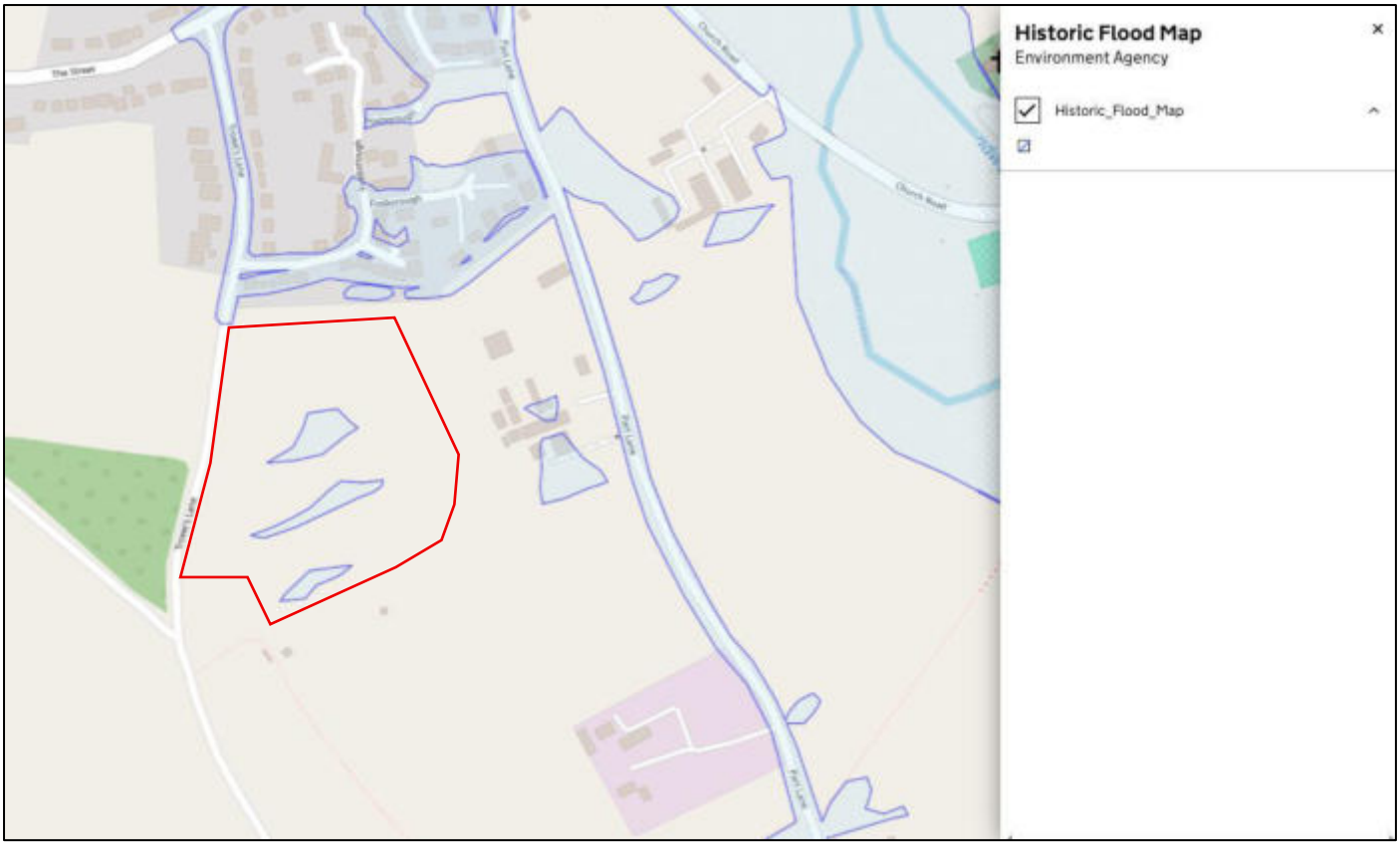
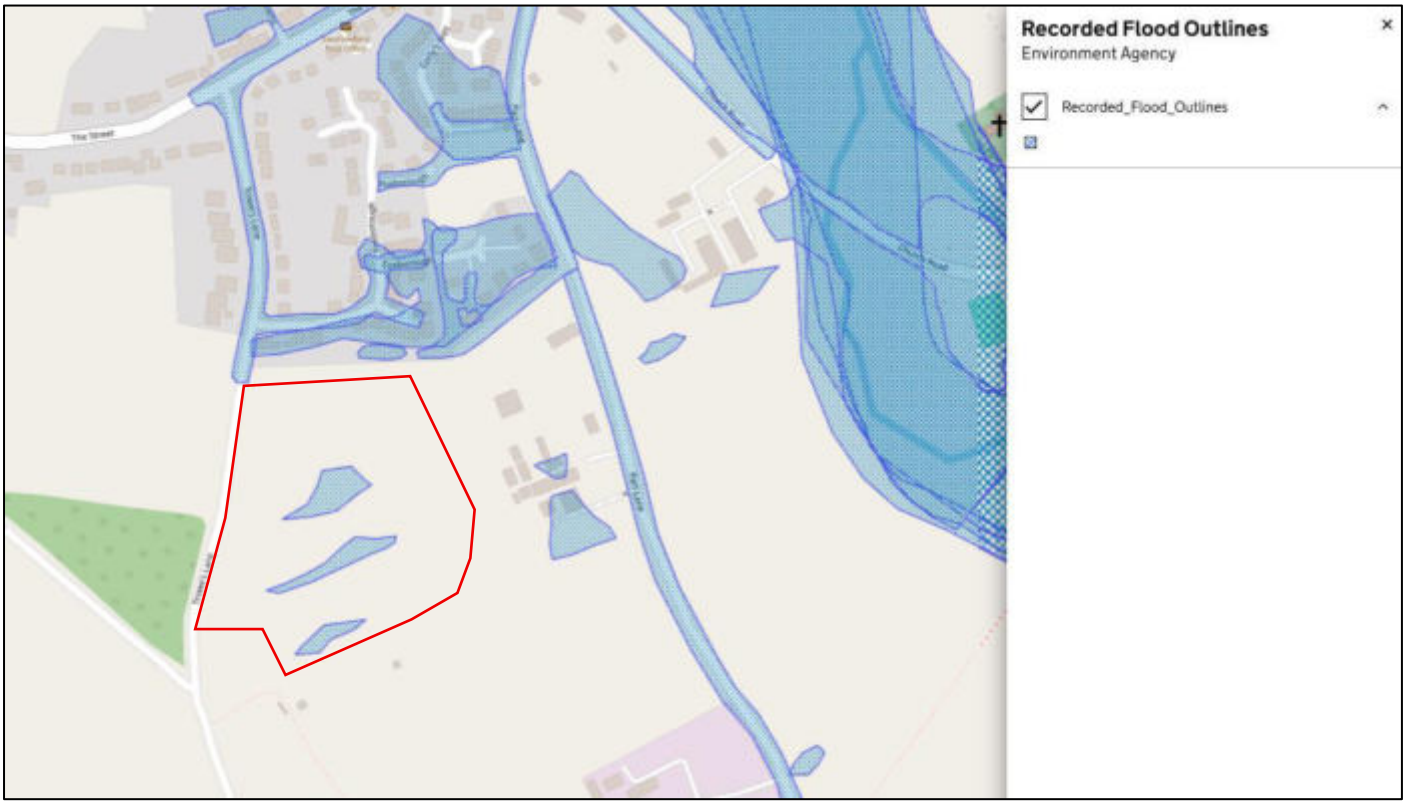
## Appendix I

Environment Agency Historic Flood Mapping and Recorded Flood Outlines

**159/2025: Land East of Trowe's Lane, Swallowfield, Reading, Berkshire, RG7 1RW**

**Environment Agency Historic Flood Mapping and Recorded Flood Outline Mapping**



## Appendix J

2013/2014 Flood Investigation Report

# WOKINGHAM BOROUGH COUNCIL FLOOD INVESTIGATION REPORTS

## WINTER 2013/2014

JANUARY 2016

WSP | PARSONS BRINCKERHOFF

# WOKINGHAM BOROUGH COUNCIL FLOOD INVESTIGATION REPORTS

## WINTER 2013/2014

**Wokingham Borough Council**

January 2016

**WSP | Parsons Brinckerhoff**
Mountbatten House
Basing View
Basingstoke
RG21 4HJ

Tel: +44(0) 1256 318 800
Fax: +44 (0) 1256 318 700
**www.wspgroup.com**
**www.pbworld.com**

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# EXECUTIVE SUMMARY

The flood event of winter 2013/14 covers the period from mid-December 2013 to early March 2014, during which time a number of areas in Wokingham Borough were affected by flooding as a result of prolonged, persistent and heavy rainfall. The scale and magnitude of the majority of the flooding could not have been predicted.

This report provides an investigation into the causes, mechanisms, consequences and responses associated with flooding in each of the affected areas within Wokingham Borough.

Between the beginning of September and the end of November 2014 research was undertaken across the borough, comprising interviews with Flood Wardens, Parish and Town Council representatives and affected residents, site surveys and analysis of data gathered by Wokingham Borough Council during the floods.

This research has enabled the production of a series of individual parish reports and maps, depicting the flooding experienced by each of the affected settlements in Wokingham Borough during the winter 2013/14 flood event. The supporting maps illustrate the affected properties, the approximate flood extents and the directions flood flows took through the town, village and / or parish.

The information obtained from this investigation has highlighted the need for the initiation of a number of general, borough-wide measures. These requirements range from better targeted and more regular maintenance of both public and private drainage systems, to gathering data on the condition of features and structures which help prevent flooding. A series of location-specific recommendations have also been proposed to help mitigate the impact of future flooding in each town and village. The recommendations cut across all flood risk management authorities, with the responsibility for delivery of each measure shown within the report.

Lessons have been learnt and Wokingham Borough Council is committed to ensuring work that communities are better able to mitigate and cope with future flood events.

# 1 INTRODUCTION

## 1.1 BACKGROUND

1.1.1 During winter 2013/14 much of the country was battered with heavy rain and winds, resulting in wide scale flooding. For the most part of 2013 rainfall totals were slightly below the long term average. However, from mid-December a succession of deep Atlantic low pressure systems caused torrential rain and strong winds. This extreme weather was fuelled by a powerful jet stream, causing it to continue throughout January and February. Areas in the south-east of the country received almost 2.5 times the volume of rainfall than expected over an average winter period. For the country as a whole, the winter, from the beginning of December until the end of February, was the wettest recorded in the UK since records began in 1766.

1.1.2 Between the 13th December and Christmas Day the total rainfall across Wokingham was up to 100mm in places, resulting in the River Loddon and the River Blackwater bursting their banks. The River Thames did not burst its banks in December as there was still capacity in the river system at this time.

1.1.3 Several dry days between Christmas and New Year allowed river levels to subside. This was followed by a second period of heavy rainfall around New Year and the first week of 2014, with rainfall totals between the 30th December and the 8th January averaging 90mm. Levels on the River Loddon rose again on New Year's Day but they did not exceed those reached over the Christmas period. Widespread property flooding was not repeated.

1.1.4 At the end of January, levels in the rivers began to slowly fall. However, heavy and sustained rainfall at the end of January and during the first week of February caused levels to rise once again. The unrelenting rainfall throughout January and February resulted in water levels on the Lower Thames reaching their highest level for more than 65 years.

1.1.5 The worst affected areas were those located close to the major rivers in the borough; the River Loddon, the River Thames and the River Blackwater. The river and groundwater levels in the catchments were high throughout the period. The repeated storms generated maximum levels on these rivers and other tributaries of the River Thames in Wokingham. This resulted in even more water being added to an already inundated Thames floodplain. The location of these rivers is illustrated in figure 70007120/1/101.

1.1.6 Figure 70007120/1/102 illustrates the areas affected by flooding during the winter 2013/14 flood event based on the total number of properties that suffered internal and/or external flooding across Wokingham.

## 1.2 PARISH FLOOD INVESTIGATION REPORTS

1.2.1 From a review of the reported flooding incidents a number of parishes were identified where property flooding had occurred. The Parish reports provide an account of how the flooding occurred, the impact of the flooding and potential measures to reduce the likelihood and/or impact of future flooding events.

1.2.2 It should be noted that much of the following record has depended upon anecdotal evidence from members of the public and potential solutions at this stage have been based upon site observations only. Prior to taking any recommendations forward, a feasibility study will be undertaken to verify the cause and effect of the flooding and the viability of solutions. For example, in cases where enlarging culverts has been discussed, this has been done in the context of relieving upstream flooding; no assessments have been made at this stage into the viability of these culverts (in terms of other services, ground conditions etc.) or into the downstream impacts of the resulting increased flow. In order to carry out works to erect or alter a culvert, consent from the Lead Local Flood Authority is required under Section 21 of the Land Drainage Act 1991.

1.2.3 The information contained in this document has been compiled for the guidance of Wokingham Borough Council Officers, as well as local residents, to provide information to the affected Parish Councils. Wokingham Borough Council does not accept any liability for any inaccuracies in the information contained in this document.

**Figure 1-1 Figure 70007120/1/101: Wokingham Borough Main River and Ordinary Watercourse Network**

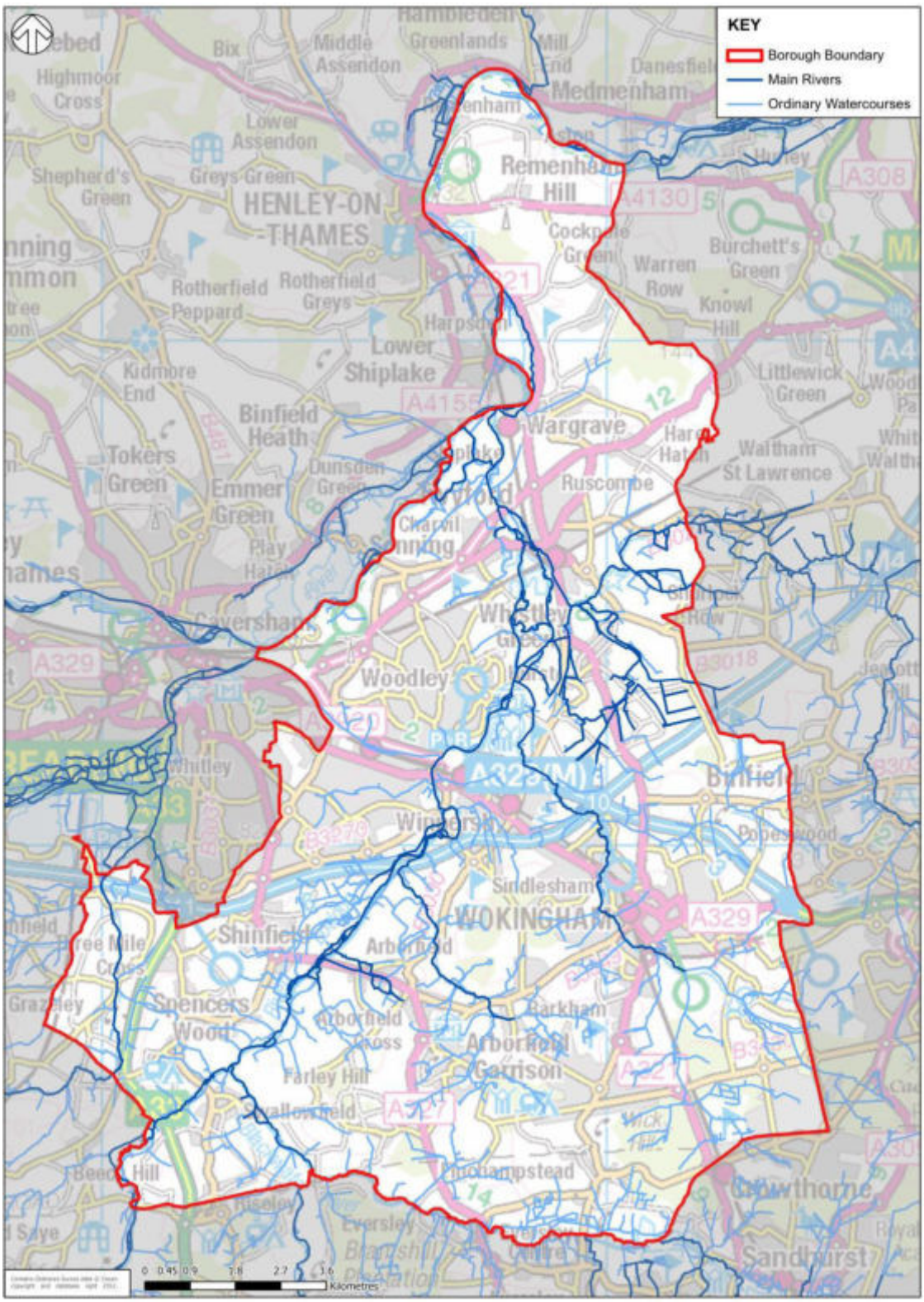
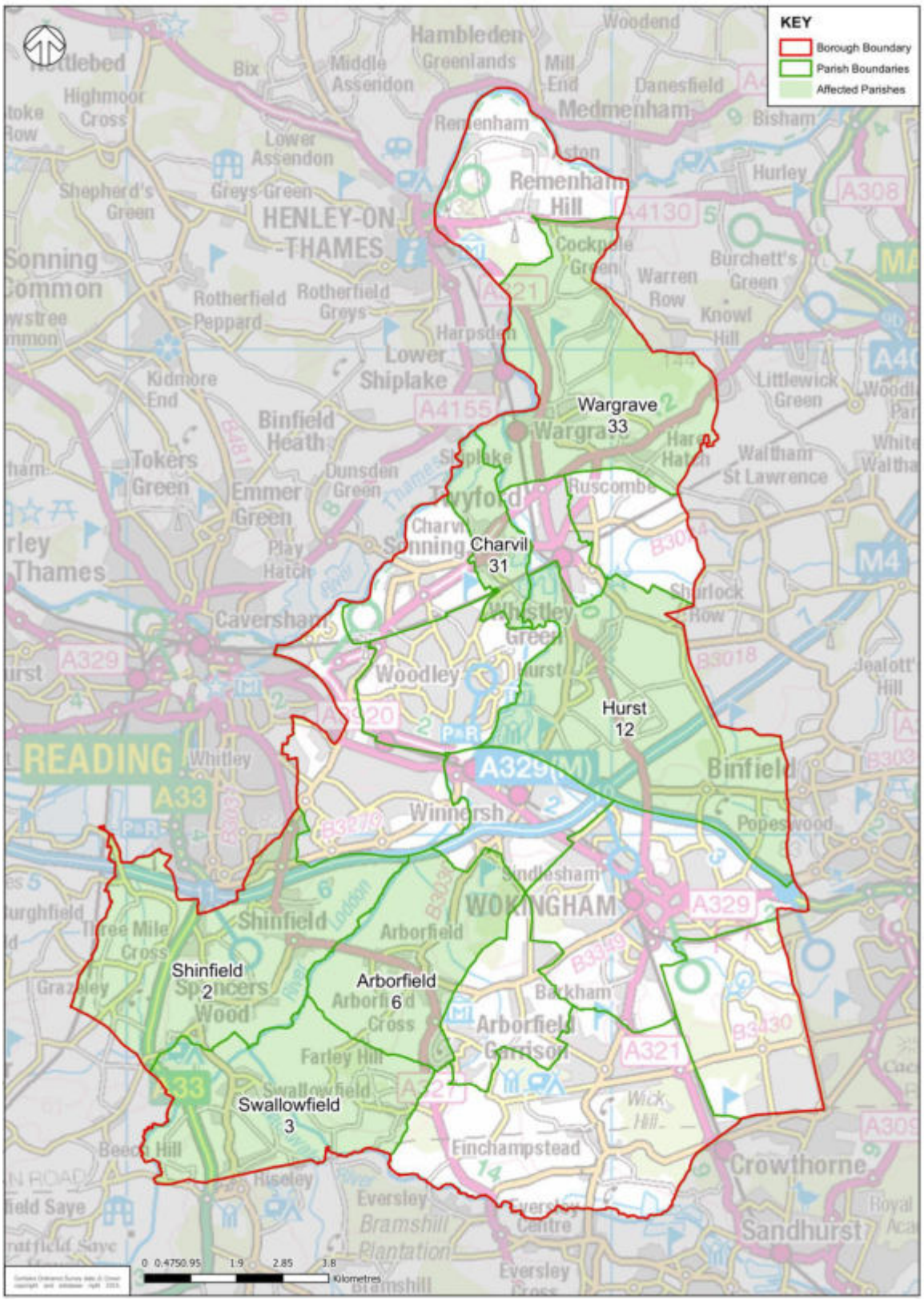


**Figure 1-2 Figure 70007120/1/102: Total Number of Internally Flooded Properties by Parish**



## 1.3 FLOOD RISK MANAGEMENT ROLES AND RESPONSIBILITIES

### WOKINGHAM BOROUGH COUNCIL

1.3.1 Wokingham Borough Council, as the Lead Local Flood Authority (LLFA), is responsible for taking the lead on managing flood risk from local sources. This includes surface water, groundwater and ordinary watercourses, including where an interaction between various sources results in river flooding. Under the Flood and Water Management Act 2010 the Council, as LLFA, has a duty to investigate and publish reports on flood events (to the extent it considers necessary) and to compile and maintain a register of structures and features that have a significant effect on flood risk. It also has responsibility for consenting third party works to ordinary watercourses.

