Appendix 4.1.C – Stantec review of supply interruptions reduction programme

Wessex Water

September 2018

Wessex Water
YTL GROUP

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Stantec

A review of reduction to supply interruptions

Independent review of Wessex Water's proposed approach to reducing Supply Interruptions

February 26, 2018

Prepared for:

Wessex Water

Prepared by:

Neil Croxton

Revision	Description	Author		Quality Check		Independent Review	
V01	Supply review	Neil Croxton					

Sign-off Sheet

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Executive Summary

This report provides an independent review of Wessex Water's IMT briefing paper on reducing supply interruptions and provides an external view on the strategic question '*Can Wessex Water achieve a customer minute lost target of 2-3 minutes by 2025*?' The review involved assessing key information and data sources to ensure that the proposed options are robust and auditable, in terms of both costs and benefits. A number of recommendations have been made in relation to the sample set of incidents reviewed to determine the project benefits and how this impacts on the level of confidence associated with the benefits presented. A confidence grade has been applied to each option based upon the reliability and accuracy of the data used.

A gap analysis has been undertaken to identify additional options for water distribution management that Wessex Water may wish to consider as part of its wider network strategy. A key component of this review is focused upon the recommendation that seeks to make use of digital data and operational technology to enable Wessex Water to move from a reactive to a more proactive state for future operations.

Although this review has put forward a number of recommendations to improve the confidence grade for each option, the necessity of the review and the availability of robust and accurate accounts of past events greater than 12 months old means that the data provided, technical judgement and industry experience have been used to put forward an informed view on the likely reduction in minute lost achievable through the development of the proposed options. From this review, and taking into account the need to address the enablers identified, it is suggested that the adjusted mid forecast presented in table 1 be used as the most likely potential savings in minutes lost. This is based upon the data provided from the past 15 key events in 2017/18 and technical judgement and experience. Table 1 indicates that the adjusted mid forecast results in a predicted reduction of 2 minutes and 15 seconds and a forecast of 00:06:45 supply interruptions for an investment of £2.4m/y.

Table 1 : Adjusted IMT breifing paper estimated time saving and costs.

	Time Saving			Annual Cost £m/yr			Cumulative Time Saving			Cumulative Totex	Forecast		
	Low	Mid	High	Opex	Capex	Totex	Low	Mid	High	£m/yr	Pessimistic	Mid	Optimistic
Assumed start point 2019/20										0	00:10:00	00:09:00	00:08:00
Always on controller	00:00:30	00:01:00	00:01:20	0.4	0	0.4	00:00:30	00:01:00	00:01:20	0.4	00:09:30	00:08:00	00:06:40
Real time data & knowledge management	00:00:30	00:00:30	00:01:15	0	0.4	0.4	00:01:00	00:01:30	00:02:35	0.8	00:09:00	00:07:30	00:05:25
Increased equipment	00:00:15	00:00:15	00:00:45	0.2	0.1	0.3	00:01:15	00:01:45	00:03:20	1.1	00:08:45	00:07:15	00:04:40
Increased standby	00:00:00	00:00:00	00:00:20	0.2	0	0.2	00:01:15	00:01:45	00:03:40	1.3	00:08:45	00:07:15	00:04:20
Network Infusions	00:00:10	00:00:20	00:00:30	0.2	0.3	0.5	00:01:25	00:02:05	00:04:10	1.8	00:08:35	00:06:55	00:03:50
Innovation fund	00:00:00	00:00:10	00:00:20	0.2	0.3	0.5	00:01:25	00:02:15	00:04:30	2.3	00:08:35	00:06:45	00:03:30
Improved interconnection - study only	00:00:00	00:00:00	00:00:00	0	0.1	0.1	00:01:25	00:02:15	00:04:30	2.4	00:08:35	00:06:45	00:03:30

However, the review has also identifed other potential technologies and tools that could be used by Wessex Water to further support their drive for reducing supply interruptions, which have not been detailed in the IMT briefing paper. Based upon experience with other UK water companies, the use of network modelling as an operational support tool has identified a potential reduction in minutes lost due to supply interruptions of around 22%. This operational modelling is focused upon post event recovery, mobile tanker deployment and rezone assessments. This reduction was estimated through the use of a similar approach as undertaken by Wessex Water for quantifying the benefits of real time data i.e. the re-engineering of past events. Given that the 22% reduction is from a company with greater urbanisation a more pessimistic forecast or 15% has been suggested.

As well as event support, a 14% reduction has been noted when models are used to fully validate supply interruptions in term of the number of customers impacted and their outage duration using more accurate modelling methodologies. In simplistic terms, the use of pressure and elevation contours does not allow for pipes

acting as network storage facilities during a supply interruption. The water available within the system during an interruption and subsequent drain-down will provide a number of customers with water for a greater period than is calculated using pressure data only.

If these two savings could be achieved at Wessex Water the use of drain down modelling could potentially save a further 1 minute 15 seconds and achieve a forecast of total minute loss of 00:04:50. Whilst the use of operational modelling to manage events could potentially save a further 1 minute 20 seconds, bringing the adjusted mid forecast estimate down to 00:04:10. These estimates are based on a UK water company with similar performance levels to Wessex Water in terms of supply interruptions, however population density is greater, and therefore the potential savings may vary.

Whilst a recommendation of this review is the assessment of the existing modelling maturity across Wessex Water to understand the potential costs and benefits associated with operational modelling, an indicative figure of £1.5 - 2 million has been proposed to better integrate existing models to other corporate data sets, live SCADA and GRPS data feeds. This figure is dependent upon the amount of system integration required to ensure that existing hydraulic models accurately reflect the water network and its performance. These potential additional reductions and costs are presented in table 2.

Table 2 : Impact of proposed additional strategic options on the IMT briefing note adjusted mid forecast

	Time saving	Annual Cost £m/yr			Cumulative Time Saving	Cumulative Totex	Forecast
	Mid	Opex	Capex	Totex	Mid	£m/yr	Mid
					Assumed start point 2019/20	0	00:09:00
Always on controller	00:01:00	0.4	0	0.4	00:01:00	0.4	00:08:00
Real time data & knowledge management	00:00:30	0	0.4	0.4	00:01:30	0.8	00:07:30
Increased equipment	00:00:15	0.2	0.1	0.3	00:01:45	1.1	00:07:15
Increased standby	00:00:00	0.2	0	0.2	00:01:45	1.3	00:07:15
Network Infusions	00:00:20	0.2	0.3	0.5	00:02:05	1.8	00:06:55
Innovation fund	00:00:10	0.2	0.3	0.5	00:02:15	2.3	00:06:45
Improved interconnection - study only	00:00:00	0	0.1	0.1	00:02:15	2.4	00:06:45
Operational modelling	00:01:20	0.2	0.2	0.4	00:03:35	2.8	00:05:25
Drain down analysis (2FTE's)	00:01:15	0.1	0	0.1	00:04:50	2.9	00:04:10

Section 3 of this report highlights the enabling activities required to achieving these mid forecast estimates with regards to reducing minutes lost, and will need further exploration as the reduction strategies are developed. The majority of the enablers relate to the degree of business transformation required to achieve success as a result of the options put forward. Given that the strategic options with the most savings are predominantly IT focused a Five Levels of IT and Business Transformation model has been used to identify key enablers.

These enablers have been grouped into the following five areas;

People change – wholesale changes will be required to staff roles, responsibilities and activities undertaken by network personnel in order to achieve the 2-3 minute supply interruption target. This may require some early Union engagement in order to build support for the need to change and will cross current organisational boundaries. A clear future target operating model should be defined as early as possible to ensure the core propose of the water distribution operations team is understood and developed with key operational personnel.

Costs - There are no costs in the briefing note for a data analytics platform, which will be required to develop the knowledge management and real time data proposal. The total costs associated with the knowledge

management option could increase by £1 to 2 million over the AMP, depending upon Wessex Water's event prediction and management requirements.

Benefits uncertainty – due to the unplanned nature of supply interruption events, it is difficult to forecast with accuracy the reduction in supply interruptions as a result of integrating new systems, equipment of technology. A number of recommendations have suggested further root cause analysis to determine if past performance could have been improved using the proposed options, however this approach is hindered by the availability of clear and concise event data for incidents greater than 12 months old.

Technology integration – the integration of new and existing technology carries a number of risks with regards to achieving performance improvements. Past experience of IT projects within the Water Industry and further afield have illustrated the difficulty with implementing new IT systems in terms of achieving the benefits originally estimated, delivering to key milestones and within budget. This does not mean that advances in technology cannot assist Wessex Water in its approach to meeting a 2-3 minutes target, but the constraints associated with new IT projects should not be underestimated and this drive for change will require support and buy-in at executive level.

