

# Ley Hill Section 19 Flood Investigation

## Final Technical Report

September 2023

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## Contract

This report describes work commissioned by Andrew Waugh, on behalf of Buckinghamshire Council, by an email dated 15 March 2021. Buckinghamshire Council’s representative for the contract was Andrew Waugh. Peter Rook, Emily Jones and Lisa Chatterjee of JBA Consulting carried out this work.

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## Purpose

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## **Acknowledgements**

We would like to thank Buckinghamshire Council and Ley Hill Parish Council for their input and support. We would also like to thank the wider community for their engagement with the investigation.

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## Executive summary

### Background

Following flooding in the Botley area of Ley Hill on 17 May 2021, Buckinghamshire Council (BC) as the Lead Local Flood Authority (LLFA) is undertaking a formal flood investigation under Section 19 of the Flood and Water Management Act 2010<sup>1</sup>. It is a statutory requirement for LLFAs to investigate flooding to the extent that it considers it necessary or appropriate.

Ley Hill is located near the Buckinghamshire-Hertfordshire border, near Chesham.

The flooding that occurred in Ley Hill on 17 May 2021 is known to have caused flooding to at least seven properties (six residential and one commercial), of which five flooded internally, and fulfils one of the criteria for a Section 19 investigation (internal flooding to five or more residential properties within an area of 1km<sup>2</sup>). Buckinghamshire Council has appointed JBA Consulting to undertake this investigation on its behalf.

For more information see Section 1.

### Stakeholder engagement

As part of the Section 19 investigation, several local stakeholders in Ley Hill were involved as part of the stakeholder engagement. This included residents, community representatives and other Risk Management Authorities. The objectives of engagement are to:

- Gather facts, opinions and data to aid the understanding of the investigation
- Involve the community in the investigation
- Disseminate the findings of the investigation to the community

For more information see Section 2.

### Catchment characteristics and long-term flood risk information

Section 3 describes the watercourses, drainage network, topography and geology of Ley Hill. Section 4 summarises existing long-term flood risk information on flood risk from rivers, surface water and groundwater. Surface water flooding, particularly along Kiln Lane, is a common occurrence in Ley Hill. However, internal flooding is uncommon, and only one resident has reported previous property flooding.

For more information see Sections 3 and 4.

### Flood Risk Management

Responsibility for flood risk can be divided into “flood risk management” and “emergency response.” Section 5 describes the roles and responsibilities of the various bodies involved in flood management and emergency response.

For more information see Section 5.

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1 Flood and Water Management Act 2010 Section 19 (accessed 17 May 2021): <https://www.legislation.gov.uk/ukpga/2010/29/section/19>

### Hydrological analysis of 17 May 2021 event

The total rainfall during the 17 May storm had a 25% chance of occurring in any one year (return period of 1 in 4 years). It should be noted that the return period does not account for hail, as the gauge cannot distinguish between different forms of precipitation. The event was not especially extreme but given the saturated catchment and freezing over of gullies by the hail, there was significant volumes of runoff generated.

### Source-pathway-receptor analysis

The sources, pathways and receptors of flooding were as follows:

- Sources – rainfall
- Pathways – surface water runoff, exacerbated by hail blocking gullies
- Receptors –flooding of at least seven properties (five internally), including one commercial, costs associated with repair and increased insurance premiums

### Condition assessment

The condition of the highway drainage was reviewed based on information provided in the CCTV survey. Both structural defects and service/operational condition were taken into consideration.

For more information see Section 9.

### Discussion, appraisal and recommendations

In this section we consider potential options to mitigate flood risk and reduce damages caused by flooding.

We undertook a high-level option appraisal focussing on benefit, practical and viability considerations. We carried out a multi-criteria analysis to compare each option which included consideration of a range of different factors, for example the potential contribution towards reducing flood risk to property, people and communities.

For more information see Section 10.

### Conclusion

A series of recommended actions for the Risk Management Authorities and stakeholder organisations are presented below.

For more information on options, recommendations and conclusions see Section 0.

Recommended actions	Risk management authority/stakeholder
Increased cleansing of highway drainage	Buckinghamshire Highways
Increased/upsized highway drainage	Buckinghamshire Highways
Improvement and exploration of adoption of Kiln Lane	Private Landowner(s)
Form a Flood Action Group	Community / Parish Council
Create a community flood action plan	Community / Parish Council
Prepare a “flood preparedness” information plan for current and future residents	Community / Parish Council
Investigate opportunities for installing PFR	Property owners / Community

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## Abbreviations

AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
BGS	British Geological Society
BC	Buckinghamshire Council
CCTV	Closed Circuit Television
DTM	Digital Terrain Model
EA	Environment Agency
FEH	Flood Estimation Handbook
GIS	Geographic Information Systems
JBA	Jeremy Benn Associates
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
PFR	Property Flood Resilience
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water (Environment Agency mapping)
WASC	Water and Sewerage Company

## 1 Introduction

### 1.1 Background to investigation

Following flooding in Ley Hill in May 2021, Buckinghamshire Council (BC) as the Lead Local Flood Authority (LLFA) is undertaking a formal flood investigation under Section 19 of the Flood and Water Management Act 2010<sup>2</sup>.

It is a statutory requirement for LLFAs to investigate flooding to the extent that it considers it necessary or appropriate. Buckinghamshire Council has outlined its criteria for undertaking a Section 19 investigation in its Local Flood Risk Management Strategy<sup>3</sup>.

- Internal flooding (including to basements) to five or more residential properties within an area of 1km<sup>2</sup>;
- Internal flooding of two or more business premises within an area of 1km<sup>2</sup>;
- Internal flooding (including to basements) of at least one property for one week or longer;
- Flooding of one or more critical infrastructure assets, which could include hospitals, health centres, clinics, surgeries, colleges, schools, day nurseries, nursing homes, emergency services (police, fire, ambulance) stations, utilities and substations; and
- Any flooding event that a risk management authority deems significant but does not meet the agreed thresholds should be assessed at the next strategic flood management group for consideration.

The flooding that occurred in Ley Hill caused flooding to at least seven properties and fulfils these criteria. Buckinghamshire Council has appointed JBA Consulting to undertake this investigation on its behalf.

### 1.2 Aims of the investigation

Section 19 of the Flood and Water Management Act 2010 sets out that a Lead Local Flood Authority (LLFA) must, to the extent that it considers it necessary or appropriate, investigate which risk management authorities have relevant flood risk management functions, and whether each of those authorities has exercised, or is proposing to exercise, those functions in response to the flood.

Within Buckinghamshire, the aims of such an investigation are extended to providing an overview of the flooding incident and its impact, any history of flooding, a rainfall analysis, and determining the main factors and mechanisms involved in the flooding. However, it is not within the remit of a Section 19 Flood Investigation to apportion blame to any organisation nor hold any risk management authority to account for their response to the floods.

A list of recommendations has also been proposed to help the various stakeholders learn from the event and improve the management of flood risk locally. We have undertaken a high-level appraisal of these recommendations, focussing on benefit, practical and viability considerations. However, it is not within the remit of a Section 19 Flood Investigation to provide designed solutions. The investigation process does not provide Buckinghamshire Council, nor any other authority, with the funding or mandate to undertake flood management works on the ground.

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2 Flood and Water Management Act 2010 Section 19 (accessed 17 May 2021):  
<https://www.legislation.gov.uk/ukpga/2010/29/section/19>

3 Buckinghamshire Local Flood Risk Management Strategy (2017):  
<https://www.buckscc.gov.uk/media/4511603/bcc-lfrms-final-version-may-2017.pdf>

The intention is instead to provide a clear understanding of the issues since this is the first step towards being able to help address a flooding problem.

Given that the scope of the investigations is limited to developing a preliminary high-level screening of options, the reports should not be viewed as an action plan nor strategy that will set out definitive flood management actions that will be taken. However, several recommendations are made that may be actioned in the short to medium term.

It will be for the relevant responsible body to assess these recommendations in terms of their legal obligation, resource implications, priority and the costs and benefits of undertaking such options.

### 1.3 Site location

Ley Hill is located on the Buckinghamshire-Hertfordshire border, near Chesham. The village is largely rural, surrounding by fields and agricultural land. Other nearby villages include Orchard Leigh and Lye Green.

### 1.4 Data collection

A wide range of different data has been collected and assessed to inform the Section 19 investigation. This has been used to understand the causes and impacts of flooding in Ley Hill and to establish the context of the area. This includes the following:

- Open source data from GOV.UK – for example, the Risk of Flooding from Surface Water mapping (RoFSW), the Flood Map for Planning, LiDAR etc;
- Historic flooding datasets;
- Rainfall data – using data from Chenies TBR rain gauge located 3km south-east of Ley Hill, and Met Office radar ;
- Asset datasets – for example, the Thames Water sewer network and Buckinghamshire Highways' highway drainage system;
- CCTV survey undertaken by FlowLine in July 2022.
- Other data such as photos and resident accounts from the event.

## 2 Stakeholder engagement

Multiple local stakeholders, including residents, community representatives, landowners, other Council departments, Parish Council, Buckinghamshire Council Members and RMA partners, were engaged with as part of the project.

The objectives of engagement are to:

- Gather facts, opinions and data to aid the understanding of the investigation
- Involve the community in the investigation
- Disseminate the findings of the investigation to the community

A list of key stakeholders and how we engaged with them is given in Table 2-1. The engagement terminology is taken from Environment Agency’s ‘Working with Others’ (2013) methodology:

- Inform - provide information
- Consult - receive, listen, understand and feedback
- Involve - decide together
- Collaborate - act together
- Empower - support independent action

**Table 2-1: Key stakeholders**

Role	Organisation	How to engage	Type of engagement
Buckinghamshire Council Members	Buckinghamshire Council	Consult	Invitation to contribute, site visit, online survey distribution, correspondence
Parish Council	Ley Hill and Latimer Parish Council	Consult	Invitation to contribute, site visit, online survey distribution, correspondence
Highways	Buckinghamshire Highways	Collaborate	Invitation to contribute, correspondence, data provision
Riparian landowner	Landowner of ditch	Consult	Invitation to contribute
WASC	Thames Water	Involve	Invitation to contribute, correspondence, data provision
Residents			Site visit, online questionnaire, correspondence

