London Borough of Redbridge

Surface Water Management Plan

2024 - 2034

This document is being produced to present the content which will be delivered as a final output on the Flood Risk Management webpages of the Redbridge Council website.

Authored by: Eliane Gebauer
Reviewed by: Tom Whitworth
Approved by: Mike Mair
Date: August 2023
Version: 2.0

Metis Consultants Ltd.
2 Sheen Road, Richmond
London, TW9 1AE
United Kingdom
t. 020 8948 0249
e. info@metisconsultants.co.uk
w. metisconsultants.co.uk

1. Introduction

1.1 What is a Surface Water Management Plan?

A Surface Water Management Plan (SWMP) is produced by the Lead Local Flood Authority (LLFA) to introduce the predicted surface water flood risk within a given area and outline how it can be managed. Redbridge Council have commissioned this updated SWMP.

The SWMP is a collaborative document which involves Risk Management Authorities (RMAs) and partners to identify the causes and effects of surface water flooding in an area. In addition to surface water flooding, other sources of flooding are also considered due to the interactions between flood sources, particularly typical within an urban area such as the London Borough of Redbridge (LB Redbridge). Using this information, the SWMP should propose effective mitigation options and a long-term Action Plan to alleviate the risk of surface water flooding.

The benefits of undertaking a SWMP study are:

- Increased understanding of the causes, likelihood, and consequences of surface water flooding
- An increased understanding of where surface water flooding may occur can be used to inform planning
- A co-ordinated plan to tackle surface water flooding can be established with partners and stakeholders
- Opportunities to implement Sustainable Drainage Systems (SuDS) to manage surface water flood risk are identified
- An Action Plan can be generated based on surface water flood risk and potential flood mitigation options

This SWMP differs from the previous Redbridge SWMP from 2011 as it adopts a Catchment-based approach. Further information is presented in 'Methodology of the Catchment-based approach' section and the Technical Overview document.

1.1.1 What are the objectives of this SWMP?

- Apply the most appropriate guidance and include the most relevant information from the existing 2011 SWMP
- Signpost other strategic and guidance-based documents
- Apply a similar approach to neighbouring Local Authorities to help develop cross-boundary authority collaboration on future projects
- Provide a new online structure that is more user-friendly for the reader
- Include up-to-date information about properties and infrastructure at risk of flooding.
- Set out a plan for managing surface water flood risk at a borough-wide level
- Enable engagement with key partners and stakeholders on developing an effective and achievable Action Plan for managing surface water flood risk

1.1.2 The previous Redbridge SWMP

The information on these webpages will replace the previous SWMP, which was published in 2011. The previous SWMP used geographic analysis and rainfall modelling to identify Local Flood Risk Zones (LFRZs) and Critical Drainage Areas (CDAs), where the risk of flooding to property from surface water was predicted to be high. The 2011 SWMP included the following key information:

- 11,354 properties were identified to be at risk of flooding in the 1 in 100-year rainfall event return period. Of these properties, 10,037 were residential, 1,515 were commercial and 91 were infrastructure. The 1 in 100-year rainfall event return period has a 1% probability of occurring or being exceeded in any given year.
- The six CDAs with the most properties at risk were: Ilford, Seven Kings Water, Goodmayes, Gants Hill and Barkingside, Newbury Park West, and Cranbrook.
- As part of an Action Plan, various options were suggested to manage surface water flood risk throughout LB Redbridge. Some examples of the proposed measures are the use of SuDS such as permeable paving, rain gardens and tree pits and other measures such as temporary demountable flood defences.

1.1.3 Other strategic flood documents

There are various strategic flood documents that link to the SWMP which are summarised below. LB Redbridge flood-related documentation can be found under the Flood Risk Management tab at the bottom of the website.

Local Flood Risk Management Strategy (2024) - The SWMP acts in alignment with the LB Redbridge Local Flood Risk Management Strategy (LFRMS), published in 2024. The Flood and Water Management Act (FWMA) from 2010 requires each LLFA to produce a LFRMS to assess the local flood risk, set out objectives for managing it, define the costs and benefits of the proposed measures and identify how the measures are proposed to be paid for.

Flood Risk Investigation Reports - Section 19 of the FWMA 2010 requires LLFAs to investigate flooding when it is 'necessary and appropriate'. Flood risk investigation reports will identify which RMAs have a flood risk management function in relation to a flooding event. It will outline what the relevant authority is going to do or has done in response to the event. A flood risk investigation report was produced regarding Westwood Recreation Ground and surrounding roads which flooded in June 2016 due to an intense rainstorm in which approximately 40mm of rain fell. A further flood risk investigation report was produced by Metis Consultants on behalf of the LB Redbridge in response to the flooding that resulted from heavy rainfall and storms on the 25th of July 2021 across much of the borough, and another is currently being produced regarding the November 2022 flooding around Westwood Recreation Ground.

Strategic Flood Risk Assessment Level 1 (2015) – A Strategic Flood Risk Assessment (SFRA) is carried out by a Local Planning Authority (LPA) to assess the current and future risk to an area from flooding. The main objective of these assessments is to assist the Planning Department of LB Redbridge in the allocation of sites for future development. The SFRA should also act as the evidence base to underpin specific flood risk-related policies that the LPA might be looking to implement or strengthen within their Local Plan.

