated works including pumping, chemical dosing/storage, mixers and analysers. The new WTW is expected to treat an average of 8.97 Ml/d, with a maximum treatment capacity of 9.96 Ml/d.	This option would involve construction of a new WTW near an existing operational site. Works would be relatively small-scale and local, and there are no European sites in close proximity to the likely working area or downstream sites that are likely to be exposed to the effects of the scheme. All construction effects are therefore avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive)	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)
382	Manchester and Pennine Aqueduct to Raw: WTW reduced flow	This option would reduce the flow of a WTW in the Kendal area from 570 Ml/d to 80 Ml/d whilst continuing to provide treated water to existing BSPs. In conjunction with Options 3, 212, 213, 214, 301, 303 and 306, it would form part of the overall solution which covers the requirements for the Manchester and Pennine Aqueduct becoming a raw water aqueduct. The option would require: modifications and refurbishment of the existing WTW to maintain the existing process but at a reduced flow of 80 Ml/d; new connections to a new inlet tank (total length circa 8km); new UV disinfection process; new final water chemical dosing and storage in bunded area – replaced existing due to new outlet position; sodium bisulphite dosing and storage for de-chlorination of start up to waste line and pre UV disinfection (prevention of fouling); dual process streaming of works to minimise plant shut-downs and ensure 50% of max flow can be maintained at all times; and a new valve chamber and new twin outlet pipelines from the WTW to supply existing BSPs.	This option would primarily involve construction near an existing operational site, but would require an 8km pipeline that would need to cross the River Mint (part of the River Kent SAC). The features of this SAC are potentially vulnerable to construction of the scheme and bespoke mitigation measures (e.g. directional drilling; avoiding construction during key migration periods) will be required to ensure that significant or significant adverse effects do not occur. All other potential construction effects are avoidable with established best-practice. This is understood to be a network solution and so no operational effects would be expected.	Construction: Yes - effects possible but significant or significant adverse effects clearly avoidable with established scheme-level avoidance or mitigation measures	Operation: Yes - no effects or clearly no LSE alone or in combination (e.g. no impact pathways; features not sensitive; within existing licence; transfer of spare water; etc.)

Summary of 'in combination' effects for each solution

Solution	In combination risks
Solution A	The individual options under this solution are generally some distance (>5km) from the nearest European sites, and no two options are likely to have significant effects on the same site, assuming normal best-practice during construction, due to the distances and absence of impact pathways. Operational effects would not be anticipated.
Solution B	The individual options under this solution are generally some distance from the nearest European sites (>5km), although two options (348 and 349) are within 5km of the Morecambe Bay Pavements SAC (both approx. 3.5 km from the site); however, these options would not be expected to have in combination effects on this site due to the distances and absence of impact pathways, and assuming normal best-practice during construction. No other sites will be vulnerable to in combination effects under this solution. Operational effects would not be anticipated.
Solution C	The individual options under this solution are generally some distance from the nearest European sites (>5km). Two options (212 and 303) are within ~3km of the Bowland Fells SPA, although effects on this site should be avoidable with normal best-practice measures. No other sites are likely to be vulnerable to in combination effects between the options of this solution, due to the distances and absence of impact pathways, assuming normal best-practice during construction. Operational effects would not be anticipated.
Solution D	The individual options under this solution are generally some distance (>5km) from the nearest European sites, and no two options are likely to have significant effects on the same site, assuming normal best-practice during construction, due to the distances and absence of impact pathways. Operational effects would not be anticipated.
Solution E	The individual options under this solution are generally some distance from the nearest European sites (>5km), although two options (37-42 and 212) are within or in close proximity to (<500m) the Bowland Fells SPA. No other sites will be vulnerable to in combination effects under this solution. Operational effects would not be anticipated.

Appendix B

Established / Assumed Avoidance and Mitigation Measures

Overview

The 'avoidance measures' that may be applied to the options are detailed below, and are grouped as follows:

- General Measures (established construction best-practice, etc.) which will be applied to all options;
- Option-specific Measures (established and reliable measures identified to avoid specific potential effects on European sites, such as in relation to mobile species from the sites).

These measures will be applied unless project-level HRAs or scheme-specific environmental studies demonstrate that they are not required (i.e. the anticipated effect will not occur), not appropriate, or that alternative or additional measures are necessary or more appropriate.

Note that these measures are not exhaustive or exclusive and must be reviewed at the project stage, taking into account any changes in best-practice as well as scheme-specific survey information or studies.

