

1 Appendix C: Understanding flood risk in Three Rivers District

1.1 Three Rivers District

The District covers an area of approximately 89km² and has a population of approximately 91,700¹. Rickmansworth is the largest town with a population of approximately 24,000 (2011 Census)². Other notable settlements include South Oxhey, Croxley Green, Abbots Langley, Chorleywood, Leavesden and Mill End. Outside the settlements, the M25 runs along the central band of the District in amongst large areas of agricultural arable land and rural settlements.

1.2 Hydrology

The principle watercourses (Appendix A) that flow through the District are:

- The River Colne flows from the east of the District to the south before its confluence with the other two main rivers.
- The River Gade flows along the eastern border of the District
- The River Chess flows from north west to south east and joins the River Colne at Rickmansworth.
- The Grand Union Canal flows from north east to south west, forming a confluence with the River Gade at Croxley Green, as well as the Rivers Chess and Colne at Rickmansworth.

The Three Rivers District covers the operational catchment of the Colne. There are numerous tributaries of the Colne in the upper catchment and lower before joining the Thames at Staines.

1.3 Topography

The topography that characterises the District is variable with higher elevations to the north west of the catchment to low lying land along the Colne Valley in the south. The higher elevations reach approximately 135m AOD at Belsize near Chipperfield with elevations decreasing in a south to south-westerly direction due to the presence of three main rivers. Elevations reach approximately 42m AOD near Maple Cross and continue to decrease along the Colne Valley southwards.

1.4 Geology and soils

The geology that underlays the majority of the District is the White Chalk Sedimentary subgroup formed approximately 66 to 100 million years ago in the Cretaceous Period. The bedrock is interspersed with small areas of Lambeth Group (Clay, Silt, Sand and Gravel) in the upper catchment of the District. South of Rickmansworth there is a significant band of Lambeth Group that is located in the south east of the District underlying South Oxhey. This bedrock was formed 56 to 66 million years ago during the Palaeogene Period. The third type of bedrock underlying the south east of the District is the Thames Group (Clay, Silt, Sand and Gravel), and youngest of the three.

Superficial Quaternary deposits within the District vary from the upper catchment to the lower extents. The central band of the catchment and towards the north east, Glacial Sand and Gravel have been deposited during the last 3 million years from glacial outwash. Separating the three sections of glacial deposition is alluvium

¹ Three Rivers District Council (June 2017). TRDC Fast Facts 2017. Available online at <https://www.threerivers.gov.uk/egcl-page/your-guide-to-the-three-rivers-area>. Accessed on 08/03/2018

² UK National Statistics (2011). Rickmansworth: Town Population Census data. Available online at <https://www.ons.gov.uk/census/2011census>. Accessed on 08/03/2018

sediment, formed due to the presence of the three rivers depositing sand and gravel detrital material. Along the channels are river terrace deposits with fine silt and clay from overbank floods forming floodplain alluvium. The final superficial deposit within the District is an area of Clay-with-Flints Formation located south-west of Rickmansworth underlying the River Colne and Stockers Lake.

Overlaying the superficial Glacial Sand and Gravel are freely draining loamy soils which characterise the naturally higher groundwater table and thus are naturally wet. Along the River Chess to the west of the District soils remain freely draining but are lime-rich loamy which is typical of chalk and limestone groundwater. Overlaying the Thames Group superficial geology is slowly permeable, base-rich loamy and clayey soils, which are seasonably wet.

1.5 Land use

The District contains several large settlements, including Rickmansworth, Oxhey and Chorleywood. The significant feature of the District is the M25 that runs from the south west to the south of Chorleywood through the greenbelt and exiting the north of the District. The region has a significant amount of arable land with varied green infrastructure such as the Colne Valley, Moor Park Golf Club, Leavesden Country Park and Rickmansworth Aquadrome.

Figure 1-1: Topography of Three Rivers.