Scale of change – the proposed performance commitment will require a stepped change across Wessex Water in terms of dealing with interruptions to supply. Whilst the year on year past performance of Wessex Water would suggest that further reductions in minutes lost could be achieved through sustained incremental changes, the majority of improvements in past performance have been through the better management of planned interruptions via enhanced processes and training and through a change in reporting methodology, which resulted in a reduction in the number of minutes lost over the past several years.

It is recommended that the options put forward in the briefing paper are prioritised and developed in the following implementation order;

1. Set a clear operational technology strategy aligned to the corporate long term vision.
2. Tankering support enhancements (network infusion).
3. Roll out increased equipment.
4. Develop real time data & knowledge management
5. Develop operational modelling requirements
6. Embed lessons learnt and drain down analysis
7. Implement Always on controller in line with the Network Operations Target Operating Model (TOM)
8. Increase standby coverage in line with the TOM

The co-dependencies that existing between Always on controller, Real time data & knowledge management and Increased standby means that the sequencing of delivery is key as benefits cannot be realised through the delivery of just one of these initiatives.

1.0 SCOPE OF REVIEW

The agreed scope of this report is to undertake an independent review of Wessex Water's proposed approach to reducing supply interruptions during AMP 7, in line with Ofwat's methodology and Wessex Water's strategic vision to be the best WaSC in the UK. The review will assess the approach taken by Wessex Water as documented in the IMT Briefing note – Supply Interruptions (Jan 18), along with the supporting information provided. The approach taken, the reduction strategies proposed, the cost and benefits detailed and the recommendations given are to be challenged and reviewed against other known technical approaches undertaken independently to Wessex Water.

The review will identify the key risks associated with the assumptions put forward in the briefing note and put forward recommendations that could further enhance Wessex Water's confidence in how they are to address the performance gap for supply interruptions to achieve upper quartile performance. This improved performance will require a reduction in supply interruptions from the expected outturn value of 15 minutes in 2017/18 to 2 - 3 minutes by 2025, as per the view from Frontier Economics with regards to upper quartile performance.

2.0 REVIEW OF THE STRATEGIC APPROACH

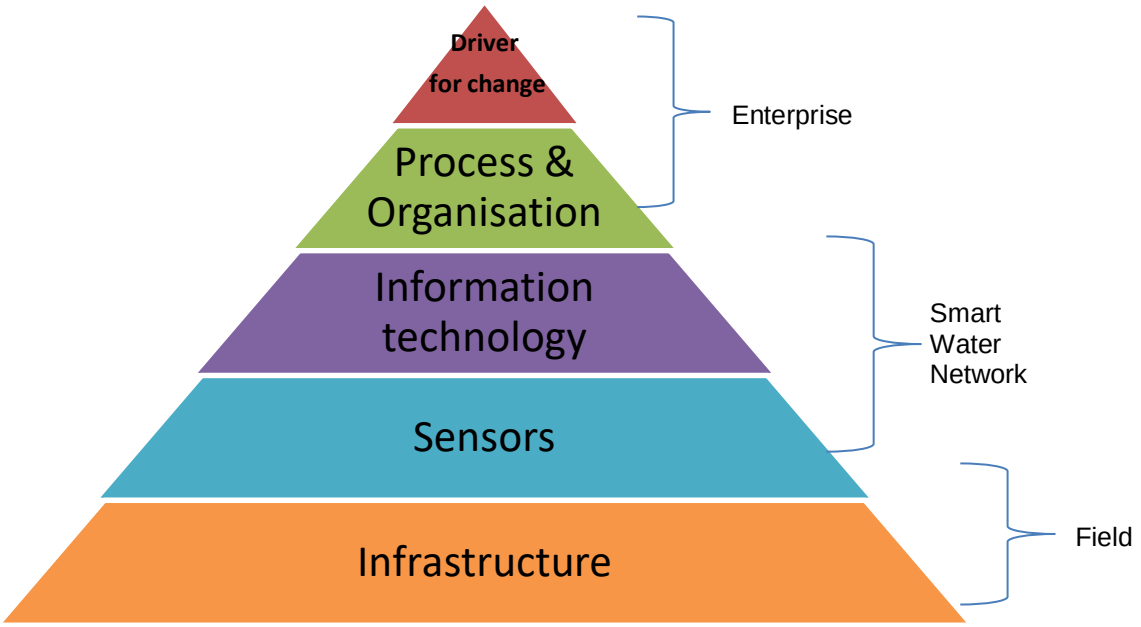
The IMT Briefing note on supply interruptions provides a list of several operational options that have been put forward to achieve a target of 2-3 minutes by 2025. Wessex Water have successfully managed to reduce their reported supply interruptions significantly over the past seven years, however this reduction has been largely due to increased operational focus on planned events as well as a reduction in minutes lost due to a change in the reporting methodology used. Once planned interruptions have been zeroed it is the reduction and response to unplanned supply interruptions that will prove more difficult to address due to their unpredictability. This is further enhanced by Wessex Water having the most dispersed population based upon pipe length, posing additional challenges when identifying and responding to supply interruptions.

The options put forward in the IMT briefing paper are very heavily reliant upon the enhanced use of both Information Technology (IT) and Operational Technology (OT) across the Wessex Water distribution network. It is clear from across the industry that there is no single technology available that would enable the identification and response to supply interruptions that could be integrated into Wessex Water to deliver minutes lost as low as 2 minutes, even with significant additional logger coverage and additional staff. However, improvements can be achieved through the combination of IT, OT and business process re-design.

There is a general trend across the utility industry that puts forward the proposed benefits of a digital water utility. This includes the deployment of sensors and use of digital platforms to enhance customer service and leverage the benefits from the every changing Industrial Internet of Things. This should be considered when developing the wider water network strategy, as setting the level of maturity the organisation seeks to achieve in operational technology can support its strategic vision.

The proposed elements that should be considered as part of a wider water network management strategy and operating model are illustrated in figure 1;

Figure 1: Water Network Management architecture



The above architecture highlights the need for combining business knowledge and technology, as well as setting the organisations operating model to ensure that the human element is full embraced in the change. The leadership and support for the need to change can be as important as the proposed integration of new technologies. The key components that should be considered as part of the general strategic approach described in the IMT briefing note are as follows;

- The drive for change needs to be set at executive level and a favorable environment set up to drive interruption reductions.
- Existing processes and organisational structure reviewed to ensure that existing processes and inter-departmental relationships are aligned to delivering the required improvement.
- IT – The acquisition of the hardware, software and services that enable the digitization process to take hold need considering so that analysis of the new, larger volumes of data is achievable.
- Sensors – the number, location and accuracy of devices need to be considered in line with business requirements.
- Infrastructure – The ongoing design and maintenance of the network is key for its effective management. The approach to maintenance, whether it is fix on fail, condition based monitoring or routine maintenance, should be clearly defined and in support of the reduction in interruptions to supply.

3.0 DETAILED REVIEW OF PROPOSED REDUCTION STRATEGIES

For this review Wessex Water provided the document *Briefing note – supply Interruptions, January 18* (see appendix A). This document provides a high level summary of the proposed reduction options put forward for investment and an estimate of the potential reductions in minutes lost each option could contribute. The nature of supply interruptions means that the intervention leading to an interruption to supply can be attributed to either a planned network intervention or an unplanned event such as mains bursts, which occur unexpectedly and can potentially impact any of the 1.3 million Wessex Water customers.

One of the overarching assumptions made in the briefing note is that planned interruptions can be successfully managed to achieve a target of zero minutes lost through enhanced internal processes and training. Whilst every incident listed in appendix A has not had a full root cause analysis undertaken as part of this review, a sample of those incidents identified and classified in the briefing note as either planned or unplanned have been assessed and their classification confirmed using the data provided i.e. DG3 reports. The review assessed the type of incident attributed to the following planned interruptions SIL No 43949, 42686 and unplanned incidents SIL No. 43926, 41680, 41473. This review confirmed that from the data provided the classification of planned and unplanned events were correctly attributed to the incidents reviewed.

The percentage of planned significant incidents in 2016/17 is around 4.5% of the total minutes lost as detailed in appendix 1. This low percentage is favorable when compared with a study undertaken for another UK Water Company in which the root cause analysis of incidents throughout 2015/16 identified that 26% of incidents occurred due to planned works. This would indicate that the assumption that business as usual activities such as continued staff training, development and planning could enable Wessex Water to achieve near zero planned interruptions to supply.

detailed Review of proposed reduction strategies

3.1.1 Always on' controller

This option focuses upon enhancing the distribution inspector's ability to undertake network interventions which are pre-determined and optimised via a central resource, whilst the inspector is on route to the event. This central resource will, through the review and determining of rezones options, provide customer support and act as the incident manager, both in and out of core hours.

