Appendix 2

# Reading Flood Investigation - January 2024

## Flood Investigation Report – Full Version

On behalf of **Reading Borough Council**

Reading Borough Council
Working better with you

Project Ref: 332611243/001 | Rev: AA | Date: May 2024

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# Document Control Sheet

**Project Name:** **Reading Flood Investigation 2024**

**Project Ref:** **332611243**

**Report Title:** **Flood Investigation Report – full version**

**Doc Ref:** **332611243/001**

**Date:** **17 May 2024**

| | Name | Position | Signature | Date |
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| **For and on behalf of Stantec UK Limited** | | | | |

| Revision | Date | Description | Prepared | Reviewed | Approved |
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# 1 Introduction

## 1.1 Purpose of Report

1.1.1 This report has been produced by Stantec UK Ltd ('Stantec') on behalf of Reading Borough Council (RBC) to record the findings of an investigation into flooding which occurred in Reading in January 2024, impacting a number of residential and commercial properties.

1.1.2 Flood Investigation Reports (FIR) are completed by RBC under their duties as the Lead Local Flood Authority (LLFA).

1.1.3 A Section 19 Flood Investigation Report has been produced by Stantec (dated March 2024) which provides a brief overview of the January 2024 flood event and impacts. It should be read in conjunction with this report.

1.1.4 This report supplements the Secction 19 report by providing an overview of the source, duration, mechanism, characteristics and consequences of the January 2024 flood event; actions taken by the relevant Risk Management Authorities (RMAs) since the flood event, and recommendations for future actions and interventions.

## 1.2 Roles and Responsibilities

1.2.1 Flood Risk Management Authorities (RMAs) have different responsibilities under the Flood and Water Management Act 2010 (FWMA) dependent on the source of flooding. These responsibilities are summarised in **Table 1-1.**

**Table 1-1: Summary of RMA Responsibilities**

| Source of Flooding | Environment Agency | LLFA [RBC] | Water Company [Thames Water] | Highways Authority [RBC/ National Highways] |
|---|---|---|---|---|
| Main River | X | | | |
| Ordinary Watercourse | | X | | |
| Surface Water | | X | | |
| Surface water on or coming from the highway | | | | X |
| Sewer | | | X | |
| Groundwater | | X | | |
| Reservoirs | | X | | |

## 1.3 Reading Flooding, January 2024

1.3.1 Low-lying land and property was flooded within the RBC administrative boundary during the first week of January 2024 due to rising water levels in the River Thames, River Kennet and tributaries. Internal flooding of residential and commercial properties occurred in the Southcote and Lower Caversham areas of Reading Borough over the weekend of 5th – 7th January 2024.

1.3.2 Internal property flooding in the Southcote area was reported by residents to have arisen from the drainage ditch network connected to the Holy Brook. Flooding in Lower Caversham was reported by residents to have arisen from Christchurch Ditch (also known locally as The Gos

Brook and Dannalls Brook) exacerbated by localised surface water drainage problems and potentially groundwater within the river gravels.

## 1.4 Sources of Information

1.4.1 This report has been prepared using information from the following sources.

- British Geological Survey/UK Centre for Ecology and Hydrology - Groundwater data and analysis for Stonor Park borehole.
- DEFRA Data Services Platform – River levels, 'Kennet at Theale' gauge.
- EA 'Monthly water situation report: Thames Area, January 2024'.
- EA 'Monthly water situation report: England, December 2023'.
- RBC 'Local Flood Risk Management Strategy' [LFRMS] dated October 2015.
- RBC 'Strategic Flood Risk Assessment' [SFRA] dated June 2017.
- River Levels UK – historic river level data, 'River Thames at Reading' and 'River Kennet at Theale' gauges.
- Thames Water 'Thames Conservancy Statistics of Rainfall, Flow and Levels on the River Thames Above Teddington, Vol. 1, 1883 – 1964', dated 1965.
- University of Reading Meteorology Department rainfall data and meteorological summary tables, October 2023 – January 2024.

1.4.2 Reading Borough Council provided copies of their records of properties affected by flooding and relevant communication/consultation with residents.

1.4.3 The Canal and Rivers Trust (CRT) was contacted but no response has been received to date.

# 2 Background Information

## 2.1 Relevant Watercourses and Responsibilities

2.1.1 The RBC administrative boundary includes reaches of the River Thames, River Kennet and Holy Brook, which are all designated as Main Rivers for which the EA holds responsibility.

2.1.2 Some navigable sections of the River Kennet within the RBC administrative boundary form part of the Kennet and Avon Canal, and maintenance of these sections is the responsibility of CRT.

2.1.3 The Holy Brook is a tributary of the River Kennet and flows eastwards from Theale through the floodplains in south Reading, passing through central Reading in open and culverted sections, and rejoining the River Kennet close to Reading Abbey ruins. Responsibility for the watercourse is held by the EA.

2.1.4 The designated floodplains to the south of Reading include a network of drainage ditches running between and flowing into the River Kennet and/or Holy Brook. The majority of this ditch network is designated as part of the Main River network, but some ditches are classified as Ordinary Watercourses, which are the responsibility of RBC.

2.1.5 Christchurch Ditch (also known locally as Gos Brook or Dannalls Brook) runs eastwards through Christchurch Meadows and Hills Meadow between Reading Bridge and Heron Island. It conveys surface water drainage from the adjacent urban area to the River Thames and has a secondary function to act as a drainage route for the floodplain after a flood event. It is classified as a Main River but is primarily located within RBC's land ownership, so RBC has maintenance responsibilities as the riparian owner.

2.1.6 Local residents whose properties adjoin the ditch also have riparian ownership responsibilities, with ownership of private land adjacent to a watercourse usually extending to include the adjacent watercourse bank and 50% of the width of the watercourse, unless otherwise specified in property deeds or by the relevant management authority. The landowner is responsible for maintenance of areas within their riparian ownership.

## 2.2 Fluvial Flood History

2.2.1 The most significant flooding of the 20th Century in Reading (and throughout the Thames Valley) occurred in March 1947, where runoff from rain and rapid snowmelt was a major contributing factor to extremely high-water levels in the River Thames and the River Kennet, causing extensive flood damage. The water level in the River Thames at Caversham during this flood event was recorded as 37.83m AOD. Significant changes were made throughout the Thames Valley to provide flood alleviation and increase the capacity of the Thames following this flood event.

2.2.2 More recent significant flood events in Reading have occurred approximately once every 10 years. The winters of 2002/3 and 2013/14 were the most recent flood events where properties were impacted by internal flooding. The flood event of early 2003 was estimated to be a 1 in 20 year (5% annual probability) flood event and the recorded water level on the River Thames reached 37.48m AOD. The probability of the 2013/14 event has not been estimated but was a double peak flood event where water levels rose to a maximum of 37.35m AOD twice within a 4 week period in January and February 2014.

## 2.3 Flood Defences and Controls

2.3.1 Water levels in the River Thames as it flows though Reading are controlled by the EA via a series of adjustable weirs located within and outside the RBC administrative boundary. The

primary control structure within Reading is Caversham Weir; however, the primary purpose of the weir is to maintain upstream navigability and not for flood protection.

2.3.2 A series of sluice gates and weirs are present on the River Kennet/Kennet and Avon Canal as it flows to the south of Reading. The sluice gates can be opened to release water into the surrounding floodplain when water levels are high. Again, the primary purpose of the control structures is to maintain navigable water levels. This process is managed by the CRT.

2.3.3 Water levels in the downstream section of the River Kennet are managed via the adjustable weir at Blake's Lock, just prior to the confluence with the River Thames. This is managed by the EA.

2.3.4 There are no formal flood defences or flood alleviation schemes within the RBC administrative area. Green spaces adjacent to the River Thames and River Kennet provide additional capacity to hold floodwater in urban areas; however if this capacity is exceeded then property flooding in the urban areas closest to the main watercourses and tributaries may occur.

2.3.5 Areas of artificially raised ground have been created in parts of Lower Caversham to provide informal protection from rising water levels in the River Thames channel. One such area lies between the eastern end of Christchurch Ditch and the River Thames.

2.3.6 Between 2018-2020 an investigation was undertaken by the EA into the potential for installation of flood defences and/or flood alleviation measures in Lower Caversham. The outcome of the investigation was that the cost of installing the shortlisted measures would be disproportionate to the number of properties protected, so the potential scheme did not proceed.

## 2.4 January 2024 Event - Antecedent Rainfall

2.4.1 EA Water Situation reports and data from the University of Reading Meteorology Department indicate that rainfall levels in November 2023, both in the wider Thames catchment and within Reading, were well above the long term average. December 2023 was the wettest December since 2012, with total rainfall in Reading recorded at 145% of the long term average rainfall total for December.

2.4.2 In the 8 days prior to Storm Henk on 4th January 2024, 54.6mm of rain was recorded at Cleeve rainfall gauge, located upstream of Reading at Goring. The Thames area received 65% of the total recorded rainfall in January 2024 between 1st - 4th January. River flows and river levels responded rapidly to the high rainfall levels due to surface water runoff and high recharge rates into underlying aquifers, which is further discussed in Section 2.5 and 2.6.

2.4.3 On the 4th January 2024, Storm Henk caused exceptionally heavy rainfall which began at 15:00, peaked at 17:00 and continued until 03:00 on the 5th January. In total, 31.5mm of rain fell on 4th and 5th January (42.5% of the recorded monthly rainfall for January).

## 2.5 January 2024 Event - Surface Water – Runoff from Catchment

2.5.1 Saturated ground conditions due to the above average rainfall between November – December 2023 are likely to have reduced or removed the capacity for infiltration of subsequent rainfall in January 2024 into the Thames catchment.

2.5.2 Soil Moisture Deficit (SMD) is an indicator of the capacity of soil to hold rainfall via infiltration, and the Water Situation Reports indicate that SMD at all sites monitored by the EA was well above the expected levels in the late autumn/early winter months, with soils considered to be fully saturated (i.e. with no possibility of further infiltration) by the end of December 2023.

2.5.3 Therefore, the rainfall preceding, during and immediately after Storm Henk led to high volumes of surface water runoff directly into rivers and associated watercourses because this water was unable to infiltrate into soils. This contributed to river flows rising and water passing downstream

more rapidly would usually be expected for the time of year, leading to an increase in flow volumes and velocities which exceeded the capacity of the river channels.

## 2.6 Groundwater Levels

2.6.1 EA Water Situation reports indicate that groundwater levels at all indicator sites rose in response to the high recharge rates from rainfall between December - early January 2024. Groundwater levels were already higher than average at most indicator sites due to high rainfall levels since October 2023. Saturated ground conditions and a high water table increase the speed at which water returns to watercourses within the catchment because deeper level infiltration to the aquifer can no longer occur, and also directly increases river baseflows where these are groundwater fed. Ephemeral streams are also present in the Thames and Kennet catchments (including the source of the Thames) which only flow when groundwater levels are sufficiently high.

2.6.2 These natural processes are likely to have contributed to the flood event in January 2024 with more water than usual for the time of year passing directly or indirectly into rivers and streams in the Upper Thames catchment, and also passing more rapidly down the catchment than usual.

