Thames Water
Trunk Mains Strategic Review

Final Report

Date of issue: 2 October 2017

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1 Executive Summary

We commissioned the Trunk Mains Forensic Review in mid-December 2016 as an independent review of the major burst / leak events that occurred in 2016. It covered the potential causes of the failures and our response, set in the context of our management framework to monitor, maintain and replace trunk mains.

We recognise how upsetting and disruptive these incidents were for our customers, and the very significant impact they had both at the time and since, particularly for people whose homes and businesses were flooded. We provided both immediate and longer term support and have been working with people to help them get their lives and businesses back to normal as quickly as possible.

This Trunk Mains Strategic Review report sets out the commitments we are making to reduce the risk of such events, and the distress and disruption they cause. The commitments have been drawn up in response to recommendations set out in the preceding Trunk Mains Forensic Review. Those recommendations have already been the subject of continuing discussions and meetings with the communities affected by the trunk main bursts of 2016, and a range of stakeholders, including their elected representatives in Parliament and London Boroughs. We have mapped the 80 recommendations in the Trunk Mains Forensic Review to 15 commitments set out in this report which we will deliver through an implementation phase over the next 18 months. Specifically;

- we have started work on 16 of the 80 Trunk Mains Forensic Review recommendations, each of which has been allocated to an accountable lead individual, and an implementation owner;
- 20 of the 80 Trunk Main Forensic Review recommendations are being addressed by business as usual activity or other programmes within Thames Water;
- 41 of the 80 Trunk Main Forensic Review recommendations are directly addressed by Trunk Main Strategic Review commitments and will be implemented through the trunk mains implementation phase though they may require some planning or, in some instances, further design work before implementation; and
- we have decided not to implement three of the Trunk Main Forensic Review recommendations at this time, and explain our reasons in this document.

We look forward to communicating and discussing the outcome of this review with affected communities, our customers more generally, their political representatives, Ofwat and other stakeholders. We recognise the importance of continuing the dialogue with them about the delivery of the commitments we have made. We are also committed to continuous learning from past and future trunk main burst events.

The Trunk Mains Forensic Review recognised that much of the trunk mains network was constructed in the early 19th century. A key recommendation was that there should be an 'intensive care' period for our Trunk Mains assets. We have interpreted this as the need for a period of focus across the end-to-end asset management lifecycle for our Water network assets. Through these two reviews, our work with communities and stakeholders, and the work to re-line and replace trunk mains that burst, we have had an intense focus on these assets since December 2016. We will continue this focus through the trunk mains implementation phase.

The trunk mains implementation phase will begin in earnest by October 2017. At its conclusion the changes and improvements that we have made will be continued as business as usual. The trunk mains implementation phase will:

- provide the focus and resource needed to implement the Trunk Mains Strategic Review commitments;

- satisfy the recommendation from the Trunk Mains Forensic Review; and
- provide the necessary end to end focus on trunk mains so that improvements are sustained.

We have set out a high level implementation plan for the trunk mains implementation phase, and it includes a number of pilot projects that will allow us to test our proposed improvements. Following these pilots we will revisit the commitments we have made in this report to confirm that we are implementing the right improvements for our customers and the business. We expect to conduct this review six months after the start of the trunk mains implementation phase. Significant improvement steps have already been taken and we have set aside additional money to support the trunk mains implementation phase. This is in addition to the dedicated budget for the re-lining of sections of burst trunk mains such as in Leigham Vale and Upper Street.

In the long term our strategy is to replace the trunk mains network, starting with those parts where the risk of a failure is greatest. Better information about our network and better risk models will help improve the detailed planning required. Our business plan for the period from 2020 onwards will be released for consultation in 2018 and will include options for a comprehensive long term programme of replacement.

The Trunk Mains Strategic Review is structured into five themes. We have made a total of 15 commitments across the five themes.

Theme 1 - Operating model: The operating model theme contains commitments that will improve the way in which the business is structured, the roles, accountabilities and responsibilities, and the governance to support this. The commitments in this theme build on work already done to develop and implement a 'Single System Owner' model for end to end asset management that is in line with international standards for asset management.

Theme 2 - Monitoring: The monitoring theme commitments will renew the trunk mains monitoring strategy, improve our use of monitoring data to proactively and reactively identify bursts, and achieve completion of the existing monitoring equipment installation programme.

Theme 3 - Asset information: The asset information theme commitments will improve the way that we collect, assure, view and analyse data on the trunk mains asset.

Theme 4 - Risk management: The risk management commitments will improve the way that we predict, model and understand the probability of a trunk mains burst and the consequence of such a burst.

Theme 5 - Event response: The event response commitments will develop and strengthen our incident and emergency management capability, including the operational response to containing the burst and repairing the trunk mains, customer communications and care, stakeholder engagement, and operational rotas and working patterns.

We are grateful for the support that Ofwat have given us in the direction and governance of the Trunk Mains Strategic Review report, including seconding their Principal Engineer to provide challenge and technical expertise through the Trunk Mains Strategic Review Steering Group.

We acknowledge that this is not the end of our learning process from the trunk main bursts in 2016, and we are committed to systematic changes that make it easier to identify and embed learning from past and future trunk main burst events. We are confident that the commitments in this report are deliverable, that they will improve our management of trunk mains, improve our response to trunk main bursts and reduce

the impact of future bursts on our customers. We also recognise that due to the nature, age and use of these assets, it is inevitable that for the foreseeable future some trunk mains may continue to fail from time to time.

A high level programme and timescales to deliver the 15 commitments are presented in Table 1.

2 Introduction

2.1 Background to trunk mains

A trunk main is a classification given to larger diameter mains in a water transmission and distribution system. Historically our trunk mains were considered as those 12" diameter and greater in London and 10" and greater in Thames Valley. We are improving the classification of Trunk Mains to incorporate their function, focusing on the key mains that convey large volumes of water at high pressure from treatment works across our network to a number of service reservoirs.