The general concept of providing an integrated control approach to incident and event management can enhance performance numbers in multiple areas. These include the improved speed of response, as the central resource can start to understand the magnitude and potential impact of an event whilst the controller is driving to the event. This can improve response and recovery time, as the central resource should have access to supporting systems and tools such as GIS and network connectivity plans, providing guidance to the Distribution Inspector on-site.

3.1.1.1 Cost and Benefits

The briefing paper states the following range of benefits;

MINUTE LOSE REDUCTION

LOW	MID	HIGH
00:00:30	00:01:00	00:01:20

The above values have been determined from a retrospective review of all reportable incidents that have occurred from April 17 to Nov 17. The root cause of these events have been identified and an assessment made of the duration of the outage that could have been avoided if the proposed option was available and had been applied during the incident. This re-engineering of events to assess any potential reduction is a sound approach when attempting to assess the benefits of potential options.

Three events from April to Nov 17 have been identified as those that would have benefited from the option of Always on controller. These 3 incidents (SIL no **41634, 43929** and **45218)** were reviewed by Wessex Water and a potential saving of 1 minute has been identified. This review of the three incidents identified a common trend of how a central resource could have been used to reduce the supply interruption through rezones, better planning or obtaining approvals earlier. To further substantiate the 1 minute reduction proposed in the briefing paper the events reviewed to determine the benefits of the Controller always on option have been assessed.

It has been identified that SIL 41634 could have been avoided through rezoning and providing alternative supplies into the area. The duration for this rezone is likely to have been less than 3 hours and therefore saving around 31 seconds of time added to the interruptions to supply total. By having a central resource with access to planned rezones and network models this review would support the claim that the duration of this incident could have been reduced, further supporting the need.

Event 43949 which added 8 seconds was a planned activity and could have been kept below three hours through mains flushing and quicker recharge, this activity could have been supported from a central resource and ensured better focus on restoring supplies in less than 3 hours.

Event 45218 was an unplanned event and could have been reduced in duration if a central resource had an overview of planned flushing activities that resulted in a delayed response to a pressure decrease in a DMA. The central resource would require access to planned network interventions, but could have deployed resources earlier as there was an assumption made that the change observed in network pressures was the result of a planned flush, rather than actual burst which had occurred and eventually resulted in a supply interruption.

From the review of the DG3 data and reports associated with the three events it is clear that the use of a central resource to support interruptions to supply, both in-terms of burst/event identification and technical support to minimise duration, would have provided savings based upon the significant events of 2017/18. However, for these benefit to be realised at the identified cost it has been **assumed that tools such as connectivity plans, GIS and network models are available to the centralised resource** in order to determine the correct network intervention that would minimise further impacts.

The annual opex cost of £0.4m/year stated in the briefing note covers the operating costs of 6 staff undertaking shifts and is deemed robust so long as the above tools and systems are made available to the central resource without additional spend.

Recommendation: To further support the assumption that interventions can provide the benefits detailed in the briefing note, a large sample of events should be reviewed to provide a more representative sample for future forecasting.

The general concept of providing an integrated control approach to incident and event management can enhance performance when managing supply interruptions. These enhancements include the speed of response, as the central resource can start to immediately understand the magnitude and potential impact of an event earlier than a Distribution Inspector arriving on-site and reviewing the situation. Another benefit of a centralised event management approach is the ability for the central resource to access key network data in near real time to ensure that the network interventions undertaken by field staff are done so in a timely and informed manner, enabling quicker resolution to supply interruptions without further detriment to other customers or water quality. The centralisation strategy also has the potential to provide an enhanced customer journey if the correct systems and tools are made available to the central resource. By managing an event centrally customers can be informed of progress made to resolve an issue and present Wessex Water with a vehicle by which they can communicate with potentially impacted customers in order to avoid unwanted contacts. The realisation of these benefits is only achievable if the correct systems, process and tools are available to the centralised team.

Recommendation: Undertake a 6 month trail in one the three regions to determine any further work required to develop existing processes, tools, staff training and capabilities to achieve the minutes lost detailed in the briefing note.

Confidence Grade = C5 (see definition in appendix B)

Grade C5 has been applied to this option due to the small sample set used and its extrapolation to provide estimated benefits.

3.1.2 Real time data & knowledge management

The real time data and knowledge option, put forward in the briefing note, involves deploying additional 15 minute Cello loggers that will provide pressure data for 100% of Wessex Water's control zones. The fundamental benefit of this additional infrastructure is that it will provide Wessex Water with a rich data stream so that the identification and management of supply events can be more effective, as well as assisting in understanding the

number of customers impacted and event duration. A **key assumption for this options is that Wessex Water will have a suitable analytics platform in place to receive this 15 minute data to ensure it is converted into useable information that will enable the effective management of the water distribution system.**

3.1.2.1 Costs and benefits

The briefing paper states the following ranges of benefits;

MINUTE LOSE REDUCTION

LOW	MID	HIGH
00:00:30	00:00:45	00:01:20

As with the proposed Always on' controller option, the above values have been determined from a retrospective review of all notable supply interruption incidents that have occurred from April 17 to Nov 17. The incidents identified by Wessex Water as potentially benefiting from Real time data and knowledge management are SIL no. 41520 and 41680. Wessex Water identified a potential reduction of 20 seconds if real time data and knowledge had been available during these two incidents.

To provide reassurance around the benefits stated in the briefing note the DG3 reports for both these incidents have been reviewed. SIL 41680 was as an unplanned interruption to supply that resulting from a mains burst. Pressure data identified a significant reduction in pressure within the area, which if alarmed would have potentially reduced the impact of this supply interruption by 3 hours and 30 minutes, saving over 14 seconds. A review of event SIL 41520 indicates that pressure and flow changes occurred 2 hours prior to the first customer contact, indicating that had the burst which caused the interruption to supply been identified using real time data then the event could have been manage to below the 3 hour mark. Having reviewed the DG3 report this assessment of reduction to minutes lost can be substantiated but again this is reliant on analytics platform providing an alarm which is then acted upon promptly. These reductions have then been extrapolated to provide the values presented under the low, mid and high reduction estimates. Given that the 20 second reduction has been estimated on 8 months of 2017/18 events data the extrapolation of this reduction would indicate that for 2017/18 the likely reduction is a further 10 seconds, aligning to the low estimate. This value has been presented at the most likely that is achievable given the analysis undertaken as part of the briefing note.

Recommendation: It is recommended that the sample of incidents reviewed is increased to further substantiate the benefits associated with enhance real-time data and knowledge

A key assumption to the successful reduction in minutes lost for the investment is the availability of a suitable analytics tool within Wessex Water. This tool will be required to analyse and provide insights from this new data stream and for which the briefing paper does not include any additional costs. For comparison purposes only, similar network management platforms such as Netbase, Takadu and i2O can carry a software and implementation cost of circa £2million, with a typical maintenance cost of 15% p.a.

Recommendation: If not already available in Wessex Water, the briefing paper should include the potential costs of an analytic platform required to process the new data streams to support the central resource and enable Wessex Water to move to a proactive approach to managing network interventions.

detailed Review of proposed reduction strategies

Confidence Grade = C5

Grade C5 due to the small sample data set used and its extrapolation to provide benefits.

3.1.3 Increased equipment

This option involves the purchasing of additional equipment to maintain and restore customer supplies as quickly as possible. This covers additional equipment to supplement the current use of hydrant wizard and line stopping equipment at Wessex Water.

3.1.3.1 Costs and benefits

The briefing paper states the following range of benefits;

MINUTE LOSE REDUCTION

LOW	MID	HIGH
00:00:15	00:00:30	00:00:45

The benefits associated with this additional equipment have been determined by Wessex Water through the use of engineering judgement and not through a retrospective review of past events.

In order to put the above minute lose reduction into context, the average shut off duration from the significant incidents for 2016/17 has been calculated as around 6hrs 30 minutes, based upon data from the 15 incidents of referenced in appendix A. These 15 incidents impacted, on average, 817 properties and in terms of supply interruptions this would equate to an average event adding circa 32 seconds to the total supply interruption figure. Whilst the use of average values is not the most accurate assessment of minutes lost, due to the degree of variability in the number of properties impacted and length of duration, it does provide an indication that the above pessimistic value of 15 seconds would require a reduction in duration of around 47%, or 3 hours. This high level assessment brings into question the mid and optimistic values put forward in the briefing note.

