S19 Flood Investigation Report
River Ash and Knowle Green Area

20 April 2015

SURREY

S19 Flood Investigation Report

Executive summary

The purpose of this report is to investigate which risk management authorities had relevant flood risk management functions during the flooding that took place around the upstream section of the River Ash in the vicinity of Leacroft and Priory Green in February 2014, and whether the relevant risk management authorities have exercised, or propose to exercise, their risk management functions (as per section 19(1) of the Flood and Water Management Act 2010). It does not address wider issues beyond that remit.

The flooding in the area in question was largely fluvial in nature, caused by unprecedented rainfall during the winter 2013/14 period (275% compared with an average winter).

The Environment Agency (EA) is the lead risk management authority for incidents of fluvial flooding from main rivers, though Thames Water and Surrey County Council also both performed other functions during that event, some of which were under different legislation including the Civil Contingencies Act 2004 and the Water industry Act 1991. The actions of all three authorities are summarised below:

Environment Agency:

- Overrode automatic settings on the River Ash sluice gate to control flooding.
- Worked with Thames Water in order to comply with the *Ash Protocol* and control flooding at the Staines Reservoir Aqueduct.
- Issued flood warnings to members of the public in the affected area and collected data on-site in relation to the extent, source and depth of the flooding.

Thames Water:

- Increased the pumping rate at the Birch Green pumping station in an attempt to control flood levels.
- Partially closed the Moor Lane sluice gate following an instruction from the EA in order to control flow levels on the River Ash and Colne Brook.
- Following the flood event, undertook repairs to the Staines Reservoir Aqueduct.
- Will agree a revised arrangement for operating assets on the Staines Aqueduct when water levels are high on nearby rivers.

Surrey County Council:

- Following the flood event, added the Staines Reservoir Aqueduct to its Flooding Asset Register, in compliance with its duty as Lead Local Flood Authority (LLFA) to create and maintain a register of assets that have a significant effect on flood risk.
- Produced this report in compliance with its duty as LLFA to investigate which risk management authorities have relevant flood risk management functions and whether these functions have been, or will be, carried out.

Recommendations:

This report recognises that there are improvements that could be made regarding the management and implementation of these risk management functions. Therefore, it is recommended that:

1. The EA and Thames Water review their processes and improve their communication links in line with their respective duties as emergency responders.

2. The EA and Thames Water agree to a revised arrangement for operating assets on the Staines Reservoir Aqueduct, and report on its implementation by autumn 2015.

1. Introduction

1.1. Section 19 Flood Investigation Requirement

Under the Flood and Water Management Act 2010 the LLFA must (to the extent that it considers it necessary or appropriate) undertake an investigation upon becoming aware of a flood incident within its area.

A Lead Local Flood Authority is defined under Section 6(7) of the Flood and Water Management Act as being the county council for that area. Section 19(1) requires that the investigation determines the risk management authorities that have relevant flood risk management functions and whether each of those authorities have exercised or is proposing to exercise those functions in response to the flood.

Section 19(2) requires that the LLFA publishes the results of its investigation and notifies the relevant risk management authorities accordingly.

1.2. Location of this Investigation

In early February 2014 the level of the upstream section of the River Ash rose dramatically over a short time period in the vicinity of Leacroft and Priory Green, until it began to overtop its banks. Fluvial flooding was caused to Leacroft, Leacroft Close and Raleigh Court, including internally to some properties. Manor Place, Chestnut Manor Close and Priory Green were flooded and this affected some properties internally. Properties on Strodes Crescent also experienced garden flooding. The elevated level of the River Ash lasted for a number of days before receding.