2.6.3 The groundwater monitoring borehole at Rockley (ID: SU17/57) is located in a chalk valley north-west of Marlborough, within the upper Kennet catchment. Groundwater levels are recorded by the UK Centre for Ecology and Hydrology (UKCEH) and reported by the British Geological Survey (BGS). BGS records note significant evidence of surface water - groundwater interaction at this borehole location and provide a graphical representation of groundwater levels per decade, where the grey area represents the area between the highest and lowest levels ever recorded, and the black dotted line represents an average level. **Figure 2-1** shows data from the 2020s thus far.

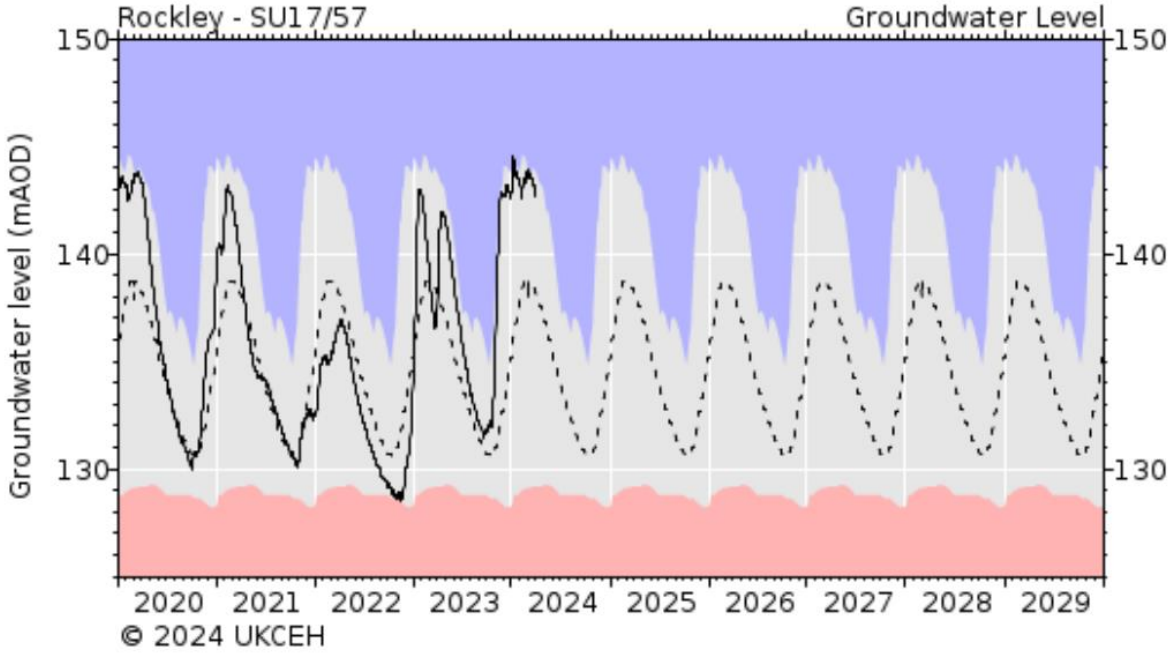



**Figure 2-1: BGS/UKCEH graphical representation of groundwater levels at Rockley borehole, 2020-2024**

2.6.4 Groundwater levels are expected to rise between autumn and spring as part of normal seasonal variations, but it is notable that groundwater levels rose particularly steeply from a just above average level in October 2023 to almost the maximum level ever recorded (purple area) in late December/early January 2024. Data from previous decades shows a similar rapid peaking of groundwater levels in December/January 2002/3 and 2013/14, which coincides with previous significant flood events in the region.

2.6.5 Within Reading Borough, direct groundwater flooding to properties is considered less likely to occur even at times of high groundwater due to the presence of a confining London Clay or Lambeth Group clay layer above the Chalk aquifer across much of the urban area. Perched groundwater may still be present within superficial deposits and some historic groundwater flooding has been noted in the RBC SFRA within low-lying areas, including Lower Caversham. Residents in this area reported flooding of basement areas (described in Section 3) which may be indicative of groundwater flooding through river gravels. However, because this occurred concurrently with flooding from other sources, it is difficult to ascertain if there was any direct contribution of groundwater flooding to the January 2024 event.

# 3 Flood Event Description and Analysis

## 3.1 Overview of Flood Event

3.1.1 In early January 2024, river levels in Reading reached their highest level since 1947 and exceeded the levels reached during the significant flood events in 2002/3 and 2013/14.

3.1.2 The water level at the 'River Thames at Reading' river level gauge has a normal range of up to 7.00m above local datum (AD), with flooding of low lying land considered to be possible above this level, and property flooding possible when levels exceed 7.25m AD. This level was exceeded on 5th January 2024 with a recorded level of 7.26m AD, peaking at 7.54m AD on the 7th January, and returning to a level consistently below 7.00m AD on the 11th January, as shown in **Figure 3-1**.

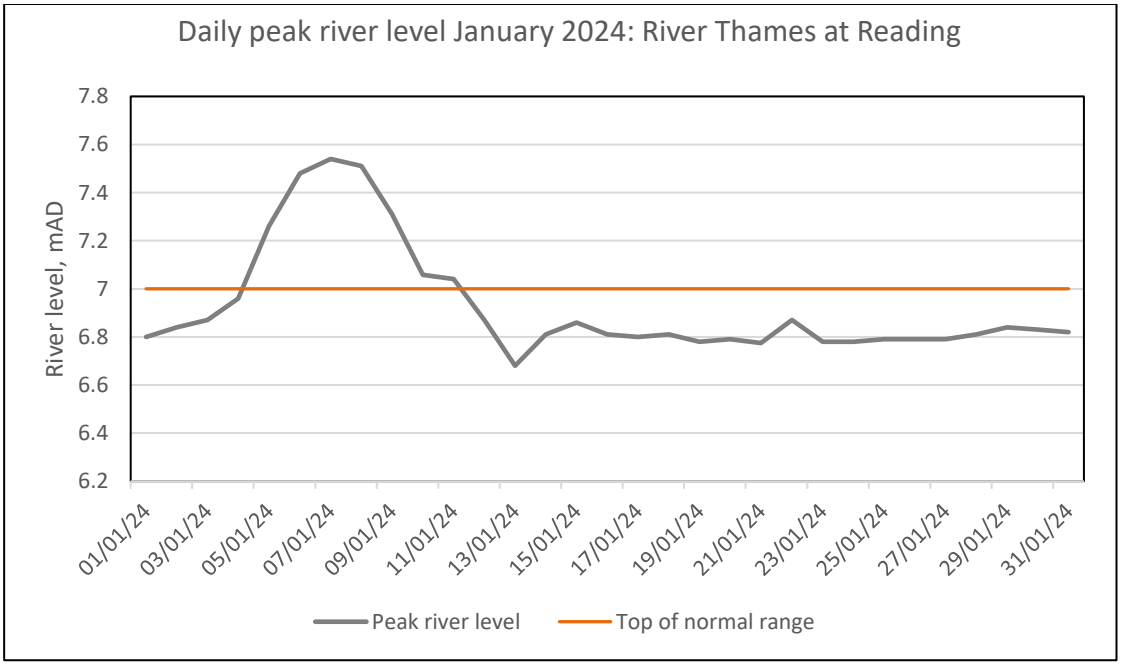



**Figure 3-1: River levels in Central Reading recorded at River Thames at Reading gauge, January 2024**

3.1.3 The previous highest ever recorded river level at this gauge was 7.41m AD, which was recorded on 4th January 2003. This level was exceeded from 6th – 8th January 2024.

3.1.4 Water levels on the River Kennet through Reading are currently only logged at the downstream end of the watercourse, just before the confluence with the River Thames at Blake's Lock. A water level monitoring gauge at Theale was formerly used to record water levels upstream of Reading but is now disused. However, river level data from the Theale gauge is still available via the DEFRA data services platform.

3.1.5 The water level at 'River Kennet at Theale' gauge has a normal range of up to 1.05m AD. **Figure 3-2** shows that this level was exceeded on 1st January 2024 and rose to a maximum level of 1.78m AD on 6th January 2024, a notable level rise of 0.33m from the previous day's peak level. Water levels in the River Kennet remained consistently above the normal range from 1st - 27th January 2024, other than a brief fall to levels of just over 1.00m AD from 20th -21st January.

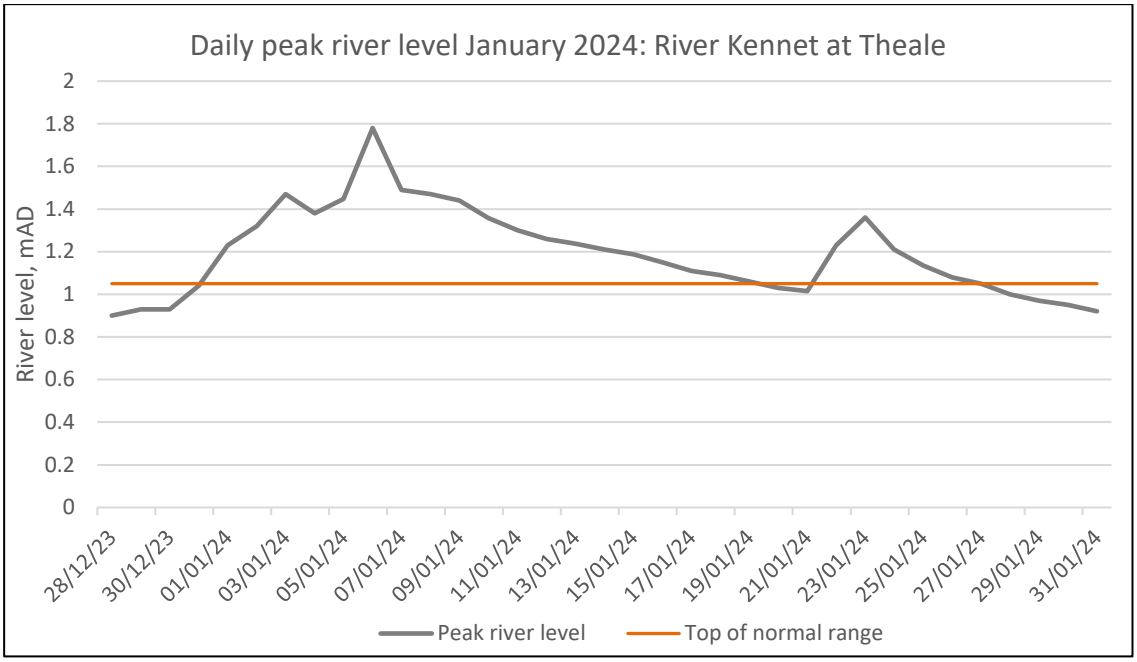



**Figure 3-2: River levels upstream of Reading recorded at River Kennet at Theale gauge, January 2024**

3.1.6 The previous highest ever recorded river level at the River Kennet at Theale gauge was 1.65m AD on 15th February 2014. This level was exceeded on 6th January 2024.

3.1.7 River levels and flood extents in the January 2024 flood event were compared to previous major flood events and available flood mapping and modelling data, to establish the probability of the flood event. This was estimated to be between a 1 in 30 and 1 in 50 year (2% – 3.3% annual probability) flood event and it is represented in **Figure 3-3**.