Figure 1 - Modern trunk main

Figure 2 - Burst trunk main from the Upper Street event

We have over 3,200km of trunk mains. Approximately 2,000 km of these and their control mechanisms are in London, buried under busy streets, red routes and key third party assets. Much of the trunk mains network was constructed before 1900 using simple techniques, and fabricated in challenging environments with little or variable quality control. We currently experience an average of 310 trunk main bursts and leaks per year[1], of which we expect approximately 60 to be the result of failures on larger-diameter mains that are 18"/450mm and above (based on averages from the last 13 years[2]). Overall, the number of bursts in the entire network is running at about the same level as in 2015/16.

The planned investment in the AMP6 objectives[3] in the Thames Water Investment Strategy for Trunk Mains totalled £147m at 2012/13 prices. This included spending money on:

- expanding the monitoring of high consequence trunk mains from 5% to 8% of the trunk mains network by the end of AMP6;
- re-laying 45km of the highest consequence trunk mains. This replaces 1.2% of the overall network; and
- gathering information and building data models on trunk main condition and deterioration, in order to support the case for further investment in the next periodic review.

In March 2017 we committed to invest an additional £97m, over and above the budget in our Investment Strategy for Trunk Mains. This includes additional expenditure on the following:

- increased expenditure on re-lining trunk mains to include the trunk mains involved in recent bursts;
- additional condition surveys and monitoring equipment installation;
- trunk main focussed studies; and
- implementation of the Trunk Mains Strategic Review commitments.

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[1] average visible leaks from the last 13 years, June (Regulatory) Return Period ("JR") JR04 – JR16
[2] JR04-JR16
[3] Asset Management Planning period 6, from April 2015 to March 2020 inclusive

2.2   Summary of our overall response to the trunk mains bursts

In response to the eight high profile bursts that occurred between October and December 2016 we have implemented a staged programme to improve the service to customers both in the short-term (by identifying things we can do immediately) and in the longer term, by identifying appropriate levels of future investment. Specifically, this programme covers:

- **Our customer response**: We recognise how upsetting and disruptive these incidents were for our customers, and the very significant impact they had both at the time and since, particularly for people whose homes and businesses were flooded. We provided both immediate and longer term support and have been working with people to help them to get their lives and businesses back to normal as quickly as possible.

- Event teams were dispatched to isolate the bursts as quickly as possible, provide immediate customer support such as alternative water supplies and accommodation, work closely with the emergency services, and to provide information on the ground and at resident's meetings. We also provided welfare units, flood remediation services, sent loss adjustors to site as part of the immediate response, made ex gratia payments of £1,000 to household customers with internal flooding, and £2,000 to household customers who have been flooded more than once.

- **Re-lining critical trunk mains**: The additional budget commitment of £97m, over the period up to 2020, to deliver the full programme of relining, monitoring, and reviews has been approved. We have committed to re-line or replace the pipes at Upper Street (around) and Leigham Vale. At the time of publication, 1.31km of the 21" main at Leigham Vale had been re-lined, 0.43km of the 36" main at Upper Street had been re-lined with a total of 0.62km planned to complete by the end of September. Additional re-lining work is underway at Baker Street and New Malden.

- **The Trunk Mains Forensic Review**: A forensic review of 31 significant trunk main bursts in 2016, starting with the eight high profile trunk main bursts that occurred between October and December 2016. The Trunk Mains Forensic Review commenced in December 2016 and the report was published on the Thames Water website in April 2017. The review was commissioned by Thames Water and independently led by Paul Cuttill, OBE. The complete list of 80 Trunk Mains Forensic Review recommendations can be found in the Trunk Mains Forensic Review report available on our website at https://corporate.thameswater.co.uk/About-us/Investing-in-our-network/Trunk-mains-review

- **The Trunk Mains Strategic Review**: A review of our strategy for managing the trunk main assets. The review sets out the actions we are taking and commitments we are making in response to the Trunk Mains Forensic Review findings and recommendations, given the wider context of ongoing business change. Ofwat have participated in the Trunk Mains Strategic Review, in particular through the involvement of their Principle Engineer as part of the Trunk Mains Strategic Review Steering Group. The output of that review is summarised in this document.

- **Long-term investment strategy**: our long term strategy is to replace the trunk mains network, starting with those parts where the risk of a failure is greatest. The improved information about our network, and better risk model outputs from the above activities will feed into the work that we are already doing to develop the detail behind this long-term approach. This will form part of our proposed business plan for the period from 2020 onwards, on which we will consult widely with all our customers and stakeholders and will include the comprehensive programme to replace all our Trunk Mains assets over the longer term.

- **Social media and communications improvement plan**: A complete review of our customer engagement methods, with the intention of helping Thames Water customer engagement teams manage their interaction with customers more effectively, and position Thames Water as a role model for incident management. This includes analysis and improvement of contact centre practices, media engagement, social media response and event broadcasting/narrowcasting.

- **Stakeholder engagement**: Our approach to engaging with stakeholders is focused on building relationships before, throughout, and in the aftermath of an event in order to keep them sufficiently

well informed to ensure that they can carry out their own functions effectively. We maintain relationships with relevant third party organisations, including emergency services and Transport for London ("TfL"). We use stakeholders' communication networks to push out key messages to a more targeted audience to reduce customer contacts and improve customer experience.

- **Ofwat engagement**: The recent event in South London is an example of where we have raised issues with Ofwat pro-actively at the earliest opportunity. We accept that we did not follow this approach with the spate of bursts in 2016 on our trunk network in London. We have taken steps to improve our communications with Ofwat and will build upon this for future engagement.

2.3   The Trunk Mains Forensic Review

Following the eight high profile trunk main bursts that occurred between October and December 2016 our Chief Executive, Steve Robertson commissioned an immediate forensic review of all our trunk main bursts in 2016. The independent Trunk Mains Forensic Review was led by Paul Cuttill OBE. Paul has over 30 years' experience in utilities, including as EDF Power Networks' Chief Operating Officer. The Trunk Mains Forensic Review commenced in December 2016 and the report was published on the Thames Water website in April 2017. The Trunk Mains Forensic Review used a management framework to assess the Thames Water approach to managing the trunk main asset network across the 4 lifecycle stages (asset planning, asset operation and maintenance, asset monitoring, and event response.) The Trunk Mains Forensic Review produced 80 recommendations derived from the findings,

Specifically the Trunk Mains Forensic Review covered:
- the factors contributing to each burst – asset condition, its location and environment, and whether any patterns of failure could be identified;
- the impact – on customers, the wider community, and the cost;
- our immediate response – identifying what we and others did well and what we need to improve; and
- the network – whether we need to make changes to network configuration, pumping and control regimes.

