C5 B

Cost and Efficiency

C5B Technical Annex 04
Service Reservoirs and Towers Investment Case:
Technical Approach and Business Case

NTPBP-INV-SER-0528

BRISTOL WATER

Contents

1 FOREWORD 1

2 EXECUTIVE SUMMARY 2

3 BACKGROUND TO OUR INVESTMENT CASE 4

3.1 CONTEXT 4
3.2 STRATEGY 6
3.3 CUSTOMER PRIORITIES 7
3.4 ASSET HEALTH, AMP7 PERFORMANCE COMMITMENTS & OUTCOME DELIVERY INCENTIVES 8
3.5 COMPLIANCE OBLIGATIONS 8
3.6 AMP6 INVESTMENT AND PERFORMANCE 9

4 DEVELOPING OUR INVESTMENT PLAN 10

4.1 INVESTMENT CASE DEVELOPMENT PROCESS 10
4.1.1 Data & Data Assurance 11
4.1.2 Risk Identification, Verification & Needs Identification Assessment 12
4.1.3 Optioneering & Intervention Development Methodology 12
4.1.4 Intervention Costing Methodology 13
4.1.5 Benefits Quantification Methodology 13
4.1.6 Investment Optimisation & Intervention Selection 15
4.2 APPLYING THE INVESTMENT PROCESS TO SERVICE RESERVOIRS AND TOWERS 15
4.2.1 Risk Identification, Verification & Needs Assessment 16
4.2.2 Optioneering & Intervention Development 17
4.2.3 Intervention Costing 19
4.2.4 Benefits Quantification 20

5 OUTCOME 21

5.1 SELECTED INTERVENTIONS 21
5.2 CONTRIBUTION TO PERFORMANCE COMMITMENTS 23
5.3 NON SELECTED INTERVENTIONS 23
5.4 ASSUMPTIONS 23
5.5 AMP 8 24
5.6 BASE MAINTENANCE 24
5.7 HISTORIC & AMP7 INVESTMENT COMPARISON 25

6 CONCLUSIONS 26

7 APPENDICES 27

7.1 APPENDIX A: LINE OF SIGHT 28
7.2 APPENDIX B: DATASETS 30
7.3 APPENDIX C1: SELECTED RISKS 32
7.4 APPENDIX C2: NON-SELECTED RISKS 36
7.5 APPENDIX D: OPTIONS CONSIDERED 46
7.6 APPENDIX E: INTERVENTIONS DEVELOPED 48
7.7 APPENDIX F: NON-SELECTED INTERVENTIONS 50

Tables

Table 1: AMP6 capital investment 9
Table 2: Example of an Unselected Risk 16
Table 3 Example of Options Selection 18
Table 4: Selected interventions and costs 21
Table 5: Water Service and Business Unit Allocation 22
Table 6 Non-Selected Interventions and Residual Risk 23
Table 7: Contribution to minimum non-infrastructure base maintenance investment 24
Table 8: Historical & AMP7 Investment 25

Figures

Figure 1: Approach to meeting Customer Priorities and Mitigating Risks 3
Figure 2: Typical Service Reservoir 5
Figure 3: Typical Water Tower 5
Figure 4: Investment Case Process Overview - Level 1 Diagram 11

1 Foreword

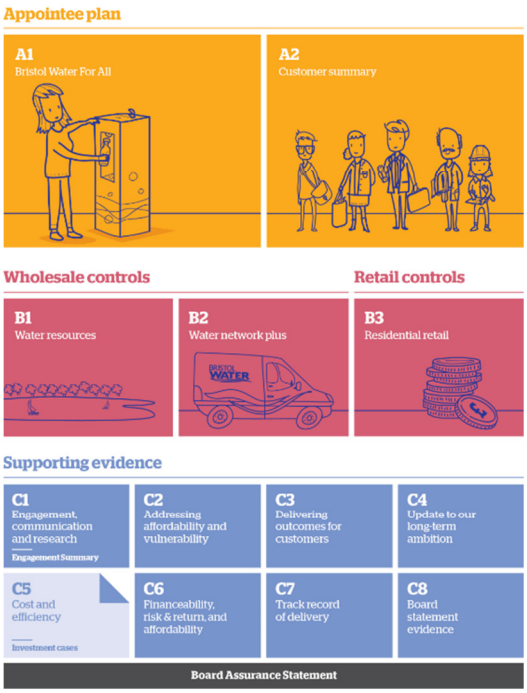
The Service Reservoir and Towers investment case will provide a base maintenance allowance for the inspection of service reservoirs. This will contribute to a Safe and Reliable Supply to our customers.

A service reservoir is an enclosed structure for the purpose of storing a large volume of potable water. Typically these are concrete or brick, grass covered, 'boxes' but in some cases the storage structure is elevated on a tower to provide a head of water to the supply. Service reservoirs and water towers provide a means of storing clean water to balance supply and demand within the water distribution network. We currently have eighty three service reservoir sites and five water tower sites.

The purpose of this document is to set out our customer led, outcome focused plan, which will mitigate risks posed by and associated with service reservoirs and towers.

This investment case, one of 21, will summarise the facts, risks and investment requirements for service reservoirs and towers for the next review period for 2020 to 2025. This investment case will also summarise performance for service reservoirs and towers for the current review period from 2015 to 2020 and our methodology for determining and delivering the future service reservoir and towers strategy.

This investment case document is a technical annex to section C5B of our overall business plan submission, as illustrated by the diagram below:



This investment case is aligned to the Water Network Plus Wholesale Control aspect of our business plan. It is recommended that this investment case is read in conjunction with the PR19 Investment Case Summary Document[1] which outlines in detail our methodology for defining investment.

[1] Bristol Water PR19 Investment Cases Summary Document NTPBP-INV-PR1-0635

2 Executive Summary

In order to provide customers with a Safe and Reliable Supply, we will focus on managing our existing service reservoirs and towers. We will achieve this by using our totex investment approach which includes investment of base maintenance and capital expenditure of £2.075m. We will deliver one intervention that will ensure we meet our statutory obligations relating to reservoir inspections. We will challenge ourselves to deliver more efficiently and apply innovation to the process we adopt to store water. When considering our efficient and innovative approach we plan to deliver our water treatment works capital programme for £1.909m.

At Bristol Water we have completed an extensive customer engagement programme that has identified that one of our four key outcomes is that we provide a Safe and Reliable Supply.

This investment case will address specific statutory obligations under the Health and Safety at Work Act (1974), the Water Supply (Water Quality) regulations and the Reservoirs Act 1975, by utilising a totex approach to determine necessary capital maintenance investment to manage these obligations. We will meet these obligations and avoid non-compliance by continuing to undertake statutory inspections of our storage reservoirs on a risk based frequency taking into account water quality and structural condition.

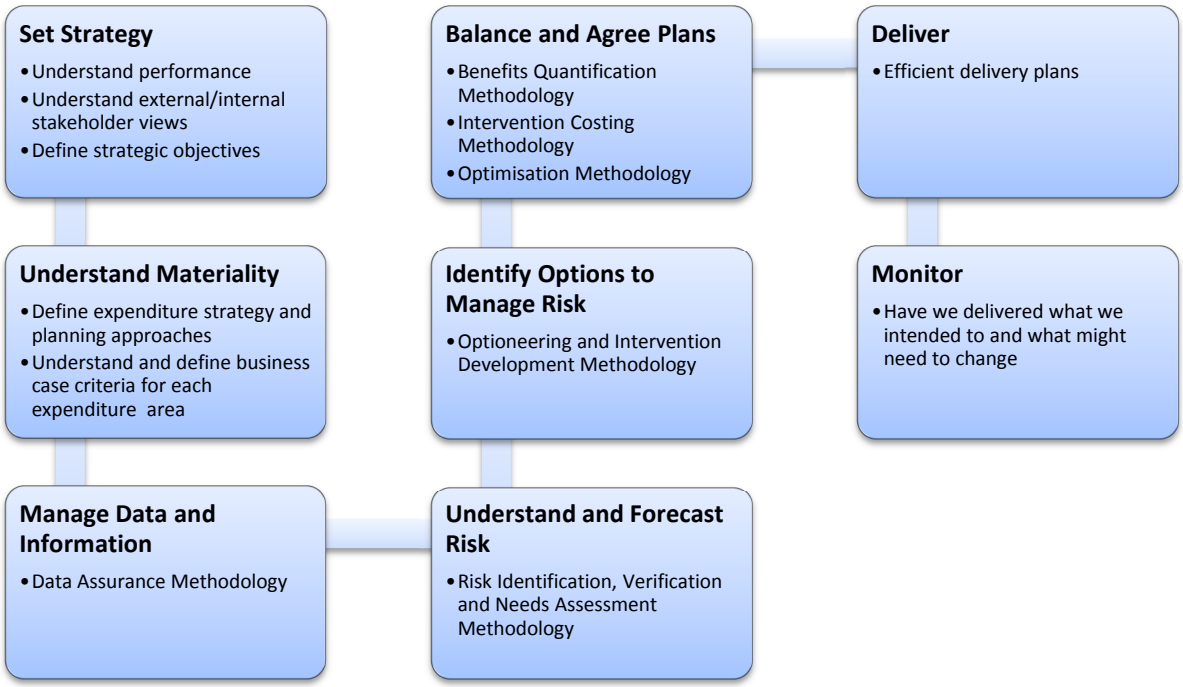
Currently service reservoirs and towers are inspected and tested on a risk based frequency taking into account water quality and structural condition. This approach will be continued in the coming review period.

Whilst the investment proposed does not contribute directly to performance enhancement via performance commitments, it does contribute more broadly towards achieving our outcome of providing a Safe and Reliable Supply. If we fail to invest and do not inspect our reservoirs, failing to identify and rectify issues that can lead to water quality failures, we risk non-compliance under the Water Supply (Water Quality) regulations. We could also contribute to unacceptable levels of asset deterioration.

At July 2018 we currently have eighty three service reservoir sites and five water towers. No new service reservoirs or towers are planned in this review period or the next.