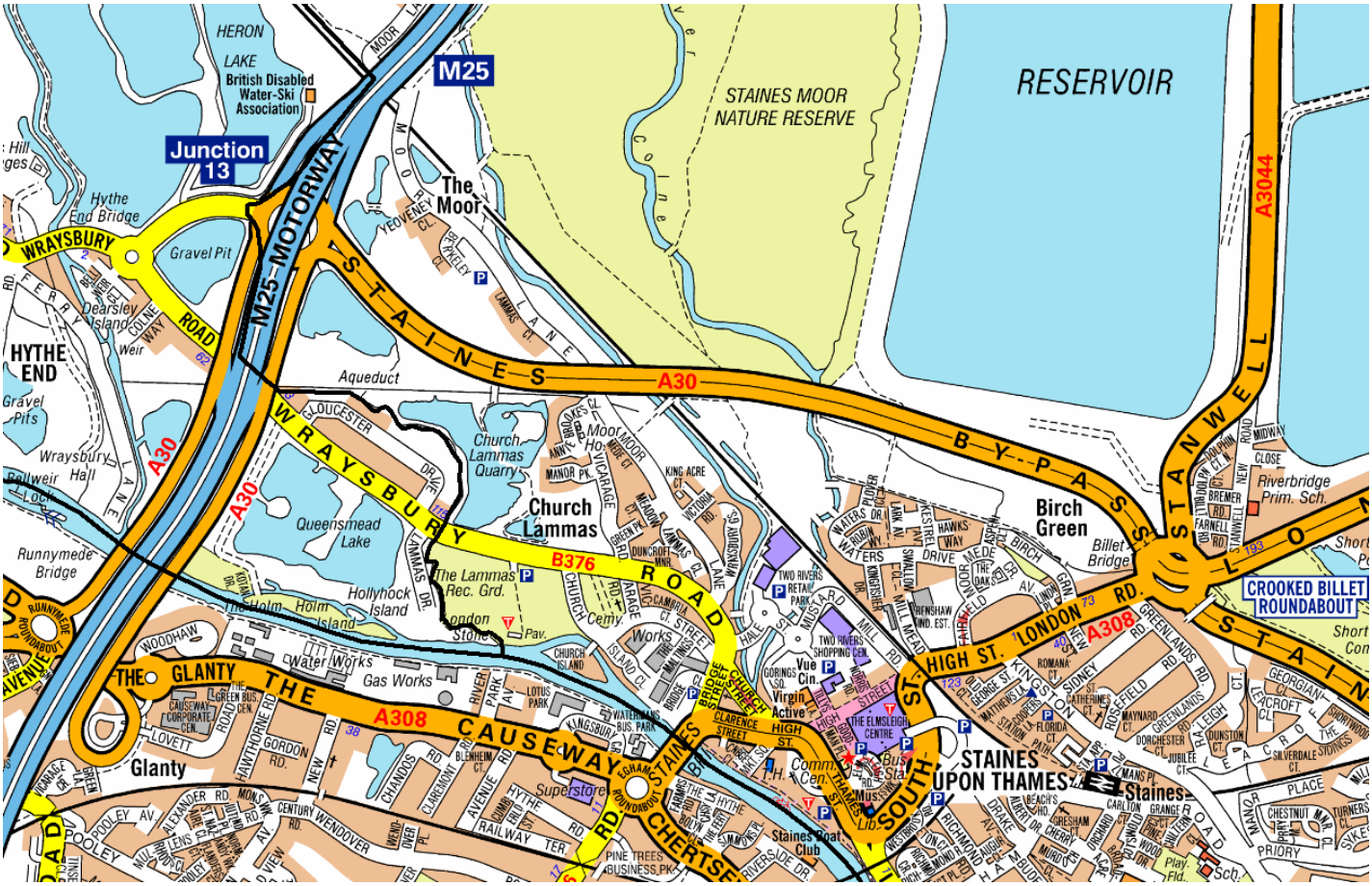

Figure 1: Location of study area

2. Flooding Incident

2.1. Trigger for S19 Report

Fluvial flooding reported in February 2014 from the River Ash and Staines Reservoir Aqueduct which, over a short time period, rose above its banks in the areas around Leacroft and Priory Green, resulting in road and internal property flooding. The source of the flooding was from high levels in the River Thames and the River Wraysbury. Fluvial water also overflowed into Herron lakes, through county ditch and into the aqueduct.

According to EA records, over 80 properties in the Birch Green and Knowle Green areas were affected by the flooding incident, including flooding in grounds, garages and outbuildings.

Based on reports received by Surrey County Council at least 11 of those properties experienced internal flooding.

2.2. Rainfall and Catchment Conditions (extract from EA report)

There was a sharp contrast between the severe, wet winter of 2013/14 and much of the weather that had been seen earlier in the year. From January to the middle of December 2013, rainfall totals were slightly below the long term average. However, a succession of deep, Atlantic low pressure systems, fuelled by a powerful jet stream, battered the country with heavy rain and winds for the rest of the month. They then continued throughout January and February. The winter as a whole, from the beginning of December until the end of February, was the wettest recorded in the UK since records began in 1766. Parts of South East England received almost two and a half times the amount of rainfall that they would normally expect.

2013 started dry and cold. The onset of spring was delayed. Both February and March saw temperatures that were well below average and it was the second coldest March on record. This weather pattern is usually driven by high pressure to the North of the UK; it draws in easterly winds from Europe and tends to block the milder, wetter weather from the Atlantic. As a result, rainfall totals tend to be lower than average.

The summer was dry. July, in particular, saw a run of settled and hot weather across large parts of the UK. Rainfall totals were below average for four months in succession, and the settled summer weather allowed the average soil moisture deficit to build up to more than 120mm. As a result, the ground had the potential to soak up rainfall and reduce the risk of flooding.

In the autumn, unsettled conditions returned. Well above average rainfall was recorded in October. However, because of the dry soils, the rise in river levels was minimal and most of the rainfall soaked away into the ground. By the end of October, soil moisture deficits had dropped slightly below the average and by the end of November they were approaching saturation. This would be expected at that time of year and gave no immediate cause for concern.

The overall amount of rainfall recorded during the winter of 2013/14 was exceptional; on average, 446 mm across the South East of England. That set new records for each of the individual months and for the season as a whole. The totals represented a significant proportion of the average annual rainfall. As can be seen in Table 1, they were more than double what would normally be expected during winter:

County	Winter 2013/14 rainfall (mm)	Winter long term average rainfall (mm)	Winter 2013/14 rainfall compared with winter average
Surrey	560	205	275%
Hampshire	570	225	255%
Buckinghamshire	420	185	230%
Berkshire	415	190	220%
Oxfordshire	350	170	205%

Table 1: average winter rainfall comparison

The period was also notable for the absence of exceptional rainfall from any single storm during January and February 2014. The highest daily total recorded at any of EA's 41 rain gauges across West Thames was 57mm in December, 37mm in January and 28mm in February. Despite late December having the largest rainfall totals for a single day, there was no flooding on the River Thames. This was because there was still capacity in the river system at this time.