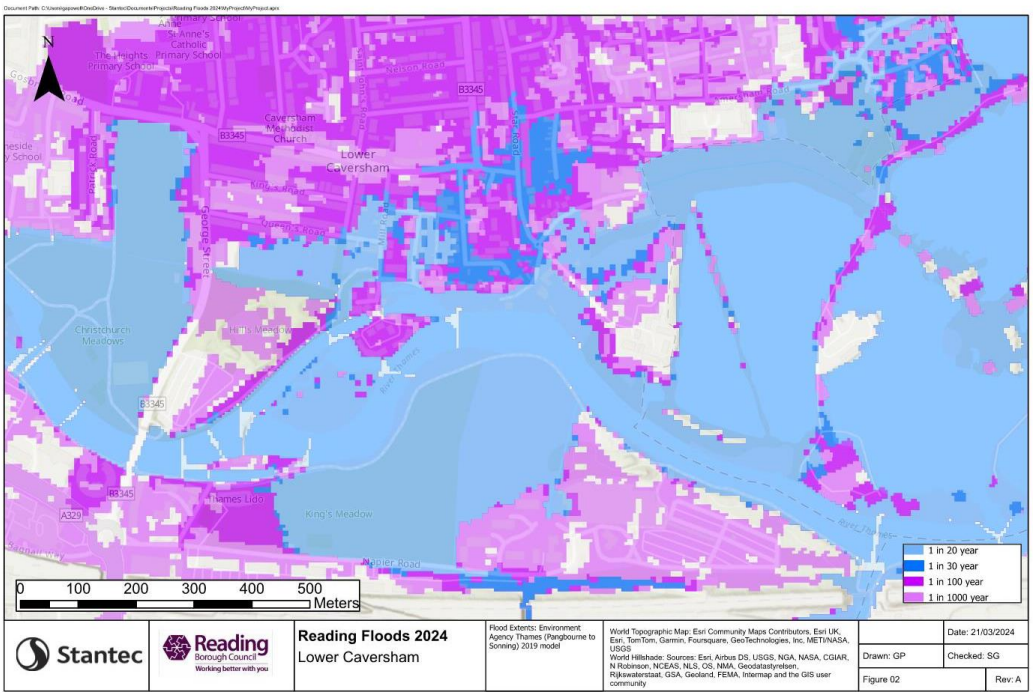



**Figure 3-3: Flood map with estimated 1 in 30 and 1 in 50 year (2% – 3.3% annual probability) flood event probability**

## 3.2 Information Provided Via Public Consultations

### Event Details

3.2.1 Public consultation events for affected residents took place on 2nd February 2024 in Lower Caversham and Southcote, which were attended by representatives from RBC and Stantec. Representatives from the EA were also present at the Lower Caversham consultation event.

3.2.2 RBC also invited residents affected by flooding to make contact via their website, and residents have also provided details and feedback via emails to RBC, contact with the EA, and contact with local councillors.

### Feedback from Residents

3.2.3 At the consultation events, local residents provided feedback, photographs and notes about the details, extents and possible causes of flooding in January 2024, which have been reviewed and incorporated into the overview and analysis of the flood event which follows. Anonymised data provided by residents is included in **Appendix A** .

3.2.4 Specific concerns reported by residents either at the public consultation events, via email or via the RBC website are noted below:

- Residents in both Southcote and Lower Caversham noted that the speed of flooding was unusually fast compared to previous flood events, giving little time to prepare and put temporary protection measures in place. In Southcote, residents had heard anecdotally that sluice gates along the River Kennet [which have been installed to facilitate a more rapid release of water into the adjacent floodplain, when required] may have been deployed.

- Residents in Southcote noted that several ditches and culverts in the area around Circuit Lane did not appear to have been maintained for some time prior to the flood event, and that some banks and paths had been damaged/lowered by previous flood events. Residents reported that accumulated debris reduced the capacity of the local ditch network to hold and transport floodwater, leading to overtopping.

- Late or no flood warnings were received by some residents in Lower Caversham via the Government's flood warning messaging system, which provides notification of flood warnings via email, phone or text.

- Sandbags were provided on 7th January 2024 to residents in Lower Caversham, which helped to prevent flooding via the front of properties but was too late to mitigate against flooding of gardens/outbuildings which had already begun to occur at this time.

- Debris carried by the floodwaters accumulated in Christchurch Ditch and partly blocked the culverts, leading to concerns that further flooding may occur in the immediate future.

- Residents reported that the side channel/pond area at Heron Island, where Christchurch Ditch outfalls, had become choked with trees and vegetation since it was constructed. Concerns were also raised about silt build-up in the marina area to the west of Heron Island.

- Surface water drainage capacity in parts of Lower Caversham seems to have been exceeded and may have been exacerbated by existing blockages.

- The raised ground/bunded area to the south of Christchurch Ditch protected the area from direct flooding from the River Thames, but also slowed down the rate at which floodwaters could drain back towards the Thames when river levels started to recede.

- It was not clear to those residents who checked flooding-related information on the RBC website where to find relevant information or how to request help via the website.

- Residents in Lower Caversham reported that there was a boat stuck on the Caversham weir downstream of Heron Island which was not removed for several weeks after the flood, and may have impeded flows through the weir during the flood event.

## 3.3 Lower Caversham Flooding - Christchurch Ditch/River Thames

### Flood Alerts and Warnings Issued

3.3.1 A Flood Alert was issued on 31st December 2023 for the 'River Thames between Mapledurham and Sonning' area. A Flood Warning was issued on 5th January 2024 for the 'Properties closest to the River Thames from Scours Lane, Reading to Caversham Lakes' area.

### Date, Location and Duration of Flooding

3.3.2 Residential properties at the eastern end of Queens Road reported exterior and basement flooding commencing in the late evening of 5th January, with internal flooding of the ground floor of several properties in Queens Road occurring on 7th January. Basement water levels were reported to have fully receded by 15th January providing a total flood duration of 10 days.

### Sources and Mechanism of Flooding

3.3.3 Residents at the eastern end of Queens Road reported flooding from multiple sources. The flooding to the rear of these properties was reported to arise from exceedance of the capacity of Christchurch Ditch, and debris causing blockages of culverts within the ditch. The flood pathway from Christchurch Ditch was recorded by a local resident as flowing via residential gardens, public footpaths and public roads into Queens Road, then extending northwards and eastwards to Mill Road, Coldicutt Street, Champion Road, Piggott's Road and Mill Green.

3.3.4 **Appendix A** contains a sketch of the flood flow path described above, provided by a resident of Queens Road. Stantec flood modelling, which was undertaken using the EA Thames (Pangbourne to Reading) 2019 hydraulic model for a 1 in 30 year event, confirms the resident's description of the flood flow path during the event and is shown in **Figure 3-4**. The area of Lower Caversham primarily affected by internal flooding is highlighted within the red box in this figure. A larger version of the figure is available in **Appendix F**

3.3.5

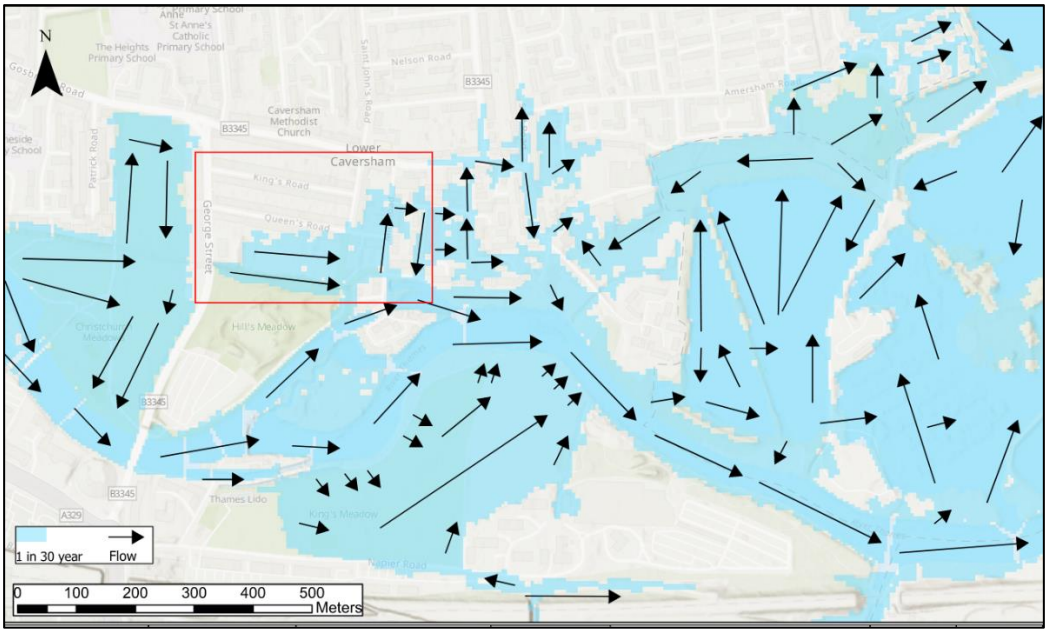



**Figure 3-4: Modelled flood flow paths for a 1 in 30 year flood event in Lower Caversham: EA River Thames (Pangbourne to Sonning) flood model**

3.3.6 Residents of Queens Road reported flooding to basements, potentially linked to rising groundwater through the river gravels.

3.3.7 Residents of Queens Road also recorded flooding to the front of their properties which appears to have arisen from the exceedance of surface water drainage capacity, causing pooling of floodwater in the street. Sandbags and airbrick covers were provided by RBC on 7th January 2024 to provide some mitigation against rising water levels.

3.3.8 The artificially raised area of ground at the eastern end of Christchurch Ditch appears to have prevented the direct ingress of fluvial floodwater flowing northwards out of the River Thames into this part of Lower Caversham.

### Significant Consequences

3.3.9 Sixteen residential properties in Lower Caversham and three commercial properties in Amersham Road reported internal flooding (basement and/or ground floor) which occurred on 7th January 2024.

3.3.10 An additional thirty-three residential properties on Queens Road, Mill Green, Coldicutt Street, George Street and Piggott's Road reported significant flooding to gardens and/or outbuildings. One additional commercial property on Amersham Road reported external flooding.

3.3.11 Two properties on Queens Road reported loss of electricity supply with no visible internal flooding.

## 3.4 Southcote Flooding - Holy Brook/River Kennet

### Flood Alerts and Warnings Issued

3.4.1 A Flood Alert was issued on 31st December 2023 for the 'River Kennet from Thatcham down to Reading' area and was upgraded to a Flood Warning on 2nd January 2024 for 'Properties closest to the River Kennet at the Burghfield, Southcote, Coley and Holybrook areas'. The Flood Warning was updated and reissued on 5th January 2024.

## Date, Location and Duration of Flooding

3.4.2 Flooding of residential properties at the south end of Circuit Lane and Sylvan Walk was reported to RBC on 6th January 2024. The duration of internal flooding is unknown.

## Sources and Mechanism of Flooding

3.4.3 Flooding was reported by residents in this area to have arisen from exceedance of the capacity of the local network of ditches connected to the Holy Brook (designated as part of the Main River network), and from culverted and open channels located within Linear Park which are located on land owned by RBC. Water accumulating in the River Kennet floodplain was reported to flow back in a northerly direction towards Circuit Lane via the area under the railway bridge; and local residents reported that backflows had occurred since November 2023, which meant that flood storage capacity north of the railway line was already full prior to the flood event in January 2024.

3.4.4 Stantec modelling of flood flow paths undertaken using the EA Lower Kennet (Tyle Mill to Thames Confluence) 2018 hydraulic model for the 1 in 30 year flood event (**Figure 3-5**) indicates a potential for backflows from the floodplain towards residential areas, which supports the reports of local residents about flood mechanisms in this area.