To ensure that we meet our customers' priorities and mitigate the risks associated with service reservoirs and towers, we have adopted an asset management totex focused approach as set out in Figure 1.

Figure 1: Approach to meeting Customer Priorities and Mitigating Risks



This approach enables us to demonstrate full 'line of sight' from customer priorities, through risk review, options analysis and investment optimisation, to outcomes and benefits provided for our customers.

We plan to invest £2.075m between 2020 and 2025 to meet specific regulatory requirements and mitigate identified risks. No direct contribution to performance commitment targets has been attributed through this investment case.

We have set ourselves a challenging target of improving our efficiency by 8% during AMP7. This will be achieved by delivery of our business transformation programme and results in in a post-efficiency investment of £1.909m.

Costs are allocated to the Treated Water Distribution business unit. Investment is all related to maintaining the long term capability of our non-infrastructure assets.

3 Background To Our Investment Case

3.1 Context

Service reservoirs and towers provide water storage volume within the distribution network which serves to:

- Provide a buffer to balance out daily peaks in demand typically experienced during the morning and evening when most water demand occurs; and
- Provide emergency storage which enables water to continue to be supplied to customers even if there is a temporary loss of supply to the service reservoir, caused for example by a power failure or burst main.

In the case of water towers, the elevation of the tower also governs the water pressure in the downstream pipework.

Water quality issues can occur at service reservoir and towers through:

- The ingress of contaminated water into the structure;
- Bacteriological growth within the structure;
- Contamination from insects or other animals; and
- Contamination through vandalism or deliberate acts of harm.

We currently undertake a risk based inspection programme that follows the Water UK Technical Guidance Note 9 (TGN 9)[2]. This is in addition to any requirements that may be necessary under the Reservoirs Act 1975 and the Security and Emergency Measures (Water and Sewerage Undertakers) Direction 1998. The intent of this risk management inspection programme is to ensure that controls and mitigations are adhered to and that the maximum interval does not overrun leading to an undesirable outcome that could have been avoided.

Water UK Technical Guidance Note 9 (TGN 9) specifically states the following:

- External and internal inspection of structures should be carried out at a frequency determined by individual risk assessment. Internal inspection should be carried out at a frequency not greater than every 10 years;
- Internal inspections should identify aspects which may impact on water quality, including a survey of internal surfaces and joints, a leakage drop test, and roof integrity test. Remedial work should be carried out prior to return to supply;
- Structures should be cleaned, disinfected and satisfactory sample results obtained prior to return to supply;

[2] Water UK. *Technical Guidance Note 9 - Treated Water Storage*. https://www.water.org.uk/publications/reports/principles-water-supply-hygiene.

- Sampling should routinely include analysis for bacteriological, physical and aesthetic parameters. Other parameters should be considered where additional contamination risks may have occurred during refurbishment and/or cleaning activities; and
- Where a structure is being filled or left standing during the return to service period, it must be configured such that flow out to the distribution system is prevented.

By ensuring the above steps are implemented, we are mitigating the potential water quality issues that can occur at service reservoirs and towers that we have described earlier in this section.

Examples of a typical service reservoir and tower are illustrated in Figure 2 and Figure 3.

Figure 2: Typical Service Reservoir

Figure 3: Typical Water Tower

The assets included in this investment case cover:

- Eighty three Service reservoir sites comprising one hundred and eight individual reservoir compartments;
- Water tower structures comprising seven compartments;
- Associated pipework and fittings;
- Ancillary structures housing instrumentation and control equipment;
- Lids and covers;
- Rechlorination equipment; and
- Service reservoir bypasses.

Strategic interventions associated with water storage assets within a treatment works, such as treated water reservoirs, blending tanks, and contact tanks, are excluded from this investment case and are covered under the Treatment Works Strategic Maintenance investment case. Similarly, raw water storage reservoirs and tanks are also excluded from this investment case and are covered under the Water Resources investment case.

The primary objective of this investment case is to maintain a stable level of risk at service reservoirs and towers and ensure an on-going and sustainable asset life at each site. This will in turn enable us to deliver a Safe and Reliable Supply to our customers.

3.2 Strategy

Developing the investment needs for our eight three service reservoirs and five water towers is underpinned by our long term corporate strategy which has the vision "***Trust beyond water-we provide excellent experiences***". Our Outcomes Delivery Framework together with our Strategic Asset Management Plan provides the strategic framework that supports this vision and enables investment in our distribution mains to clearly focus in delivering against outcomes and performance commitments.

Our long term strategy, as set out in the Outcome Delivery Framework (section C3 of our business plan), has a focus on resilience and a growing need to ensure that our assets are, and remain, fit and well maintained and effective in meeting our performance requirements. There are three strategic drivers identified that together, ensure we meet our current and future needs for customers and stakeholders. These are:

- **Operational Resilience** - which have performance commitments to reflect reliability, resilience and quality of water;
- **Customer Focused** - performance commitments to reflect customer service and affordability; and
- **A Sustainable Business** - performance commitments to reflect the environment representing our community and sustainable resources.

Within this strategy there is a specific outcome that is influencing our investment in service reservoirs and towers, which is a Safe and Reliable Supply.

Our Asset Management Strategy has objectives developed in alignment with the long term strategy and delivery of corporate objectives and outcomes. These objectives cover both our short-term needs and longer-term aims, and drive the capability development plan and asset planning activities. Delivery of the investment for our service reservoirs and towers will be driven through the Asset Management Framework, which is designed to enable the efficient and effective planning and delivery of all our asset related activities, to successfully deliver our business and customer outcomes. The framework aligns to, and interacts with, our corporate drivers, which in turn are there to deliver the external expectations and requirements placed upon us by our stakeholders.

We need to ensure that planned investment is sufficient for the continuation of business as usual activities and routine and reactive maintenance, and the continued provision of high quality water to our customers.

Our Strategy for Service Reservoirs and Towers is to maintain a risk level within the network that translates into a stable and acceptable level of service for our customers. One of our four customer outcomes is maintaining a Safe and Reliable Supply.

3.3 Customer Priorities

Customer priorities relating to our outcomes and performance commitments have been determined through customer engagement and research. This ensures that at Bristol Water we have engaged effectively with our customers on longer-term issues, and have taken into account the needs and requirements of future customers.

Through this process our customers have told us that their top priorities have remained largely unchanged from PR14 and have been identified as:

- You can get a bill you can afford;
- Keeping the water flowing to your tap;
- Help to improve your community;
- Save water before developing new supplies; and
- You get the best possible experience every time you need us.

This engagement has resulted in the development of four specific outcomes for PR19, which capture what our customers and stakeholders have said; these are:

- Excellent Customer Experiences;
- Safe and Reliable Supply;
- Local Community and Environmental Resilience; and
- Corporate Financial Resilience.

To deliver our customers' priorities and outcomes, we will measure progress via twenty six performance commitments for which we have set delivery targets.

Whilst the investment proposed does not contribute directly to performance enhancement via performance commitments, it does contribute more broadly towards achieving our outcome of providing a Safe and Reliable Supply. If we fail to invest and do not inspect our reservoirs, failing to identify and rectify issues that can lead to water quality failures, we risk non-compliance under the Water Supply (Water Quality) regulations. We could also contribute to unacceptable levels of asset deterioration.

Specific details on our planned investment for service reservoirs and towers can be found in Section 5.

3.4 Asset Health, AMP7 Performance Commitments & Outcome Delivery Incentives

The investment case for service reservoirs and towers is concerned with meeting specific regulatory requirements and mitigating identified risks. No direct contribution to performance commitment targets has been attributed through this investment case.

3.5 Compliance Obligations

Statutory and compliance obligations have influenced the development of interventions in this investment case and the investment for AMP7. Relevant legislation is detailed below.

We have statutory obligations under the Safety at Work Act (1974) and the Water Supply (Water Quality) Regulations to inspect our reservoirs. The procedure for inspections and inspection frequencies are set out in the 'Written Scheme of Examination for Potable Water Structures'.

We have a statutory obligation under the Reservoirs Act 1975 to safeguard against failure of our large raised reservoirs[3] and the consequential catastrophic impact on local communities, property and the environment.

Industry best practice for treated water storage is also provided in the Water UK Technical Guidance Note 9 (TGN 9)[4]. This states that 'External and internal inspection of structures should be carried out at a frequency determined by individual risk assessment. Internal inspection should be carried out at a frequency not be greater than every 10 years'.

Within this investment case there are specific risks that we are seeking to mitigate to ensure our continued compliance with these regulations. They are explained in Section 5.

[3] Defined as having a capacity greater than 25,000m^3 sitting above natural ground level.
[4] Water UK. *Technical Guidance Note 9 - Treated Water Storage*. https://www.water.org.uk/publications/reports/principles-water-supply-hygiene.

3.6 AMP6 Investment and Performance

A summary of our AMP6 investment in treatment works strategic maintenance is provided in Table 1 below. We have re-categorised data used in line with the scope of our investment cases. For historic data we have used the 2016/17 wholesale cost assessment data (data tables 1 and 2). Forecast data has been derived from PR19 data (data tables WS1 and WS2)..

Table 1: AMP6 capital investment

Year	Service Reservoirs and Towers capex (£m)
2015/16 actual	0.330
2016/17 actual	0.545
2017/18 actual	0.632
2018/19 forecast	0.612
2019/20 forecast	0.989
AMP6 forecast	**3.108**

Our AMP6 investment allows us to fulfil our statutory obligations in relation to the required potable water structures inspections in 2015 to 2020, and provides targeted remedial works following these inspections as well as other targeted reservoir improvements. No direct contribution to AMP6 performance commitment targets has been attributed.

4 Developing Our Investment Plan

As we have discussed earlier, the starting point for investment case development is to understand our customers' priorities and determine associated performance commitments. We have adopted totex principles to determine how we should invest in order to deliver these priorities and associated commitments. The totex approach we have adopted considers which the best solution is because it is the lowest cost over the whole life of the asset, regardless of whether it is operational expenditure or capital expenditure.

Whilst we do not currently have health and risk indices across our asset groups, we do have a wealth of data. In some cases, analytical models such as the mains deterioration model, provides us with a view of how our assets are performing, as well as a view on their deterioration. The following section describes the process we have created and followed in order to develop our investment cases.