The key findings from the Trunk Mains Forensic Review are:
- there is no single common cause of the bursts. Whilst age and condition of the pipes is an underlying factor in the eight high-profile failures, there were no systematic failings that could be said to have consistently caused or enabled the bursts
- there is a clear investment strategy and plan for our trunk mains that is supported by advanced risk and statistical modelling, we improve our understanding of our network and improve how we manage our existing data and knowledge
- the 'building blocks' necessary to deliver our trunk main plans and commitments are in place, we focus on improving the management of our planned works and make better use of local knowledge
- improving how we monitor our trunk mains and spot potential future bursts, recommending that we accelerate the roll-out of monitoring units (equipment that can monitor where bursts may happen or have already occurred), refresh how we prioritise alarms, increase our capacity to analyse data, and work with our alliances to develop new, innovative ways of assessing the condition of our pipes and
- a number of recommendations for improving communication with both customers and within the company immediately after bursts have happened, our capacity to deal with multiple major incidents, and how we can better learn from incidents after they've taken place.

The findings from the Trunk Mains Forensic Review have been communicated to our stakeholders and customers, particularly those who were affected by the 2016 bursts. This has involved presentations at London Borough Scrutiny committees, community liaison events, London Assembly committee meetings, and in one-to-one briefings. The Review is also available on our website.

2.4 Purpose and approach of the Trunk Mains Strategic Review

The purpose of the Trunk Mains Strategic Review is to:

- define and document our response to the Trunk Mains Forensic Review and the changes that we will commit to in order to meaningfully address its recommendations;
- deliver discrete improvements to trunk mains management based on the Trunk Mains Forensic Review recommendations; and
- define the changes we will make to reduce the impact of a trunk mains burst on our customers
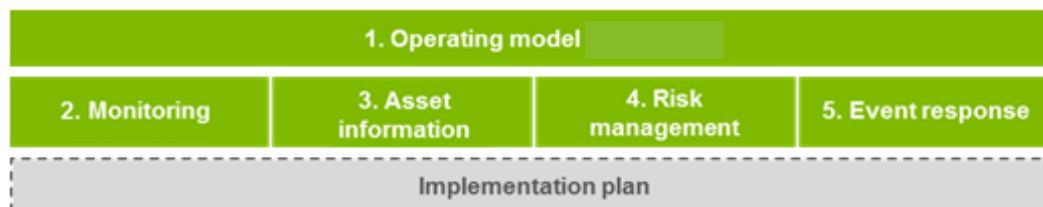
We commenced the Trunk Mains Strategic Review in February 2017 to coincide with and follow on from the Trunk Mains Forensic Review. We recognised that we needed to review our capability, supporting systems and accountabilities in light of the 2016 trunk main bursts and the findings of the Trunk Mains Forensic Review. The publication of this report is an important milestone in our programme of learning and improvements following the trunk mains bursts in 2016.

We look forward to communicating and discussing the outcome of this review with affected communities, our customers more generally, their political representatives, Ofwat and other stakeholders. We recognise the importance of continuing the dialogue with them about the delivery of the commitments we have made. Following the publication of this report we will focus on the implementation of the commitments through the trunk mains intensive care period, building on the changes that we have put in place already.

3 Summary of Commitments

This section provides a summary of each of the 15 Trunk Mains Strategic Review commitments. The Trunk Mains Strategic Review commitments were grouped into 5 themes, underpinned by an implementation plan. There are up to four commitments in each theme. Each commitment is made up of a number of improvements that we are committing to in order address specific Trunk Mains Forensic Review recommendations.

Further detail on each commitment can be found in sections 4 to 8.

Trunk Mains Strategic Review themes

3.1   Theme 1: Operating Model

The operating model theme contains commitments that will improve the way in which the business is structured, the roles, accountabilities and responsibilities, and the governance to support this. The commitments in this theme build on work already done to develop and implement a 'Single System Owner' model for end to end asset management that is in line with international standards for asset management. There is one commitment in the operating model theme.

- Commitment 1.1: Develop a 'Single System Owner' model and implement through the Trunk Mains Intensive Care Period

3.2   Theme 2: Monitoring

The monitoring theme commitments will renew the trunk mains monitoring strategy, improve our use of monitoring data to proactively and reactively identify bursts, and achieve completion of the existing monitoring equipment installation programme. There are four commitments in the monitoring theme.

- Commitment 2.1: Formalise the trunk mains monitoring policy
- Commitment 2.2: Provide updated and repeatable control room training
- Commitment 2.3: Develop our data utilisation capabilities
- Commitment 2.4: Revitalise the monitoring unit installation process

3.3   Theme 3: Asset information

The asset information theme commitments will improve the way that we collect, assure, view and analyse data on the trunk mains asset. There are four commitments in the asset information theme.

- Commitment 3.1: Improve our visibility of and access to reliable asset information
- Commitment 3.2: Develop new methods of data collection
- Commitment 3.3: Improve processes so that data is reliably collected across the trunk main network
- Commitment 3.4: Improve asset information standards and policies

3.4 Theme 4: Risk management

The risk management commitments will improve the way that we predict, model and understand the probability of a trunk mains burst and the consequence of such a burst. There are three commitments in the risk management theme.

- Commitment 4.1: Increase utilisation of existing risk management resources, models and tools
- Commitment 4.2: Improve risk management capability
- Commitment 4.3: Investigate an operational risk model

3.5 Theme 5: Event Response

The event response commitments will develop and strengthen our incident and emergency management capability, including the operational response to containing the burst and repairing the trunk mains, customer communications and care, stakeholder engagement, and operational rotas and working patterns. There are three commitments in the event response theme.