Further relevant documents include:

- SFRA Level 2 (2016) with addendum (2016)
- Preliminary Flood Risk Assessment (2011) with addendum (2017)
- Regional Flood Risk Appraisal (2014)
- Thames Catchment Flood Management Plan (2009)
- Thames River Basin District Flood Management Plan (2021 to 2027)
- Thames Estuary 2100 Plan

1.2 Relevant projects

Since the publication of the 2011 SWMP, several major flood alleviation schemes have been progressed to reduce the risk of flooding in the LB Redbridge. These include:

- **Westwood Recreation Ground** – In recent years, various works have been investigated to alleviate flooding and improve environmental quality at Westwood Recreation Ground. Options explored have included detention basins, de-culverting the watercourse and improvements to the existing bund. Most recently, LB Redbridge LLFA obtained funding from the Greater London Authority (GLA). A scheme is currently being developed with the aim of improving biodiversity whilst also alleviating flood risk at Westwood Recreation Ground and to surrounding properties.
- **Hurtsleigh Gardens** – Construction of a bund and attenuation pond as part of the Clayhall Flood Alleviation Scheme.
- **The River Roding Project** – A project led by the Environment Agency (EA) to reduce flooding to properties in the Woodford and Ilford areas. The project includes the construction of a flood storage area on the River Roding at Shonks Mill Bridge and the refurbishment of the flood embankment in Woodford. Construction is expected to commence in Summer 2023.
- **Ilford Jewish Primary School, King Solomon High School, and Caterham High School SuDS** – LB Redbridge won two grants from the Department for Education and Thames Water Utilities Limited (TWUL) to implement SuDS in schools that suffered from flooding in the July 2021 storms. A number of planters that connect to the building rainwater drainage systems have already been constructed.
- **Deynecourt Gardens SuDS** – Raingardens have been constructed in Deynecourt Gardens to help alleviate the accumulation of surface water. This location has a prominent flow path of surface water as it follows topographical low points travelling towards the Roding Farm Allotments.

In addition to physical schemes, LB Redbridge have arranged a series of flooding roadshows to help inform residents and local businesses about flooding in their local areas. The roadshows also include the demonstration of PFR measures. 98 gully sensors have also been installed to provide real time data on the functioning of gullies and can be used to identify blockages. More information can be found in the LFRMS which is available on the LB Redbridge Flood Risk Management webpages.

1.3 Stakeholder engagement

Various RMAs and stakeholders were engaged through the creation of the updated SWMP. Their involvement in the project is outlined in *Table 1-1.*

Table 1-1 Stakeholder Involvement in the SWMP

Stakeholder	Involvement
LLFA Team	• Acted as main liaison throughout the formation of the SWMP document. • Attended a stakeholder engagement meeting which outlined the delivery approach, proposed draft structure and the programme of the new SWMP. • Attended a stakeholder engagement meeting to review the new Basins and Catchments created to ensure that known areas of flood risk are being captured and represented correctly. • Provided information on proposed and ongoing schemes since 2011 for incorporation into relevant Basin and Catchment sections.
GIS Team	• Provided advice on the delivery of the online mapping information tool.
Communication and Webpage Team	• Attended a meeting which outlined the online format of the SWMP and provided advice on the delivery.
Key organisations	
Environment Agency	• Provided relevant data and information.
Thames Water Utilities Limited	• Provided relevant data and information.
Neighbouring boroughs and counties	
London Borough of Newham	• Engaged to review the new Catchments and Basins created and to ensure that known areas of flood risk are being represented correctly.
London Borough of Barking and Dagenham	
London Borough of Waltham Forest	
London Borough of Havering	
Essex County Council	

2. Flood risk overview

2.1 Borough overview

The London Borough of Redbridge (LB Redbridge) is bordered by London Borough of Havering (LB Havering) and the London Borough of Barking and Dagenham (LB Barking and Dagenham) to the east, London Borough of Newham (LB Newham) to the south and London Borough of Waltham Forest (LB Waltham Forest) to the west. Additionally, Essex County borders the north of LB Redbridge. The topography of the LB Redbridge is influenced by the River Roding with areas in Hainault and Woodford representing the highest elevation in the LB Redbridge. LB Redbridge lies within the Thames River Basin District, which encompasses all Greater London.

Key infrastructure and amenities in LB Redbridge include:

- A designated Special Area of Conservation to the north of LB Redbridge in Lord's Bushes
- Areas of London's Statutory Green Belt such as Wanstead Flats, Wanstead Park, Roding Valley Park, Fairlop Plain, Hainault Fields and Hainault Forest
- Hospitals including Goodmayes Hospital, King George Hospital, Roding Hospital and Redbridge Primary Care Trust
- The M11 motorway
- The A406 and A12 dual carriageways
- The Network Rail and the London Underground Central and Elizabeth Lines

Land use in LB Redbridge is mostly urban, except for various large green spaces and sections of agricultural land in the northeast. More detail on land use can be viewed on the Council website mapping tool.

2.2 Interactions with neighbouring authorities

There are various interactions between LB Redbridge and the surrounding boroughs. LB Redbridge forms part of the Northeast London Strategic Flood Group, along with LB Barking and Dagenham, and LB Havering. Representatives from these boroughs use this Strategic Flood Group to collaborate on the management of flood risk. There are various other drainage interactions between LB Redbridge and surrounding boroughs due to sewer connections and watercourses. For example, the boundary between Loxford in LB Redbridge and LB Barking is defined by Loxford Water, a main river.

2.3 Flooding overview

According to 2010 guidance from the Department for Environment, Food and Rural Affairs (DEFRA), the main sources of flooding to be investigated in a Surface Water Management Plan (SWMP) are:

- Surface water runoff
- Groundwater

- Sewers
- Open-channel and culverted watercourses

Although these will be the focus, it is important to recognise that there are other sources of flood risk in LB Redbridge, such as, tidal, and fluvial (river) flood risk. Many types of flood risk interact with each other. The following sections define each type of flood risk, provide an overview of the different potential sources and present information on how flooding has impacted LB Redbridge. Maps displaying this information regarding each type of flood risk can be viewed on the online SWMP mapping tool.

2.3.1 Surface water flood risk

Surface water flooding occurs when high intensity rainfall leads to large volumes of runoff. This is also referred to as 'flash flooding'. The high intensity causes the ground to become saturated, and the drainage systems may reach capacity in a short amount of time. As a result, the water is unable to drain through the ground or travel through the sewer network. Surface water flooding is more likely to occur in low-lying areas or surrounding sewers as this is where water naturally travels to. In urban areas, impermeable surfaces such as concrete, are extensive. This increases the risk of surface water flooding because there are less areas where water can infiltrate. Surface water flooding can cause significant disruption in local areas and can occur at any time of the year.

The Environment Agency (EA) has a Risk of Surface Water Flooding (RoFSW) map which assesses surface water flooding scenarios based on the 1 in 30, 1 in 100 and 1 in 1000-year rainfall event return periods. Further information regarding this dataset can be found on the 'Risk of flooding from surface water' map guidance and it can be viewed on the online mapping tool. For locations that are predicted to be at risk of surface water flooding in the 1 in 30-year rainfall event return period there is a 3.3% chance that flooding may occur in any given year.