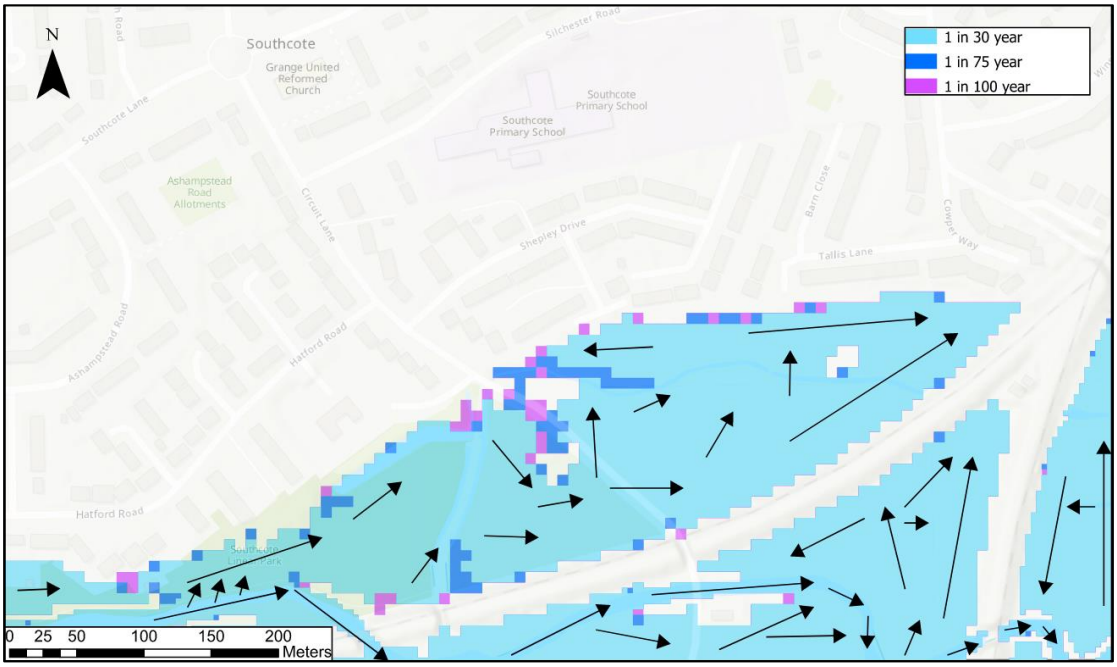



**Figure 3-5: Modelled flood flow paths for a 1 in 30 year flood event in Southcote: EA Lower Kennet Tyle Mill to Thames Confluence flood model**

3.4.5 Residents reported that the drainage ditch located immediately south of Circuit Lane was blocked by woody debris which had accumulated over many years, reducing the capacity of the ditch during the flood event.

3.4.6 Subsequent to the flood event, it was discovered that a culvert at the northern end of the ditch was blocked by sheet piling. There are reports that the culvert partially collapsed causing a hole in the road historically; it is not known who carried out the repairs but the blockage may have occurred then. These works have caused significant reduction of flows through the culvert.

### Significant Consequences

3.4.7 Four residential properties on Circuit Lane and Sylvan Walk reported internal flooding (ground floor) on 6th January 2024.

3.4.8 Collapse of bank and footpath damage to an area of the Holy Brook north of the railway line.

3.4.9 Flooding occurred at the allotment site south of Brunel Road, impacting on allotment holders.

## 3.5 Flooding Impacts in Other Areas

3.5.1 Flooding was recorded at the park homes site at Scours Lane, impacting one residential property internally. No further details are available of the specific flood impacts at this site or property.

3.5.2 Residents in Katesgrove reported damage to banks/footpaths on the River Kennet [responsibility for repairs in this location lies with CRT].

## 3.6 Summary of Significant Consequences and Other Impacts – All Areas

3.6.1 In total, the owners/occupiers of twenty-one residential properties and three commercial properties reported to RBC and/or the EA that they had experienced internal flooding during the January 2024 flood event. The duration of internal flooding (including basement areas) was up to 8 days.

3.6.2 An additional thirty-three owners/occupiers of residential properties and one commercial property reported significant flooding to gardens, hard-standing areas and/or outbuildings to RBC.

3.6.3 RBC staff visited affected residents living in park homes at Scours Lane. The entire site was observed to be flooded. One property at the site reported internal flooding and this is included in the total in paragraph 3.10.1.

3.6.4 Several other properties in flooded areas were observed to be affected by significant external flooding during visits to affected areas by RBC or EA staff, and may have been impacted by internal flooding, but the owner/occupiers did not formally report this to any of the RMAs so it has not been possible to include specific data in this report.

3.6.5 Recreational facilities for local residents (Thames Path, public green spaces, play areas) were temporarily unavailable due to flooding of land adjacent to the River Thames and River Kennet/Holy Brook.

3.6.6 Allotment holders in areas adjacent to the Holy Brook were unable to access their plots and the extended presence of flood water may have future impacts on growth/edibility of produce at the site.

3.6.7 Flood damage to ditch and river banks, and adjacent footpaths, was recorded in several areas including around the Holy Brook and the River Kennet in Katesgrove.

3.6.8 Photographs of the flood event are included in **Appendix B** .

# 4 Actions Taken to Address Flood Risk

## 4.1 Actions Taken by RBC

4.1.1 Following the flood event, the following actions have been taken by RBC in February/March 2024 to address factors which are known or considered most likely to be linked to the flood event.

4.1.2 Photographs of areas identified for the priority post-flood interventions described below are included in **Appendix D** , and photographs of actions taken are included in **Appendix E** .

### Lower Caversham

4.1.3 The open section of Christchurch Ditch between George Street and the public footpath adjacent to residential properties at Heron Island was cleared of accumulated debris within the channel and on the RBC-owned bank. A tree creating a partial blockage in the channel was also removed.

4.1.4 A further tree has been felled which was growing adjacent to and through the wingwall of the culvert located at the eastern end of Hills Meadow.

4.1.5 The local surface water drainage network in Queens Road has been checked and cleared by RBC Highways Team.

4.1.6 A preliminary meeting was held with the Heron Island Residents Association (HIRA) to discuss potential culvert clearance works..

### Southcote

4.1.7 The ditch immediately south of Circuit Lane has been cleared of debris. During clearance works, sheet piling was discovered in the channel (located on private land), which is believed to have potentially been used to support ground previously affected by a sinkhole, and which is now blocking the downstream face of the culvert impacting on the capacity of the ditch to convey flood flows. Onsite investigations revealed the culvert is also blocked by material upstream of the sheet piling. This requires further investigation.

4.1.8 A temporary clay bund has been constructed across the footpath under Briscoe's Bridge [railway bridge] to hold back floodwater within the floodplain and prevent backflows towards Circuit Lane.

4.1.9 Bank and footpath repairs have been undertaken to the Holy Brook to the east of Briscoe's Bridge.

## 4.2 Actions Taken or Planned by Other RMAs

4.2.1 Residents who reported bank and footpath damage in the Katesgrove area, adjacent to the River Kennet, were encouraged by RBC to report this to the CRT as this section is designated as part of the Kennet and Avon Canal and falls within CRT responsibility for maintenance.

4.2.2 CRT have been contacted to request information about their actions during the flood event and subsequently, but no response has been received to date.

# 5 Further Actions Recommended

## 5.1 Joint actions for RBC/EA - Lower Caversham

- CCTV drainage survey of the closed section of the Christchurch Ditch culvert from the footbridge at the eastern end of Hills Meadow to the Heron Island outfall point, to investigate its state of repair and capacity. The outfall structure at Heron Island is overgrown with vegetation and cannot be viewed at present. This will be subject to the agreement of the private landowners. There are also ecological constraints due to nesting swans in this area.

- Review if there is any requirement for localised repairs to the footbridge at the eastern end of Hills Meadow and/or wingwalls following removal of the tree and review the need for localised repairs to damaged banks.

- Installation of a trash screen to the culvert at the eastern end of Hills Meadow, to capture debris before it enters the closed section of the culvert and improve the ease of future clearance works.

- Establishment of a checking/maintenance schedule for the ditch and trash screen.

- Installation of a level gauge board at the eastern end of Christchurch Ditch to provide a visual indicator of water levels and potential flood risk to residents.

- After the water levels in Christchurch Ditch had returned to normal post-flood levels, local residents noted some fallen blocks in the ditch close to the footbridge at the eastern end. This should be reviewed and repair works carried out as necessary.

## 5.2 Joint actions for RBC/EA - Southcote

- Investigate the potential for permanent raising of the access road level under Briscoe's Bridge. This could potentially be achieved by installing a full-width speed bump with the top level set at the flood level for a 1 in 2 year return period. This would prevent backflow of water in the floodplain south of the railway bridge towards Circuit Lane, and the temporary clay bund which has been installed has already been established to be effective in reducing backflows. The most appropriate method of ground-raising will need to be discussed and agreed with all stakeholders.

- Further bank and footpath works to the Holy Brook and associated ditches will require consultation with and consent from the EA.

- Further investigation of requirements for ditch and culvert clearance, in consultation with relevant landowners, and providing reminders to riparian owners of their repair and maintenance responsibilities.

- Discussion of the removal of sheet piling from the culvert south of Circuit Lane with the landowner and suitable replacement material, to re-establish flow through the culvert to the designed levels.

- Establishment of a checking/maintenance schedule for the ditch network connected to the Holy Brook.

- Installation of a level gauge in the Holy Brook to provide a visual indicator of water levels and potential flood risk to residents.

## 5.3 Scours Lane

- Limited information is available about the flooding of park homes at Scours Lane during the January 2024 flood event and any longer-term impacts. Further advice could be provided about temporary flood protection measures for the site to be implemented when flood warnings are issued, if required.

## 5.4 RBC – Administrative Actions

- Review website to make information about flooding easier to find, in particular what to do and who to contact when residents are impacted by or concerned about flooding.

- Review timing of sandbag distribution during flood events.

## 5.5 EA - Administrative Actions

- Review the text/email/phone call flood alert system in the Thames/Lower Caversham area to ensure that all roads adjacent to and north of Christchurch Ditch are included in any relevant River Thames flood alert messages for the areas both upstream and downstream of Caversham Lock.

# 6 Summary and Conclusions

## 6.1 Summary of Flood Event

6.1.1 A flood event arising from the River Thames and River Kennet, and associated watercourses, affected residents of Reading borough in the first two weeks of January 2024. The flood event caused internal flooding to 21 residential properties, triggering RBC's requirement for investigation and reporting under Section 19 of the FWMA.

6.1.2 The primary cause of the flood event was high levels of antecedent rainfall in the weeks and months prior to the flood event, leading to fully saturated ground conditions and high groundwater levels.

6.1.3 Subsequent heavy rainfall in late December 2023 and early January 2024 was unable to infiltrate into soil or deeper levels of the aquifer, causing a large amount of run-off from the upper catchment and accumulating throughout the catchment as floodwaters passed downstream. This led to the highest recorded river levels in Reading since 1947 which exceeded the capacity of the rivers and local floodplains, causing property flooding in low-lying areas.

6.1.4 The estimated probability of the flood event lies between a 1 in 30 and 1 in 50 year event (2 – 3.3% annual probability).

## 6.2 Summary of Consequences

6.2.1 Internal flooding of 21 residential properties and 3 commercial properties was reported to RBC. Internal flooding was reported by residents between 5th – 7th January 2024 and persisted for up to 10 days.