- Commitment 5.1: Mobilise a dedicated out of hours event response capability
- Commitment 5.2: Trunk mains event response improvement programme
- Commitment 5.3: Improve customer care standards and communications during a trunk mains event response

4 Theme 1: Operating Model

This section sets out the commitments under the operating model theme. The operating model theme contains commitments that will improve the way in which the business is structured, the roles, accountabilities and responsibilities, and the governance to support this. The commitments in this theme build on work already done to develop and implement a 'Single System Owner' model for end to end asset management, in line with international standards for asset management.

There is one commitment under the operating model theme:

- 1.1: Develop a 'Single System Owner' model and implement through the Trunk Mains Intensive Care Period

This components of this commitment have already been implemented. Further implementation of this commitment will be undertaken outside the trunk mains implementation phase. They will be implemented alongside other operating model improvements across the Thames Water business. The high level implementation plan can be found in section 9 of this report.

4.1 Commitment 1.1: Develop a 'Single System Owner' model and implement through the Trunk Mains Intensive Care Period

In order to provide clear ownership of the end-to-end asset management process and line of sight from organisation strategy to activity on the ground, the Strategy, Planning and Assurance (SPA) team took on an enhanced System Owner role for Infrastructure (below ground) in late 2016. Through this commitment we will further define and implement the Single System Owner model, which includes the enhanced System Owner role as well as establishing a new Head of Networks role. We will be commencing an implementation period by October 2017 to improve the focus across the end-to-end trunk main asset management lifecycle, and make it more consistent.

We have appointed a Head of Networks to operate as the Asset Manager alongside the role of SPA, and made some changes to the delivery of trunk mains outcomes by clarifying the role of deliverer, for example for trunk mains leak detection and repair, emergency repairs, trunk mains monitoring installation and trunk mains replacement.

We will complete the detailed design of the Single System Owner model and implement alongside wider operating model changes within our business. This will be done in line with a wider Organisation Design review to align with the delivery of our corporate strategy. This will improve our asset management capabilities in line with the Single System Owner model, and increase control of our assets through the establishment of four new roles.

- **Owner –** the head of the SPA team currently takes on this role of Asset Owner with accountability for the longer-term planning and end-to-end management of our assets;
- **Manager –** The Asset Owner will take on accountability for implementation of the recommendations in this report. We recruited a new Head of Networks in May 2017 who will fulfil the Manager role. This will address a gap we identified in translating the longer-term plan and strategy into a rolling 1 year plan. They will be responsible for ensuring the delivery of the plan to the correct standards.
- **Controller –** the Systems Operations teams currently perform the role of the Controller. They are accountable for maintaining the security of supply for the system by managing the operating risks. This includes facilitating access to the network for repair, installation and

shutdown. They are also responsible for managing the asset system during an event and managing the operating priorities across the asset system; and

- **Deliverer –** our alliances, eight$_2$O and the Infrastructure Alliance ("IA"), are accountable for delivering the programme of work agreed by the Head of Networks, to the agreed budget and timescales. They undertake maintenance and construction including trunk mains replacement and re-lining.

In addition, improvements to risk escalation processes through the risk management framework must encompass all relevant risks and not focus specifically on trunk mains risks. We are progressing these improvements across risk types, via our Enterprise Risk Management project.

5 Theme 2: Monitoring

This section sets out the commitments under the monitoring theme. The monitoring commitments will renew the trunk mains monitoring strategy, improve our use of monitoring data to proactively and reactively identify bursts, and achieve completion of the existing monitoring equipment installation programme.

There are four commitments under the monitoring theme:

- 2.1: Formalise the trunk mains monitoring policy;
- 2.2: Provide updated and repeatable control room training;
- 2.3: Develop our data utilisation capabilities; and
- 2.4: Revitalise the monitoring unit installation process.

The four commitments will be implemented as part of the Monitoring workstream activities in the trunk mains implementation phase. The high level implementation plan can be found in section 9 of this report.

Syrinix and Hydroguard are the two primary types of monitoring units that are used to identify bursts and leaks across the trunk mains network. They operate by detecting changes to pressure and sound in the trunk main. Data collected by Syrinix and Hydroguard is sent back to their respective third party servers and notifications are sent to us when certain thresholds are crossed, either by text message or email. Syrinix units are our preferred monitoring unit because it can alert us to leaks and bursts whereas Hydroguard units can only alert us to bursts.

Photograph of a Syrinix monitor on a main

5.1 Commitment 2.1: Formalise the trunk mains monitoring policy

Through this commitment we will develop and implement a policy that will shape how the business approaches trunk mains monitoring. This will provide us with appropriately-timed, accurate, and usable data to assist in response to trunk main leaks and bursts. This commitment seeks to provide the right data to support informed business planning, risk mapping, condition assessment, performance assessment and network optimisation.

There is internal monitoring guidance on how to invest in, use, and manage trunk mains monitoring solutions, however there is no detailed process documentation that sets out a consistent approach to achieving the end-to-end trunk mains monitoring policy. This commitment will address this.

The trunk mains monitoring policy will be structured into three tiers. The three tiers are aligned to our approach to risk management and the division of our trunk mains into sections ('spans') based on consequence of failure levels. Our risk model assigns a consequence level to each trunk main span. Tier 1 is composed of the trunk main spans with the highest consequence and tier 3 is composed of the lowest. Each tier has a different approach to trunk mains monitoring.

Once concluded, the policy will identify the appropriate monitoring equipment and supporting infrastructure, data collection, analysis and reporting for a range of conventional applications. Our formal change process will be improved to allow better adoption of learning and innovation across the monitoring network.

5.2   Commitment 2.2: Provide updated and repeatable control room training

Through this commitment we will increase the ability of the control room team to correctly and consistently use monitoring unit data. This will improve our ability to identify possible bursts and leaks.

The control room is a component of the System Controller role who acts as one of the primary users of the information received from the monitoring units. As part of this role, the System Controller will provide an auditable trail as to how alarms are responded to across all of the monitoring units. The System Controller will also develop capabilities for the proactive use of monitoring data to better inform risk management and event response.

