

# FURTHER GROUNDWATER INVESTIGATIONS



PREPARED FOR THE LONDON BOROUGH OF RICHMOND UPON  
THAMES

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## EXECUTIVE SUMMARY

In 2019, the London Borough of Richmond upon Thames carried out an investigation on groundwater influenced flooding in the Richmond Hill area. Based on the information available, the investigation concluded that the Richmond Hill area may be at risk of groundwater influenced flooding via throughflow. Following the investigation, several recommendations were put forward, including the following:

- A borough-wide flood history survey is undertaken to gauge resident experiences with all sources of flooding, including groundwater flooding.
- Further work is completed to better define the extent of the Richmond Hill area impacted by groundwater flooding for planning and policy development purposes.
- Planning and policy requirements for basement and cellar developments are developed.

Based on the results of the Richmond Hill investigations and the accompanying recommendations, further investigation work was commissioned to analyse the risk of groundwater influenced flooding via throughflow. As part of this investigation, an online reporting tool has been developed to gather information on all sources of flooding throughout the borough. A catchment analysis has also been undertaken to determine if there are any other catchments which may also have developments at risk of flooding via throughflow. The catchment areas were created using a spatial modelling tool in QGIS. Following application of a bespoke methodology to identify catchments that may have developments at risk of throughflow flooding, two sets catchment types were identified:

- **Throughflow catchment areas** – catchments which met all the requirements in the methodology, and therefore having possessing properties which may be at risk of throughflow flooding.
- **Potential throughflow catchment areas** – catchments that met all the requirements but have characteristics that may mitigate against potential throughflow flood risk impacting downstream properties. This includes possessing a downhill ‘throughflow’ region with development located in an area underlain by aquifers/permeable superficial deposits.

The following five catchments were identified as either ‘throughflow catchment areas’ or ‘potential throughflow catchment areas’:

- Richmond Hill (Richmond) – Throughflow catchment area
- Strawberry Hill (Twickenham) – Throughflow catchment area
- Marble Hill (Twickenham) – Throughflow catchment area
- St. Margarets West – Throughflow catchment area
- East Sheen Common – Potential throughflow catchment area

The investigation identifies that if subsurface developments take place in upstream areas of the other catchments identified as ‘throughflow catchment areas’, then properties in the downstream regions of the catchment may be at risk of flooding due to throughflow. In recognition that new basement developments may have an influence on subsurface level flows, a set of recommended policies and guidance recommendations have been developed for these catchment areas. The London Borough of Richmond upon Thames should seek to implement these policies and guidance recommendations to help manage subsurface developments and throughflow related flood risk to properties in these areas. The following policy recommendations were made:

1. The London Borough of Richmond upon Thames should designate the catchments categorised as ‘throughflow catchment areas’ as throughflow and groundwater policy zones. Subsurface structure development proposals within these zones will need to fulfil site-specific requirements to

demonstrate that basements and/or cellars can be safely developed without increasing throughflow and groundwater related flood risk. The catchments which should be identified as 'throughflow catchment areas' are as follows:

- a. Richmond Hill (Richmond)
  - b. Strawberry Hill (Twickenham)
  - c. Marble Hill (Twickenham)
  - d. St. Margarets West
2. The London Borough of Richmond upon Thames should ensure that basement and cellar developments within throughflow and groundwater policy zones are confined to the curtilage of the site. They should not exceed a maximum of 50 percent of each garden / open space area of the site.
  3. The London Borough of Richmond upon Thames should ensure that a Screening Assessment is carried out for all basement and cellar proposals in the throughflow and groundwater policy zones. Information provided as part of the screening assessment should address the following areas:
    - a. Subterranean characteristics
    - b. Land stability (including site slope)
    - c. Flood risk and drainage (including throughflow, groundwater and surface water)

If the Screening Assessment determines that the proposed subsurface development may have an impact on the local environment, or if it determines that further investigation is required, then a Basement Impact Assessment, carried out and signed off by a chartered professional, is required. Details submitted in Basement Impact Assessment are dependent on the results of the Screening Assessment. All impact assessments should include geotechnical information about the site, plans outlining the subsurface level structure(s), and engineering information detailing the potential impacts of the proposed subsurface structure. These should identify the geological conditions on or close to the development site, the infiltration potential, and the height of any groundwater.

4. The London Borough of Richmond upon Thames should ensure applicants provide detailed borehole information for the proposed site as part of the Basement Impact Assessment. Borehole records should provide information for at least two different points in time, with data recordings taking place within at least a 12 month period to account of potential seasonal variations.
5. If the identified potential impacts of the proposed subsurface development are not acceptable, then mitigation measures should be proposed to reduce and/or alleviate the risk posed by development.