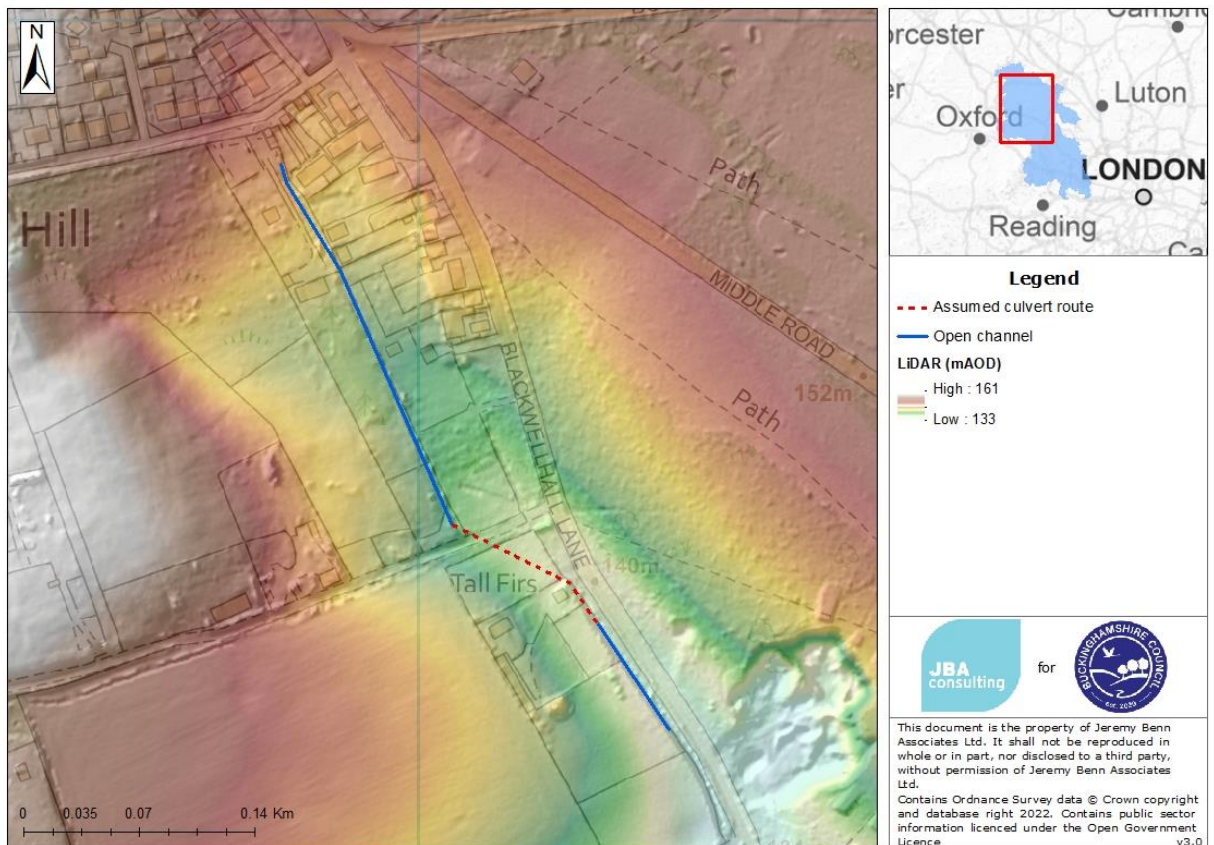
### 3 Catchment characteristics

#### 3.1 Drainage system and river network

##### 3.1.1 Watercourses

There are no mapped watercourses within the vicinity of Ley Hill. There is a drainage ditch (shown in Figure 3-1) into which there are two known outfalls from the highway drainage. The ditch flows through Horticon Nurseries before it is culverted below the unnamed road off Blackwell Hall Lane.

It is assumed that the culvert outfall is located along Blackwell Hall Lane, downstream of an access road to a property. This is yet to be confirmed through CCTV/dye tracing. Street View imagery from 2010 shows that there was an additional section of open channel upstream of the access road. However, when a site visit was completed, this is no longer open channel. It is not understood if the section was culverted or simply infilled. Further discussion in Section 10.2.1.3.



**Figure 3-1: Approximate route of ditch and assumed culvert route**

##### 3.1.2 Sewers

Within Ley Hill, there is only a foul sewer system. The Thames Water data shows no formal surface water drainage system.

##### 3.1.3 Highway drainage

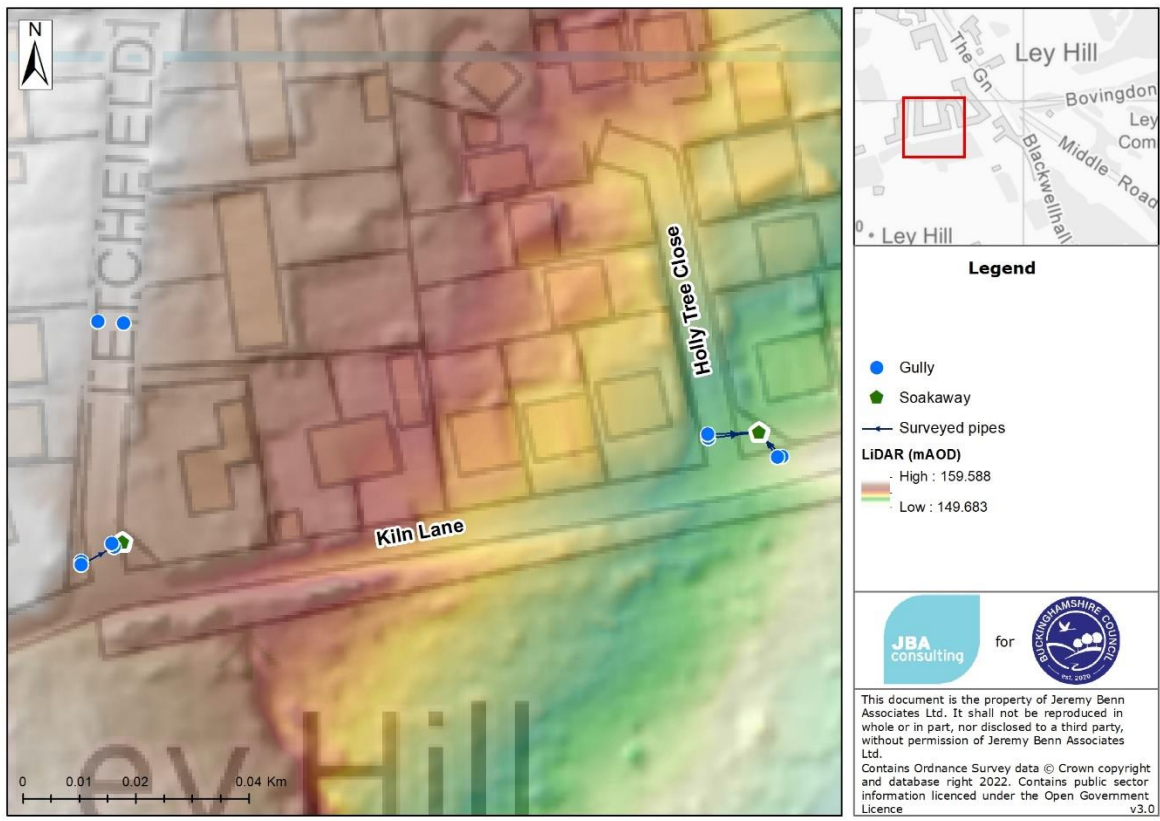
Highway drainage data was provided by Buckinghamshire Highways. In addition, survey of the network was collected in July 2022 to fully understand the drainage in the village, and connections to the ditch. Figure 3-2 shows the location of highways drainage assets around Crown Cottages. There are several gullies along Blackwell Hall Lane which connect into a highway drainage piped system, which flows in a south-westerly direction below the footpath outside Crown Cottages. This system discharges into the drainage ditch to the south-west.

There is also a gully and piped network on Kiln Lane which connects into this piped section of the highways drainage network outside of the Crown Cottages. Along Kiln Lane, there are further gullies which also discharge into the ditch from the north, these however do not form part of the public highway drainage network.



**Figure 3-2: Surveyed highway drainage near Crown Cottages**

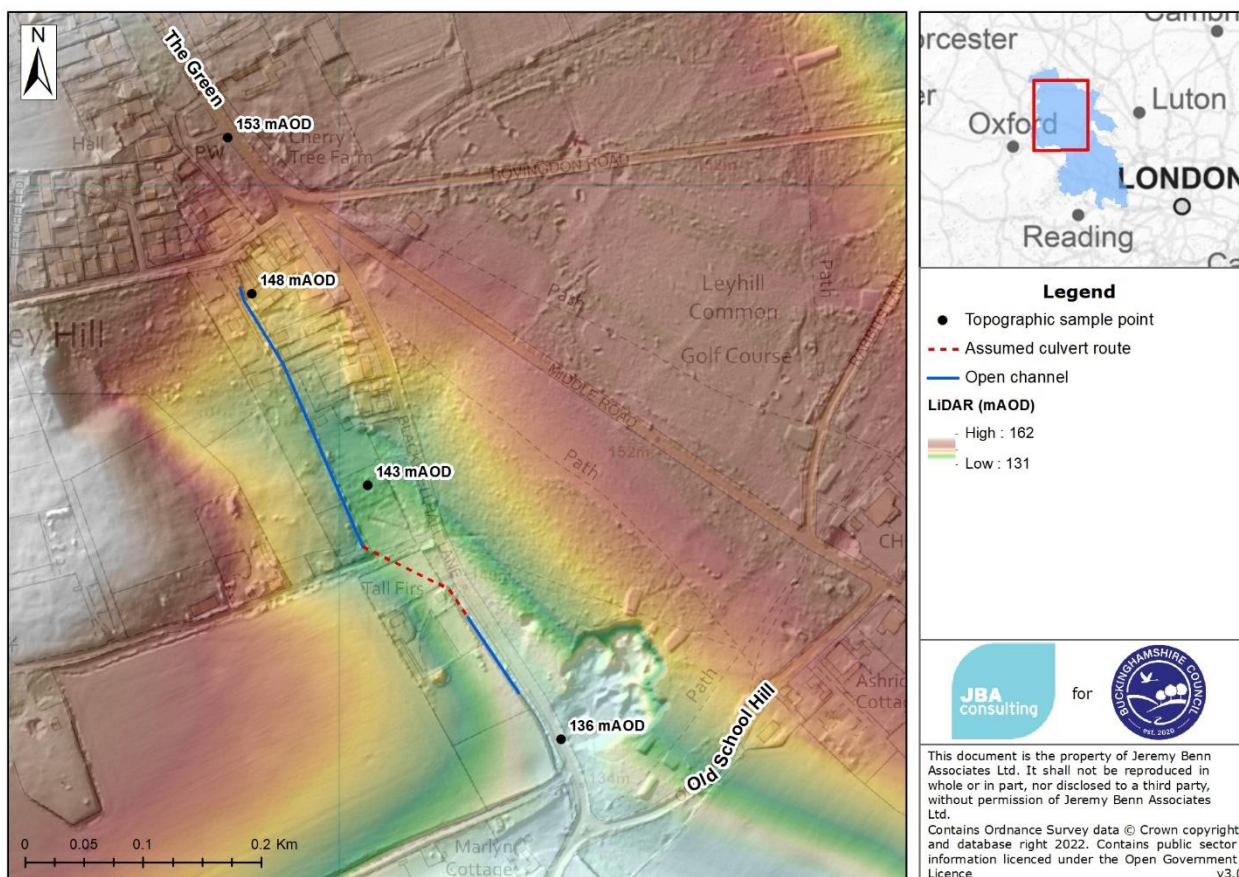
Further west along Kiln Lane, there are two soakaways, into which the gullies from Letchfield and Holly Tree Close discharge, as shown in Figure 3-3.



**Figure 3-3: Surveyed highway drainage along Letchfield and Holly Tree Close**

### 3.1.4 Topography

The topography of Ley Hill is shown in Figure 3-4. The village slopes south, from The Green towards Old School Hill. The topography also slopes, from both the west and east, towards Blackwell Hall Lane in a valley-like shape.