4.1 Investment Case Development Process

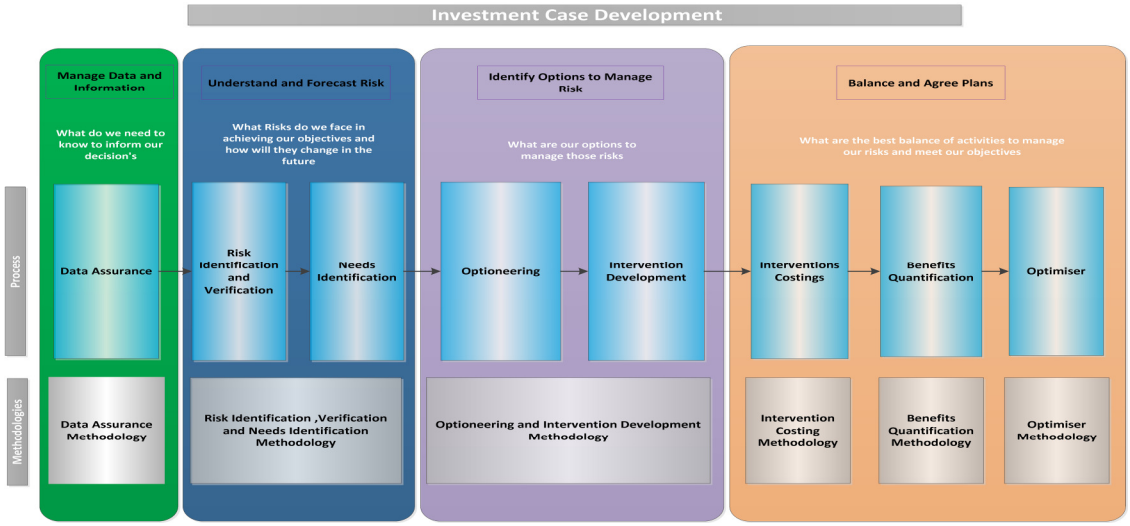
We have created and implemented a process that is supported by a set of six methodologies. When developing the methodologies, we wanted to ensure that they:

- Deliver what the customers have asked for;
- Satisfy our business needs; and
- Deliver a high quality business plan in accordance with Ofwat's Company Monitoring Framework.

The collective application of these methodologies has enabled us to develop investment proposals that are well evidenced through a line of sight approach, ensuring our investment plan achieves the required targets at the optimal cost.

Figure 4 illustrates, at a high level, the process required to identify risks that require addressing in AMP7, and the subsequent development of appropriate interventions.

Figure 4: Investment Case Process Overview - Level 1 Diagram



4.1.1 Data & Data Assurance

The development of our investment cases is dependent on having consistent, accurate and assured data. We therefore recognise that we must be able to demonstrate the quality of the data and information used in the development of our investment cases.

Wherever possible, we have utilised data from our core company systems in order to undertake our analysis and we have sense checked the quality of the data as we have used it.

However, in addition, we have applied a data assurance methodology. We have assessed data quality in terms of completeness, accuracy and reliability. In addition, the methodology also assesses whether data is used as part of the Annual Performance Report to Ofwat, and hence already subject to existing Annual Performance Report assurance mechanisms.

In total we have developed twenty one investment cases. The values of these investment cases range from less than £1m to over £37m. Our overall capital investment plan totals circa £212m.

We have selected a sample of nine investment cases, and have applied detailed data assurance based on their value and complexity. The total value of these nine investment cases represents 66% (circa £140m) of the total capital investment plan, and represents two hundred and eighty six individual data types. We have evaluated all two hundred and eighty six data types and we have evaluated them for quality and their use in the Annual Performance Report process. The overall data quality assessment identified 93% of the data as being good quality, and 55% as having been used and assured through the Annual Performance Report process.

This investment case was not included as part of the sample of nine investment cases. We will continue to focus on improving the quality of our data and the associated assurance processes.

4.1.2 Risk Identification, Verification & Needs Identification Assessment

The purpose of our risk identification, verification and need assessment is to ensure that:

- The risks that we are currently facing are captured in a single risk register;
- Each risk is assessed and verified to determine details about the nature and magnitude of the risk and whether any mitigation is currently planned in this AMP period;
- Each risk is scored on a common basis to allow risks to be compared; and
- The most significant risks are identified, and that for each a clear and uniquely referenced statement of need is produced to define the problem as clearly as possible, and to identify what benefits or performance commitments mitigation of this risk will achieve.

The risk score is the product of the likelihood and consequence, each is scored 1 to 5 and then multiplied together to provide a potential maximum risk score of 25.

Risks scoring 15 to 25 are the most significant strategic risks, and these were developed into needs statements.

Those scoring 10 or 12 were subject to a further round of review. Where the risk was confirmed, it was developed into a needs statement. Where the risk was not confirmed (for example it is currently being addressed in AMP6 or the risk was assessed to be not as significant as initially scored), it was not considered further as part of the PR19 investment planning process.

The risks scoring 1 to 9 were considered to be risks of a lower priority and were therefore not considered further as part of the PR19 investment planning process.

The risks not considered further as part of the PR19 investment planning will continue to be monitored and assessed as part of the live business and on-going business as usual risk management process. Where there is a need to mitigate these risks within the AMP, we will respond with appropriate action, such as increased base maintenance.

Further development of our business as usual risk management process is on-going and we are looking to innovate by developing smarter systems to optimise this process.

We developed need statements for all selected risks.

4.1.3 Optioneering & Intervention Development Methodology

The next stage in our process is to develop options of how we could meet the needs of the selected risks.

To generate the options, data was gathered from a number of sources (see Appendix B). This included meetings with stakeholders, asset inventory, inspection reports, and inspection programmes, historical records that included reviews following operational events, previous scheme proposal reports and previous options assessment reports.

We then progressed to data assimilation, analysis and consultation with key stakeholders. Multiple options were developed and recorded. These options were reviewed and all options identified as not viable were discarded.

All viable options were identified as proposed interventions with a unique reference number and were taken forward for further scope development, benefits calculation and costing.

4.1.4 Intervention Costing Methodology

In order to provide assurance of our investment costs and to ensure standardisation, we engaged ChandlerKBS as our costing partner. They were selected in part due to their ability to provide us with industry comparable cost data, often at intervention level. They supported us in several ways:

- In some instances development and analysis of intervention costs, and
- Support to build our cost database.

Indirect overheads, such as contractor costs, design costs, contract management, and our overheads have been applied at intervention level. Wherever possible we used our data or if unavailable, we used industry average costs.

Therefore we have to assess the expected capital cost of each intervention.

Expected Capital Cost (capex after)

If we deliver the capital expenditure intervention in a planned way, we have labelled it as ‘capex after’. This is the expected capital cost of the intervention.

Cost estimates were usually based on high level scopes, which contained activity schedules, and sketches provided by ourselves, and were developed using the cost model we developed with ChandlerKBS.

4.1.5 Benefits Quantification Methodology

The benefits for each intervention are those which are considered to affect company performance during subsequent AMP periods.

Benefits can be assessed as either being:

- Direct – savings in reactive capex or savings in opex; or
- Indirect – improvement in performance commitments or other resultant effects on the company’s performance.

Both direct and indirect benefits are considered and quantified.

Direct Benefits

We have a totex approach which considers both capital and operational expenditure.

Expected Capital Cost (capex before)

If we deliver the capital expenditure intervention in an unplanned way, we have labelled it as 'capex before'. This is the reactive cost that would potentially arise if we had to deliver the intervention in an unplanned way.

We could respond to this scenario in one of two ways:

- 'Patch and Repair'; or
- Implementation of the intervention in an un-programmed accelerated manner.

The capex before was estimated for each intervention. For most interventions the estimate is site specific. A risk factor, taken from the likelihood score recorded in the risk register, was applied to the initial capex value to produce the final capex before value.

Where a 'patch & repair' solution would not be appropriate, should the risk materialise, this would lead to the immediate implementation of the intervention. The cost of the intervention in this scenario is the expected capital cost of the intervention (capex after), with the application of a suitable uplift to cover the costs associated with fast-tracking the intervention, for example, the cost of labour at premium rates.

The expected capex before effectively formed the 'Do Nothing' option.

Expected Opex Before & Opex After

In most cases we have made an estimate of the operational expenditure levels either with investment - opex after or without investment - opex before. Opex includes power, chemicals, materials, contract hire and in house labour.

Opex before represents the opex expenditure associated with not mitigating a risk through capital investment, for example, increased maintenance visits or replacement of components.

Opex after represents the additional opex cost to the business after the implementation of an intervention. These could include negative values associated with predicted savings associated with increased plant efficiency or performance, or positive values where there is an operational cost increase, for example greater inspection levels.

It should be noted that no opex impacts were identified for the interventions associated with the Service Reservoir and Towers investment case.

Indirect Benefits

To measure our performance against our customers' priorities and the associated performance enhancements associated with interventions; we measure the impact that each intervention had on the performance commitment measure.

Other Benefits

In addition to the performance commitments described above, other indirect benefits which do not relate to performance commitments were calculated and recorded in the benefits calculations where appropriate. This includes avoidance of health and safety penalties, customer compensation payments, and environmental penalties. These benefits have been monetised.

Once the benefits were prepared, the interventions were put forward for investment optimisation.

4.1.6 Investment Optimisation & Intervention Selection

The investment optimisation process determines which interventions are selected to provide the optimal AMP7 investment plan, by delivering the targeted performance commitment improvements, at the lowest cost. We have utilised a water industry standard system (Servelec 'Pioneer') to optimise our AMP7 investment plan. Pioneer provides the functionality for us to assess all interventions developed across all of the investment cases. It will assess the interventions both individually and in comparison to other interventions. It is a decision support tool that produces an optimal investment plan to meet the targeted performance commitment improvements required in AMP7.

The Pioneer investment optimiser model assesses interventions primarily on the overall benefit, which takes account of performance and whole life costs. The investment optimiser calculates the whole life cost as the net present value over forty years. This determines if an intervention is cost beneficial.