1.3.2 The Council also has other related roles in planning and development control, public health, emergency planning and highway drainage.

1.3.3 Wokingham Borough Council is also the Highway Authority and has the following powers and duties:

- maintain highways, including ensuring that highway drainage systems are clear and that blockages on the highway are cleared;
- deliver works that they consider necessary to protect the highway from flooding, either on the highway itself or on land which has been acquired by the Highway Authority in the exercising of highway acquisition powers; and
- divert parts of watercourses or carry out any other works on any form of watercourse if it is necessary for the construction, improvement or alteration of the highway or provides a new means of access to any premises from the highway.

### ENVIRONMENT AGENCY

1.3.4 The Environment Agency is responsible for providing a national strategic overview of flooding from all sources (including rivers, surface water and groundwater). The Environment Agency is also responsible for managing flood risk from Main Rivers.

1.3.5 The Environment Agency has a key role in providing flood warnings to the public and in protecting and improving the natural environment.

1.3.6 The Environment Agency has permissive powers to reduce flood risk by undertaking work on Main Rivers and flood defence structures.

### THAMES WATER

1.3.7 Thames Water has responsibility for the public foul and surface water sewer systems in its ownership. Thames Water is also responsible for treating sewage from its foul network and to empty and dispose of the contents of their sewers. The Water Company has a general duty (under Section 94 of the Water Industry Act 1991) to provide, extend and improve public sewer systems, ensuring they are ‘effectively drained’.

1.3.8 Thames Water must also maintain a register (known as the DG5 Register) of flooding from sewers. The DG5 Register records information which is used to apply for investment funds from Ofwat to undertake improvements or repairs. Investment is agreed with Ofwat on a five year cycle referred to as Asset Management Periods (AMP). The current AMP runs from 2010-2015. The Investment plan for the next period 2015-2020 has been finalised and signed off by Ofwat.

### PARISH COUNCILS AND COMMUNITY EMERGENCY GROUPS

1.3.9 Parish Councils have no formal duties in the management of flood risk. However, Parish Councils can be instrumental in establishing local flood action groups and assisting in the development of Community Flood Plans as they typically have the local knowledge needed to help manage flood risk.

1.3.10 Parish Councils are encouraged to recruit Community Emergency/Flood Wardens, who can assist with the management of local flood risk by:

- working within their communities to prepare them for flooding and to develop flood resilience;
- receiving flood alerts/warnings from the Environment Agency directly and ensuring the community is aware of them;
- ensuring the community is aware of what the Environment Agency flood warnings mean, what people need to do and where further information can be obtained;
- assisting during floods by supporting people in the community;
- being a conduit for the flow of information between Wokingham Borough Council and the community;
- identifying vulnerable people within the community who may need special assistance during flood events;
- reporting blocked drains, ditches and other watercourse issues to the relevant authorities; and
- recording flooding incidents to assist with improving the Borough's knowledge for planning purposes

1.3.11 A number of informal Flood Wardens were operating in parts of the borough prior to the winter 2013/14 flood event, including in Swallowfield and Hurst. These communities have noted the advantages of such wardens, but there is a need to establish Flood Wardens in each parish affected by flooding to ensure all communities in the borough are effectively covered and that they work together.

### RIPARIAN LANDOWNERS

1.3.12 Landowners whose property is adjacent to a river, a stream or a ditch are likely to be 'riparian owners'. Riparian owners have a responsibility to maintain the bed and banks of any watercourse within or adjacent to their property, in most cases even if that watercourse is adjacent to a highway, and to ensure there are no obstructions to the natural flow of water.

### PROPERTY OWNERS

1.3.13 Responsibility for protecting property from flooding lies in the first instance with the property owner. Property owners whose home or business premises are located in areas known to be at risk of flooding should consider making their own flood defence preparations. Property owners also have a common law duty to mitigate their losses during a flood event.

## 1.4 TYPES OF FLOODING

### BACKGROUND

1.4.1 There are several forms of flooding that affect Wokingham Borough. A brief overview is provided below. It is however, important to emphasise that the causes of flooding are not always certain and cannot always be attributed to just one source of flooding.

## RIVER FLOODING

1.4.2 River flooding, also known as fluvial flooding, occurs when a river channel cannot accommodate the volume of water flowing into it, causing water to burst its banks onto the surrounding land or floodplains. These events normally follow an extended period of heavy rainfall and can usually be predicted by the Environment Agency and Met Office.

1.4.3 River flooding is attributed as a significant component of the flooding experienced in a number of settlements during the winter of 2013/14, including Wargrave, Shinfield and Charvil.

## SURFACE WATER FLOODING

1.4.4 Surface water flooding, also known as pluvial flooding or flash flooding, occurs when heavy rainfall generates runoff which flows over the ground and ponds in low lying areas. This type of flooding is usually short lived and associated with heavy downpours of rain. Surface water flooding is made much worse when the ground is already saturated and little rainfall can infiltrate. Often there is limited advance notice of surface water flooding; however, weather forecasts from the Met Office can give an indication of the flood risk.

1.4.5 During the winter 2013/14 surface water flooding affected a number of areas within the borough, including Swallowfield and Charvil.

## SEWER FLOODING

1.4.6 Sewer flooding occurs when a sewer network cannot cope with the volume of water entering it or when the pipes within the network become blocked. Due to the age of much of the sewer network it is also possible for groundwater to enter into it and surcharge its capacity.

1.4.7 Swallowfield and Hurst experienced sewer flooding during the winter 2013/14 flood event.

## GROUNDWATER FLOODING

1.4.8 Groundwater flooding occurs when water levels in the ground rise above the ground surface. Groundwater flooding occurs after long periods of rainfall and can last for several weeks or even months. The area's most at risk are often low-lying areas where the water table is more likely to be at a shallow depth in relation to the ground surface. Groundwater flooding can be predicted well in advance by the Environment Agency who monitor groundwater levels throughout the year. Groundwater flooding is not a common occurrence in Wokingham Borough.

1.4.9 During the winter 2013/14 flood event Swallowfield was the only parish to be affected by groundwater flooding; however high groundwater levels in parts of Wokingham contributed to other types of flooding.

## HIGHWAY FLOODING

1.4.10 Highway flooding is caused by heavy rainfall which, coupled with blocked drains, gullies or roadside ditches, causes water to pond within the highway.

## CLIMATE CHANGE

1.4.11 There is an increasingly large body of evidence indicating that periods of substantially heavier rainfall experienced in recent years are related to a changing climate. Although it is not possible to attribute single events to global warning because of the natural variation of the weather, extreme rainfall is consistent with the predictions for global warning, i.e. more frequent and intense rainstorms and many more days of heavy rainfall in the winter. Those residents that are

at risk of flooding may therefore be susceptible to more frequent and more severe flooding in future years as a result of climate change.

## 1.5 INVESTIGATIONS

### FLOOD WARDENS AND/OR PARISH & TOWN COUNCIL DETAILS

1.5.1 This report was prepared with the assistance and co-operation of Flood Wardens and/or Parish and Town Council representatives throughout Wokingham Borough. Table 1-1 details the affected parishes and the relevant contact(s) that assisted with the investigation.

1.5.2 A series of discussion points and questions were posed to the Parish and Town Councils by email, along with a request to meet with the relevant Flood Warden and/or Parish/Town Council representative. Meetings were arranged with each of the contacts to undertake a site walkover and discuss the flood event.

1.5.3 Much of the information in each of the investigation reports is based on the anecdotal information provided by Flood Wardens and Parish and Town Council representatives.

**Table 1-1 Parish Contact Details**

| | Parish/ Town | National Grid Reference | River valley | Primary source of flooding | Contact | Flood Warden/ Parish/Town Council representative/ Resident |
|---|---|---|---|---|---|---|
| 1 | Arborfield | | River Loddon | Sewage | Chris Danbury | Resident |
| | | | | | Lyn Bailey | Resident |
| | | | | | Beverly Bartlett | Resident |
| 2 | Swallowfield | | River Blackwater & River Loddon | Surface Water | Lee Atkins | Swallowfield Flood Resilience Group Representative |
| 3 | Shinfield | | River Loddon | Fluvial | Carole Headland | Resident |
| 4 | Charvil | | River Loddon & River Thames | Fluvial | Miranda Parker | Parish Council Representative |
| 5 | Hurst | | River Loddon | Fluvial | Ian Lucken | Resident |
| | | | | | Howard Larkin | Parish Council Representative |
| 6 | Wargrave | | River Thames | Fluvial | Gill van Zwanenberg | Resident |
| | | | | | Charles Sanderson | Resident |
| | | | | | Sarah Pomeranz | Resident |

### OTHER SOURCES OF INFORMATION

#### WOKINGHAM BOROUGH COUNCIL HIGHWAY MAINTENANCE OFFICERS

1.5.4 The Council's Highway Maintenance officers are responsible for inspecting and maintaining highway infrastructure in the borough. These officers visited a number of the affected locations during the winter 2013/14 flood event. The information they collected during these visits and their existing knowledge of the Borough has contributed to the preparation of this report. With their knowledge of the Borough and their experience during the emergency period, they were able to highlight problem areas and offer potential solutions.

#### WOKINGHAM BOROUGH COUNCIL EMERGENCY OPERATIONS CENTRE (EOC)

1.5.5 The EOC was operational throughout the winter 2013/14 flood event, during which period extensive records of complaints, service requests and flooded properties were logged. The EOC log was made available for this study and cross referenced against other data received, in particular that from the Parish and Town Councils.

### PHOTOGRAPHS

1.5.6 Photographs of the flooding throughout Wokingham Borough were obtained, including aerial photography of some of the worst affected areas along the River Loddon and River Thames. These photographs provided an insight into the extent of the flooding and gave an indication of how badly certain areas were affected.

## IMPACT AND EFFECT OF THE FLOODING

1.5.7 The winter 2013/14 flood event significantly impacted six parishes in Wokingham Borough, with six individual villages within these parishes experiencing internal and/or external property flooding. Several of the parishes which did not experience property damage experienced minor flooding of highways. This minor flooding is not discussed in this report.

1.5.8 The degree and extent of flooding experienced varied between locations, with some villages only suffering external flooding to a handful of properties, whilst others had a number of properties flooded internally to the extent that the residents had to leave their homes. When undertaking the site visits for this study between September and November 2014, approximately five houses were still uninhabited as a result of the damage caused by the flood water.

1.5.9 Further information on the effects and source of the flooding in each of the affected areas is provided in the individual parish reports.

1.5.10 Table 1-2 summarises the properties that flooded in each of the parishes and towns during the winter 2013/14 flood event.

**Table 1-2 Impact of Flooding in Each Parish**

| | Parish/Town | Total No. of properties flooded | No. of properties flooded internally | No. of properties flooded externally |
|---|---|---|---|---|
| 1 | Arborfield | 6 | 3 | 3 |
| 2 | Swallowfield | 3 | 0 | 3 |
| 3 | Shinfield | 2 | 2 | 0 |
| 4 | Charvil | 31 | 0 | 31 |
| 5 | Hurst | 12 | 8 | 4 |
| 6 | Wargrave | 34 | 27 | 7 |
| | **TOTAL** | **88** | **40** | **48** |

## EMERGENCY RESPONSE TO THE FLOODING

1.5.11 The emergency response to the flooding varied for each risk management authority and for each location. This section provides an overview of the types of response undertaken by each of the risk management authorities, with further details, specific to each location, provided in the parish reports.

### WOKINGHAM BOROUGH COUNCIL

1.5.12 Wokingham Borough Council's response primarily involved closing flooded roads that were impassable or worsening the flooding to properties alongside the highway and providing sandbags to at risk or affected residents. The Council also undertook work to clear blocked structures and alleviate flooding where possible through the use of pumps, as well as providing Portaloos to some residents unable to use their toilets due to sewage water backing-up. The activities were prioritised on a risk based approach.

### THE ENVIRONMENT AGENCY

1.5.13 The Environment Agency issued a number of fluvial flood alerts and warnings for areas of Wokingham. These warnings were issued in good time and those at risk were made aware.

1.5.14 Wokingham Borough Council has not been made aware of any other action taken by the Environment Agency during the winter 2013/14 flood event.

### THAMES WATER

1.5.15 Thames Water officers visited some of the affected villages / properties to assess the issues. A 'Sewer Flooding Questionnaire' was distributed to affected residents in Arborfield following the flood event; the purpose of which was not made clear to residents.

1.5.16 Wokingham Borough Council has not been made aware of any other action taken by Thames Water during the winter 2013/14 flood event in Wokingham.

## 1.6 RECOMMENDATIONS

1.6.1 Following analysis and consideration of the winter 2013/14 flood event, the following general recommendations should be considered in order to alleviate the risk of flooding in the Borough in the future. Specific recommendations have been made for each of the affected areas in the individual parish reports.

### MAINTENANCE

### PUBLIC SURFACE WATER SYSTEM

1.6.2 The agreement of Thames Water should be sought to their carrying out regular inspections and, where found necessary, cleansing of the public surface water system, particularly in areas known to be susceptible to flooding. Public Foul Water System

1.6.3 The agreement of Thames Water should be sought to their carrying out regular inspections, and where found necessary, repairs to the public foul water system, particularly in areas known to be susceptible to groundwater and surface water ingress.

### HIGHWAY DRAINAGE SYSTEM

1.6.4 Wokingham Borough Council should continue to provide and develop drainage cleansing services on a risk management basis in accordance with the Highway Maintenance Management 'Well Maintained Roads', July 2005.

### WATERCOURSES

1.6.5 Wokingham Borough Council should encourage local flood wardens and/or town/parish council members to undertake regular inspection of watercourses in their area and to report identified issues to Wokingham Borough Council for review and action where necessary.

1.6.6 Wokingham Borough Council should share / agree a register of critical watercourses and/or structures with local flood wardens and/or town/parish council members warranting regular inspection to ensure that ditches, ponds and watercourses in private ownership are properly maintained

1.6.7 There are also a number of structures associated with the watercourses in Wokingham that need to be regularly maintained to ensure they do not increase the risk of flooding in certain locations.

Wokingham Borough Council should liaise with the Environment Agency and landowners, where relevant, to ensure adequate maintenance is undertaken in relation to these structures.

## FLOOD ALLEVIATION WORKS AND PROPOSED DRAINAGE IMPROVEMENTS

1.6.8 A number of capital schemes are recommended for specific locations as detailed in the individual parish reports. These capital schemes are intended to help alleviate the risk of flooding in certain locations. These schemes range from re-profiling ditches, to installing property level protection measures.

1.6.9 Solutions at this stage are based upon site observations only. Prior to taking any recommendations forward, detailed studies will be required to ensure that solutions are technically, environmentally and economically sound. Studies will need to also be undertaken to determine the affordability and cost benefit of the various schemes. Where larger schemes affect assets owned by a number of stakeholders, a partnership approach should be explored to fund the optimum solution.

## PREPARATION FOR FUTURE EVENTS

1.6.10 Wokingham Borough Council could develop a list of critical trash screen and culvert locations to ensure screens on culvert entry and exit points and on balancing pond overflows are inspected and kept clear. Once the various locations are established, Wokingham Borough Council could contact the relevant Flood Warden / Parish Council representative to establish the condition / maintenance status of the trash screen and/or culvert. This information would enable the Council to proactively manage their flood response as opposed to reactively responding to calls once flooding has occurred.

# 2 ARBORFIELD

## 2.1 INTRODUCTION

2.1.1 The Parish of Arborfield is located in the south of Wokingham Borough, with the village of Arborfield located approximately 7km south-east of Reading and 6.4km west of the town of Wokingham. The National Grid Reference (NGR) for the Parish is (475500, 167500). The village is surrounded by open agricultural land, with the M4 located approximately 2km to the north-west of the village. The topography of the village slopes gently from east to west, falling towards the River Loddon, which is located approximately 750m to the west.

2.1.2 The Barkham Brook (designated as Main River) flows through the parish of Arborfield. In addition a number of the roadside ditches within the village were designated as Main River following the 2000 floods, as they are critical watercourses. No named ordinary watercourses flow through Arborfield village itself; however there are a series of surface water drainage ditches and highway drainage ditches.

2.1.3 In the winter of 2013-14 the village suffered flooding as a result of groundwater flooding and foul sewer flooding. A number of properties and roads also experienced surface water flooding as a result of high groundwater levels which reduced the volume of water that was able to infiltrate into the surrounding fields, resulting in overland flows.

2.1.4 Three properties suffered flooding to internal areas, as a result of groundwater and sewer flooding. An additional three properties suffered external flooding as a result of overland flows. Reading Road (A327) was flooded in several locations. Drawing No. 70007120/01/101 identifies the flooded properties, the approximate flood extents and overland flows routes through the village during this event.

## 2.2 FLOODING IN ARBORFIELD

### GROUNDWATER FLOODING

2.2.1 High groundwater levels in the area surrounding Arborfield during the winter 2013-14 resulted in a series of overland flow paths in and around the village. These flow paths emerged to the east of the village and flowed in a westerly direction, following the general topography of the village. In addition to these overland flow paths, a number of drainage ditches are situated in and around Arborfield, including two which run either side of Reading Road (A327) (designated as Main River). Anecdotal evidence suggests the high groundwater levels meant these ditches were unable to cope with the high volume of water during the winter 2013-14 flood event.

2.2.2 With roadside drainage ditches at capacity, a significant volume of water was channelled along Reading Road (A327) towards Church Lane. This water flowed into Church Lane, collecting in a low point within 200m of the Reading Road junction. This flood water covered the road from the junction with Reading Road to the point at which Church Lane turns to run to the east. The maximum depth of the flood water was approximately 600mm.

2.2.3 A second overland flow path ran along Church Lane from the east. The water flowed in a westerly direction and added to the volume of water collecting in the first 200m stretch of the highway (from the Reading Road junction). Water also flowed across the field to the east of Church Lane, further contributing to the flood water in this area. A drainage ditch cuts across this field, flowing north-west from Reading Road (A327) (this ditch is designated as Main River). High groundwater levels prevented this ditch from effectively draining the area. This section of Church Lane was partially flooded from the beginning of February through to March 2014.

2.2.4 A drainage ditch (designated as Main River) also runs immediately adjacent to the eastern side of the initial 200m of Church Lane. Prior to the flood event this channel was clear; during the event it became partially silted and blocked with vegetation and debris. The ditch is approximately 600mm deep when cleared. The falls on the ditch mean water drains towards the middle of Church Lane and is therefore not able to flow away from the local properties. This ditch did not therefore help alleviate the flooding during February and March 2014.

2.2.5 The majority of surface water from the section of Church Lane running from west to east is channelled to the River Loddon by a series of pipes, culverted channels and ponds. The surface water pipe network conveys flows to the first pond, located within the grounds of Lavender Cottage. This pipe network is 225mm in diameter. Water then flows in a 225mm diameter culvert beneath the road, before passing along an open channel through the grounds of Rose Cottage. Historically, the water flowed beneath the garden of Rose Cottage in the pipe network. Over time this pipe become badly damaged and stopped functioning effectively. The owners of Rose Cottage had the channel dug through the garden in order to minimise flooding to the garden. Since construction of the channel approximately 10 years ago, it has served to prevent flooding of the garden. This channel passes back into culvert (225mm in diameter) beneath Jakanora, before flowing into the second, larger pond. From this pond, the water is channelled to the River Loddon.

2.2.6 The flood water on Church Lane flooded external areas of the three properties fronting the road; Hamilton Lodge, Badger Wood and Merrie Bells. Sandbag walls were constructed across the entrance to the driveways of Hamilton Lodge and Badger Wood in an attempt to prevent water flowing into the external areas of the properties. The flood water breached the sandbags and flooded the front gardens and driveways of these properties to a depth of approximately 150mm. Merrie Bells was also flooded externally, with the flood water surrounding the property. Water did not enter internal areas of any of these three properties.

2.2.7 Arborfield Grange is situated to the west of Church Lane and is split into a number of flats. The ground floor flats are approximately 600mm below the surrounding ground level. Groundwater rose up through the floor of No. 2 and No.3 Arborfield Grange on the 2nd February. Both properties have a sunken patio area, accessed by French doors. Groundwater rose and collected in these areas and entered the properties via the French doors, adding to the groundwater flooding inside the properties. The flood water was approximately 50mm deep inside the properties. The water level receded after 24 hours and did not rise to a level resulting in internal flooding for a second time.

2.2.8 Further west along Reading Road, surface water flooding resulted in the road being closed in early February as the depth of water made it impassable. Reading Road was also closed to the west of the village, again as a result of the depth of surface water flooding on the road.