**Figure 3-4: Topography around Ley Hill**

### 3.1.5 Geology

British Geological Survey (BGS)<sup>4</sup> data indicates that the underlying bedrock geology is chalk. To the west is an area underlain by Lambeth Group, comprising of clay, silt, sand and gravel. The entire area is underlain by superficial deposits of clay with flints. Soilscape<sup>5</sup> mapping characterises the soil types in Ley Hill as 'Slightly acid loamy and clayey soils with impeded drainage.' Typically, chalk bedrock geology would provide effective infiltration and drainage. However, where there is overlaying superficial deposits consisting of clay, this drainage may be impeded due to the impermeable nature of the overlaying clay. It should also be noted that the effect of urbanising areas with hardstanding surfaces further impedes drainage and prevents infiltration to underlying bedrock.

4 BGS Geology of Britain viewer: <https://mapapps.bgs.ac.uk/geologyofbritain/home.html>

5 Cranfield University soilscape mapping: <http://www.landis.org.uk/soilscape/>



## 4 Flood risk

### 4.1 Long-term flood risk information

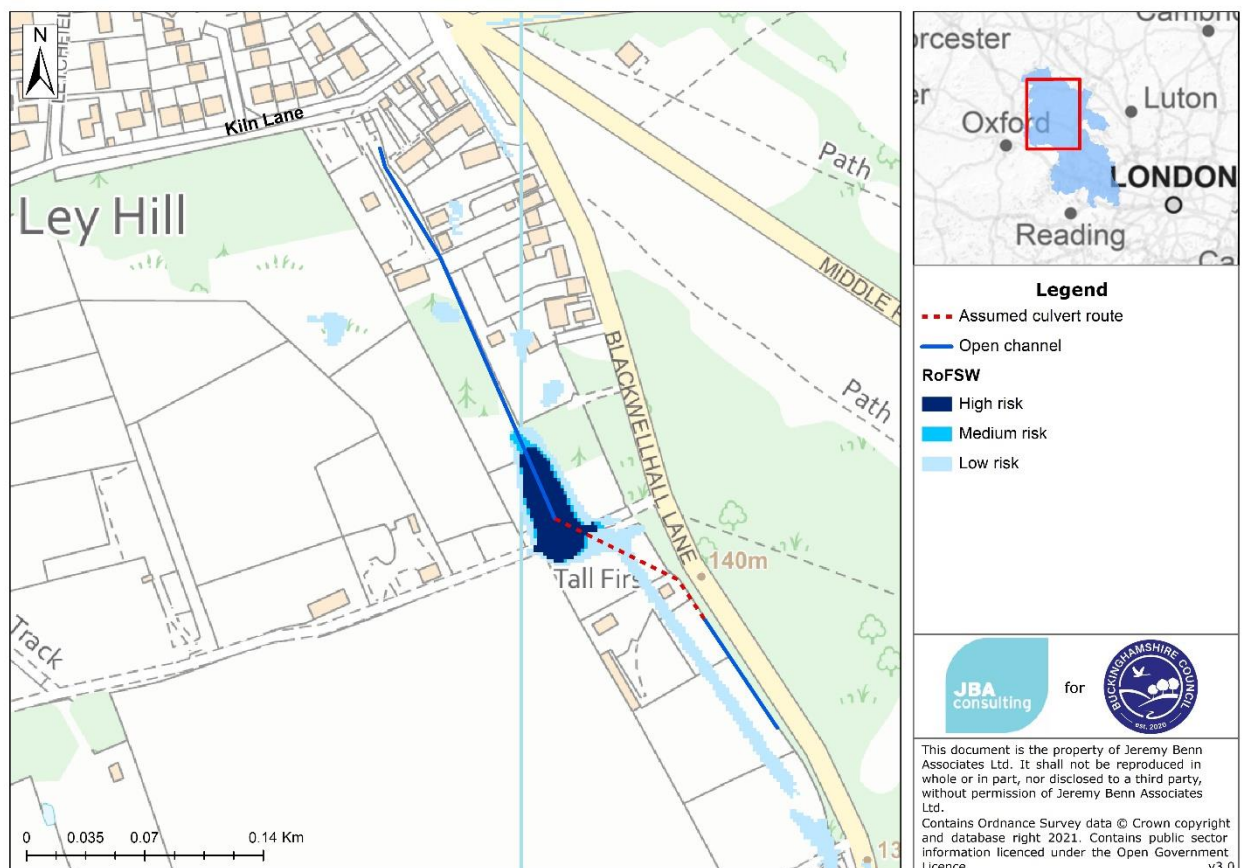
#### 4.1.1 Risk of flooding from rivers and sea

There are no existing fluvial Environment Agency Flood Zones for Ley Hill.

#### 4.1.2 Risk of flooding from surface water

Broadscale modelling was carried out by the Environment Agency in 2012/2013 to prepare the Risk of Flooding from Surface Water dataset. As a national dataset, some local details are not well captured, such as the capacity and condition of local drainage networks and runoff from permeable geologies like chalk, as is the case here. Therefore, its representation of the surface water flood risk to Ley Hill is likely to be limited. However, we have included it here for reference.

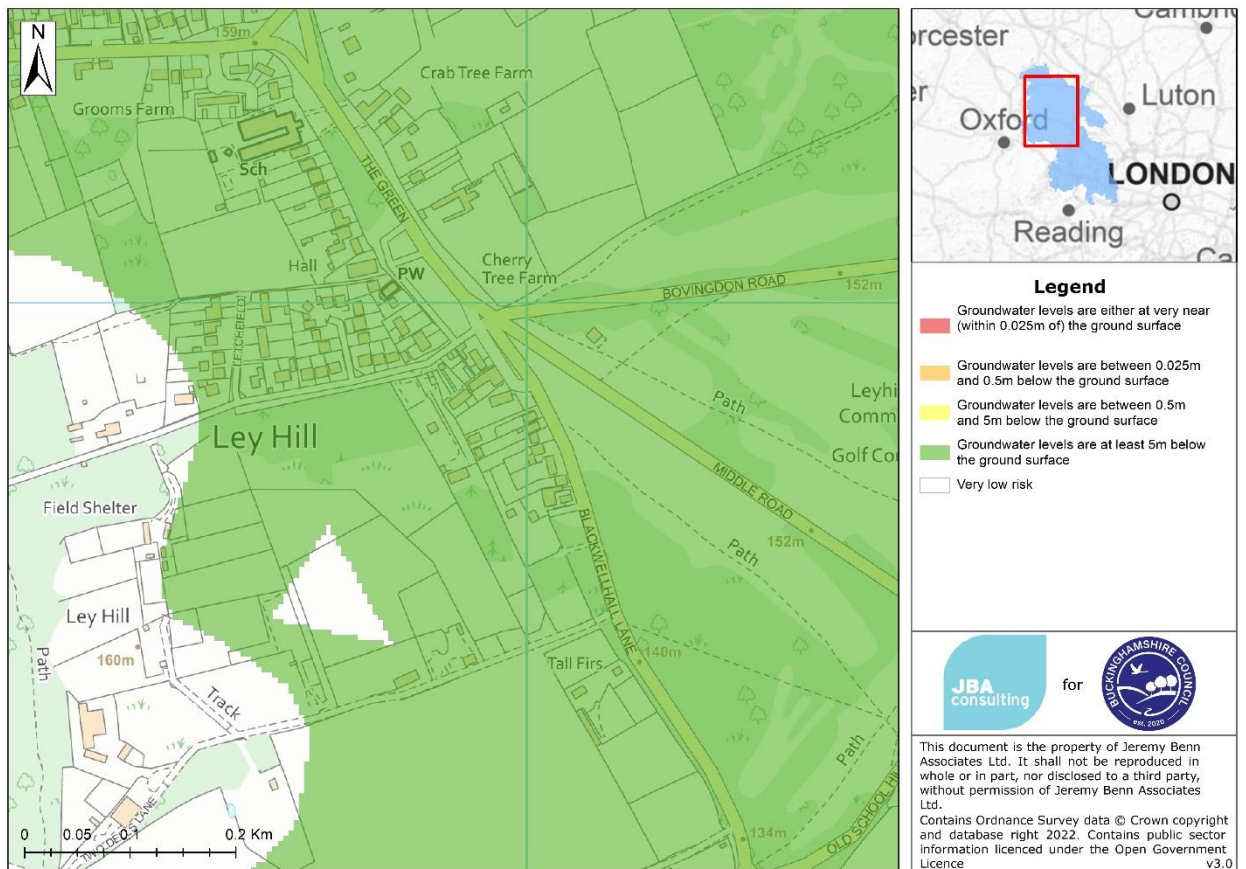
Figure 4-1 indicates the risk of flooding from surface water within Ley Hill. Overall, the mapping suggests that there is a very low risk of surface water flooding, with only small areas of ponding around properties. South of Kiln Lane, there is a large area of ponding which is associated with a topographic low point. There are no properties within this area. However, as outlined above, this mapping is unlikely to represent flood risk well in this area.



**Figure 4-1: Risk of flooding from surface water**

#### 4.1.3 Risk of flooding from groundwater

Figure 4-2 shows JBA’s Groundwater Map for Ley Hill, which indicates groundwater flood risk during a 1% annual chance event. The mapping suggests that there is a low risk of flooding across the village, with groundwater levels at least 5m below ground level in a 1% annual chance event.



**Figure 4-2: Risk of flooding from groundwater**

## 4.2 Flood history

Flood history in Ley Hill is limited but details were collected using the online stakeholder engagement surveys and from speaking to affected residents during the site visit to Ley Hill. The residents in Ley Hill reported that surface water flooding is a recurring problem. The flow routes during that May 2021 event can be seen in Figure 8-1 and reflect the typical overland surface water flow routes in the area during a rainfall event. During heavy rainfall, Kiln Lane was described to be “like a river” with significant volumes flowing from the woodland area to the west. However, several residents stated that the 17 May 2021 event was the most severe they had seen. It was noted that flooding occurs every couple of years, but rarely enters properties, and only floods gardens. One resident mentioned flooding in the 1960’s which led to internal flooding.

## 5 Flood risk management

Responsibility for flood risk can be divided into “flood risk management” and “emergency response.” The following section describes the roles of the various bodies involved in flood management, with roles and responsibilities for emergency response described in Section 5.2.

### 5.1 Flood risk management roles and responsibilities

Flood risk in England is managed by a range of different Risk Management Authorities (RMAs) and other stakeholders. However, it should be noted that the responsibility for reducing the impacts of flooding to any property remains with the owner of that property, not with any risk management authority. Risk Management Authorities may have statutory powers to carry out works for flood risk management purposes, but are under no statutory duty to do so.

The Flood and Water Management Act places a duty on all flood risk management authorities to co-operate with each other. The act also provides Lead Local Flood Authorities and the Environment Agency with a power to request information required in connection with their flood risk management functions.

These roles and responsibilities are summarised in Table 5-1.

#### 5.1.1 Lead Local Flood Authority

Lead Local Flood Authorities (LLFAs) are responsible for coordinating the mitigation of risk of flooding from surface water, groundwater (water which is below the water table under the ground) and ordinary watercourses (non-main rivers). The LLFA is also responsible for developing, maintaining and applying a strategy for local flood risk management in their area and for maintaining a register of flood risk assets.