6.2.2 Public consultation with residents who had been impacted by the flood event identified a series of immediate and longer-term actions for consideration by RBC.

## 6.3 Actions Taken by RBC

6.3.1 Clearance of accumulated debris and blockages in ditches which fall within RBC's riparian ownership in Lower Caversham and Southcote has been undertaken.

6.3.2 Temporary bank repairs and a temporary clay bund have been implemented in Southcote. Permanent bank repairs and other potential solutions to mitigate flood risk in these areas (raising of the access road at Briscoe's Bridge, further ditch clearance/remediation works) require discussion with and the consent of other RMAs and private landowners.

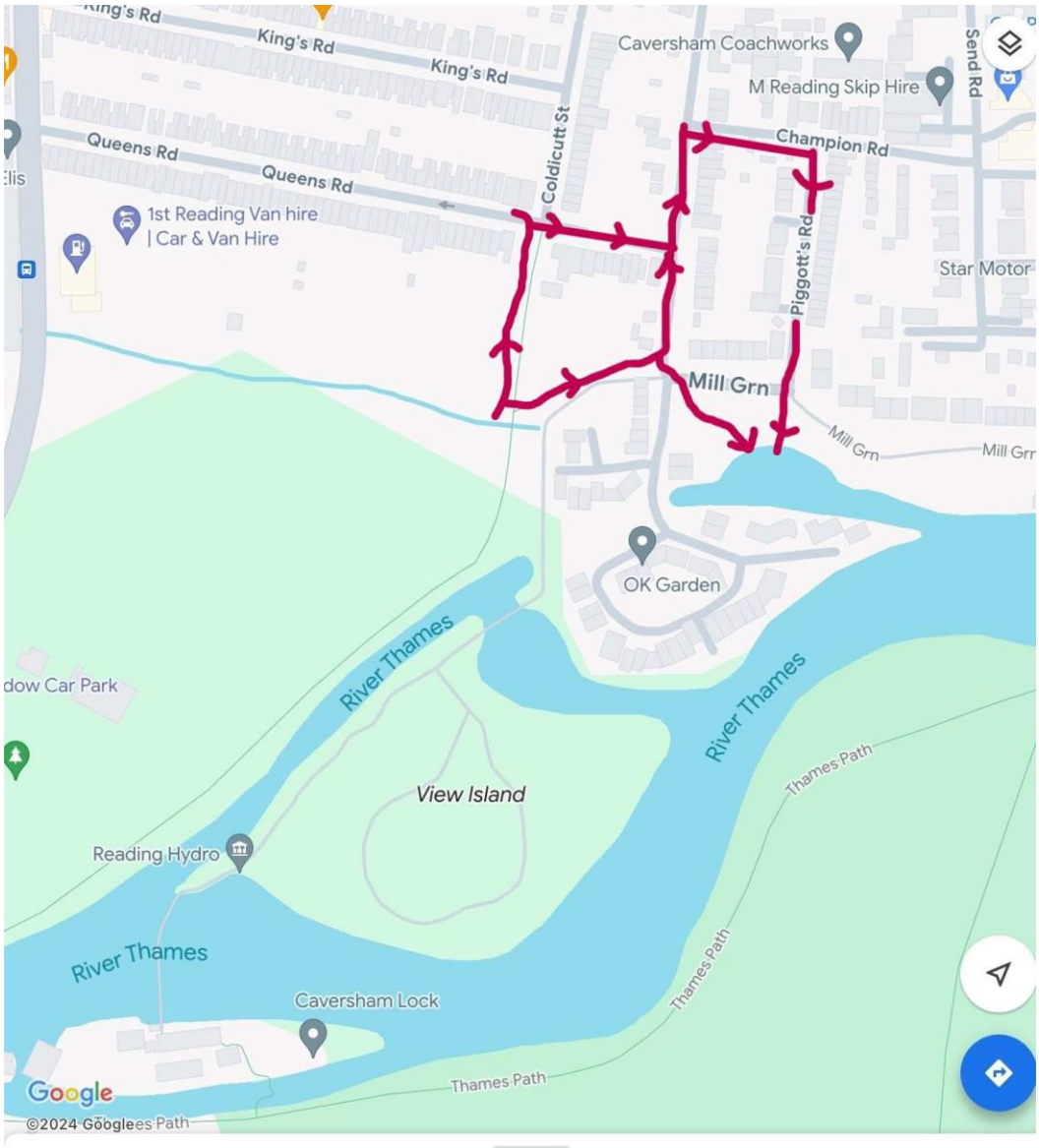
## 6.4 Next Steps

6.4.1 Recommendations for further actions, which are subject to landowner consent, include surveys to identify the need for further ditch and channel clearance works, installation of water level gauges to Christchurch Ditch and the Holy Brook, installation of a trash screen to Christchurch Ditch, removal of existing sheet piling works and replacement with a suitable alternative, and establishment of a checking and maintenance schedule for ditches within RBC ownership. Consideration of these actions will be taken forward by RBC, and other RMAs as required.

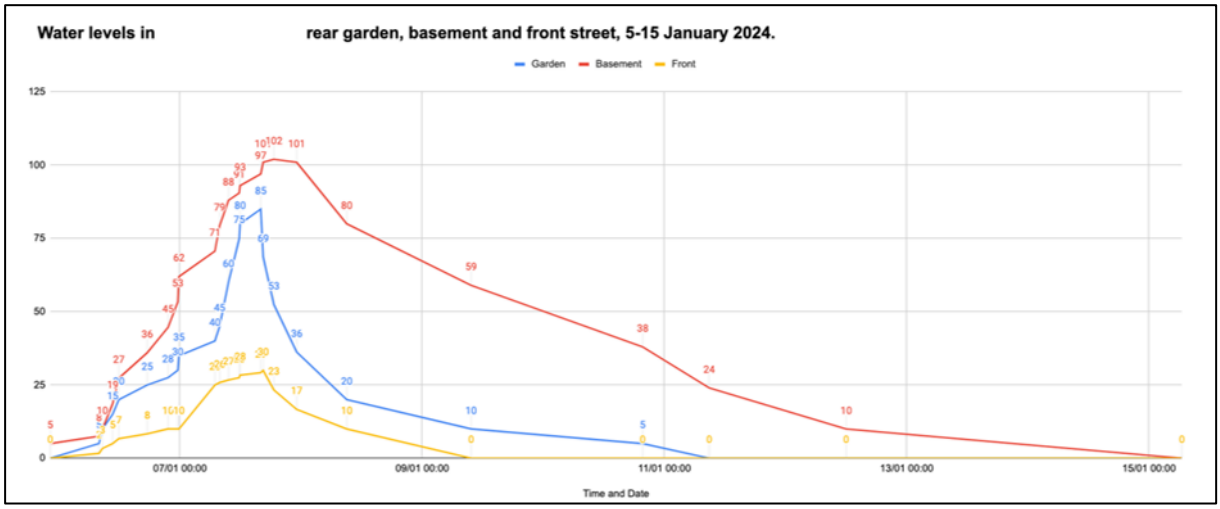
6.4.2 The information within this report can be used to inform future policies and decisions regarding flood management strategies in the low-lying areas of Reading.

# Appendix A Flood Information Provided by Residents

Information provided by a Queen's Road resident regarding the observed flow path of floodwater from Christchurch Ditch northwards into Lower Caversham:



Information provided by a Queen's Road resident regarding water levels in and around their property between 5th – 15th January 2024, and a timeline of flooding to their property and adjacent properties:




| Date | Time | Description of Flooding | Additional comments |
|---|---|---|---|
| Friday 5 January 2024 | 1610-1629 | Metal path under Reading Bridge seen to have flooded alongside areas of Thames Path and Christchurch Meadow. | |
| | 2125-2140 | Reading river level seen to be rising over 7.2m with possible flood warnings at 7.25m. Christchurch Ditch filling but some clearance under brick arch by footpath remains. | Queen's Road beyond Coldicutt St not in "Act" only "Prepare" area on flood warning map. |
| | 2218 | Flood water in basement. | |
| | 2306 | Reading river level still not at 7.25m. | |
| Saturday 6 January 2024 | 0754-0758 | Water observed in back gardens of properties in Queens Road. Wellies needed to access shed. | |
| | 0806-0828 | Water seen on grass beside cycle path opposite Coldicutt St. Christchurch Ditch brick arch and space under concrete bridge now underwater. Queen's Road gardens backing onto the Ditch now beginning to flood. Some flooding on ditch-adjacent footpath. | |
| | 0957 | Water seen to be collecting in access path. | |
| | 1040 | Water in back gardens continuing to rise but manageable with wellies. | |
| | 1041 | Ditch continuing to rise with debris building against brick arch with flow being impeded by the concrete bridge. | |
| | 1109 | Reading river level now 7.38m. | |