2.3.2 Properties at risk

It is possible to estimate the number of properties at risk of surface water flooding in different rainfall event return periods, using the EA dataset 'Properties at Risk of Flooding' (2014). A breakdown of the estimated properties in LB Redbridge at risk in each rainfall event is presented in *Table 2-1*. The 'other' property classification includes transport, infrastructure, or unclassified properties. Properties may be unclassified due to a lack of information and property use may have changed since the dataset was produced.

Table 2-1 Number of properties at risk of flooding from surface water in LB Redbridge

Property Type	Properties at RoFSW 1 in 30-year rainfall event	Properties at RoFSW 1 in 100-year rainfall event	Properties at RoFSW 1 in 1000-year rainfall event
Residential	1,305	3,496	12,172
Commercial	163	372	1,049
Other	365	819	2,357
Total	**1,833**	**4,687**	**15,578**

2.3.3 Ordinary watercourse flood risk

Ordinary watercourses are defined in the Land Drainage Act 1991 as a watercourse that does not form part of a main river. Due to this, it is considered separately to fluvial (river) flood risk. Unlike main rivers, flood risk from ordinary watercourses is not the responsibility of the EA, it falls within the Lead Local Flood Authorities (LLFAs) duties. Ordinary watercourses may flood when the capacity of the channel is exceeded. There are numerous ordinary watercourses in LB Redbridge which are tributaries of main rivers. They usually fall within one of the following categories: streams, ditches, drains, cuts, and culverts. For example, Sheep Water in Hainault Forest Country Park. The risk of ordinary watercourse flooding is included in the EA RoFSW mapping.

2.3.4 Groundwater flood risk

Groundwater flooding can occur when the level of water below the surface (the water table) rises to ground level. When this occurs, water starts to seep through the surface and can cause flooding. Rises in the water table may be due to seasonal fluctuations or due to a greater volume of surface water infiltrating into the ground during intense rainfall events.

The risk of groundwater flooding is influenced by topography and geology. Much of LB Redbridge is underlain by the London Clay Formation which is usually composed of silty clay with some sandy layers. It is more difficult for water to infiltrate through soils with a large clay content. Information on geology and the risk of groundwater flooding in LB Redbridge can be viewed on the online mapping tool.

2.3.5 Sewer flood risk

Sewer flooding occurs when the volume of rainfall entering the sewer network is greater than the sewer capacity. The original sewer system in London was designed to cope with less rainfall and to support a smaller population. As a result, these assets are under pressure with unprecedented amounts of water. This pressure may be increased by:

- Intense rainfall events which exceed the system-designed event such as ‘flash flooding’
- An increase in sewer flow caused by new developments
- A failure of key infrastructure such as pumps
- Poor maintenance of the network which can lead to the build-up of debris and blockages
- Groundwater infiltrating into pipes
- Limited outflow from the sewer system due to high water levels in the receiving watercourses

Sewer flooding can be unpredictable and disruptive. Particularly in the case of foul sewer flooding where sewerage can pose a risk to human health. Whilst combined sewers are present, most of LB Redbridge is served by separate foul and surface water Thames Water Utilities Limited (TWUL) sewers. TWUL have provided data on sewer flooding incidents in LB Redbridge which has been mapped on the online tool.

2.3.6 Fluvial flood risk

Fluvial flood risk is the risk of flooding from EA designated 'main rivers', of which there are four in Redbridge. Fluvial flooding occurs when the water level in the river rises and overflows onto the surrounding land. The most prominent main river in LB Redbridge is the River Roding which flows from Essex County through London until it reaches the River Thames. Additional main rivers include Seven Kings Water, Cran Brook and Loxford Water, all of which are linked to the River Roding.

The EA is the authority responsible for managing main rivers. They carry out maintenance, improvement, or construction work on main rivers to manage flood risk. Additionally, the EA produce a Flood Risk Map for Rivers and Sea. Areas within Flood Zone 2 are predicted to have between a 1 in 100 and 1 in 1000 annual probability of fluvial flooding. Areas within Flood Zone 3 are predicted to have a 1 in 100 or greater annual probability of fluvial flooding. This dataset has been mapped on the online mapping tool.

2.3.7 Flood risk from tidal sources

Tidal flooding can occur during extreme high tide or storm surges. The River Roding is tidal in the southern half of LB Redbridge. The EA Reduction in Risk of Flooding from Rivers and Sea due to Defences Map shows areas that benefit from the presence of defences in a 1 in 100 chance of flooding each year from rivers. If the defences were not present, these areas would be predicted to flood in a 1 in 100 or larger flooding incident. For locations in the LB Redbridge that benefit from flood defences, please visit the online mapping tool.

2.3.8 Flood risk from artificial sources

Artificial flooding occurs because of infrastructure failure and human behaviour. Typical sources of artificial floods are reservoirs or canals. The EA's Reservoir Flood Extents 'Wet Day' dataset shows the predicted extent of flooding if reservoirs were to fail and release the water they hold on a 'wet day' when local rivers had already overflowed their banks. It represents a prediction of the worst-case scenario. Sources of possible reservoir flooding identified in LB Redbridge are displayed in the online mapping tool.

2.4 Recorded flood incidents within Redbridge

Redbridge Council maintains a record of historic flood incidents as this helps the Council understand the risk of flooding and how this risk may be changing due to climate change. Residents are encouraged to report flood incidents to the Council's online form. In a significant flood event where internal flooding of a property has occurred, a flood risk investigation may be undertaken by the Council. A flood risk investigation report was produced for Westwood Recreation Ground in response to storms in June 2016. Another flood risk investigation report was produced for LB Redbridge by Metis Consultants regarding borough-wide flooding in 2021, which can be found online.

Recorded flood event data has been provided by the EA, dating back to 1947. This has been presented within the SWMP mapping tool. Since 2000, there have been three flood incidents recorded in Redbridge within this dataset. The first occurring in 2000 with flooding from the River Roding. Then in

2016 at Westwood Recreation Ground due to the obstruction of a culvert of Seven Kings Water. The third occurring at the same location in 2019 due to the channel capacity being exceeded.