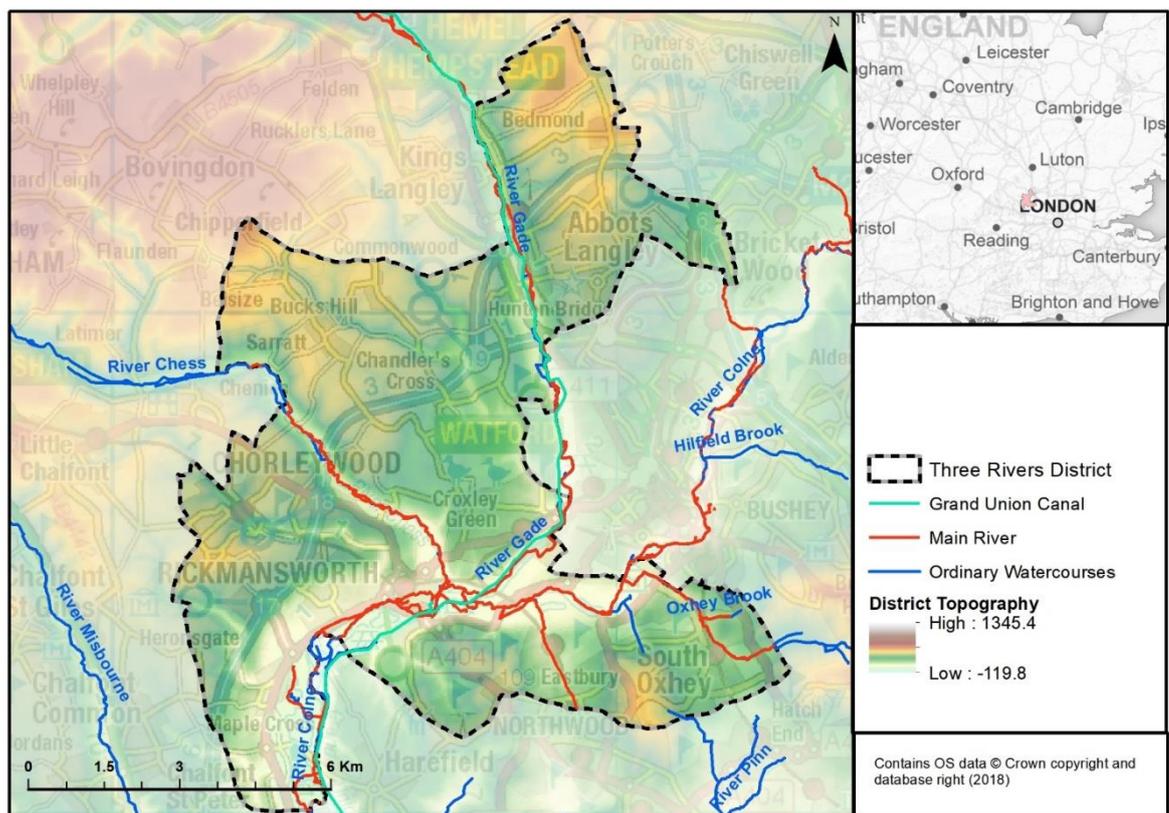


Figure 1-2: Bedrock geology of Three Rivers