The unrelenting rainfall throughout January and February kept the River Thames running at capacity, as all the swollen tributaries flowed into it. That resulted in the highest levels seen on the Lower Thames for more than 65 years.

2.3. Catchment Description

The area is part of the River Colne catchment, one of the principal rivers in Hertfordshire and North London Area, draining a total area of around 900km^2 before discharging into the Thames at Staines.

The catchment is diverse in character. The Upper Colne is defined as the reach upstream of Denham, with an area of around 740km^2, and drains the Chalk of the Chiltern escarpment. The main tributaries are the Rivers Ver, Gade, Chess and Misbourne, all of which are typical Chalk streams.

The Lower Colne is a much more complex system and it is characterised by multiple channels and watercourses. There are several assets like weirs, gates and sluices that are used to maintain suitable levels for the purposes of navigation, flood relief, water supply and the environment. The catchment has been subject to a significant number of flood improvement works in the past.

The main rivers crossing the area of interest are, starting from the west, the Colne Brook, County Ditch, Yeoveney Lodge Ditch, the Staines Bypass Channel, Wraysbury River, and the River Colne. A portion of the flows from the River Colne are diverted into the Ash, which discharges directly into the Thames at Shepperton.

An additional important feature is the Staines Aqueduct, which abstracts water from upstream of Bell Weir in the River Thames. The water flows by gravity to Birch Green Pumping Station, near the Crooked Billet roundabout on the A30 Staines Bypass, from where it is pumped into Kings George VI and Staines Reservoirs. This section of the aqueduct then terminates at the permanently closed sluice gate just past the pump intake. The remaining length of aqueduct, from the Crooked Billet roundabout to Kempton Park Water Treatment Works, is used to transfer water by gravity from the reservoir to the treatment works.

Last winter, as levels on the River Thames were so high, those rivers were not able to discharge into it as they normally would. This caused them to back up and spill into the Aqueduct at various points. This was compounded by the fact that, following months of persistent rain, there was also high groundwater levels (saturated ground) meaning that water could not drain away. It was a combination of saturated ground, high

rainfall and high levels on the River Thames, causing its tributaries to back up, that caused the flooding experienced in the Staines-upon-Thames area.

The Staines Reservoir Aqueduct was over topping into the River Ash at the Crooked Billet side weir and this contributed to increased flow in the Ash. This overtopped in various points, but significantly in the Birch Green and Ashford areas. Figure 2 below shows the River Ash, along with the Aqueduct and locations of gauges and sluice gates:

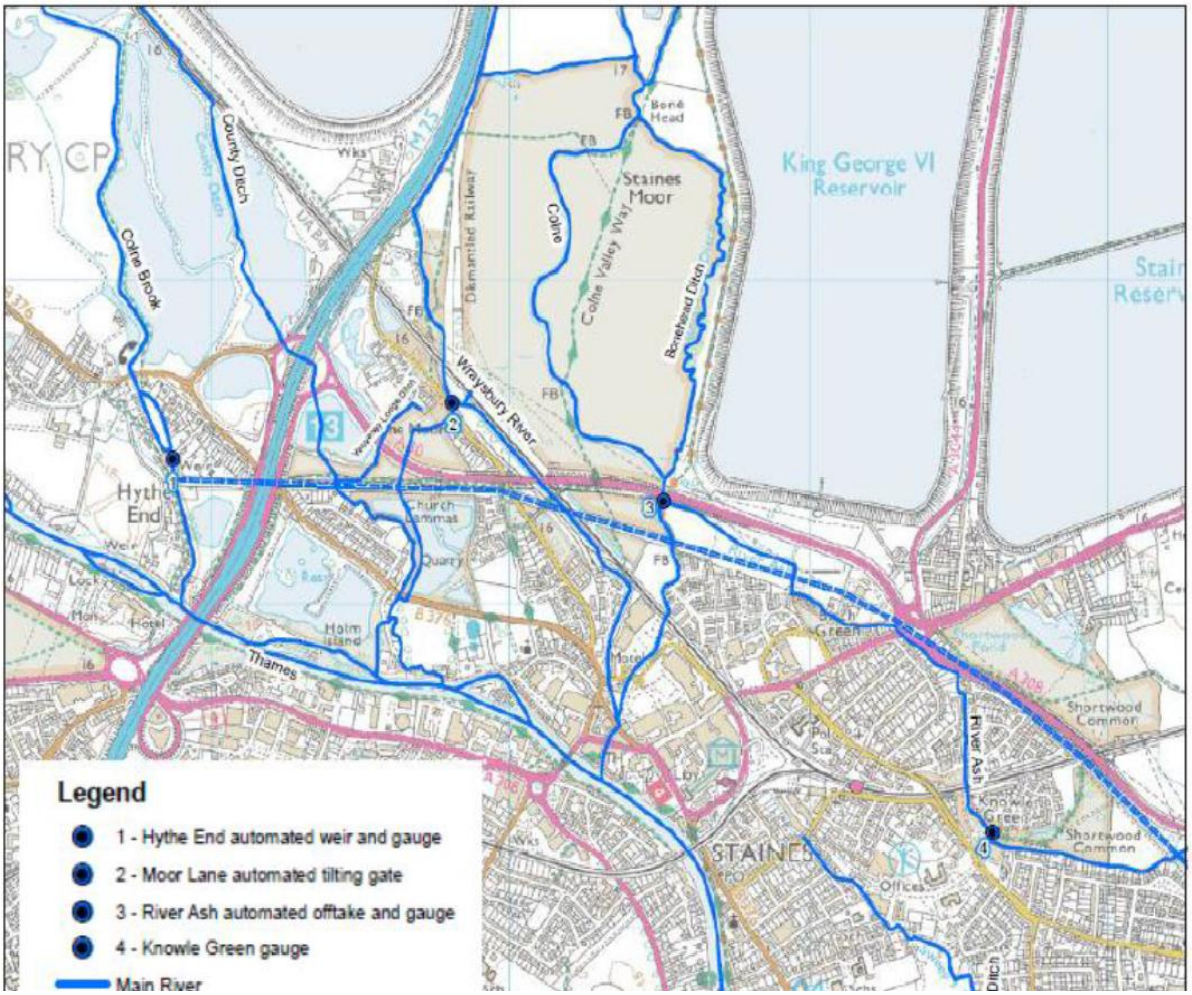

Figure 2: Locations of aqueduct, gauges and sluice gates

2.4. Flood risk and history of flooding

The following information details the types of flood risk that are relevant to the area in question, along with an overview of the history of local flooding (please refer to appendix 1 to view this information in the associated mapping):

Fluvial

The area is located predominately within Flood Zones 2 and 3, with a moderate to high chance of flooding from fluvial sources. The flood zones do not take into account climate change and are designed only to give an indication of flood risk to an area of land and are not sufficiently detailed to show whether an individual property is at risk of flooding.

Groundwater

The area is also located within an area which is classed as having a potential for groundwater flooding to occur at the surface. This is based on a conceptual understanding of the regional geology and hydrogeology and is therefore only an indication of where geological conditions could enable groundwater flooding to occur.

It does not indicate hazard or risk and it does not provide any information on the depth to which groundwater flooding may occur or the likelihood of the occurrence of an event of a particular magnitude. This information should not be used on its own to make planning decisions at any scale, particularly site scale, or to indicate the risk of groundwater flooding.

Surface Water

The area is shown to be at risk of surface water flooding in the following return period events; 1 in 30, 1 in 100 and 1 in 1000. The surface water flood extents are not appropriate to be used in assessing flood risk at an individual property level. In addition, the methods used to derive the flood extents are based on modelled design rainfall (i.e. not observed patterns of rainfall) and consequently these maps cannot definitively show that an area of land or property is, or is not, at risk of flooding.

The Updated Flood Maps for Surface Water (UFMfSW) have been created from the EA's nationally produced surface water flood mapping, and appropriate locally produced mapping from Lead Local Flood Authorities such as Surrey County Council. This means that in different areas, the flood extents have varying levels of suitability scales for viewing or assessing. This area's information is only suitable for assessing flood risk at a 'county to town' scale. This scale is suitable for identifying which parts of counties or towns are at risk, or which counties or towns have the most risk. It is unlikely to be reliable for assessing risk in a more localised area.

Historical Evidence of Flooding

The area is within the extent of the EA's Historic Flood Map. This gives an indication that the area has previously been flooded by rivers, groundwater or a combination of these sources.

Wetspots indicate the approximate location of known previous flooding on the highway. There is a wetspot near to the area of interest and this highlights that there has been historic flooding in the vicinity.

According to Surrey County Council's Property Flooding Database, there have been previous instances of property flooding nearby, either internally or externally. Property flooding is sensitive information and property owners/ occupiers may not always report flooding accurately. Hence whilst this dataset is the most comprehensive record of property flooding in Surrey, there may be instances of property flooding which were not reported and are therefore not recorded.

Surrey County Council's Historic Flooding Incident Database highlights all reported, non point location specific, flooding incidents e.g. example road was flooded. The data indicates that there is a nearby location which has previously reported flooding. Please see the mapping attached which shows the indicative location of known historic flooding.

3. Risk Management Authorities

3.1. Identification of Relevant Risk Management Authorities (RMAs)

In the Flood & Water Management Act 2010, a risk management authority means –

a) the Environment Agency,
b) a Lead Local Flood Authority,
c) a District Council for an area for which there is no unitary authority,
d) an Internal Drainage Board,
e) a water company, and
f) a Highway Authority.

The RMAs together cover all sources of flooding.

