March 2019

Kent County Council

Flood Investigation Report

Flooding affecting the Tunbridge Wells Area on

19 July 2017

This document has been prepared by Kent County Council Flood and Water Management Team as the Lead Local Flood Authority under Section 19 of the Flood and Water Management Act 2010, with the assistance of:

- **Tunbridge Wells Borough Council**
- **Kent Fire and Rescue Service**
- **Southern Water**
- **Tunbridge Wells Flood Action Group**

The findings in this report are based on the information available to KCC at the time of preparing the report. KCC expressly disclaim responsibility for any error in or omission from this report. KCC does not accept any liability for the use of this report or its contents by any third party.

For further information or to provide comments, please contact us at flood@kent.gov.uk

Document Status:

Issue	Revision	Description	Date
0	0	First draft for internal comment	21/06/2018
1	1	Second draft for internal comment	12/10/2018
2	2	Third draft for internal comment	19/10/2018
3	3	Fourth draft for external comment	23/11/2018
4	4	Final Draft for issue	13/12/2018
5	5	Final for publication	19/03/2019

Contents

1 Introduction

Significant flooding in parts of Tunbridge Wells was reported to Kent County Council (KCC) and other authorities on the 19 July 2017. Many of the areas affected experienced extensive highway flooding and inundation of properties. As a consequence, KCC has undertaken an investigation into this flood event. This is the report of that investigation.

1.1 Requirement for Investigation

As the Lead Local Flood Authority (LLFA) for Kent, KCC has a duty to investigate flood incidents as set out in Section 19 of the Flood and Water Management Act 2010 (the Act). The Act says:

> (1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate:
>
> (a) which risk management authorities have relevant flood risk management functions, and
>
> (b) whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.
>
> (2) Where an authority carries out an investigation under subsection (1) it must:
>
> (a) publish the results of its investigation, and
>
> (b) notify any relevant risk management authorities.

A flood investigation does not necessarily require a thorough investigation of the flood and its mechanisms, only the determination of the risk management authorities who have the relevant functions. However, KCC may choose to undertake a more detailed investigation into a flood incident in order to better deliver the objectives of Kent's Local Flood Risk Management Strategy, for instance to improve the understanding of flood risk.

1.2 Trigger for Investigation

As the primary purpose of an investigation is to determine the responsible body or bodies to respond to the flood that occurred, KCC will undertake a flood investigation where no other risk management authority is exercising or is proposing to exercise its functions in respect of the flood and where the flood is significant. A significant flood is defined by Section 5.1 of the Local Flood Risk Management Strategy for Kent, and is one that causes:

- internal flooding to one or more properties;
- external flooding of five or more properties;
- flooding of roads, rail and other transport infrastructure to an extent that they become impassable by vehicles;
- flooding of or near locally important services or infrastructure, for example health centres and electricity substations, to an extent that they cannot function normally.

1.3 This investigation

The flood event in Tunbridge Wells on the 19 July 2017 meets the criteria of a significant flood event and therefore requires investigation. Whilst other RMAs are exercising their functions in response to the event, an investigation was also deemed necessary due the widespread nature of the flooding and public interest, and to provide information for further studies into flood risk of this area.

2 Background Information

2.1 Location and Known Extent of Flooding

Widespread flooding was reported on 19 July 2017 within the town of Tunbridge Wells. Many of the areas affected in this flood were also affected during the 2015 flood. Further information about the flooding in 2015 can be found within the report *Investigation of Flooding affecting Tunbridge Wells Area on 24th August 2015*.

Table 1 provides a summary of the locations where properties were internally flooded in July 2017 based on reports received by Tunbridge Wells Borough Council (TWBC), Kent Fire and Rescue Service (KFRS), Southern Water Services (SWS) and Kent County Council (KCC).

Table 1 Summary of investigated flooding issues and known flooding extent.

Location	Details of flooding	Source of Report
Royal Victoria Place Area		
Calverley Road	Internal flooding to 1 basement flat property Internal flooding to 1 commercial property	TWBC KFRS
Lansdowne Road	Flooding reported at 2 residential properties	TWBC KFRS
Lime Hill Road	Flooding reported at 2 residential properties	TWBC KFRS, SWS
Jackwood Way	Flooding reported at 6 residential properties	KFRS, KCC, SWS
Monson Road	Flooding reported at 3 commercial properties	TWBC
Medway Road	Flooding reported at 1 commercial property	SWS
Mount Pleasant Road	Flooding reported at 6 properties	KCC
High Brooms Area		
Dougal Close	Flooding reported at 14 properties	KFRS, KCC
Brook Road	Flooding reported at 6 residential properties	KCC
Sandhurst Close	flooding reported at 2 residential properties	KCC
The Pantiles Area		
The Pantiles	Flooding reported at 17 commercial properties	KCC
Cumberland Walk, including Upper Cumberland Walk	Flooding reported at 6 properties	KCC
Warwick Park	Flooding reported at 6 properties with a possible further 6 affected properties	KCC
Market Street	Flooding reported at 1 property	KCC
Nevill Street	Flooding reported at 2 properties	KCC
Nevill Gate	Flooding reported at 2 properties	KCC
Linden Gardens	Flooding reported at 1 property	KCC
Individual Roads		
Birling Road	Flooding reported at 1 property	KCC
Broadwater Down	Flooding reported at 2 properties	KCC
Ferndale	Flooding reported at 1 property	KCC
Molyneux Park Road	Flooding reported at 1 property	KCC, SWS
St Johns Road	Flooding reported at 1 property	KCC, SWS
Boyne Park	Flooding reported at 1 property	KCC, SWS

Kent Fire and Rescue Service (KFRS) received over 60 calls as a result of the flood incident, with reports of over 1 metre of water within some properties. Fire officers attended the incidents with three fire engines which carried out pumping of some of the properties and fire crews provided humanitarian assistance. By 4.30am the water had receded and KFRS scaled back its response.

Figures 1, 2 and 3 show the locations of the main areas affected by the flood events that occurred in 2017.

It should be noted that this list of affected locations is not exhaustive, and many other localised incidences of flooding were reported at this time.