Buckinghamshire Council is the LLFA for the whole of Buckinghamshire, including Ley Hill.

#### 5.1.2 Environment Agency

The Environment Agency is sponsored by the Government’s Department for Environment, Food & Rural Affairs (Defra), and is tasked with the protection and conservation of the water environment in England, the natural beauty of rivers and wetlands and the wildlife that lives there.

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

Flood risk management work can include: constructing and maintaining ‘assets’ (such as flood banks or pumping stations) and works to main rivers to manage water levels and make sure flood water can flow freely; operating flood risk management assets during a flood; dredging the river; and issuing flood warnings.

The Environment Agency’s responsibilities include: water quality and resources; fisheries; conservation and ecology; and operational responsibility for managing the risk of flooding from main rivers (usually large streams and rivers), reservoirs, estuaries and the sea.

The Environment Agency can also do work to prevent environmental damage to watercourses, or to restore conditions where damage has already been done.

The strategies for flood and coastal erosion risk management show how communities, the public sector and other organisations can work together to manage this risk.

#### 5.1.3 Internal Drainage Board

Internal drainage boards (IDB) are independent public bodies, established in areas of special drainage need known as drainage districts. The IDB is responsible for the supervision of land drainage, water level management and flood risk management works and regulation of

ordinary watercourses. The IDB also plays an important role in the areas they cover (approximately 10% of England at present) in working in partnership with other authorities to actively manage and reduce the risk of flooding.

Ley Hill is not within a IDB drainage district.

#### 5.1.4 Water and sewerage company

Water and sewerage companies are responsible for the provision of wastewater collection and treatment systems, including for managing the risks of flooding from surface water and foul or combined public sewer systems providing drainage from buildings and yards.

Thames Water is the Water and Sewerage company for Ley Hill.

#### 5.1.5 Highway Authority

The Highway Authority for Ley Hill is Buckinghamshire Council, and the highways function is managed by Buckinghamshire Highways. It is responsible for maintaining the highway drainage system to an acceptable standard and ensuring that road projects do not increase flood risk.

#### 5.1.6 Riparian owners

Riparian landowners who own land or property next to a river, stream or ditch, (including where this runs through a pipe or culvert). They have rights and responsibilities over the management of the land including: a responsibility to let water flow through the land without any obstruction, pollution or diversion which affects the rights of others; keeping banks clear of anything that could cause an obstruction and increase flood risk; maintaining the bed and banks of the watercourse; and keeping structures clear of debris. There is more information on these rights and responsibilities in the Environment Agency guide 'Owning a watercourse'<sup>6</sup> and in Buckinghamshire Council's guidance, "Maintaining a river or stream you own"<sup>7</sup>.

#### 5.1.7 Local residents

Local residents should find out about any flood risk in the area, and make a written plan of how they will respond to a flood situation. Business owners should also make a flood plan for their business. There are measures that can be taken to reduce the amount of damage caused by flooding and properties at risk should be insured. Local residents can find out if their property is at risk, prepare for flooding, get help during a flood and get help after a flood.

### 5.2 Emergency roles and responsibilities

The emergency responsibilities of different organisations are outlined in Table 5-1 below. Please note that Parish and Town Councils do not have a legal obligation to respond to emergencies. Whatever service they provide is voluntary and unique to each Parish or Town Council.

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6 Owing a watercourse (<https://www.gov.uk/guidance/owning-a-watercourse>)

7 <https://www.buckinghamshire.gov.uk/environment/flooding-and-flood-risk-management/maintaining-a-river-or-stream-you-own/>

**Table 5-1: Roles and responsibilities in an emergency, during and after a flood event**

<b>Local Authorities (Buckinghamshire Council)</b>	
Coordinate emergency support within their own functions Deal with emergencies on 'non main rivers' Coordinate emergency support from the voluntary sector Liaise with central and regional government departments Liaise with essential service providers Open rest centres Manage the local transport and traffic networks Mobilise trained emergency social workers Provide emergency assistance Deal with environmental health issues, such as contamination and pollution Coordinate the recovery process Manage public health issues Provide advice and management of public health Provide support and advice to individuals Assist with business continuity	
<b>Police Force</b>	<b>Utility Providers</b>
Save life Coordination and communication between emergency services and organisations providing support Coordinate the preparation and dissemination	Attend emergencies relating to their services putting life at risk Assess and manage risk of service failure Assist with recovery process, that is, water utilities manage public health considerations
<b>Fire and Rescue Service</b>	<b>Internal Drainage Board</b>
Save life rescuing people and animals Carry out other specialist work, including flood rescue services Where appropriate, assist people where the use of fire service personnel and equipment is relevant	Operate strategic assets to reduce flood risk in partnership with RMAs and public
<b>Ambulance Service</b>	<b>Town and Parish Councils</b>
Save life Provide treatment, stabilisation and care at the scene	Support emergency responders Increase community resilience through support of community emergency plan development
<b>Voluntary Services</b>	
Support rest centres Provide practical and emotional support to those affected Support transport and communication Provide administration Provide telephone helpline support	

## Environment Agency

Issue Flood Warnings (where available) and ensure systems display current flooding information  
 Provide information to the public on what they can do before, during and after a flood event  
 Monitor river levels and flows  
 Work with professional partners and stakeholders and respond to requests for flooding information and updates  
 Receive and record details of flooding and related information  
 Operate water level control structures within its jurisdiction and in line with permissive powers  
 Flood event data collection  
 Arrange and take part in flood event exercises  
 Respond to pollution incidents and advise on disposal  
 Assist with the recovery process, for example, by advising on the disposal of silt, attending flood surgeries

### 5.2.1 Local resilience forum

Local resilience forums (LRFs) are multi-agency partnerships made up of representatives from local public services, including the emergency services, local authorities, the NHS, the Environment Agency and others. These agencies are known as Category 1 Responders, as defined by the Civil Contingencies Act.

LRFs are supported by organisations, known as Category 2 responders, such as the Highways Agency and public utility companies. They have a responsibility to co-operate with Category 1 organisations and to share relevant information with the LRF. The geographical area the forums cover is based on police areas.

The Local Resilience Forum is not a legal entity, nor does a Forum have powers to direct its members. Nevertheless, the Civil Contingencies and the Regulations provide that emergency responders, through the Forum, have a collective responsibility to plan, prepare and communicate for emergencies in a multi-agency environment.

The Local Resilience Forum for Ley Hill is the Thames Valley Local Resilience Forum (TVLRF). TVLRF have Emergency Response Arrangements which provides the response framework for a multi-agency response. The current arrangements for TVLRF require a Partner Activated Teleconference (PAT) to be convened by any TVLRF agency or organisation who feels that this is necessary, or an event meets the trigger criteria. A PAT is not Command and Control but could identify the need for the implementation of Command and Control structures. The purpose of a PAT is information sharing and situational awareness.

The TVLRF Multi-Agency Flood Plan (MAFP) provides the framework for the multi-agency response to a flooding incident in the TVLRF area.

## 5.3 Existing flood risk management activities

### 5.3.1 Flood warning services

Ley Hill is not covered by the Environment Agency's flood warning information service, which only covers Main Rivers. There is no flood warning service for ordinary watercourses or surface water flooding.

### 5.3.2 Met Office Weather Warnings

While there are no flood warning services for ordinary watercourses or surface water flooding, the Met Office issues regional weather warnings<sup>8</sup> for rain, snow, wind, fog and ice.

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8 Met Office Weather Warnings: UK Weather Warnings  
<https://www.metoffice.gov.uk/weather/warnings-and-advice/uk-warnings#?date=2023-09-01>

These warnings are publicly available and while at a regional level, it is possible to search for specific locations to keep up to date with local weather warnings.

### 5.3.3 Maintenance

The Riparian owner maintains the majority of the ditch. It is understood that there is however a short section of the ditch, between the two piped drainage network outfalls into the ditch, which is agreed to be maintained by Buckinghamshire Highways.

The highways drainage assets (gullies, soakaways and manholes) that lie within the public highway extents are cleaned by Buckinghamshire Highways. It is understood that the gullies in Ley Hill have historically been on a three-year cleansing programme, however for the financial year 2022/2023 and 2023/2024 the gullies have and will be cleansed annually. Besides that, there is also reactive cleaning which takes place following reports of issues with the drainage assets from local members and/or residents. The reactive cleansing is not limited to gullies but also the soakaways in the area. Additionally, there are multiple gullies in the privately-owned section of Kiln Lane which Buckinghamshire Highways do not own, but they have previously cleaned them due to blockages as a good will gesture, this was last undertaken in 2021/22. Responsibility of maintaining and clearing the gullies on the privately owned section of Kiln Lane lies with the private landowner(s).

**Table 5-2: Cleansing undertaken in area, of gullies, soakaways and manholes**

Date	Road
December 2019	Botley Road
February 2021	Kiln Lane
August 2021	Blackwell Hall Lane, Kiln Lane, The Green
October 2021	Blackwell Hall Lane, Kiln Lane, The Green
December 2021	Botley Road
March 2022	Kiln Lane, Holly Tree Close, Letchfield, Botley Road

### 5.3.4 Property Flood Resilience

There are no reports of any existing Property Flood Resilience (PFR) measures fitted to properties in the area

### 5.3.5 Flood alleviation schemes

There are currently no formal flood risk management schemes in the catchment.

### 5.3.6 Informal management schemes

Over the years, several informal actions have been taken by local residents to try and mitigate flooding to the properties in Ley Hill. While there are no formal records of this, these measures include:

- Installation of road gully at top of Kiln Lane (opposite junction with Letchfield)
- Speed bump-like feature along Kiln Lane, to divert water into nearby gully
- Raising of driveways off Kiln Lane to obstruct flow path
- Building of walls across path in front of Crown Cottages to obstruct flow path
- Clearing of gullies