2.4.1 Sewer flood incidents

Sewer flood incidents are the responsibility of TWUL in LB Redbridge as they are the local sewerage company. The locations and types of incidents have been presented in *Table 2-2* and mapped on the online tool. The 'other' column includes incidents that were reported in schools, hospitals, and industrial buildings. It is important to note that the postal districts are not uniform in size which may impact on number of incidents.

Table 2-2 TWUL sewer flood incidents grouped by postal district within LB Redbridge between January 2014 and November 2022

Postal District	Residential	Commercial	Other	Total
E11	52	2	4	58
E12	0	0	0	0
E18	79	18	1	98
E7	0	0	0	0
IG1	296	83	3	382
IG11	0	0	0	0
IG2	150	14	2	166
IG3	163	20	2	185
IG4	66	5	0	71
IG5	141	2	0	143
IG6	146	11	3	160
IG7	0	0	0	0
IG8	121	3	3	127
IG9	0	0	0	0
RM5	0	0	0	0
RM6	117	3	0	120
RM8	14	0	0	14
Total	**1,345**	**161**	**18**	**1,524**

3. Basins and Catchments

3.1 Methodology of the Catchment-based approach

A Catchment-based approach has been adopted for the updated Surface Water Management Plan (SWMP). This differs to the previous 2011 SWMP which identified Critical Drainage Areas (CDAs) in the London Borough of Redbridge (LB Redbridge). The Catchment-based approach aligns with the Environment Agency's (EA) recommended framework for flood risk management. For more information on the background of the Catchment-based approach and the supporting policy, please view the technical overview document.

3.1.1 How the approach was applied

To identify the Basins and Catchments, elevation data was analysed to identify the natural low points in which water would flow towards. These points were used to identify the Basin and Catchment boundaries. A Basin is defined as a larger area in which rainfall should flow towards the same natural low point. A Catchment is a smaller area with more local flow paths. Catchments link together to form a wider Basin. The boundaries were then refined manually using the following data as a guide:

- Topography
- River network
- The sewer system and flow directions
- Railways and major roads
- Historic flooding reports
- The EA's Risk of Flooding Surface Water (RoFSW) mapping

Using this approach, six Basins and twelve Catchments were produced. These can be viewed on the online mapping tool.

3.1.2 Cross-boundary Basins and Catchments

Several of the identified Basins and Catchments extend past the LB Redbridge boundary. This is due to the Catchment method used. *Table 3-1* summarises the Basins, Catchments, and relevant cross-boundary authorities for each. After they were identified, the Basins and Catchments were shared with the relevant neighbouring boroughs who were able to review them and provide feedback.

Table 3-1 Basins and Catchments in this SWMP

Code	Basin	Catchment Code	Catchment Name	Local Authority (Cross Boundary Catchment)
A	The Ching Basin	R01	The Ching	London Borough of Waltham Forest (LB Waltham Forest)
B	The River Roding Basin	R02	Woodford	Essex County Council
		R03	Snaresbrook	LB Waltham Forest
		R04	Clayhall	Essex County Council
		R05	Wanstead	London Borough of Newham (LB Newham)
C	Waterworks River Basin	R06	Southwest Redbridge	LB Newham
D	Cran Brook Basin	R07	Barkingside	N/A
		R08	North Ilford	N/A
E	Seven Kings Water Basin	R09	Hainault	Essex County Council
		R10	East Redbridge	London Borough of Barking and Dagenham (LB Barking and Dagenham)
		R11	Seven Kings and Loxford	LB Barking and Dagenham
F	River Rom Basin	R12	North Havering	London Borough of Havering (LB Havering) and Essex County Council

3.2 Basins

This section presents the Basins in LB Redbridge and has been produced to be read alongside the mapping tool. In addition to this, please refer to the mapping layers with the EA RoFSW mapping and historic flooding incidents.

3.2.1 Basin A - The Ching Basin

The Ching Basin is in the northwest corner of LB Redbridge and named after the Ching River which flows through it. It is located mostly in the LB Waltham Forest with the eastern extent being within the LB Redbridge. There are no recorded flooding incidents within this Basin since 2000. The predicted surface water flood risk is greatest along the watercourses of Hatch Forest and surrounding streets.

3.2.2 Basin B - The River Roding Basin

The River Roding Basin is one of the larger Basins in LB Redbridge, covering most of the western half. Previous flooding incidents in this Basin include the River Roding bursting its bank in December 2000 and the intense rainfall events during summer 2021 where 96

incidents of flooding were recorded. These included a mix of highways, internal and external flooding and were investigated in the borough-wide Section 19 report. The predicted surface water flood risk is varied throughout this Basin with greater risk areas being Clayhall, Broadmead Playing Fields, Woodford Green, Ashton Playing Fields, and Snaresbrook.

3.2.3 Basin C - Waterworks River Basin

The Waterworks River Basin is in the southwest corner of LB Redbridge. It falls partly within the LB Redbridge but extends outside of the boundary to the Waterworks River in the LB Newham. There is one recorded flood incident which was highways flooding during the 2021 heavy summer rainfall. The predicted surface water flood risk is greatest along the train lines, within the playing fields and around Forest Lane Park.

3.2.4 Basin D - Cran Brook Basin

The Cran Brook Basin is in the centre of LB Redbridge and is the only Basin to lie entirely within the LB Redbridge. The Cran Brook flows from the northeast to the southwest point of this Basin. There were 51 recorded flooding incidents from the 2021 summer events within this Basin. The predicted surface water flood risk is greatest across the Fairlop Waters Country Park, west of the Barkingside Garden of Rest and along the southeast edge of Clayhall Park.

3.2.5 Basin E - Seven Kings Water Basin

The Seven Kings Water Basin is the largest of the six Basins and encompasses most of the eastern half of LB Redbridge, extending from the southern borough boundary in Barking to the northern boundary. The Seven Kings Water and Loxford Water watercourses flow through this Basin. There are 22 recorded flooding incidents within this Basin from the borough-wide flood risk investigation report (2022). Additionally, the Seven Kings Water flooded within Westwood Recreation Ground in 2016 and 2022. This flood was caused by an intense rainstorm which lasted several hours. A flood risk investigation report is currently being produced for the most recent events.