We will select interventions for one or more of the following reasons:

- The intervention is mandated (i.e. Drinking Water Inspectorate - water quality requirement);
- The intervention is cost-beneficial; or
- The intervention is required to achieve the performance commitment targets.

Any performance commitment improvement obtained from mandated or cost-beneficial interventions will contribute to overall performance improvement.

A series of business reviews and sense checks of the investment optimiser results have been undertaken prior to finalising the AMP 7 investment plan.

We can of course model any number of scenarios, and during the process of engaging our customers we ran three scenarios as described in Appendix C1 (slower Improvement plan, suggested improvement plan and faster improvement plan).

4.2 Applying the investment process to Service Reservoirs and Towers

Each of the following sections describes the specific details associated with the application of the investment case development process for service reservoirs and towers.

4.2.1 Risk Identification, Verification & Needs Assessment

There were one hundred and eight two risks identified in the Strategic Risk Register[5] associated with this investment case. Every risk went through a process of assessment, scoring and review, following the Methodology for Risk Identification, Verification and Needs Identification.

Only three risks were identified as significant strategic risks and therefore developed into needs statements. The risk descriptions, scoring and associated needs statements are captured in the Strategic Risk Register. Details of the selected risks are provided in Appendix C.1.

One hundred and seventy nine risks were not considered to be significant strategic risks and these risks return to being monitored and reviewed under our business as usual risk management process. Details of the non-selected risks are provided in Appendix C.2.

An example of a non-selected risk is given below in Table 2.

Table 2: Example of an Unselected Risk

SRR ID	IC No	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score
SRR6	3	Cheddar Cliffs Reservoir	IF stagnant water from deadlegs caused by removal of water quality instruments enters supply THEN possible customer complaints, taste and odour, and water quality failures..	2	2	1	1	2	2	2	4

In the example above, the likelihood and risk score was assessed by engaging with stakeholders within Bristol Water. This confirmed that the volume of potential stagnant water is very small compared to the flow supplied from the reservoir and therefore the potential impact is low. The risk is not likely to arise in the coming AMP period and if the risk did occur, the impact would be low across all categories of the impact scoring. The risk is therefore not considered a strategic risk that will impact on our ability to meet our performance commitments.

[5] Bristol Water, 2018. *NTPBP-CAL-STR-0127 Strategic Risk Register (WIP).xlxs*

The 'Line of Sight' for the whole process, beginning with the selected risks, the source of the risk, a record of source documents used to verify the risks, and the needs statements, is captured in the Service Reservoirs and Towers Maintenance Interventions Register[6].

Two main risk groups dominate the non-selected risks as follows:

Reservoir By-passes

Typically new service reservoirs are constructed with twin compartments so that one compartment can be taken out of service for inspection and maintenance whilst the other is kept in service to maintain supply to customers. However, some older reservoirs have only a single compartment, so to maintain supply to customers during maintenance, either a pipeline by-pass around the reservoir is required or a tankered supply of water. The latter is only possible where the population served by the single compartment reservoir is very small. A review has been undertaken of all the single compartment reservoirs and no reservoirs have been identified which cannot be taken out of service either by using a by-pass or a tankered supply of water.

Reservoir Maintenance and Remedial Work

The reservoir inspection reports identify maintenance and remedial work required at each reservoir. Typically this work may be routine work requiring little design input and/ or may be low value. Such work may include replacement of joint sealant to prevent bacteriological growth or repair of valves or access covers. Our Reservoirs and Towers Asset Inventory summarises the output of all reservoir inspection reports. A review of this together with the assessment of risks as described in the Methodology for Risk Identification, Verification and Needs Identification, resulted in all maintenance and remedial work being judged as routine and/ or low value and was therefore classified as Base Maintenance (see Section 5.6).

The 'Line of Sight' for the whole process, beginning with the selected risks, the source of the risk, a record of source documents used to verify the risks, and the needs statements, is captured in the Service Reservoir and Towers Interventions Register.

4.2.2 Optioneering & Intervention Development

As described in Section 4.2.1, three risks were selected and developed into a needs statement. Further investigation of these needs included data assimilation, analysis and consultation with key stakeholders.

Multiple options were developed and recorded for each of the three needs statements. These options were peer reviewed and all options identified as not viable were discarded. For example, against the selected risk regarding the failure of brick cladding to surrounding Chase Reservoir, four options were identified and one of these was developed into an intervention, as shown in Table 3.

[6] Bristol Water, 2018. *NTPBP-CAL-SER-0139 Service Reservoir and Towers IC Intervention Register.xlsx*

Table 3 Example of Options Selection

Risk Need	Mitigation Options				Proposed Interventions		
Need Description	Proposed Option Nam	Proposed Option Description	Option Viability?	Option to be Developed into an Intervention?	Ref No	Intervention Title	Scope of Intervention
The brickwork cladding to Chase reservoir is degrading. Some localised repairs have been undertaken and this has revealed the brickwork to be poorly laid with the frogs down. This creates air gaps in the brickwork and makes it susceptible to frost damage. The deterioration may lead to masonry falling from the wall. Investment is required to make the site safe and to: - meet obligations under the Health and Safety at Work Act 1974 and the Corporate Manslaughter and Corporate Homicide Act 2007; - avoid liability and reputational damage in the event of accident or injury resulting from an unsafe asset.	Business as Usual	Fixing wall defects as and when they occur. This will progressively worse and more expensive.	This is not acceptable as the risk of injuring someone remains and is not mitigated.	N	N/A	N/A	
	Replace entire cladding wall	Remove existing cladding wall (total length 168m and height 3m). Replace existing wall with new cladding (either brickwork or other).	This is an acceptable solution.	Y	3.002.01	Chase Reservoir	Externally the reservoir is raised above ground level and has a decorative brick wall cladding over the reinforced concrete structure, this brickwork is in poor condition with frost damage, cracks in various areas and the coping stones starting to deteriorate. It is recommended that all of the wall is demolished, rebuilt and mortar repairs carried out to areas of spalled concrete on the internal parapet wall and a Cementitious coating applied to provide extra cover over the concrete. Wall height 3m approx. Wall length 168m.
	Remove cladding	Remove existing cladding wall (total length 168m and height 3m). Make good exposed concrete surface.	This may not be an acceptable solution because it may be a planning condtion that the structure is clad. Structurally and functionally this is an acceptable solution.	N	N/A	N/A	
	Repair only the most worst sections of wall	Localised removal and rebuild of brickwork	The problems seem to arise from brickwork laid with frogs down. This creates air pockets in the brickwork making it susceptible to frost damage. Localised repair only solves the problem in the short term.	N	N/A	N/A	

A summary of all selected risks and their associated options is included in Appendix D. A summary of all non-selected risks is given in Appendix C.2.

Once interventions were developed, costings could be prepared which are discussed in section 4.2.3.

4.2.3 Intervention Costing

In this investment case costs for interventions 03.002.01 (Chase Reservoir) and 03.002.02 (Weston Woods No.3 Reservoir) were calculated in collaboration with ChandlerKBS, based on high level scopes and sketches supplied by Bristol Water. Indirect overheads (contractor on-costs including preliminaries, design costs, contract management) and Bristol Water overheads were then applied at intervention level. These overheads are based on Bristol Water data where available, or using industry average, where Bristol Water data was not available.

As described in section 4.2.2, we have identified a total of three interventions to be taken forward for scope development and cost estimation. For the two interventions to be costed by ChandlerKBS (03.002.01 Chase Reservoir and 03.002.02 Weston Woods No. 3 Reservoir), high level scope documents were developed including an activity schedule, and where appropriate, explanatory sketches and annotated drawings. ChandlerKBS utilised a water industry unit cost database to complete estimation in accordance with their own assured methodology.

The costed activity schedules were returned to Bristol Water for peer review, leading to further refinement in collaboration with ChandlerKBS.

Intervention 03.003.01 (Service Reservoir Inspections) was costed in-house based on historic spend on service reservoir inspections, as this is an in-house capitalised activity.

The cost for each intervention that was developed is presented in Appendix E. An example of how these costs have been developed is outlined below.

Cost Example: Weston Woods No.3 Reservoir

Investment is needed to grit blast and paint the columns and beams to extend the life of our Weston Woods No.3 Reservoir asset. A timely intervention now will avoid the need for a significantly greater intervention in the future.

We have established a direct cost of undertaking the works of £0.023m, this includes labour and materials as well as contractual costs. The latter includes items such as (but not limited to) contractor accommodation, contractor management, contractor overhead and profit, and design. We have then applied Bristol Water's overhead of £0.003m for internal activities associated with the intervention, such as project management, land and compensation, legal, environmental costs, commissioning/handover, contract management, operations and system support, consultants and administration.

All of the direct costs above gave us an intervention cost of £0.027m to implement the intervention in a planned way (the capex after).

If however, we did not undertake the work to repair the asset proactively, then we would have to complete it reactively. Should we have to undertake this work reactively it would be completed as a 'patch and repair'. We have therefore used the patch and repair cost, calculated as £0.1m and have applied a factor to account for the likelihood of the risk materialising within the 5 year AMP. We have assessed this probability as 0.23 based on a cumulative probability of the 5 year AMP (asset failure probability of 0.5 in any 1 year), giving a reactive cost of £0.023m (£0.1m multiplied by 0.23).

We have established that regardless of whether we undertook the above intervention in either a planned or reactive way, there would be no change in operational expenditure (opex after).

Once interventions were costed, benefits could be calculated which are discussed in Section 4.2.4.

4.2.4 Benefits Quantification

Three service reservoir interventions were assessed for Direct and Indirect benefits. These are presented in Appendix E:

In terms of indirect benefits, there are no performance commitments that relate directly to the interventions in this investment case, but 'Other Benefits' do contribute.

Once the benefits were prepared, the interventions were put forward for investment optimisation.

5 Outcome

5.1 Selected Interventions

The three interventions developed within the Service Reservoirs and Towers investment case were assessed through the investment optimisation process. Of these three interventions, one has been selected.