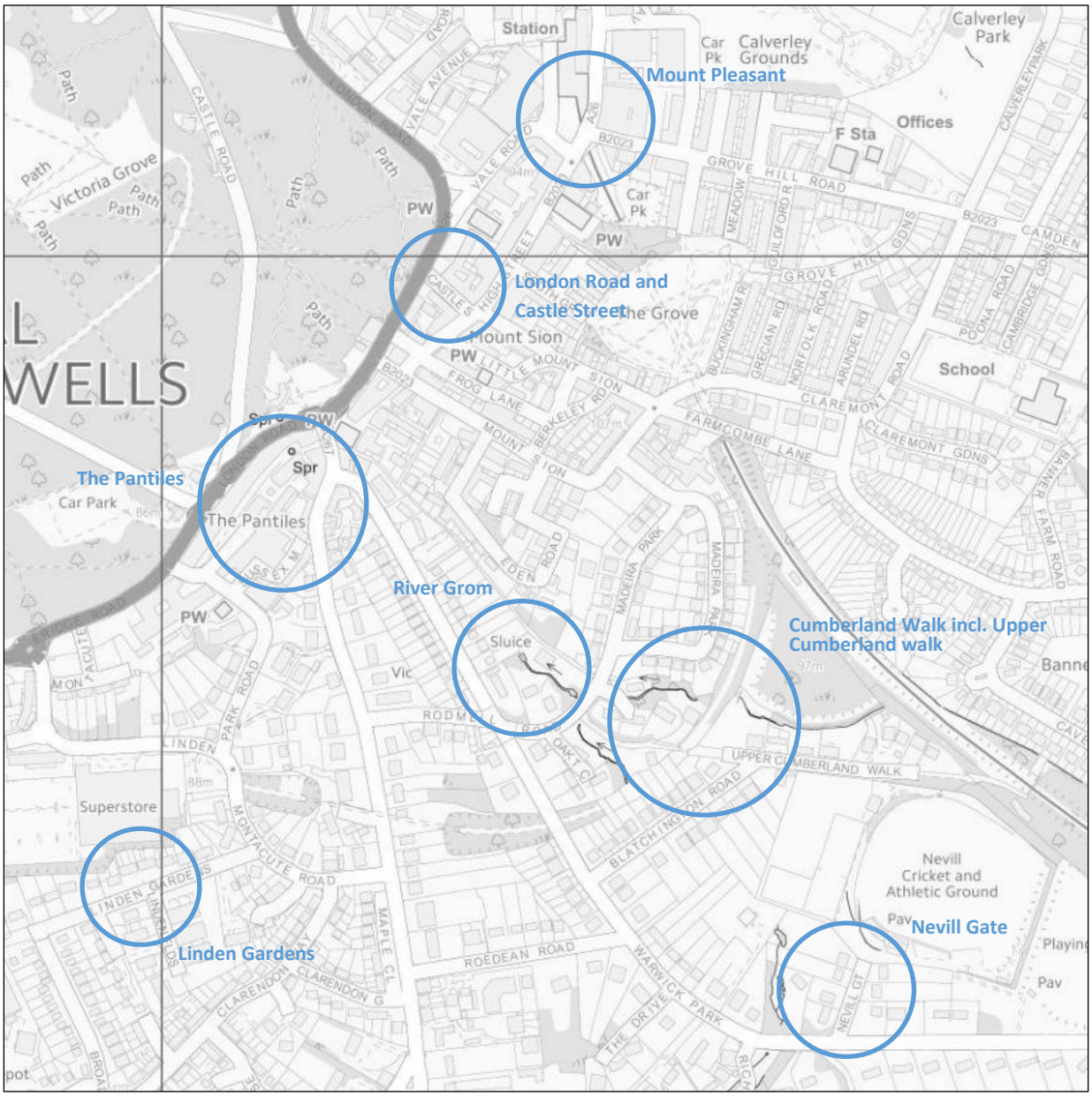

Figure 1 Locations of flooding in 2017 – Warwick Park and Pantiles

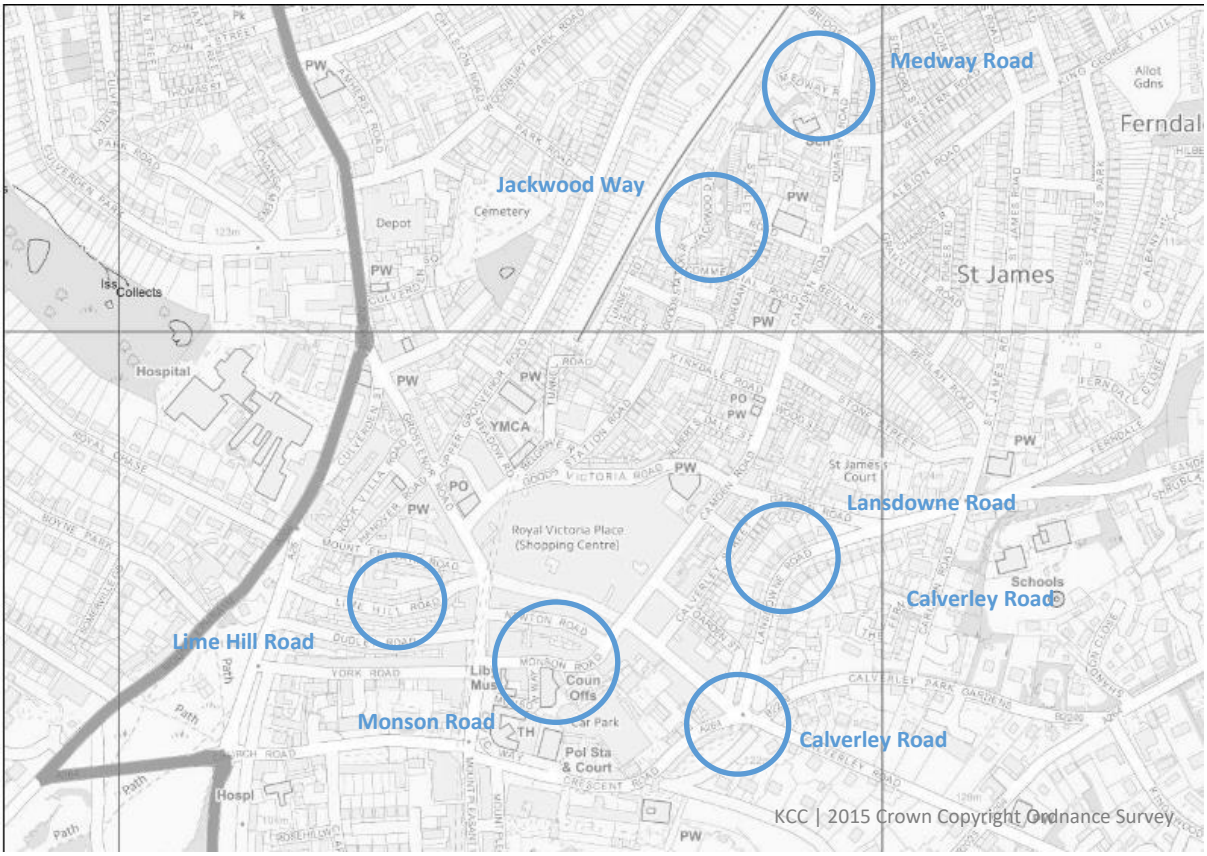

Figure 2 Locations of Flooding in 2017 – Royal Victoria Place

Figure 3 Locations of Flooding in 2017 – High Brooms

2.2 Rainfall Data

Rainfall around the county is recorded by a series of rain gauges operated by the Environment Agency. Following the event rainfall data was requested by KCC for analysis. Data was collected from three gauges at Tunbridge Wells, Lamberhurst and Redgate Mill. The location of these rain gauges is shown in Figure 4.

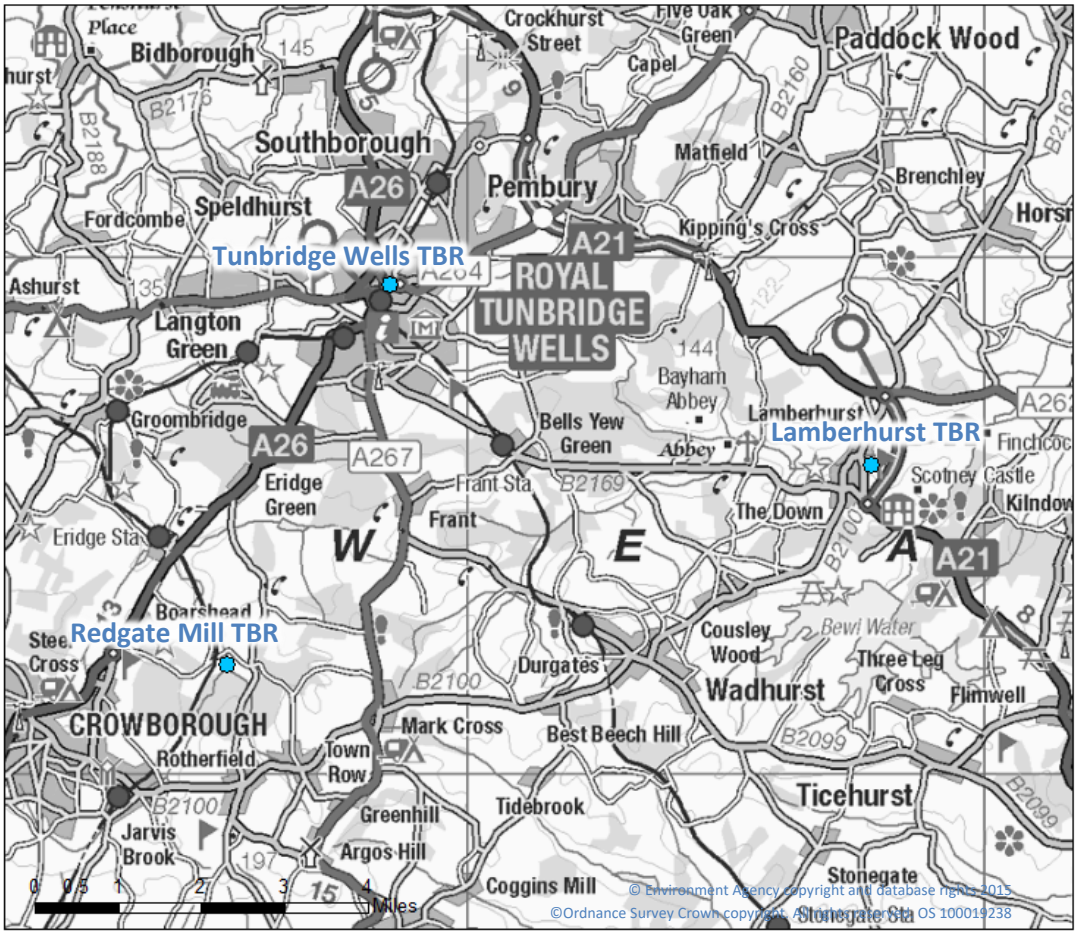

Figure 4 Rain gauge locations

The most significant rainfall was recorded between 02:00am[1] and 02:45am with a total of 32mm of rain falling within a 45-minute period. However, within this period a more intensive event of 22.6mm of rainfall occurred in a 15-minute period between 02:15am and 02:30am, this intensive rainfall has a return period estimated as 1 in 32-year return period using the Flood Estimation Handbook (FEH)[2] and would have been the main factor in the flooding experienced.