Similarly, to the Waterworks River Basin, the predicted surface water flood risk is greater along the train lines as these have a lower topography. Other notable areas which are at greater risk are Westwood Recreation Ground, Goodmayes Park and various streets in Newbury Park, Hainault and Grange Hill.

3.2.6 Basin F - River Rom Basin

The River Rom Basin is located on the north-eastern edge of LB Redbridge but most of its extent is within LB Havering. The northern part is located within the County of Essex. The drainage in this Basin is heavily influenced by the River Rom and its tributaries, such as Spurgate Brook. Recorded flood incidents in this Basin include when River Rom burst its bank in June 2016. The predicted surface water flood risk is more substantial in this Basin due to the many watercourses, which can influence the EA modelling.

3.3 Catchment portfolios

The information in the following sections presents the 12 Catchments and has been produced to be read alongside the mapping tool. For each Catchment, please refer to the EA RoFSW mapping, historic flooding incidents and the TWUL sewer incidents per postcode. It is important to note that not all flood incidents are reported to the Council and there may still be predicted flood risk in these locations.

3.3.1 Catchment R01 – The Ching

The Ching Catchment is located in the north-western corner of LB Redbridge and extends into LB Waltham Forest.

Risk of flooding from surface water and historic flooding:

As shown by the EA RoFSW mapping, the most prominent areas predicted to be at risk of flooding in the 1 in 30-year rainfall event are Whitehall Road (A110) and Mornington Road. There have been no recent recorded surface water flood incidents in this Catchment. The number of properties predicted to be at risk in this Catchment for each rainfall event return period can be seen in *Table 3-2*. Parts of this Catchment fall within the postcode IG8 which had 127 sewer flooding incidents.

Table 3-2 Properties at risk in Catchment R01 The Ching

Property Type	Number of Properties at risk of flooding from surface water		
	1 in 30-year Rainfall Event	1 in 100-year Rainfall Event	1 in 1000-year Rainfall Event
Residential	12	51	157
Commercial	0	0	1
Other	3	7	24
Total	**15**	**58**	**182**

3.3.2 Catchment R02 – Woodford

The Woodford Catchment is located in the north-western corner of LB Redbridge and extends into Essex County in the north.

Risk of flooding from surface water and historic flooding:

The Woodford Catchment has several notable areas of flood risk, as identified in the EA RoFSW mapping. The mapping indicates that Cherry Tree Rise, Bush Road, and various streets across Woodford Wells in the northern half of the Catchment are at risk of surface water flooding in a 1 in 30-year event. In the southern half, the areas surrounding Brackley Square, Broadmead Playing Fields, Snakes Lane West, and St Albans Road show a similar risk. A summary of the properties predicted to be at risk in this Catchment for each rainfall event return period can be seen in *Table 3-3.*

According to the TWUL sewer flood incidents data, there have been 127 reported sewer flooding incidents since 2014 in IG8. Furthermore, there were 21 recorded flooding incidents

within this Catchment from the summer 2021 rainfall events. These incidents were spread throughout the Catchment including three near Bancroft Rugby Club and four along the railway line north of Broadmead Road.

Table 3-3 Properties at risk in Catchment R02 Woodford

Property Type	Number of Properties at risk of flooding from surface water		
	1 in 30-year Rainfall Event	1 in 100-year Rainfall Event	1 in 1000-year Rainfall Event
Residential	120	248	756
Commercial	24	33	54
Other	43	86	183
Total	**187**	**367**	**993**

3.3.3 Catchment R03 – Snaresbrook

The Snaresbrook Catchment is on the western edge of LB Redbridge and overlaps with parts of LB Waltham Forest. The Deynecourt Gardens Sustainable Drainage Systems (SuDS) project has been carried out in this Catchment.

RoFSW and historic flooding:

The EA RoFSW mapping identifies the North Circular Road (A406) and Chigwell Road (A113) to be at risk of flooding for the 1 in 30-year event. There is a notable flow path along Elmcroft Avenue between the south of Roding Valley Park across the Catchment to Eagle Pond in Leyton Flats which can be seen on the mapping. A summary of the properties predicted to be at risk in this Catchment for each rainfall event return period can be seen in *Table 3-4.*

According to TWUL data, there were 98 reported sewer incidents in E18 and 58 in E11. Additional flooding incidents in this Catchment include 37 which were reported during summer 2021.

Table 3-4 Properties at risk in Catchment R03 Snaresbrook

Property Type	Number of properties at risk of flooding from surface water		
	1 in 30-year Rainfall Event	1 in 100-year Rainfall Event	1 in 1000-year Rainfall Event
Residential	188	315	965
Commercial	11	19	48
Other	41	52	157
Total	**240**	**386**	**1,170**

3.3.4 Catchment R04 – Clayhall

The Clayhall Catchment is located in the north-western half of LB Redbridge and extends into Essex County in the north. Clayhall was one of the areas within LB Redbridge which were investigated in the Section 19 flood risk investigation report regarding the 2021 events. The

Hurtsleigh Gardens Flood Alleviation Scheme (FAS) and the SuDS at Caterham High School are located in this catchment.

Risk of flooding from surface water and historic flooding:

There is a large area in the centre of this Catchment that is shown in the RoFSW for the 1 in 30-year event. Additional areas predicted to be at risk for the 1 in 30-year event are Roding Lane South, Gaynes Hill Road, and Brunel Road. The properties predicted to be at risk in this Catchment for each rainfall event return period are presented in *Table 3-5.*

This Catchment covers parts of IG8, IG5 and IG4. According to TWUL, 127, 143 and 71 sewer flooding incidents have been recorded in each of these postcodes, as shown on the online tool. Additionally, there 29 flooding incidents which were reported during summer 2021 within this Catchment.