Recommendation: It is recommended that the sample of incidents reviewed is increased to the last three years in order to further substantiate the benefits associated with purchasing additional equipment.

Confidence Grade = D4

Grade D4 as based upon engineering judgement and no data sets.

3.1.4 Increased standby

This proposed option seeks to introduce an organisational change that will formalise a Utility Inspector standby rota to manage customer incidents, enabling Distribution Inspectors to focus on recovering supply interruptions as quickly as possible.

detailed Review of proposed reduction strategies

3.1.4.1 Costs and benefits

The briefing paper states the following range of benefits;

MINUTE LOSE REDUCTION

LOW	MID	HIGH
00:00:00	00:00:10	00:00:20

The costs associated with this option are simply the additional man hours and standby premiums required to introduce this Utility Inspector standby rota.

From the analysis of DG3 incidents from April 17 to Nov 17, it is unclear if the minute lose reduction of 10 to 20 seconds is achievable if a new standby arrangement was introduced at Wessex Water. On average the mid reduction of 10 seconds would need have to achieve a 2 hour reduction in the duration of events, based upon the use of average values for notable incidents during 2017/18. As per the additional equipment option, it is recommended that to further substantiate the benefits of this option a review of post events is undertaken. For the purpose of this review the low minute lose reduction is carried forward as the most likely, based upon the analysis undertake to inform the IMT briefing paper.

Recommendation: It is recommended that the sample of incidents reviewed is increased to the last three years in order to further substantiate the benefits associated with the introduction of a Utility Inspector standby rota.

Confidence Grade = D4

Grade D4 as based upon engineering judgement and no data sets.

3.1.5 Network Infusions

The Network infusion option involves the use of emergency tankers to support incidents and reduce the impact of interruptions to supply through reducing the number of customers impacted and the duration of the supply interruption. This tried and tested approach to reducing customer minutes lost is widely used across the industry and a key component of its effectiveness is ensuring that tankers are deployed in a timely manner, and to the best location in terms of being able to gravitate or pump supplies into the system.

3.1.5.1 Costs and benefits

The briefing paper states the following range of benefits;

MINUTE LOSE REDUCTION

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LOW	MID	HIGH
00:00:10	00:00:20	00:00:30

The minute lose reduction estimates have been developed by Wessex Water using engineering judgement rather than post event reviews. In order to put some context round the mid forecast figure of 20 seconds, this reduction would require, on average a reduced in duration of circa 65%, or over 4 hours. A full tanker could supply around 271 properties for one and a half hours, and the cost presented in the briefing note are based upon deploying two tankers, enabling one tanker to be refilling whilst the other maintains customer supplies. It is this combination of tanker refills that would support the proposed reduction in minutes lost.

The costs of tankering is based upon deploying two tankers using the supplier Chard and takes into account the operating costs and the number of incidents for 2017/18. The total costs are based upon responding to a calculated year end number of events of 112 and a cost of £2000 per incident. The capex cost associated with this option relates to the purchasing of an additional six tankers, two per division.

Recommendation: Provide further detailed clarification of the capex associated with this option.

Confidence Grade = D6

Grade D6 as based upon engineering judgement and no other data sets

3.1.6 Innovation fund

This element of the IMT Briefing note is an allowance for reviewing external developments from across the water sector, with a view to trialing new technology that could minimise interruptions to supply.

3.1.6.1 Costs and benefits

The benefits of this innovation funding are not known and as such there is no data available to review the minute lost reduction projected in the table below. However, in order for Wessex Water to keep up to speed with developments across the industry an allocation of innovation funding is recommended. This funding could enable small scale pilot trials of new technologies to be evaluated.

MINUTE LOSE REDUCTION

LOW	MID	HIGH
00:00:00	00:00:10	00:00:20

Key enablers

Given that there are no further details on the types of tools, systems or processes that this innovation fund may generate, it is recommended that the low value of zero minutes reduction be carried forward for any further cost benefits analysis, as the mid to high reductions are not auditable.

Confidence Grade = D2

Grade D2 as costs can be managed but the benefits are unknown due to the nature of funding innovation.

3.1.7 Improved Interconnectivity

The improved connectivity project involves the assessment of Wessex Water's distribution system to identify where interconnectivity can be enhanced to provide alternative supplies and therefore reduce the impact and duration of supply interruptions.

3.1.7.1 Costs and benefits

There have been no tangible minute lose reduction savings attributed to this option as it will seek to identify candidate projects for capital investment. An opex cost of £0.1m/year will account for additional modelling resources undertaking this type of analysis.

Elsewhere in the industry the approach to connectivity enhancements has been deployed using a Failure Model Effect Analysis methodology. This FMEA approach seeks to identify those sections of pipelines that are most critical to the system should they failure, and provides hydraulic modelling optimisation to identify both the impact and likelihood of failure using past mains failure data and system hydraulics. The typical man hour effort required to run this type of F-link analysis on a single water supply zone is in the order of 80 hours to review the model, run the analysis and provide a brief report of opportunities. The opex costs proposed in the IMT briefing paper would enable approximately 50 Water Supply Zones to be analyzed a year, based upon 2 FTE's. This indicates that the costing element included within the briefing paper is in line with the expected outcome.

Confidence Grade = B3

Grade B3 as no benefits detailed and costs validated using old assessments and extrapolation.

4.0 KEY ENABLERS

Below is a list of the key enablers and risks that have been identified during this review and should be considering to ensure the successful implementation of the strategy proposed in the IMT Briefing note;

- Development of a clear overarching Operational Technology strategy.
- The availability of Internal IT resource availability.
- Agile project delivery to ensure the programme keeps pace with a rapidly changing technological environment.
- Selection of the correct IT procurement route.

Key enablers

- Time scales – new system integration can take 2-3 years from requirement definition to system acceptance.
- Organisational culture and its willingness to change.
- Competitors – technology likely to be available to others unless developed in house (longer integration time)
- Costs – level of requirements definition means cost estimates are likely to change.
- Unforeseeable event – even if the best monitoring, control and operations system and processes are in place, there is a risk that an unknown could result in the supply interruption target being missed.
- The required degree of business transformation

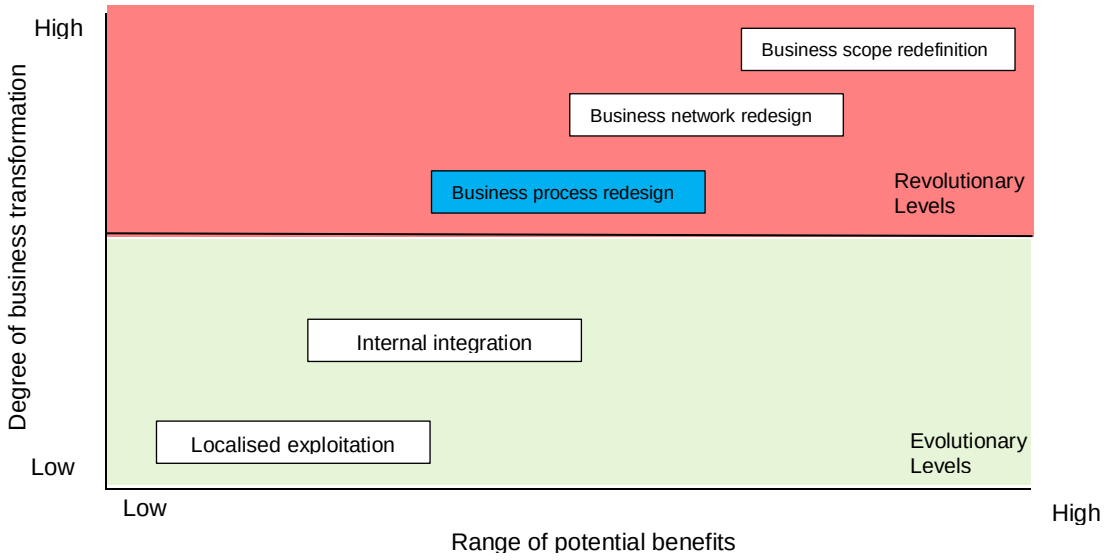


Figure 2 – Five levels of IT – Enabled business transformation (The OU, 2015)

The potential degree of business transformation required as a result of the proposed options presented in the IMT briefing note have been reviewed using the Five Levels of IT model presented in figure 2.