Rain gauges located at Redgate Mill (approximately 7.5km southwest of Tunbridge Wells) and Lamberhurst (approximately 10km southeast of Tunbridge Wells) each recorded heavy rainfall during the early hours of 19 July 2017. Redgate Mill recorded 28.84mm of rainfall between 00:45 and 03:00 and Lamberhurst recorded 22.53mm of rainfall between 01:30 and 02:45.

[1] Environment Agency rain gauges operate on Greenwich Mean Time, times have been adjusted for British Summer Time

[2] FEH is the standard tool in the UK to estimate rainfall return periods. It is used by the Environment Agency and all professional hydrologists to estimate rainfall and rainfall return periods.

The rainfall recorded at these sites corresponds with the quantities and times of rainfall experienced within Tunbridge Wells.

2.3 Drainage Infrastructure

The majority of this area is urban development of residential and commercial properties associated with this town centre location. The area therefore has a high percentage of impermeable area due to buildings, car parks, hard standings and highways, which drain to either combined sewers (carrying both foul and surface water) or to dedicated surface water sewers where they are available. The public sewers in Tunbridge Wells are owned and maintained by Southern Water. The public highway generally drains to the public sewer network in this area via road gullies and pipework owned and maintained by KCC as the Highway Authority.

The town centre area to the northeast of The Pantiles is generally drained by combined sewers ultimately discharging to the Tunbridge Wells South Wastewater Treatment Works. There are only a few dedicated surface water sewers in this part of the town.

The Royal Victoria Place area is within the older area of the town and is drained almost exclusively by combined sewers.

To the south and east of The Pantiles, much of the area has separate surface water and foul water drainage. The surface water sewers generally discharge to watercourses which ultimately flow into the River Grom.

North of the town centre, and areas of more recent construction, there are also separate systems of foul and surface water public sewers in many areas. The surface water sewers generally discharge into ordinary watercourses throughout the area. The ordinary water courses which flow through Hilbert Woods and Grosvenor Park receive water from 11 surface water discharge points and a combined sewer outfall.

A plan of the public sewers in Tunbridge Wells can be seen in Figure 5. The concentration of combined sewers (red in the map) indicates the older areas of the town; with the separate system (blue for surface water and brown for foul) the more recently developed areas.

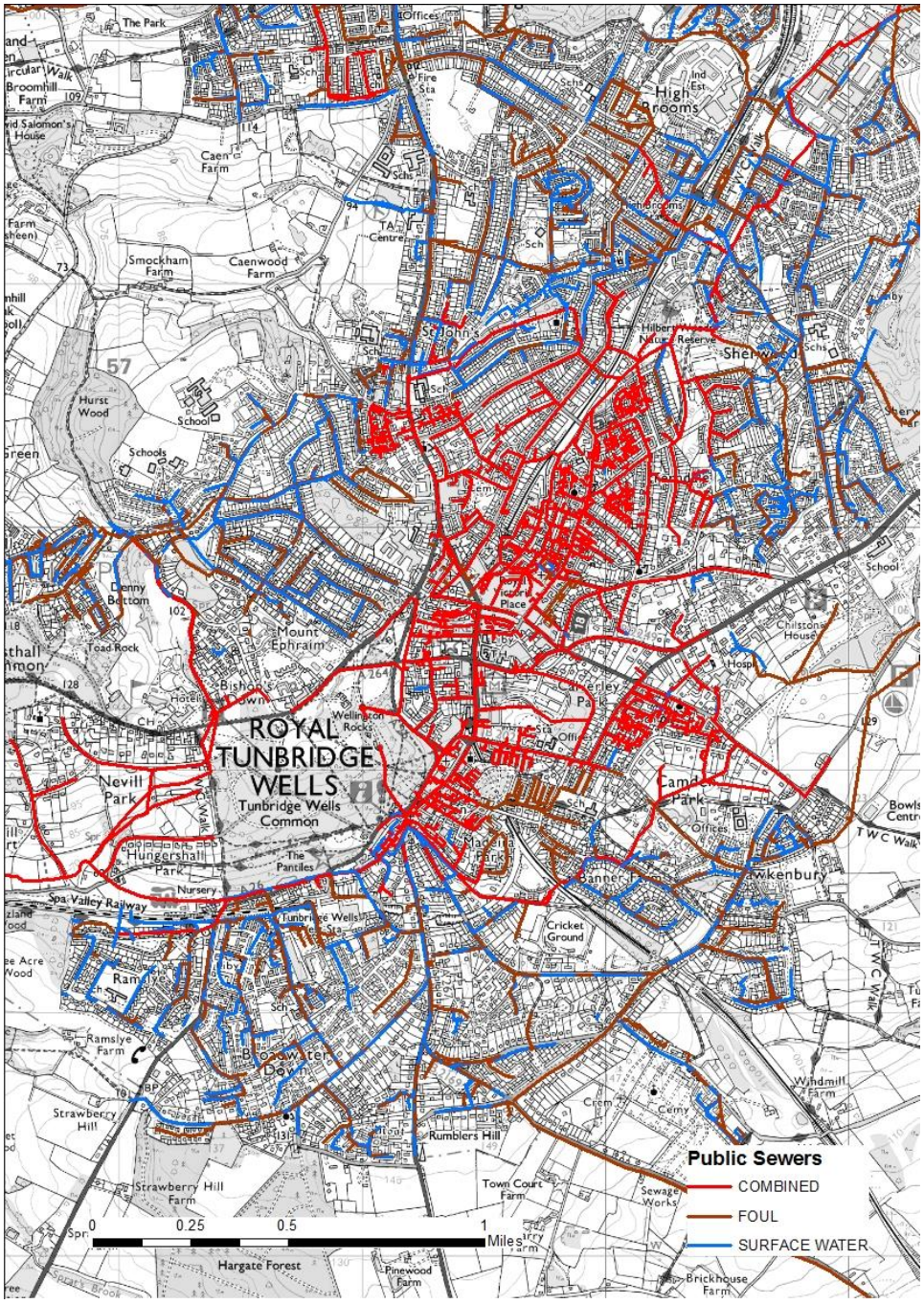

Figure 5 Public sewers in Tunbridge Wells

Modern sewerage in the UK is designed according to the standards set out in Sewers for Adoption guidance together with the sewerage undertaker's own supplementary design stations. Sewers for Adoption was first published in 1980 and sets out a design standard for sewers and drains of 1 in 30 years plus climate change, i.e. a new sewer system should be designed to contain a storm of 1 in 30 years return period, storms that exceed this intensity needn't be contained in the sewer system. Water companies that own the public sewer network can invest in the sewers according to their business plan, however this investment is regulated by the water regulator, OfWat, and must be cost beneficial. Consequently, it is rare for improvement works on sewers to provide a capacity greater than the 1 in 30-year standard where the existing system does not already exceed this standard.

2.4 Watercourses

2.4.1 River Grom

The River Grom is a watercourse that flows through the lower part of Tunbridge Wells around the Pantiles and Nevill Cricket Ground area. It was first culverted (i.e. piped) in the late Victorian era to enable development above it, probably in stages, and cannot be seen in the town centre.

The exact source and route of the tributaries of the River Grom is now unclear as there has been so much development in this area. The approximate course of the River Grom culvert can be seen in Figure 6.

There is a Combined Sewer Overflow (CSO) from the public combined sewer in the culverted section of the River Grom that allows the combined sewer in the Pantiles area of Tunbridge Wells to discharge into it if its capacity is exceeded. This is an Environment Agency consented discharge. There are also some surface water sewers that discharge into the River Grom culvert that drain the areas to the south of the river.