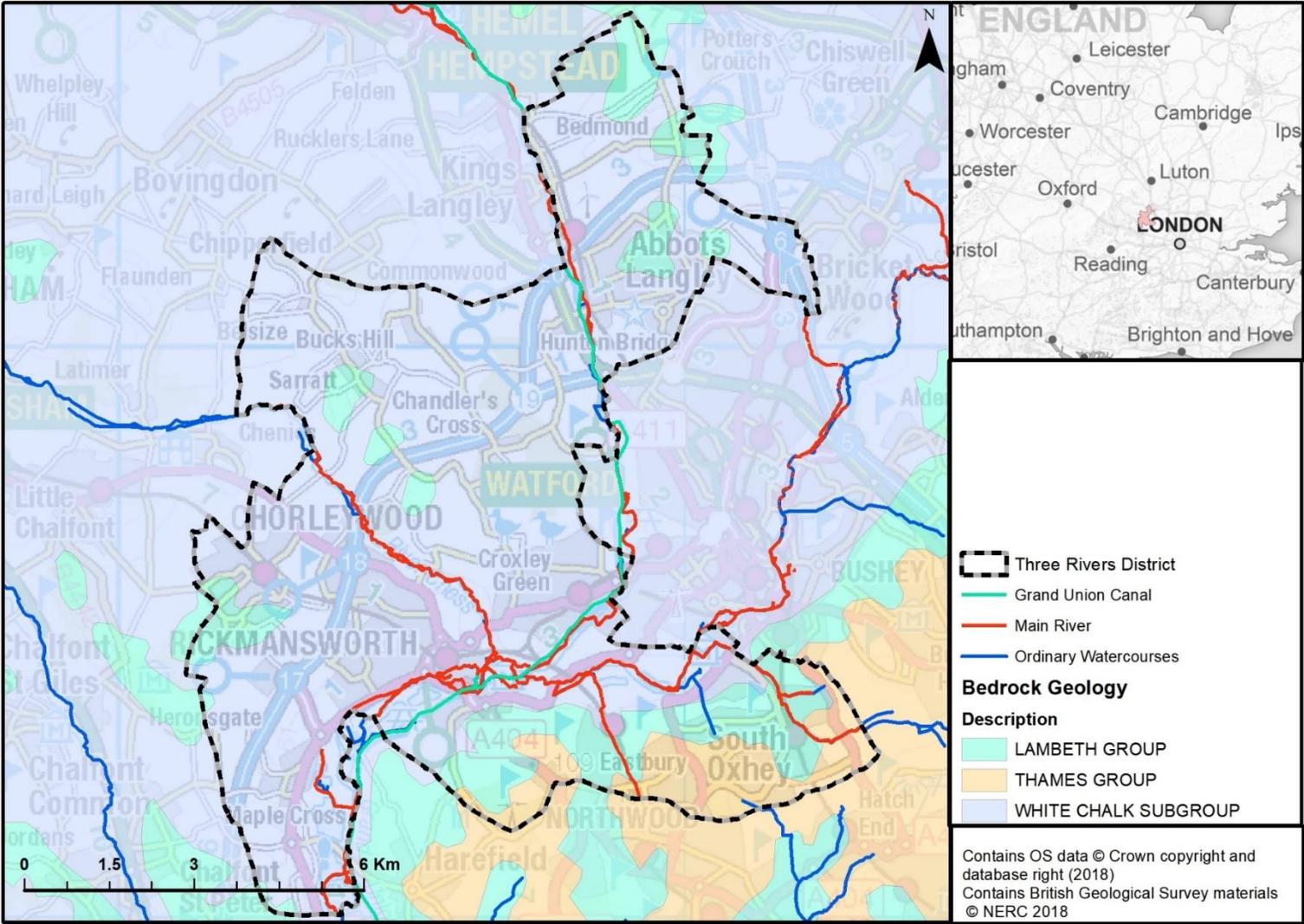
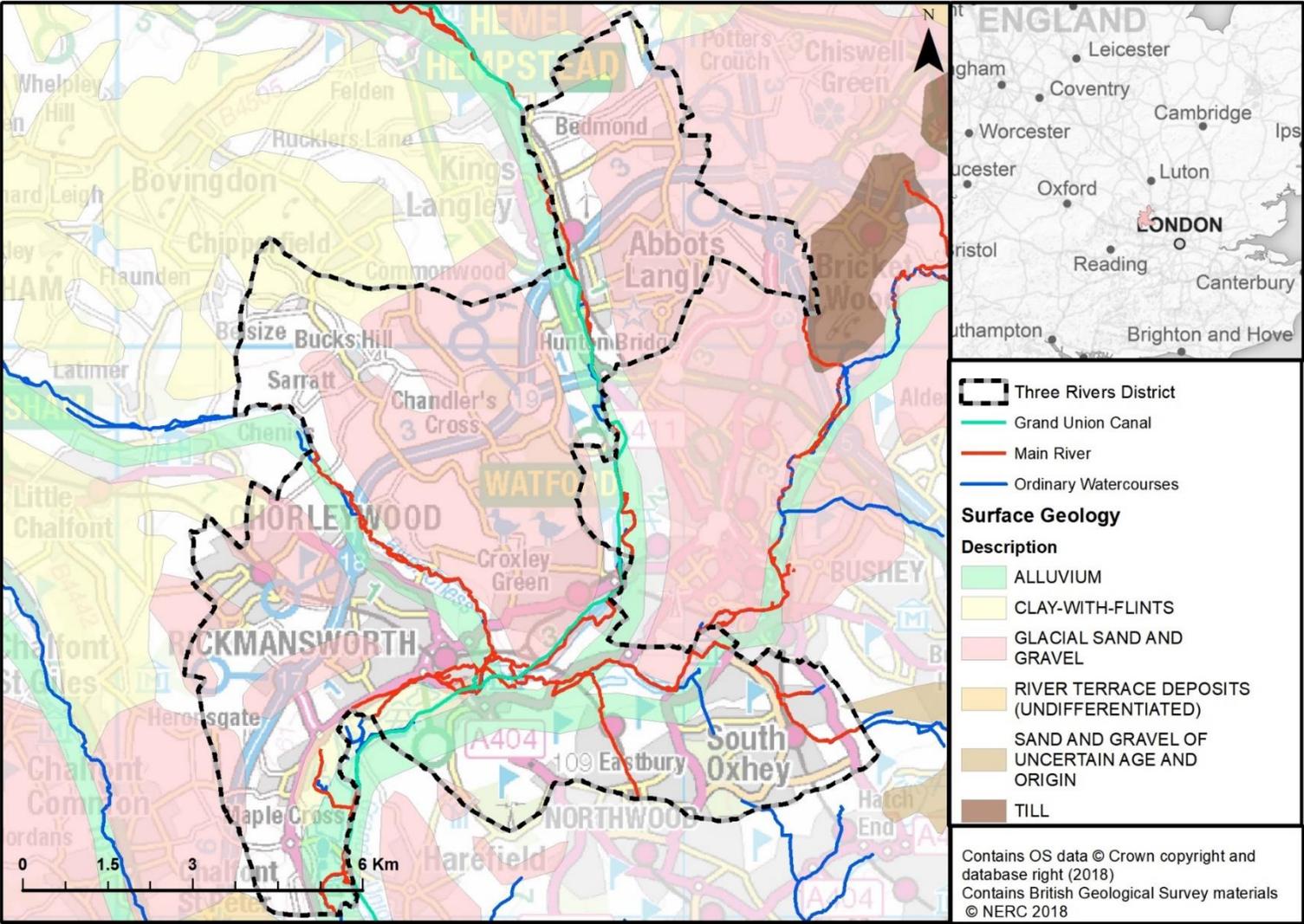