The vast majority of options proposed in the briefing note require enhanced IT or OT development and will require a degree of business process redesign to support the successful implementation of the new technology and to ensure benefits are realised. The degree of business transformation required is likely to be across a number of different departments, including operations and engineering, and potentially impacting the existing control center as it becomes an intelligence hub that is the eyes and ears of the network. The degree of business transformation required should be considered at all stages of developing the options put forward as part of the future strategy.

5.0 GAP ANALYSIS

Figure 3 – Gap analysis of strategic options

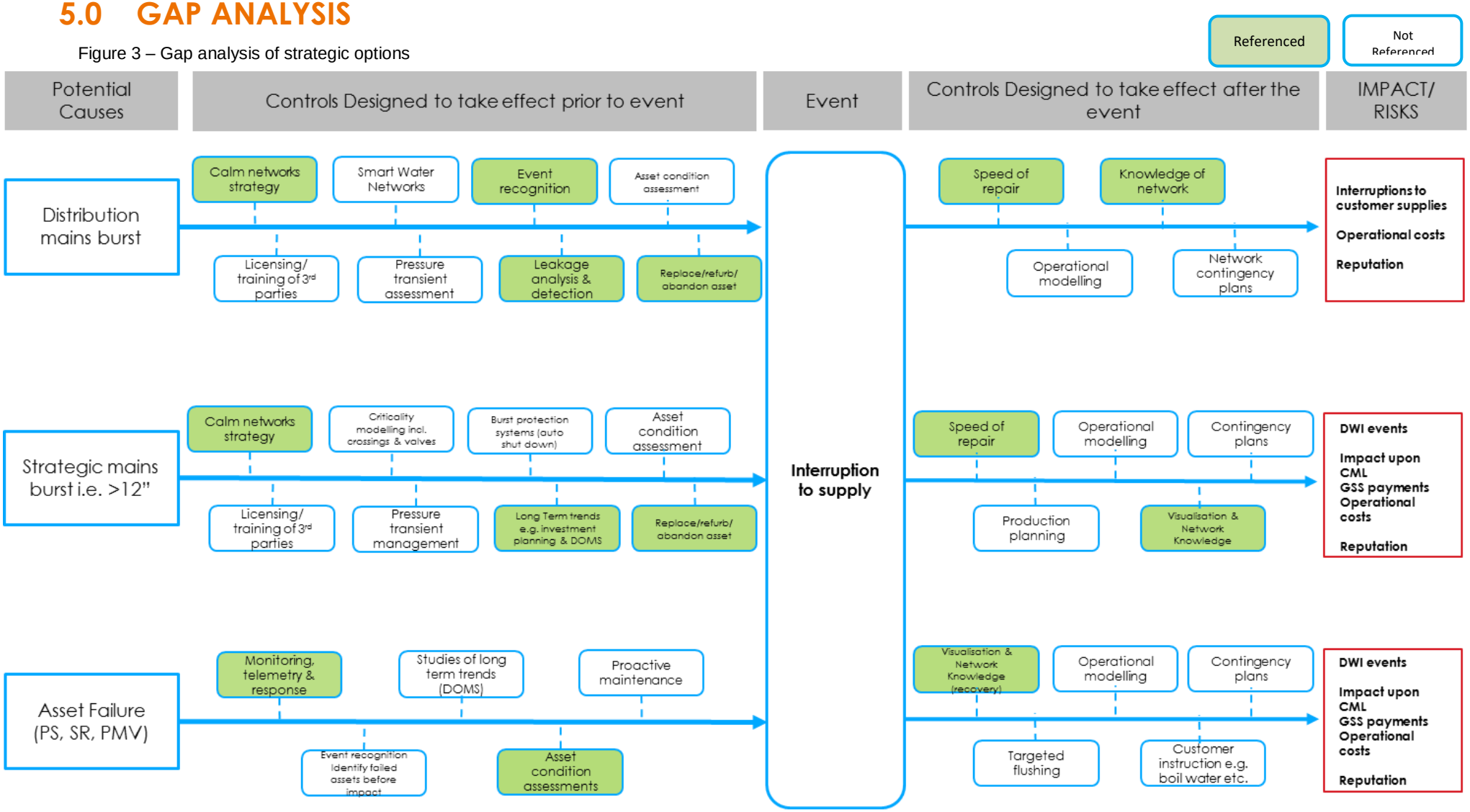


Figure 3 attempts to illustrate the strategic options that have been put forward in the Wessex Water IMT briefing note and those options that are used elsewhere across the UK Water Industry. This gap analysis illustrates how the control strategies deployed to manage interruption to supplies can be categorised into those that take effect prior to the event and those that can be deployed after the event has occurred, and seek to minimise the impact and speed up recovery.

Section 5 will discuss some of the opportunities that have been detailed in the IMT briefing paper but are being developed elsewhere in the UK Water sector.

5.1.1 Proactive interventions

5.1.1.1 Smart Water Networks

The concept of a Smart Water Network is the collection of data-driven components in order to assist in the operation of the data-less physical layer of pipes, pumps, reservoirs and valves. The concept of smart networks is alluded to in the Contoller always on and the Real time data & Knowledge management options, however the development of smart water networks can also provide solutions that improve efficiency, longevity as well as the reliability of the physical water network. This is achieved by providing better measurements, secure data collection, data analytics and greater insights which can be acted upon to better manage the system during a range of network events, not just supply interruptions.

Figure 4: Smart Water Network data ecosystem (SWAN 2016)

Figure 3 provides a framework developed by SWAN which seeks to put forward a blue print for smart water networks. The SWAN forum is a nonprofit organisation that brings together key players in the water sector to collaborate and share knowledge. SWAN provides a structured approach to understanding and reviewing the relative intelligence of a water company's distribution system, taking into account its level of sensing and control, communication frequency, data management and its use of analytics. A recommendation of this report is that

Wessex Water undertakes a bench mark using SWAN or similar frameworks to understand how mature its operational technology is with regards to water distribution.

Recommendation: Undertake a SWAN smart score review to understand the intelligent of the existing water distribution architecture at Wessex Water.

5.1.1.2 Pressure transient assessment

A key root cause of pipe failure and fatigue is down to water hammer or transients. As logging costs have reduced significantly over the past decade, the use of high frequency pressure loggers is becoming more prevalent across the UK Water Industry. The deployment of pressure loggers in areas of repeated mains failure can provide vital insights into the reason for re-occurring issues, whilst also providing reassurance that any capital intervention is targeted at the correct problem. Whilst the deployment of such transient loggers isn't typically undertaken across the entire water distribution system, if the criticality of such infrastructure is understood that transient loggers can assist a Utility in managing the risk of failures. This should be considered when purchasing any GSM/GPRS loggers, as many now have the functionality to record at much higher frequencies for short durations.

5.1.1.3 Asset criticality assessments

In order to achieve a proactive approach to network interventions, a key step used cross many UK Water Companies has been to understand the relative criticality or resilience of each network asset. Failure Model Effect Analysis can provide critical insights into customers that may be most vulnerable to asset failure, whether that be a pipe burst, shut off overrun, PMV failure, pump outage or SR drain down. By understanding the relative criticality of the distribution system a proactive method for managing that critical component can be determined. Stantec have used an approach to understanding mains failures using hydraulic models. At a high level, the approach taken seeks to analyse the effects of the outage for a defined section of the strategic water network, taking into account;

- The number and type of customers affected
- The availability of network storage
- The duration of the outage
- The estimated repair times
- The ability to provide alternative means of supply

Recommendation: Following on from the PR14 work, refresh the impact and severity assessment of the network via a criticality assessment of its infrastructure assets.

5.1.1.4 Event Recognition

The use of network data to recognise when an event has occurred is becoming a growing area of development for specialist companies such as Syrinix, Takadu, Optiqua Eventlab and Servelec. The costs of such systems can range from £2 to £4 million for full installation and often require a vast amount of systems integration with the Utility companies own existing IT infrastructure.

In the context of this review, other UK Water companies have, and are planning on investing in multi-million pound projects to enhance their understanding of network performance with a view to moving them into a more proactive position when managing the network. One UK water company has invested over £10 million during AMP6 on its intelligent water management system. This investment has included enhancing its logger coverage with 15 minute data at key network points including the outlet of PMV's and the inlet to DMA's in order to assist its analytic detection algorithms. This project is also delivering a number of remote control solutions which will provide self-rectifying pumping stations and pressure valves to support the delivery of a calm water network.

A key enabler to developing this capability was a sizeable investment in network visualization (circa £2.7million). This project delivered a single visualization of all water network activities, enabling interventions, whether reactive or proactive, to be managed in an efficient and timely manner. The project aimed to not only reduce minutes lost but also make better use of field resources through a reduction in unnecessary visits, to reduce cost to serve, to increase first time call resolution and to improve event evaluation and response for proactive alerts.