## SEWER FLOODING

2.2.9 A number of properties to the north of Reading Road (A327) have historically suffered from issues with public foul water sewers in the area. These sewers are understood to be around 150 years old and subject to groundwater ingress. As a result, when the groundwater table is high, groundwater ingresses into the pipe network and surface water/overland flows enter the system via the manhole covers. At times of heavy rainfall, this results in the foul system becoming inundated. During the winter 2013-14 flood event, residents observed manhole covers in Church Lane being forced open by flows from the sewers as a result of the high volume of water in the system.

2.2.10 The Thames Water Arborfield Pumping Station is located immediately west of Church Lane, adjacent to Reading Road (A327). This pumping station serves the sewage network in Church Lane and is understood to direct flows to the Thames Water Sewage Treatment Works at Farley Hill. A number of properties to the north of Reading Road (A327), in the vicinity of Church Lane, experience sewage water back-up when the Arborfield Pumping Station stops operating. It is not understood whether the pumping station stops working due to a level based cut-off, a trip-switch linked to the volume being pumped, or simply the pump being inadequate to pump significant volumes for sustained periods (as a result of groundwater ingress).

2.2.11 In early February the pumping station stopped operating and a number of the properties in Church Lane experienced sewage water back-up, meaning they were unable to use toilets, showers etc. The cease in pumping resulted in Arborfield House suffering internal flooding, with sewage water rising to a depth of approximately 150mm inside the property. As a result of the flooding, Thames Water fitted a non-return valve on the pipeline leading from the property. This valve has not yet been tested.

2.2.12 No. 2 and No. 3 Arborfield Grange also experienced visible foul water back-up, with foul water emerging from the bath plug hole. This water did not flood internal areas of the properties. Arborfield Grange has a non-return valve fitted on the foul pipe leading from the property. This valve was fitted prior to the winter 2013-14 flood event; however it did not serve to prevent foul water backing-up in these properties during the flood event.

## 2.3 SUMMARY OF ARBORFIELD FLOODING

2.3.1 Arborfield was affected by groundwater and foul water flooding during the winter 2013-14 flood event. High groundwater in the vicinity of the village resulted in surface water flooding on a number of the roads in the village. Information on the adequacy of the foul drainage network in the vicinity of Arborfield has not been made available to inform this study.

## 2.4 RISK MANAGEMENT AUTHORITY RESPONSES

### WOKINGHAM BOROUGH COUNCIL EMERGENCY RESPONSE

2.4.1 Wokingham Borough Council undertook clearing and jetting of a number of gullies in and around Arborfield during the flood event in order to reduce flood water collecting on the highways.

2.4.2 The Council also provided sandbags to a number of properties in Arborfield following requests from residents.

### WOKINGHAM BOROUGH COUNCIL HIGHWAY AUTHORITY

2.4.3 Wokingham Borough Council regularly undertakes maintenance to the highway drainage network. The Highway Department undertook general clearing and gulley maintenance along the Reading Road (A327) on in May 2013 and November 2013, prior to the winter 2013-14 flood event.

2.4.4 Wokingham Borough Council has undertaken jetting works to the culvert in the vicinity of Arborfield during January and February 2015 following requests from residents.

### ENVIRONMENT AGENCY

2.4.5 The Environment Agency issued a Flood Warning to areas of Arborfield on 24 December 2013; this warning was removed on the 27 December 2013. A second Flood Warning was issued on the 4 January 2014 and removed on the 10 January 2014.

2.4.6 A Flood Alert was issued for the length of the River Loddon, including Arborfield, on the 25 April 2014; this alert was removed on 4 May 2014.

2.4.7 Wokingham Borough Council has not been made aware of any further action taken by the Environment Agency.

### THAMES WATER

2.4.8 A Thames Water officer visited Arborfield House whilst the property was flooded and recommended that a tanker be deployed to the property to clear the sewage water flooding internal areas of the house. A tanker was not deployed and Thames Water did not assist the residents of the property any further.

2.4.9 Wokingham Borough Council has not been made aware of any works to clean up areas affected by foul water flooding in Arborfield, either during or following the flood event.

2.4.10 The residents of Arborfield House were sent a 'Sewer Flooding Questionnaire' following the flood event, which they completed and returned. A second questionnaire was then sent to the residents a few months later, despite completion of the first. The residents have not received a response following the submission of either of the questionnaires.

2.4.11 Wokingham Borough Council is not in possession of information regarding the maintenance undertaken at the Arborfield Thames Water Pumping Station and to the foul network in Arborfield prior to the winter 2013-14 flood event.

2.4.12 Thames Water has stated that none of their Pumping Stations in the Borough failed during the winter 2013-14 flood event. This statement conflicts with the information received from residents in Arborfield and the remedial actions undertaken by Thames Water following the flood event.

## 2.5 RECOMMENDATIONS

2.5.1 In order to reduce the risk of flooding in Arborfield the following measures should be considered. These recommendations are grouped according to relevant Risk Management Authorities and local stakeholders.

### RIPARIAN OWNERS

2.5.2 The various ditches and gullies in and around Arborfield need to be regularly maintained to ensure they remain free from excess silt build up and vegetation.

2.5.3 The inlets and outlets of both ponds in the vicinity of Church Lane should be regularly checked and maintained to ensure they do not become blocked and cause flood issues upstream.

### PARISH COUNCIL

2.5.4 It is recommended that the Parish Council recruit a Flood Warden(s) for Arborfield, who can help manage local flood risk by:

2.5.5 working within the community and riparian owners to prepare them for future flooding and to develop flood resilience;

2.5.6 receiving flood alerts/warnings from the Environment Agency directly and ensuring the community is aware of them;

2.5.7 ensuring the community is aware of what the Environment Agency flood warnings mean, what people need to do and where further information can be obtained;

2.5.8 assisting during floods by supporting people in the community;

2.5.9 being a conduit for the flow of information between Wokingham Borough Council and the community;

2.5.10 identifying vulnerable people within the community who may need special assistance during flood events; and

2.5.11 reporting blocked drains, ditches and other watercourse issues to the relevant authorities.

## WOKINGHAM BOROUGH COUNCIL

2.5.12 Wokingham Borough Council should determine the riparian ownership of the first pond to ensure this pond is effectively maintained.

2.5.13 Wokingham Borough Council should investigate the potential to install groundwater telemetric monitoring to provide residents with warnings when groundwater levels are rising and when there is a risk of flooding from groundwater.

## THAMES WATER

2.5.14 The feasibility and benefits of lining the foul network should be established, and if viable, this action should be undertaken in the village by Thames Water to help reduce the incidence of sewage water backing-up and surcharging from manholes. In the interim the potential to fit further properties with non-return valves should be investigated.

2.5.15 The potential for increasing the wet well at the Thames Water Arborfield Pumping Station should be investigated to determine whether this well can feasibly provide additional capacity.

# 3 SWALLOWFIELD

## 3.1 INTRODUCTION

3.1.1 The Parish of Swallowfield is located in the south-west of Wokingham Borough, alongside the Borough boundary. The National Grid Reference (NGR) for the Parish is (472500, 164500). The Parish includes the villages of Swallowfield, Riseley and Farley Hill, along with the hamlet of Stanford End. Both Swallowfield and Riseley suffered flooding in winter 2013-14.

3.1.2 The village of Swallowfield is located approximately 8km south of Reading and 1.6km north of the County boundary with Hampshire. The village is surrounded by open agricultural land, with the River Loddon and the River Blackwater flowing to the west and east of the village, respectively. The A33 is located approximately 500m to the west of the village. Riseley village is approximately 1.5km to the south-west of Swallowfield, alongside the A33 (known locally as the Swallowfield Bypass).

3.1.3 The topography of the surrounding land slopes gently from the A33, falling to the east and north-east, towards the River Blackwater. There are no formal watercourses flowing through Swallowfield or Riseley; however there are a series of surface water drainage ditches and highway drainage ditches which are key in channelling surface water flows through and away from the villages.

3.1.4 In the winter of 2013-14 Riseley suffered flooding from surface water runoff, predominantly linked to the A33. Swallowfield village suffered flooding from three sources: surface water runoff from surrounding farmland; sewage water from the surcharging Thames Water foul network; and river flooding from both the Loddon and Blackwater. Groundwater levels in and around the parish were also high during winter 2013-14, exacerbating the flooding in the villages.

3.1.5 No properties in Swallowfield suffered flooding to internal areas of their property; however six suffered external flooding. Highway flooding was evident across much of the parish, but particularly along Church Road, Part Lane and The Street. Drawing No. 70007120/02/101 identifies the flooded properties, the approximate flood extents and the directions overland flows took through the village.

## 3.2 FLOODING IN SWALLOWFIELD

### SURFACE WATER AND FLUVIAL FLOODING

3.2.1 Swallowfield typically suffers from surface water flooding as a result of runoff from land to the west of the village during times of prolonged heavy rainfall. As a result of previous flood events both the Parish Council and Swallowfield Flood Resilience Group (SFRG) had been proactive in working with landowners and residents to clear the drainage ditches and balancing ponds in and around Swallowfield, in an effort to channel the surface water away from the village.

3.2.2 To the south of the village centre, surface water runoff is dealt with by a network of field drains and ditches, which connect to the River Blackwater. During the winter 2013-14 flood event a significant volume of surface water flowed off the fields to the west and was drained to the River Blackwater via this system.

3.2.3 The first formal ditch into which runoff is channelled is the land drainage ditch to the west of Oakleigh Farm (known locally as the 'Naylors Ditch'). This ditch has been re-profiled in the past and is consequently of a significant depth in comparison to typical land drains. The ditch runs east from Trowe's Lane to Oakleigh Farm; on reaching the farm it turns to flow north towards Swallowfield before continuing east to Part Lane. This ditch feeds into the surface water drainage system beneath Part Lane. Once in the Part Lane surface water drain, the water flows south and is fed into the Brookside Nursery Ditch, which discharges to the River Blackwater.

3.2.4 A relief ditch (known locally as 'Pigeon Ditch') has been dug to the south of Oakleigh Farm, which allows excess water to bypass Oakleigh Farm and join the Part Lane surface water drainage system to the south of the farm. From this point, the water flows in a northerly direction to meet the entrance to the Brookside Nursery ditch.

3.2.5 Both the Pigeon Ditch and the Naylors Ditch are frequently maintained by the Parish Council and landowners. The Brookside Nursery Ditch is maintained by the Environment Agency. Members of the SFRG clear the entrance to this ditch when required.

3.2.6 A significant volume of water was seen to be channelled via these ditches during the winter2013/14 flood event. All but the Brookfield Nursery Ditch contained the flows.

3.2.7 The Brookfield Nursery Ditch discharges into the River Blackwater, just south of the Church Road Bridge. The significant volume of water discharging from this ditch during the winter 2013-14 flood event contributed to the water level in the river exceeding the span of the bridge. This resulted in water backing up along the ditch, and spilling over onto Church Road. This caused external flooding to Brookfield Nursery and the two residential properties to the north-west of the bridge.

3.2.8 In addition to the surface water drain beneath Part Lane, an open field ditch was dug in the field to the east of Part Lane prior to the flood event in an attempt to try and improve surface water drainage in this part of the village. This ditch flows from north of Oakfield Farm and discharges to the Brookside Nursery Ditch.

3.2.9 Further north surface water flows from the village are channelled to the Swallowfield Park Ditch, which runs from the junction of Church Street and The Street to the River Blackwater. Presently the ditch flows to the south of the Swallowfield Park drive, discharging into the River Blackwater upstream of the Pitt Bridge. During the winter 2013-14 flood event the water in the river exceeded the span of the bridge and spilled out of bank. The field to the south of the drive for Swallowfield Park was completely flooded; however the field to the north remained dry due to the driveway forming a barrier and the reduced volume of water passing beneath Pitt Bridge. The velocity and volume of water in the river damaged the structure of the bridge.

3.2.10 In order to regulate surface water flows the village is served by a number of balancing ponds. These ponds were seen to be at capacity throughout the winter 2013-14 flood event, but did not flood. The ponds were all well maintained prior to the event by the parish council, SFRG and local residents.

3.2.11 To the west of the village, the surrounding topography results in surface water flows from the fields to the west flowing onto the B3349. This water is then channelled along the B3349, before flowing down Swallowfield Street, resulting in flooding of the highway. The junction of the B3349 and Swallowfield Street flooded in late December, along with an area of Swallowfield Street.

3.2.12 To the north of the village the River Loddon came out of bank and flooded the fields to the east and west of the watercourse. This flood water did not cause flooding to any properties or highways.

### SEWER FLOODING

3.2.13 Swallowfield is served by Thames Water's foul drainage network, with two pumping stations located in the village. One of these pumping stations (situated next to the Village Hall) is owned and operated by Thames Water. The second, built in 1994 to serve new development in the village, is still owned by Linden Homes and pumps foul flows from the development to the Thames Water pumping station. It is understood this pumping station will imminently be adopted by Thames Water.

3.2.14 Historically sewage water flooding has affected large areas of Swallowfield, with sewage back-up a common occurrence following periods of heavy rainfall. Prior to the winter 2013-14 flood event, the pumps at the Thames Water pumping station were upgraded in an effort to reduce the occurrence of sewage flooding in the village. The capacity of the pumping station remains limited however, due to the size of the outlet and rising main. In previous correspondence with the Swallowfield Parish Council, Thames Water has stated that this outlet cannot be upgraded due to the 3km of pipe that would need to be replaced.

3.2.15 As a result of this limited capacity, many households throughout Swallowfield suffered blocked lavatories and non-flowing waste water drainage during the winter 2013-14 flood event, despite the upgrade of the pumps.

3.2.16 Foul water mixed with flood water on Swallowfield Street, The Street and Part Lane. Once the flood water had receded a considerable amount of sewage debris was left on the roads, which Wokingham Borough Council Environmental Health department, the Parish Council and residents worked to clear.

## 3.3 SUMMARY OF SWALLOWFIELD FLOODING

3.3.1 The Swallowfield Flood Resilience Group has worked extremely hard in the years since the flooding in 2007 and Wokingham Borough Council believe that the Groups' efforts helped protect the village from significant flooding during the 2013/14 event.

3.3.2 Ingress of surface water and groundwater into the Thames Water foul network resulted in sewage flooding in the village. It is understood the surface water drainage ditches in Swallowfield village were well maintained prior to the flood event. The condition of the River Loddon, River Blackwater and Thames Water sewer network in Swallowfield prior to the winter 2013-14 flood event has not been made available to inform this study.

## 3.4 RISK MANAGEMENT AUTHORITY RESPONSES

### WOKINGHAM BOROUGH COUNCIL

3.4.1 Wokingham Borough Council Environmental Health department assisted with the clearing of sewage debris on Swallowfield Street, The Street and Part Lane, following the sewage flooding.

3.4.2 Given the history of flooding in the area a number of gullies in Swallowfield are maintained on a 6 monthly basis, including Church Road, Swallowfield Street, The Street, Part Lane and the Basingstoke Road. Gullies in these roads were emptied in May and November 2013. All other adopted highways in Swallowfield are emptied annually.

3.4.3 Officers from Wokingham Borough Council were in regular contact with the Flood Resilience Group during the event and the Gully emptier attended the Swallowfield area on 10 occasions to assist with blocked drains and ditches during the floods. The council responded to all requests for Sandbags in the area and inspected the section of Church Road in Swallowfield to check flood depths to see whether a road closure was necessary.

### ENVIRONMENT AGENCY

3.4.4 The Environment Agency issued a Flood Warning for the River Loddon and the River Blackwater at Swallowfield on the 4 January 2014; this warning was removed on the 5 January 2014. A Flood Alert was issued for the length of the River Loddon, including Swallowfield, on the 25 April 2014; this alert was removed on the 4 May 2014.

3.4.5 Wokingham Borough Council is not in possession of information regarding the maintenance undertaken by the Environment Agency on the Main Rivers within the vicinity of Swallowfield prior to the winter 2013-14 flood event.

3.4.6 Wokingham Borough Council has not been made aware of any further action taken by the Environment Agency.

### THAMES WATER

3.4.7 Wokingham Borough Council has not been made aware of any works undertaken by Thames Water in Swallowfield during the winter 2013-14 flood event.

3.4.8 Wokingham Borough Council is not in possession of information regarding the maintenance undertaken at the Swallowfield Thames Water Pumping Station and to the foul network in Swallowfield prior to the winter 2013-14 flood event.

## 3.5 RECOMMENDATIONS

3.5.1 In order to reduce the risk of flooding in Swallowfield the following measures should be considered. These recommendations are grouped according to relevant Risk Management Authorities and local stakeholders.

### RIPARIAN OWNERS

3.5.2 The maintenance and vegetation clearance works undertaken by the Parish Council, SFRG and local residents prior to the winter 2013-14 flood event helped ensure drainage ditches and balancing ponds were kept clear and had the maximum capacity possible during the flood event. It is recommended this valuable work is continued. In addition, it is suggested that regular liaison is established between residents undertaking the works and Wokingham Borough Council / Environment Agency to ensure all bodies undertaking flood alleviation and drainage work within the village are aware of previous works and the timeframes of other bodies.

### WOKINGHAM BOROUGH COUNCIL

3.5.3 It is recommended that an investigation is completed to determine the feasibility of allowing the Swallowfield Park Ditch to pass beneath the drive for Swallowfield Park, meaning the outfall from the ditch would be downstream of the Pitt Bridge. The potential for features such as a number of small culverts under the drive should be considered to enable the ditch to pass beneath the road. The impact on the downstream flood risk should be considered. Alternatively, the possibility of formalising the field upstream of the Pitt Bridge as a flood alleviation area should be established. This may help control the flood water in this area.

3.5.4 The feasibility of establishing a formal attenuation area in the field to the south of Brookfield Nursery should be investigated. This attenuation area could be used to store surface water flows from the Brookfield Nursery Ditch, helping to prevent this channel from backing up and flooding properties to the north of the ditch and Church Road.

## THAMES WATER

3.5.5 It is recommended that Thames Water seal the manhole covers in Swallowfield to prevent the ingress of flood water into the foul sewer system in this area and hopefully sustain capacity for longer during future flood events.

3.5.6 The potential for increasing the wet well at the Thames Water Pumping Station should be investigated to determine whether this well can feasibly provide additional capacity for Swallowfield and help relieve sewage issues in the village following periods of heavy rainfall.

3.5.7 In addition to investigating the potential for increasing the wet well, the feasibility of providing a second outfall and parallel rising main from the pumping station should be determined in order to increase the capacity of the pumping station and reduce the incidences of sewage back-up and sewage flooding in Swallowfield.

# 4 SHINFIELD

## 4.1 INTRODUCTION

4.1.1 The Parish of Shinfield is located in the south-west of Wokingham Borough, alongside the Borough boundary with West Berkshire. The National Grid Reference (NGR) for the Parish is (473500, 168500). The parish includes the villages of Three Mile Cross, Spencers Wood and Shinfield. Shinfield was the only village of the three affected by flooding during the winter 2013-14 flood event.

4.1.2 The village of Shinfield is located approximately 5km south-east of Reading and 4km east of the Borough boundary. The village is 0.5km south of the M4 motorway, which passes along the northern boundary of the parish. The A33 passes through the centre of the parish, from north to south.

4.1.3 Shinfield village is surrounded by open agricultural land. The Foudry Brook flows from south to north through the western area of the parish and the River Loddon flows from the south-west, along the south-eastern boundary.

4.1.4 The topography of the village slopes gently from north-west to south-east, with a very slight fall towards the River Loddon. There are no formal watercourses flowing through the village; however there are a series of surface water drainage ditches and highway drainage ditches which are key in channelling surface water flows from within the village and the surrounding area.

4.1.5 Two properties experienced internal flooding during the winter 2013-14 flood event as a result of water flowing out of bank from the River Loddon. No further properties in Shinfield experienced external and/or cellar flooding. Highway flooding was evident across the parish, but particularly along the A327 Arborfield Road between the villages of Shinfield and Arborfield. Drawing No. 70007120/03/101 identifies the flooded properties, the approximate flood extents and the directions overland flows took through the village.

## 4.2 FLOODING IN SHINFIELD

4.2.1 The River Loddon burst its banks in the week before Christmas 2013 and flowed across the fields to the south-east of the village towards the village (refer to drawing no. 70007120/03/101). These fields, and the fields to the east and north-east of the village, constitute the floodplain for the River Loddon.

4.2.2 The flood water continued to flow north onto the A327 Arborfield Road and collected on the road surface to a depth of approximately 0.5m. At the peak of the flood event the depth of this flood water meant the road was only accessible to 4x4 type vehicles.

4.2.3 The A327 Arborfield Road was not closed during the flood event and vehicles continued to use the route. This resulted in a number of vehicles getting stuck in the flood water as well as large bow waves being created by the flooding.

4.2.4 The River Loddon also burst its banks to the north of the A327 Arborfield Road, with a significant volume of water flowing towards the road from the north-east. This flood water did not reach the road (refer to drawing no. 70007120/03/101).