When it comes to delivering our programme of works we know that we must continue to be innovative and efficient. We have set ourselves a challenging target of reducing our costs by 8% during AMP7. This will be achieved by delivery of our business transformation programme.

We see innovation as integral to our everyday working at Bristol Water: We have deliberately embedded it within the business-as-usual processes of our asset management teams by embracing the full flexibility that totex and outcomes enables. We will look to be innovative in the following ways:

- **Open Innovation**: We have defined our strategic innovation challenges and run events such as our "Innovation Exchange" that invite suppliers to present their innovative solutions to predefined challenges that we set
- **Market Scanning**: We conduct market scanning through for cutting edge technology against our strategic innovation challenges and feed this into our optioneering process. In particular we subscribe to the Technology Approval Group which regularly scans and meets with water companies to unearth the most promising innovations for the sector
- **Partnering**: we undertake leading research into areas that we provide effective solutions for the future.

We will specifically look for process innovations that mean we can contribute to our 8% efficiency challenge and keep our customers' bills low into the future.

The one selected intervention is set out in Table 4, along with details of the associated costs.

Table 4: Selected interventions and costs

ID	Intervention Title	Capex (£)	Change in opex per annum (£)
03.003.01	Service Reservoir Inspections	£2,075,000	£0
Service reservoirs and towers capital investment (pre-efficiency)		**£2,075,000**	**£0**
Service reservoirs and towers capital investment with 8% capex efficiency		**£1,909,000**	

The service reservoir inspections intervention was selected because it is mandatory to meet regulatory obligations.

Inspection and testing of service reservoirs and towers is required to:

- Ensure that safe water is supplied to our customers by ensuring that internal surfaces of the reservoirs are not deteriorating, that there is no significant depth of sediment in the reservoir and that the roof of the reservoir is not leaking. A deteriorating surface can more readily harbour harmful bacteria and a leaking roof can let in contaminants or bacteria. Further, sediment build up on the floor of reservoirs can be a source of harmful bacteria;
- Ensure that the water supply is reliable by ensuring that there are not structural or other physical defects associated with the reservoir. If the service reservoir structure or any other assets associated with the service reservoir, such as pipework, fail, the supply to customers could be disrupted;
- Ensure that service reservoirs and towers are safe to anyone entering the site or for our own operatives. This is particularly true for water towers where the potential for harm from falling is that much greater; and
- Ensure early signs of deterioration are identified by measuring what volume of water is lost from a filled reservoir. This in turn enables remedial works to be identified and this contributes to minimising leakage.

Without investment, we will not meet our statutory obligations in relation to reservoir inspections.

The total service reservoirs and towers capital investment, including Water Service and Business Unit Allocation, is summarised in Table 5. This investment case is aligned to the Water Network Plus Wholesale Control category of our business plan. All costs are allocated to the Treated Water Distribution business unit. Investment is all related to maintaining the long term capability of our non-infrastructure assets.

Table 5: Water Service and Business Unit Allocation

Wholesale Control	**Water Network Plus**	**Total Capital Investment**
Business Unit Allocation	***04 Treated Water Distribution***	
Service reservoirs and towers capital investment (%)	**100.0%**	**100%**
Service reservoirs and towers capital investment	**£2.075m**	**£2.075m**
Maintaining the long term capability of the assets - non-infra	£2.075m (100%)	£2.075m (100%)
Service reservoirs and towers - capital investment with 8% efficiency		**£1.909m**

5.2 Contribution to Performance Commitments

Our AMP7 investment in treatment works strategic maintenance will help ensure our assets are being maintained appropriately to deliver resilient water services to current and future generations.

The investment case for service reservoirs and towers is concerned with meeting specific regulatory requirements and mitigating identified risks. No direct contribution to performance commitment targets has been attributed through this investment case.

5.3 Non Selected Interventions

Of the three interventions developed within this investment case, two were not selected because they were not cost beneficial. The risks associated with these interventions represent residual risks that will be carried during AMP7. We will continue to monitor these residual risks throughout AMP7, and where this process requires these risks to be mitigated, we will respond with appropriate action. Details of the 2 non-selected interventions are given in Table 6.

Table 6 Non-Selected Interventions and Residual Risk

SSR ID	Risk & Need Statement	Non-Selected Intervention & Residual Risk
SRR594	The brickwork cladding to Chase reservoir is degrading. Some localised repairs have been undertaken and this has revealed the brickwork to be poorly laid with the frogs down. This creates air gaps in the brickwork and makes it susceptible to frost damage. The deterioration may lead to masonry falling from the wall.	Non-Selected Intervention: 03.002.01 Chase Reservoir Residual Risk: If the brickwork cladding to Chase reservoir continues to degrade then someone could be injured by falling masonry.
SRR621	The cast iron columns and roof beams at Weston Woods No.3 reservoir are corroding. Investment is needed to grit blast and paint the columns and beams to extend the life of these assets. A timely intervention now will avoid the need for a significantly greater intervention in the future	Non-Selected Intervention: 03.002.02 Weston Woods No3 reservoir Residual Risk: IF deterioration of the (Weston Woods No.3) cast iron columns and steel beams is allowed to continue THEN bacteria within the reservoir will be more difficult to control and the reservoir could fail a water quality test and be taken out of service.

5.4 Assumptions

There are a number of general assumptions that have been made in the development of our investment cases. These are discussed in detail in section 11 of the PR19 Investment Cases Summary Document[7]. Assumptions specific to this investment case are discussed below.

The reservoir inspection reports identify the maintenance and remedial work required at each reservoir. Typically this work may be routine and may require little design input and/or may be low in value. Such

[7] Bristol Water, 2018. *NTPBP-INV-PR1-0635 PR19 Investment Cases Summary Document.docx*

work may include the replacement of joint sealant to prevent bacteriological growth, or the repair of valves or access covers. The assumption has been made in this investment case that only where maintenance and remedial work is atypical, or more strategic, has it been put forward as a separate intervention for consideration in the investment optimisation process.

5.5 AMP 8

At the time of writing, the overall number of service reservoirs and towers is understood to remain constant through AMP8. Therefore investment in service reservoirs and towers in AMP8 is likely to be similar to the AMP7 investment.

There are a number of risk items that have been developed into interventions which have not been selected for inclusion in the AMP7 Business Plan (see Appendix F), which will be reappraised for investment in AMP8.

5.6 Base Maintenance

We have established minimum levels of investment in relation to the base maintenance of treatment works, pumping stations, service reservoirs and customer meter installation, as set out in the Non-Infrastructure Base Maintenance investment case. These minimum levels provide investment for routine and reactive maintenance, to ensure the continuation of 'business as usual'. The minimum value for service reservoir inspections and remedial works is £4.2m. These minimum levels have been determined through a combination of analysis of historical activity and costs, deterioration modelling to establish underlying asset deterioration, and investment planning analysis. Full details are provided in the Non-Infrastructure Base Maintenance investment case.

The investment planned through this investment case contributes towards the minimum investment levels.

In relation to this investment case, the Non-Infrastructure Base Maintenance investment case defines minimum levels of expenditure for service reservoirs and towers inspections and remedial works. The minimum investment levels for this investment case are summarised in Table 7.

Table 7: Contribution to minimum non-infrastructure base maintenance investment

Non-infrastructure base maintenance asset group	Minimum AMP7 investment to maintain asset health (£m)	AMP7 investment provided through Service Reservoirs and Towers interventions (£m)	AMP7 investment provided through all interventions (£m)	Additional investment requirement as base maintenance (£m)
Service reservoir inspections and remedial works	4.2	2.075	2.075	2.125

5.7 Historic & AMP7 Investment Comparison

A summary of historical service reservoirs and towers investment is provided in Table 8 along with our AMP7 investment in service reservoirs and towers interventions. We have re-categorised data used in line with the scope of our investment cases. For historic data we have used the 2016/17 wholesale cost assessment data (data tables 1 and 2). Forecast data has been derived from PR19 data (data tables WS1 and WS2).

Table 8: Historical & AMP7 Investment

AMP	Values	Investment (£m)
AMP5	AMP5 actual	1.348
AMP6	2015/16 actual	0.330
	2016/17 actual	0.545
	2017/18 actual	0.632
	2018/19 forecast	0.612
	2019/20 forecast	0.989
	AMP6 forecast	**3.108**
AMP7	AMP7 pre-efficiency	2.075
	AMP7 8% capex efficiency applied	1.909

Our AMP7 investment in service reservoirs and towers is higher than in AMP5, but lower than in AMP6. Our AMP5 and AMP6 investment ensures we fulfil statutory obligations in relation to the required potable water structures inspections in 2015 to 2020, and provides targeted remedial works following these inspections as well as other targeted reservoir improvements. In AMP7, our investment also relates to inspections to meet our statutory obligations in relation to reservoirs. Targeted remedial works will be undertaken as necessary as part of base maintenance activities.

6 Conclusions

An initial list of one hundred and eight two risks was narrowed down to a total of three interventions. These interventions have been developed and assessed through our asset management totex focused processes as set out in this investment case, and put forward for investment optimisation. Of these, only one intervention, statutory inspections was selected, on the basis that the intervention was mandated in our investment optimisation process to ensure we meet all compliance and statutory obligations, avoiding non-compliance. However, it does contribute more broadly towards achieving our outcome of providing a Safe and Reliable Supply to our customers.

If we fail to invest and do not inspect our reservoirs, failing to identify and rectify issues that can lead to water quality failures, we risk non-compliance under the Water Supply (Water Quality) regulations. We could also contribute to unacceptable levels of asset deterioration.

We plan to invest a pre-efficiency total of £2.075m on service reservoirs and towers. This total falls to £1.909m after 8% efficiency is applied. These interventions will not generate any additional operating expenditure.

Those interventions not selected through investment optimisation form the residual risk for base maintenance and/or delivery in AMP8.

Our Business Plan will provide assurance that it will deliver and monitor delivery of its outcomes, meet relevant statutory requirements and licence obligations and take account of the UK Government strategic policy statements.