Figure 1-3: Surface geology of Three Rivers



1.6 Flood History

Several flood incidents have been recorded in the District in recent years, with the greatest number occurring in Rickmansworth. The sources of flooding are diverse, ranging from surface water flooding caused by overland flows and exceeded sewer systems, to groundwater flooding and overtopping of the River Colne.

Based on information from the Environment Agency, Thames Water and Hertfordshire County Council, a listing of known recorded events in the District and sources of information is provided in Table 1-1.

Table 1-1: Recorded flood incidents in Three Rivers.

Date	Settlement / location	Severity / description of incident
February 2004	Church Street, Batchworth, Rickmansworth	Groundwater flooding
November 2006	Kewferry Road, Rickmansworth	Groundwater flooding
2007	Uxbridge Road, Rickmansworth	Surface water drainage exceedance as a result of River Colne rising. Properties flooded.
2007	High Street, Rickmansworth	Surface water drainage exceedance during flood event, causing flooding to commercial properties.
1988	South Oxhey	112 properties flooded in the area, 42 by a mixture of foul and surface water, 70 by surface water only.
1988	Uxbridge Road, Rickmansworth	15 properties experienced flooding from foul sewerage system, 12 were flooded from surface water and 14 experienced rear gardens being flooded.
2013 and 2014	Green Street, Chorleywood	Overland surface water flows onto Green Street which led to prolonged flooding of the highway. Dangerous flood level depths meant road closure.
7 th February 2014	Harefield Road & Juniper Dell, Rickmansworth	19 properties flooded from surface water flowing down road due to 'failed culverts'
February 2014	Drayton Ford Cottages, Rickmansworth	Two properties flooded from overtopping of defences from the Colne.
16 th September 2016	Church Street, Chorleywood Bottom, Lower Road & Links way; Rickmansworth	11 properties flooded from surface water due to blocked drains.

1.1 Flood Risk in Three Rivers

1.1.1 Fluvial

Fluvial flood risk in Three Rivers is concentrated in the Rivers Colne, at Batchworth and Rickmansworth, where the river forms a confluence with the incoming Rivers Gade and Chess, and interacts with the Grand Union Canal. Flood Zone 2 and 3 are most extensive at this location.