## 6 Hydrological analysis of May 2021 event

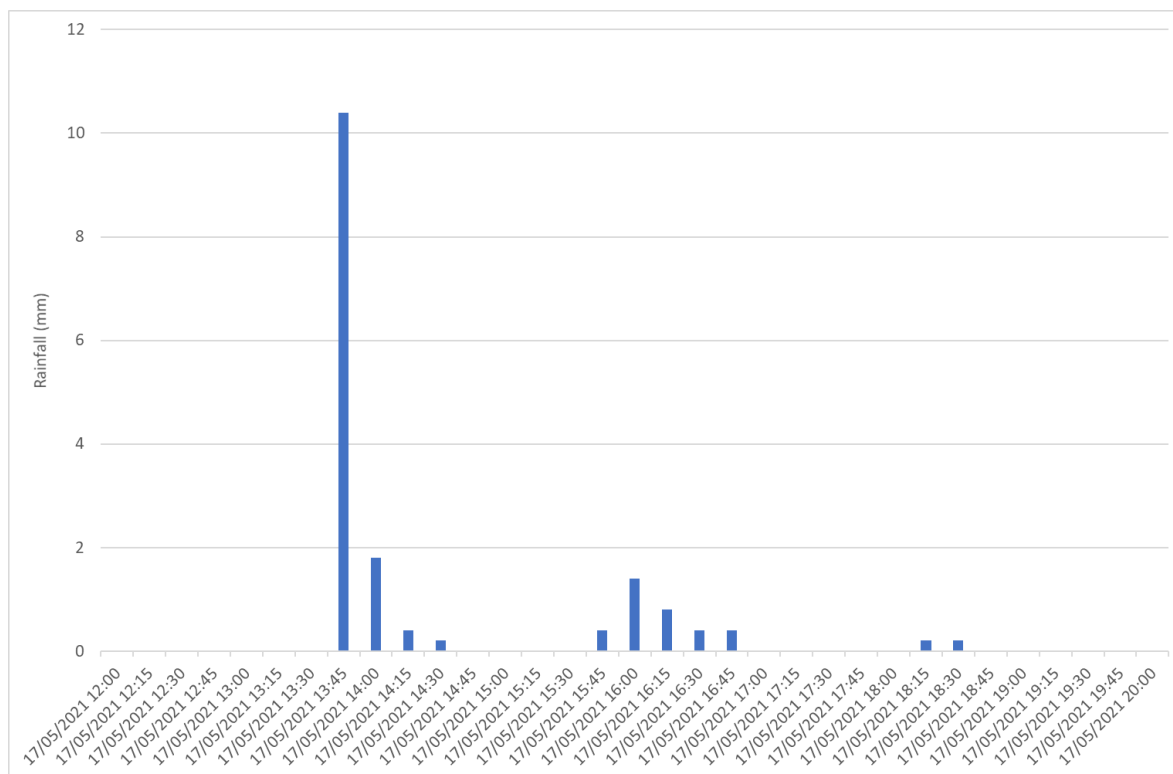
### 6.1 Conditions at the time

At the end of February, rainfall and catchment soil dryness were about normal for the time of year. March and April proved to be much drier months with the latter experiencing exceptionally low rainfall, about 25% of the monthly average. This led to an increase in soil moisture deficit (an indication of soil dryness) meaning soils were significantly drier than the long-term average.

However, May experienced notably higher levels of rainfall. In the two weeks prior to the event, approximately 60mm rain fell at Chenies rain gauge (located about 3km south-east of Ley Hill), this is higher than the rainfall for the whole of February and significantly higher than the rainfall for March (29mm) and April (6mm). This led to a below average soil moisture deficit (10-20mm), meaning soils were wetter than average for the time of year by the start of the event on 17th May.

### 6.2 The event

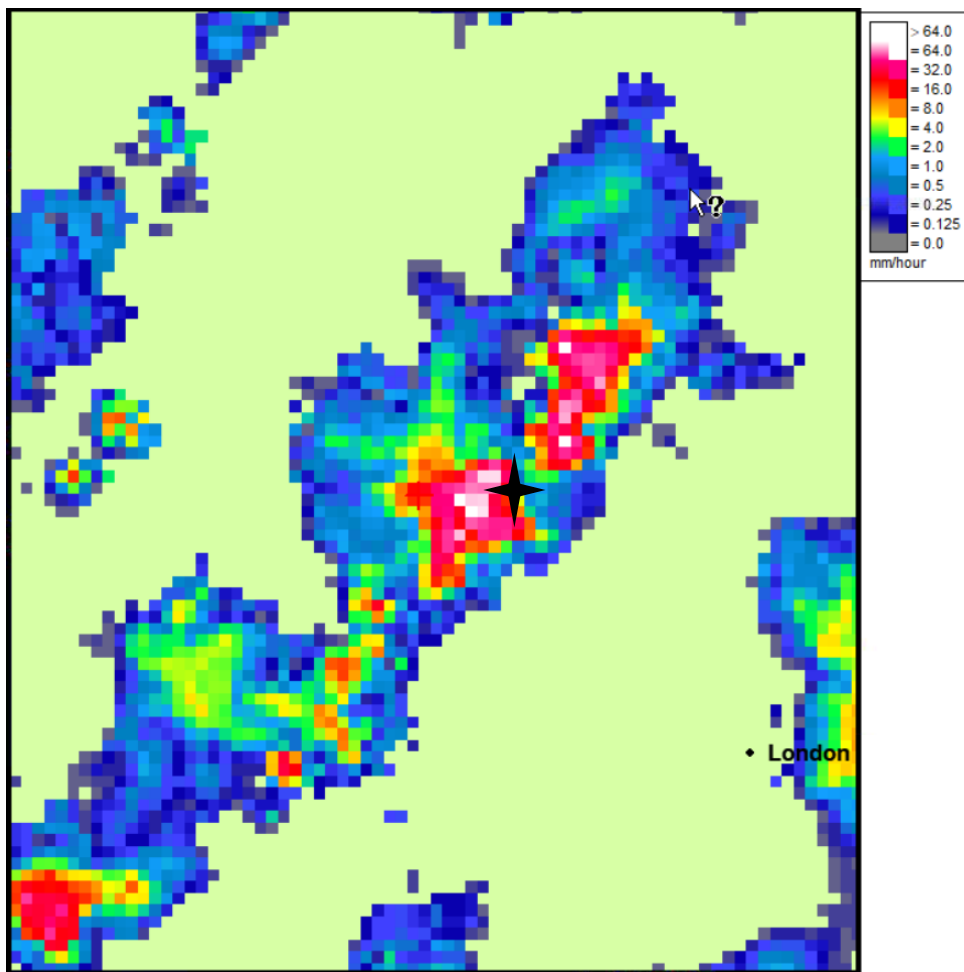
Figure 6-1 shows the rainfall measured at Chenies TBR rain gauge during the 17 May event. This shows a very intense period of rainfall at the start of the event at 13:45 which quickly passed after an hour. This was followed by another hour of less intense rainfall at 15:45. Observations from the event show that precipitation included both rain and hail, though it is unclear whether this was at the start of the event or after.



**Figure 6-1 Rainfall recorded at Chenies rain gauge**

Observed radar data from the Met Office confirms that the storm was short and intense. The image below shows the observed radar rate for Ley Hill (shown as a black star) at 13:45 on 17<sup>th</sup> May.





**Figure 6-2 Radar rainfall rate at 13:45 on 17th May**

Rain gauge	Distance from Ley Hill (km)	3hr total rainfall (mm)	45 minute maximum* (mm)	15 minute maximum* (mm)	Grid reference
Chenies	3.3	16.2	12.8	10.4	501686, 200016
Radar	0	18.3	13.4	9.6	498942, 201927

\*Total rainfall for the most intense 45 minute period (13:45-14:30) and 15 minute period (13:45-14:00).

### 6.3 Rainfall return period estimation

The total rainfall during the 17 May event had up to a 25% chance of occurring in any one year approximately (return period of up to 1 in 4 years). This is not especially extreme but given the highly intensive and localised nature of the rainfall, falling on a wetter than average catchment, the catchment was very sensitive to heavy rainfall.

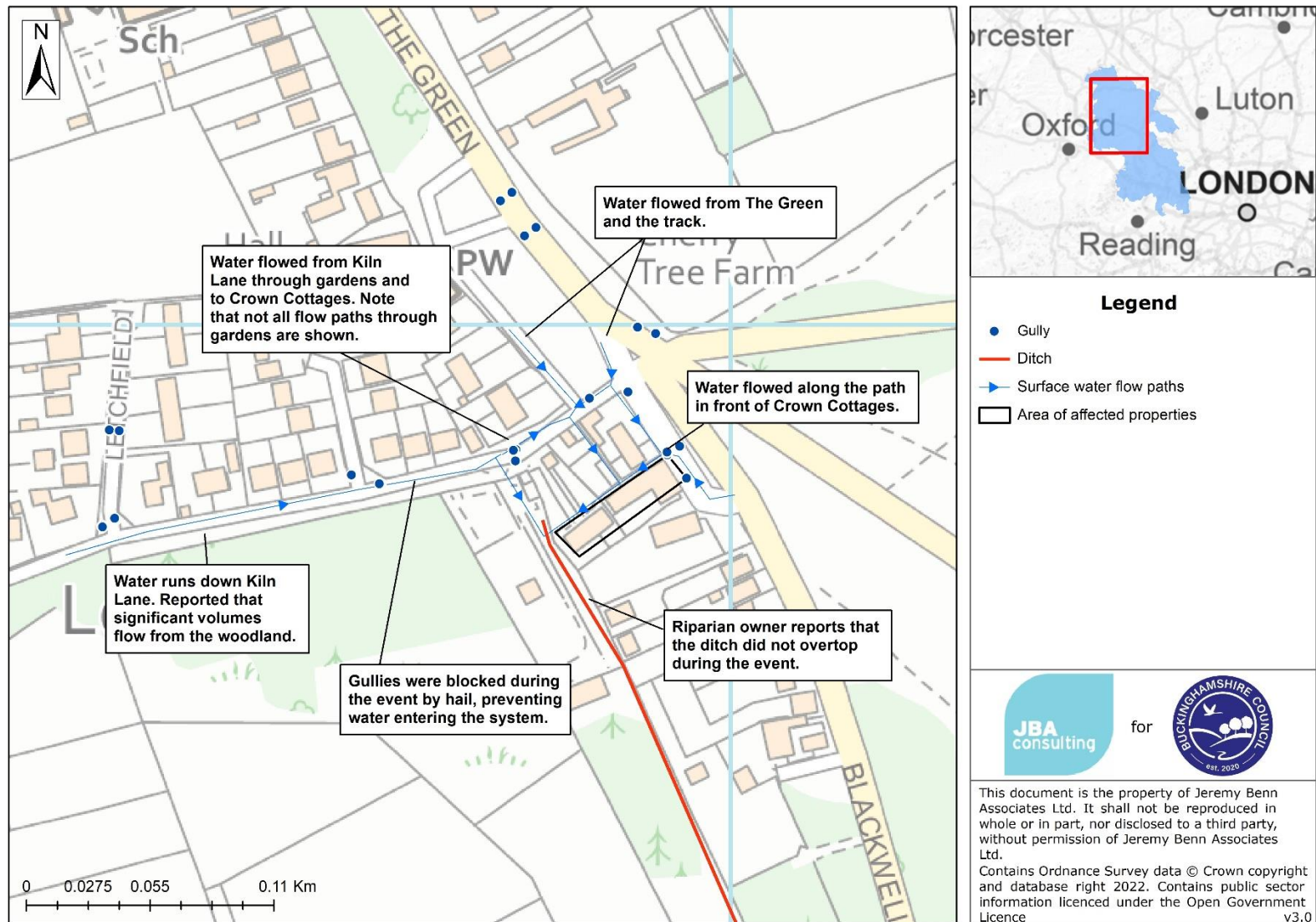
It is difficult to take into account the impact of hail on the rainfall return period as the rain gauge does not distinguish between types of precipitation, which is likely to be a mix of rain and hail in this case, plus there is no standard method for estimating return period based on measurements of hail. In terms of flooding, hail has the potential to block drains/gutters and therefore may exacerbate local flooding. Figure 8-2 shows the extent of the hail.

## 7 Incident response

No authorities responded to the flooding in Ley Hill during the event, and residents did not contact any authorities. Several residents were at work when the flooding occurred, so were not able to take any potentially preventative actions to protect their properties. The residents managed the flooding to their properties themselves after the event.

## 8 Source-pathway-receptor analysis

We analysed all the information available to determine the main sources of the flood water, the pathways it took and the main receptors. These are summarised in Figure 8-1.