The **EA** is responsible for taking a strategic overview of the management of all sources of flooding and coastal erosion in England and Wales. They have prepared strategic plans which set out how to manage risk, provide evidence (for example, their online flood maps), and provide advice to the Government. They provide support to the other RMAs through the development of risk management skills and provide a framework to support local delivery. The EA also has operational responsibility for managing the risk of flooding from main rivers, reservoirs, estuaries and the sea, as well as being a coastal erosion risk management authority. Main rivers are defined through an agreed map which is updated annually. These tend to be the larger rivers in the country.

LLFAs are responsible for developing, maintaining and applying a strategy for local flood risk management in their areas. As part of this, the LLFA liaises regularly with the EA as well as the other RMAs to ensure that all sources of flooding in their area are being properly managed, and filling in any gaps in responsibility where the relevant RMA is unclear. They need to produce reports when there is a reported flood, and they have to keep a register of their flood management assets. They also have lead responsibility for managing the risk of flooding from surface water, groundwater and ordinary watercourses. Ordinary watercourses are rivers which are not designated as 'Main Rivers'.

District Councils can carry out flood risk management works on minor watercourses, working with the LLFA. Through the planning processes, they control development in their area, ensuring that flood risks are effectively managed. If they cover part of the coast, then district and unitary councils also act as coastal erosion risk management authorities.

Internal Drainage Boards (IDB) are responsible for water level management in low lying areas. Not all areas require an IDB, and they currently cover approximately 10% of England. They work in partnership with other authorities and land owners to actively manage and reduce the risk of flooding. This area is not covered by an IDB.

Water and sewerage companies are responsible for managing the risks of flooding from drainage systems, including both their surface water only systems and combined sewer systems. In this area, Thames Water is the water and sewage company. Water and sewerage companies have no specific duties under the Flood and Water Management Act 2010 other than the duty to cooperate with other risk management authorities. However they still need to operate under the Water Industry Act 1991.

Highway Authorities are responsible for providing and managing highway drainage which may include provision of roadside drains and ditches, and must ensure that road projects do not increase flood risk. Surrey County Council is the highway authority for this location.

Table 2 below summarises the RMAs in this location. The ticks indicate which authorities have responsibility for which function and the highlighted cells show which functions are relevant to the flooding from River Ash at Priory Green and surrounding areas.

Flood Source	Environment Agency	Lead Local Flood Authority	Land Drainage Authority		Water Company	Highway Authority
		Surrey County Council		Spelthorne Council	Thames Water	Surrey County Council
Main River	✓					
Surface Water		✓				
Surface Water (on or coming off the highway)						✓
Sewer flooding					✓	
Ordinary Watercourse			✓	✓		
Groundwater		✓				
Reservoirs	✓					

Table 2: Risk Management Authorities

3.2. Exercised Flood Risk Management Functions during the flood event

The primary source of flooding that contributed to this flooding incident was fluvial in nature; the Environment Agency is the lead on managing fluvial flood risk.

This section provides details on the actions taken by risk management authorities to carry out flood risk management functions relevant to this flooding incident.

The Environment Agency Hertfordshire and North London area first opened their incident room to respond to the increasing flood risk in the area on 23 December 2013. The focus on the flood event moved to the Staines-upon-Thames area in early February. For the duration of the flood event the EA worked closely with professional partners to minimise flooding across the area. Field teams were out across the area, managing their flood risk assets, clearing screens and river blockages to ensure that, wherever possible, rivers and streams were flowing freely.

In the Staines area, the two key assets that needed to be managed during the flooding were a sluice gate on the River Ash and Thames Water's Staines Aqueduct.

River Ash sluice gate:

The EA owns and operates a sluice gate which controls flow from River Colne to the River Ash. This sluice gate is designed to ensure there is always a base flow in the River Ash to maintain the ecosystem of the

river. This sluice gate adjusts automatically to send flow into the River Ash as needed. In the February event the EA overrode the automatic settings on this gate to control flooding.

In accordance with their functions to manage fluvial flood risk, the EA undertook the following actions:

On 9 February: the sluice gate was closed manually to minimise flood flows entering the River Ash from the River Colne. As river levels on the Ash were low immediately downstream of the sluice gate it later automatically re-opened (as designed to do) to send a base flow back into the Ash.

On 11 February: the sluice gate was closed again and prevented from automatically re-opening, even if the river levels immediately downstream were low.

On 13 February: the sluice gate was reopened to allow a small flow back into the Ash to prevent damage to the river as a result of a dry riverbed.

Staines Reservoir Aqueduct:

In normal conditions Thames Water pump water from the Aqueduct in Staines-upon-Thames into their reservoirs. In the February event the EA worked with Thames Water to decide how this asset should be managed to prevent flooding in the area which resulted in the operating of the sluice gate on this asset.

On 8 February water levels at Hythe End rose to levels that triggered the *Ash Protocol.* This protocol considered the options for both the pumping and sluice gate operation on the Aqueduct as a part of the overall flood management for the River Ash. Thames Water intake gates at Hythe End were in automatic mode to control the water level in the Aqueduct.

On 9 February (morning), EA reported that the Hythe End intake gates to the Aqueduct were fully closed. And that from this point, the Aqueduct was being fed solely with floodwater originating from the County Ditch and Wraysbury River. Thames Water increased the pumping rate from 270 million litres-a-day to 350 million litres-a-day from its Birch Green pumping station in an attempt to control flood levels.