7 Appendices

Appendix A: Line of Sight

Appendix B: Datasets

Appendix C1: Selected Risks

Appendix C2: Non-Selected Risks

Appendix D: Options Considered

Appendix E: Interventions Developed

Appendix F: Non-Selected Interventions

7.1 Appendix A: Line of Sight

Service Reservoirs Line of Sight

Investment Case
NTPBP-INV-SER-0528

Customer Priorities

Performance Commitments

Optimiser Input Form Reference

NTPBP-CAL-DIS-0347

Other Monetised Benefits

Interventions

03.003.01
Service Reservoir Inspections

OFWAT Initial Assessment Tests

OFWAT Initial Assessment Tests	Test Area
What is the quality of the Company's customer engagement and participation and how is it incorporated into the companies business plan and ongoing operations	Engaging Customers
How well has the company used the best available evidence to objectively assess and prioritise the diverse range of risks and consequences of disruptions to its systems and services and engaged effectively with customers on its assessment of the risks and consequences	Securing long term resilience
How well has the company objectively assessed the full range of mitigating options and selected the solutions that represent the best value for money over the long term and support from customers	
To what extent has the company clearly demonstrated that it has considered whether all relevant projects are technically suitable for direct procurement for customers. Where it has one or more such projects, to what extent has the Company provided a well reasoned and well evidenced value for money assessment	Targeted controls , markets and innovation
To what extent does the company have a good track record of producing high quality data, taking into account the company's data submission, assurance process and statement of high quality , and our 2018 assessment of the company under the Company Monitoring Framework	Securing Confidence and Assurance
Board Requirements	
Assurance that the company's business plan has been informed by customer engagement and feedback from the company's CCG about the quality of its customer engagement and how this has been incorporated into the plan	Customer Engagement
Assurance that the company's business plan has been informed by a robust and systematic assessment of the resilience of the company's systems and services; customer views on managing resilience and a comprehensive and objective assessment of interventions to manage resilience in customers long term interests	Resilience
How has it challenged an satisfied itself that the overall strategy for data assurance and governance processes delivers a high quality data	Business Planning
How has it challenged and satisfied itself that the business plan will enable the company to meet its statutory and licence obligations , now and in the future and take account of the UK and Welsh governments strategic policy statements.	
How has it challenged and satisfied itself that its plan will deliver operational financial and corporate resilience over the next control period and the long term through its governance and assurance processes, taking into account of its track record of performance	

Performance Commitment Key

- Common Performance Commitment
- Common New Performance Commitment
- Bespoke Performance Commitment
- Bespoke New Performance Comittment

Document Number NTPBP-MET-SER-07177

7.2 Appendix B: Datasets

This appendix lists the datasets used in this investment case and where they have been utilised.

Dataset File Name	Data Summary	Process In Which Data Has Been Used			
		Risk Identification, Verification and Needs Assessment	Optioneering	Intervention Costing	Benefits Quantification
REQ-0131 - Chase B 2016.docx	Inspection reports for Chase Reservoir	✓	-	-	✓
Reservoir Yearly Costs Planned and Actual 2017 to 2021.xlsx	Programme and costs of SR inspections	✓	-	-	-
REQ-0216 Written Scheme of Examination - Potable Service Reservoirs.docx	Copy of the Written Scheme of Examination for Potable Water Structures	-	-	-	✓
Reservoirs Towers and Tanks - Asset Inventory - v26.xlsx	Most recent service reservoir inspection reports	✓	-	-	✓
WestonWoods3_2017.docx	Inspection Reports and drawings for Weston Woods 3 Reservoir	-	-	-	✓

7.3 Appendix C1: Selected Risks

This appendix shows the 20 selected risks of the 182 relevant risks.

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score	Risk Confirmed?
SRR10	Durdham Down	IF the degradation of the inner surface and floor of the reservoir continues THEN bacteria within the reservoir will become more difficult to control and the reservoir could fail a water quality test and be taken out of service.	3	2	3	3	2	4	4	12	N
SRR11	Durdham Down	IF the degradation of the inner surface and floor of the reservoir continues THEN bacteria within the reservoir will become more difficult to control and the reservoir could fail a water quality test and be taken out of service.	3	2	3	3	2	4	4	12	N
SRR16	Maesbury Reservoir	IF the degradation of the reservoir internal joint sealant continues THEN bacteria within the reservoir will become more difficult to control and the reservoir could fail a water quality test and be taken out of service.	4	2	3	2	2	3	3	12	N
SRR18	Backwell Hill Reservoir	IF the degradation of the joint sealant continues THEN bacteria within the reservoir will become more difficult to control and the reservoir could fail a water quality test and be taken out of service.	2	2	3	2	5	3	5	10	N
SRR26	Victoria Res	IF degradation of Victoria is allowed to continue without mitigation THEN the reservoir could be taken out of service.	2	4	4	4	5	4	5	10	N
SRR438	Almondsbury	Loss of supply to Almondsbury 1A Service Reservoir is Out of Service for Water Quality issues	3	3	3	3	4	4	4	12	N

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score	Risk Confirmed?
SRR439	Almondsbury	Loss of supply to area Almondsbury 1B Service Reservoir is Out of Service for Water Quality issues	3	3	3	3	4	4	4	12	N
SRR442	Blagdon East	Loss of supply to area Blagdon East 1A Service Reservoir is Out of Service for Water Quality issues	3				4		4	12	N
SRR443	Blagdon East	Loss of supply to area Blagdon East 1B Service Reservoir is Out of Service for Water Quality issues	3				4		4	12	N
SRR447	Knowle SR	Loss of supply to area Knowle No 1 Service Reservoir is Out of Service for Water Quality issues	3				4		4	12	N
SRR448	Knowle SR	Loss of supply to area Knowle No 2 Service Reservoir is Out of Service for Water Quality issues	3				4		4	12	N
SRR449	Mast SR	Loss of supply to area Mast 1A. Service Reservoir is Out of Service for Water Quality issues	3				4		4	12	N
SRR450	Mast SR	Loss of supply to area Mast 1B Service Reservoir is Out of Service for Water Quality issues	3				4		4	12	N
SRR451	Pucklechurch SR	Loss of supply to area Pucklechurch A Service Reservoir is Out of Service for Water Quality issues	2	3	3	4	5	5	5	10	N
SRR454	Shipham SR	Loss of supply to area Shipham Service Reservoir is Out of Service for Water Quality issues	3				4		4	12	N

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score	Risk Confirmed?
SRR594	Chase TWR	If the brickwork cladding to Chase reservoir continues to degrade then someone could be injured by falling masonry.	3	4	3	3	3	1	4	12	Y
SRR606	Failand Tower	HSE incident from current location of Internal ladder at Failand Tower TWR	3	4	3	3	3	3	4	12	N
SRR621	Weston Woods Tower	IF deterioration of the (Weston Woods No.3) cast iron columns and steel beams is allowed to continue THEN bacteria within the reservoir will be more difficult to control and the reservoir could fail a water quality test and be taken out of service.	2	2	3	2	5	3	5	10	Y
SRR661	Maesbury Reservoir	Loss of supply to area Maesbury No. 1 B is Out of Service for Water Quality issues	4	2	3	2	2	3	3	12	N
SRR787	All service reservoirs and towers	IF we do not continue inspections of our service reservoirs and towers THEN we will fail to provide our Customers with a Safe and Reliable Supply of water and will be unable to monitor deterioration of our service reservoir and towers.	3	4	2	2	5	3	5	15	Y

7.4 Appendix C2: Non-Selected Risks

This appendix shows the 162 non-selected risks of the 182 relevant risks.

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score
SRR6	Cheddar Cliffs Reservoir	**IF** stagnant water from deadlegs caused by removal of water quality instruments enters supply **THEN** possible customer complaints, taste and odour, and water quality failures.	2	2	1	1	2	2	2	4
SRR7	Rowberrow Hill Reservoir	**IF** stagnant water from deadlegs caused by removal of water quality instruments enters supply **THEN** possible customer complaints, taste and odour, and water quality failures.	2	2	1	1	2	2	2	4
SRR8	Pucklechurch Reservoir	Pucklechurch TWR failing section 10 or section 12 inspection	1	4	4	4	5	5	5	5
SRR9	Brent Knoll Reservoir	UCML from failure of mains feeding Brent Knoll Service Reservoir (Bypass and control)	2	2	1	2	4	4	4	8
SRR12	Cadbury Reservoir	Loss of supply to area Cadbury Camp TWR is Out of Service for Water Quality issues	2	1	2	2	2	3	3	6
SRR13	Highridge PS	Loss of supply to area Highridge No:2 is Out of Service for Water Quality issues	3	2	3	2	2	3	3	9
SRR14	Blackdown Reservoir	Loss of supply to area Blackdown TWR is Out of Service for Water Quality issues	3	2	3	2	2	3	3	9
SRR15	Maesbury Reservoir	Loss of supply to area Maesbury No. 1 A TWR is Out of Service for Water Quality issues	3	2	3	2	2	3	3	9
SRR17	Stanton Wick PS	Loss of supply to area Stanton Wick B TWR is Out of Service for Water Quality issues	2	3	2	2	3	1	3	6
SRR19	Backwell Hill Reservoir	Loss of supply to area Backwell Hill A TWR is Out of Service for Water Quality issues	3	2	3	2	2	3	3	9
SRR20	Hillhouse	Loss of supply to area Hillhouse B TWR is Out of Service for Water Quality issues	3	2	3	2	2	3	3	9
SRR22	Barrow NSS	IF the Barrow treated water reservoir roof leaks in a different area to the patch repairs THEN water quality issues in both compartments	2	4	3	3	2	4	4	8
SRR23	North Wootton Reservoir	Ball Valve sticking at North Wootton TWR which could lead to loss of supply [Reservoir Civils]	2	1	3	2	2	3	3	6
SRR437	Almondsbury	WQ failures from Almondsbury Service Reservoir single inlet/outlet main (DWSP risk)	2	2	2	2	3	4	4	8
SRR440	Backwell Hill	Loss of supply to area Backwell Hill 1A Service Reservoir is Out of Service for Water Quality issues	2	3	3	3	4	3	4	8
SRR441	Backwell Hill	Loss of supply to area Backwell Hill 1B Service Reservoir is Out of Service for Water Quality issues	2				4		4	8
SRR444	Cromhall	Loss of supply to area Cromhall. Service Reservoir is Out of Service for Water Quality issues	2	3	3	3	4	4	4	8
SRR445	Highridge SR	Loss of supply to area Highridge 1 Service Reservoir is Out of Service for Water Quality issues	2	3	3	3	4	4	4	8
SRR446	Highridge SR	Loss of supply to area Highridge 2 Service Reservoir is Out of Service for Water Quality issues	2	3	3	3	4	4	4	8
SRR452	Rhodyate SR	Loss of supply to area Rhodyate A Service Reservoir is Out of Service for water quality issues	2	3	3	3	4	4	4	8
SRR453	Rhodyate SR	Loss of supply to area Rhodyate B Service Reservoir is Out of Service for Water Quality issues	2	3	3	3	4	4	4	8
SRR455	Withywood SR	Loss of supply to area Withywood A Service Reservoir is Out of Service for Water Quality issues	2	3	3	3	4	4	4	8