The focus of this commitment is to provide all control room staff with the latest and most appropriate training on the Syrinix and Hydroguard systems so that raw data received from the monitoring units can be better interpreted and used. This will include training on how to perform analysis on the Syrinix and Hydroguard data so that we can identify trends that can be used to better mitigate the risk of or react to bursts and, in the longer term leaks. The longer term vision is that training will be provided to control room staff across all our relevant monitoring units to interpret leak data in order to develop a proactive response to identify and fix leaks before they result in bursts.

5.3   Commitment 2.3: Develop our data utilisation capabilities

Through this commitment we will make appropriate use of the data that is gathered by our monitoring units and increase our in-house capabilities to further the level of analysis that is carried out on this data to inform decisions.

The control room is staffed 24 hours a day so that burst alarms are appropriately dealt with. We have developed a process which sets out how a Syrinix or Hydroguard burst alarm will be dealt with. The process has been formally documented and is available to all control room staff for burst alarms however no such process or training exists for leak alarms.

There is guidance in place on how to set alarm thresholds across the trunk mains network. In some cases however, thresholds are not calibrated to account for the characteristics of leaks and bursts on particular spans of the trunk mains network. We are planning to conduct a pilot study to improve how we actively manage alarm thresholds. We are also carrying out a deep dive analysis exercise to identify potential leading indicators for a burst. This forms part of a wider review of all our existing trunk mains monitoring data to understand how we can get the best use from it.

To improve the visibility of trunk mains monitoring data the aim is improve the integration of all data. The integration of our Syrinix and Hydroguard monitoring unit data is being managed outside of the Trunk Mains Strategic Review and will form part of the business plan for the five year period from 2020. In the interim we are installing a bespoke desk in the control room which will receive all the raw data that is gathered by Syrinix, Hydroguard, and the district meters. This will allow an individual to view all monitoring data on dedicated screens so they do not have to log into separate systems on screens displaying other control room data.

5.4   Commitment 2.4: Revitalise the monitoring unit installation process

Through this commitment we will increase the speed and reduce the complexity of our processes for installing and commissioning Syrinix and Hydroguard monitoring units.

Through this commitment we will increase the pace of installation and commissioning of all monitoring units. We will develop a target profile of trunk main locations that should have monitoring units installed, aligning with the trunk mains monitoring policy as set out in commitment 2.1. The target profile will include an assessment of buildability risk to reduce the instances of the location not being suitable for installation due to a lack of physical space, encroachment by other utilities or difficulty in securing road closures.

The improvements identified will implemented as part of our ongoing trunk mains monitoring programme to design, scope, commission, install and handover new Syrinix monitoring units.

6 Theme 3: Asset Information

This section sets out the commitments under the asset information theme. The asset information commitments will improve the way that we collect, assure, view and analyse data on the trunk mains asset.

There are four commitments under the asset information theme:

- 3.1: Improve our visibility of and access to reliable asset information;
- 3.2: Collate historical data and develop new methods of data collection;
- 3.3: Improve processes so that data is reliably collected across the trunk main network; and
- 3.4: Improve asset information standards and policies.

The four commitments will be implemented as part of the Asset Information workstream activities in the trunk mains implementation phase. The high level implementation plan can be found in section 9 of this report.

6.1 Commitment 3.1: Improve our visibility of and access to reliable asset information

Through this commitment we will create and trial a tool that improves the visibility of all trunk main asset information to inform decision-making across our wholesale water business.

We are working with external experts to develop our current GIS[4] tool based on feedback and requirements from across the Wholesale Water business. This is referred to as the 'visibility tool' and it will include additional risk and event response features including contingency plans. We will pilot this tool with a limited user group and then will make decisions about further development and rollout.

Preliminary designs indicate that the tool will have a number of layers. Each layer will provide a map of the trunk main network overlaid with information that can be used by different teams working on the trunk main network. All the layers will be available to all our staff regardless of whether their role is office or field based. Pending a successful pilot and rollout across the business, certain features of the tool will then be made available to relevant external stakeholders (e.g. the emergency services) as appropriate.

We will invest in the setup and delivery of a programme of work to update our trunk main contingency plans for our trunk main 'shut-able' sections' (the length of trunk main between two shut-able valves). Once developed, the updated contingency plans will be regularly reviewed and updated. This will be done in conjunction with the development of the visibility tool as it is important the visibility tool allows easy access to the required contingency plans.

6.2 Commitment 3.2: Develop new methods of data collection

Through this commitment we will focus on developing new methods of data collection. In time, we expect that this will help drive a greater emphasis on the value of good quality data. This commitment will also collate our historic trunk mains data and improve its availability for evidence based decision-making.

By developing an accurate single view of data and increasing the interaction between our SPA[5] and operations teams, we will drive a culture that recognises the importance of data as a business asset. The

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SPA team is committed to engaging directly with our operations teams to formalise the understanding of how data will be accurately, consistently and efficiently updated in GIS.

We are committed to developing new and innovative technologies to better analyse trunk main condition. We will continue to work closely with the University of Surrey to develop these technologies and we are in the process of developing a new testing rig, operational in 2018, that will allow us to work with our supply chain to test new tools for assessing asset condition. This is being managed as a project outside of the Trunk Mains Strategic Review by our innovation team.

We are collating all of our historic trunk main burst data across the various databases to produce a single view of the data. We are undertaking infill analysis for trunk main spans where we have identified gaps or where we have low confidence in the data that is currently being recorded. We will develop and communicate a revised process to our in-house operations teams and our alliances, that clearly sets out how all trunk main bursts will be recorded in one single database in an accurate and timely manner.

6.3 Commitment 3.3: Improve processes so that data is reliably collected across the trunk main network

Through this commitment we will identify the most informative data types that exist for our trunk mains network and then develop appropriately governed processes that, once implemented, enable us to collect this data in a reliable and consistent way.

We will first identify the most informative trunk main data types that exist to enhance risk management and event response decisions. Once these data types have been identified we will assess the quality of the current data and the current process by which information is updated for each data type. We will then prioritise which data types and associated processes will be taken forward for improvement.