On 9 February, according to the EA, they asked Thames Water to close the Moor Lane sluice gate, which is located on the Aqueduct. Thames Water claimed to have no record of receiving that request and as a consequence, the gate was not closed

On 10 February, consideration was given to closing the gate. However, Thames Water raised concerns that making an active decision might lead to further flooding upstream for a number of reasons, namely: the gate had not been operated for 10 years; closing it might lead to further flooding upstream and severely limit pumping capability; and, in order to guarantee that the gate could be re-opened once closed, additional lifting gear would be required. Thames Water requested authorisation from the senior Environment Agency Officer who was working at the Strategic Coordinating Centre, (Mount Browne police HQ). This was due to concerns that closing the gate would cause flooding upstream of the gates,

On 10 February (afternoon), after discussions with the EA, pumping from the Birch Green Pumping Station was further increased to 420 million litres-a-day by Thames Water,. This involved bringing an additional pump online and was agreed despite a high risk of damage to both the Aqueduct and the pumping system and further deterioration of water quality in the Staines Reservoirs.

On 11 February (evening), Thames Water was sent an instruction by a senior officer in the EA that the Moor Lane sluice gate was to be 50% closed: this was started immediately.

By 00:30 on 12 February, the sluice gate had been 50% closed by Thames Water. Flows began to recede on the Ash and Colne Brook on the afternoon of 12 February, so the sluice gate was not required to be closed any further.

On 14 February, Thames Water reduced its pumping to one pump because of low levels of water in the Aqueduct. The River Thames intake remained closed. The Moor Lane sluice gate was raised again to allow pumping to take place.

On the 17 February, the EA agreed that Thames Water could reopen its River Thames intake and return to normal operations because water levels in the area were then low.

Following the flood event, Thames Water discovered that the Aqueduct had partially collapsed while causing significant damage. The aqueduct was out of service throughout the summer of 2014 to allow repair, which have now been completed.

Informing the public:

The EA had flood data recorders and flood ambassadors in the Staines-upon-Thames area from 10-14 February. They were on site to collect and record data on the location and number of flooded properties, as well as the flood extent, water levels and, where possible, the source and depth of flooding. They were also speaking to the public and on-hand to answer any questions.

As all landlines within the flood warning area are registered automatically - all residents in these warning areas would have received the warnings to their home phone number unless they have previously opted out from the service. Those fully registered on the EA's Flood Warnings Direct service would have received them to their chosen contact numbers.

In accordance with their functions the EA issued the following flood alerts and warnings that cover the Staines-upon-Thames area:

River Thames:

- 24 December 2013 flood alert "River Thames from Datchet to Shepperton Green"
- 7 February 2014 flood warning "River Thames at Staines and Egham"
- 9 February 2014 severe flood warning "River Thames at Staines and Egham"

River Colne:

- 29 January 2014 flood alert "Lower River Colne and Frays River"
- 7 February 2014 flood warning "River Colne and Frays River at West Drayton and Stanwell Moor"

Colne Brook:

- 31 January 2014 flood alert "Colne Brook at Iver and Colnbrook"
- 31 January 2014 flood warning "Colne Brook at Colnbrook"

River Ash:

- 10 February 2014 flood alert "River Ash in the Borough of Spelthorne including Ashford and Staines"
- 10 February 2014 flood warning"River Ash at Ashford and Staines, including Birch Green, Knowle Green, Littleton and Shepperton"

Surrey County Council

Flooding Asset Register:

As a LLFA, Surrey County Council has a duty to create and maintain a register of assets that have a significant effect on flood risk. Following this flooding incident, the Staines Reservoir Aqueduct has been added to the SCC Flooding Asset Register to highlight the importance this asset has on flood risk to other organisations and the public.

Flood Investigation Report:

This report was produced as part of Surrey County Council's duty as LLFA to investigate which risk management authorities have relevant flood risk management functions (as defined in the Flood & Water Management Act 2010) and whether these functions have been carried out or will be carried out.

Local Flood Risk Management Strategy:

Surrey County Council has consulted and published its Local Flood Risk Management Strategy, which is in line with the National Strategy.

4. Actions and on-going work

Working in partnership:

The EA, Surrey County Council, Spelthorne Borough Council and Thames Water are working more closely with the local community to promote flood resilience awareness in areas at risk of flooding and to look into possible flood alleviation schemes for the area.

Staines Aqueduct:

The EA is working with Thames Water to agree a revised arrangement for operating assets on the Staines Aqueduct when water levels are high on nearby rivers. The sluice gate has now been removed and new isolation valves installed on the siphon under the railway. A detailed protocol is no longer required as Thames Water will take full ownership of their assets and carry out monitoring on the river and aqueduct. They will close the new valves as soon as the level in the aqueduct reaches an established trigger (before it overtops) without the need for any external instruction.
The EA will, however, alert Thames Water when their monitoring shows water levels reaching a certain trigger point on the River Thames or its tributaries, before flood warnings are issued. This will give Thames Water the additional notice time they need to take suitable action. Once alerted, Thames Water will operate their assets on the Aqueduct to manage flood risk.