4.2.5 The two properties that flooded in Shinfield are situated on the A327 Arborfield Road; the Magpie and Parrot and No. 20 (refer to drawing no. 70007120/03/101). The Magpie and Parrot public house first suffered internal flooding in the winter of 1999, and has since flooded internally on a number of occasions.

4.2.6 As a result of the previous floods, the property owners installed demountable flood defence across the entrance to the car park of the property in 2009. These defences have served to prevent internal flooding to the property since installation. However, during the winter 2013-14 flood event the flood defences were damaged as a result of a vehicle reversing into the barrier, and water was able to flow into the front garden and car park of the pub. This flood water entered internal areas of the pub, flooding three of the ground floor rooms to a depth of approximately 100mm. The three flooded rooms are approximately 150mm lower than the main bar area, which remained dry during the flood event.

4.2.7 The demountable flood defences across the entrance to the car park of the property have been repaired since the winter 2013-14 flood event.

4.2.8 Flood water also rose in the rear garden of the Magpie and Parrot. Anecdotal evidence indicates this water was initially rising groundwater followed by fluvial water from the River Loddon. The rising groundwater flows through the permeable sediments of the floodplain. These sediments provide a subsurface route for flood waters to bypass higher ground along the banks of the river, which would otherwise protect these areas. The flood water rose to approximately 10m from the rear of the pub, but did not reach the pub. Historically this water has risen in the garden, but never comes closer than approximately 10m from the property.

4.2.9 No. 20, A327 Arborfield Road experienced internal flooding as a result of flood water from the River Loddon flowing across the field to the south of the property. This flood water rose in the rear garden of the property, before entering the property via the rear access. The flood water is understood to have flooded the downstairs rooms to a depth of 100mm.

## 4.3 SUMMARY OF SHINFIELD FLOODING

4.3.1 Shinfield was affected by Main River flooding as a result of the River Loddon coming out of bank to the south-east and north-east of the village. Areas alongside the River Loddon were also affected by groundwater rising up through the permeable sediments associated with the floodplain.

## 4.4 RISK MANAGEMENT AUTHORITY RESPONSES

### WOKINGHAM BOROUGH COUNCIL

4.4.1 Wokingham Borough Council was not made aware of the need for emergency response in Shinfield during the winter 2013-14 flood event.

### ENVIRONMENT AGENCY

4.4.2 The Environment Agency issued a flood warning for the River Loddon at Shinfield on the 24 December 2013. This warning was removed on the 27th December 2013. A second flood warning was put in place on 4 January 2014 and was removed on 10 January 2014.

4.4.3 Wokingham Borough Council is not in possession of information regarding the maintenance undertaken by the Environment Agency on the Main Rivers within the vicinity of Shinfield prior to the winter 2013-14 flood event.

4.4.4 Wokingham Borough Council has not been made aware of any further action taken by the Environment Agency.

### THAMES WATER

4.4.5 Wokingham Borough Council has not been made aware of any works undertaken by Thames Water in Shinfield, either during or following the flood event.

## 4.5 RECOMMENDATIONS

4.5.1 In order to reduce the risk of flooding in Shinfield the following measures should be considered. These recommendations are grouped according to relevant Risk Management Authorities and local stakeholders.

### RIPARIAN OWNERS

4.5.2 The condition of the ditches and ordinary watercourses in and around Shinfield village was unknown prior to the winter 2013-14 flood event; however it is recommended that riparian owners continue to work to regularly maintain all waterbodies on their land to ensure they remain free from excess silt build up and vegetation. This will enable the free flow of water from the village to the River Loddon.

### PARISH COUNCIL

4.5.3 It is recommended that the Parish Council recruit a Flood Warden(s) for Shinfield, who can help manage local flood risk by:

- working within the community to prepare them for future flooding and to develop flood resilience;
- receiving flood alerts / warnings from the Environment Agency directly and ensuring the community is aware of them;
- ensuring the community is aware of what the Environment Agency flood warnings mean, what people need to do and where further information can be obtained;
- assisting during floods by supporting people in the community;
- being a conduit for the flow of information between Wokingham Borough Council and the community;
- identifying vulnerable people within the community who may need special assistance during flood events; and
- reporting blocked drains, ditches and other watercourse issues to the relevant authorities.

### WOKINGHAM BOROUGH COUNCIL

4.5.4 As part of the approved Eastern Shinfield Relief Road changes to the flooding in the area are anticipated. Part of the work involves raising a new section of road which will provide some protection to the Magpie and Parrot. These works result in an increase to No.20 Arborfield Road, therefore a new flood bund has been constructed around the property to mitigate this risk.

## ENVIRONMENT AGENCY

4.5.5 Alleviating the flood risk to the properties of Shinfield from local main rivers would require investment in a capital works scheme by the Environment Agency. The small number of properties affected by flooding in Shinfield means a capital works scheme in this location is highly unlikely to be economically viable and would not therefore qualify for National Government funding. National Government funding for Flood Risk Alleviation Works is allocated on a prioritisation basis, which reflects the economic benefits that can be provided by a scheme over its lifetime. This funding mechanism is designed to maximise the economic return (measured as future flood losses avoided) for the minimum possible cost (measured as capital expenditure necessary to achieve the avoidance of future losses). This approach for Main Rivers normally favours schemes designed to address large scale flood risk issues to hundreds of properties.

# 5 CHARVIL

## 5.1 INTRODUCTION

5.1.1 The parish of Charvil is located in the north-west of Wokingham Borough, alongside the Borough boundary. The National Grid Reference (NGR) for the Parish is (477500, 176500). The village of Charvil is located approximately 7km north-east of Reading and 8km north-west of Wokingham. The village is surrounded by open agricultural land, with the River Loddon (Main River) flowing along the eastern parish boundary and the River Thames (Main River) flowing along the northern boundary. A number of additional watercourses and drainage channels flow through the parish, including St Patrick's Stream. There are also a number of lakes in the southern half of the parish. The A4 cuts through the centre of the parish, linking the village with Twyford and Sonning.

5.1.2 The topography of the village slopes gently from south-west to north-east, falling towards the River Loddon. There are no formal watercourses flowing through Charvil; however there are a series of watercourses (Ordinary Watercourses) and lakes to the east of the village, which form part of the Loddon Nature Reserve.

5.1.3 In the winter of 2013-14 the village suffered flooding as a result of fluvial flooding and surface water runoff. A localised area of the parish also suffered sewer flooding as a result of a failure at the Charvil Thames Water Pumping Station.

5.1.4 None of the properties in Charvil suffered flooding to their internal areas; however 31 properties are understood to have suffered external flooding. Localised highway flooding occurred in some areas of the parish. Drawing No. 70007120/04/101 and 70007120/04/102 identify the flooded properties, the approximate flood extents and the directions overland flows took through the village.

## 5.2 FLOODING IN CHARVIL

### THAMES DRIVE

5.2.1 Thames Drive is located to the north of Charvil village, alongside the River Thames. St Patrick's Stream (Main River) flows to the east of the properties, meaning the properties are effectively located on an ait (refer to drawing no. 70007120/04/101). Approximately ten houses are located on Thames Drive. Each of these properties' rear gardens slope down to the bank of the River Thames.

5.2.2 During the winter 2013-14 flood event it is understood that all of these properties experienced external flooding. None of the properties were reported to have experienced internal flooding. The majority of the buildings along Thames Drive are raised above the floodplain to protect the internal areas from flood water.

5.2.3 Flood water in this area prevented residents of Thames Drive reaching their properties via vehicle for approximately two weeks during the January.

### CHARVIL VILLAGE

5.2.4 A number of localised areas in Charvil experienced flooding.

5.2.5 The New Bath Road (A4) between Twyford and Hurst had a significant volume of standing surface water on the carriageway for a number of weeks in January and February (refer to drawing no. 70007120/04/102). The road was not closed and traffic was able to pass, albeit at reduced speeds. The bow waves from passing traffic did not affect properties alongside the road.

5.2.6 Newlands Farm, located on the New Bath Road (A4) at the junction with Loddon Drive, suffered external flooding in January as a result of fluvial floodwater from the Old River (Main River) and the River Loddon. This farm is located outside of the fluvial floodplain.

5.2.7 Within Charvil village, Old Acres Lane was partly flooded as a result of floodwater from the lakes to the east. The level of water in the lakes was raised as a result of the Old River and the River Loddon, located to the east of these lakes, coming out of bank and flowing into the lakes. This floodwater collected along parts of Old Acres Lane, as well as the car park of the River Court apartments. The driveways of two of the properties along Old Acres Lane also flooded (refer to drawing no. 70007120/04/102). This floodwater did not affect internal areas of properties along Old Acres Lane.

5.2.8 Further south from Old Acres Lane, a number of properties in Vale View, which back onto the Twyford Lakes, came close to experiencing internal flooding (refer to drawing no. 70007120/04/102). These properties have not flooded prior to the winter of 2013-14. The houses are less than ten years old.

5.2.9 Sections of the Old Bath Road (A3032) were flooded from the Twyford Lakes and the River Loddon. The road remained open and passable throughout the flood event. A number of commercial units are located on the Old Bath Road (A3032); all of these units are understood to have experienced external flooding from the lakes and the River Loddon (refer to drawing no. 70007120/04/102). Anecdotal evidence suggests that a number of the units also experienced internal flooding; however this has not been confirmed.

5.2.10 Further areas of Charvil village affected during the winter 2013-14 flood event were Thornbers Way and Edwards Road (refer to drawing no. 70007120/04/102). Both of these roads experienced extensive sewer flooding as a result of a failure of the Thames Water Pumping Station in Charvil. It is not understood whether the pumping station stopped working due to a level based cut-off, a trip-switch linked to the volume being pumped, or simply the pump being inadequate to pump significant volumes for sustained periods (as a result of flood water ingress). Effluent collected in both roads, in driveways and in front gardens and remained for over two weeks during January. The meadows to the east of these roads were also covered in foul water.

## 5.3 SUMMARY OF CHARVIL FLOODING

5.3.1 The majority of flooding in Charvil resulted from the Main Rivers within the vicinity of the village, the Old River and the River Loddon, coming out of bank due to increased levels in the watercourses. The condition of these watercourses and the lakes in Charvil prior to the winter 2013-14 flood event has not been made available to inform this study.

## 5.4 RISK MANAGEMENT AUTHORITY RESPONSES

### WOKINGHAM BOROUGH COUNCIL

5.4.1 Wokingham Borough Council was not made aware of the need for emergency response in Charvil during the winter 2013-14 flood event.

5.4.2 Wokingham Borough Council regularly undertakes maintenance to the highway drainage network. Wokingham Borough Council Highway Department undertook general clearing and gulley maintenance along the New Bath Road (A4) in April 2013 and September 2013, prior to the winter 2013-14 flood event.

### ENVIRONMENT AGENCY

5.4.3 The Environment Agency issued a flood warning for the River Loddon, including Charvil, on the 18th January 2014. This warning was removed on the 21st January. The Environment Agency re-issued a flood warning for Charvil from the River Loddon on the 2nd February 2014; this warning was removed on the 23rd February.

5.4.4 Wokingham Borough Council is not in possession of information regarding the maintenance undertaken by the Environment Agency on the Main Rivers within the vicinity of Charvil prior to the winter 2013-14 flood event.

5.4.5 Wokingham Borough Council has not been made aware of any further action taken by the Environment Agency.

### THAMES WATER

5.4.6 Wokingham Borough Council has not been made aware of any works to clean up areas affected by foul water flooding in Charvil, either during or following the flood event.

5.4.7 Wokingham Borough Council is not in possession of information regarding the maintenance undertaken at the Charvil Thames Water Pumping Station and to the foul network in Charvil prior to the winter 2013-14 flood event.

5.4.8 Thames Water has stated that none of their Pumping Stations in the Borough failed during the winter 2013-14 flood event. This statement conflicts with the information received from residents in Charvil.

## 5.5 RECOMMENDATIONS

5.5.1 In order to reduce the risk of flooding in Charvil the following measures should be considered. These recommendations are grouped according to relevant Risk Management Authorities and local stakeholders.

### RIPARIAN OWNERS

5.5.2 The condition of the ditches and ordinary watercourses in and around Charvil village was unknown prior to the winter 2013-14 flood event; however it is recommended that riparian owners continue to work to regularly maintain all waterbodies on their land to ensure they remain free from excess silt build up and vegetation. This will enable the free flow of water from the village to the Old River, the River Loddon and the River Thames.

### PARISH COUNCIL

5.5.3 It is recommended that the Parish Council recruit a Flood Warden(s) for Charvil, who can help manage local flood risk by:

- working within the community to prepare them for future flooding and to develop flood resilience;
- receiving flood alerts/warnings from the Environment Agency directly and ensuring the community is aware of them;
- ensuring the community is aware of what the Environment Agency flood warnings mean, what people need to do and where further information can be obtained;
- assisting during floods by supporting people in the community;

- being a conduit for the flow of information between Wokingham Borough Council and the community;
- identifying vulnerable people within the community who may need special assistance during flood events; and
- reporting blocked drains, ditches and other watercourse issues to the relevant authorities.

## WOKINGHAM BOROUGH COUNCIL

5.5.4 It is recommended that Wokingham Borough Council Highway Department undertake an investigation into the condition of the highway drainage system on the New Bath Road (A4) to determine the reason for standing water on the carriageway during the winter 2013-14 flood event. This investigation should determine whether remedial works to the highway drainage network are required, or whether the flooding was a result of the sheer volume of water in the vicinity of Charvil due to the fluvial flooding.

5.5.5 An investigation should be undertaken into the feasibility and benefits of seeking Environment Agency funding for property level flood protection measures at the affected units within the Bath Road industrial estate in order to alleviate the flood risk to these properties.

## THAMES WATER

5.5.6 An investigation should be undertaken to establish the reason for the failure of the Thames Water Pumping Station at Charvil. The potential for increasing the wet well at the Pumping Station should be investigated to determine whether this well can feasibly provide additional capacity. If it is concluded that the cause of the pumping failure originates from flood water in the system, the potential for lining the foul network in Charvil village should be investigated.

5.5.7 None of the properties on Thornbers Way and Edwards Road were reported to have suffered internal flooding as a result of foul water backing up and surcharging. If further investigation indicates that properties suffered internal flooding or were unable to use their toilets, showers etc. due to foul water backing up, Thames Water should investigate the potential for fitting non-return valves.

## ENVIRONMENT AGENCY

5.5.8 Alleviating the flood risk to the properties of Charvil from local main rivers would require investment in a capital works scheme by the Environment Agency. The small number of properties affected by flooding in Charvil means a capital works scheme in this location is highly unlikely to be economically viable and would not therefore qualify for National Government funding. National Government funding for Flood Risk Alleviation Works is allocated on a prioritisation basis, which reflects the economic benefits that can be provided by a scheme over its lifetime. This funding mechanism is designed to maximise the economic return (measured as future flood losses avoided) for the minimum possible cost (measured as capital expenditure necessary to achieve the avoidance of future losses). This approach for Main Rivers normally favours schemes designed to address large scale flood risk issues to hundreds of properties.

# 6 HURST

## 6.1 INTRODUCTION

6.1.1 The Parish of Hurst is located in the east of Wokingham Borough, with the village of Hurst located approximately 8.6km east of Reading and 5.6km north of the town of Wokingham. The National Grid Reference (NGR) for the Parish is (479500, 173500). The village is surrounded by open agricultural land, with the M4 located approximately 2.4km to the south east of the village. The A321 runs through the centre of the parish from Wokingham to Henley-on-Thames. The topography of the parish slopes gently from the south-east towards the River Loddon.

6.1.2 In addition to the main channel of the River Loddon, which flows along the western boundary of the Parish, the Emm Brook and the Twyford Brook branch off the Loddon to the south-west and north-west of the village respectively. Copperbridge Brook and Old River also flow along the western parish boundary. Numerous surface water drainage ditches and highway drainage ditches cross the Parish. The village of Hurst is surrounded by a number of streams and drainage ditches. These channels predominantly drain from the south and south-east of the village, flow along the eastern and western boundaries of the village, to the River Loddon to the north-west of the village.

6.1.3 The Parish of Hurst was predominantly affected by highway flooding during the winter 2013-14 flood event as a result of the high number of streams and drainage ditches within the area. The A321 flooded in three distinct areas in the parish. In addition to this main road, a number of the smaller highways in and around the village of Hurst were flooded, including Whistley Mill Lane, which experienced significant fluvial flooding. A number of residential and commercial properties along Whistley Mill Lane were also affected by this flooding.

6.1.4 Six residential properties suffered external flooding in Hurst, with two of these properties flooding internally. A further six commercial properties also suffered internal flooding during the winter of 2013-14. Drawings No. 70007120/05/101 and 70007120/05/102 identify the flooded properties, the approximate flood extents and overland flow routes through the village during this event.

## 6.2 FLOODING IN HURST

6.2.1 The water levels in local streams and ditches throughout the parish began to rise in December 2013. Flooding was first encountered in the parish during winter 2013-14 a few days before Christmas. The water levels receded and rose again on a number of occasions throughout the period.

6.2.2 Hurst commonly experiences flooding from the network of surrounding watercourses and the flooding experienced during the winter 2013-14 event was typical of the flooding experienced in previous years.

### FLOODING IN HURST VILLAGE

6.2.3 To the south of the village, a number of the local roads flooded during the winter 2013-14 flood event. The junctions of Dunt Avenue and Lines Road, and Nelson's Lane and Islandstone Lane were both significantly flooded (refer to drawing no. 70007120/05/101). The flood water at the junction of Dunt Avenue and Lines Road extended along Dunt Avenue for approximately half a mile. Both remained passable in a normal car; however the road verges were obstructed by the flood water, making driving through the flooded area unsafe.

6.2.4 Further north, the highway was also flooded between the two Hinton Road culverts (refer to drawing no. 70007120/05/101) as a result of water spilling out of the two sections of river in this area. The western culvert is referred to as the Green Man culvert and the eastern one the Stow culvert. For the purposes of this report, the unnamed streams draining through the culverts are referred to as the Green Man Stream (western stream) and the Stow Stream (eastern stream). Both the streams in this area were silted and were believed to contain a considerable amount of vegetation and debris prior to the flood event. The screens of both culverts were also partially blocked. It is understood that these screens are sporadically cleared by the Environment Agency. The road remained passable in this area and none of the properties further west along Hinton Road were affected by the flood water.

6.2.5 Downstream of the culverts both watercourses came out of bank. The Green Man Stream caused flooding to Hogmoor Lane. This flooding was compounded by a second drainage channel that originates next to this highway which also flowed out of bank, across Hogmoor Lane. The Stow Stream came out of bank and caused flooding to Poplar Lane and the field to the north of the road. The properties in Poplar Lane are not thought to have been affected by the flood water.

6.2.6 To the south-east of Hogmoor Lane, Broadcommon Lane also experienced flooding along the road and in the adjacent fields due to the Broadcommon Stream coming out of bank in this area (refer to drawing no. 70007120/05/101). The road remained passable and it is not thought any properties were affected by flood water in this area.

6.2.7 In the western area of the village, Sawpit Road experienced sewage back-up as a result of failure at the Thames Water pumping station in the village. Groundwater ingress to the foul network in and around the village is thought to have occurred. It is not understood whether the pumping station stopped working due to a level based cut-off, a trip-switch linked to the volume being pumped, or simply the pump being inadequate to pump significant volumes for sustained periods.

6.2.8 The increased volume of water in the foul network along Sawpit Road caused the system to back-up, meaning the properties in Sawpit Road were unable to flush their toilets. These properties were supplied with Portaloo facilities for approximately two weeks in early January. The foul water did not surcharge the system and there were no incidences of sewage flooding in Hurst.

## FLOODING ON THE A321

6.2.9 The A321 was flooded in three places through Hurst during winter 2013-14.

6.2.10 To the south of Hurst village approximately half a mile of highway was flooded between Islandstone Lane and Pound Lane (refer to drawing no. 70007120/05/101) due to the watercourse to the east of the road coming out of bank. The fields either side of the road were also flooded. This water was passable and the road was not closed in this location. The properties along the A321 in this area were not affected by the floodwater.

6.2.11 Further north, the A321 was also flooded at the junction with Whistley Green (refer to drawing no. 70007120/05/101). The flood water in this location was thought to have been a combination of surface water, fluvial water and blocked highway drains. The water collected on the highway in this location in early February. The road was passable and was not closed. The bow waves from cars caused external flooding to No.1 and No.2 Gloster Cottages. Anecdotal accounts suggest that No.2 would have experienced internal flooding via the airbricks if sandbags had not been placed along the front of the property.

6.2.12 In an attempt to reduce the volume of water on the road, residents cleared two of the road gulleys in Whistley Green. The water receded within 18 hours of this clearance; however it is not known whether this was as a result of the gulley clearance.

6.2.13 To the north of the junction with the B3030, the A321 flooded as a result of water spilling out of the Twyford Brook and the stream running alongside the western side of the B3030 (refer to drawing no. 70007120/05/101). This stream joins the Twyford Brook just south of the junction of Broad Hinton and the A321. Anecdotal accounts suggest both watercourses were unable to cope with the volume of water in this location, with this flooding a result of a combination of fluvial water and surface water that was unable to drain away.