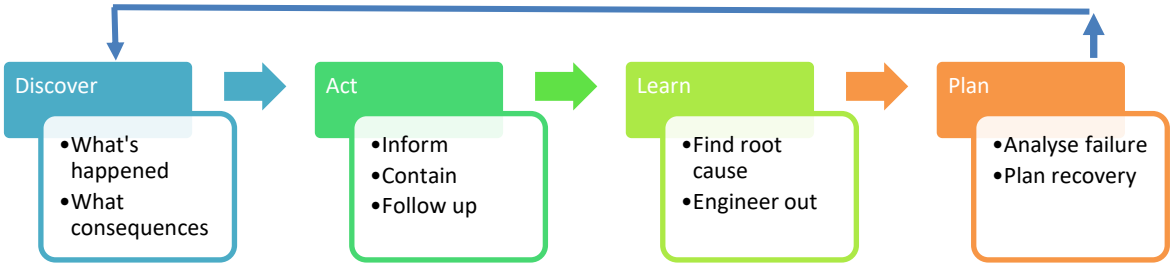
It should be noted that it is too early in the post implementation of these new systems to fully ascertain their success in reducing interruptions to supply, however the investment formed part of a companywide enhancement project which was driven by the overarching strategic goal of moving the organisation from a reactive operating model, relying on customers to provide the triggers for intervention, to a digitally enhanced proactive organisation, ensuring effective interventions and maintenance in order to provide an enhanced level of service to customers.

5.1.2 Enhanced reactive interventions

5.1.2.1 Failure planning and contingency

In order to reduce customer minutes lost organisations are developing clear failure recovery plans to ensure that failures are dealt with as quickly as possible and that any lessons leant and embedded into future activities. Figure 5 illustrates the high level stages of failure planning which could be incorporated into Wesex Water standard operating procures.

Figure 5: The stages in failure planning



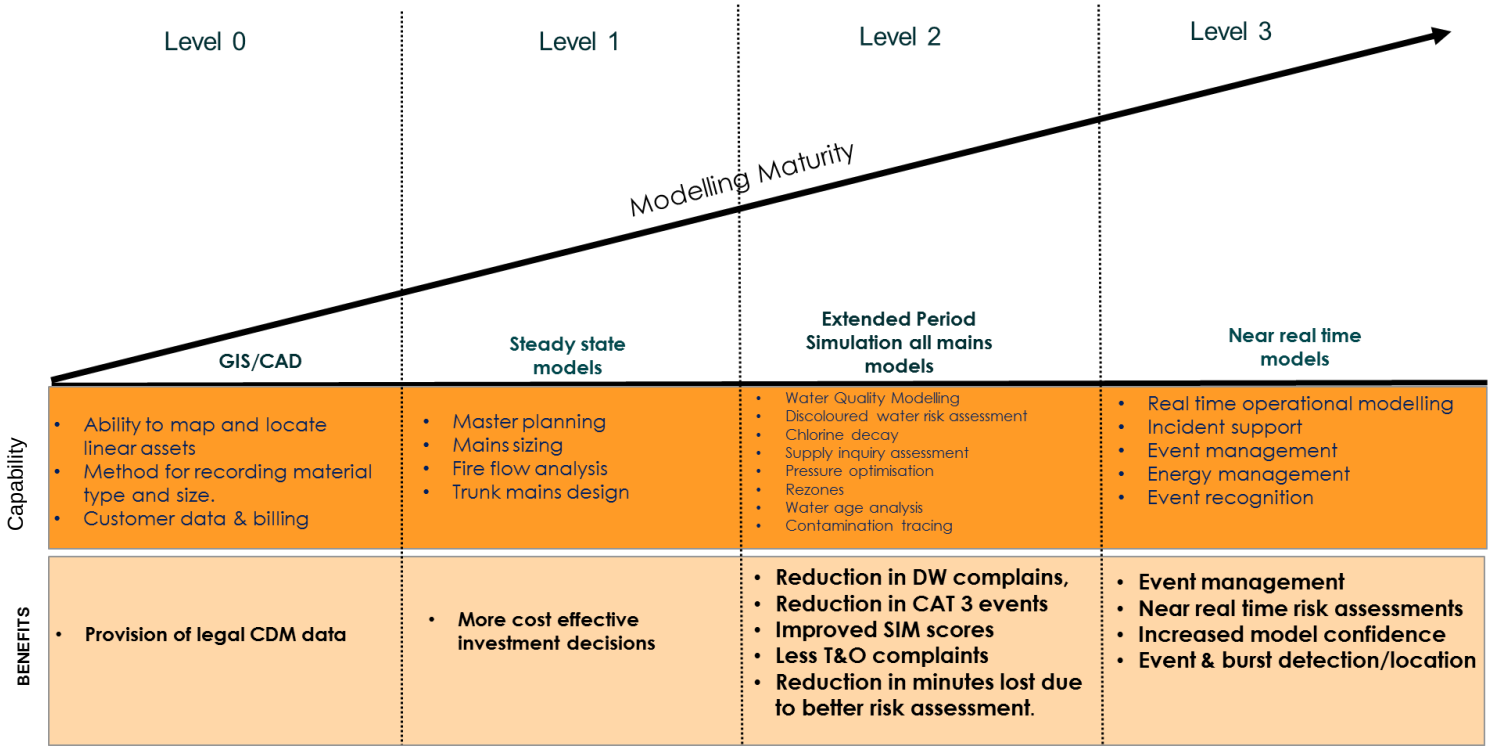
The key stages that could be incorporated into the Wessex Water interruption to supply process are the Learn and Plan phase. These phases are key as they provide benefits from past failures in terms of providing learning opportunities. These lessons should be incorporated into a knowledge management approach, which would also contain contingency plans based upon critical asset failures and the proposed steps required to resolve these issues.

5.1.2.2 Operational modelling

As computing technology has advanced, modelling is used operationally at many water companies across the UK in order to improve the service offered to their customers. With up to date network models and the right modelling system, a water company can transform its handling of events and incidents.

Figure 6 is a maturity model which attempts to illustrate how the development of up to date and integrated models can provide additional benefits to models that are run off-line and maintained annually. The key additional benefits of these near realtime models are focused upon event management, risk assessments and event and burst detection. Each UK water company will gain slightly different benefits from operational modelling, however one company has estimated a potential reduction of 22% in customer minutes lost from operational modelling. This reduction is based upon the improved management of events which was shown to improve event recovery time.

Figure 6 : Clean water modelling maturity scale



Recommendation: Undertake an assessment of Wessex Waters current modelling maturity and determine the additional benefits and costs associated with undertaking operational modelling.

Gap analysis

The benefits and potential reduction in customer minutes lost as a result of Operational modelling are illustrated in table 3 and 4.

Table 3: Potential savings from operational modelling

	BENEFIT	DESCRIPTION	BUSINESS CASE VALUE*
Savings	Reduction in costs for Model Maintenance	Automatic Model Maintenance using GIS and Telemetry Data	**£0.4m per annum**
Potential ODI savings	Minutes Lost	Reduction in ODI for Minutes Lost (averaged across the Region)	22% reduction, leading to > 2m30s reduction in Minutes Lost
	Water Quality Service Index	Improvement in WQSI due to fewer customer contacts for Water Quality	24% reduction in Water Quality contacts (2,200 fewer)
	Reliable Water Service Index	Improvement in RWSI due to fewer customer contacts for No Supply	5% reduction in No Supply contacts (2,400 fewer)

Table 4: The benefits of Operational Modelling

Managing Events and Incidents	1. Reduced People Time and Cost 2. Reduced Contractor Cost 3. Improved modelling service 4. Reduced Minutes Lost 5. Reduced Customer Contacts 6. Improved ODI Reporting	Event and Incident Management will be improved by using Modelling to: • improve mitigation activities (by using rezone, flushing, and discolouration modelling) • investigate alternatives and identify the best way to reduce the impact • visualise the customer impact The benefits result from: • resolving the event quicker • improving mitigation activities • limiting the scale of the event • reducing the risk of a secondary event • using modelling to calculate minutes lost for DG3 reporting Soft benefits are: • better decision making during events • manage the event in a better way • increased confidence in managing events

6.0 CONCLUSIONS

In conclusion, the review of Wessex Water's IMT briefing note on Supply Interruptions has decided that based upon the strategic options detailed in the briefing note the most likely forecast for supply interruptions for the investment proposed is 00:06:45. This assessment has been based upon the review of the seven options put forward in the briefing note and the events used to understand potential benefits, supplemented with technical judgement and experience. A gap analysis has identified a number of further options that Wessex Water may wish to consider as part of its Supply Interruptions strategy for AMP7. These are focused upon the use of digital information to move from a proactive to a more reactive state when managing water network interventions. The two options that have been estimated as potentially providing further minute loss reductions for Wessex Water are the use of models for supporting and aiding event recovery through Operational Modelling and the use of models to assess drain down duration to provide a more accurate account of the number of properties impacted and duration. This review has suggested that for the further investment of £0.5 million/year in Operational Modelling and Draindown analysis the forecast for supply interruptions could be further reduced to 00:04:10.