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score
SRR456	Withywood SR	Loss of supply to area Withywood B Service Reservoir is Out of Service for Water Quality issues	2	3	3	3	4	4	4	8
SRR461	Babdown SR	Loss of supply to area Babdown A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR462	Babdown SR	Loss of supply to area Babdown B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR463	Bagley SR	Loss of supply to area Bagley Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR464	Banwell Treatment Works Clear Water Tanks A	Loss of supply to area Banwell Treatment Works Clear Water Tanks A Service Reservoir is Out of Service for Water Quality issues	3	0	0	0	0	0	0	0
SRR465	Banwell Treatment Works Clear Water Tanks B	Loss of supply to area Banwell Treatment Works Clear Water Tanks B Service Reservoir is Out of Service for Water Quality issues	3	0	0	0	0	0	0	0
SRR466	Barrow Filtered Water Tank -	Loss of supply to area Barrow Filtered Water Tank - Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR467	Beggar Bush A	Loss of supply to area Beggar Bush A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR468	Beggar Bush B	Loss of supply to area Beggar Bush B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR469	Blackdown	Loss of supply to area Blackdown Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR470	Bleadon Service Reservoir	Loss of supply to area Bleadon Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR471	Brean	Loss of supply to area Brean Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR472	Brottens A Service Reservoir	Loss of supply to area Brottens A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR473	Brottens B Service Reservoir	Loss of supply to area Brottens B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR474	Cadbury Camp	Loss of supply to area Cadbury Camp Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR475	Chase A Service Reservoir	Loss of supply to area Chase A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR476	Chase B	Loss of supply to area Chase B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR477	Cheddar Cliffs No 1	Loss of supply to area Cheddar Cliffs No 1 Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR478	Cheddar Cliffs No 2 Service Reservoir	Loss of supply to area Cheddar Cliffs No 2 Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score
SRR479	Cheddar Treatment Works Clear Water 1A Service Reservoir	Loss of supply to area Cheddar Treatment Works Clear Water 1A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR480	Cheddar Treatment Works Clear Water 1B	Loss of supply to area Cheddar Treatment Works Clear Water 1B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR481	Cheddar Treatment Works Clear Water 2A	Loss of supply to area Cheddar Treatment Works Clear Water 2A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR482	Cheddar Treatment Works Clear Water 2B	Loss of supply to area Cheddar Treatment Works Clear Water 2B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR483	Clandown A	Loss of supply to area Clandown A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR484	Clandown B Service Reservoir	Loss of supply to area Clandown B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR485	Clutton A	Loss of supply to area Clutton A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR486	Clutton B	Loss of supply to area Clutton B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR487	Coldharbour	Loss of supply to area Coldharbour Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR488	Compton Road A	Loss of supply to area Compton Road A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR489	Compton Road B	Loss of supply to area Compton Road B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR490	Cottles Lane A (West Pennard)	Loss of supply to area Cottles Lane A (West Pennard) Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR491	Cottles Lane B (West Pennard) Service Reservoir	Loss of supply to area Cottles Lane B (West Pennard) Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR492	Cottles Lane (West Pennard) Inlet Chamber	Loss of supply to area Cottles Lane (West Pennard) Inlet Chamber Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR493	Croscombe A	Loss of supply to area Croscombe A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR494	Croscombe B	Loss of supply to area Croscombe B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR495	Dial Hill A	Loss of supply to area Dial Hill A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score
SRR496	Dial Hill B	Loss of supply to area Dial Hill B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR497	Down Road A	Loss of supply to area Down Road A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR498	Down Road B	Loss of supply to area Down Road B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR499	Draycott A	Loss of supply to area Draycott A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR500	Draycott B	Loss of supply to area Draycott B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR501	Dry Hill A	Loss of supply to area Dry Hill A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR502	Dry Hill B	Loss of supply to area Dry Hill B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR503	Dundry A	Loss of supply to area Dundry A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR504	Dundry B	Loss of supply to area Dundry B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR505	East Pennard A	Loss of supply to area East Pennard A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR506	East Pennard B Service Reservoir	Loss of supply to area East Pennard B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR507	Elderbush Service Reservoir	Loss of supply to area Elderbush Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR508	Failand Tower A	Loss of supply to area Failand Tower A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR509	Failand Tower B	Loss of supply to area Failand Tower B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR510	Frome No 3A	Loss of supply to area Frome No 3A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR511	Frome No 3B	Loss of supply to area Frome No 3B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR512	Hawkesbury Upton No 1	Loss of supply to area Hawkesbury Upton No 1 Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR513	Hawkesbury Upton No 2	Loss of supply to area Hawkesbury Upton No 2 Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR514	Ivythorn A	Loss of supply to area Ivythorn A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR515	Ivythorn B .	Loss of supply to area Ivythorn B Service Reservoir is Out of Service for Water Quality issues.	3	1	1	1	1	1	1	3

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score
SRR516	Leigholt Service Reservoir	Loss of supply to area Leigholt Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR517	Leigh-on-Mendip	Loss of supply to area Leigh-on-Mendip Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR518	Leigh-on-Mendip B	Loss of supply to area Leigh-on-Mendip B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR519	Little Sodbury A	Loss of supply to area Little Sodbury A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR520	Little Sodbury B	Loss of supply to area Little Sodbury B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR521	Little Sodbury Inlet Chamber	Loss of supply to area Little Sodbury Inlet Chamber Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR522	Littleton Treatment Works Clear Water Tank A & B	Loss of supply to area Littleton Treatment Works Clear Water Tank A & B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR523	Marshfield A	Loss of supply to area Marshfield A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR524	Marshfield B	Loss of supply to area Marshfield B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR525	Milbury Heath Tower	Loss of supply to area Milbury Heath Tower Service Reservoir is Out of Service for water quality issues	3	1	1	1	1	1	1	3
SRR526	Millmarsh Break Pressure Tank	Loss of supply to area Millmarsh Break Pressure Tank Service Reservoir is Out of Service for Water Quality issues	0	0	0	0	0	0	0	0
SRR527	Milton Clevedon No 2A	Loss of supply to area Milton Clevedon No 2A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR528	Milton Lane No 3 A	Loss of supply to area Milton Lane No 3 A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR529	Unable to supply area Milton Lane No 3 B	Unable to supply area Milton Lane No 3 B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR530	Montpelier No 2	Loss of supply to area Montpelier No 2 Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR531	Norton St. Philip A	Loss of supply to area Norton St. Philip A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR532	Norton St. Philip B	Loss of supply to area Norton St. Philip B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR533	Oldford A	Loss of supply to area Oldford A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR534	Oldford B	Loss of supply to area Oldford B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score
SRR535	Oldmixon A	Loss of supply to area Oldmixon A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR536	Oldmixon B	Loss of supply to area Oldmixon B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR537	Page Lane A (West Pennard)	Loss of supply to area Page Lane A (West Pennard) Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR538	Page Lane B (West Pennard)	Loss of supply to area Page Lane B (West Pennard) Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR539	Paulton A	Loss of supply to area Paulton A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR540	Paulton B	Loss of supply to area Paulton B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR541	Peasedown St. John A	Loss of supply to area Peasedown St. John A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR542	Peasedown St. John B	Loss of supply to area Peasedown St. John B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR543	Pucklechurch B	Loss of supply to area Pucklechurch B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR544	Purton Clear Water Tank A	Loss of supply to area Purton Clear Water Tank A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR545	Purton Clear Water Tank B	Loss of supply to area Purton Clear Water Tank B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR546	Purton High Lift Pump Sump A	Loss of supply to area Purton High Lift Pump Sump A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR547	Purton High Lift Pump Sump B	Loss of supply to area Purton High Lift Pump Sump B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR548	Rocks Lane A	Loss of supply to area Rocks Lane A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR549	Rocks Lane B	Loss of supply to area Rocks Lane B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR550	Rowberrow Clear Water Tank A	Loss of supply to area Rowberrow Clear Water Tank A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR551	Rowberrow Clear Water Tank B	Loss of supply to area Rowberrow Clear Water Tank B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR552	Rowberrow Hill A	Loss of supply to area Rowberrow Hill A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR553	Rowberrow Hill B	Loss of supply to area Rowberrow Hill B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR554	Shipton Moyne Filtered Water A & B	Loss of supply to area Shipton Moyne Filtered Water A & B Service Reservoir is Out of Service for water quality issues	3	1	1	1	1	1	1	3