## FLOODING ON WHISTLEY MILL LANE

6.2.14 High water levels on the River Loddon during the winter of 2013-14 resulted in fluvial flooding impacting the Whistley Mill Lane area. Anecdotal evidence suggests this flooding was exacerbated by the number of fallen trees and vegetation debris in the River Loddon prior to the flood event. The depth and velocity of the flood water along Whistley Mill Lane made accessing this area by car impossible from early December through to the beginning of March.

6.2.15 Four residential properties are located along Whistley Mill Lane. Two are situated immediately west of Whistley Bridge, either side of the lane. The other two are situated on an island, in between Copperbridge Brook and a branch of the River Loddon, referred to as Old River (refer to drawing no. 70007120/05/102). These two properties are part of the Lands End Stables, located approximately 80m west of Copperbridge Brook and 40m east of Old River. In addition to the two residential properties, there is also understood to be 6 commercial properties located at Lands End Stables, one of which is the riding stables.

6.2.16 Whistley Mill Lane crosses the River Loddon via Whistley Bridge and crosses Copperbridge Brook via a second smaller bridge. The lane crosses the Old River via a ford (refer to drawing no. 70007120/05/102).

6.2.17 Flooding began to impact Whistley Mill Lane in late November 2013 as the levels in the Old River and surrounding watercourses and waterbodies began to rise. The river came out of bank at the ford, rising along the road towards Lands End Stables. The water level continued to rise flooding along the lane until on the 16th December the depth of water meant that the properties at Lands End Stables were inaccessible by car. The water level remained high for approximately 3½ months, through to the end of March 2014. The two properties at Whistley Bridge were only accessible via 4x4 during this period.

6.2.18 The residents at Lands End Stables had to wade through the flood water to access the property. At the height of the flooding, the flood water along the lane reached a depth of approximately 1.3m outside Lands End Stables.

6.2.19 The depth of flood water along Whistley Mill Lane meant it flowed into the yard of Lands End Stables, flooding this area to a depth of approximately 600mm. The water flooded the outbuildings and animal stables, along with the commercial units situated at the Stables.

6.2.20 The water flooded the porch of the main residential property at Lands End Stables, as this part of the property is situated at a lower level than the main building. The main building remained dry throughout the flood event. The second property at Lands End Stables did not suffer internal flooding due to the threshold levels.

6.2.21 The borehole and sceptic tank serving Lands End Stables were inundated by the flood water. As a consequence the property was without a supply of clean drinking water for over 3 months and had to buy bottled water. The residents of Lands End Equestrian Centre have continued to drink bottled water due to the poor quality of the water in the borehole since the flood event. Portaloos were not provided for Lands End Equestrian Centre.

6.2.22 One of the two properties at Whistley Bridge suffered internal flooding during the winter 2013-14 flood event. The other property experienced external flooding in the garden and driveway of the property.

## 6.3 SUMMARY OF HURST FLOODING

6.3.1 The majority of flooding in Hurst resulted from the ordinary watercourses and the Main Rivers in the vicinity of the village, the Old River and the River Loddon, coming out of bank due to increased levels in the watercourses. The condition of the Main Rivers in the vicinity of the village prior to the winter 2013-14 flood event has not been made available to inform this study. The ordinary watercourses in and around the village were reported to be in varying condition prior to the winter 2013-14 flood event.

## 6.4 RISK MANAGEMENT AUTHORITY RESPONSES

### WOKINGHAM BOROUGH COUNCIL EMERGENCY RESPONSE

6.4.1 Wokingham Borough Council provided four Portaloos to the residents of Sawpit Road in January for two weeks. The Council also provided sandbags to a large number of properties in Hurst following requests from residents. Pumps were provided to alleviate an area of significant groundwater flooding adjacent to St Nicholas School; the pumping was carefully supervised to ensure no risk was passed on downstream.

6.4.2 Wokingham Borough Council undertook emergency clearance works to ditches in and around the Sawpit Road area to alleviate flooding on School Road and to try to alleviate the ingress of surface water into the sewer system. Ditches were cleared as emergency works along the Straight Mile and around Nelsons Lane. Wokingham Borough Council emptied gullies and jetted pipe work at several locations including the A321, Tape Lane. Flood Warning signs were placed across the area. Wokingham Borough Council also provided pumps and supervised their utilisation to protect one property on Orchard Road from groundwater flooding.

6.4.3 Wokingham Borough Council regularly undertakes maintenance to the highway drainage network. Most roads in Hurst are annually maintained although the gullies on the A321 are cleared on a 6 monthly basis. Prior to the winter 2013-14 flood event the gullies on the A321 were cleared in April 2013 and September 2013.

### ENVIRONMENT AGENCY

6.4.4 Information on the Environment Agency Flood Warnings and Flood Alerts issued to Hurst during the winter 2013-14 flood event have not been made available at the time of writing.

6.4.5 A Flood Alert was issued for the length of the River Loddon, including Hurst, on the 25 April 2014; this alert was removed on 4 May 2014.

6.4.6 Wokingham Borough Council has not been made aware of any further action taken by the Environment Agency.

### THAMES WATER

6.4.7 Wokingham Borough Council has not been made aware of any works undertaken by Thames Water in Hurst during the winter 2013-14 flood event.

6.4.8 Wokingham Borough Council is not in possession of information regarding the maintenance undertaken at the Hurst Thames Water Pumping Station and to the foul network in Hurst prior to the winter 2013-14 flood event.

6.4.9 Thames Water has stated that none of their Pumping Stations in the Borough failed during the winter 2013-14 flood event. This statement conflicts with the information received from residents in Hurst.

## 6.5 RECOMMENDATIONS

6.5.1 In order to reduce the risk of flooding in Hurst the following measures should be considered. These recommendations are grouped according to relevant Risk Management Authorities and local stakeholders.

### RIPARIAN OWNERS

6.5.2 The various ditches and gullies in and around Hurst need to be regularly maintained to ensure they remain free from excess silt build up and vegetation. Wokingham Borough Council provided copies of the Riparian Owners information leaflet to the Parish Council which were distributed with the newsletter to improve public awareness of the responsibilities of landowners.

6.5.3 The main rivers and associated culverts in and around Hurst also need to be regularly maintained to ensure they are able to flow freely and remain free from excess vegetation debris.

### PARISH COUNCIL

6.5.4 It is recommended that the Parish Council recruit a Flood Warden(s) for Hurst, who can help manage local flood risk by:

- working within the community to prepare them for future flooding and to develop flood resilience;
- receiving flood alerts/warnings from the Environment Agency directly and ensuring the community is aware of them;
- ensuring the community is aware of what the Environment Agency flood warnings mean, what people need to do and where further information can be obtained;
- assisting during floods by supporting people in the community;
- being a conduit for the flow of information between Wokingham Borough Council and the community;
- identifying vulnerable people within the community who may need special assistance during flood events; and
- reporting blocked drains, ditches and other watercourse issues to the relevant authorities.

### WOKINGHAM BOROUGH COUNCIL

6.5.5 The feasibility of raising Whistley Mill Lane should be investigated to determine whether this would reduce the impact of flooding and allow the properties to be accessed via vehicle for less intense flood events.

### THAMES WATER

6.5.6 The feasibility and benefits of fitting non-return valves at the properties in Sawpit Road should be established, and if viable, this action should be undertaken in the village by Thames Water to help reduce the incidence of sewage water backing-up.

6.5.7 The potential for increasing the wet well at the Thames Water Hurst Pumping Station should be investigated to determine whether this well can feasibly provide additional capacity.

## ENVIRONMENT AGENCY

6.5.8 Alleviating the flood risk to the properties of Hurst from local main rivers would require investment in a capital works scheme by the Environment Agency. The small number of properties affected by flooding in Hurst means a capital works scheme in this location is highly unlikely to be economically viable and would not therefore qualify for National Government funding. National Government funding for Flood Risk Alleviation Works is allocated on a prioritisation basis, which reflects the economic benefits that can be provided by a scheme over its lifetime. This funding mechanism is designed to maximise the economic return (measured as future flood losses avoided) for the minimum possible cost (measured as capital expenditure necessary to achieve the avoidance of future losses). This approach for Main Rivers normally favours schemes designed to address large scale flood risk issues to hundreds of properties.

# 7 WARGRAVE

## 7.1 INTRODUCTION

7.1.1 The Parish of Wargrave is located in the north of Wokingham Borough, with the village of Wargrave located approximately 8.5km north-east of Reading and 3.5km south-east of the town of Henley-on-Thames. The National Grid Reference (NGR) for the Parish is (478500, 178500). The village is surrounded by open agricultural land, with the River Thames immediately to the west of the village. The village of Wargrave is located between the Shiplake and Henley Locks. The topography of the village slopes from north-east to west, falling towards the River Thames.

7.1.2 In addition to the River Thames, the River Loddon flows from south to north to the south-west of Wargrave. The River Loddon joins the River Thames approximately 400m to the west of Wargrave village centre. A number of other watercourses are located within the vicinity of the village, including the St Patricks Stream, which branches off the River Thames to the south-west of the village. The Hennerton Backwater also branches off the Thames to the north of the village, passing by a number of properties in the Willow Lane area. Furthermore, Heron's Ditch branches off the River Thames to the west of the village, passing by a number of properties on Loddon Drive and Watermans Way. Wargrave,

7.1.3 In the winter of 2013-14 two areas of the village suffered flooding as a result of fluvial flooding; Willow Lane and Loddon Drive. The Loddon Drive area also experienced sewage flooding as a result of the release of sewage water from the Thames Water Sewage Treatment Works into the flooded River Loddon and the inundation of private sewage treatment facilities in individual residences.

7.1.4 26 properties in Wargrave suffered flooding to internal areas as a result of fluvial flooding, including two businesses. An additional seven properties suffered flooding to external areas. Both Willow Lane and Loddon Drive were completely inundated with flood water. Drawings No. 70007120/06/101 and 70007120/06/102 identify the flooded properties, the approximate flood extents and overland flow routes through the village during this event.

## 7.2 FLOODING IN WARGRAVE

### WILLOW LANE

7.2.1 The properties on Willow Lane are effectively located on an island, with the River Thames flowing to the west and the Hennerton Backwater flowing to the east (refer to drawing no. 70007120/06/101). Approximately 20 residential properties and 5 commercial properties are located off Willow Lane, on the southern half of the island area. The original properties along Willow Lane are Edwardian, when they were constructed as summer houses. Due to their riverside location, the properties were designed to allow flood water to flow beneath the main structure, typically being built on a network of arches. A number of the properties have been modified and altered over the years and as a result not all of the properties along Willow Lane continue to allow flood water to flow beneath them.

7.2.2 The northern half of the island comprises Wargrave Marsh; this area remains boggy for the majority of the year. The whole island is designated as fluvial floodplain.

7.2.3 To the south of the island, on the opposite side of the River Thames, the fluvial floodplain extends across the fields to the Twyford to Henley-on-Thames railway line.

7.2.4 During the winter 2013-14 flood event both the River Thames and Hennerton Backwater came out of bank in early February, flooding a wide area alongside both watercourses. The flood water from the River Thames flowed in a north-easterly direction towards Willow Lane, completely flooding external areas of the properties on the western side of Willow Lane. The properties on the eastern side of Willow Lane suffered external flooding as a result of flood water from the Hennerton Backwater combining with the water from the Thames.

7.2.5 The flood water rose quickly, with residents observing a 175mm rise within a few hours on the morning of the 1st February. The flood water was observed to be approximately 900mm at its deepest and remained at this level for approximately 3 weeks, before receding. The flood water covered the majority of the island area, along with the fields to the west and south of the village. The water extended beyond the Twyford to Henley-on-Thames railway line, flooding a number of sections of the track.

7.2.6 The Hennerton Backwater came out of bank along its length. Willow Lane crosses the Hennerton Backwater via a small bridge near to the junction with the A321 (refer to drawing no. 70007120/06/101). The Willow Lane bridge is understood to be approximately 200 years old and has a relatively low soffit. During the winter 2013-14 flooding the water level in the Backwater rose above the soffit level, resulting in a significant volume of water spilling out of bank and flowing along Willow Lane.

7.2.7 Willow Lane itself became a quasi-stream, with a considerable volume of water being channelled along the road due to a combination of flood water from the River Thames and water spilling out of the Hennerton Backwater. This water was approximately 900mm deep on the road and was fast flowing at times, presenting a danger to residents.

7.2.8 The residents of three of the properties along Willow Lane moved out at the beginning of the flood event. These residents had small children or were elderly and moved out due to access concerns.

7.2.9 Seventeen of the residential properties along Willow Lane suffered internal flooding during the winter 2013-14 flood event (refer to drawing no. 70007120/06/101). It is understood that the properties that suffered internal flooding are not raised up out of the floodplain.

7.2.10 At the southern end of Willow Lane, there are a number of commercial properties located at the point where the Hennerton Backwater branches off from the River Thames. Wyatt Marina offices and Mec Marine experienced internal flooding during the flood event.

7.2.11 A number of the Willow Lane residents have formed the Backwater Committee and regularly undertake work on the Hennerton Backwater to try and reduce the risk of flooding. Prior to the winter 2013-14 flooding the Committee worked to clear a number of fallen trees across the Backwater. Had this work not been undertaken, the fallen trees were likely to have constrained the volume of water in the channel and increased the volume of flood water leaving the Backwater during the winter 2013-14 flood event.

### LODDON DRIVE

7.2.12 Loddon Drive is located to the south of Willow Lane, alongside the River Loddon.

7.2.13 The River Thames flows to the west and north of Loddon Drive. The St Patricks Stream branches off the River Thames to the south-west of Loddon Drive, flowing north to re-join the Thames. An arm of the St Patricks Stream flows east to meet the River Loddon, south of Loddon Drive. The River Loddon flows from south to north through the Loddon Drive area to meet the River Thames (refer to drawing no. 70007120/06/102).

7.2.14 This network of watercourses means that an area of Loddon Drive is situated on an island in-between these three watercourses. The whole of this island is classified as floodplain.

7.2.15 Two backwater channels of the River Thames are located to the north of Loddon Drive. Heron's Ditch branches off the River Thames immediately after the confluence of the Thames and the Loddon. Heron's Ditch then flows alongside Loddon Drive in a south-easterly direction before flowing north-east towards the River Thames, through south-west Wargrave. Presently water does not flow through Heron's Ditch due to a large volume of rubble in an area of the channel next to Loddon Drive (refer to drawing no. 70007120/06/102).

7.2.16 The second backwater branches off the Thames downstream of Heron's Ditch and re-joins the main river upstream of the point at which Heron's Ditch re-joins it (refer to drawing no. 70007120/06/102). Prior to the winter 2013-14 flood event this backwater was reported by local residents to be badly silted.

7.2.17 Local residents reported that the River Loddon was silted and clogged with vegetation debris prior to the winter 2013-14 flood event, resulting in the river flowing more slowly than it naturally would.

7.2.18 The floodplain to the east of the River Loddon is limited by the Henley-on-Thames to Twyford railway embankment. The height of this embankment serves to limit the volume of water able to flow east towards Wargrave village (refer to drawing no. 70007120/06/102).

7.2.19 A Thames Water Sewage Treatment Works is located to the south of Loddon Drive. This treatment works is understood to serve approximately 100,000 houses and has a permit to discharge treated effluent into the River Loddon. It also has an allowance for emergency discharges into the River Loddon in circumstances such as extreme weather, for example flooding.

7.2.20 There are around 30 houses located along Loddon Drive. A number of these properties have been designed with the living accommodation raised up from the ground level, either through an arch or stilt design, allowing flood water to flow beneath the properties.

7.2.21 The River Loddon, River Thames and St Patricks Stream came out of bank in this area of Wargrave during the winter 2013-14 flood event. The area was flooded in excess of two months from late-December through to the beginning of March. The water level fluctuated during this period, with the water receding completely in mid-January alongside the Loddon on the southern parts of Loddon Drive, before rising again. The water level rose again 4 days later; the flood levels during this period were significantly higher, with the water level estimated to be approximately 1.3m at its deepest. Residents need to wear waders to walk through the flood water. However, during late-January and February this water was too deep and fast flowing to walk through. During this period (late December to early March) the properties along Loddon Drive were inaccessible by car.

7.2.22 In accordance with the allowance to discharge untreated foul effluent into the River Loddon during times of emergency, the Thames Water Sewage Treatment Works discharged sewage water into the River Loddon over the course of the flood event due to a lack of capacity within the works to retain the foul water. As the Sewage Treatment Works is situated downstream of Loddon Drive, this water mixed with the fluvial flood water affecting properties in this area.

7.2.23 It is understood that a number of properties in the Loddon Drive area have private foul drainage systems and these are likely to have been inundated during the flood event.

7.2.24 During the winter 2013-14 flood event seven properties along Loddon Drive were reported to have suffered internal flooding (refer to drawing no. 70007120/06/102). All seven of the properties are understood to have experienced internal flooding during both flood incidences.

7.2.25 The Watershed, The Moorings, Whynot and Loddon Acres were all flooded internally. Both Watershed and The Moorings are not insured for flooding. The damage to Whynot caused by the flooding resulted in the residents having to move out of the property and live in alternative accommodation for a number of months following the flood event.

7.2.26 Greengates also experienced internal flooding in both the main house and the boathouse (which is designed and used as a residential property). The Greengates boathouse was designed on stilts at a height above the 1947 flood event. The boathouse was first flooded in 2003, with the internal entrance steps flooded to a depth of approximately 600mm. The boathouse was flooded to the same depth during the winter 2013-14 flood event. The main house was flooded internally to a depth of 400mm.

7.2.27 The Farthings experienced internal flooding during the winter 2013-14 flood event due to damage to the floor of the property. The Farthings is built on stilts to enable flood water to flow beneath the property. During the winter 2013-14 flood event an oak tree stump, being carried in the floodwater, was channelled beneath the property, causing significant damage to the flooring. The property needs to be completely rebuilt as a result of the damage caused during the flood event.

7.2.28 The River House is located in the northern area of Loddon Drive, with the River Thames running along the property's northern boundary, and Heron's Reach flowing along the southern boundary, parallel with Loddon Drive itself. The River House suffered internal flooding as a result of flood water from the River Loddon and St Patricks Stream flowing across the floodplain and into the property from the south. The property is constructed over the River Thames and therefore also experienced floodwater entering internal areas as a result of increased levels in the Thames. The flood water from the River Loddon and St Patricks Stream was reported to be flowing quickly with a strong current, making it unsafe to walk through. From the week before Christmas to early March the residents were only able to access the property via wading through the floodwater or using their right of access from the railway line. In order to try and reduce the risk of entering and exiting the property through the flood water, the residents raised a number of wooden planks above the flood water along the driveway to the railway embankment. It is understood this access route was used by other residents along Loddon Drive during the flood event to access the area. At its deepest, flood water inside River House was approximately 600mm. The residents built a series of levies; three in total, from twelve pallets of sandbags, in combination with a series of pumps to significantly reduce the level of flood water inside the property, which were reported to work effectively. The extent of the flooding and the unsafe nature of accessing the property due to the current in the flood water resulted in the residents moving out of the property for a number of weeks in February. The property was reported as being 'dry' in June 2014, and repair work is yet to begin on the property due to the extent of the damage.

7.2.29 At the southern end of Loddon Drive, Downmead suffered internal flooding. This property has flooded on previous occasions and is reported by local residents to be uninsurable in terms of flooding as a result.

7.2.30 On both occasions when the water level rose, Loddon Drive was impassable by vehicle, with the water around 1.5m deep. Residents had to wade through the water to access their properties, or use boats.

## 7.3 SUMMARY OF WARGRAVE FLOODING

7.3.1 The flooding in Wargrave resulted from the Main Rivers within the vicinity of the village, the River Thames and the River Loddon, coming out of bank due to increased levels in the watercourses. The condition of these watercourses in the vicinity of Wargrave prior to the winter 2013-14 flood event has not been made available to inform this study.

## 7.4 RISK MANAGEMENT AUTHORITY RESPONSES

### WOKINGHAM BOROUGH COUNCIL

7.4.1 Wokingham Borough Council provided nearly 1,000 sandbags to the Wargrave area following requests by individual properties and businesses. In January and February 2014 the Wokingham Borough Council Gully Emptier and Jetter attend sites in Wargrave on over 30 occasions to tanker away floodwater and empty gullies. Several roads were closed and required considerable clean up after reopening.

7.4.2 During the storms on the 14th February a large tree fell into the watercourse near Watermans Way; this was removed by Wokingham Borough Council contractors to alleviate the blockage to the flow of water.

### ENVIRONMENT AGENCY

7.4.3 The Environment Agency issued a Flood Warning for the River Thames from Shiplake to Wargrave on 31 January 2014; this warning was removed on the 24 February 2014.

7.4.4 A Flood Alert was issued for the River Thames from Shiplake to Wargrave on the 24 December 2014; this alert was removed on 9 March 2014.