Where necessary, the London Borough of Richmond upon Thames will undertake site visits to better understand the impacts of groundwater influenced flooding via throughflow. The properties identified for a potential site visit will be dependent on flooding reports submitted within the borough-wide flood history survey, with properties prioritised based on the following:

- The reported source of flooding, with properties that have experienced flooding from groundwater or groundwater influenced sources taking priority.
- The location of flooding, with properties that have experienced internal flooding to their basements and/or cellars taking priority.
- The location of the property, with properties falling within one of the designated 'throughflow catchment areas' taking priority.

These identified properties may be assessed in the future alongside several of the at risk properties identified in the 2019 Richmond Hill Groundwater Investigation study. This will be to better understand groundwater related flood sources in the area and the impact that the local subterranean characteristics have on the subsurface structures at these properties.

# CONTENTS

<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
1.1	BACKGROUND AND OBJECTIVES	1
1.2	DOCUMENT STRUCTURE – USER GUIDANCE	1
<b>2</b>	<b>DATA AND METHODOLOGY</b>	<b>2</b>
2.1	DATA	2
2.2	METHODOLOGY	2
<b>3</b>	<b>CATCHMENTS</b>	<b>4</b>
3.1	THROUGHFLOW CATCHMENT AREAS	4
3.2	POTENTIAL THROUGHFLOW CATCHMENT AREAS	4
<b>4</b>	<b>POLICY RECOMMENDATIONS</b>	<b>6</b>
4.1	OVERVIEW	6
4.2	RECOMMENDED POLICIES	6
<b>5</b>	<b>GUIDANCE RECOMMENDATIONS</b>	<b>8</b>
5.1	OVERVIEW	8
5.2	RECOMMENDED GUIDANCE	8
5.2.1	SITE CURTILAGE AND MAXIMUM 50% GARDEN EXTENT	8
5.2.2	SCREENING ASSESSMENT	8
5.2.3	BASEMENT IMPACT ASSESSMENT	9
5.2.4	MITIGATION MEASURES	10
<b>6</b>	<b>CONCLUSIONS AND NEXT STEPS</b>	<b>11</b>
6.1	CONCLUSIONS	11
6.2	NEXT STEPS	11
	<b>APPENDICES</b>	<b>12</b>
	<b>APPENDIX A – THROUGHFLOW CATCHMENT AREAS MAP</b>	<b>12</b>

# FIGURES AND TABLES

**Figure 3-1. Throughflow Catchment Areas..... 5**

**Table 2-1. Data sources analysed as part of the borough-wide investigations..... 2**

# ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
EA	Environment Agency
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems

# GLOSSARY

Term	Definition
Aquifer	Underground layers of water-bearing permeable rock from which groundwater can be extracted
Basement	Subsurface level structure typically located within the footprint of a building. Commonly built to a standard which provides conditions suitable for accommodation.
Bedrock	Solid geological formations which underlie newer, unconsolidated geological material
Cellar	Subsurface level structure typically located within the footprint of a building. Commonly used for storage and for servicing the building.
Groundwater	Water that is found below the ground surface level in rocks and other geological strata. This could be within bedrock geology or superficial deposit geology.
Subterranean	Below the surface of the earth
Superficial Deposit	The most recent of geological formations which include unconsolidated material that lies on or near the ground surface level
Throughflow	Where there are no aquifers/permeable superficial deposits for water to flow through, water can continue to travel downhill through the interface of the made ground subsurface level and the clay geology stratum

# 1 INTRODUCTION

## 1.1 Background and Objectives

The London Borough of Richmond upon Thames became aware of subsurface level flood incidents in the Richmond Hill area of the borough in 2018. Residents reported incidents of flooding within basement and cellar substructures, believed to have been linked to groundwater and subsurface level developments. Investigations were carried out in 2019 to gain a better understanding of groundwater and the potential source of subsurface level flooding in the Richmond Hill area.

Based on the information available, the investigation concluded that the Richmond Hill area may be at risk of groundwater influenced flooding via throughflow. Groundwater travels downhill through the aquifers/permeable superficial deposits in the area. If there are no aquifers/permeable superficial deposits for water to flow through, water can continue to travel downhill through the interface of the made ground subsurface level and the clay geology stratum. This is known as throughflow.