**Figure 8-1: Map showing the sources, pathways and receptors during the flood event**

## 8.1 Source

### 8.1.1 Rainfall and hail

The intense rainfall in Ley Hill caused a large volume of water to fall directly onto the ground surface in the village. The total rainfall during the 17<sup>th</sup> of May storm event had up to a 25 chance of occurring in any one year (return period of up to 1 in 4 years) (see Section 6).

The storm also resulted in a significant amount of hail, which cannot be measured in the same way (see Section 6). Some of the hail was washed along with surface water flows, and some was left behind to melt slowly in situ. Figure 8-2 shows the depths of the hail against a low brick wall previously constructed to divert flows of water away from properties during heavy rainfall.



**Figure 8-2: Photograph showing hail outside Crown Cottages during the event**

### 8.1.2 Ditch

There was no reported flooding from the ditch during the flood event. The riparian owner reported that there was adequate capacity in the ditch, and no overtopping occurred.

## 8.2 Pathways

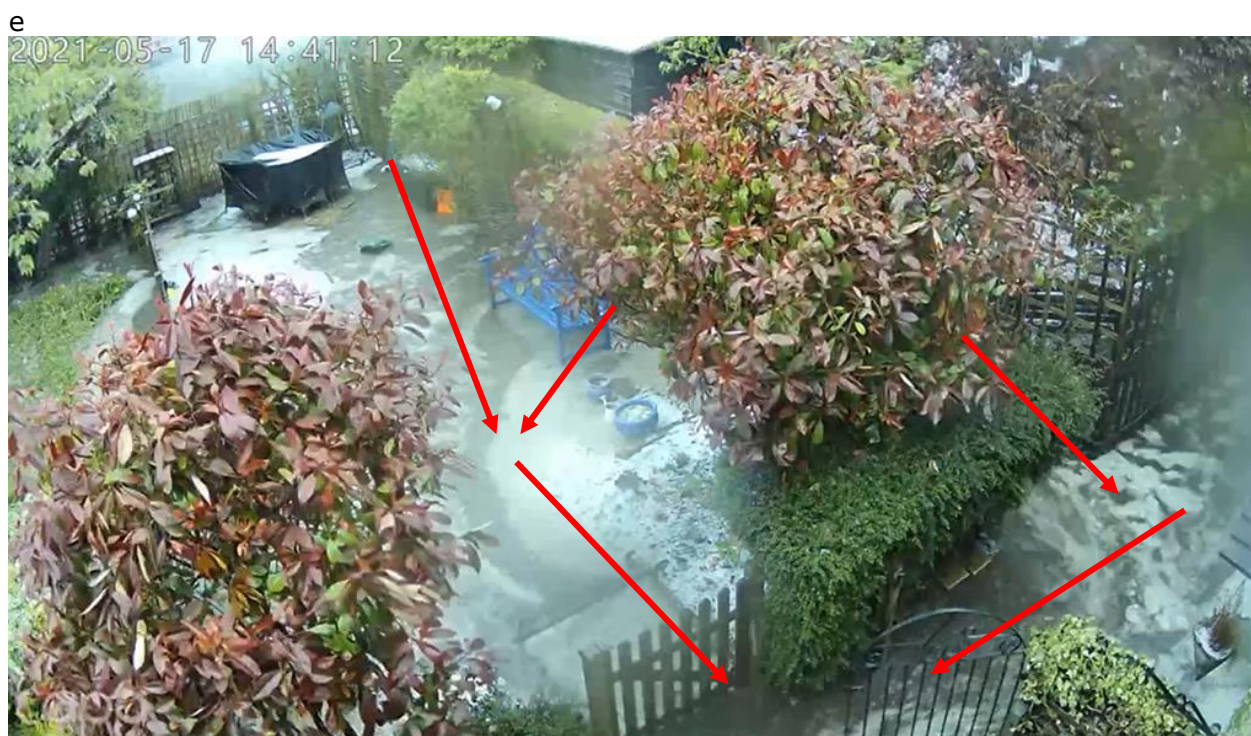
### 8.2.1 Surface water runoff

As a result of the heavy rainfall experienced in Ley Hill, surface water formed rapidly over the impermeable surfaces and flowed overland towards Crown Cottages, which are located in a topographic low point.

There were several surface water flow routes (shown in Figure 8-3). Notably, along Kiln Lane, the gullies are typically in a poor condition as a result of excess surface material from the degrading road. It is reported that the debris from the road often blocks the gullies which would inhibit the capacity of the drainage system and increase overland flow volumes.

The drainage system was further restricted during the event by the hail, which is reported to have sealed the gullies, preventing the drainage of surface water. The hail was also washed along with the surface water runoff, which may have increased the volume of the flow. Surface water from Kiln Lane affected properties by flowing through the front gardens, shown in Figure 8-3.

Surface water flows were also reported from The Green and Blackwell Hall Lane towards The Crown pub, where water flowed down the path in front of Crown Cottages.



**Figure 8-3: Screenshot taken from video during the event, from Crown Cottages in the direction of Kiln Lane. Video shows hail floating on top of surface water.**

## 8.3 Receptor

### 8.3.1 People

The flooding in Ley Hill impacted affected residents and is known to have caused flood damage to at least seven properties. Residents reported having to claim on their insurance, which will likely increase their premiums in the future and adding an additional financial burden from the event. Several residents reported that, following the event, they have struggled to get home insurance, and once they have found a supplier, the price has more than doubled.

### 8.3.2 Property

At least seven properties are known to have flooded during the event: five internally and two externally. This includes one commercial property along with six residential properties. Several residents reported that the flooding affected the whole downstairs of their property, as many properties are open plan. Reported damages include damage to flooring (in some cases requiring full replacement), skirting boards, walls, carpets and sofas. No residents reported that they were required to temporarily move out.

During the event, internal flooding to a basement was also recorded which resulted in damage to possessions and the walls.

Several residents reported damage to their gardens as a result of surface water runoff.

### **8.3.3 Services**

There were no local services such as schools, shops, doctor's surgeries etc. affected by the flooding.

## 9 Highway drainage condition assessment

### 9.1 Introduction

The survey collected in July 2022 by Buckinghamshire Council included CCTV of the highway drainage system in the vicinity of Kiln Lane.

The condition of the highway drainage was reviewed based on information provided in the Flowline CCTV survey, with defect grades based on the Sewerage Rehabilitation Manual 5 (SRM 5) grading system.

Both 'structural defects' and 'service/operational condition' were taken into consideration. Structural scoring considers any physical defects in the wall of the pipe, whereas the service/operational scoring highlights the performance of the pipe and is often linked to the cross-sectional area of the pipe. Table 9-1 and Table 9-2 show the structural and service/operational defects of the highway drainage.

Within the survey, several recommendations were provided where action is required to improve the network. The majority of these recommendations involved a 'patch repair' to repair cracks, fractures or displaced joints. In some instances, a full relining of the pipe was also recommended. Root cutting is also recommended for several pipes. Finally, in some sections, further jetting is required in order to complete full CCTV.

While structural defects and the service/operational condition of the public highway drainage network in the area have been considered as part of this investigation, it is important to recognise public highway drainage systems are not designed to receive runoff from private roads and/or residential areas. Instead, public highway drainage is simply designed to drain a catchment of the public highway. This means that if private roads and residential areas are not adequately drained themselves, then surface water runoff generated by these areas can ultimately flow towards the public highway drainage network. This is the case in Ley Hill where the privately owned road, Kiln Lane, has limited drainage assets. This means that rainfall falling on Kiln Lane is unable to drain away, and runoff is instead directed to the public highways network which is not designed to accommodate this additional runoff and can therefore be overwhelmed, especially when the public highway drainage is further compounded by the debris from Kiln Lane/the woodland (please refer to section 10.2.1.1 for further information).

### 9.2 Structural defect summary

The survey recorded five Grade 5 defects, although none of these are located along the main piped highways network that runs beneath the footpath outside of the Crown Cottages. One of the Grade 5 defects is associated with the pipe connecting a gully into the soakaway along Holly Tree Close (here there is a hole in the pipe). Adjacent to The Crown pub, there is another Grade 5 defect in a pipe connecting a gully into the highway drainage (defect here is a hole in the pipe). The other Grade 5 defects are along The Green, north of Kiln Lane, where the gullies discharge to a soakaway which are associated with a displaced joint equalling more than 10% of the pipe diameter.

There are several other less severe defects identified (Grade 3 and 4) which are associated with fractures and / or holes in the pipes and broken pipes. All of the Grade 4 defects are associated with pipes along Kiln Lane. All of these defects are fractures, cracks or displaced joints.

Table 9-1 summarises the structural defects identified during the CCTV survey.



**Table 9-1: Structural defects on the highway drainage**

Defect grade	Number of recorded defects	Defect grade description (taken from SRM5)
Grade 3	6	Best practice suggests consideration should be given to repairs in the medium term
Grade 4	5	Best practice suggests consideration should be given to repairs to avoid a potential collapse
Grade 5	5	Best practice suggests that this pipe is at risk of collapse at any time. Urgent consideration should be given to repairs to avoid total failure.

### 9.3 Service/operational defects summary

The CCTV survey identified no Grade 5 service/operational defects. However, several Grade 3 and 4 defects were identified. One of the Grade 4 defects is along a pipe below the path outside Crown Cottages. Here, there are deposits in the pipe totalling 20% of the cross-sectional area. The second Grade 4 defect is in a pipe connecting a gully to the soakaway along Letchfield, where there are roots growing through the pipe.

The Grade 3 defects are also located in the pipes below the pathway outside Crown Cottages and along Kiln Lane. These defects are associated with deposits accounting for 5-10% of cross-sectional area.

**Table 9-2: Service/operational defects on the highway drainage**

Defect grade	Number of recorded defects	Defect grade description (taken from SRM5)
Grade 3	6	Best practice suggests consideration should be given to maintenance activities in the medium term
Grade 4	2	Best practice suggests consideration should be given to maintenance activity to avoid potential blockages.
Grade 5	0	Best practice suggests that this pipe is at a high risk of backing up or causing flooding

### 9.4 Impact of condition on flood risk

Several defects were identified during the CCTV survey. The structural defects identified, particularly those that are Grade 5, highlight areas where there is risk of potential collapse which would consequently increase flood risk due to blockage in the pipe (from collapsed material) and subsequent exceedance and overland flows. It should be reiterated that none of the structural defects are located in the immediate vicinity of the Crown Cottages. There were also several service/operational defects identified, but these were not as severe as the structural defects. The most significant defect was a loss of 20% cross sectional area due to deposits. However, overall, there is no significant risk to increased flood risk from the service/operational defects.

It should also be noted that, although not noted as a defect, at the time of survey the pipes along Kiln Lane were heavily silted and required significant jetting to pass the CCTV camera. Silting at this level would result in a large loss of capacity and therefore increased flood risk. Therefore, prior to the jetting and survey being carried out the service/operational defects may have been more severe with probable lower capacity of the gullies and piped network due to the heavy silting.

## 10 Discussion, appraisal and recommendations

### 10.1 Introduction

In this section we consider potential options to mitigate flood risk and reduce damages caused by flooding.

This includes consideration of measures such as improvements to highway drainage, including asset maintenance and refurbishment, and community and property flood resilience measures.