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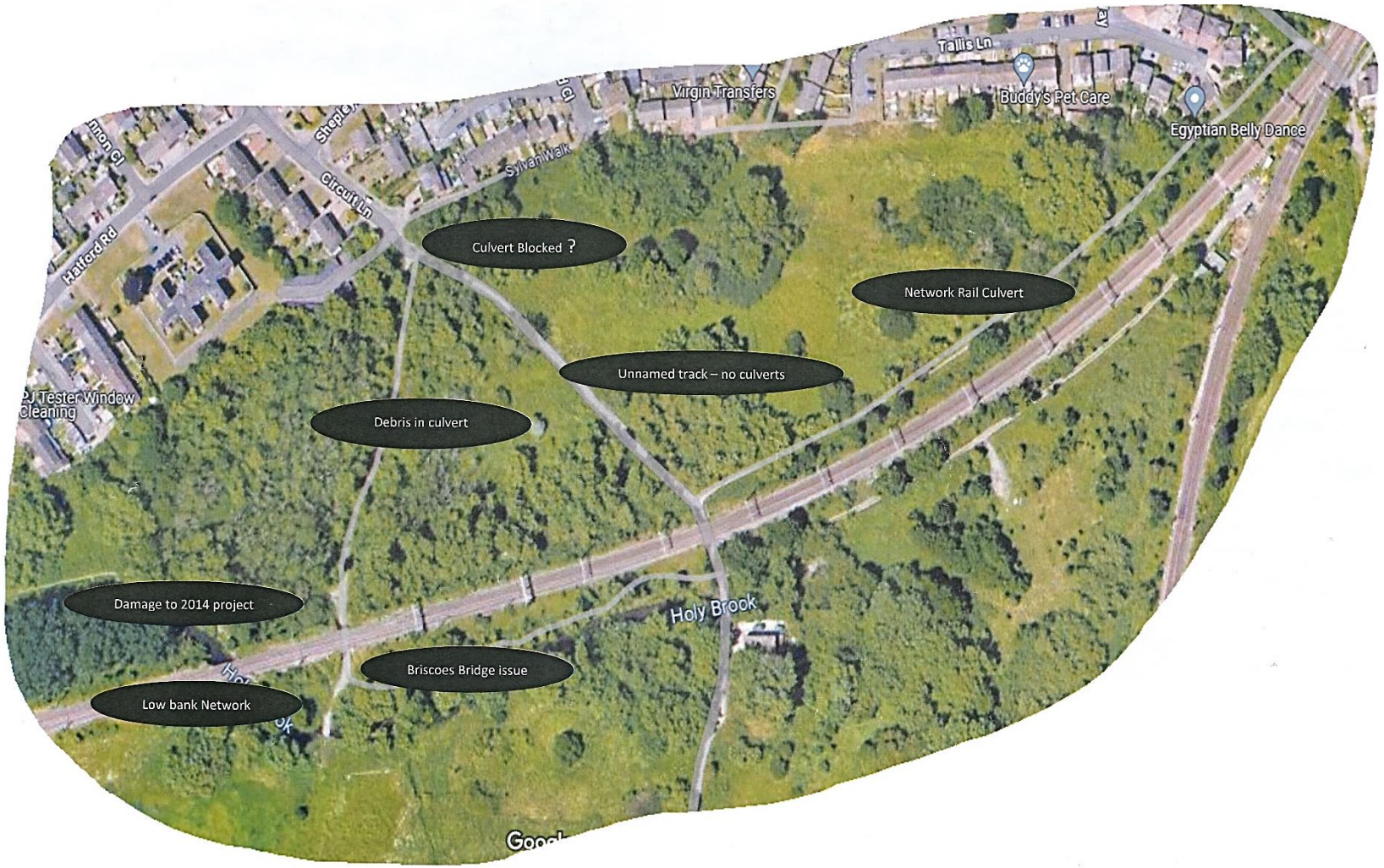
|---|---|---|---|
| | 1153-1226 | Back gardens, access path and Ditch water levels continue to rise. | |
| | 1519 | Water from gardens of houses begins to flood the cycle path. Path adjacent to Ditch now flooded. Debris building against brick arch. | |
| | 1721 | Cycle path flood increasing. Ditch overflowing onto footpaths behind Queen's Road (eastern end). Back garden water passable with wellies, water level against brickwork of outbuilding. | |
| | 1820 | Reading river level observed exceeding record (7.41m) reaching 7.44m. | |
| | 1946 | Outbuilding surrounded by water up to brick below its damp course. | |
| | 2138-2141 | Water flowing down cycle path and across front of houses at eastern end of Queen's Road. Water on the pavement in lower sections. Flow impeded by debris blocking gutters and raised curb around bollards. Footpaths behind Queen's Road increasingly full of Ditch overflow. | |
| | 2334 | Outbuilding has water at its damp course. | |
| | 2348 | Drain at end of Queen's Road observed reaching full capacity. | |
| Sunday 7 January 2024 | 0008 | Basement flooding (6 inches depth) and backflow of water into toilet at one property. | |
| | 0043 | Water has risen to gate level of one property. | |
| | 0655-0700 | Queens Road flooded beyond parking bay lines with water on front paths, almost at front doors. | |
| | 0700 | Partial loss of electricity to one property. | |
| | 0723-0734 | Ditch overflowing into back gardens over footpaths. Ditch also overflowing from adjacent path to blue benches by Hills Meadow and into Thames. Cycle path water flowing fast, over ankle deep. | |
| | 0739 | Water reaches front doors of houses. | |
| | 0751-0756 | Water in garden over height of wellies. Outbuilding has flooded during the night. Water over the level of the skirting board. | |
| | 0828 | RBC person says they are making our road a "priority area" and sandbags will be delivered. | Several properties call and tweet RBC for assistance. |
| | 0911 | RBC informs resident that they are sending someone this morning. | |
| | 0937 | 25cm gap between floodwater and ground floor | |

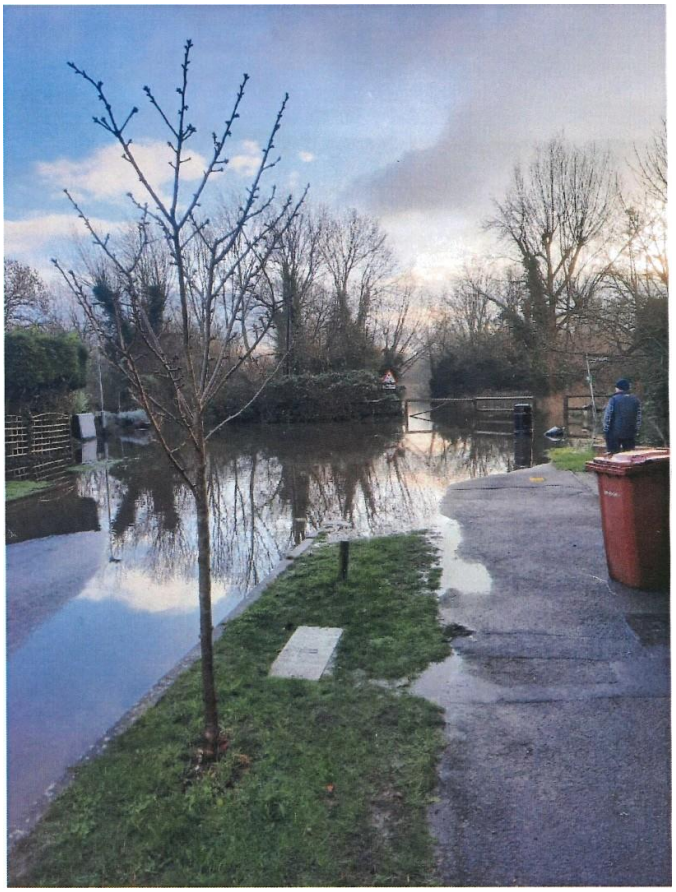
| | | | |
|---|---|---|---|
| | | level in basement of one property. | |
| | 0940 | Water from apartment block car park starts overflowing into a Queen's Road garden. QR gardens fill up rapidly from this point. | |
| | 0958 | RBC provides sandbags at eastern end of Queens Road. | |
| | 1008 | Electrical issues at several properties at eastern end of Queens Road. | |
| | 1040 | One property has 30cm gap from top of floodwater to ground floor level in basement. | |
| | 1117 | RBC sandbags in position at front of houses and airbrick covers applied. | |
| | 1145 | Outbuilding flood water up to seat level. | |
| | 1153 | Back garden flood approx. 1m from house. | |
| | 1155 | 20cm gap from top of floodwater to ground floor in basement. | |
| | 1347 | One property has flood water seeping into kitchen. | |
| | 1417 | Pumping commences at one property to mitigate rising levels under the house. | |
| | 1501 | Car park and gardens along Mill Road are flooded. | |
| | 1526 | Two properties begin bailing water out of basement. | |
| | 1600 | Flood reaches back door sandbags. | |
| | 1622 | Pumping at two properties to mitigate rising levels under the house. | |
| | 1629-1657 | Approx. 1cm gap from ground floor to basement flood water. | |
| | 1710 | Another property has 16cm gap from basement flood to floor.<br>Kitchen floodwater levels steady at 2-3cm. | |
| | 1836 | Basement flood reaches ground floor level. | |
| | 1953 | Fire Brigade come to check on no. XX after kitchen begins to flood. Residents ask for basements to be pumped but Senior Company Officer says it would be ineffective given the amount flowing across front of the houses. Advice to turn off ground floor electricity where possible. | |

| | | | |
|---|---|---|---|
| | 2309-2311 | Water is receding in front of eastern end of Queens Road followed by evidence that basement flood levels are dropping. Approx 1cm clearance under ground floor. | |
| Monday 8 January 2024 | 0903 | Water level at front of property is within the gutter. Back garden water level is approx 3m away from house. | |
| | 1138 | Another property garden shed is in 50cm of water, after level begins receding. | |
| | 1511 | Ditch no longer overflowing but debris still present at brick arch which is full. | |
| Tuesday 9 January 2023 | 0941 | Garden flood water now passable with wellies. Outbuilding no longer flooded. | |
| Wednesday 10 January | 1941 | Water still present in basement approx 38cm deep. Two properties which were pumping out basements stop pumping. | |
| Thursday 11 January 2024 | 0851 | No standing water in garden. | |
| Friday 15 January 2024 | 0630 | No water in basement. | |

Information provided by a Southcote resident about ditches and watercourses impacted by recent and previous flood events to the south of Circuit Lane.

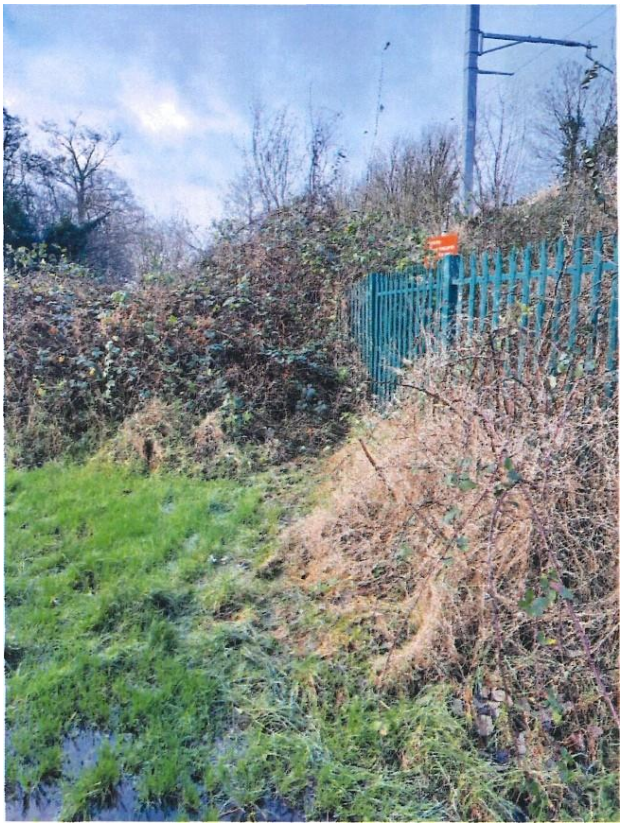


Debris build up north of railway bridge (Briscoe's Bridge), Southcote – 5th January 2024



Flooding at southern end of Circuit Lane

Photos provided by Southcote resident.



Network Rail low bank at Briscoe's Bridge.

Water flowing from River Kennet flood plain northwards under Briscoe's Bridge.

Photos provided by Southcote resident.

Damage to post-2014 bank and path repairs near Holybrook overbridge, Southcote

Photos provided by Southcote resident.

Outfall location of Christchurch Ditch at Heron Island. Access to outfall blocked by vegetation.

# Appendix B Photographs of Flood Event

Photos taken by RBC staff, Sunday 7th January 2024, between 08:00 – 09:00

Scours Lane at junction with Stadium Way, Tilehurst


Queens Road opposite Coldicutt Street (facing south), Lower Caversham

Queens Road opposite Coldicutt Street (facing west), Lower Caversham

Queens Road/Mill Road junction, Lower Caversham


Eastern end of Queens Road (opposite Coldicutt Street, facing east), Lower Caversham

Mill Green, Lower Caversham

Extent of flooding of Caversham Meadow including Christchurch Ditch (from Reading Bridge), Monday 8th January 2024, 08:15 (photo taken by report author)

Flooding of allotment site south of Brunel Road, Southcote (photo provided by RBC, date/time unknown)

Blockage of culvert by woody debris, eastern end of Hills Meadow, Lower Caversham

# Appendix C Photographs From Stantec Site Visit on 02/02/2024

Christchurch Ditch upstream of Heron Island, eastern end of Hills Meadow, Lower Caversham

Floodwater in the River Kennet floodplain, on the road north of Briscoe's Bridge, Southcote

Southern banks of Christchurch Ditch upstream of footbridge, Hills Meadow, Lower Caversham

Backflow of floodwater from the River Kennet floodplain, north of Briscoe's Bridge, Southcote

# Appendix D Photographs of Immediate Works Required, Post-Flooding

Partial blockage of culvert by woody debris and tree growing into footbridge, eastern end of Hills Meadow, Lower Caversham

Tree, debris and vegetation in Christchurch Ditch, Hills Meadow, Lower Caversham

Accumulated debris in Christchurch Ditch, Hills Meadow, Lower Caversham

Evidence of excessive weed and debris covering the banks in Christchurch Ditch, Hills Meadow, Lower Caversham

Christchurch Ditch outlet location showing silt and vegetation accumulation, downstream of the closed section of the culvert at Heron Island.