General Measures and Principles

Scheme Design and Planning

All options will be subject to project-level environmental assessment as they are brought forward, which will include assessments of their potential to affect European sites during their construction or operation. These assessments will consider or identify (inter alia):

- opportunities for avoiding potential effects on European sites through design (e.g. alternative pipeline routes; micro siting; etc);
- construction measures that need to be incorporated into scheme design and/or planning to avoid or mitigate potential effects - for example, ensuring that sufficient working area is available for pollution prevention measures to be installed, such as sediment traps;
- operational regimes required to ensure no adverse effects occur (e.g. compensation releases - although note that these measures can only be identified through detailed investigation schemes).

Pollution Prevention

The habitats of European sites are most likely to be affected indirectly, through construction-site derived pollutants, rather than through direct encroachment. There is a substantial body of general construction good-practice which is likely to be applicable to all of the proposed options and can be relied on (at this level) to prevent significant or adverse effects on a European site occurring as a result of construction site-derived pollutants. The following guidance documents detail the current industry best-practices in construction that are likely to be relevant to the proposed schemes:

- Environment Agency Pollution Prevention Guidance Notes[3], including:
  - PPG1: General guide to the prevention of pollution (May 2001);
  - PPG5: Works and maintenance in or near water (October 2007);

[3] Note, the Environment Agency Pollution Prevention Guidance Notes have been withdrawn by the Government, although the principles within them are sound and form a reasonable basis for pollution prevention measures.

- PPG6: Pollution prevention guidance for working at construction and demolition sites (April 2010);
- PPG21: Pollution incident response planning (March 2009);
- PPG22: Dealing with spillages on highways (June 2002);

- Environment Agency (2001) Preventing pollution from major pipelines [online]. Available at www.environment-agency.gov.uk/static/documents/Business/pipes.pdf. [Accessed 1 March 2011];
- Venables R. et al. (2000) Environmental Handbook for Building and Civil Engineering Projects. 2nd Edition. Construction Industry Research and Information Association (CIRIA), London.

The best-practice procedures and measures detailed in these documents will be followed for all construction works derived from the WRMP as a minimum standard, unless scheme-specific investigations identify additional measures and/or more appropriate non-standard approaches for dealing with potential site-derived pollutants.

General measures for species

Most species-specific avoidance or mitigation measures can only be determined at the scheme level, following scheme-specific surveys, and 'best-practice' mitigation for a species will vary according to a range of factors that cannot be determined at the strategic (WRMP) level. In addition, some general 'best-practice' measures may not be relevant or appropriate to the interest features of the European sites concerned (for example, clearing vegetation over winter is usually advocated to avoid impacts on nesting birds; however, this is unlikely to be necessary to avoid effects on some SPA species (such as overwintering estuarine birds) and the winter removal of vegetation might actually have a negative effect on these species through disturbance). However, the following general measures will be followed to minimise the potential for impacts on species that are European site interest features unless project level environmental studies or HRA indicate that they are not required or not appropriate, or that alternative or additional measures are more appropriate/necessary:

- Scheme design will aim to minimise the environmental effects by 'designing to avoid' potential habitat features that may be used by species that are European site interest features when outside the site boundary (e.g. linear features such as hedges or stream corridors; large areas of scrub or woodland; mature trees; etc.) through scheme-specific routing studies;
- The works programme and requirements for each option will be determined at the earliest opportunity to allow investigation schemes, surveys and mitigation to be appropriately scheduled and to provide sufficient time for consultations with NE;
- Night-time working, or working around dusk/dawn, should be avoided to reduce the likelihood of negative effects on nocturnal species;
- Any lighting required (either temporary or permanent) will be designed with an ecologist to ensure that potential 'displacement' effects on nocturnal animals, particularly SAC bat species, are avoided;
- All compounds/pipe stores etc. will be sited, fenced or otherwise arranged to prevent vulnerable SAC species (notably otters) from accessing them;
- All materials will be stored away from commuting routes/foraging areas that may be used by species that are European site interest features;
- All excavations will have ramps or battered ends to prevent species becoming trapped;
- Pipe-caps must be installed overnight to prevent species entering and becoming trapped in any laid pipe-work.

Option-Specific Measures

Option specific measures (if required) will be determined as the preferred options are identified. However, it is assumed that the lowest-impact solution will be pursued, particularly regards construction solutions – for example, directional drilling beneath sensitive rivers rather than open cut; etc.