Table 3-5 Properties at risk in Catchment R04 Clayhall

Property Type	Number of properties at risk of flooding from surface water		
	1 in 30-year Rainfall Event	1 in 100-year Rainfall Event	1 in 1000-year Rainfall Event
Residential	333	624	1,137
Commercial	39	72	130
Other	64	100	188
Total	**436**	**796**	**1,455**

3.3.5 Catchment R05 – Wanstead

The Wanstead Catchment is located towards the south-western edge of LB Redbridge and extends into LB Newham in the south.

Risk of flooding from surface water and historic flooding:

Within this Catchment, the A12 and A406 roundabout are included in the EA RoFSW mapping for the 1 in 30-year rainfall event return period. From this area, surface water flow paths follow the A12, Margaret Way, Redbridge Lane East and Wanstead Park Road. The number of properties predicted to be at risk of surface water flooding for different return periods in this Catchment are displayed in

Table 3-6.

Using the TWUL data, it was determined that E11 had 58 sewer flooding incidents, IG4 had 71 and IG1 had 382. Furthermore, there were eight surface water flooding incidents recorded during summer of 2021.

Table 3-6 Properties at risk in Catchment R05 Wanstead

Property Type	Number of properties at risk of flooding from surface water		
	1 in 30-year Rainfall Event	1 in 100-year Rainfall Event	1 in 1000-year Rainfall Event
Residential	37	168	617
Commercial	10	17	46
Other	7	37	124
Total	**54**	**222**	**787**

3.3.6 Catchment R06 – Southwest Redbridge

The Southwest Redbridge Catchment is in the south-western corner of LB Redbridge. It extends into LB Newham towards Stratford.

Risk of flooding from surface water and historic flooding:

Areas within the Catchment shown to be at risk in the RoFSW for the 1 in 30-year rainfall event return period include the railway line, adjacent roads and Cemetery Road bordering West Ham Cemetery. *Table 3-7* presents the properties at risk in this Catchment.

Within the Summer 2021 reports, there is only one historic incident in this Catchment which occurred as highway flooding on Blake Hall Road (A114). This Catchment falls mostly outside the LB Redbridge boundary and intersects with postcodes E11, E7 and E12. The data provided by TWUL indicates that there were 58 sewer flooding incidents in E11. E11 covers multiple Catchments so these may have occurred outside of Southwest Redbridge.

Table 3-7 Properties at risk in Catchment R06 Southwest Redbridge

Property Type	Number of Properties at risk of flooding from surface water		
	1 in 30-year Rainfall Event	1 in 100-year Rainfall Event	1 in 1000-year Rainfall Event
Residential	0	0	30
Commercial	0	0	1
Other	0	1	27
Total	**0**	**1**	**58**

3.3.7 Catchment R07 – Barkingside

As shown on the online mapping tool, the Barkingside Catchment is in the centre of LB Redbridge. The Ilford Jewish Primary School and King Solomon High School SuDS projects are located in this Catchment.

Risk of flooding from surface water and historic flooding:

Areas at risk of surface water flooding in the 1 in 30-year rainfall event within this Catchment include parts of Forest Road in Fullwell Cross and the trainline near Fairlop Plain Golf Course. A summary of the properties at risk is presented in *Table 3-8*Table 3-8.

The Barkingside Catchment overlaps with postcodes IG5, IG6 and IG2. Data provided by TWUL reported that there were 143 sewer flooding incidents in IG5, 160 in IG6 and 166 in IG2. There were 35 surface water flooding incidents reported in summer 2021 within this Catchment. They were mostly spread throughout the Catchment, with a cluster in Fulwell Cross.

Table 3-8 Properties at risk in Catchment R07 Barkingside

Property Type	Number of Properties at RoFSW		
	1 in 30-year Rainfall Event	1 in 100-year Rainfall Event	1 in 1000-year Rainfall Event
Residential	11	63	294
Commercial	0	0	15
Other	1	8	45
Total	**12**	**71**	**354**

3.3.8 Catchment R08 – North Ilford

The North Ilford Catchment is in the centre of LB Redbridge.

Risk of flooding from surface water and historic flooding:

According to the EA mapping, areas predicted to be at risk in the 1 in 30-year event include the southern edge of Clayhall Park and the streets bordering the A406 in Ilford. Properties predicted to be at risk in this Catchment are presented in *Table 3-9.*

Approximately half of this Catchment falls within the postcode IG1 which had 382 reported sewer flooding incidents from the TWUL dataset. Smaller areas of the Catchment fall within IG2 and IG5 which had 166 and 143 reported incidents respectively. In addition to the sewer flooding incidents, there were 17 reported surface water incidents in the summer 2021 period within the North Ilford Catchment area.

Table 3-9 Properties at risk in Catchment R08 North Ilford

Property Type	Number of Properties at risk of flooding from surface water		
	1 in 30-year Rainfall Event	1 in 100-year Rainfall Event	1 in 1000-year Rainfall Event
Residential	68	119	278
Commercial	1	3	58
Other	30	44	106
Total	**99**	**166**	**442**

3.3.9 Catchment R09 – Hainault

The Hainault Catchment is in the north-eastern corner of LB Redbridge and extends into Essex County.

RoFSW and historic flooding:

Areas at risk of surface water flooding in the 1 in 30-year event include Huntsman Road and Peregrine Road in the east. In the centre of the Catchment, Manford Primary School, Manford Way and Woodman Path are at risk in this rainfall event return period. In the west of the Catchment, the RoFSW mapping shows New North Road and Henry's Walk for the 1 in 30-year event. Detail regarding the properties at risk can be viewed in *Table 3-10.*

Most of the Hainault Catchment aligns with the IG6 postcode, which had 160 sewer incidents since 2014, according to TWUL. There were seven surface water incidents reported in summer 2021.

Table 3-10 Properties at risk in Catchment R09 Hainault

Property Type	Number of Properties at risk of flooding from surface water		
	1 in 30-year Rainfall Event	1 in 100-year Rainfall Event	1 in 1000-year Rainfall Event
Residential	260	809	2,465
Commercial	39	84	168
Other	53	138	364
Total	**352**	**1,031**	**2,997**

3.3.10 Catchment R10 – East Redbridge

The East Redbridge Catchment extends from Marks Gate in the north to Barking in the south.