The accumulation of excessive woody debris along the channel leading to the culvert entry upstream of Heron Island.



Backflow of floodwater from the River Kennet floodplain northwards under Briscoe's Bridge, Southcote

# Appendix E Post-Flooding Works Undertaken

Temporary repairs to damaged banks, Holy Brook, west of Briscoe's Bridge

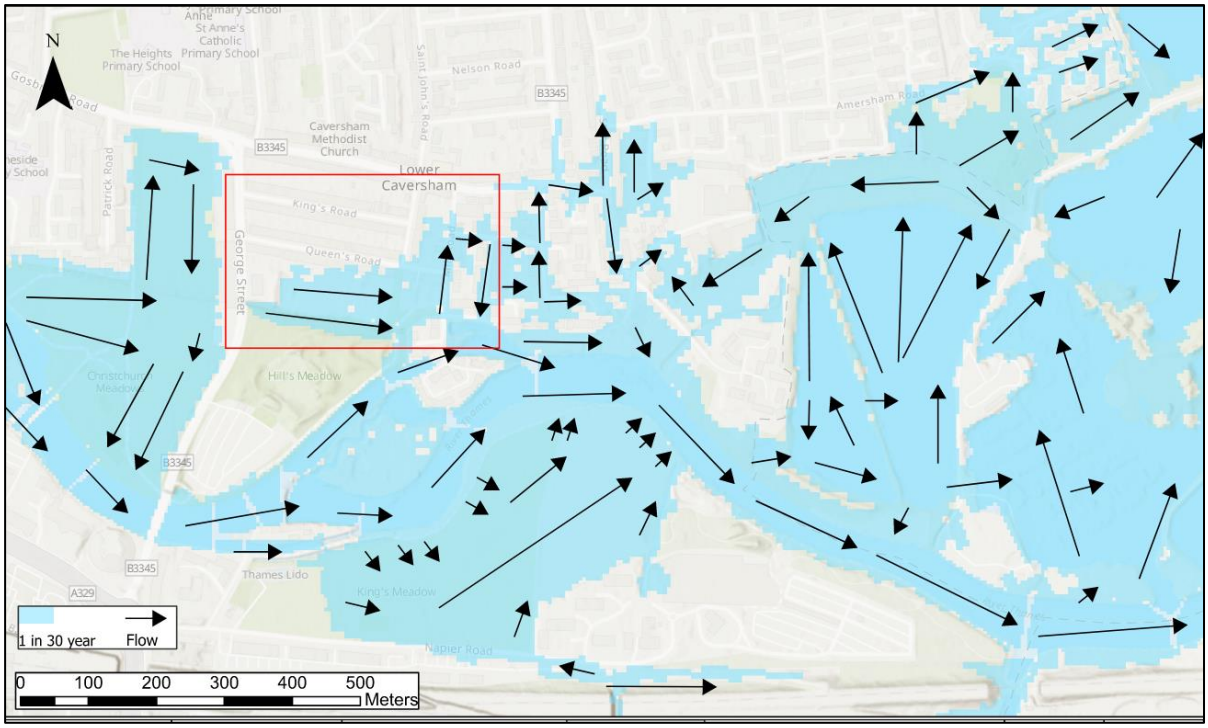
Temporary clay bund under Briscoe's Bridge, Southcote

Photo provided by local resident, 8th March 2024, showing effectiveness of temporary bund holding back water from floodplain under Briscoe's Bridge

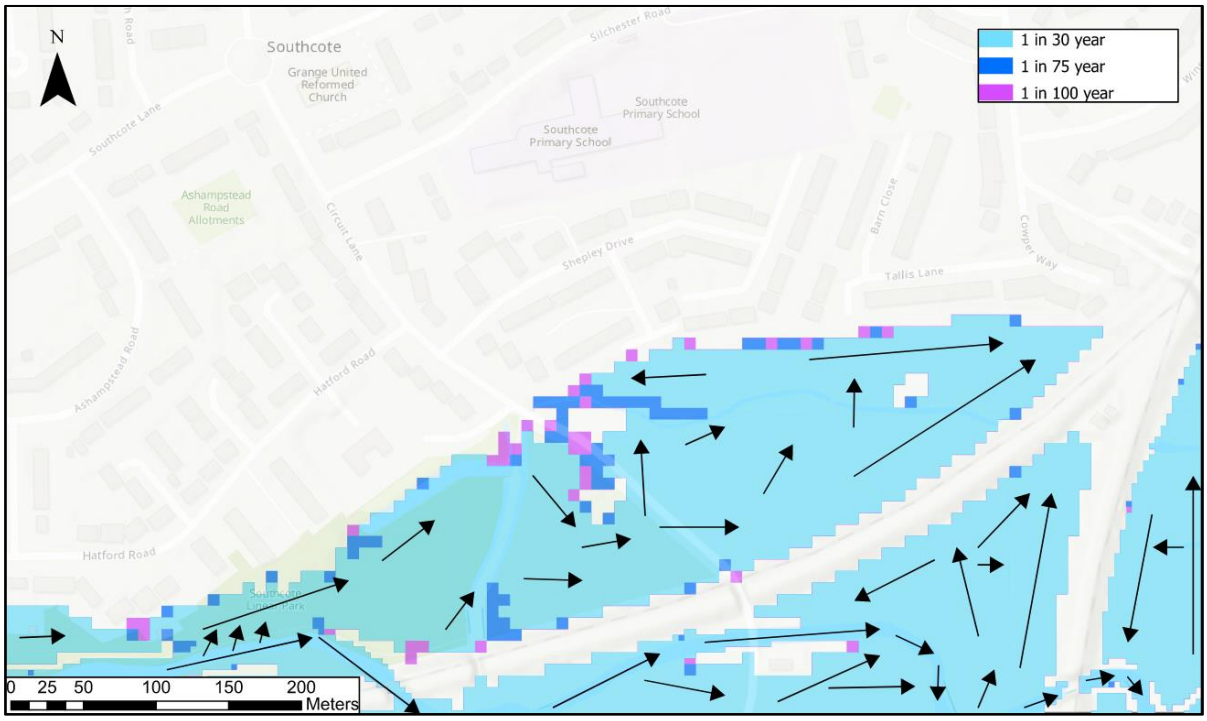
Ditch clearance south of Circuit Lane, Southcote

# Appendix F Flood Modelling Outputs

Modelled Flood Flow Paths

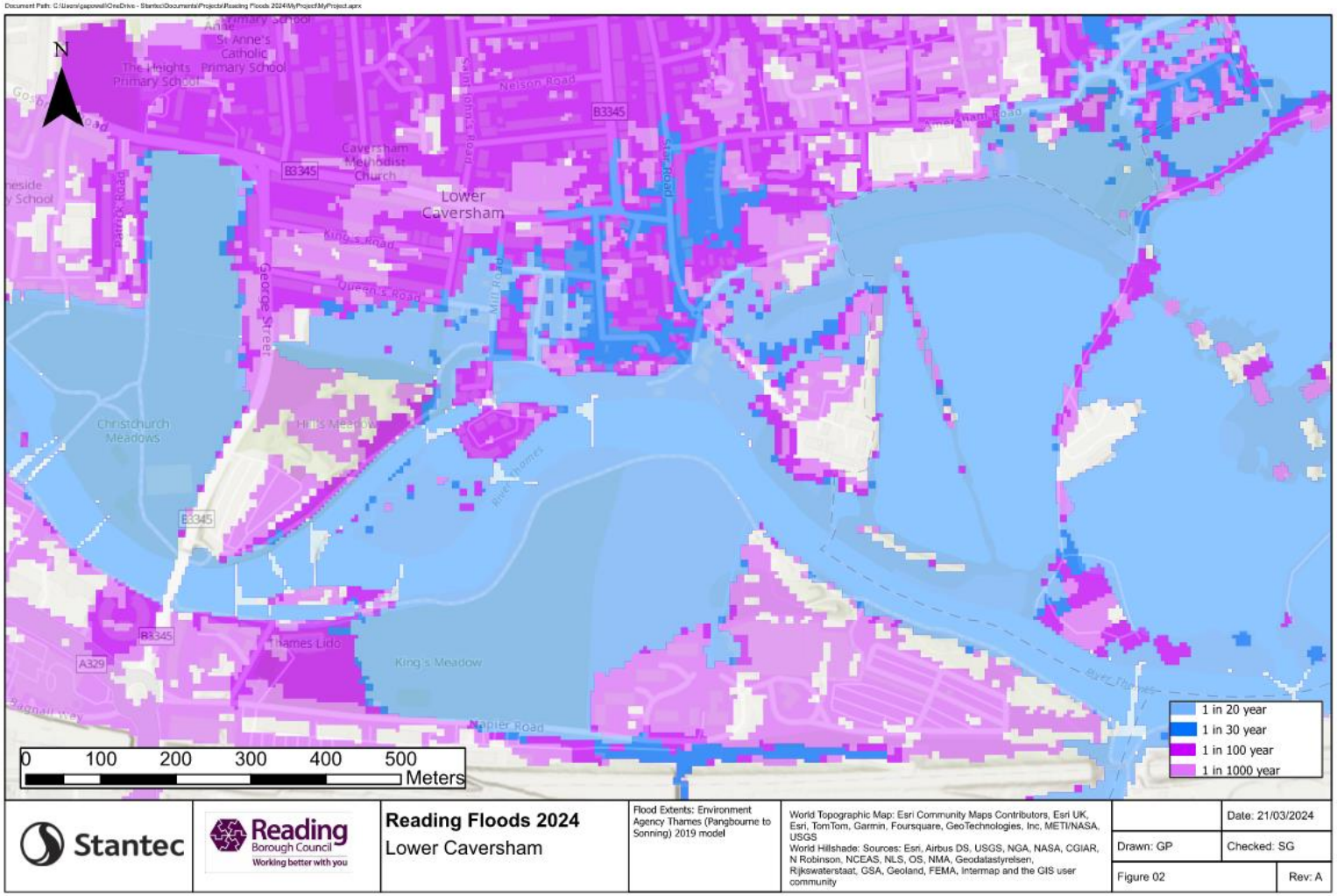



Lower Caversham flood flow direction modelling indicating 1 in 30 year event flood flow paths.