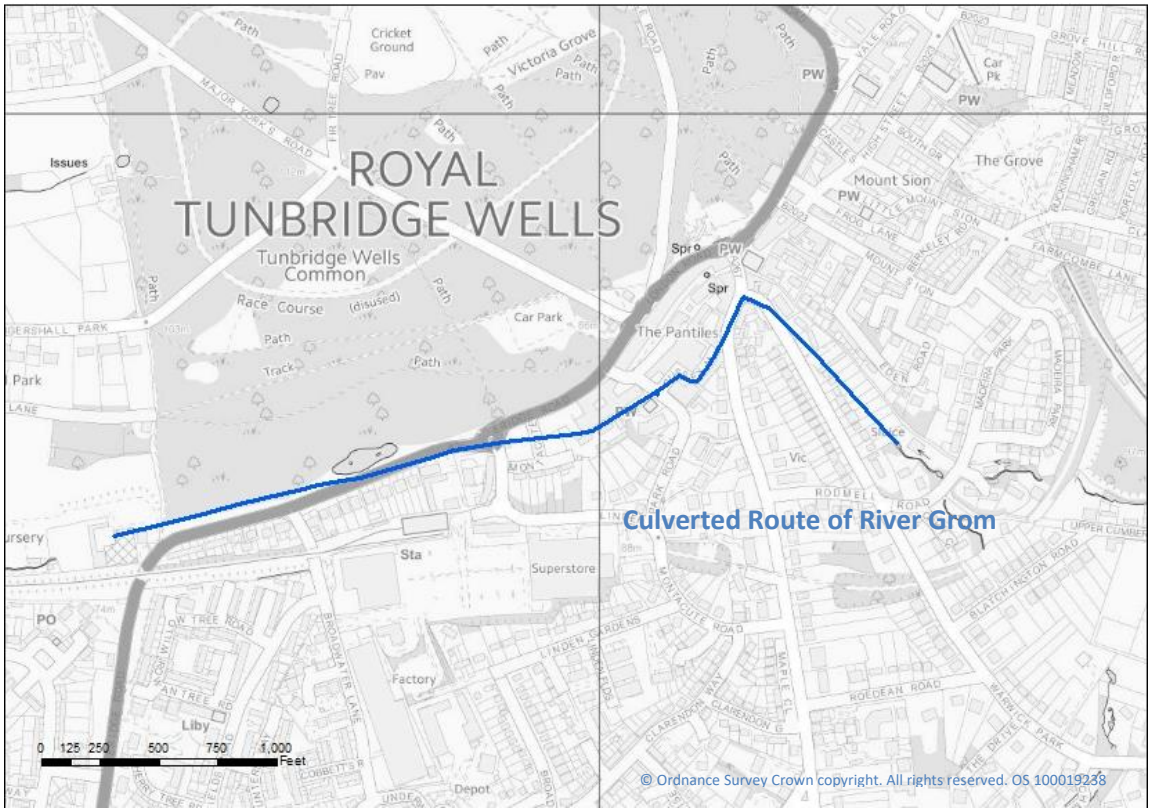

Figure 6 Approximate location of the River Grom culvert in Tunbridge Wells

The culvert is large, ranging in width from approximately 0.9 m up to 1.8 m in places. The geometry of the culvert changes, in places it is a Victorian brick arch culvert in others a concrete circular culvert. There are no records of flooding from the culverted section. The open section upstream of the culvert has experienced flooding in the past.

At the time of writing the report of the 2015 flood event, the River Grom was designated as an adopted sewer, which was noted in the report. Southern Water have since changed this designation to an ordinary watercourse, which is its primary purpose. This means that the maintenance of the

structure is not the responsibility of Southern Water, instead it falls to each landowner along its length. This change of designation has caused confusion amongst some land owners as they have conflicting correspondence from Southern Water. In fact, some of the landowners affected by this change continue to consider the River Grom at this location to be an adopted sewer. Southern Water will inform customers of the change of status of the River Grom on their records.

2.4.2 Southborough Stream

Tributaries of the Southborough Stream rise in Grosvenor Park and Hilbert Woods, the channels are mainly natural in character and have a channel width of no more than one metre. The eastern branch of the stream rises in woodland behind properties on Springhead road, it flows through Hilbert Woods before entering a culvert 500m from the source. The stream flows through the culvert for approximately 120m before becoming open channel again and continuing north for 100m before joining the western branch of the stream at the north edge of the park. This section of the stream drains the Sherwood area of Tunbridge Wells and receives discharge from the surrounding surface water drainage with seven discharge points along its course.

The western branch of the stream rises within Grosvenor Park within the wetland area, the stream flows north through the park and has a relatively low gradient but is confined within a small steep sided valley. The stream drains Dorking Road with two surface water discharge points entering at the source of the stream. A combined sewer overflow (CSO) discharges immediately north of the wetland area into the stream.

After the confluence of these two branches, the stream flows northeast and leaves the park, it continues within a steep sided channel passing under Addison Road and flowing past Dougall Close where the channel forms part of the open space to the front of the properties. At the boundary of the former Gasholder Station and Dougall Close the stream enters a brick arch culvert for 55m . The stream then flows through a small area of scrubland for 30m. At this point the watercourse is joined by another tributary that drains the High Brooms area. This watercourse flows along Silverdale Road and collects surface water drainage from the surrounding area. Until recently this watercourse was designated as a sewer

The watercourse continues in a northerly direction through a brick arch culvert which becomes a 1500mm concrete pipe. The stream is open channel for 30m between Sandhurst Road and Brook Road before entering a 1500mm concrete culvert. The stream continues through a culvert system flowing in a northerly direction. The geometry of this culvert changes, in places it is brick arch culvert and in others circular concrete culvert pipe

At Dowding Way the watercourse is designated main river, the main river (see Section 2.4.) flows to the northeast under the Tunbridge Wells Business Park. On the northern side of the business park the watercourse exits the culvert and is an open watercourse to the north of Tunbridge Wells.

The location of the culverts on the Southborough Stream can be seen in Figure 7, please note that the route of culverts is usually interpreted and this map only represents the approximate route of the culverted sections.

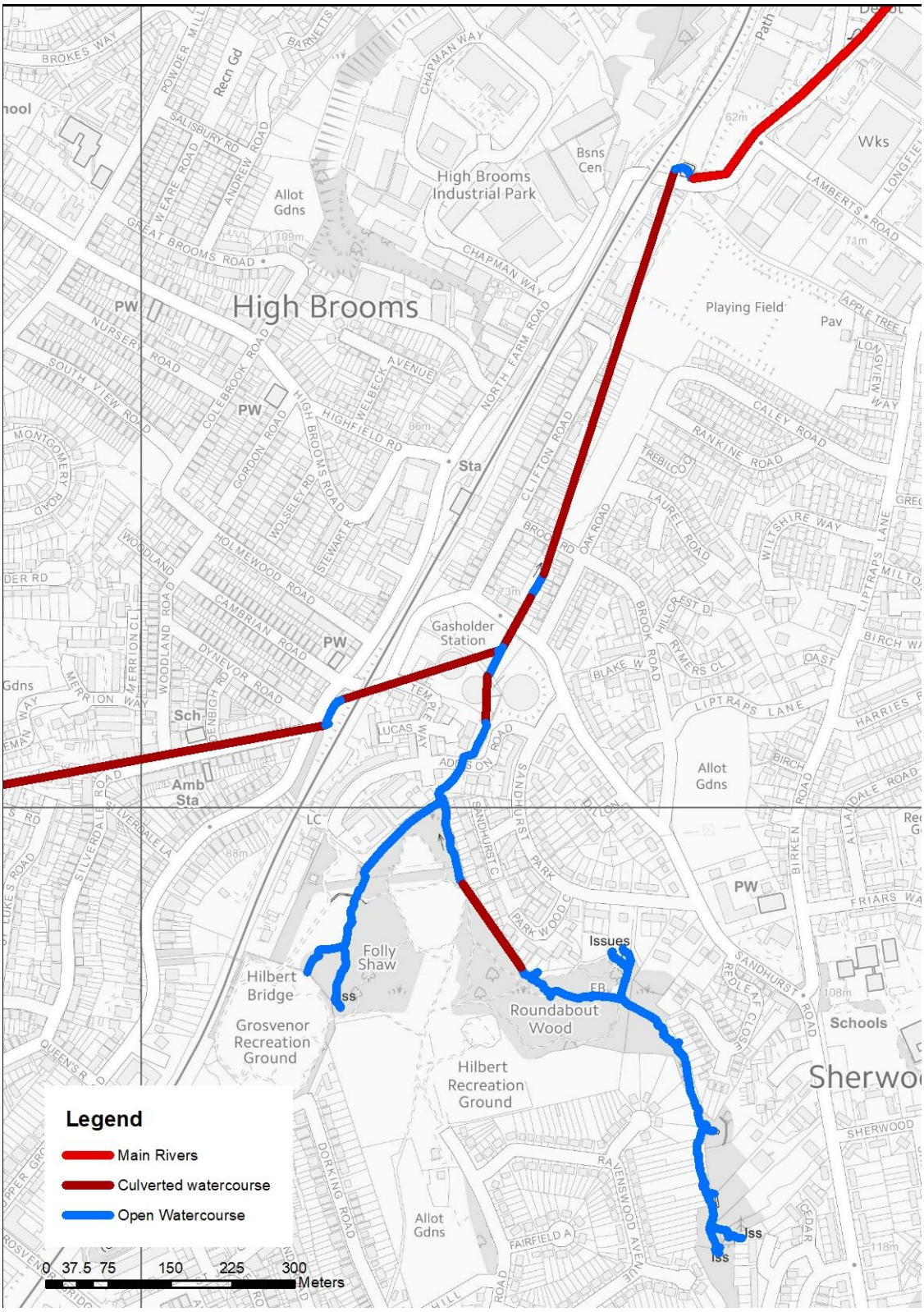

Figure 7 Approximate location of culverted sections of the Southborough Stream

2.5 Roles and Responsibilities

2.5.1 Kent County Council

KCC is the lead local flood authority for Kent and the highway authority. The Flood and Water Management Act 2010 gives lead local flood authorities powers and duties for the strategic overview of local flooding and for some flood-risk management functions including:

- a duty to investigate flooding
- a duty to maintain a register of significant structures and features
- powers to regulate ordinary watercourses
- A duty as a statutory consultee to review drainage strategies and surface water management provisions associated with applications for major development

As the highway's authority KCC are responsible for the maintenance and operation of drainage gullies and pipework connecting these to the public sewers for the proper function of highways and safety of highway users.

2.5.2 Tunbridge Wells Borough Council

Tunbridge Wells Borough Council (TWBC) is responsible for street cleaning / sweeping within the area. They are also a category one responder under the Civil Contingencies Act 2004, along with KCC and the emergency services during emergency responses such as that required by a flooding event.

2.5.3 Environment Agency

The Environment Agency is responsible for taking a strategic overview of the management of all sources of flooding and coastal erosion. The Agency also has operational responsibility for managing the risk of flooding from main rivers, reservoirs, estuaries and the sea.

2.5.4 Statutory Undertaker for Public Sewers

Southern Water are responsible for the maintenance and operation of the public sewer network throughout the area carrying foul water, surface water or combined (sewers carrying both foul and surface water).

2.5.5 Riparian Landowners

Private landowners have responsibilities for the maintenance and upkeep of ordinary watercourses, including any associated culverts, and the bed / banks of any watercourse adjacent to or within their land. They should clear away any debris from the watercourse or culvert even if it did not originate from their land.

2.5.6 Residents and Property Owners

Private landowners are responsible for the maintenance and operation of drainage assets and connecting pipework located on privately owned roads and footways, car parks and other hard standings and for building surface water drainage.

Residents and property owners who know they are at risk of flooding have responsibilities to mitigate the risk of flood damage to their property as far as is reasonably practicable. They should take measures to protect themselves and their property when flooding is imminent. Residents and property owners have the right to defend their property as long as they do not subsequently increase the risk of flooding to other properties.

3 Analysis of the Flood Event

The details of the flooding in the areas affected during the event on 19 July 2017 are set out in more detail in this section of the report. This section collates existing and published information and details recorded during the investigations of the flooding event.

3.1 Pantiles Area (Including Nevill Street, Cumberland Walk including Upper Cumberland Walk, The Pantiles, Warwick Park, Market Street, Nevill Gate, Linden Gardens)

3.1.1 Summary of Impact

The Pantiles area experiences flooding as a result of surface water naturally flowing towards the River Grom which is culverted underneath the Pantiles area. Due to the arrangements of the roads, surface water collects at Nevill Street between the junctions of London Road and Warwick Park, above the River Grom.

On the 19 July 2017 the Pantiles area was affected by surface water flooding due to the intensity of the rainfall and the exceedance of the drainage system. Approximately 18 residential properties are known to have flooded in this area (including Warwick Park and Cumberland Walk) along with 17 businesses in the Pantiles.

Initial reports suggested that dispersal of water was slower than in previous events (2009, 2012, 2015), however there is no evidence to confirm this.

The Warwick Park area was also affected by surface water, two properties are reported to have flooded from runoff from the highway. Warwick Park also is at risk of flooding from the River Grom. The watercourse is reported to have overflowed the entrance to the culvert near Rodmell Road during the heavy rainfall leading to the gardens on the north eastern side of Warwick Park to be inundated and causing internal flooding to one property. There are also reports of the combined sewer that flows through these gardens overflowing through manholes.

3.1.2 Site Location, Topography

The River Grom catchment topography naturally drains in a north westerly direction from Warwick Park. The entrance to the culvert for the River Grom lies in a private garden on Warwick Park Road, the entrance to the culvert has a complicated arrangement which may be impeding flow and contributing to the flood risk when peak flows are experienced. The flow at this point has come from a mixture of open watercourses, culverted sections of watercourse and drainage from the developments in the area to the north, south and southeast of the Nevill Cricket Ground.

Surface water from the surrounding hills, including the Tunbridge Wells Common, London Road and Mount Pleasant Road flow towards the watercourse and collect at the junction of Nevill Street, The Pantiles and Warwick Park, which lie within a local low point at approximately 80.3mAOD. There are also low points at Market Street of approximately 81mAOD and at Sussex Mews, at the junction with Linden Park Road at approximately 79.3mAOD. In addition to these low points, many buildings affected by flooding have basements below street level.

The updated Flood Map for Surface Water (uFMfSW), shown in Figure 8, is published on the Environment Agency website and provides information on areas considered at risk of flooding due to surface water.

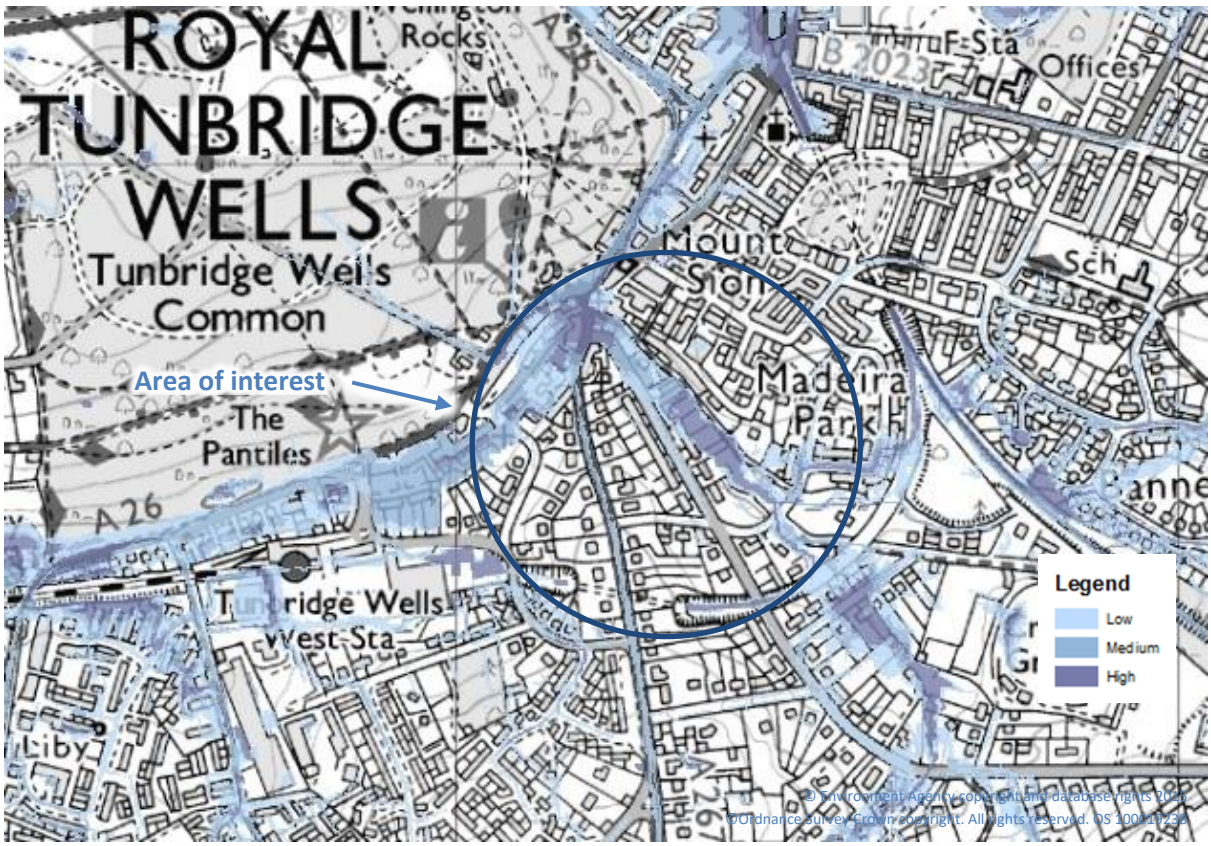

Figure 8 Surface water flood risk local to The Pantiles Area

The affected area includes locations indicated to be at high risk of surface water flooding. High risk is defined as a chance of flooding during a 1 in 30-year event. This map does not take into account the presence of watercourses, sewers or other drainage features that convey water efficiently and is only indicative of areas at risk of surface water flooding.