Following the investigation, several recommendations were put forward, including the following:

- A borough-wide flood history survey is undertaken to gauge resident experiences with all sources of flooding, including groundwater flooding.
- Further work is completed to better define the extent of the Richmond Hill area impacted by groundwater flooding for planning and policy development purposes.
- Planning and policy requirements for basement and cellar developments are developed.

It is intended that this document will build on the Richmond Hill investigation and will assist the London Borough of Richmond upon Thames in obtaining a better understanding of groundwater related flooding in the borough. The investigation results will assist in the formation of planning and policy requirements for basement and cellar developments.

## 1.2 Document Structure – User Guidance

The document is followed by the following four sections:

- **Section 2 (Methodology)** provides an overview of the methodology used to carry out the borough-wide investigations.
- **Section 3 (Catchments)** provides details of the identified catchments that require basement and cellar development policy following application of the investigation's methodology.
- **Section 4 (Policies)** provides a set of recommended policies for basement and cellar construction in the identified catchments. These policies are based on the findings of this investigation.
- **Section 5 (Recommendations)** provides guidance recommendations for affected properties in the catchments identified in Section 3 of this document. These recommendations are for proposed basement and cellars that may be constructed.

## 1.3 Online Reporting Tool

An online reporting tool has been developed to gather information on all sources of flooding throughout the borough. The tool enables residents to submit reports of flooding borough-wide, meeting the requirements of the first recommendation from the 2019 Richmond Hill Groundwater Investigation project. Results from the survey will enable the London Borough of Richmond to improve their understanding of flood risk throughout the borough, including the risk posed by groundwater influenced sources via throughflow.



## 2 DATA AND METHODOLOGY

### 2.1 Data

As part of the borough-wide groundwater related investigations, a data collection exercise was conducted to obtain the information necessary to identify catchment areas that may have properties at risk of flooding from throughflow. The data obtained and reviewed as part of the data collection exercise is listed in *Table 2-1*.

**Table 2-1.** Data sources analysed as part of the borough-wide investigations

Data	Source
Aquifer Designation Map - Bedrock Geology	EA
Aquifer Designation Map - Superficial Deposits	EA
Areas Susceptible to Groundwater Flooding	EA
Detailed River Network	EA
Groundwater Vulnerability	EA
LiDAR (Composite Digital Terrain Model (DTM) - 2m)	EA
Risk of Flooding from Surface Water (ROFSW)	EA
Groundwater Flooding Incidents – Surface Water Management Plan Records	London Borough of Richmond upon Thames
Increased Potential for Elevated Groundwater	Greater London Authority (the Drain London project)
Susceptibility to Groundwater Flooding	British Geological Survey
Bedrock Geology Map	British Geological Survey (Online)
Borehole Records	British Geological Survey (Online)
Superficial Deposit Geology Map	British Geological Survey (Online)
Gravity Sewer Network Map	Thames Water Utilities Limited

### 2.2 Methodology

The catchment areas were created using a spatial modelling tool in QGIS. The outputs of the tool provided hydrological sub-catchment areas and drainage/flow path data. These sub-catchments were merged to form larger catchment areas, with the following parameters serving as a guide as to which sub-catchments should be merged:

- Aquifers
- Available borehole data
- Drainage/flow path output data
- Geology
- River network
- Thames Water sewer network
- Topography

In total, 39 catchments were created across the borough. Catchments rather than sub-catchments were used to better enable planning policy and guidance to be assigned. This also reflects the ‘catchment based approach’ that the London Borough of Richmond upon Thames’ Local Flood Risk Management Strategy (2015) promotes to manage the risk of flooding across the borough. Each catchment was then appraised to determine if they may be impacted by throughflow. To establish if water may travel below the surface as throughflow, the following data was appraised in each catchment:

- Aquifers
- Geology
- Topography

All catchments with a change in aquifers/permeable superficial deposits were assessed based on steep topographical changes and the presence of developments in the downstream region of the catchment area. The analysis sought to identify catchments that go from a productive aquifer (geology that can



facilitate groundwater flows and provide water storage) and/or permeable superficial deposits, to unproductive aquifers (geology with low permeability that has negligible significance on groundwater flows or water storage) and/or low permeable geology. All catchments that met these criteria have been categorised as one of the following:

- throughflow catchment areas
- potential throughflow catchment areas

Areas identified as '**throughflow catchment areas**' meet all the appraisal requirements as identified above. These catchments have been identified as requiring policy and development recommendations regarding subsurface level development. Catchments that have been identified as '**potential throughflow catchment areas**' meet all the requirements but have characteristics that may mitigate against potential throughflow flood risk impacting downstream properties. This includes possessing a downhill 'throughflow' region with development located in an area underlain by aquifers/permeable superficial deposits. See [Appendix A](#) for further details on the catchment areas.