Thames Water will be running annual tests to ensure communications and operations around the Aqueduct are adequate in case of a high water level event. This is a temporary procedure - the options that will be developed as part of the 6-year programme will look into possibility to make the area more resilient to flooding without the above emergency arrangement.

Flood warning system:

Information from the February 2014 event, including flood level information and feedback from members of the public, has been used to check the accuracy of flood warning thresholds at the Knowle Green river level monitoring site.

As a result of this review, the river level thresholds for issuing flood alerts and flood warnings have been reduced on the River Ash. This means that those signed up to receive flood warnings will receive them at an earlier stage of a potential flood event.

Flood and Coastal Risk Management (FCRM) 6-year investment programme

The River Ash at Staines has been allocated funding of £30k for year 2014-15. With this funding, the EA will develop and improve existing flood modelling to better understand the flood risk and the interactions between the rivers in this area. The updated modelling will include the Thames, the Ash, the Aqueduct, the Colne, the Colne Brook, and the County Ditch and will be used to better represent the flooding mechanisms that occur. This will be done as part of the wider River Thames Scheme which is looking at options to manage flood risk on the Thames between Datchet and Teddington. The effect of the River Thames on these rivers and the flood risk in Staines will be considered.

Once the model is completed, funding available from year 2016 to year 2021 will be used to look at the potential options for managing flood risk from the Ash and other rivers in this area.

River Thames Scheme:

The River Thames Scheme will reduce flood risk to all communities between Datchet and Teddington, including Spelthorne. It includes large scale engineering work to construct a new flood channel, improvements to three weirs and provide flood protection products (known as property level products) for up to 1200 homes. There will also be work to improve flood incident response plans. The scheme is a major partnership project between the EA, local councils (including Spelthorne), the Regional Flood and Coastal Committee, and Thames Water. The Government has made a commitment to fund 75% of the cost of the scheme. However there remains a funding gap of some £50m which needs to be found locally. The EA is working to find the funding needed to deliver the scheme, with the work due to start in 2016 and be completed by 2025.

5. Conclusions and recommendations

The objectives of this report were to investigate which risk management authorities had relevant flood risk management functions during the flooding that took place around the upstream section of the River Ash in the vicinity of Leacroft and Priory Green in February 2014, and whether the relevant risk management authorities have exercised, or propose to exercise, their risk management functions (as per section 19(1) of the Flood and Water Management Act 2010).

The report has established that EA had flood risk management duties in relation to flooding on the Main River and detailed actions taken during and after the flooding. The report also established that as LLFA Surrey County Council had no direct flood risk management functions during the event, whilst also listing the actions taken in relation to the Asset Register and other general duties.

Whilst Thames Water may not have specific flood risk management functions under the Flood and Water Management Act 2010, which was the subject of this investigation, they still have to comply with other legislation, including the Water Industry Act 1991 and are accountable to the Water Services Regulatory Authority (Ofwat). They are also an emergency responder (Category 2) under the Civil Contingencies Act 2004. This report has detailed the actions taken by Thames Water both during and after the event.

At the meeting held in June 2014 at Spelthorne Borough Council and chaired by Kwasi Kwarteng MP, both EA and Thames Water met with the local residents and it was held that the most important aspect was about alleviating the risk of reoccurrence of the flooding.

From the chain of events, it is apparent that the cause of the property flooding in the Birch Green area was predominantly due to a sharp rise in water levels along the River Ash. Opening of the sluice gate would have caused levels downstream to rise locally, however there is no evidence that this in itself caused the river to overtop. Water from the various watercourses getting into the aqueduct would have also caused levels to rise and spill over into the River Ash. It is likely that a combination of those led to the sharp rise of water level on the River Ash witnessed by residents. The flooding mechanisms in this area are complex, with potential

interactions between many different watercourses which could possibly have been further compounded by saturated ground conditions and the prolonged period of rainfall over that period. As such, this report is unable to ascertain the exact cause of this rush of water, nor quantify the impact on the overall flooding by any single action carried out by any of the risk management authorities.

However, the modelling work due to be carried out by the EA will take account of more local features and assets, including the Staines Aqueduct, and this will provide an improved understanding of localised flood risk and flood mechanisms in the area which, in turn, will inform more robust water management measures in the future.

This report has set out to investigate the risk management authorities and their functions, whilst it has not been possible to identify a single cause of the flooding, which is outside the scope of this report, Surrey County Council recognise the devastating impact this flooding has on the local residents. With this in mind, based upon the findings of this report, there are improvements that could be made regarding the management and implementation of those risk management functions, irrespective under which piece of legislation it sits. Thames Water have committed to run regular tests to ensure communications and operations around the Aqueduct are adequate in case of a high water level event and this is most welcome. Nonetheless, this report still indicates that there were some communication issues between the EA and Thames Water and it is therefore recommended that a review of communications during flooding incidents between these organisations is carried out. It is also apparent that a revised arrangement for operating assets on the Staines Reservoir Aqueduct is needed.

Recommendations:

1. The EA and Thames Water review their processes and improve their communication links in line with their respective duties as emergency responders.