The map indicates the risk in this area is due to the number of flow routes converging in this area with limited ability for the water to flow away over the ground.

3.1.3 Existing Drainage and Watercourses

Both highway and private drainage systems in this area predominantly discharge to the public combined sewer, either by gravity or via a localised pumped system. A small pump serves the foul drainage of the properties at the end of Warwick Park and on Nevill Street, as they have basements and their drainage is lower than the sewer. Some highway drainage in the area was connected to this pump system. As a consequence, highway runoff increased the load on the pump, which meant that it was more likely to be overwhelmed, potentially causing flooding of the basements served by the pump. It also meant that the highway drained via this small pump, which is likely to have increased the time for water accumulated on the highway to discharge.

The culverted River Grom flows underground below Warwick Park and to the south of The Pantiles.

3.1.4 Flood History

The Tunbridge Wells Surface Water Management Plan notes instances of foul and surface water flooding reported by Southern Water due to hydraulic overload of foul and surface water sewers at Warwick Park in 2009 and 2012.

KCC have received reports of flooding affecting properties in the area of Nevill Street and Warwick Park in November 2013, December 2013, February 2014, October 2014 and August 2015.

3.1.5 Flooding Mechanism

The main cause of flooding was excessive rainfall which exceeded the capacity of the drainage system, the intensity of the rain meant that surface water was unable to enter the sewer network fast enough and accumulated in the topographical lows points. The heavy rainfall also caused the surcharging (backing-up) of the combined sewer network causing the drains to back up into properties.

KCC have carried out a CCTV inspection of the River Grom culvert to ascertain if damage or blockages of the culvert was a contributing cause of the flooding. The CCTV of the River Grom was carried out between the inlet at Rodmell Road through to Linden Park Road with the junction of Sussex Mews. The CCTV survey reports that there are no major defects, damage or blockages along the length of the culvert. The report records that there are some minor deposits within the culvert which result in a 5% cross-sectional loss and in one location there is a root mass which results in a 10% cross-sectional loss. However, there is no significant loss of capacity within the system which would prevent it from operating effectively and the culvert is likely to have become overwhelmed by the excessive rainfall entering the system.

The entrance to the culvert has an unusual arrangement. The entrance to the culvert is largely closed by what appears to be a rendered wall, which only has a small opening to allow water to pass under it into the entrance chamber. The entrance chamber is also lower than the culvert. This arrangement is likely to impede the flow of water into the culvert and may lead to the flooding of the gardens at Warwick Park.

3.2 Mount Pleasant Road, London Road and Castle Street

3.2.1 Mount Pleasant Road

Flooding in this location is reported to have affected two commercial properties in the ground floor and basement levels due to water flowing through doorways and into the basement and the surcharging (backing-up) of the sewer system causing toilets to flood. Flooding was also reported on the highway.

The details and local information for this area are similar to those reported in the 2015 event. Details for this area can be found within the report *Investigation of Flooding affecting Tunbridge Wells Area on 24th August 2015*.

The primary cause of flooding was excessive rainfall which exceeded the capacity of the drainage in this area. This meant that surface water was unable to enter the sewer network fast enough and accumulated in the topographical low points, which reached sufficient depths to enter property.

3.2.2 London Road and Castle Street

Flooding in this location was reported to Kent County Council by Kent Police, the KCC Out of Hours Duty Officer arrived on site at 03:54 am by which time the water had cleared from the highway. The Officer reported three blocked drains on Castle Street and the High Street which were cleansed and audited on the 20 July.

The details and local information for this area are similar to those reported in the 2015 event. Details for this area can be found within the report *Investigation of Flooding affecting Tunbridge Wells Area on 24th August 2015*.

The primary cause of flooding was excessive rainfall which exceeded the capacity of the drainage in this area. This meant that surface water was unable to enter the sewer network fast enough and accumulated in the topographical low points, which reached sufficient depths to enter property.

3.3 Royal Victoria Place (Including Calverley Road, Lansdowne Road, Lime Hill Road, Jackwood Way, Monson Road)

3.3.1 Summary of Impact

Flooding within this area was reported between 02:21and 04:12am at around the time of the most intensive rainfall, this area is drained solely by highway gullies and combined sewers, which were over whelmed by the intensity of the rain.

A total of 15 properties were affected by the flooding, approximately 11 residential properties and 4 commercial properties.

3.3.2 Location

This area is drained by the highway drainage system, as this is an older part of the town the drainage discharges exclusively into the combined sewer system. The large urban catchment and extensive roof network also discharges into the combined sewer system which would have taken all the surface water during this event.

The area around Lansdowne Road, Calverley Road and Monson Road all drain towards Mount Pleasant Road to the west. The area to the north of Royal Victoria Place, drains in a northerly direction.

A 675mm combined sewer system from Royal Victoria Place drains towards Jackwood Way, where it has been diverted to accommodate new development. Figure 9 shows the sewer network for pipes 400mm and greater which drain towards Jackwood Way.

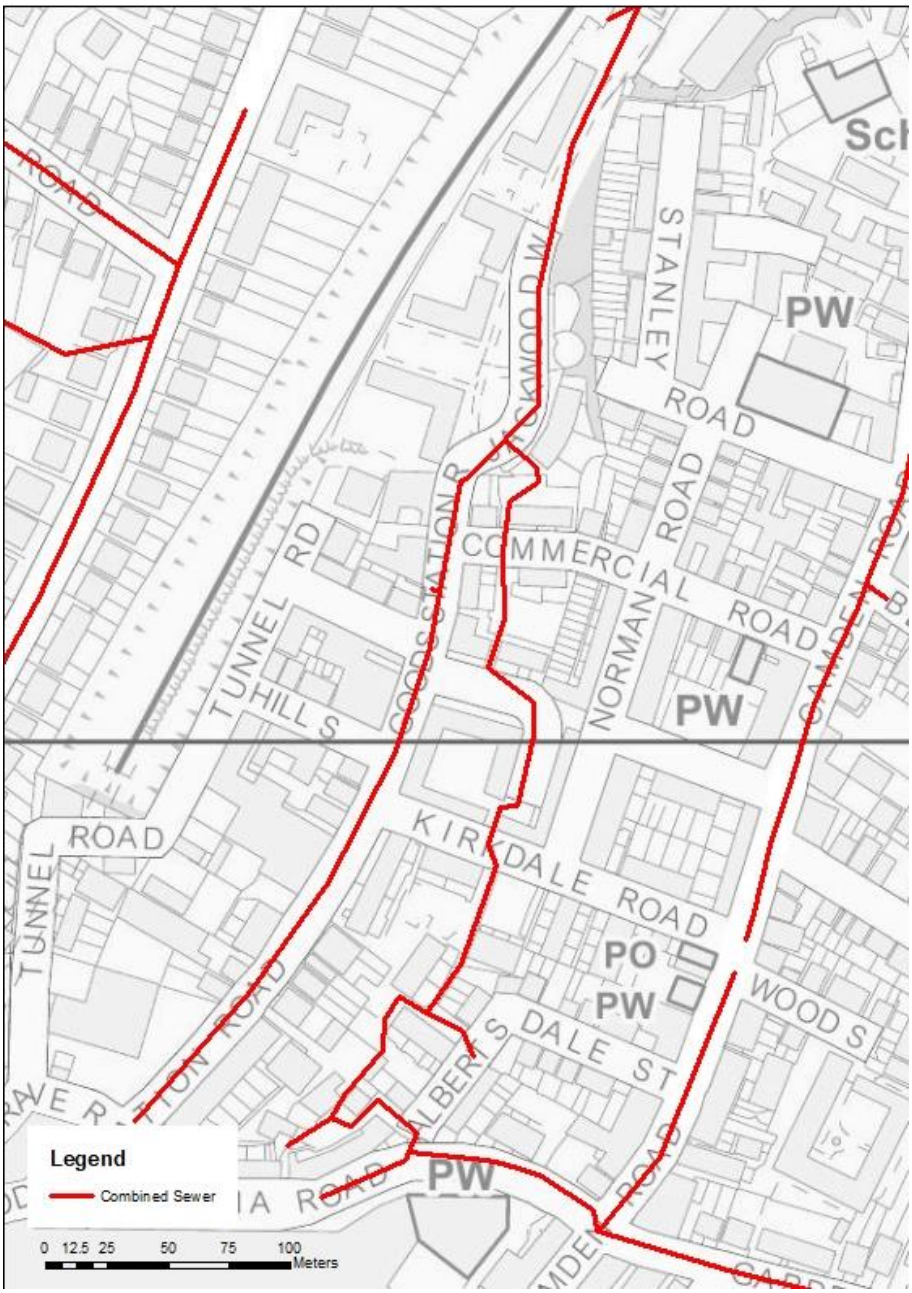

Figure 9 Sewer network upstream of Jackwood Way

3.3.3 Flooding Mechanism

The primary cause of the flooding around Royal Victoria Place was intensive rainfall which exceeded the capacity of the drainage and sewer systems in this area. The intensity of the rainfall meant that the sewer system is likely to have reached capacity leading to it being exceeded and overflowing.