## 3 CATCHMENTS

Following application of the investigation's methodology (*Section 2*) the following five catchments were identified as either 'throughflow catchment areas' or 'potential throughflow catchment areas':

- Richmond Hill (Richmond)
- Strawberry Hill (Twickenham)
- Marble Hill (Twickenham)
- St. Margarets West
- East Sheen Common

### 3.1 Throughflow Catchment Areas

As identified in the Methodology (*Section 2.2*), throughflow catchment areas are catchments that change geologically with the change in topography. The upstream regions possess a productive aquifer and/or permeable superficial deposits and change to unproductive and/or low permeable geology in the downstream regions. These catchments are also characterised by steep topographical changes and the presence of building developments in the areas with unproductive and/or low permeable geology. The following four catchments have been designated as throughflow catchments based on the investigations. For further information on their locations, see *Figure 3-1* and *Appendix A*.

- Richmond Hill (Richmond) – 341 hectare catchment which falls from south to north. Properties which lie outside of the area underlain by aquifers/permeable superficial deposits include those around Sheen Road and Church Road. Properties within the area contained by Paradise Road, Church Road, Friars Stile Road, Hill Rise, and Richmond Hill have experienced subsurface level flooding.
- Strawberry Hill (Twickenham) – 269 hectare catchment which falls from west to east. Properties which lie outside of the area underlain by aquifers/permeable superficial deposits include those around King Street, Holly Road and Grosvenor Road.
- Marble Hill (Twickenham) – 63 hectare which falls from west to east. The entire catchment lies outside of an area underlain by aquifers/permeable superficial deposits. This catchment is identified at risk of potential flooding via throughflow due to its proximity to the Strawberry Hill catchment, which lies to the west.
- St. Margarets West – 139 hectare catchment which falls from west to east, and west to north. The south eastern extent of the catchment lies outside of an area underlain by aquifers/permeable superficial deposits. This includes properties along Amyand Park Road, Stafford Road, Haggard Road and Marble Hills Garden. This catchment is identified as being at risk of potential flooding via throughflow due to its proximity to the Strawberry Hill catchment, which lies to the west.

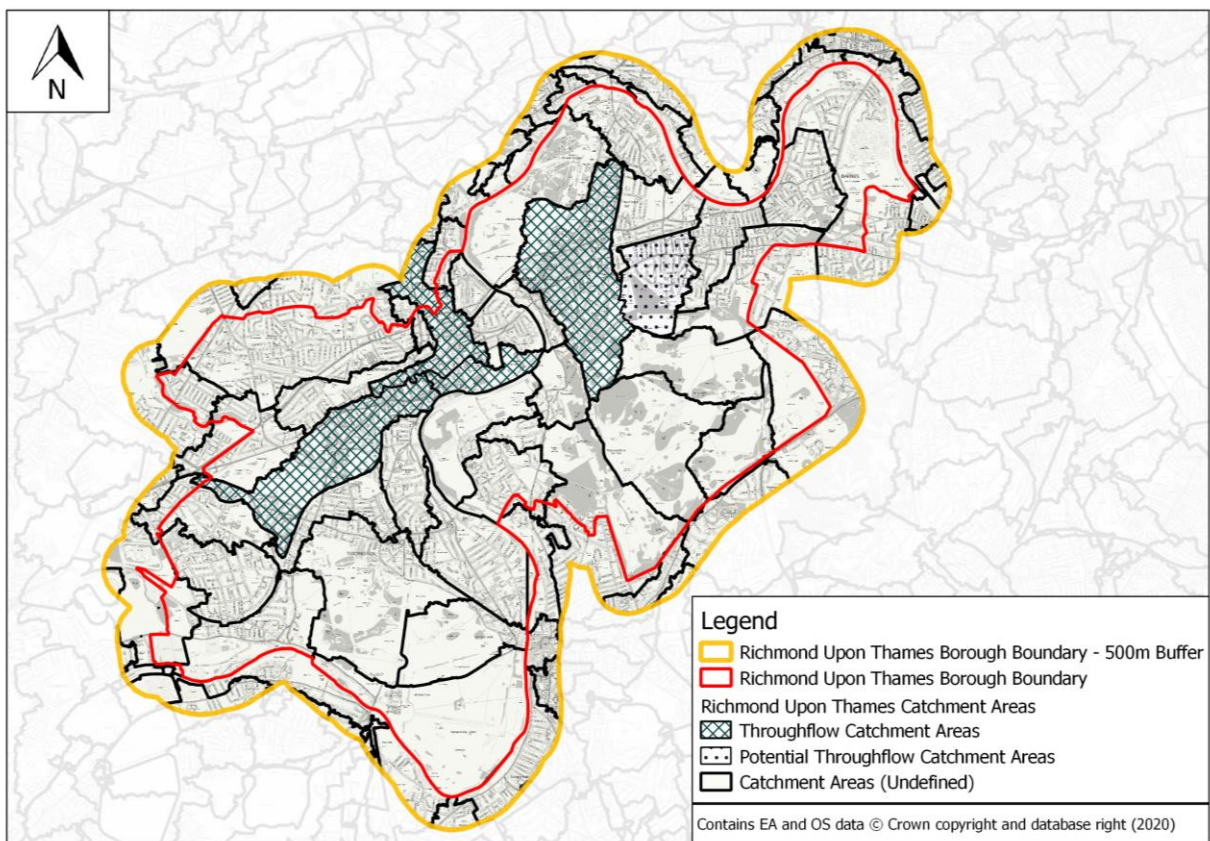
### 3.2 Potential Throughflow Catchment Areas