7.4.5 The Environment Agency was not present in the Willow Lane or Loddon Drive areas during the flood event.

7.4.6 Wokingham Borough Council has not been made aware of any further action taken by the Environment Agency.

### THAMES WATER

7.4.7 Wokingham Borough Council has not been made aware of any works undertaken by Thames Water in Wargrave during the winter 2013-14 flood event.

7.4.8 Wokingham Borough Council is not in possession of information regarding the maintenance undertaken at the Wargrave Thames Water Sewage Treatment Works and to the foul network in Wargrave prior to the winter 2013-14 flood event.

7.4.9 Thames Water has confirmed that the Foul Water Pumping Stations in the vicinity of Wargrave did not cease to operate during the winter 2013-14 flood event.

## 7.5 RECOMMENDATIONS

7.5.1 In order to reduce the risk of flooding in Wargrave the following measures should be considered. These recommendations are grouped according to relevant Risk Management Authorities and local stakeholders.

### RIPARIAN OWNERS

7.5.2 The various ditches in the Wargrave area need to be regularly maintained to ensure they remain free from excess silt build up and vegetation. Loddon Drive is a private road and therefore gullies and drainage in this area is the responsibility of the residents.

## PARISH COUNCIL

7.5.3 It is recommended that the Parish Council recruit a Flood Warden(s) for Wargrave, who can help manage local flood risk by:

- working within the community to prepare them for future flooding and to develop flood resilience;
- receiving flood alerts/warnings from the Environment Agency directly and ensuring the community is aware of them;
- ensuring the community is aware of what the Environment Agency flood warnings mean, what people need to do and where further information can be obtained;
- assisting during floods by supporting people in the community;
- being a conduit for the flow of information between Wokingham Borough Council and the community;
- identifying vulnerable people within the community who may need special assistance during flood events; and
- reporting blocked drains, ditches and other watercourse issues to the relevant authorities.

## ENVIRONMENT AGENCY

7.5.4 The feasibility and benefits of clearing and allowing the free flow of water through Heron's Ditch should be investigated to determine whether this channel can help alleviate excess volume during flood periods. The channel is currently blocked off due to a large volume of rubble in the channel. If feasible, the downstream flood risk impact of these works must be investigated prior to these works being undertaken and work must not be undertaken if shown to worsen flood risk in other areas.

7.5.5 The feasibility and benefits of clearing and allowing the free flow of water through the bypass channel, located between the River Thames and Heron's Ditch, should also be investigated. This channel is presently badly silted.

## THAMES WATER

7.5.6 The potential for increasing the wet well at the Thames Water Sewer Treatment Works in Wargrave should be investigated to determine whether this well can feasibly provide additional capacity and reduce the volume of excess sewage water that is discharged into the River Loddon during a flood event.

# GLOSSARY OF TERMS AND CONDITIONS

- **Balancing Ponds**: large concave areas of open land designated to temporarily accommodate excess surface water, when a storm generates runoff in excess of the capacity of the drainage system.
- **Borehole:** there are a series of boreholes managed by the Environment Agency which are used to monitor groundwater levels in the aquifer deep beneath areas of Wokingham.
- **Borehole Monitoring:** groundwater levels in the aquifer are monitored throughout the year by the Environment Agency. During the winter months, as levels begin to rise, the frequency of monitoring is increased and the results are passed to Wokingham Borough Council for information purposes.
- **Climate Change:** a long-term change in the statistical distribution of weather patterns over periods of time that range from decades to millions of years. Climate change may be limited to a specific region, or may occur across the whole planet.
- **Culverts:** pipelines usually of a fairly large diameter (450mm or greater) which convey surface water through a catchment to outfall to a river or other major watercourse. Culverts were mostly formed by piping natural watercourses. Maintenance is generally the responsibility of Thames Water except where culverts pass beneath highways, where responsibility passes to Wokingham Borough Council.
- **Ditches:** channels usually man made, cut for the purpose of conveying surface water runoff to streams and rivers. Maintenance is typically the responsibility of the riparian landowner.
- **Drains:** pipelines which convey foul sewage or surface water runoff from a single property. A drain is still a drain, even if it passes outside of a property boundary, until it joins a sewer. Maintenance is the responsibility of the property owner.
- **Floodplain:** this is a natural feature and is defined as an area of land along the course of a river valley that has historically been the subject of flooding. Floodplain extents are detailed on statutory definitive maps published by the Environment Agency.
- **Flood Warden:** a local volunteer responsible for raising awareness within the local community about the prevention of flooding and acting as a focal point for flood issues. The Environment Agency, Wokingham Borough Council and the emergency services can communicate directly with them if necessary.
- **Fluvial: Fluvial flooding occurs when the capacity of a river (designated as Main River) is exceeded or the channel becomes blocked, causing water to spill onto the floodplain.**
- **Highway Drains:** pipelines which convey surface water runoff from the public highway only. Highway drains discharge to public sewers, watercourses and rivers. Maintenance is the responsibility of Wokingham Borough Council.
- **Highway Grips:** small channels which cut through highway verges to convey surface water runoff from the highway directly to roadside ditches or watercourses. Maintenance is the responsibility of Wokingham Borough Council.
- **Highway Gullies:** receive surface water runoff from the highway, trapping minor debris before the water is discharged into the highway drains. Maintenance is the responsibility of Wokingham Borough Council.
- **Main River:** usually larger streams and rivers, but also include smaller watercourses of strategic drainage importance. A main river is defined as a watercourse shown as such on a main river map, and can include any structure or appliance for controlling or regulating flow or

water in, into or out of a main river. The Environment Agency's powers to carry out flood defence works apply to main rivers only. Main rivers are designated by Defra.

- **Manholes:** chambers constructed on sewers at changes of direction or level in the pipeline and for the purpose of gaining access for maintenance purposes.
- **Ordinary watercourses:** any other river, stream, ditch, cut, sluice, dyke or non-public sewer which is not a Main River.
- **Pluvial:** Pluvial flooding occurs when the capacity of a river (designated as Main River) is exceeded or the channel becomes blocked, causing water to spill onto the floodplain.
- **Private sewers:** any sewers which are not public sewers. Maintenance is the responsibility jointly of the property owners/beneficiaries.
- **Public sewers:** sewers which have been adopted as public sewers or were in use before 1st October 1937. Maintenance is the responsibility of Thames Water.
- **Riparian landowners:** under common law riparian landowners are responsible for the maintenance of any watercourse within or adjacent to the boundary of their property. Where a watercourse is sited between two or more property boundaries each owner may be equally responsible. A riparian owner is responsible for the maintenance of the bank and bed to avoid any obstruction of flow in the watercourse.
- **Sewers:** pipelines which convey foul sewage or surface water runoff from more than one property. Sewers may be either public or private.
- **Sluices:** control structures on watercourses, primarily rivers and canals, constructed for the purpose of controlling water levels and flows. Maintenance is the responsibility of individual owners, however the Environment Agency has prescriptive management rights to enable them to maintain or operate the sluices should they need to.
- **Trash Screens:** metal grilles fixed across the entry points to culverts to prevent children and animals gaining access and to prevent debris being washed in. Maintenance responsibility depends on the precise location but it generally the responsibility of either Thames Water or Wokingham Borough Council.
- **Trigger levels:** based on past experience each borehole has been assigned a trigger level. The trigger level, which varies from borehole to borehole, is a datum level below ground, above which rises in the water table are more closely monitored. They do not indicate impending flooding.

Date Modified: 06/10/2014

Drawn By: ukcxf016

## KEY

- Parish Boundary
- Flood Extent
- Main Rivers

**Properties Flooded**

- External
- Direction of Flow

RIVER LODDON

Blackwater River

SURFACE WATER RUNOFF FLOWED ALONG THE B3349 AND DOWN THE STREET - WATER FROOZE AT THE JUNCTION, RESULTING IN TWO ROAD TRAFFIC ACCIDENTS IN JAN 2014

THAMES WATER PUMPING STATION

SWALLOWFIELD PARK DRIVE

PITT BRIDGE

GROUNDWATER ROSE IN THE REAR GARDENS OF 3 PROPERTIES ON THE STREET

RAW SEWAGE IN THE FLOOD WATER

PUMPING STATION (TO BE ADOPTED BY THAMES WATER)

SWALLOWFIELD PARK DITCH

CHURCH ROAD BRIDGE

PART LANE WAS OFFICIALLY CLOSED - THE WATER WAS APPROXIMATELY 600MM DEEP

CHURCH ROAD DRAINAGE DITCH

BRAMBLES

APPROXIMATE LOCATION OF THE HIGHWAY DRAINAGE SOAKAWAY CONSTRUCTED APPROXIMATELY 5 YEARS PRIOR TO THE WINTER 2013/14 FLOOD EVENT

DITCH DUG PRIOR TO THE FLOOD EVENT TO IMPROVE SURFACE WATER DRAINAGE

BROOKFIELD NURSERY

SURFACE WATER DRAINAGE SYSTEM

BROOKSIDE NURSERY DITCH

TROWE'S LANE

THE NAYLORS DITCH

PART LANE DITCH

PIGEON DITCH

Girdlers

Recn Gd

Hall

Depot

THE STREET

B3349

FOXBOROUGH

CHURCH ROAD

Brookside Nursery

Swallowfield

Oakleigh House

Oakleigh Farm

CHARLTON LANE

0 0.0225 0.045 0.09 0.135 0.18 Kilometres



WSP | PARSONS BRINCKERHOFF

**WINTER 2013-14 FLOOD INVESTIGATION REPORT**

SWALLOWFIELD FLOOD SURVEY PLAN
SHEET 1 OF 1

FIGURE 70007120/02/101

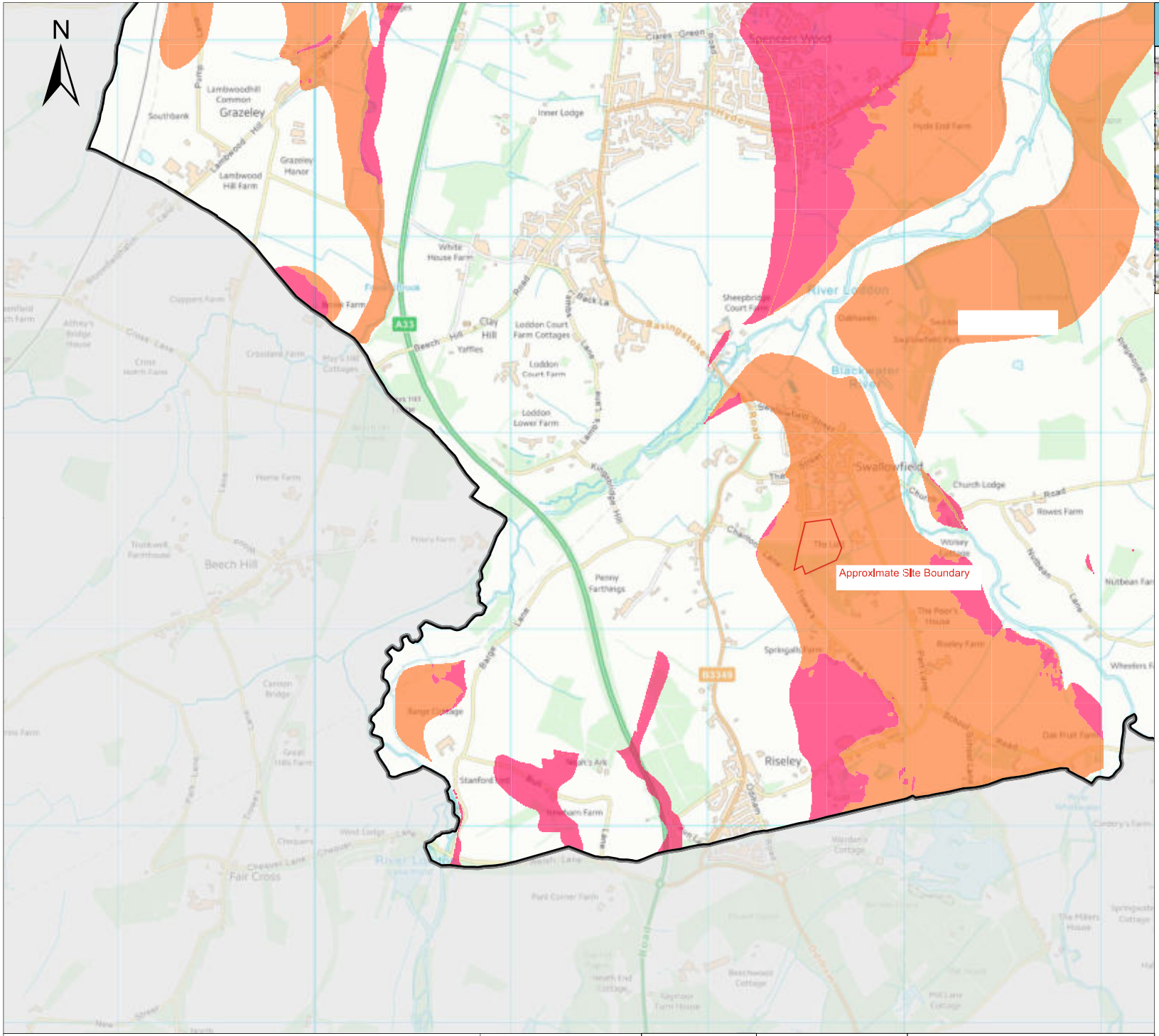
JUNE 2015

1:3,500

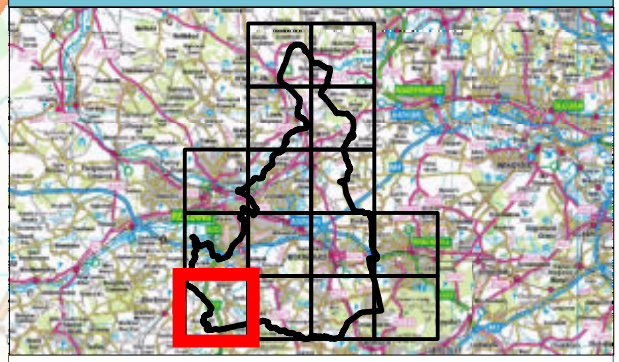
File: Q:\WSP_UK\WSP_D\Basing\Wokingham Flood Investigation\Arborfield.mxd

## Appendix K

Strategic Flood Risk Assessment - Areas Susceptible to Groundwater Flooding and Groundwater Emergence mapping




## Wokingham Level 1 Strategic Flood Risk Assessment



### Legend

Wokingham Borough Council boundary

**Watercourses**
- Main Rivers
- All Watercourses

**Fluvial Flood Zones**
- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2

**Fluvial Flood Extent with Climate Change**
- 1% AEP with Central Climate Change allowance
- 1% AEP with Higher Central Climate Change allowance

**Risk of Flooding from Surface Water**

**Surface Water Extent**
- 3.3% AEP
- 1% AEP
- 0.1% AEP

**Surface Water Extent plus climate change**
- 3.3% AEP plus 35% climate change
- 1% AEP plus 40% climate change

**Risk of Groundwater Flooding**

EA Areas Susceptible to Groundwater Flooding
- < 25%
- >= 25% <50%
- >= 50% <75%
- >= 75%

**JBA Groundwater Emergence Map 5m Resolution)**

Depth below ground surface
- =/-0.025m
- 0.025m - 0.5m
- 0.5m - 5m
- =/5m+
- No risk

**Risk of Flooding from Reservoirs**
- Risk of Reservoir flooding- Wet Day
- Risk of Reservoir flooding- Dry Day

**Flood Defences**
- Demountable Defence
- Embankment
- Wall
- Natural High Ground

**Flood Mitigation**
- Flood Alert Areas
- Flood Warning Areas

**Flood History**
- EA Historic Flood map



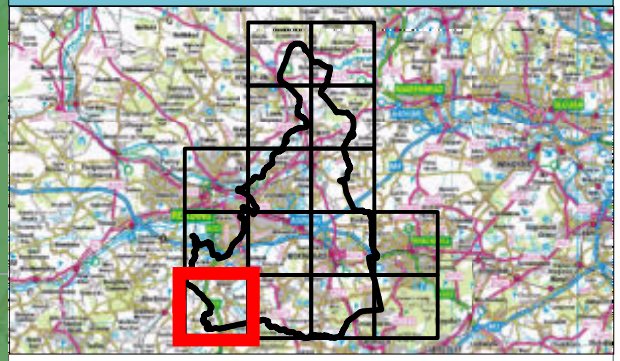
0 250 500 M

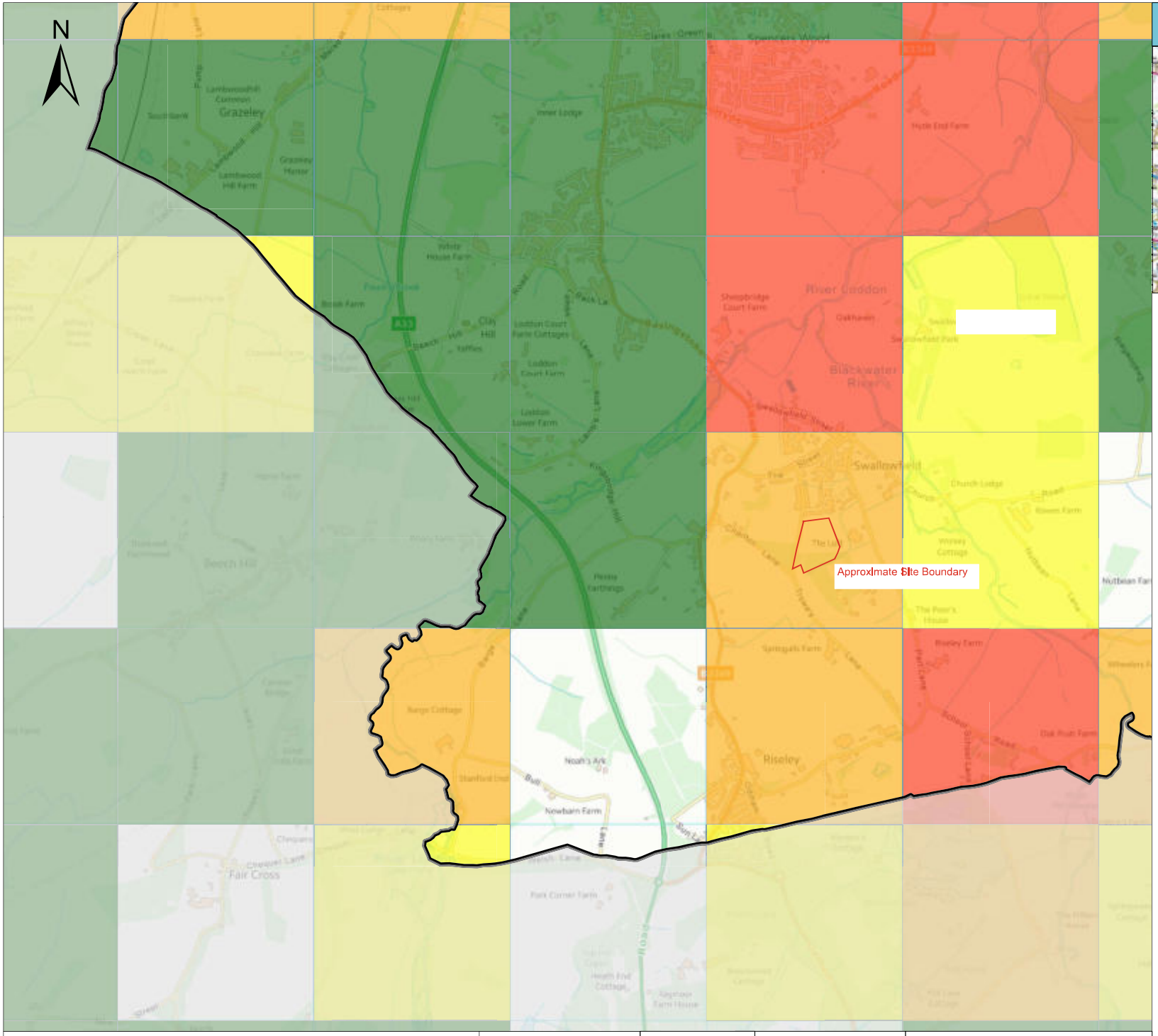


IDT-JBAU-XX-XX-MP-HM-0002-GeoPDF_E1

**Notes**
Please see the accompanying user guide of the SFRA report for further guidance on the sources of data included within the map.
This map should be opened using Adobe Acrobat Reader.