Risk of flooding from surface water and historic flooding:

Areas shown in the RoFSW for the 1 in 30-year event can be found surrounding New City College, High Road and the railway line which dissects this Catchment through the middle. The number of properties at risk are presented in *Table 3-11.*

The East Redbridge Catchment covers multiple postcodes including IG11, IG3, RM6, RM8 and IG7. The number of TWUL sewer flooding incidents reported in IG3 was 185, in RM6 was 120 and in RM8 was 14. There were four reported surface water incidents during summer 2021.

Table 3-11 Properties at risk in Catchment R10 East Redbridge

Property Type	Number of properties at risk of flooding from surface water		
	1 in 30-year Rainfall Event	1 in 100-year Rainfall Event	1 in 1000-year Rainfall Event
Residential	130	409	1,586
Commercial	13	27	114
Other	53	102	250
Total	**196**	**538**	**1,950**

3.3.11 Catchment R11 – Seven Kings and Loxford

As displayed on the online mapping tool, the Seven Kings and Loxford Catchment is in the eastern half of Redbridge. Additionally, the Westwood Recreation Ground scheme is located in this Catchment.

Risk of flooding from surface water and historic flooding:

Areas predicted to be at risk for the 1 in 30-year rainfall event return period include Newbury Park Tube Station, Buxton Road, the railway line, and streets between Loxford Park and South Park. The properties at risk in this Catchment are summarised in *Table 3-12*Table 3-12.

IG1 covers most of the Catchment in which there were 382 TWUL sewer flooding incidents since 2014. Additionally, there were 185 in IG3 and 166 in IG2. Further flooding incidents in this Catchment include Seven Kings Water at Westwood Recreation Ground which flooded in June 2016. This affected houses in the surrounding streets and prompted a Section 19 flood risk investigation. In the summer of 2021, there were 11 reports of surface water flooding from residents.

Table 3-12 Properties at risk in Catchment R11 Seven Kings and Loxford

Property Type	Number of properties at risk of flooding from surface water		
	1 in 30-year Rainfall Event	1 in 100-year Rainfall Event	1 in 1000-year Rainfall Event
Residential	144	688	3,879
Commercial	26	117	413
Other	62	230	862
Total	**232**	**1,035**	**5,154**

3.3.12 Catchment R12 – North Havering

The North Havering Catchment is located on the east of LB Redbridge with most of its extent falling within LB Havering and Essex County.

RoFSW and historic flooding:

Due to its many watercourses, the RoFSW for the 1 in 30-year event indicates several locations within this Catchment are at risk. Watercourses can influence the EA modelling. Within the LB Redbridge boundary, these locations are mostly agricultural land except for Forest Farm Equestrian Centre and the housing development at Five Oaks Lane. The properties predicted to be at risk in this area, as presented in

Table 3-13 are quite low compared to other Catchments. There were no reported surface water flooding incidents within this Catchment that were investigated in the borough-wide Section 19 flood investigation report.

Table 3-13 Properties at risk in Catchment R12 North Havering

Property Type	Number of Properties at RoFSW		
	1 in 30-year Rainfall Event	1 in 100-year Rainfall Event	1 in 1000-year Rainfall Event
Residential	2	2	8
Commercial	0	0	1
Other	8	14	27
Total	**10**	**16**	**36**

4. Borough-wide mitigation options

4.1 Mitigation options

Following the identification of the highest risk areas, the options to mitigate the risk from surface water flooding have been explored. There are three types of mitigation interventions that have been considered, based on the source-pathway-receptor model. Further information on this model can be found in the Technical Overview.

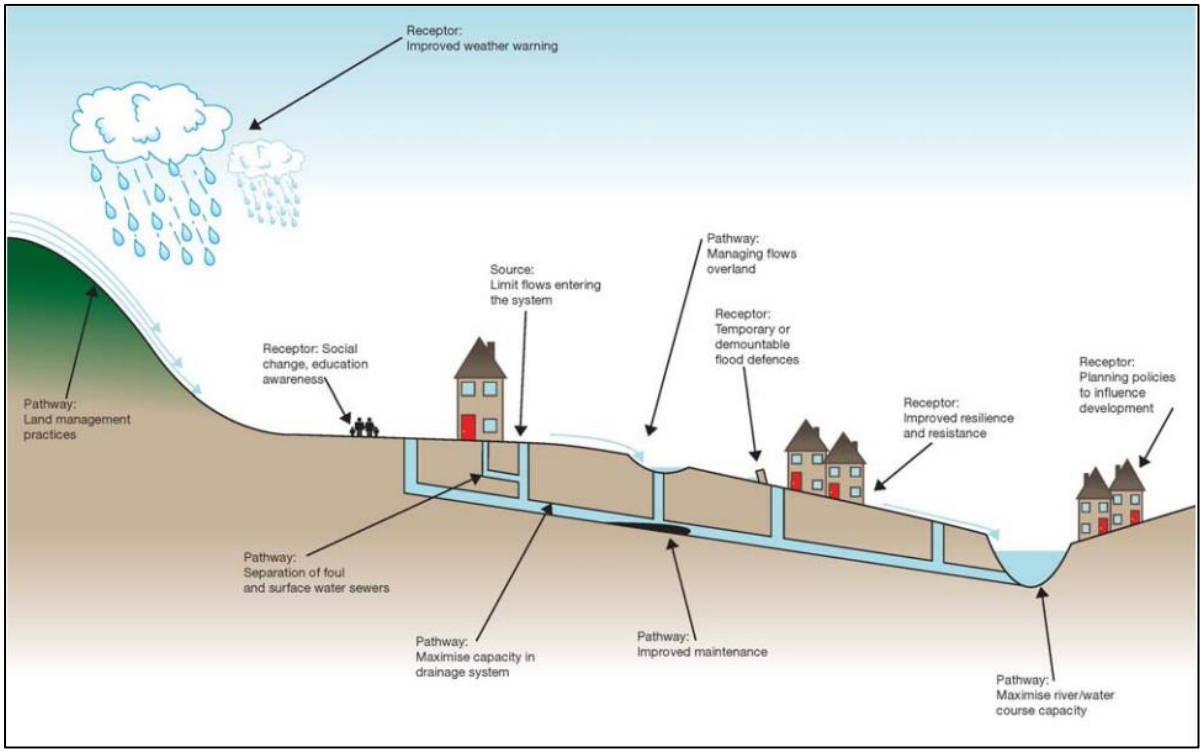

Figure 4-1 Mitigation measures which can be considered to reduce surface water flood risk (Source: DEFRA)