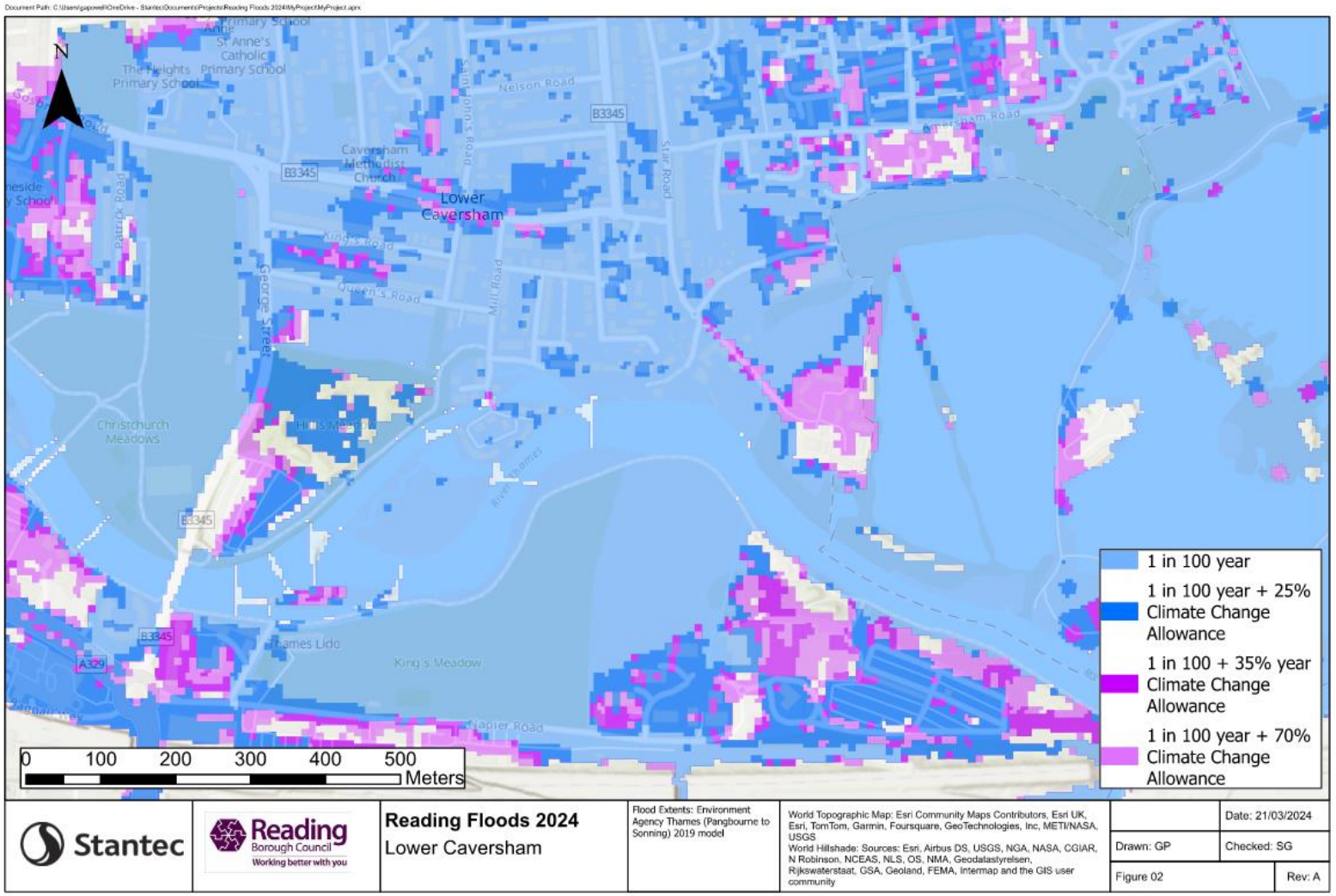



Southcote flood flow direction modelling indicating 1 in 30 year event flood flow paths.

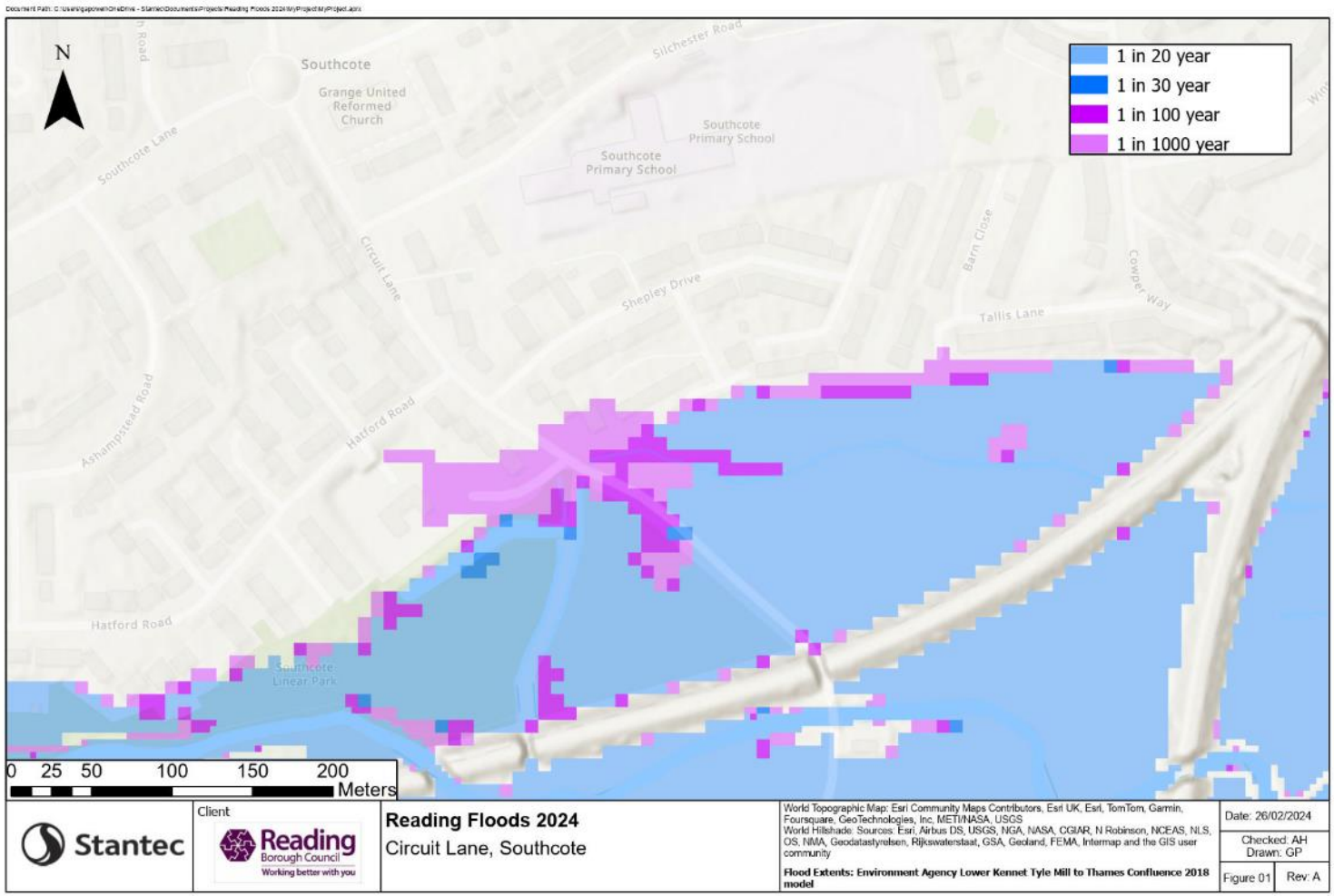
Modelled Flood Extents



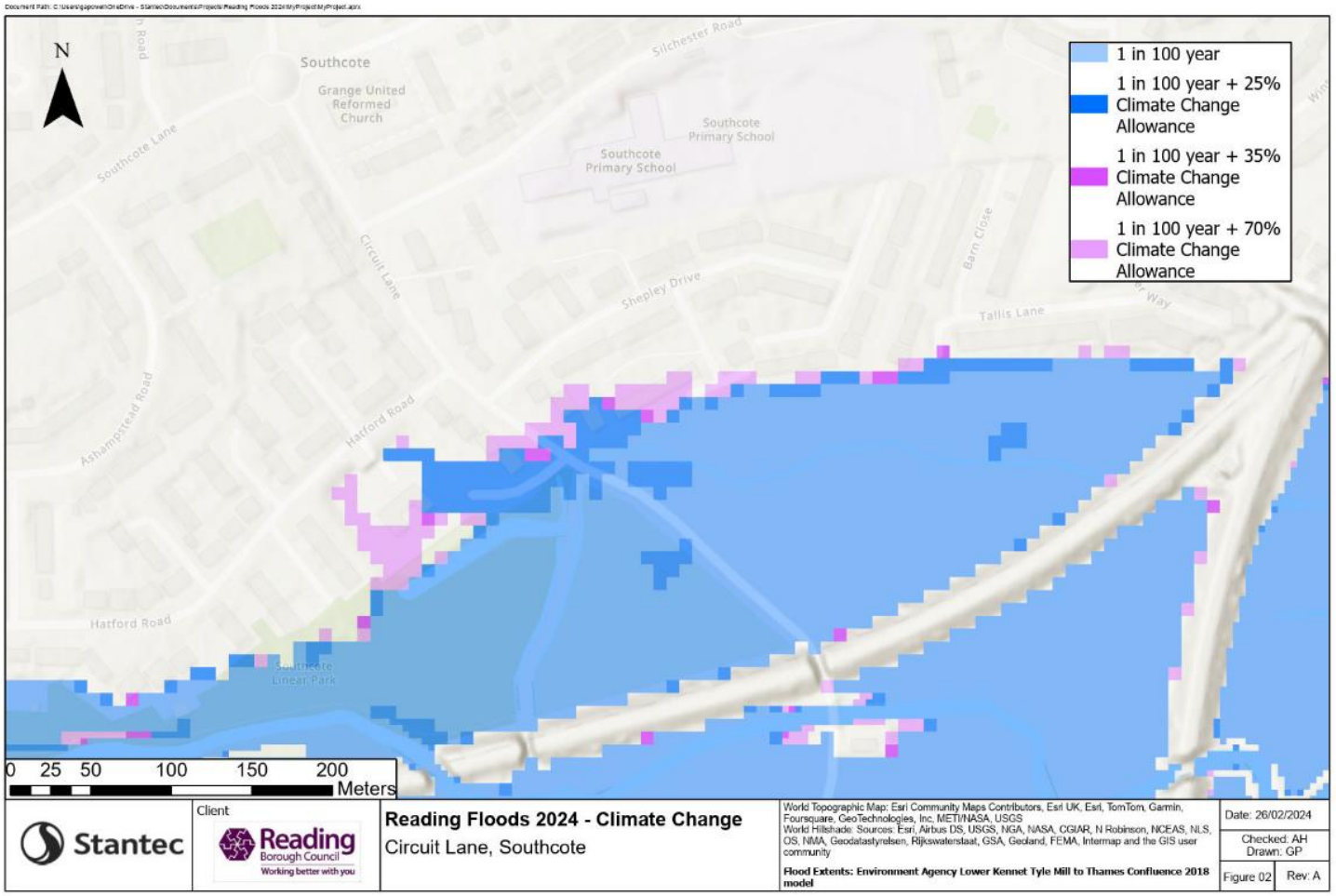

Lower Caversham: Present day flood map showing the modelled 1 in 20 to 1 in 1000 year flood extents




Lower Caversham: Climate change flood map showing flood extents for the 1 in 100 year event with climate change allowances between 25 – 70%




Southcote: Present day flood map showing the modelled 1 in 20 to 1 in 1000 year flood extents




Southcote: Climate change flood map showing flood extents for the 1 in 100 year event with climate change allowances between 25 – 70%