Potential throughflow catchment areas share many of the same characteristics as throughflow catchment areas. Geological changes coincide with changes in topography, with productive aquifer and/or permeable superficial deposits located in the upstream regions and unproductive and/or low permeable geology in the downstream regions. They also possess building developments in the lower topographical area of the catchments. However, the area underlain with unproductive and/or low permeable geology is in a different area to the building developments. The following catchment has

been designated as a potential throughflow catchment area based on the investigation. For further information on its location, see *Figure 3-1* and *Appendix A*.

- East Sheen Common – 134 hectare catchment which falls from south to north. The extent of the catchment which falls outside of an area underlain by aquifers/permeable superficial deposits is an area within Richmond Park/East Sheen Common referred to as ‘The Bog’. The most downstream areas of the catchment where the properties are located is underlain by aquifers/permeable superficial deposits.

Catchments identified as ‘potential throughflow catchment areas’ do not require policy as the downstream properties should not be at risk of flooding via throughflow. However, they should be monitored for future subsurface level developments.



**Figure 3-1.** Throughflow Catchment Areas

## 4 POLICY RECOMMENDATIONS

### 4.1 Overview

The 2019 Richmond Hill Groundwater Investigation study identified that local geological conditions and evidence may justify a variation to planning policy. However, planning policy variations would be required on a borough-wide scale and would therefore require a borough-wide evidence base for validation. As part of the Richmond Hill Groundwater Investigation outputs, it was recommended that planning and policy requirements for basement and cellar developments were developed. The policy recommendations developed as part of these investigations form part of the Borough's Level 1 Strategic Flood Risk Assessment (SFRA) (2020) policy recommendations.

### 4.2 Recommended Policies

A set of policies have been developed for the designated throughflow catchment areas. These policies have been developed based on the catchment analysis and outputs produced as part of this investigation, and the outputs from the Richmond Hill Groundwater Investigation. The recommended policies are as follows:

1. The London Borough of Richmond upon Thames should designate the catchments categorised as 'throughflow catchment areas' as throughflow and groundwater policy zones. Subsurface structure development proposals within these zones will need to fulfil site-specific requirements to demonstrate that basements and/or cellars can be safely developed without increasing throughflow and groundwater related flood risk. The catchments which should be identified as 'throughflow catchment areas' are as follows:
  - a. Richmond Hill (Richmond)
  - b. Strawberry Hill (Twickenham)
  - c. Marble Hill (Twickenham)
  - d. St. Margarets West
2. The London Borough of Richmond upon Thames should ensure that basement and cellar developments within these throughflow and groundwater policy zones are confined to the curtilage of the site. In addition, they should not exceed a maximum of 50 percent of each garden or open space area of the site.
3. The London Borough of Richmond upon Thames should ensure that a Screening Assessment is carried out for all basement and cellar proposals in the throughflow and groundwater policy zones. Information provided in the screening assessment should address the following areas:
  - a. Subterranean characteristics
  - b. Land stability (including site slope)
  - c. Flood risk and drainage (including throughflow, groundwater and surface water)

If the Screening Assessment determines that the proposed subsurface development may have an impact on the local environment, or if it determines that further investigation work is required, then a Basement Impact Assessment, carried out and signed off by a chartered professional, is required. Details submitted as part of the Basement Impact Assessment are dependent on the results of the Screening Assessment. However, all impact assessments should include geotechnical information about the site, plans outlining the subsurface level structure(s), and engineering information detailing the potential impacts of the proposed subsurface

structure. These should identify the geological conditions on or close to the development site, the infiltration potential, and the height of any groundwater.