An opportunity assessment has been carried out using the 'Red, Amber, Green' (RAG) method. The rating relates to the impact of the opportunity on flood risk alleviation if it were to be implemented:

- *Red* – The measure is not deemed applicable due to its perceived ineffectiveness in providing sufficient flood alleviation within the area
- *Amber* – Intermediate flood risk alleviation is likely from the proposed measure
- *Green* – Flood risk alleviation is likely to provide benefits in line with damages avoided
- *Grey* – The proposed measure may have flood alleviation benefits but is considered unfeasible due to difficulty of implementation

The long list of options with the opportunity assessment can be viewed here. A similar process has been undertaken for the London Borough of (LB) Redbridge Local Flood Risk Management Strategy (LFRMS). However, duplication between the Action Plans of both documents have been avoided. Please view the LFRMS Action Plan on the LB Redbridge Flood Risk Management webpages for further recommended actions.

4.2 Action Plan

An Action Plan has been created to prioritise the potential mitigation options identified. It also provides a structure through which the Lead Local Flood Authority (LLFA) and key partners can deliver surface water flood risk management. The Action Plan sets out tasks and timeframes for managing surface water across the London Borough of Redbridge (LB Redbridge). Timeframes are provided as short term (1-2 years), medium term (3-5 years), and long term (6-10 years). The Action Plan is kept as an internal LB Redbridge document so it can be updated and amended by the LLFA as needed.

4.3 Stakeholder Engagement Plan

A borough-wide Stakeholder Engagement Plan has been created to assist LB Redbridge in increasing awareness of the updated Surface Water Management Plan (SWMP) and to increase the opportunities for collaboration in flood risk management. The plan outlines how different partners can use the updated SWMP to enable effective and ongoing collaborative working with LB Redbridge throughout the future. The stakeholders considered fall within different categories which are outlined below.

4.3.1 LB Redbridge

Several departments in LB Redbridge have been identified as key collaborators with the LLFA:

- Environment, Biodiversity and Climate Change
- Highways
- Parks
- Planning
- Traffic and Transport
- Sustainability
- Regeneration and Neighbourhoods

Internal departments, such as those listed above can work collaboratively with the LLFA to deliver joint flood risk management projects or develop strategies which integrate flood risk management.

4.3.2 Key organisations

There are key organisations that LB Redbridge should work with closely to strengthen local flood risk management. These organisations include:

- Environment Agency (EA)
- Greater London Authority (GLA)
- Thames Water (TWUL)
- Transport for London (TfL)

The above organisations should be considered as main stakeholders in many of the actions identified. It is highly recommended that the EA, TWUL and TfL are engaged when considering schemes for flood alleviation. These stakeholders may be able to supply funding for the development of such schemes.

4.3.3 Cross-boundary Local Authorities

The following Councils contacted during the creation of this updated SWMP to ensure that it appropriately reflects a Catchment-based collaborative approach to flood risk management:

- London Borough of Waltham Forest
- London Borough of Newham
- London Borough of Barking and Dagenham
- London Borough of Havering
- Essex County Council

It is vital that collaboration with these authorities is continued throughout the enactment of the Action Plan. These Councils should also be engaged in the creation of future strategic plans to integrate surface water flood risk throughout the wider area.

4.3.4 Other groups

There are numerous stakeholders and local groups which also have an interest in local flood risk management that do not fall into the above categories. Many individuals are likely to be affected by the decisions made by the LB Redbridge LLFA.

- Thames 21
- London Drainage Engineers Group (LoDEG)
- Thames Regional Flood and Coastal Committee
- Residents and businesses
- Riparian Owners
- 'Friends of' groups such as the Friends of the River Roding

These stakeholders can be engaged in various actions and flood management practices. As they are likely to be impacted by the decisions made by the LLFA, they should be kept informed about relevant projects.

5. Recommendations

The analysis that has been undertaken throughout the development of the updated London Borough of Redbridge (LB Redbridge) Surface Water Management Plan (SWMP) has allowed areas of higher risk to be identified. Subject to securing funding, feasibility studies should be undertaken to determine viable options for mitigation in these areas. The Westwood Recreation Ground and Clayhall Flood Alleviation Schemes (FASs) are two existing examples of such work. This SWMP document should be reviewed periodically and updated when significant changes occur. These changes may include the completion of a FAS, improvements in the knowledge of local flood risk and/or changes in policy affecting flood risk.

Further general recommendations have been identified as:

- LB Redbridge Lead Local Flood Authority (LLFA) should continue to work with neighbouring Local Authorities and stakeholders, using the engagement made during the SWMP as an opportunity for managing flood risk where Catchments overlap administrative boundaries.
- LB Redbridge LLFA should continue to work with stakeholders and partners to identify potential funding contributions and to secure funding for potential schemes.
- LB Redbridge LLFA should ensure that flood incidents are recorded consistently and accurately. In case of repeat or significant flood incidents, investigations into the cause and potential solutions should be carried out.
- LB Redbridge should ensure that regular maintenance of the drainage systems such as gullies and drains is carried out.
- LB Redbridge LLFA should liaise with LB Redbridge's Planning Team to ensure that new developments incorporate rainwater harvesting and sustainable drainage infrastructure.

This updated SWMP study has fulfilled the objectives of increasing understanding of the causes, probability, and consequences of surface water flooding in LB Redbridge. Partners and stakeholders have been identified for an engaged and co-ordinated approach to surface water management. Opportunities to implement Sustainable Drainage Systems (SuDS) to manage surface water flood risk have been identified and an Action Plan has been generated. Using this information, yearly programmes of flood management schemes will be presented in annual Capital Programme report to Cabinet and the Cabinet Member as per LB Redbridge's decision-making process and updates will be provided to LB Redbridge Leadership including the relevant committees as necessary.