2. That the Environment Agency and Thames Water agree to a revised arrangement for operating assets on the Staines Reservoir Aqueduct, and report on its implementation by autumn 2015 – taking account of the improved river model and work on the 6-year programme .

6. Further Considerations

The remit of this investigation is limited to the flood risk management functions as defined in the Flood & Water Management Act 2010.

While legislation may define what the flood risk management functions are and what may be expected from each risk management authority, it in itself does not alleviate the risk of flooding.

Surrey County Council has set up the Surrey Flood Risk Partnership Board bringing together all the flood risk management authorities with a view of sharing knowledge and resources to alleviate flood risks for the benefits of its residents. Following the winter 2013/14 flooding officers have been working closely together to address issues about how each risk management authority communicate with each other and how data is collected and shared.

The Council has also recruited a Community Resilience Officer, who has been establishing contact with communities affected by flooding, raising flood awareness and helping residents become more flood resilient. To date over fifteen local flood fora have been set up and are operating across the county.

Document History

Location Name	River Ash and Knowle Green area
Date(s) of incident	Winter 13/14 flood event
Trigger for S19 Report (as defined by SCC's policy)	Multiple internal property flooding

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Glossary

The table below defines some of the frequently used terminology within the flood risk management industry for general information.

Acronym/Term	Definition
Annual Probability	Throughout this document, flood events are defined according to their likelihood of occurrence. The term 'annual probability of flooding' is used, meaning the chance of a particular flood occurring in any one year. This can be expressed as a percentage. For example, a flood with an annual probability of 1 in 100 can also be referred to as a flood with a 1% annual probability. This means that every year there is a 1% chance that this magnitude flood could occur.
Flood Zone 1	Area with a low probability of flooding from rivers (< 1 in 1,000 annual chance of flooding).
Flood Zone 2	Area with a medium probability of flooding from rivers (1 in 100 – 1 in 1,000 annual chance of flooding).
Flood Zone 3	Area with a high probability of flooding from rivers (> 1 in 100 annual chance of flooding).
Main River	Main rivers are usually larger streams and rivers, but some of them are smaller watercourses of local significance. Main Rivers indicate those watercourses for which the Environment Agency is the relevant risk management authority.
Ordinary Watercourse	Ordinary Watercourses are displayed in the mapping as the detailed river network. An ordinary watercourse is any watercourse (excluding public sewers) that is not a Main River, and the Lead Local Flood Authority or Internal Drainage Board. are the relevant risk management authority.
UFMfSW	Updated Flood Maps for Surface Water

Sources of Flooding

The following report highlights the risk of flooding from fluvial, surface water and groundwater sources. It also reports nearby historic evidence of flooding from these sources, alongside historical evidence of sewer flooding (where available). It is important to note that there are other sources of flood risk which may impact the area of interest and are not considered in this report; all sources of flood risk are described below.

Source	Description
Fluvial flooding	Exceedance of the flow capacity of river channels (whether this is a Main River or an Ordinary Watercourse), leading to overtopping of the river banks and inundation of the surrounding land. Climate change is expected to increase the risk of fluvial flooding in the future.
Tidal flooding	Propagation of high tides and storm surges up tidal river channels, leading to overtopping of the river banks and inundation of the surrounding land.
Surface water flooding	Intense rainfall exceeds the available infiltration capacity and / or the drainage capacity leading to overland flows and surface water flooding. Climate change is expected to increase the risk of surface water flooding in the future. This source is also referred to as pluvial flooding.
Groundwater	Emergence of groundwater at the surface (and subsequent overland flows) or into subsurface voids

flooding	as a result of abnormally high groundwater flows, the introduction of an obstruction to groundwater flow and / or the rebound of previously depressed groundwater levels.
Sewer flooding	Flooding from sewers is caused by exceedance of sewer capacity and / or a blockage in the sewer network. In areas with a combined sewer network system there is a risk that land and infrastructure could be flooded with contaminated water. In cases where a separate sewer network is in place, sites are not sensitive to flooding from the foul sewer system.
Other sources of flood risk	Flooding from canals, reservoirs (breach or overtopping) and failure of flood defences.

Flood Risk Data Sources

The following sources of data have been used in preparing this report and its associated mapping:

- Fluvial Flood Risk
  - Flood Zones (Environment Agency)
  - Flood Warning and Alert areas (Environment Agency)
- Surface Water Flood Risk
  - Updated Flood Maps for Surface Water (UFMfSW) (Environment Agency)
- Groundwater
  - Susceptibility to Groundwater Flooding (British Geological Survey)
- Historic Flood Evidence
  - Historic Flood Map (Environment Agency)
  - Wetspots (Surrey County Council)
  - Property Flooding Database (Surrey County Council)
  - Historic Flooding Incidents Database (Surrey County Council)

[Information for this report has been extracted from the Environment Agency reports for the West Thames Area and Lower Colne and Ash Area reports]

Surrey County Council welcomes evidence of any historical flooding in the area which is not highlighted on the mapping attached, please report it, with any evidence (for example photos or videos), to flooding.enquiries@surreycc.gov.uk.