4. The London Borough of Richmond upon Thames should ensure applicants provide detailed borehole information for the proposed site as part of the Basement Impact Assessment. Borehole records should provide information for at least two different points in time, with data recordings taking place within at least a 12 month period to account for potential seasonal variations.
5. If the identified potential impacts of the proposed subsurface development are not acceptable, then mitigation measures should be proposed to reduce and/or alleviate the risk posed by the development.

# 5 GUIDANCE RECOMMENDATIONS

## 5.1 Overview

The 2019 Richmond Hill Groundwater Investigation study recognised that policies would need to be supported by guidance. The study recommended that basement and cellar development guidance is produced to accompany locally specific planning and policy requirements developed as part of any borough-wide investigations. These recommendations are designed to support the basement and cellar guidance provided as part of the London Borough of Richmond upon Thames' Level 1 SFRA (2020) for development proposals within the designated throughflow catchment areas.

## 5.2 Recommended Guidance

The London Borough of Richmond upon Thames has developed a [Good Practice Guide on Basement Developments](#) (2015). The guidance provided as part of this investigation is designed to accompany the guidance provided within the Good Practice Guide, whilst providing additional guidance and requirements for subsurface structure development proposals within the designated throughflow catchment areas.

### 5.2.1 Site Curtilage and Maximum 50% Garden Extent

No basement / cellar developments should extend beyond the curtilage of the site. This means subsurface structures must not extend into areas such as the public highway, public open spaces or cross the site boundary into another site. If the extent of the proposed subsurface structure extends beyond the surface level development, it must not exceed 50% of the garden or open space extent. The maximum extent will be measured for each separate garden and/or open space part of the site. For example, if the site layout means that there are separate, front, back and/or side garden areas, then the substructure extent will be measured for each area to ensure that it is less than 50% in all areas. If there is no physical separation between the garden or open space areas, then measurements for the whole garden will be taken. It is advised that the subsurface structure is developed as close to the surface level structure as possible.

The policy is designed to control the extent of subsurface structure development and reduce the potential of throughflow and groundwater levels backing up around the finished structure and potentially impacting neighbouring basements. It is also designed to ensure there is adequate space for sustainable drainage systems (SuDS) to be implemented for surface water management.

### 5.2.2 Screening Assessment

A Screening Assessment should be carried out for all subsurface structure development proposals in the designated throughflow catchment areas. The purpose of the assessment is to identify if there are any potential issues which would require a more detailed investigation. If so, a Basement Impact Assessment should be carried out. To identify if a Basement Impact Assessment is required, the following areas should be covered as part of the Screening Assessment:

- Subterranean characteristics
- Land stability (including site slope)
- Flood risk and drainage (including throughflow, groundwater and surface water)

Analysis within these areas should focus on the impact on the site, neighbouring properties, and the wider natural environment. The following questions should also be addressed for each area:



### **Subterranean Characteristics**

- Does the recorded water table extend above the base of the proposed subsurface structure?
- Is the proposed subsurface development structure within 100m of a watercourse or spring line?
- Are infiltration methods proposed as part of the site's drainage strategy?
- Does the proposed excavation during the construction phase extend below the local water table level or spring line (if applicable)?
- Is the most shallow geological strata at the site London Clay?
- Is the site underlain by an aquifer and/or permeable geology?

### **Land Stability**

- Does the site, or neighbouring area, topography include slopes that are greater than 7°?
- Will changes to the site's topography result in slopes that are greater than 7°?
- Will the proposed substructure extend significantly deeper underground compared to the foundations of the neighbouring properties?
- Will the implementation of the proposed substructure require any trees to be felled or uprooted?
- Has the ground at the site been previously worked?
- Is the site within the vicinity of any tunnels or railway lines?

### **Flood Risk and Drainage**

- Will the proposed subsurface development result in a change in impermeable area coverage on the site?
- Will the proposed subsurface development impact the flow profile of throughflow, surface water or groundwater to downstream regions?
- Will the proposed subsurface development increase throughflow or groundwater flood risk to neighbouring properties?

As part of answering the Screening Assessment questions, applicants are required to provide information to justify their answers. For all questions where the response is "yes", or where the answer is currently unknown, these matters should be taken forward and investigated as part of a Basement Impact Assessment.