The review has also identified a number of key interdependencies between the options which result in benefits of some options being dependent upon the delivery of others. This will need to be considered when determining future investment decisions and a proposed sequence for delivery has been recommended.

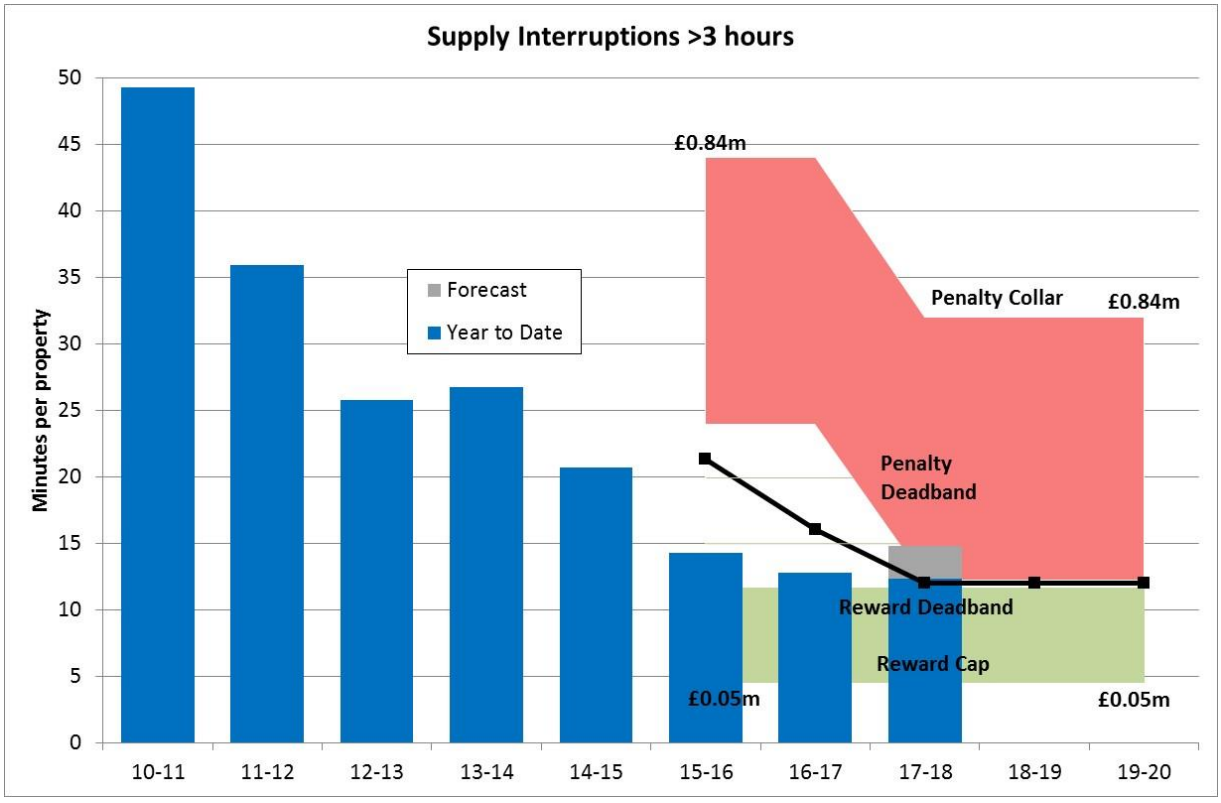
7.0 REFERENCES

Appendix A

INVESTMENT MANAGEMENT TEAM
Briefing note – Supply Interruptions
Ashlea Lane – January 2018

Background

We have done a great job reducing supply interruptions over the last seven years, achieving just under 13 minutes last year. This year we are forecasting just under 15 minutes mainly due to two large unplanned incidents and a small number of medium sized unplanned incidents, (see Appendix 1). Planned interruptions are likely to outturn at just under 2 minutes.



The expectation for 2018/19 and 2019/20 with our current strategy is that planned interruptions will be close to zero and unplanned interruptions likely to be between 8 and 10 minutes dependent on the number and nature of incidents that occur in each year.

Supply interruptions is a PR 19 common performance commitment, and the latest view from Frontier Economics is that the upper quartile in 2025 may be around 3 minutes and we should propose this target in our business plan in accordance with the Ofwat methodology.

Reduction strategies

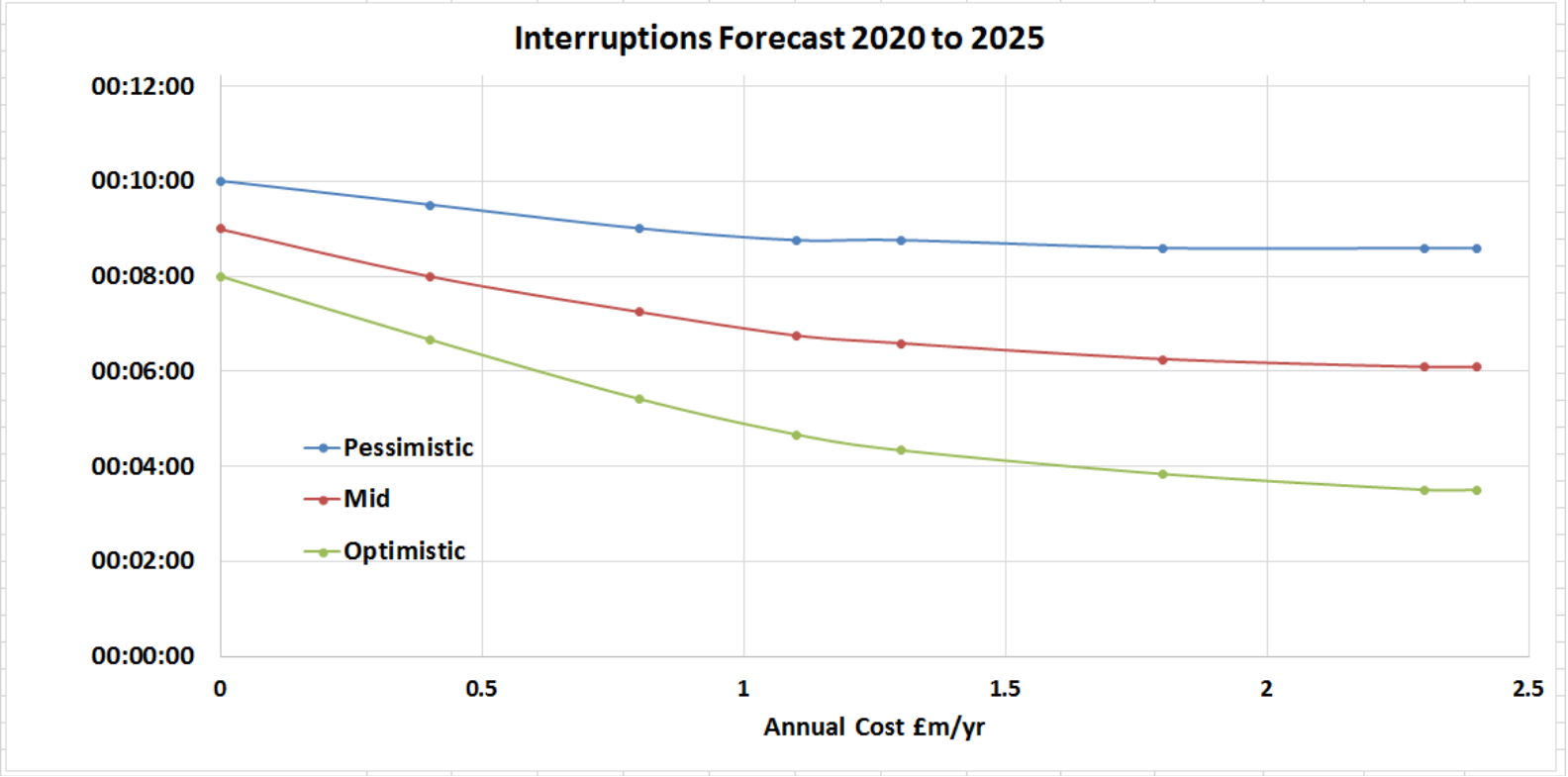
We have done a review of all our supply interruption reduction options as summarised on the following page, (with more detail in Appendix 2).