The sewer system to the south of Jackwood Way is reported to have been under sufficient hydraulic overload to cause the manhole to surcharge. Water from the sewer flowed from manholes in Kirkdale Road and Commercial Road to Jackwood Way. The houses at Jackwood Way sit lower than the land to the south, the flood water entered the rear gardens where it ponded and reached sufficient depth to enter the properties from the rear.

3.4 High Brooms (Including Dougall Close, Brook Road, Sandhurst Close)

3.4.1 Summary of Impact

Approximately 20 residential properties are known to have flooded in this area, including on Brook Road, Dougall Close and Sandhurst Close. The properties at risk lie near to the Southborough Stream, which is an ordinary watercourse. The properties were flooded directly by the Southborough Stream when it over topped its banks. Figure 10 shows the approximate location of the watercourses in this area.

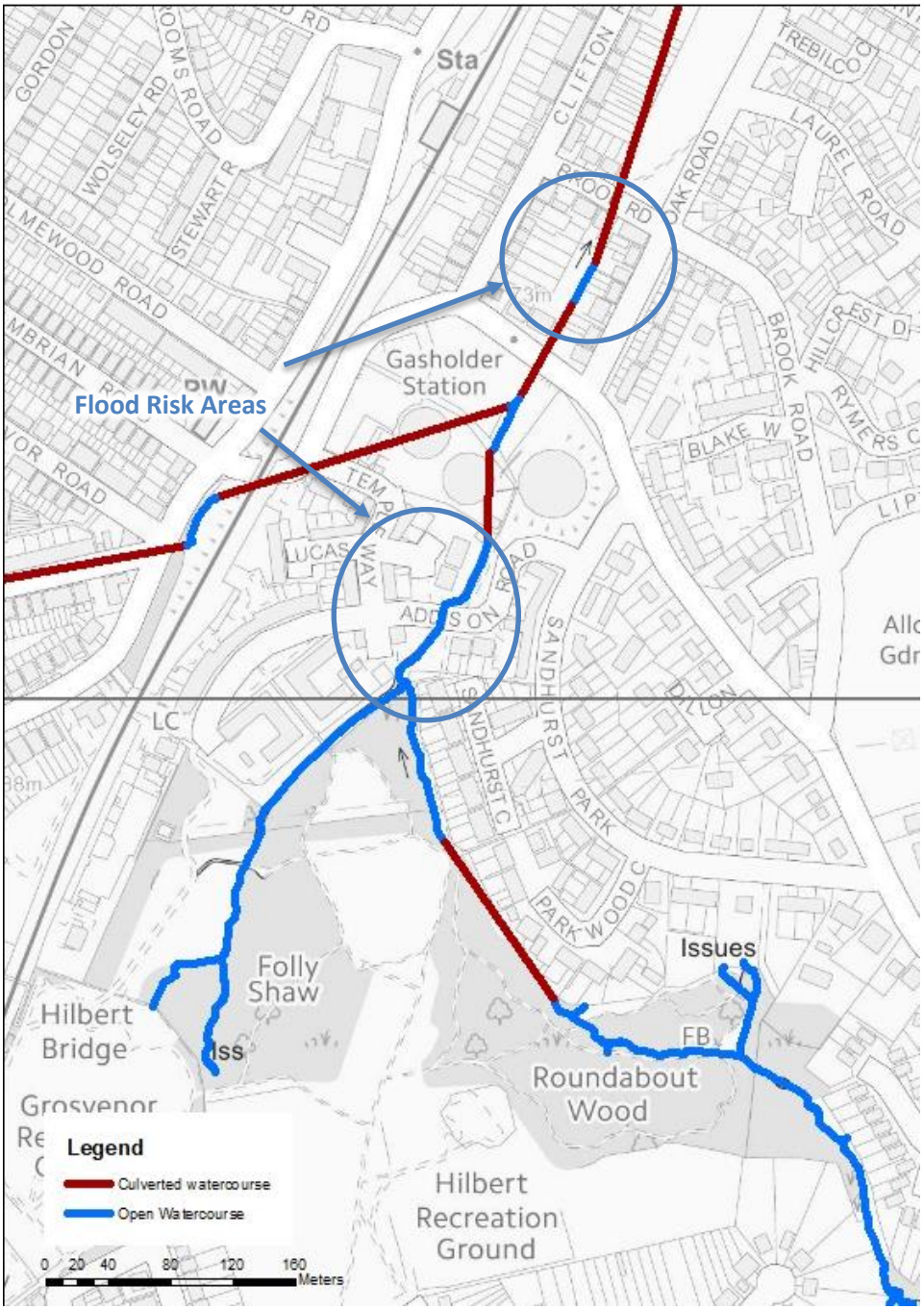

Figure 10 Proximity of properties to the watercourse

3.4.2 Site Location and Topography

High Brooms lies within the catchment of the Southborough Stream, the catchment drains in a northerly direction towards Tonbridge and the River Medway. The stream rises at a number of springs in Hilbert Wood and Grosvenor Park and two branches of the streams flow through the woodland and managed parkland.

The Hilbert Wood branch of the channel flows along the rear of properties on Sandhurst Close, approximately 20 m from the houses. Immediately downstream of Sandhurst Close the stream meets the branch of the channel from Grosvenor Park at the northern boundary of the park and is contained within a steep sided channel passing under Addison Road. As the stream passes to the front of properties at Dougall Close the banks of the channel slope towards the narrow channel of the stream which sits 10m from the properties forming part of the landscaped frontage.

At the boundary of the former Gasholder Station and Dougall Close the stream enters a large concrete culvert chamber, the entrance to the chamber is fronted by a large trash screen. As the water enters the system it flows over a metal sluice gate. The purpose of the sluice is unknown, and may be a feature of the previous drainage arrangement prior to the development. After the sluice the watercourse falls into a large chamber where the chamber discharges through a brick arch culvert for 55m.

The stream then flows through a small area of scrubland for 30m. At this point the watercourse is joined by another tributary that drains the High Brooms area. This watercourse flows in a north-easterly direction along Silverdale Road and collects surface water drainage from the surrounding area. Until recently this watercourse was designated as a sewer.

The watercourse continues in a northerly direction through a brick arch culvert which becomes a 1500mm concrete pipe. The stream is open channel for 30m between Sandhurst Road and Brook Road at the car park at the rear of Taylor Court. The carpark and properties that surround this carpark are at a lower level than the surrounding land.

The watercourse then enters a 1500mm concrete culvert, which continues through a culvert system flowing in a northerly direction. The geometry of this culvert changes, in places it is brick arch culvert and in others circular concrete culvert pipe. The catchment is heavily influenced by the surrounding urban area, the urban run-off discharges into the stream via the highway.

The affected area sits within the lower areas of a steep catchment and includes locations indicated to be at high risk of surface water flooding as shown in Figure 11. Due to the topography of the area the surface water naturally flows towards the stream.

Recent development in the area has clearly affected the flood risk. The properties at Dougall Close were built as part of the Connaught Park development in the mid-2000s. Details of this development are available on the TWBC Public Access website, though the details of the arrangements on the site prior to this development are limited, it would appear that changes to the watercourse and its layout were implemented. Some of the site history indicates that a pond has been filled in as part of the development and a culverted watercourse was replaced with an open watercourse.