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score
SRR555	Sperrings Green A	Loss of supply to area Sperrings Green A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR556	Sperrings Green B	Loss of supply to area Sperrings Green B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR557	Stanton Wick A	Loss of supply to area Stanton Wick A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR558	Stanton Wick B	Loss of supply to area Stanton Wick B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR559	Stowey Clear Water Tank	Loss of supply to area Stowey Clear Water Tank Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR560	Tenacre Service Reservoir	Loss of supply to area Tenacre Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR561	Tetbury Tower	Loss of supply to area Tetbury Tower Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	2	2	6
SRR562	Timsbury No 1	Loss of supply to area Timsbury No 1 Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR563	Timsbury No 2 A	Loss of supply to area Timsbury No 2 A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR564	Timsbury No 2 B	Loss of supply to area Timsbury No 2 B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR565	Tor Hill A	Loss of supply to area Tor Hill A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR566	Tor Hill B	Loss of supply to area Tor Hill B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR567	Tresham	Loss of supply to area Tresham Service Reservoir is Out of Service for Water Quality issues	3	2	2	2	2	2	2	6
SRR568	West Hill	Loss of supply to area West Hill Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR569	Westcombe A	Loss of supply to area Westcombe A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR570	Westcombe B	Loss of supply to area Westcombe B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR571	Weston Woods Tower	Loss of supply to area Weston Woods Tower Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR572	Windmill Hill A	Loss of supply to area Windmill Hill A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR573	Windmill Hill B	Loss of supply to area Windmill Hill B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR574	Winscombe Hill A	Loss of supply to area Winscombe Hill A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score
SRR575	Winscombe Hill B	Loss of supply to area Winscombe Hill B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR576	Worle A	Loss of supply to area Worle A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR577	Worle B	Loss of supply to area Worle B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR578	Yarley	Loss of supply to area Yarley Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR579	Almondsbury A	Loss of supply to area Almondsbury A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR580	Almondsbury B	Loss of supply to area Almondsbury B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR581	Blagdon East A	Loss of supply to area Blagdon East A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR582	Blagdon East B	Loss of supply to area Blagdon East B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR583	Mast A	Loss of supply to area Mast A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR584	Mast B	Loss of supply to area Mast B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR585	Pucklechurch A	Loss of supply to area Pucklechurch A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR586	Rhodyate A	Loss of supply to area Rhodyate A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR587	Rhodyate B	Loss of supply to area Rhodyate B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR588	Shipham	Loss of supply to area Shipham Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR589	Withywood A	Loss of supply to area Withywood A Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR590	Withywood B	Loss of supply to area Withywood B Service Reservoir is Out of Service for Water Quality issues	3	1	1	1	1	1	1	3
SRR592	Pucklechurch TWR	Loss of supply to area Pucklechurch B TWR is Out of Service for Water Quality issues	2	3	4	3	4	4	4	8
SRR593	Pucklechurch TWR	Loss of supply to area Pucklechurch A TWR is Out of Service for Water Quality issues	2	3	4	3	4	4	4	8
SRR595	Failand Tower	Loss of supply to area Failand Tower A is Out of Service for Water Quality issues	2	2	3	2	4	3	4	8
SRR596	Failand Tower	Loss of supply to area Failand Tower B is Out of Service for Water Quality issues	2	2	3	2	4	3	4	8
SRR601	Montpelier TWR	WQ failures if isolating valve fails to abandoned Montpellier Service Reservoir	1	3	3	3	5	3	5	5
SRR602	Horfield TWR	Horfield TWR abandoned structure isolating valve failure causing UCML and WQ [Abandoned Structure]	1	3	3	3	5	3	5	5

SRR ID	Location/Zone	Revised Risk Description	Likelihood	Human Health / Environment	Ease to Resolve	Publicity & Reputation	Regulatory Impacts	Customers Impacted	Max Impact	Risk Score
SRR603	Shirehampton PS	Shirehampton PS abandoned structure isolating valve failure causing UCML and WQ [Abandoned Structure]	1	3	3	3	5	3	5	5
SRR607	Knowle TWR	Risk of Knowle Water Tower roof falling off in high winds and causing harm and damage	4						0	0
SRR620	Durdham Down Tower	Loss of supply and pollution of supply (water quality) through structural deterioration of Durdham Down Tower	4						0	0

7.5 Appendix D: Options Considered

This appendix shows the 7 options considered from the 3 confirmed risks.

Strategic Risk Register (SRR) Reference	SRR Revised Risk Description	Risk Need		Identification & Viability of Options		
		SRR Need ID	Need Description (from SRR)	Proposed Option Name	Proposed Option Description	Option Viability?
SRR594	If the brickwork cladding to Chase reservoir continues to degrade then someone could be injured by falling masonry.	SRRN13	The brickwork cladding to Chase reservoir is degrading. Some localised repairs have been undertaken and this has revealed the brickwork to be poorly laid with the frogs down. This creates air gaps in the brickwork and makes it susceptible to frost damage. The deterioration may lead to masonry falling from the wall. Investment is required to make the site safe and to:	Business as Usual	Fixing wall defects as and when they occur. This will progressively worse and more expensive.	This is not acceptable as the risk of injuring someone remains and is not mitigated.
			- meet obligations under the Health and Safety at Work Act 1974 and the Corporate Manslaughter and Corporate Homicide Act 2007;	Replace entire cladding wall	Remove existing cladding wall (total length 168m and height 3m). Replace existing wall with new cladding (either brickwork or other).	This is an acceptable solution.
			- avoid liability and reputational damage in the event of accident or injury resulting from an unsafe asset.	Remove cladding	Remove existing cladding wall (total length 168m and height 3m). Make good exposed concrete surface.	This may not be an acceptable solution because it may be a planning condition that the structure is clad. Structurally and functionally this is an acceptable solution.
				Repair only the most worst sections of wall	Localised removal and rebuild of brickwork	The problems seem to arise from brickwork laid with frogs down. This creates air pockets in the brickwork making it susceptible to frost damage. Localised repair only solves the problem in the short term.
SRR621	IF deterioration of the (Weston Woods No.3) cast iron columns and steel beams is allowed to continue THEN bacteria within the reservoir will be more difficult to control and the reservoir could fail a water quality test and be taken out of service.	SRRN45	The cast iron columns and roof beams at Weston Woods No.3 reservoir are corroding. Investment is needed to grit blast and paint the columns and beams to extend the life of these assets. A timely intervention now will avoid the need for a significantly greater intervention in the future.	Do nothing	Do nothing	Yes viable option
				Grit blast and paint columns and beams	Grit blast and epoxy paint 8" x 4" steel RSJ roof beams of reservoir - total length 100m. Grit blast and epoxy paint 10 no 7" diameter cast iron columns each 5.3m high.	Yes viable option
SRR787	IF we do not continue inspections of our service reservoirs and towers THEN we will fail to provide our Customers with a Safe and Reliable Supply of water and will be unable to monitor deterioration of our service reservoir and towers.	SRRN234	We have 158 service reservoir compartments and 5 water towers. Inspections and testing of these are carried out on a risk based approach. This ensures that the reservoirs are safe for our Customers and ensure our Customers receive a reliable and resilient supply. Investment is needed to continue this rolling programme of inspection and testing on a risk based approach.	Service Reservoir Inspections	Inspection and testing of all service reservoirs and towers	Yes viable option

7.6 Appendix E: Interventions Developed

This appendix shows the 3 interventions developed from the 7 options

Strategic Risk Register (SRR) Reference	SRR Revised Risk Description	Risk Need		Identification & Viability of Options			Proposed Interventions		Costs		Benefits
		SRR Need ID	Need Description (from SRR)	Proposed Option Name	Proposed Option Description	Option Viability?	Ref. No.	Intervention Title	Capex After (£)	Change in Opex (£)	Other monetised benefits
SRR594	If the brickwork cladding to Chase reservoir continues to degrade then someone could be injured by falling masonry.	SRRN13	The brickwork cladding to Chase reservoir is degrading. Some localised repairs have been undertaken and this has revealed the brickwork to be poorly laid with the frogs down. This creates air gaps in the brickwork and makes it susceptible to frost damage. The deterioration may lead to masonry falling from the wall. Investment is required to make the site safe and to: - meet obligations under the Health and Safety at Work Act 1974 and the Corporate Manslaughter and Corporate Homicide Act 2007; - avoid liability and reputational damage in the event of accident or injury resulting from an unsafe asset.	Replace entire cladding wall	Remove existing cladding wall (total length 168m and height 3m). Replace existing wall with new cladding (either brickwork or other).	This is an acceptable solution.	03.002.01	Chase Reservoir	£116,777	0.000	0.353
SRR621	IF deterioration of the (Weston Woods No.3) cast iron columns and steel beams is allowed to continue THEN bacteria within the reservoir will be more difficult to control and the reservoir could fail a water quality test and be taken out of service.	SRRN45	The cast iron columns and roof beams at Weston Woods No.3 reservoir are corroding. Investment is needed to grit blast and paint the columns and beams to extend the life of these assets. A timely intervention now will avoid the need for a significantly greater intervention in the future.	Grit blast and paint columns and beams	Grit blast and epoxy paint 8" x 4" steel RSJ roof beams of reservoir - total length 100m. Grit blast and epoxy paint 10 no 7" diameter cast iron columns each 5.3m high.	Yes viable option	03.002.02	Weston Woods No3 reservoir	£27,124	0.000	0.000
SRR787	IF we do not continue inspections of our service reservoirs and towers THEN we will fail to provide our Customers with a Safe and Reliable Supply of water and will be unable to monitor deterioration of our service reservoir and towers.	SRRN234	We have 158 service reservoir compartments and 5 water towers. Inspections and testing of these are carried out on a risk based approach. This ensures that the reservoirs are safe for our Customers and ensure our Customers receive a reliable and resilient supply. Investment is needed to continue this rolling programme of inspection and testing on a risk based approach.	Service Reservoir Inspections	Inspection and testing of all service reservoirs and towers	Yes viable option	03.003.01	Service Reservoir Inspections	£2,075,000	0.000	0.000

7.7 Appendix F: Non-Selected Interventions

This appendix shows the 2 non-selected interventions. See appendix D for costs or performance commitments.

Ref. No.	Intervention Title	Expected Capex after (£)	Change in Opex (£)	Residual Risk
03.002.01	Chase Reservoir	£116,766	£0	If the brickwork cladding to Chase reservoir continues to degrade then someone could be injured by falling masonry.
03.002.02	Weston Woods No3 reservoir	£27,123	£0	IF deterioration of the (Weston Woods No.3) cast iron columns and steel beams is allowed to continue THEN bacteria within the reservoir will be more difficult to control and the reservoir could fail a water quality test and be taken out of service.