We undertook a high-level option appraisal focussing on benefit, practical and viability considerations. We carried out a multi-criteria analysis to compare each option which included consideration of:

- Contribution towards reducing flood risk to property
- Contribution towards reducing flood impacts on people/communities
- Contribution to improving the availability of data, evidence and modelling to support option development or flood incident response
- Deliverability (including construction complexity, access, designations, services, space, land ownership, available materials and expert equipment or advice required)
- Community / resident acceptability
- Contribution towards biodiversity and water quality betterment
- Contribution towards amenity benefits
- Contribution to carbon reduction
- Maintenance requirements
- Approximate timescales
- Relative benefit-cost ratios

Relative costs and timescales are provided for information only and are not included in the scoring.

The scoring criteria and full results are described in more detail in Appendix A. Options were given a relative score and recommendations made for further work to be carried out, or quick-win actions. Indicative timescales are given. Doing nothing was the least beneficial option, followed by continuing with a 'business as usual' approach to managing flood risk in Ley Hill. Opportunities identified within the multi-criteria analysis with a score above 7 were taken forward as a recommendation.

It is important to note that whilst JBA and Buckinghamshire Council have liaised with partner organisations regarding this assessment, this is a high-level, preliminary assessment undertaken by and on behalf of Buckinghamshire Council. Therefore, it is for the relevant responsible body or persons to assess these recommendations in terms of their legal obligation, resource implications, priority and the costs and benefits of undertaking such options.

Buckinghamshire Council will monitor progress on all these recommendations through the Buckinghamshire Strategic Flood Committee, but does not have powers to enforce their delivery by others.

## 10.2 Discussion of options

### 10.2.1 Highway drainage improvements

#### 10.2.1.1 Increased cleansing of the highway drainage

The CCTV survey has shown that the highway drainage, particularly around Kiln Lane, is heavily silted. There is also evidence of the gullies being blocked or silted over. The source of the debris is largely from Kiln Lane itself where the road is degrading, but also the woodland located at the top-end of Kiln Lane. The CCTV also shows that several of the soakaways are in poor condition with heavy silting.

Despite Kiln Lane being unadopted, Buckinghamshire Highways are responsible for the gullies and soakaways on Holly Tree Close and Letchfield as these roads are adopted and the assets lie within the highway extent, not the privately-owned Kiln Lane.

There are gullies at the eastern end of Kiln Lane which Buckinghamshire Highways are responsible for as these also lie within the highway extent. It is understood that the drainage in the area has historically been on a three-year cleansing schedule, however, will be cleansed annually between 2022 and 2024, additional reactive works are also undertaken when required. However, as discussed in Section 5.3.3, there are unadopted gullies along Kiln Lane for which Buckinghamshire Highways are not responsible for cleansing. An increased frequency schedule would ensure that the highway drainage system can operate at increased capacity, compared to when it is heavily silted. Therefore, in heavy rainfall events, the system will capture more surface water and reduce the likelihood of flooding.

#### 10.2.1.2 Repairs/improved condition of highway drainage

The CCTV survey of the highway drainage (see Section 9) found several sections of pipe which require improvement. The survey found there to be more issues structurally with the network, in comparison to service/operational defects. The structural defects also included multiple which were given a Grade 5 score. These included holes and/or fractures in pipes and displaced joints. Although these defects may not directly increase flood risk, there is a high risk of collapse (particularly with Grade 5 defects) which would result in blockage of the pipe and consequently increased flood risk. Therefore, it is recommended that these defects are addressed, to prevent the risk of collapse. A number of these defects include the privately owned pipes which connect the gullies to the ditch along Kiln Lane. The CCTV survey highlights where repairs are required.

Full details of the defects and recommendations provided by the surveyors are in Section 9.

#### 10.2.1.3 Increased/upsizing highway drainage

To alleviate pressure on the existing public highway drainage system, additional gullies could be added, or/and the existing system could be upsized/upgraded. This could be done through a Buckinghamshire Highways capital drainage scheme at various locations throughout the wider highways network in the area. At time of writing, Buckinghamshire Highways are investigating the feasibility a scheme in the area.

While investigating the feasibility of increasing/upsizing the public highways drainage in the wider area, as explained in section 9.1, the public highway drainage network is not designed to receive runoff from private roads and/or residential areas, simply the public highway. Therefore, it is also recommended that increasing/upsizing drainage on the privately owned Kiln Lane is investigated (see below).

It is noted that the number of gullies along Kiln Lane is limited, compared to the catchment they are serving. There are four gullies at the low point of Kiln Lane (shown in Figure 3-2) which discharge to the ditch. Three of these gullies connect into a 225mm pipe. There are

four additional gullies further along Kiln Lane (to the West), but it is understood that these are designed to serve Letchfield and Holly Tree Close and connect to two soakaways.

Additional gullies along Kiln Lane would reduce the overland flows which are reported to commonly occur. They could be placed along Kiln Lane, as well as oversized gullies in the low point, which is the most suitable location to capture flows from Kiln Lane. However, the existing pipe (which conveys water to the ditch) should be also considered, as this may require upsizing to ensure adequate capacity and further investigation/hydraulic modelling would be required to confirm this. The ownership of Kiln Lane also requires consideration. As it is a private road, any works on the drainage would be required from the private owner(s), not Buckinghamshire Highways. For a new system to operate at full capacity, works would also be required to improve the condition of Kiln Lane as, in its current state, any additional drainage would continue to be blocked by the debris. Please see section 10.2.1.4 for more information regarding road improvement works and the adoption process.

Further investigation into the outfall of the ditch downstream would also be required in support of any scheme to provide additional drainage along Kiln Lane.

#### 10.2.1.4 Improvement and exploration of adoption of Kiln Lane

Although improvement, and any potential subsequent adoption, would not directly improve flood risk, there are indirect benefits. In its current condition, there is significant degradation of the road surface on Kiln Lane resulting in excess loose material which flows into the drainage and results in blockages. Therefore, if the road surface were to be improved, the amount of loose material would reduce, both decreasing build up in gullies and pipes and the need for regular cleansing. Once the road surface has been improved the owner(s) could explore the road adoption process with Buckinghamshire Highways. Adoption of the road could ensure the continued maintenance and clearance of drainage assets such as gullies. However, it should be recognised that the road adoption process is not straightforward and has many constraints associated with it. Buckinghamshire Highways would not adopt Kiln Lane in its current poor state of repair. It would be the responsibility of the private landowner(s) to bring Kiln Lane up to an improved standard and then explore the road adoption process with Buckinghamshire Highways. Please note that at the time of writing, following a review of public records, the ownership of Kiln Lane remains unclear however it is important to note that there may be more than one owner.

**Table 10-1: Recommendations for highway drainage improvements**

Option	Organisation(s) responsible	Multi-criteria analysis score	Recommendation	Timescale
Increased cleansing of highway drainage	Buckinghamshire Highways/private owner(s) of Kiln Lane	9	Recommend	< 1 year
Repairs/improved condition of highway drainage	Buckinghamshire Highways / private owner(s) of Kiln Lane	8	Recommend	1 – 5 years
Increased/upsized highway drainage	Buckinghamshire Highways / Private owner(s) of Kiln Lane	8	Further investigation of feasibility	1 – 5 years

Option	Organisation(s) responsible	Multi-criteria analysis score	Recommendation	Timescale
Improvement and exploration of adoption of Kiln Lane	Private owner(s) of Kiln Lane	7	Further investigation of feasibility	1 – 5 years

### 10.3 Property flood resilience (PFR)

Responses and discussions with residents indicate that water entered many properties in Ley Hill through multiple points including the doors to the property.

We suggest that Property Flood Resilience (PFR) could be an option for the properties in Ley Hill that experienced flooding in May 2021, to make them more resilient. PFR involves assessing how floodwater enters a property and recommending measures at an individual property level to mitigate potential flooding.

PFR could provide effective products and measures at an individual property level to reduce the impact of any future flooding in Ley Hill, by either aiming to limit water entry in the first place (resistance) or by adapting the internal fabric of the property to limit damage (resilience). Resistance measures can include flood doors, flood barriers, automatic airbricks and non-return valves. Resilience measures include raising electrics, using porous plaster, and fitting solid floors or tiled floor coverings instead of carpets.

Although resistance measures are not able to entirely prevent flood water ingress, they aim to limit damage and ensure properties are adapted to cope with the impacts of floods and recover quickly from these disruptive events. Constraints of both resistance and resilience approaches include funding, resident willingness and the appropriateness of the individual property for installing PFR measures.

PFR can either be taken forward as a community-wide scheme by a lead organisation such as Buckinghamshire Council, or privately by individual property owners. Buckinghamshire Council do have long-term aspirations to lead and deliver PFR more widely across the county in the coming years. However, this would require appropriate staffing and sufficient funding to be secured, and is subject to much uncertainty at present.

Individual property owners at risk of flooding, or those who have experienced flooding previously, may wish to consider installing PFR products and make making their properties more resilient on a private basis<sup>9</sup>. Before any products are fitted, an independent PFR survey should be commissioned to identify the points of ingress and recommend appropriate measures<sup>10</sup>. Kitemarked PFR products should be supplied and installed by an

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9 The Homeowners' Guide to Flood Resilience'

([https://www.knowyourfloodrisk.co.uk/sites/default/files/FloodGuide\\_ForHomeowners.pdf](https://www.knowyourfloodrisk.co.uk/sites/default/files/FloodGuide_ForHomeowners.pdf))

aims to inform homeowners about how to reduce flood risk to their homes and the variety of PFR methods available. It also includes contact details for surveyors/providers of Kitemarked flood protection equipment.

The National Flood Forum provide a webpage and guidance leaflet for homeowners on the steps towards installing their own PFR measures, and a tool to provide indicative costs of measures at: <https://nationalfloodforum.org.uk/about-flooding/reducing-your-risk/protecting-your-property/>

10 The Blue Pages, a directory for flood risk reduction services provided by the National Flood Forum, list a number of companies who may be able to undertake such individual flood risk surveys: <https://bluepages.org.uk/listing-category/surveys-building/>.

approved supplier, to ensure the efficacy and reliability of the PFR measures. If residents are unable to fund such works individually, the community could look to apply for grant funding from charities that can help with flood recovery (such as Heart of Bucks or the National Lottery Community Fund).

In the period immediately following a flood event, we recommend that residents speak with their insurance companies regarding support with the costs of implementing measures to 'build back better,' helping to better protect properties against future flooding when repairing a property after a flood event.

**Table 10-2: Recommendations for PFR**

Option	Organisation(s) responsible	Multi-criteria analysis	Recommendation	Timescale
Investigate opportunities for installing PFR at relevant at risk properties	Property owners/community	8	Recommend	1 – 5 years

#### 10.4 Community flood resilience

A community approach to resilience can significantly increase residents' ability to prepare, respond, and recover from floods in the future, and so reducing the impact of flooding on the community. In Ley Hill, there is no existing flood group to support and respond to the flood risk. It is recommended that a community Flood Action Group be established in Ley Hill with the aim of increasing the community's resilience to flooding.

Buckinghamshire Council<sup>11</sup> and the National Flood Forum<sup>12</sup> have resources to assist communities with planning and preparing for flooding, which could include establishing a Flood Action Group<sup>13</sup> and creating a community flood plan<sup>14</sup>. A flood plan should be developed led by the community, Flood Action Group or Parish, to inform residents how to prepare for, respond to and recover from flooding.