Based on an assumed starting position of 8 to 10 minutes it may be possible to achieve 3 minutes by 2025 for an extra £2.5m/yr once or twice in a five year period. Or hit a 5 minute target three or four times in a five year period for an extra £2.5m/yr.

The extra £2.5m/yr is around 50% Opex, with the 50% Capex being on short life assets and therefore repeating in perpetuity like the Opex.

References

	Time Saving			Annual Cost £m/yr			Cumulative Time Saving			Cumulative Totex	Forecast		
	Low	Mid	High	Opex	Capex	Totex	Low	Mid	High	£m/yr	Pessimistic	Mid	Optimistic
Assumed start point 2019/20										0	00:10:00	00:09:00	00:08:00
Always on controller	00:00:30	00:01:00	00:01:20	0.4	0	0.4	00:00:30	00:01:00	00:01:20	0.4	00:09:30	00:08:00	00:06:40
Real time data & knowledge management	00:00:30	00:00:45	00:01:15	0	0.4	0.4	00:01:00	00:01:45	00:02:35	0.8	00:09:00	00:07:15	00:05:25
Increased equipment	00:00:15	00:00:30	00:00:45	0.2	0.1	0.3	00:01:15	00:02:15	00:03:20	1.1	00:08:45	00:06:45	00:04:40
Increased standby	00:00:00	00:00:10	00:00:20	0.2	0	0.2	00:01:15	00:02:25	00:03:40	1.3	00:08:45	00:06:35	00:04:20
Network Infusions	00:00:10	00:00:20	00:00:30	0.2	0.3	0.5	00:01:25	00:02:45	00:04:10	1.8	00:08:35	00:06:15	00:03:50
Innovation fund	00:00:00	00:00:10	00:00:20	0.2	0.3	0.5	00:01:25	00:02:55	00:04:30	2.3	00:08:35	00:06:05	00:03:30
Improved interconnection - study only	00:00:00	00:00:00	00:00:00	0	0.1	0.1	00:01:25	00:02:55	00:04:30	2.4	00:08:35	00:06:05	00:03:30



Further refinement of these options will continue in advance of our business plan submission.

Recommendation

IMT are asked to consider bringing forward investment in the “always on controller”, “real time data & knowledge management” and “improved interconnection study” options to place us in the best possible position on supply interruptions in 2020.

The always on controller will require an increase in Opex of £0.4m/yr in perpetuity.

The improved interconnection study will require an increase in Capex of £0.15m/yr in perpetuity for an increase to our modelling capability.

To implement the real time data & knowledge management we would require £0.8m/yr in Capex in 18/19 and 19/20.

References

APPENDIX 1 – SIGNIFICANT INCIDENTS IN 2016/17 TO DATE

Date	Type	SIL No	Address/area	Interruption minutes	Length of shut	No of properties	Minutes/seconds added
01/09/2017	Unplanned	43926	Westbury 18" - North	1,813,482	Various	Various	2 mins 56 secs
12/05/2017	Unplanned	41470 / 41430	Yetminster - West	1,201,595	Various	Various	1 min 57 secs
25/07/2017	Unplanned	42762	Great Somerford - North	431,452	Various	Various	42 seconds
30/06/2017	Unplanned	41652	Rodbourne - North	431,208	05:39	1272	42 seconds
09/07/2017	Unplanned	41680	Ryme Intrincia - West	366,240	08:00	763	36 seconds
27/06/2017	Unplanned	41634	Muchelney - West	319875	Various	Various	31 seconds
19/07/2017	Unplanned	42736	Upper Stoke - North	210990	Various	Various	21 seconds
08/05/2017	Unplanned	41401	Yetminster - West	206,010	04:30	763	20 seconds
12/08/2017	Unplanned	43846	Rowde - North	194,235	05:45	563	19 seconds
25/09/2017	Unplanned	45042	Heytesbury - North	126,812	Various	Various	12 seconds
04/09/2017	Unplanned	43935	Bishops Cannings - North	119,800	03:20	599	12 seconds
28/07/2017	Unplanned	42783	Chetnole - West	91,483	03:30	405	9 seconds
06/09/2017	Planned	43949	Wellington - West	85,050	03:30	405	8 seconds
03/07/2017	Planned	42686	Dorchester - South	83,145	05:45	241	8 seconds
23/05/2017	Unplanned	41473	Bath - North	74,670	03:10	375	7 seconds

APPENDIX 2 – INTERRUPTIONS REDUCTION OPTIONS

Project	Description
Planned Work	This would see us using non-interruption techniques for all appropriate planned work. This approach is more costly and will mean that each job takes longer. This will give us an option to either reduce the volume of mains rehab work that is carried out to keep costs the same or increase forecast spend on these schemes by 10-15%
Always on' controller	The first 30 minutes of any incident is critical in determining response and impact. Out of hours (where 84% of minutes lost occurs) this assessment is completed by the distribution inspector when they arrive on site. This project would provide a central resource that is able to determine options for rezones, provide customer support and act as incident manager. All of this analysis would be carried out whilst the Distribution Inspector is traveling to site, saving valuable time and helping to ensure a better outcome.
Real time data & knowledge management	We have areas of our network that have limited flow and pressure data and the information that we do have is updated every 24 hours or some monthly. This means that our first warning of a supply interruption is often when the customers call to say they have no water. This project would involve the installation of live data monitors to our critical points (highest points) in each DMA. The information from these monitors will alert us to a drop in pressure as soon as it occurs and in many cases before customers experience a loss of service. We currently rely on customer's calling in to alert us to a burst, so this improvement will be felt most significantly out of hours. This significant increase in field data will need to be managed through a suitable data analytics system to ensure that the most important alarms are elevated above less important alarms.
Improved interconnection	The more interconnection options that we have available the greater chance we have of restoring supplies to customers quickly. This project would see an increase in our network modeling capability, focused on exploring options to improve the interconnectivity of our system. These candidate projects would be prioritised and either additional investment could be made, or funding reprioritised from the mains replacement budget. Project prior to the start of AMP 7 for modelers to analyse our hydraulic models and determine a prioritisation list of projects
Increased equipment	Improving the availability and familiarisation of interruption avoidance equipment and techniques would allow us to get more people back into water if a rezone option isn't available
Network Infusions	This would involve pumping back into the network, usually from a tanker, to maintain supplies. This has been successfully trialled on a small scale but some network modifications would need to be made to roll out, along with investment in additional tanker capacity.
Increased coverage of standby (DI/UI)	There are currently 10 distribution inspectors to cover the supply business out of hours and at weekends. This means that there can be significant travel times involved for an inspector to attend a suspected burst or supply interruption. This project would see the introduction of a Utility Inspector standby to manage customer incidents allowing the DI's greater focus during a supply interruption.
Asset replacement	Replacing older assets with a significant burst history reduces the number of bursts and therefore likelihood of supply interruption events. The impact of this method however is limited and comes at significant cost
CALM network training	Analysis carried out by other companies has shown that activities carried out on the network by water company staff can cause pressure transients. These are high pressure waves three times the normal operating pressure of the system. Operating valves and equipment in a slower or 'calm' way reduces the size of these waves and therefore the damage they cause. This project would put everyone that operates the network through training course that requires an individual to demonstrate they can operate valves without causing a transient.
Calm network management	Transients can also be caused by our customers and other users of the network. This project would see a small team created to track down and investigate the source of transients and work with customers to inform them of their damaging affect and help eliminating them.

References

APPENDIX B – CONFIDENCE GRADE METHODOLOGY

Appendix A

Reliability band	Description
A	Sound textual records, procedures, investigations or analysis properly documented and recognised as the best method of assessment.
B	As A, but with minor shortcomings. Examples include old assessment, some missing documentation, some reliance on unconfirmed reports, some use of extrapolation.
C	Extrapolation from limited sample for which Grade A or B data is available.
D	Unconfirmed verbal reports, cursory inspections or analysis.

Accuracy band	*Accuracy to or within +/-*	But outside +/-
1	1%	-
2	5%	1%
3	10%	5%
4	25%	10%
5	50%	25%
6	100%	50%
X	Accuracy outside +/- 100 %, small numbers or otherwise incompatible (see table below)	