To address immediate recommendations on operational data collection from the Trunk Mains Forensic Review we have simplified the process to fully capture all local knowledge. We have also arranged a series of "toolbox talks" (workshops for our operations teams) to deliver the message to our operations teams on the importance of updating asset information and the correct process to follow.

6.4 Commitment 3.4: Improve asset information standards and policies

Through this commitment we will improve existing standards and policies to address how asset information will be collected and validated.

We will formalise key definitions regarding our trunk mains network (e.g. risk probability) in order to develop a consistent policy for trunk mains asset information that can be communicated and used across our wholesale water business. This policy will also formalise how we identify which trunk mains require a contingency plan.

The policy will also include all the trunk main data types identified as part of commitment 3.3 and will set out the owner and the formal processes that have been developed to collect data for each data type. We will underpin the data standards and policies by encouraging a cultural shift that places more trust in the information provided by our operations teams, rather than performing excessive validation activities. Appropriate governance and regular checks of the information provided by our operations team will continue to take place to maintain accuracy.

7 Theme 4: Risk Management

This section sets out the commitments under the risk management theme. The risk management commitments will improve the way that we predict, model and understand the probability of a trunk mains burst and the consequence of such a burst.

There are three commitments under the asset information theme:

- 4.1: Increased utilisation of existing risk management resources, models and tools;
- 4.2: Improve risk management capability; and
- 4.3: Develop an operational risk model.

The three commitments will be implemented as part of the Risk Management workstream activities in the trunk mains implementation phase. The high level implementation plan can be found in section 9 of this report.

7.1 Commitment 4.1: Increased utilisation of existing risk management resources, models and tools

Through this commitment we will focus on increasing the extent to which we utilise our existing risk management capabilities and tools to their full potential, enabling increased understanding of risk, improved maintenance of the trunk main network, and better resolution of trunk main events.

To support a one-off improvement activity we will conduct a capability assessment of the risk model to understand its strengths and weaknesses and compare it to risk models and methods used by companies and industries with similar asset failure risks to Thames Water. The assessment will cover the consequence and probability calculations as well as the quality and types of data used. This assessment will inform a number of improvement initiatives that we will prioritise and undertake as part of this commitment, for example development of our predictive analysis capability. It will also provide evidence on whether or not our approach to risk modelling is fit for purpose.

7.2 Commitment 4.2: Improve risk management capability

Through this commitment we will further develop and improve our risk management capability and, where possible and helpful, identify and manage risk at an operational level. This will require us to re-assess the capabilities of the existing risk model, harness the skills and experience of operations teams, seek more innovation in asset condition assessment and place greater emphasis on continuous improvement.

We are in the process of developing a more detailed model that will enhance our ability to accurately predict the flooding footprint of potential events. This in turn will improve our consequence modelling and enable future decision support tools for the control room team to use for 'what if' scenarios when managing events and assessing risk.

We are working more closely with our supply chain to develop new and innovative ways of assessing asset condition. The most notable examples of this are the trunk main condition assessment tool project and the building of a physical testing environment for testing new asset assessment tools. Going forward, this type of collaborative project will be incorporated into business as usual.

7.3 Commitment 4.3: Develop an operational risk model

Through this commitment we will develop and trial a dynamic operational risk model that can be used by our strategic business planning, system control and operational teams.

Once we have proved the use of the strategic hydraulic models we will adapt this model to include risks and make it usable as a day-to-day dynamic operational risk model. This model will be available for use by SPA, system control and operations team members to assess the impact of bursts, network changes and asset enhancements in a dynamic way that supports day-to-day network management decisions. The model will utilise up-to-date asset and network information, including asset status information, from the risk model, SAP and operational activity. This commitment is to develop a trial operational risk model and to pilot it with a limited user group. We will then make decisions about further development and rollout based on the success and benefits of the pilot.

8 Theme 5: Event Response

This section sets out the commitments under the event response theme. The event response commitments will develop and strengthen our incident and emergency management capability, including the operational response to containing the burst and repairing the trunk mains, customer communications and care, stakeholder engagement, and operational rotas and working patterns.

There are 3 commitments under the asset information theme:

- 5.1: Mobilise a dedicated trunk mains event response capability;
- 5.2: Trunk mains event response improvement programme; and
- 5.3: Ensure we provide appropriate customer care.

The three commitments will be implemented as part of the Event Response workstream activities in the trunk mains implementation phase. The high level implementation plan can be found in section 9 of this report.

8.1 Commitment 5.1: Mobilise a dedicated out of hours event response capability

Through this commitment, we will improve our ability to respond to water mains events by establishing a dedicated out of hours operational event response capability. This is in addition to the changes we have already made to provide a dedicated customer response team for major events such as a Trunk Mains burst..

We are considering various methods to better control and contain the impact of a burst main. Whilst we evaluate and develop a sustainable solution that works in the longer-term (commitment 5.2) we will mobilise a suitably equipped dedicated event response capability to handle mains bursts. These teams will be our first response to a potential burst and will work to provide on-the-ground information, control and contain the impact.

The service will bring together teams and expertise from across Thames Water and our alliances to ensure that when a burst occurs we can contain and isolate it in the most effective manner. We will define the processes, policies and service levels required to manage this team in line with our corporate strategy for improved holistic network management.

8.2 Commitment 5.2: Trunk mains event response improvement programme

Through this commitment, we will instigate a programme of works to improve our response and recovery capabilities by making changes to the way we are organised, our processes and governance as well as our capacity to respond to major events. We will evaluate options on how we manage events, and better prepare our core operations by reviewing skills, tools & equipment and ways of working across Thames Water and our alliances. We will set appropriate Service Level Agreements aligned to customers and stakeholder needs to improve our performance, and refine our event response processes to bring them closer into line with those of the Category 1 responders under the Civil Contingency Act.

Transforming the way our organisation operates will not happen overnight. Under commitment 5.1 we will take steps to reduce the time between an event being triggered and containment but this is not enough to radically improve the way we operate. Achieving longer-term sustainable change requires a coordinated programme of initiatives to understand, design, pilot, review and implement new ways of working.