The Flood Action Group could also create a 'flood preparedness' information pack for current and future residents in the area. The pack may contain advice on taking out contents' insurance on belongings, property resistance and resilience measures and a checklist of what to do in the event of a flood. This may help to give reassurance to residents on what can be done in the event of another flood and minimise future loss of belongings and damage to properties.

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11 Working with your community:

<https://www.buckscc.gov.uk/services/environment/flooding/how-to-deal-with-a-flood/working-with-your-community/>

12 National Flood Forum: <https://nationalfloodforum.org.uk/working-together/communities/what-is-a-flood-action-group/>

13 Set up a Flood Action Group:

<https://www.buckscc.gov.uk/services/environment/flooding/set-up-a-flood-action-group/>

14 Community flood plan template - GOV.UK ([www.gov.uk](http://www.gov.uk))

**Table 10-3: Recommendations for community resilience**

Option	Organisation(s) responsible	Multi-criteria analysis score	Recommendations	Timescale
Form a Flood Action Group	Ley Hill and Latimer Parish Council / Community	8	Recommend	<1 year
Create a community flood action plan	Ley Hill and Latimer Parish Council / Community	8	Recommend	<1 year
Prepare a “flood preparedness” information plan for current and future residents	Ley Hill and Latimer Parish Council / Community	12	Recommend	<1 year



## 11 Conclusions and Recommendations

### 11.1 Conclusions

The flooding that occurred in Ley Hill on 17 May 2021 led to the flooding of at least seven properties in the village, with further properties experiencing external flooding. Buckinghamshire Council, as the Lead Local Flood Authority, has exercised their power to undertake a Section 19 investigation as this fulfilled its criteria of 'significant flooding'.

The total rainfall during the 17 May storm event had a 25% chance of occurring in any one year (return period of 1 in 4 years). This is not especially extreme but the catchment was wetter than average and hail blocked gullies resulting in significant volumes of runoff. The combination of these factors (i.e. heavy rainfall, wetter than average catchment and hail-blocked gullies) exacerbated the flood risk. However, it should be recognised that this combination of events would have a much lower likelihood of occurring again (in comparison to the rainfall alone).

Residents indicate that the rainfall started at approximately 13:45. It is unclear exactly what time properties started to flood internally, as several residents were at work at the time.

The source of the flooding appears to be solely surface water runoff. The ditch did not overtop during the event. The runoff was exacerbated by the impeded drainage due to hail blocking gullies. Furthermore, the heavy silting of the highway drainage system along Kiln Lane resulted in limited capacity and backing up of water from the outfall which discharges into the ditch.

The surface water flowed through the front gardens of Crown Cottages from Kiln Lane, as well as along the access path from Blackwell Hall Lane (adjacent to the Crown Pub).

Five properties are known to have flooded internally (and two further externally), including one property which experienced flooding to the basement. Multiple properties reported flooding throughout the ground floor. The timing of the storm meant many residents were at work, and so they were not able to take any action to mitigate the impact of flooding to their properties.

### 11.2 Recommendations

Based on the identified causes and mechanisms of flooding, potential options to mitigate flood risk and/or damages have been considered.

A high-level appraisal of possible flood risk management options has been undertaken (Section 10), which includes consideration of measures such as expanding/improving highway drainage, increased maintenance on sewers, exploration of the adoption of Kiln Lane, property flood resilience and community resilience. The appraisal involved multi-criteria analysis (see Section 10.1 for details) of which the results are summarised below in Table 11-1.

Doing nothing was the least beneficial option, followed by continuing with a 'business as usual' approach to managing flood risk in Ley Hill. The options which scored the highest were those that could ultimately result in a more resilient community, including:

- Increased cleansing of highway drainage including gullies and soakaways
- Create a Community Flood Action Plan and prepare/update individual flood plans
- Increasing/upsizing highway drainage within Ley Hill
- PFR for properties

**Table 11-1: Summary of multi-criteria analysis**

Recommended actions	Risk management authority/stakeholder
Increased cleansing of highway drainage	Buckinghamshire Highways / private owner(s) of Kiln Lane
Repairs/improved condition of highway drainage	Buckinghamshire Highways / private owner(s) of Kiln Lane
Increased/upsized highway drainage	Buckinghamshire Highways / private owner(s) of Kiln Lane
Improvement and exploration of adoption of Kiln Lane	Private owner(s) of Kiln Lane
Investigate opportunities for installing PFR at relevant at-risk properties	Property owners
Form a Flood Action Group	Ley Hill and Latimer Parish Council / Community
Create a Community Flood Action Plan	Ley Hill and Latimer Parish Council / Community
Prepare a “flood preparedness” information plan for current and future residents	Ley Hill and Latimer Parish Council / Community

## **Appendices**

### **A Multi-criteria analysis**

**Buckinghamshire Section 19 Investigations**  
Multi-Criteria Appraisal Matrix

<b>Originated</b>	Emily Jones	05/08/2022
<b>Checked</b>	Anna Beasley	28/09/2022
<b>Approver</b>	Anna Beasley	28/09/2022

**Evaluation Scoring: See tab 'Scoring Criteria' for details**

-2	Major negative impact.
-1	
0	Neither positive or negative impacts
1	
2	
3	
4	
5	Major positive impact

Objective	Weighting
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
11	0

Reference	Opportunities	Lead RMA	1	2	3	4	5	6	7	8	9	10	TOTAL
			Flood risk benefit to property	Flood impact on people	Data and evidence	Deliverability	Community/resident acceptability	Biodiversity and water quality betterment	Amenity benefits	Carbon reduction	Maintenance costs	Cost (for information only)	
1	Do nothing	N/A	-1	-1	0	0	-1	0	0	0	0	3	-3
2	Business as usual	All	0	-1	0	0	0	0	0	0	0	3	-1
<b>Data and evidence</b>													
3	Invest in further flood modelling and mapping for surface water flood risk in Ley Hill	Buckinghamshire Council (LLFA)	0	0	2	1	0	0	0	0	0	3	3
<b>Mult-Agency Management</b>													
4	Develop a catchment wide flood response framework to ensure consistency in response between different local resilience forums	Environment Agency	0	0	4	-1	0	0	0	0	0	3	3
<b>Community, property and infrastructure flood resilience</b>													
5	PFR scheme for properties in Ley Hill	Environment Agency?	1	4	0	1	1	0	0	0	1	5	8
6	Works with the local community to set up a flood group, create a Community Flood Action Plan and formalise any existing arrangements.	Community/Buckinghamshire Council (LLFA)	1	4	0	1	2	0	0	0	0	5	8
7	Community to prepare, review and update individual flood plans	Community/Buckinghamshire Council (LLFA)	1	4	0	1	2	0	0	0	0	5	8
8	Community engagement re installing resilient measures that may be of benefit to properties at risk	Buckinghamshire Council (LLFA)	1	4	0	-1	-1	0	0	0	0	5	3
<b>Maintenance and minor works</b>													
9	Increased cleansing of highway drainage including gullies and soakaways	Transport for Buckinghamshire	3	3	0	2	2	0	0	0	-1	4	9
10	Repairs to highway drainage based on CCTV survey defects	Transport for Buckinghamshire	2	2	0	2	2	0	0	0	0	3	8
<b>Capital/Flood Risk Management schemes</b>													
11	Highway improvements along Kiln Lane to reduce debris accumulating in gullies/highway drainage	Transport for Buckinghamshire (agreement dependent)	2	2	0	-2	2	2	0	0	1	4	7
12	Increased drainage in surrounding area e.g. The Green, Blackwell Hall Lane, Kiln Lane (adoption dependent). Includes upsizing of existing drainage	Transport for Buckinghamshire	4	3	0	1	1	0	0	0	-1	4	8
13	Highway drainage improvements	Transport for Buckinghamshire	4	3	0	-1	2	0	0	0	0	3	8

1	Contribute towards reducing flood risk to property	Likely change in internal flood risk to property	
		-2	Increase in flood risk to any property
		-1	N/A
		0	No perceived change
		1	Reduction in flood risk to 1 - 10 properties
		2	Reduction in flood risk to 10 - 30 properties
		3	Reduction in flood risk to 30 - 70 properties
2	Contribute towards reducing flood impacts on people/communities	Likely change in flood impacts on people/communities. Encompassing community preparedness and resilience; stress, health, mental health impacts; nuisance flooding (gardens, roads etc); disruption to access and egress; vehicle damages; risk to life and evacuation costs.	
		-2	Major negative change in flood impacts on people/communities
		-1	Minor negative change in flood impacts on people/communities
		0	No perceived change
		1	Minimal positive change in flood impacts on people/communities (e.g. reduction in nuisance flooding)
		2	Minor positive change in flood impacts on people/communities (e.g. reduction in disruption to toilet use)
		3	Minor positive change in flood impacts on people/communities (e.g. improvements to access and egress)
3	Contribute to improving the availability of data, evidence and modelling to support option development or flood incident response	This criteria focusses on the benefits of further data collection and evidence studies to support option development	
		0	Does not improve the availability of data, evidence and modelling
		1	
		2	Will provide additional data, evidence or modelling, helpful in development of interventions
		3	
		4	
		5	Improvement to data, evidence and modelling which is essential to the development of a capital scheme
4	Deliverability	Likely deliverability of the intervention considering construction complexity, access, designations, services, space, land ownership, available materials and expert equipment or advice required.	
		-2	Deliverability is at high risk of complexity/constraints
		-1	
		0	Not known/not applicable
		1	
		2	Deliverability is at low risk of complexity/constraints
5	Community / resident acceptability	Community buy in or perceived residents opinion.	
		-2	Community/residents are likely to have objections
		-1	Community/residents may not be receptive
		0	No known objections / constraints
		1	Community/residents are likely to be receptive but may have some constraints
6	Contribute towards biodiversity and water quality betterment	Potential for the intervention to provide creation of habitats and river restoration, as well as improving existing water quality.	
		-2	Significant detriment
		-1	Some detriment
		0	No perceived change
		1	Some betterment
7	Contribute towards amenity benefits	Potential for the intervention to improve the amenity value of the surrounding area.	
		-2	Significant detriment
		-1	Some detriment
		0	No perceived change
		1	Some betterment
8	Contribute to carbon reduction	Potential for the intervention to contribute towards carbon reduction via sustainable construction techniques or carbon sequestration from increased planting.	
		-2	Significant net carbon increase
		-1	Some net carbon increase
		0	Not known/no effect
		1	Some net carbon reduction
9	Maintenance	High level assessment of maintenance requirements.	
		-2	N/A
		-1	High cost/frequency maintenance, requires new and specialised maintenance routines
		0	Not known/no effect
		1	Low-cost maintenance, can be compelled as part of existing maintenance routines
10	Timescale		
		1	Long term strategic aim (>10yrs to progress, funding route unclear)
		2	
		3	Likely to be able to progress in next 1 - 5 yrs e.g. through FCERM partnership funding programme
		4	
11	Cost	High level assessment of cost of implementing	
		1	£>2m
		2	£1m to 2m
		3	£500k-£1m
		4	£100-500k
5	<£100k		

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