# Wokingham Level 1 Strategic Flood Risk Assessment






## Legend

Wokingham Borough Council boundary

**Watercourses**
- Main Rivers
- All Watercourses

**Fluvial Flood Zones**
- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2

**Fluvial Flood Extent with Climate Change**
- 1% AEP with Central Climate Change allowance
- 1% AEP with Higher Central Climate Change allowance

**Risk of Flooding from Surface Water**

**Surface Water Extent**
- 3.3% AEP
- 1% AEP
- 0.1% AEP

**Surface Water Extent plus climate change**
- 3.3% AEP plus 35% climate change
- 1% AEP plus 40% climate change

**Risk of Groundwater Flooding**

EA Areas Susceptible to Groundwater Flooding
- < 25%
- >= 25% <50%
- >= 50% <75%
- >= 75%

**JBA Groundwater Emergence Map 5m Resolution)**

Depth below ground surface
- =/-0.025m
- 0.025m - 0.5m
- 0.5m - 5m
- =/5m+
- No risk

**Risk of Flooding from Reservoirs**
- Risk of Reservoir flooding- Wet Day
- Risk of Reservoir flooding- Dry Day

**Flood Defences**
- Demountable Defence
- Embankment
- Wall
- Natural High Ground

**Flood Mitigation**
- Flood Alert Areas
- Flood Warning Areas

**Flood History**
- EA Historic Flood map



0 250 500 M



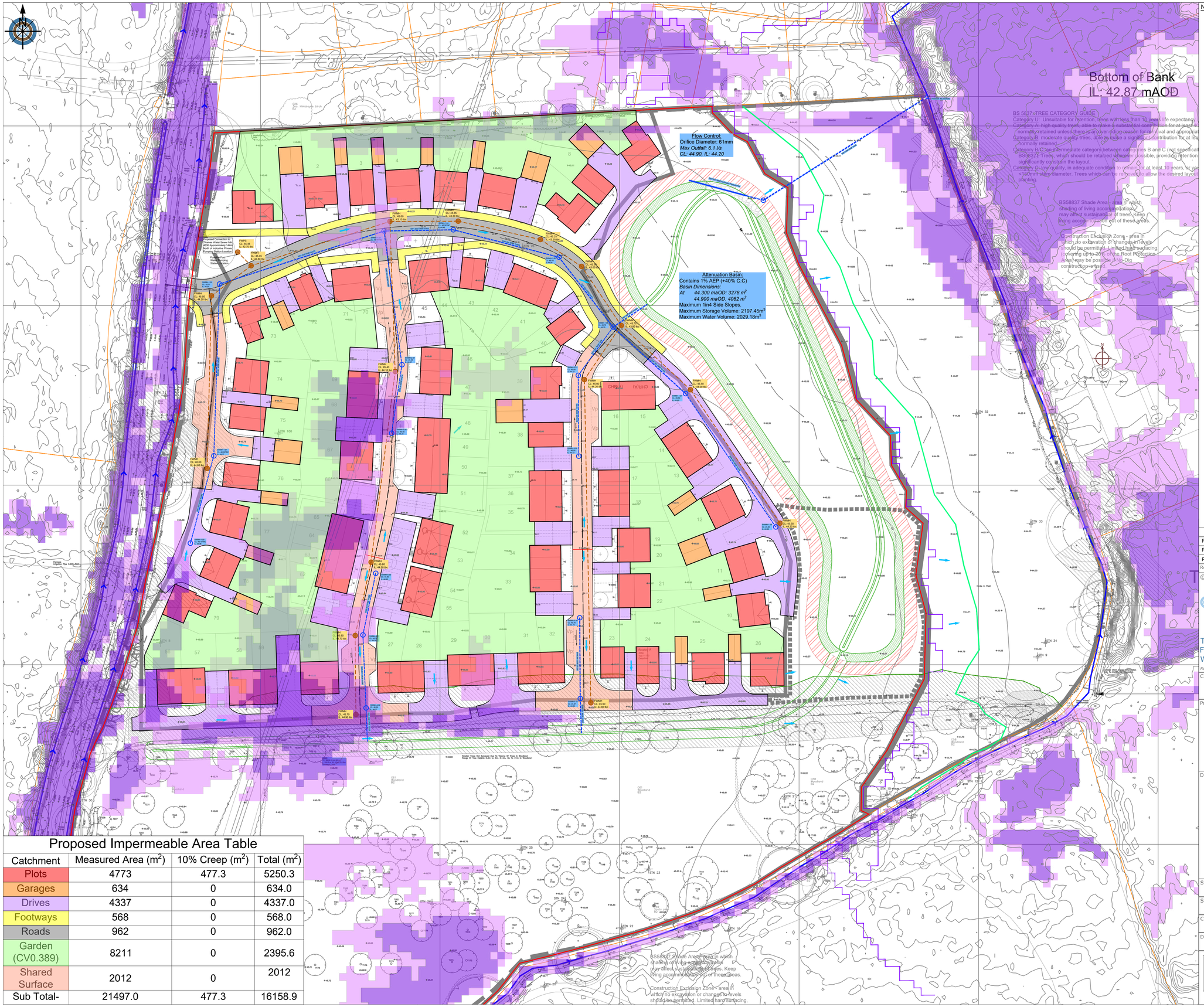
IDT-JBAU-XX-XX-MP-HM-0002-GeoPDF_E1

**Notes**

Please see the accompanying user guide of the SFRA report for further guidance on the sources of data included within the map. This map should be opened using Adobe Acrobat Reader.

## Appendix L

Proposed Drainage Strategy Drawings




NOTES:

1. This drawing is to be read in conjunction with GHB series 159/2025 drawings and documents and any other relevant project team documents.
2. Preliminary Issue - This drawing is not to be used for construction or detailed pricing purposes. Any work undertaken before approvals are received (in writing) are at risk of abortive works.
3. This drawing has been produced based upon the following information:
   Topographical Survey by RANDALL SURVEYS (Ref. 16781/LT/1 dated May 2022) subject to transformation of :
   Scale 1 and translation (0,0,0) about point (0,0,0).
   Architectural Layout by JCN DESIGN (Ref. CC017 dated Sep 2025) subject to transformation of :
   Scale 1 and translation (0,0,0) about point (0,0,0).
4. All site levels and finished floor levels to remain indicative for planning purposes and are subject to verification following detailed design.
5. This drawing has been prepared solely for the purpose of obtaining a Planning Consent based on information available and planning requirements at the date of issue only.

LEGEND

- Site Boundary- Area: 4.8 ha
- Existing Open Channel Watercourse
- Greenfield: Greenfield run-off rate: 2.8 l/s/ha
- Proposed Attenuation Basin
- Proposed Swale
- Flow Control- Discharge rate: 6.2l/s
- Defra Data Services Platform Environment Agency Risk of Flooding from Surface Water Climate Change 1 - HIGH RISK (>3.3% AEP)
- Defra Data Services Platform Environment Agency Risk of Flooding from Surface Water Change 1 - MEDIUM RISK (1%-3.3%)
- Environment Agency Product 4 Flood Level Data:1%+20% Climate Change Defences Removed Flood Level: 44.64-44.69mAOD.
- Primary Contours (0.5m)
- Proposed Exceedance Flowpath
- 00.00 Indicative Proposed Levels
- Indicative Surface Water Network
- Indicative Foul Water Network

## Proposed Impermeable Area Table

| Catchment | Measured Area ($m^2$) | 10% Creep ($m^2$) | Total ($m^2$) |
|---|---|---|---|
| Plots | 4773 | 477.3 | 5250.3 |
| Garages | 634 | 0 | 634.0 |
| Drives | 4337 | 0 | 4337.0 |
| Footways | 568 | 0 | 568.0 |
| Roads | 962 | 0 | 962.0 |
| Garden (CV0.389) | 8211 | 0 | 2395.6 |
| Shared Surface | 2012 | 0 | 2012 |
| Sub Total- | 21497.0 | 477.3 | 16158.9 |

| Rev | Rev Date | Description | Drawn | Chck'd |
|---|---|---|---|---|
| P3 | 25/09/25 | Note Highlighting the Proximity of the Thames Water Foul Network | BAF | JAH |
| P2 | 19/09/25 | Product 4 Data Range Shown | PRJ | JAH |
| P1 | 19/09/25 | Initial Issue | PRJ | JAH |



GHBullard & Associates LLP
Civil and Traffic Engineering Consultants
27 Barton Road,
Thurston,
Suffolk,
IP31 3PA
T: (01359) 235071
F: (01359) 231138
W: http://www.ghbullard.co.uk
Partnership No. OC383830, Registered in England and Wales

Client: CITY AND COUNTRY

Project: TROWES LANE, SWALLOWFIELD, WOKINGHAM

Drawing Title: FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY INDICATIVE IMPERMEABLE AREA PLAN AND PROPOSED DRAINAGE STRATEGY

Status: FOR INFORMATION

Scale: 1:500 @ A1

Created: SEP 2025 | Drawn: PRJ

DWG Reference: 159-2025.DWG | Checked: JAH

Drawing Number: 159/2025/004

Revision: P3

P# = Preliminary, C# = Construction, AB# = As Built

D400 Ductile Iron Double Cover and Frame (600 mm x 600 mm x 100 mm) to BS-EN 124, Bedded on Class M1, M2 or Epoxy Mortar

2No.Courses Class B Engineering Brickwork (215 mm thick) to BS 5911 Bedded on and Pointed in Sand/Cement Mortar (10 mm thick)

Precast Cover Slab to BS-EN1917 and BS 5911 Bedded on Sand/Cement Mortar (10 mm thick)

DN1200* Precast Chamber Sections to BS 5911 (Lifting Eyes to be Pointed) Bedded with Mortar, Proprietary Bitumen or Resin Mastic Sealant
*(**Bottom Precast Section to be Built Min. 75 mm into Concrete Foundation)*

In-Situ Class C32/40 Concrete Surround (150 mm thick) to SHW Clause 1704

600 mm (length) Rocker Pipe of Bend on All Inlets and Outlets

Construction Joint

In-Situ Class C32/40 Concrete Foundation to SHW Clause 1704

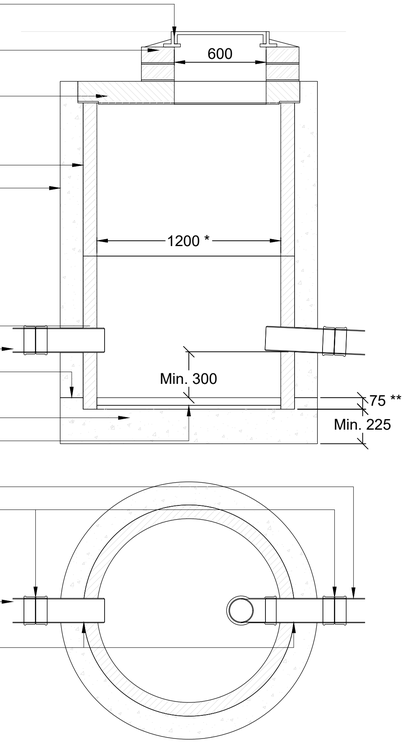
Mortar Fillet (50 mm thick)

Outlet Pipe (Invert Level and Diameter as Detailed on Plan)

Flexible Joint within 600 mm of Inside Face of Manhole

Inlet Pipe (Invert Level and Diameter as Detailed on Plan)

Entry & Exit Points Thoroughly Packed and Sealed with Mortar Around Joints




| *Largest Pipe Diameter* | **Internal Diameter of Chamber* |
|---|---|
| *<375* | *1200* |
| *375 to 700* | *1500* |

TYPICAL CATCHPIT DETAIL

D400 Ductile Iron Double Cover and Frame (600 mm x 600 mm x 100 mm) to BS-EN 124, Bedded on Class M1, M2 or Epoxy Mortar

2No.Courses Class B Engineering Brickwork (215 mm thick) to BS 5911 Bedded on and Pointed in Sand/Cement Mortar (10 mm thick)

Precast Cover Slab to BS-EN1917 and BS 5911 Bedded on Sand/Cement Mortar (10 mm thick)

DN1200* Precast Chamber Sections to BS 5911 (Lifting Eyes to be Pointed) Bedded with Mortar, Proprietary Bitumen or Resin Mastic Sealant
*(**Bottom Precast Section to be Built Min. 75 mm into Concrete Foundation)*

In-Situ Class C32/40 Concrete Surround (150 mm thick) to SHW Clause 1704

In-Situ Class C32/40 Concrete Mounting Block to SHW Clause 1704

300 mm x 300 mm x 10 mm Stainless Steel Orifice Plate (with 61 mm Orifice) Bolted to Mounting Block with 4No. M12 Stainless Steel Resin/Chemical Resistant Anchor Bolts (Min. embedment 75 mm) and Neoprene Gasket/Seal between Plate and Mounting Block.

600 mm (length) Rocker Pipe of Bend on All Inlets and Outlets

Construction Joint

In-Situ Class C32/40 Concrete Foundation to SHW Clause 1704

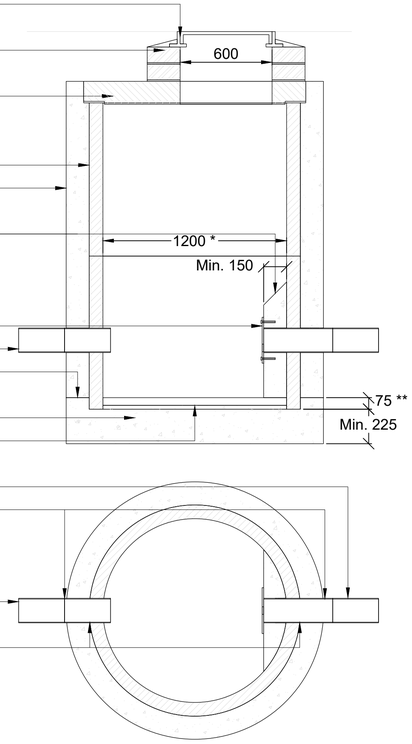
Mortar Fillet (50 mm thick)

Outlet Pipe (Invert Level and Diameter as Detailed on Plan)

Flexible Joint within 600 mm of Inside Face of Manhole

Inlet Pipe (Invert Level and Diameter as Detailed on Plan)

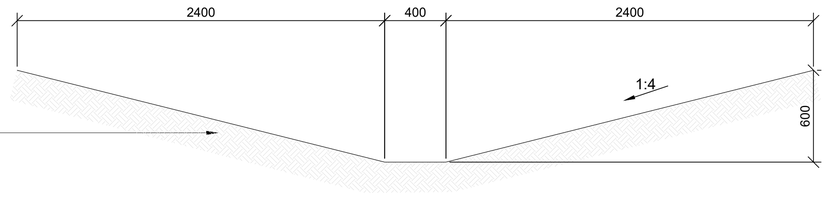
Entry & Exit Points Thoroughly Packed and Sealed with Mortar Around Joints



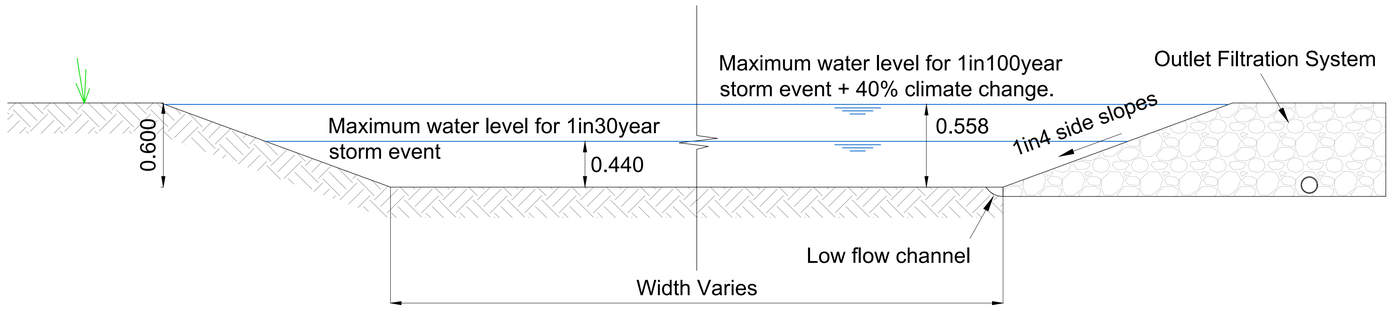

| *Largest Pipe Diameter* | **Internal Diameter of Chamber* |
|---|---|
| *<375* | *1200* |
| *375 to 700* | *1500* |

TYPICAL ORIFICE PLATE FLOW CONTROL CATCHPIT DETAIL

300 - 400 Landscaping and Topsoil Specially Selected for Use in Wet Flow Conditions. Turfed or Seeded with Swale Vegetation in Coir Matting until Vegetation Established.




TYPICAL SWALE PROFILE




Typical section: Attenuation Basin With Outlet Filtration System

NOTES:

1. This drawing is to be read in conjunction with GHB series 159/2025 drawings and documents and any other relevant project team documents.
2. Preliminary Issue - This drawing is not to be used for construction or detailed pricing purposes. Any work undertaken before approvals are received (in writing) are at risk of abortive works.
3. This drawing has been produced based upon the following information:
   Topographical Survey by RANDALL SURVEYS (Ref. 16781/LT/1 dated May 2022) subject to transformation of :
   Scale 1 and translation (0,0,0) about point (0,0,0).
   Architectural Layout by JCN DESIGN (Ref. CC017 dated Sep 2025) subject to transformation of :
   Scale 1 and translation (0,0,0) about point (0,0,0).
4. All site levels and finished floor levels to remain indicative for planning purposes and are subject to verification following detailed design.
5. This drawing has been prepared solely for the purpose of obtaining a Planning Consent based on information available and planning requirements at the date of issue only.

| Rev | Rev Date | Description | Drawn | Chck'd |
|---|---|---|---|---|
| P2 | 25/09/25 | Drawing Revised Based Upon Client Comments | BAF | JAH |
| P1 | 19/09/25 | Initial Issue | PRJ | JAH |



GHBullard & Associates LLP
Civil and Traffic Engineering Consultants
27 Barton Road,
Thurston,
Suffolk,
IP31 3PA
T: (01359) 235071
F: (01359) 231138
W: http://www.ghbullard.co.uk
Partnership No. OC383830, Registered in England and Wales

Client: CITY AND COUNTRY

Project: TROWES LANE, SWALLOWFIELD, WOKINGHAM

Drawing Title: FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY CONSTRUCTION DETAILS

Status: FOR INFORMATION

Scale: N.T.S

Created: SEP 2025 | Drawn: PRJ

DWG Reference: 159-2025.DWG | Checked: JAH

Drawing Number: 159/2025/005 | Revision: P2

*P# = Preliminary, C# = Construction, AB# = As Built*

## Appendix M

Info-Drainage Calculations

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Junctions<br>Storm Phase: Phase | Company Address: | | |

## Outlets

| Junction | Outlet Name | Outgoing Connection | Outlet Type |
|---|---|---|---|
| SWMH1.00 | Outlet | SW1.000 | Free Discharge |
| SWMH1.01 | Outlet | SW1.001 | Free Discharge |
| SWMH1.02 | Outlet | SW1.002 | Free Discharge |
| SWMH2.00 | Outlet | SW2.000 | Free Discharge |
| SWMH2.01 | Outlet | SW2.001 | Free Discharge |
| SWMH1.03 | Outlet | SW1.003 | Free Discharge |
| SWMH1.04 | Outlet | SW1.004 | Free Discharge |
| SWMH1.05 | Outlet | SW1.005 | Free Discharge |
| SWMH3.00 | Outlet | SW3.000 | Free Discharge |
| SWMH3.01 | Outlet | SW3.001 | Free Discharge |
| SWMH4.00 | Outlet | SW4.000 | Free Discharge |
| SWMH4.01 | Outlet | SW4.001 | Free Discharge |
| SWMH1.06 | Outlet | SW1.006 | Free Discharge |
| SWMH5.00 | Outlet | SW5.000 | Free Discharge |
| SWMH5.01 | Outlet | SW5.001 | Free Discharge |
| SWMH16 | Outlet | SW5.002 | Free Discharge |
| SWMH6.00 | Outlet | SW6.000 | Free Discharge |
| SWMH6.01 | Outlet | SW6.001 | Free Discharge |
| SWFCC1.07 | Outlet | SW1.008 | Orifice |
| | Diameter (m) | 0.061 | |
| | Coefficient of Discharge | 0.600 | |
| | Invert Level (m) | 44.200 | |

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Stormwater Controls<br>Storm Phase: Phase | Company Address: | | |

**Pond**

Type : Pond

## Dimensions

| | |
|---|---|
| Exceedance Level (m) | 44.900 |
| Depth (m) | 0.600 |
| Base Level (m) | 44.300 |
| Freeboard (mm) | 0 |
| Initial Depth (m) | 0.000 |
| Porosity (%) | 100 |
| Average Slope (1:X) | 6.078 |
| Total Volume (m³) | 2197.447 |

| Depth (m) | Area (m²) | Volume (m³) |
|---|---|---|
| 0.000 | 3278.390 | 0.000 |
| 0.600 | 4060.361 | 2197.447 |

## Advanced

| | |
|---|---|
| Perimeter | Circular |
| Length (m) | 143.549 |
| Friction Scheme | Manning's n |
| n | 0.045 |