Elsewhere, the fluvial flood risk is relatively well constrained, with a section of Flood Zone 2 at Carpenders Park and Oxhey, within the valleys of the Hartsbourne and Oxhey Brooks. Flood Zone 2 and 3 covering the River Chess extends into southern Loudwater, and becomes more extensive upstream of the M25, where the river becomes braided. The floodplain of the River Gade at is very restricted, and does not extend into the adjacent Chorleywood

The extent of fluvial flood risk can be seen in Appendix A.

1.1.2 Surface Water

Surface water flood risk is largely confined to the urban areas of Three Rivers District. Surface water flow paths cut across residential areas of Eastbury, South Oxhey, Carpenders Park and Rickmansworth, following the natural topography to the River Colne. To the north at Croxley Green, overland flows are routed in two directions, eastwards to the River Gade and southwards into the Colne.

Surface water ponding occurs where the topography flattens on the floodplain of the River Colne, at Rickmansworth, Carpenders Park and Croxley Green. In addition, the railway embankment crossing Eastbury, Moor Park, Rickmansworth and Chorleywood causes some backing up of surface water against the steeper topography.

Appendix A provides the surface water flood risk mapping for Three Rivers.

1.1.3 Groundwater

Groundwater flood risk within Three Rivers is concentrated in the floodplains of the Rivers Colne, Chess and Gade. Here, the chalk geology and gravel surface deposits can result in heightened groundwater levels at or just below the ground surface. The settlements identified as at highest risk of groundwater flooding are Rickmansworth, eastern Croxley Green, western Loudwater and Oxhey.

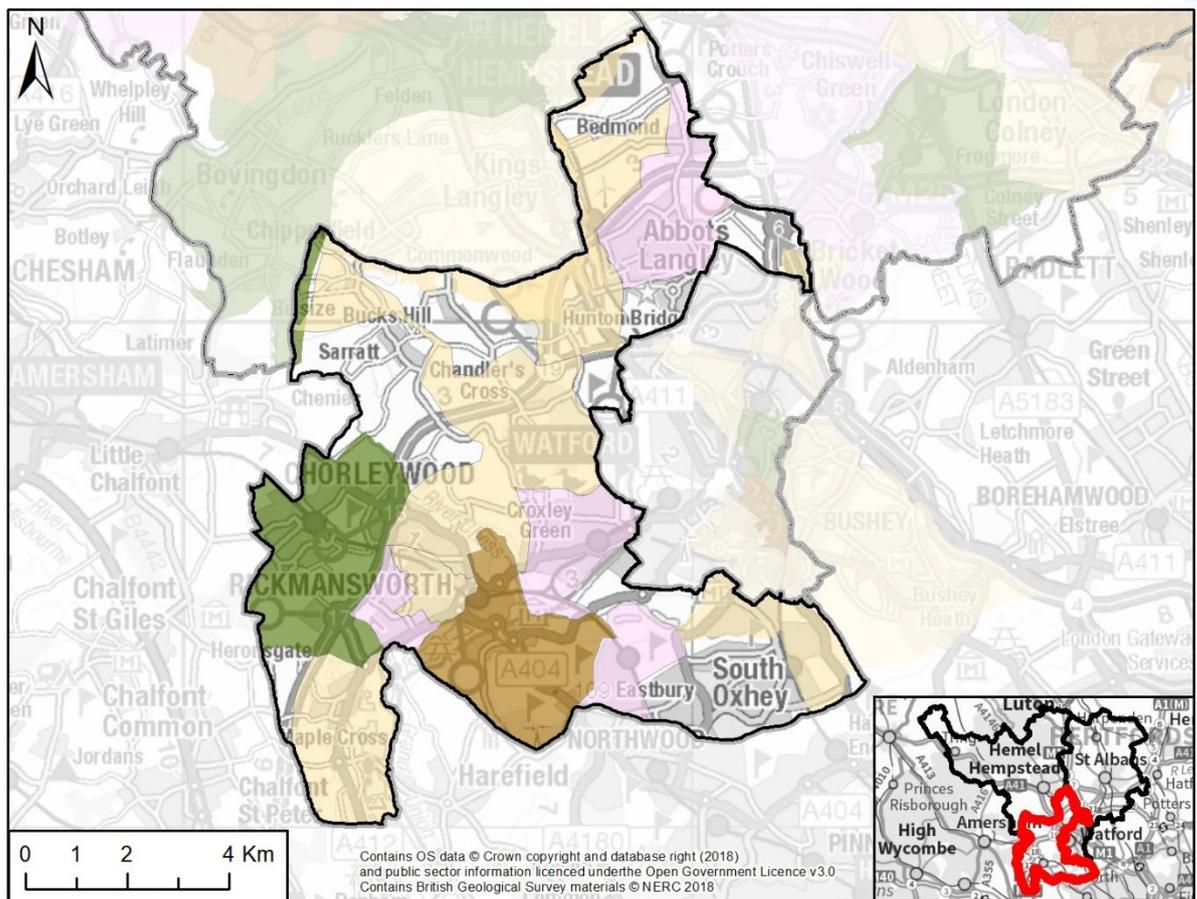
The groundwater flood risk map for Three Rivers is provided in Appendix A.