## **5.2.3 Basement Impact Assessment**

Guidance provided under 'Structural Impact Assessments' as part of the [Good Practice Guide on Basement Developments](#) (2015) should be followed to produce a Basement Impact Assessment. The impact assessment should evaluate the potential direct and indirect impacts of the proposed development, in line with the Screening Assessment. They must be carried out and signed off by a chartered professional or specialist. Examples of specialists that have the required skills and qualifications to carry out assessments necessary for a Basement Impact Assessment include:

- Civil engineer
- Geotechnical specialist
- Geologist
- Hydrologist
- Hydrogeologist

The chartered professional(s) who carried out the assessment(s) should complete the 'Site and Assessment Verification Form' included in the [Basement Assessment User Guide](#) (2021). This form should be submitted as part of the planning application. The assessments must also include, but are not limited to, the following:



- Detailed borehole information on-site or from nearby to the development site. At least two data recordings should take place within at least a 12 month period to demonstrate any potential seasonal variations. Measurements should capture geological conditions on or close to the development site, the infiltration potential, and the height of any local groundwater.
- Mitigation measures if the identified potential impacts of the proposed subsurface development are not acceptable (see [Section 5.2.4](#) for more information).

As highlighted in the policy, the impact assessment should include geotechnical information about the site, plans outlining the subsurface level structure(s), and engineering information detailing the potential impacts of the proposed surface structure. Other matters that may be included or referenced as part of the Basement Impact Assessment include a:

- Flood Risk Assessment
- Demolition and Construction Management Plan
- Site Waste Management Plan
- BREEAM Assessment
- Environmental Impact Assessment / Environmental Statement

#### 5.2.4 Mitigation Measures

If the identified potential impacts of the proposed subsurface development are not acceptable, then mitigation measures should be proposed to reduce and/or alleviate the risk posed by the development. If, for example, the assessment identifies that the proposed development may result in water ingress to the new development and/or to neighbouring properties, then mitigation measures should be proposed to reduce and/or alleviate the risk of flooding. Flood risk must not be worsened as a result of the proposed development. Examples of flood risk mitigation include, but are not limited to, the following:

- Underground corridors with a high permeability
- Controlled subsurface structure drainage systems (including pumps)

Further flood risk mitigation measures are provided under 'Groundwater and Flooding' in the [Good Practice Guide on Basement Developments](#) (2015) document.

## 6 CONCLUSIONS AND NEXT STEPS

### 6.1 Conclusions

This further groundwater flooding investigation has been conducted to identify any areas across the borough that may have subsurface structure developments at risk of throughflow influenced flooding. This investigation follows on from the 2019 Richmond Hill Groundwater Investigation study which identified that the reported subsurface level flooding may have arisen due to the geological and topographical characteristics of the catchment area which facilitate throughflow flooding.

Including Richmond Hill, this investigation identified four catchments with characteristics which may leave properties in the downstream regions of the catchment at risk of flooding due to throughflow. In recognition that new basement developments may have an influence on subsurface level flows, a set of recommended policies and guidance recommendations have been developed for these catchment areas. The London Borough of Richmond upon Thames should seek to implement these policies and guidance recommendations to help manage subsurface developments and throughflow related flood risk to properties in these areas.

### 6.2 Next Steps

To better understand the impacts of groundwater influenced flooding via throughflow, the London Borough of Richmond upon Thames will carry out site visits where necessary. The properties identified for a potential site visit will be dependent on flooding reports submitted within the borough-wide flood history survey, with properties prioritised based on the following:

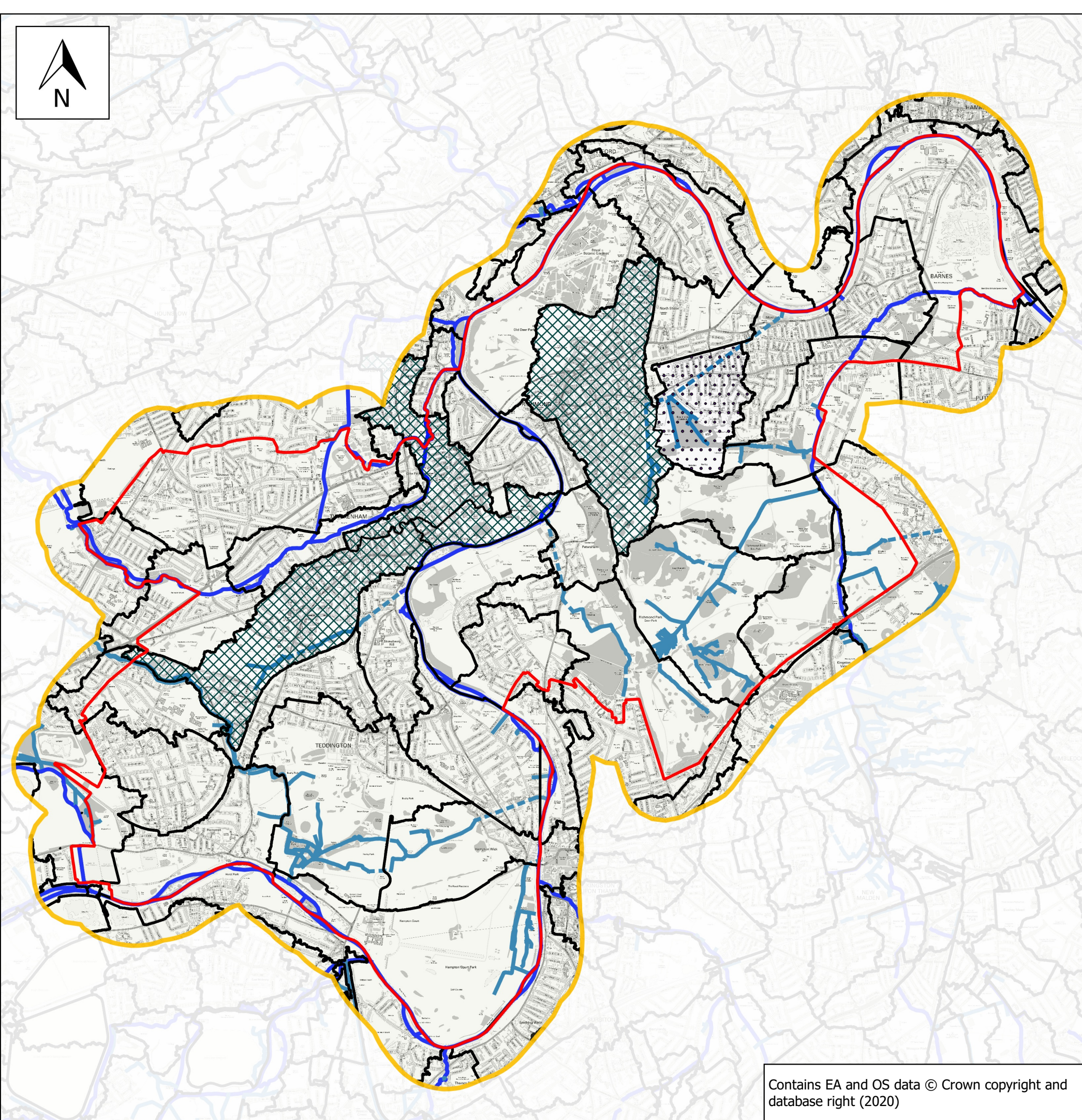
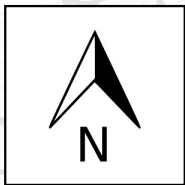
- The reported source of flooding, with properties that have experienced flooding from groundwater or groundwater influenced sources taking priority.
- The location of flooding, with properties that have experienced internal flooding to their basements and/or cellars taking priority.
- The location of the property, with properties falling within one of the designated 'throughflow catchment areas' taking priority.

These identified properties may be assessed in the future alongside several of the at risk properties identified in the 2019 Richmond Hill Groundwater Investigation study. This will be to better understand groundwater related flood sources in the area and the impact that the local subterranean characteristics have on the subsurface structures at these properties. The findings from these assessments will be summarised in subsequent investigation reports where deemed necessary in line with the London Borough of Richmond upon Thames' Lead Local Flood Authority's duties under Section 19 of the Flood and Water Management Act 2010 and will help to better manage flood risk from throughflow sources.










# APPENDICES

## Appendix A – Throughflow Catchment Areas Map





**Legend**

-  Richmond Upon Thames Borough Boundary - 500m Buffer
-  Richmond Upon Thames Borough Boundary
- Richmond Upon Thames Catchment Areas
  -  Throughflow Catchment Areas
  -  Potential Throughflow Catchment Areas
  -  Catchment Areas (Undefined)
- Detailed River Network
  -  Main River
  -  Main River - Culverted
  -  Ordinary Watercourse
  -  Ordinary Watercourse - Culverted



Client



Project Title

Richmond - Further Groundwater Investigations

Drawing Title

Throughflow Catchment Areas

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Drawing Size  
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Appendices Map