We will instigate a comprehensive Trunk Mains Improvement Programme that will:

- Better align our operational response to customers & stakeholders needs;
- Provide our people with the right skills, training and support now and for the future;
- Streamline governance and decision making;
- Codify our processes and policies to simplify the way we work;
- Introduce technology and making better use of the of the data we manage; and
- Ensure we have the right equipment and resources in place to do our jobs well.

Whilst in many ways the high-level process and technical capabilities will not change significantly, cultural change is an integral part of the transformation journey for our Event Response. The working environment in which managers and staff operate will change considerably. The introduction of new technology, data transparency, simplifying governance arrangements and alternative working patterns will change the way in which staff are expected to operate daily. It will be these new ways of working and shaping a new culture of response that is focused on impacts and outcomes for customers.

8.3 Commitment 5.3: Improve customer care standards and communication during a trunk mains event response

Through this commitment, we will change the way customers and stakeholders experience a Trunk Mains burst event, mitigating the impact through communication, engagement and our in-field response. We will also develop a more joined up approach in line with commitment 5.2 on what we do for our customers during an event.

We will join up our customer communications across event response and customer teams to ensure accurate and consistent messaging. Our Customer Communications Playbook will also provide the Customer Incident Management team with clear standard messaging to support with customer engagement across all channels within input from Events Communications Lead.

There is a team within the contact centre that has clear accountability for liaising with operations teams to understand the customer impact and to ensure that customer messages are disseminated across all channels within 15 minutes and updated regularly.

We utilise a number of methods to interact and communicate with our customers in order to keep them regularly informed. We are investing more into social media, as this is a channel increasingly used by our customers. We have assigned more of our people to provide coverage 24/7 and we have a new tool that enables us to listen to customer conversations about Thames Water on social media and can respond rapidly.

During the recovery phase of an event we will aim where possible to return life back to normal for customers. Our commitment to customer communication and engagement will continue, our customer facing teams will be provided with clear information on the clean-up and insurance processes. Focus will be given to communicating to customers what our insurance coverage is able to provide to them and how to submit a claim.

A new Customer Advice booklet is being developed to be used by the insurance loss adjusters when engaging with customers. This will make it simpler and easier for customers, and teams engaging with customers, to understand insurance claims.

9 High Level Trunk Mains Strategic Review Implementation Plan

This section sets out the high level implementation plan for delivering the commitments through the trunk mains implementation phase. The implementation of the Trunk Mains Forensic Review recommendations has been in progress for several months as we did not want to wait for the conclusion of the Strategic Review to begin. Changes already implemented are those which did not require further design work to determine a solution and were identified as quick to implement.

The remainder of the recommendations were aligned to one of the five themes identified for the Trunk Mains Strategic Review for further investigation and development. Where these recommendations can be implemented this will occur during the trunk mains implementation phase.

There are three Trunk Mains Strategic Review recommendations that will not be implemented at this time. These are:

Recommendation	Reason for not addressing
R4.2.3 Remote valve cost/benefit analysis Work should be undertaken to better understand the feasibility and risks of increased valve automation on the network in order to build a cost/benefit analysis of the investment.	Increasing the number of automated valves on the network is considered as part of the existing trunk mains strategy for this AMP and will continue to be reviewed within our current business processes.
R6.6.1b Establish maximum response times Analysis of flood impact over time in different scenarios should be undertaken in order to understand the impact of response times on the extent of flooding and establish a 'maximum response time' for Trunk Main bursts, with a clear and detailed policy accordingly.	There is a dependency on the further development of the risk model to understand flood impact before dynamic SLAs can be put in place. This is not a capability that is currently available. The focus of the commitments for operational response will be to establish out of hours dedicated response teams.
R6.5.1b Contact Centre Location moved Move the Contact Centre location to sit alongside the Control Room to improve the dissemination of customer information and insight to the Control Room.	Physical space issues prohibit the movement of the Contact Centre to alongside the Control Room; this will be considered as part of any future reviews of our control functions.

The trunk mains implementation phase is a period of 'intensive care' of at least 18 months to improve and make more consistent our focus across the end-to-end asset management lifecycle. We will be commencing this period in October 2017. Within 18 months the changes and improvements that we have made will be continued as business as usual. The trunk mains implementation phase will:
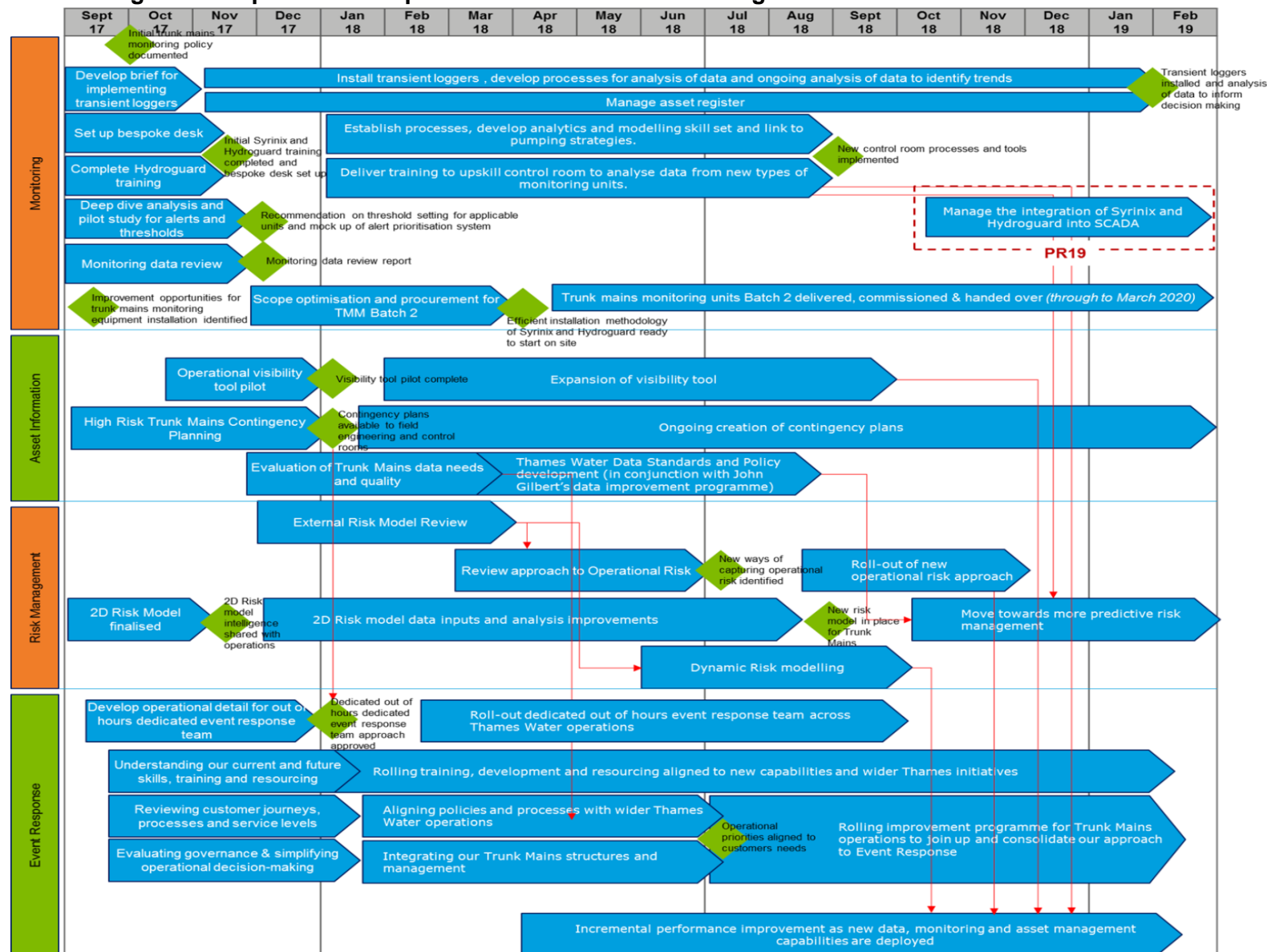
- provide the focus and resource needed to implement the Trunk Mains Strategic Review commitments;