A flood risk assessment was undertaken as part of planning for this development, however, a copy of it cannot be found. Comments on surface water and foul drainage were made to TWBC by Southern

Water and the EA and were reported in the report to the Planning Committee, with conditions recommended that were included in the Decision Notice. Drawing S80402-D100 dated 23 September 2004, shows the layout at Dougall Close including the current watercourse and cross-sections of the bridge at Addison Road. A copy of Drawing S80402-D100 can be found in Appendix 1.

Figure 11 Surface Water Flood Map for High Brooms

This drawing includes what appear to be flood levels for 1 in 2 year, at 72.06 m, 1 in 30 year, at 72.3 m, and 1 in 100 year, at 72.4 m. These levels appear to be below the finished floor level of the Dougall Close properties, though only by a small margin.

The flood levels on this drawing indicate that the flood risk from the watercourse was assessed as part of the planning application, however, the subsequent flooding shows that this may not have considered all the factors in the catchment that contribute to the flood risk. Without reviewing the report for this assessment, it is impossible to know how this assessment differs from the real situation, it is also not known whether this assessment is the final assessment or if this was revised. Factors that could affect the discrepancy between the assessed risk and the actual risk include: changes to the watercourse or development layout since the flood risk was assessed; downstream

effects that were not included in the assessment, such as capacity or blockages; the appropriate critical storm duration for the catchment; and potentially more.

3.4.3 Flooding Mechanism

As is characteristic of the upper reaches of a river, the channel is narrow but captures flow from a large urban area with numerous surface water discharge points entering the stream along its length. The size of the catchment draining into the stream results in it responding quickly to intensive rainfall and resulting in river levels rising quickly.

Additionally, there are a number of factors which may be contributing to the flooding mechanism beyond the surface water flows and size of the channel.

The trash screen at the entrance of the culvert chamber is the first main feature within the channel which if blocked by debris from upstream would contribute to the flooding at Dougall Close.

The capacity of the culvert system may also be contributing to the flooding by causing water to back up within the system. A CCTV survey of the culvert shows a number of minor defects and blockages which are unlikely to have been a direct cause of flooding. However, a larger obstruction of woody debris results in an estimated 40% cross-sectional area loss and would have reduced the capacity and impeded the flow of water through the culvert.

In addition, the presence of the culvert limits the available flood plain of the watercourse, so that when the capacity of the watercourse is exceeded it can only flood in the open sections or through the manholes on the culverted sections. Several of the open sections of the watercourse happen to have properties in close proximity, which are at a high risk of flooding as a consequence.

4 Actions taken to address flood risk

Section 19 Flood Reports have been produced for both the 2012 and 2015 flood events and can be found here.

Following the 2012 flood event

KCC has liaised with the Home Group Ltd, the housing association responsible for the watercourse at Brook Road to improve the maintenance of the stream and ensure debris does not block the culvert or trash screen.

Following the 2015 flood event

KCC developed a plan to disconnect the highway drainage on Nevill Street from the combined sewer. The sewer was managed by a small pump which during heavy rain could become overwhelmed. Removing the water from the combined sewer and discharging the surface water into the River Grom culvert reduced the risk of sewer surcharging.

KCC have replaced the trash screen on the entrance to the River Grom as shown in Image 1 and 2, the previous vertical screens have been replaced with a single raked trash screen. The new screen allows more effective and safer maintenance of the screen as it can be cleared of debris during higher flows and allows water to pass through easily.

Image 1 and 2 River Grom trash screen before (above) and after (below)

KCC and residents have liaised with the property management company, First Port, to arrange regular maintenance of the trash screen near Dougall Close at the entrance to the culvert chamber on the Southborough Stream. Maintenance is being carried out on a quarterly basis to ensure that debris is removed and that high flows can enter the system without being impeded.

Following the 2017 flood event

KCC have undertaken drainage cleansing on the following roads in Tunbridge Wells that were affected by flooding:

- Broadwater Down
- Brook Road
- Boyne Park
- Commercial Road
- Frant Road
- Mount Pleasant Road
- Nevill Street
- Warwick Park
- London Road
- Sandhurst Road

KCC have undertaken CCTV inspections on both the Southborough Stream culvert system and the River Grom culvert to assess for damage, defects and blockages. The details of the surveys are detailed within the report and any remedial work as a result of the surveys has been listed within the recommendations.

KCC is working with the National Flood Forum (NFF) across Kent and has established a flood action group of residents affected by the flooding within Tunbridge Wells. This group has regular meetings to identify the key issues and concerns that they feel need to be addressed in managing flood risk and the NFF facilitate discussion with the various risk management authorities to answer these questions.

KCC through its partnership with the Countryside Management Partnerships has been delivering natural flood management (NFM) measures within Hilbert Woods and Grosvenor Park.

The construction of leaky dams along the watercourse, replicates naturally fallen timber which helps to dam peak flows and reduce the speed at which water reaches pinch points and areas of high flood risk. The dams are fixed securely to the bed and banks of the channel to remove the risk of debris detaching and causing additional flood risk. An example is shown in Image 3.

Image 3 Example of a beaver dam on the Southborough Stream

To address the issue of sewer surcharging, Southern Water have fitted non-return valves to toilets in the basement of commercial properties in Mount Pleasant Road to prevent sewers from backing up and causing or exacerbating flooding.

KCC have completed works identified and developed after the 2015 flood event to disconnect the highway drainage system from the combined sewer network and discharge the highway water into the River Grom. This has provided some capacity within the combined public sewer served by the small pumping station at Warwick Park and will help reduce the risk of surcharging within the properties connected to this pump and should increase the rate at which water discharges from the highway, as it will not be pumped by this small pump.

5 Conclusions and Recommendations

The flooding that occurred on the 19 July 2017 was the result of intensive rainfall, with 32 mm falling in 45 minutes and 22.6 mm of this total falling within a 15-minute period, which had a return period of 1 in 32 year. This storm exceeded the design standards of drainage systems, as a consequence, surface water could not enter drainage networks quickly enough and the capacity of the drainage network was exceeded, flood waters flowed to local low points where flooding was experienced.

The River Grom and Southborough Streams, which receive flows from the highway system, quickly reached peak flows as the surface water drainage discharged into these watercourses. This resulted in the River Grom overflowing at the entrance to the culvert system and the Southborough Stream flooding out of bank at local topographical low points adjacent to property.

Whilst fluvial and surface water flooding from a similar event cannot be fully prevented (as drainage infrastructure is not commonly designed to accommodate the intensity of rainfall that was experienced during this event and flows within a watercourse may exceed the natural capacity), there may be steps that can be undertaken to reduce the risk to communities. Some measures that risk management partners will work together to investigate are set out below.

Recommendations

1. Southern Water will publish a summary of its Drainage Area Plans for Tunbridge Wells South and Tunbridge Wells North catchment areas.

2. KCC and Tunbridge Wells Borough Council will investigate options of re-development sites including Sustainable Urban Drainage Schemes in Tunbridge Wells that can collect and store surface water run-off and discharge water slowly to reduce the peak amount of runoff. TWBC is developing future planning policies in the new Local Plan to require this for future development (once the new Local Plan is adopted).

3. KCC in partnership with the Tunbridge Wells Flood Action Group, will investigate options for Natural Flood Management measures on The Common which can reduce the rate of overland flow and reduce the risk of surface water flooding forming on Nevill Street.

4. The Countryside Management Partnerships, the Friends of Hilbert Woods and Grosvenor Park, KCC and Tunbridge Wells Borough Council will continue to support the delivery of Natural Flood Management measures in Hilbert Woods and Grosvenor Park to reduce the risk to properties downstream.

5. KCC will investigate the arrangement of the culvert entrance on the River Grom.

6. KCC will monitor the flow in the River Grom and Southborough Stream to assess the flow regime in the watercourses and to aid our understanding of the catchments and potential mitigation options.

7. KCC will liaise with Tunbridge Wells Borough Council to arrange clearance of the culvert on the Southborough Stream to remove blockages and carry out a cleanse of the system.

8. Southern Water will implement the Protocol for correctly classifying Culverted Watercourses and Sewers to watercourses and sewers that have recently been reclassified on their sewer map in Tunbridge Wells.

9. KCC in partnership with the Tunbridge Wells Flood Action Group have approached the Tunbridge Wells Common Conservators to develop proposals for natural flood management measures across the common. Natural flood management measures may be able to retain water on the common for longer to reduce the rate of discharge onto surrounding roads and to create additional habitat features on the site. The Countryside Management Partnerships Natural Flood Management officer will work with the conservators to develop natural flood management proposals.

APENDIX 1: Drawing S80402-D-100