1.1.4 Sewers

Thames Water provided their sewer flooding register for Three Rivers, which is detailed below in Table 1-2 and Figure 1-4. The largest number of incidents within a single postcode area are recorded in WD19, which covers the areas of Oxhey and Carpenders Park. A further area with many incidents is WD3, which includes the settlements of Rickmansworth, Chorleywood and Croxley Green.

The mechanism of flooding is not specified in the register, however the presence of fluvial, surface water and groundwater flood risk in these areas suggests an interaction with the sewer network, perhaps due to ingress or restricted outfalls at high river levels.

Figure 1-4: Map of sewer flooding incidents recorded on Thames Water register.



**South West Hertfordshire
Level 1 Strategic Flood
Risk Assessment**

- Number of recorded sewer flooding events**
- 1-5
 - 6-10
 - 11-15
 - 16-22

Table 1-2: Thames Water sewer flooding register for Three Rivers.

Postcode Area	Coverage	Internal property flooding			External property flooding			Total
		2 in past 10-years	1 in past 10-years	1 in past 20-years	2 in past 10-years	1 in past 10-years	1 in past 20-years	
HA6 2	Moor Park	0	1	0	0	0	5	6
HA6 3		0	0	0	0	0	0	0
WD19 4	Oxhey, South Oxhey, Carpenders Park	0	0	4	0	0	2	6
WD19 5		0	0	0	0	1	1	2
WD19 6		0	0	26	0	0	4	30
WD19 7		0	0	19	0	0	1	20
WD3 1	Rickmansworth, Chorleywood, Croxley Green, Maple Cross, Loudwater, Mill End, Sarratt, Batchworth, West Hyde	0	0	4	0	5	6	15
WD3 3		0	0	2	0	0	4	6
WD3 4		0	0	1	0	1	3	5
WD3 5		0	0	6	4	1	7	18
WD3 7		0	0	0	0	2	0	2
WD3 8		0	0	8	0	2	0	10
WD3 9		0	0	1	0	0	3	4
WD4 8		Rucklers Lane, Bucks Hill, Hunton Bridge	0	0	0	1	0	0
WD5 0	Bedmond, Abbots Langley	0	0	1	1	6	1	9
TOTAL		0	1	72	6	18	37	134

1.1.6 Canal

There is a risk of flooding from the Grand Union Canal, where it interacts with the River Colne at Rickmansworth and further downstream. Data received from the Canal and Rivers Trust indicates that there have been several incidents of canal overtopping between Rickmansworth and West Hyde, in response to heavy rainfall and raised levels or overtopping of the River Colne. The incidents occurred in April 2013 and February 2014, largely affecting the canal towpath between Coppermill Lane and Coppermill Lock, with no damage to property reported.

1.1.7 Reservoir

A considerable area of Three Rivers District is identified as having a residual risk of reservoir flooding. As there are no designated reservoirs within the District, the flood risk originates from Aldenham and Hillfield Park Reservoirs to the east, and is conveyed by the Rivers Chess and Colne, as well as the Hartsmere Brook. The residual flood risk is largely confined to the floodplains of these watercourses.

However, it should be noted that reservoir safety is closely controlled by operators and regulators, and the likelihood of a flood event due to reservoir breach is low.