- satisfy the intensive care period recommendation from the Trunk Mains Forensic Review; and

- provide the necessary end-to-end focus on trunk mains so that improvements are sustained.

To guide the activity during the trunk mains implementation phase we have developed an implementation plan aligned to the Trunk Mains Strategic Review commitments detailed in sections 4 to 8.

The high level implementation plan for the trunk mains implementation phase includes a number of pilot projects that will allow us to test our improvements. Following these pilots we will revisit the commitments we have made in this report to confirm that we are implementing the right improvements for our customers and the business. We will commence this review six months after the start of the trunk mains implementation phase. The implementation plan will be managed by a dedicated Programme Management Office (PMO) and overseen by the Head of Networks.

The implementation plan on the following page outlines the key activities and milestones. Each activity is aligned to the relevant theme and associated commitments.

Table 1: High level implementation plan for the Trunk Mains Strategic Review

10 Appendix 1: Glossary of Terms

AIM	Asset Investment Manager
AMP	Asset Management Planning period
AMP5	Asset Management Planning period 5, from April 2010 to March 2015 inclusive
AMP6	Asset Management Planning period 6, from April 2015 to March 2020 inclusive
AMP7	Asset Management Planning period 7, from April 2020 to March 2025 inclusive
APS	Asset Planning System
ARRC	Audit, Risk and Regulatory Committee
Broadcasting	Provision of information to a wide audience i.e. information available on the Thames Water website
Capex	Capital expenditure
CCTV	Closed Circuit Television
DEFRA	Department for Environment, Food and Rural Affairs
DMA	Distribution Management Areas
eight$_2$O	Alliance partnership to deliver capital investment programmes
FTE	Full Time Equivalent
GIS	Geographical Information Services
GPR	Ground penetrating radar
HCV	High consequences valve
Hydroguard	Monitoring units that are installed on trunk main valves that, through monitoring pressure and flow, can identify bursts. When a burst is identified a notification is sent to the Thames Water Control Room
IAD	Investment Area Document
IAM	Institute of Asset Management
IBM	A global cloud platform and cognitive solutions company who are part of the eight$_2$O alliance.
Infrastructure Alliance ("IA")	Alliance partnership to maintain Thames Water's supply network
IPT	Integrated programme team within the eight$_2$O alliance
ISO 55001	The requirements specification for an integrated, effective management system for asset management
LA	Local Authority
MP	Member of Parliament
Narrowcasting	Provision of information to a particular audience i.e. those within a specific postcode
NST	Network Service Technician
ODI	Outcome Delivery Incentive
Ofwat	Regulator for water and sewerage providers in England and Wales
Opex	Operational Expenditure
PR	Periodic review conducted by Ofwat for the purpose of determining one or more price controls in accordance with Condition B of the Thames Water Instrument of Appointment
PR14	Price Review 2014 covering the regulatory period from 1 April 2015 to 31 March 2020

PR19	Price Review 2019 covering the regulatory period from 1 April 2020 to 31 March 2025
PTW	Permit to Work
ROCC	Risk, Opportunities and Controls Committee
Sahara	A probe that is placed into the trunk mains network, whilst under pressure, that uses acoustics to identify leaks within the internal walls of the pipes
SFT	Strategic Field Technicians
SI4	Unplanned interruptions to customer > 4 hours
SI12	Unplanned interruptions to customer > 12 hours
SLA	Service Level Agreement
SPA	Strategy, Planning and Assurance
Syrinix	Leak and burst detection system that is installed on trunk mains that 'listens' to the acoustics of the water flow. When bursts are detected notifications are sent to the Thames Water Control Room
Single System Owner Operating Model	An operating model aligned to ISO 55001 and the Institute of Asset Management. It is intended to develop System Owner, System Management, System Controller and System Deliverer capabilities across end-to-end asset management.
TfL	Transport for London
Transient loggers	A monitoring unit that captures momentary pressure variations in our network
Trunk mains	A classification of larger diameter mains (typically 18" or greater) in a water distribution system
TTA	Thames Technology Alliance composed of Accenture, Bilfinger, Deloitte and IBM
WSC	Wholesale Service Centre