**Swale**

Type : Swale

## Swale

| | |
|---|---|
| Exceedance Level (m) | 45.190 |
| Depth (m) | 0.600 |
| Base Level (m) | 44.590 |
| Top Width (m) | 5.200 |
| Side Slope (1:X) | 4.00 |
| Base Width (m) | 0.400 |
| Freeboard (mm) | 0 |
| Length (m) | 201.300 |
| Long. Slope (1:X) | 333.30 |
| Filtration Rate (m/hr) | 0.0 |
| Friction Scheme | Manning's n |
| n | 0.045 |
| Total Volume (m³) | 338.184 |

## Advanced

### Swale

| | |
|---|---|
| Porosity (%) | 100 |

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Inflow Summary<br>Storm Phase: Phase | Company Address: | | |

| Inflow Label | Connected To | Flow (L/s) | Runoff Method | Area (ha) | Percentage Impervious (%) | Urban Creep (%) | Adjusted Percentage Impervious (%) | Area Analysed (ha) |
|---|---|---|---|---|---|---|---|---|
| Basin Area | Pond | | Time of Concentration | 0.406 | 100 | 0 | 100 | 0.406 |
| Catchment Area | SWMH3.00 | | Time of Concentration | 0.011 | 100 | 10 | 110 | 0.012 |
| Catchment Area (1) | SWMH3.00 | | Time of Concentration | 0.009 | 100 | 10 | 110 | 0.009 |
| Catchment Area (2) | SWMH6.00 | | Time of Concentration | 0.009 | 100 | 10 | 110 | 0.009 |
| Catchment Area (3) | SWMH1.05 | | Time of Concentration | 0.008 | 100 | 10 | 110 | 0.009 |
| Catchment Area (4) | SWMH5.00 | | Time of Concentration | 0.019 | 100 | 10 | 110 | 0.021 |
| Catchment Area (5) | SWMH2.00 | | Time of Concentration | 0.010 | 100 | 10 | 110 | 0.011 |
| Catchment Area (6) | SWMH2.01 | | Time of Concentration | 0.011 | 100 | 10 | 110 | 0.012 |
| Catchment Area (7) | SWMH2.01 | | Time of Concentration | 0.011 | 100 | 10 | 110 | 0.012 |
| Catchment Area (8) | SWMH2.00 | | Time of Concentration | 0.019 | 100 | 10 | 110 | 0.021 |
| Catchment Area (9) | SWMH5.00 | | Time of Concentration | 0.011 | 100 | 10 | 110 | 0.012 |
| Catchment Area (10) | SWMH5.00 | | Time of Concentration | 0.011 | 100 | 10 | 110 | 0.012 |
| Catchment Area (11) | SWMH6.00 | | Time of Concentration | 0.011 | 100 | 10 | 110 | 0.012 |
| Catchment Area (12) | SWMH3.00 | | Time of Concentration | 0.013 | 100 | 10 | 110 | 0.014 |
| Catchment Area (13) | SWMH3.00 | | Time of Concentration | 0.007 | 100 | 10 | 110 | 0.007 |
| Catchment Area (14) | SWMH3.01 | | Time of Concentration | 0.008 | 100 | 10 | 110 | 0.008 |
| Catchment Area (15) | SWMH4.01 | | Time of Concentration | 0.012 | 100 | 10 | 110 | 0.013 |
| Catchment Area (16) | SWMH4.01 | | Time of Concentration | 0.011 | 100 | 10 | 110 | 0.012 |
| Catchment Area (17) | SWMH4.00 | | Time of Concentration | 0.009 | 100 | 10 | 110 | 0.009 |
| Catchment Area (18) | SWMH4.00 | | Time of Concentration | 0.009 | 100 | 10 | 110 | 0.009 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Catchment Area (19) | SWMH4.00 | | Time of Concentration | 0.008 | 100 | 10 | 110 | 0.008 |
| Catchment Area (20) | SWMH6.01 | | Time of Concentration | 0.009 | 100 | 10 | 110 | 0.009 |
| Catchment Area (21) | SWMH6.01 | | Time of Concentration | 0.008 | 100 | 10 | 110 | 0.008 |
| Catchment Area (22) | SWMH6.01 | | Time of Concentration | 0.007 | 100 | 10 | 110 | 0.007 |
| Catchment Area (23) | SWMH6.01 | | Time of Concentration | 0.006 | 100 | 10 | 110 | 0.006 |
| Catchment Area (24) | SWMH6.01 | | Time of Concentration | 0.011 | 100 | 10 | 110 | 0.012 |
| Catchment Area (25) | SWMH6.01 | | Time of Concentration | 0.011 | 100 | 10 | 110 | 0.012 |
| Catchment Area (26) | SWMH16 | | Time of Concentration | 0.011 | 100 | 10 | 110 | 0.012 |
| Catchment Area (27) | Swale | | Time of Concentration | 0.010 | 100 | 10 | 110 | 0.011 |
| Catchment Area (28) | Swale | | Time of Concentration | 0.013 | 100 | 10 | 110 | 0.014 |
| Catchment Area (29) | Swale | | Time of Concentration | 0.013 | 100 | 10 | 110 | 0.014 |
| Catchment Area (30) | SWMH1.00 | | Time of Concentration | 0.008 | 100 | 10 | 110 | 0.009 |
| Catchment Area (31) | SWMH1.00 | | Time of Concentration | 0.008 | 100 | 10 | 110 | 0.008 |
| Catchment Area (32) | SWMH1.00 | | Time of Concentration | 0.009 | 100 | 10 | 110 | 0.009 |
| Catchment Area (33) | SWMH1.00 | | Time of Concentration | 0.007 | 100 | 10 | 110 | 0.007 |
| Catchment Area (34) | SWMH1.01 | | Time of Concentration | 0.007 | 100 | 10 | 110 | 0.007 |
| Catchment Area (35) | SWMH1.01 | | Time of Concentration | 0.009 | 100 | 10 | 110 | 0.009 |
| Catchment Area (36) | SWMH1.02 | | Time of Concentration | 0.008 | 100 | 10 | 110 | 0.009 |
| Catchment Area (37) | SWMH1.02 | | Time of Concentration | 0.006 | 100 | 10 | 110 | 0.006 |
| Catchment Area (38) | SWMH1.03 | | Time of Concentration | 0.010 | 100 | 10 | 110 | 0.011 |
| Catchment Area (39) | SWMH1.04 | | Time of Concentration | 0.010 | 100 | 10 | 110 | 0.011 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Catchment Area (40) | SWMH1.05 | | Time of Concentration | 0.006 | 100 | 10 | 110 | 0.006 |
| Catchment Area (41) | SWMH1.06 | | Time of Concentration | 0.006 | 100 | 10 | 110 | 0.006 |
| Catchment Area (42) | SWMH1.05 | | Time of Concentration | 0.011 | 100 | 10 | 110 | 0.012 |
| Catchment Area (43) | SWMH1.05 | | Time of Concentration | 0.008 | 100 | 10 | 110 | 0.009 |
| Catchment Area (44) | SWMH1.05 | | Time of Concentration | 0.007 | 100 | 10 | 110 | 0.007 |
| Catchment Area (45) | SWMH1.04 | | Time of Concentration | 0.009 | 100 | 10 | 110 | 0.009 |
| Catchment Area (46) | SWMH1.04 | | Time of Concentration | 0.008 | 100 | 10 | 110 | 0.008 |
| Catchment Area (47) | SWMH1.03 | | Time of Concentration | 0.009 | 100 | 10 | 110 | 0.009 |
| Catchment Area (48) | SWMH1.03 | | Time of Concentration | 0.007 | 100 | 10 | 110 | 0.007 |
| Catchment Area (49) | SWMH1.03 | | Time of Concentration | 0.008 | 100 | 10 | 110 | 0.008 |
| Catchment Area (50) | SWMH1.02 | | Time of Concentration | 0.008 | 100 | 10 | 110 | 0.009 |
| Catchment Area (51) | SWMH3.01 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (52) | SWMH1.03 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (53) | SWMH4.01 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (54) | SWMH4.00 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (55) | SWMH4.00 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (56) | SWMH6.01 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (57) | SWMH6.01 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (58) | SWMH1.00 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (59) | SWMH1.00 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (60) | SWMH1.00 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Catchment Area (61) | SWMH1.01 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (62) | SWMH1.01 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (63) | SWMH1.02 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (64) | SWMH1.05 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (65) | SWMH1.05 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (66) | SWMH1.04 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (67) | SWMH1.04 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (68) | SWMH1.03 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (69) | SWMH1.03 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (70) | SWMH1.03 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (71) | SWMH1.03 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (72) | SWMH1.03 | | Time of Concentration | 0.010 | 100 | 0 | 100 | 0.010 |
| Catchment Area (73) | Swale | | Time of Concentration | 0.047 | 100 | 0 | 100 | 0.047 |
| Catchment Area (74) | SWMH2.01 | | Time of Concentration | 0.007 | 100 | 0 | 100 | 0.007 |
| Catchment Area (75) | SWMH1.01 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (76) | SWMH1.01 | | Time of Concentration | 0.004 | 100 | 0 | 100 | 0.004 |
| Catchment Area (77) | SWMH2.00 | | Time of Concentration | 0.007 | 100 | 0 | 100 | 0.007 |
| Catchment Area (78) | SWMH5.00 | | Time of Concentration | 0.020 | 100 | 0 | 100 | 0.020 |
| Catchment Area (79) | SWMH1.00 | | Time of Concentration | 0.031 | 100 | 0 | 100 | 0.031 |
| Catchment Area (80) | SWMH5.00 | | Time of Concentration | 0.010 | 100 | 0 | 100 | 0.010 |
| Catchment Area (81) | SWMH5.00 | | Time of Concentration | 0.010 | 100 | 0 | 100 | 0.010 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Catchment Area (82) | SWMH2.00 | | Time of Concentration | 0.009 | 100 | 0 | 100 | 0.009 |
| Catchment Area (83) | SWMH2.01 | | Time of Concentration | 0.007 | 100 | 0 | 100 | 0.007 |
| Catchment Area (84) | SWMH2.01 | | Time of Concentration | 0.007 | 100 | 0 | 100 | 0.007 |
| Catchment Area (85) | SWMH1.05 | | Time of Concentration | 0.004 | 100 | 0 | 100 | 0.004 |
| Catchment Area (86) | SWMH1.05 | | Time of Concentration | 0.007 | 100 | 0 | 100 | 0.007 |
| Catchment Area (87) | SWMH1.04 | | Time of Concentration | 0.004 | 100 | 0 | 100 | 0.004 |
| Catchment Area (88) | SWMH1.03 | | Time of Concentration | 0.004 | 100 | 0 | 100 | 0.004 |
| Catchment Area (89) | SWMH1.02 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (90) | SWMH1.04 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (91) | SWMH1.04 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (92) | SWMH1.05 | | Time of Concentration | 0.008 | 100 | 0 | 100 | 0.008 |
| Catchment Area (93) | SWMH1.05 | | Time of Concentration | 0.021 | 100 | 0 | 100 | 0.021 |
| Catchment Area (94) | SWMH4.00 | | Time of Concentration | 0.073 | 100 | 0 | 100 | 0.073 |
| Catchment Area (95) | SWMH16 | | Time of Concentration | 0.017 | 100 | 0 | 100 | 0.017 |
| Catchment Area (96) | SWMH6.01 | | Time of Concentration | 0.028 | 100 | 0 | 100 | 0.028 |
| Catchment Area (97) | SWMH6.01 | | Time of Concentration | 0.015 | 100 | 0 | 100 | 0.015 |
| Catchment Area (98) | SWMH3.00 | | Time of Concentration | 0.007 | 100 | 0 | 100 | 0.007 |
| Catchment Area (99) | SWMH3.00 | | Time of Concentration | 0.006 | 100 | 0 | 100 | 0.006 |
| Catchment Area (100) | SWMH6.00 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (101) | SWMH6.00 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (102) | SWMH6.00 | | Time of Concentration | 0.007 | 100 | 0 | 100 | 0.007 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Catchment Area (103) | SWMH3.00 | | Time of Concentration | 0.007 | 100 | 0 | 100 | 0.007 |
| Catchment Area (104) | SWMH3.00 | | Time of Concentration | 0.007 | 100 | 0 | 100 | 0.007 |
| Catchment Area (105) | SWMH3.01 | | Time of Concentration | 0.009 | 100 | 0 | 100 | 0.009 |
| Catchment Area (106) | SWMH3.01 | | Time of Concentration | 0.003 | 100 | 0 | 100 | 0.003 |
| Catchment Area (107) | SWMH1.04 | | Time of Concentration | 0.001 | 100 | 0 | 100 | 0.001 |
| Catchment Area (108) | SWMH1.03 | | Time of Concentration | 0.001 | 100 | 0 | 100 | 0.001 |
| Catchment Area (109) | Pond | | Time of Concentration | 0.091 | 100 | 0 | 100 | 0.091 |
| Catchment Area (110) | SWMH1.03 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (111) | SWMH1.02 | | Time of Concentration | 0.005 | 100 | 0 | 100 | 0.005 |
| Catchment Area (112) | SWMH1.03 | | Time of Concentration | 0.001 | 100 | 0 | 100 | 0.001 |
| Catchment Area (113) | SWMH1.02 | | Time of Concentration | 0.006 | 100 | 0 | 100 | 0.006 |
| Catchment Area (114) | SWMH1.06 | | Time of Concentration | 0.015 | 100 | 0 | 100 | 0.015 |
| Catchment Area (115) | SWMH1.06 | | Time of Concentration | 0.023 | 100 | 0 | 100 | 0.023 |
| Catchment Area (116) | SWMH1.02 | | Time of Concentration | 0.002 | 100 | 0 | 100 | 0.002 |
| Catchment Area (117) | SWMH2.00 | | Time of Concentration | 0.089 | 100 | 0 | 100 | 0.089 |
| Catchment Area (118) | SWMH3.00 | | Time of Concentration | 0.074 | 100 | 0 | 100 | 0.074 |
| Catchment Area (119) | SWMH1.01 | | Time of Concentration | 0.037 | 100 | 0 | 100 | 0.037 |
| Catchment Area (121) | Pond | | Time of Concentration | 0.240 | 100 | 0 | 100 | 0.240 |
| Swale Area | Swale | | Time of Concentration | 0.115 | 100 | 0 | 100 | 0.115 |
| **TOTAL** | | **0.0** | | **2.083** | | | | **2.130** |

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Outfall Details<br>Storm Phase: Phase | Company Address: | | |

## Outfalls

| Outfall | Outfall Type | Gated | Fixed Surcharged Level (m) | Level Curve |
|---|---|---|---|---|
| Outfall | Free Discharge | | | |

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Title:<br>Rainfall Analysis Criteria | Company Address: | | |

| | |
|---|---|
| Runoff Type | Dynamic |
| Output Interval (mins) | 5 |
| Time Step | Default |
| Urban Creep | Use Catchment Values |
| Junction Flood Risk Margin (mm) | 300 |
| Perform No Discharge Analysis | ☐ |

## Rainfall

### FEH

Type: FEH

| | |
|---|---|
| Site Location | GB 472601 164487 SU 72601 64487 |
| Rainfall Version | 2022 |
| Summer | ☑ |
| Winter | ☑ |

## Return Period

| Return Period (years) | Increase Rainfall (%) |
|---|---|
| 2.0 | 0.000 |
| 30.0 | 35.000 |
| 100.0 | 40.000 |

## Storm Durations

| Duration (mins) | Run Time (mins) |
|---|---|
| 15 | 30 |
| 30 | 60 |
| 60 | 120 |
| 120 | 240 |
| 180 | 360 |
| 240 | 480 |
| 360 | 720 |
| 480 | 960 |
| 600 | 1200 |
| 720 | 1440 |
| 960 | 1920 |
| 1440 | 2880 |
| 2160 | 4320 |
| 2880 | 5760 |
| 4320 | 8640 |
| 5760 | 11520 |
| 7200 | 14400 |
| 8640 | 17280 |
| 10080 | 20160 |

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Junctions Summary<br>Storm Phase: Phase | Company Address: | | |

**FEH: 2 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Depth**

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Junctions Summary<br>Storm Phase: Phase | Company Address: | | |

| Junction | Storm Event | Cover Level (m) | Invert Level (m) | Max. Level (m) | Max. Depth (m) | Max. Inflow (L/s) | Max. Resident Volume (m³) | Max. Flooded Volume (m³) | Max. Outflow (L/s) | Total Discharge Volume (m³) | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SWMH1.00 | FEH: 2 years: +0 %: 15 mins: Summer | 46.100 | 44.860 | 44.954 | 0.094 | 14.6 | 0.107 | 0.000 | 13.9 | 6.345 | OK |
| SWMH1.01 | FEH: 2 years: +0 %: 15 mins: Summer | 46.000 | 44.770 | 44.891 | 0.121 | 27.9 | 0.137 | 0.000 | 25.2 | 12.431 | OK |
| SWMH1.02 | FEH: 2 years: +0 %: 15 mins: Summer | 45.510 | 44.640 | 44.766 | 0.126 | 34.3 | 0.142 | 0.000 | 27.5 | 16.246 | OK |
| SWMH2.00 | FEH: 2 years: +0 %: 15 mins: Summer | 45.600 | 44.730 | 44.843 | 0.113 | 27.2 | 0.128 | 0.000 | 26.4 | 11.835 | OK |
| SWMH2.01 | FEH: 2 years: +0 %: 15 mins: Summer | 45.600 | 44.640 | 44.766 | 0.126 | 35.6 | 0.142 | 0.000 | 33.2 | 15.847 | OK |
| SWMH1.03 | FEH: 2 years: +0 %: 15 mins: Summer | 45.600 | 44.510 | 44.720 | 0.210 | 76.1 | 0.237 | 0.000 | 65.0 | 38.543 | OK |
| SWMH1.04 | FEH: 2 years: +0 %: 15 mins: Summer | 45.500 | 44.460 | 44.676 | 0.216 | 74.6 | 0.244 | 0.000 | 66.3 | 42.599 | OK |
| SWMH1.05 | FEH: 2 years: +0 %: 15 mins: Summer | 45.550 | 44.390 | 44.632 | 0.242 | 85.1 | 0.274 | 0.000 | 76.0 | 50.604 | OK |
| SWMH3.00 | FEH: 2 years: +0 %: 15 mins: Summer | 46.000 | 44.720 | 44.842 | 0.122 | 29.1 | 0.138 | 0.000 | 28.3 | 12.635 | OK |
| SWMH3.01 | FEH: 2 years: +0 %: 15 mins: Summer | 45.850 | 44.570 | 44.668 | 0.098 | 33.2 | 0.111 | 0.000 | 32.3 | 14.789 | OK |
| SWMH4.00 | FEH: 2 years: +0 %: 15 mins: Summer | 45.500 | 44.900 | 45.001 | 0.101 | 21.6 | 0.114 | 0.000 | 20.5 | 9.405 | OK |
| SWMH4.01 | FEH: 2 years: +0 %: 15 mins: Summer | 45.500 | 44.600 | 44.693 | 0.093 | 26.2 | 0.106 | 0.000 | 24.5 | 11.847 | OK |
| SWMH1.06 | FEH: 2 years: +0 %: 15 mins: Summer | 45.760 | 44.330 | 44.590 | 0.260 | 141.7 | 0.294 | 0.000 | 121.4 | 80.858 | OK |
| SWMH5.00 | FEH: 2 years: +0 %: 15 mins: Summer | 45.800 | 44.900 | 45.379 | 0.479 | 17.4 | 0.542 | 0.000 | 15.4 | 6.375 | Surcharged |
| SWMH5.01 | FEH: 2 years: +0 %: 15 mins: Summer | 45.700 | 44.840 | 45.359 | 0.519 | 15.4 | 0.587 | 0.000 | 15.7 | 4.947 | Surcharged |
| SWMH16 | FEH: 2 years: +0 %: 30 mins: Summer | 45.700 | 44.770 | 45.344 | 0.574 | 20.3 | 0.649 | 0.000 | 15.8 | 10.067 | Surcharged |
| SWMH6.00 | FEH: 2 years: +0 %: 30 mins: Summer | 45.700 | 44.730 | 45.345 | 0.615 | 4.6 | 0.696 | 0.000 | 5.1 | 3.319 | Surcharged |
| SWMH6.01 | FEH: 2 years: +0 %: 30 mins: Summer | 45.870 | 44.630 | 45.345 | 0.715 | 18.6 | 0.809 | 0.000 | 18.7 | 13.222 | Surcharged |
| SWFCC1.07 | FEH: 2 years: +0 %: 960 mins: Winter | 44.900 | 44.200 | 44.469 | 0.269 | 3.8 | 0.304 | 0.000 | 3.8 | 339.976 | OK |
| Outfall | FEH: 2 years: +0 %: 960 mins: Winter | 44.150 | 43.340 | 43.374 | 0.034 | 3.8 | 0.000 | 0.000 | 3.8 | 339.833 | OK |

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Junctions Summary<br>Storm Phase: Phase | Company Address: | | |

**FEH: 30 years: Increase Rainfall (%): +35: Critical Storm Per Item: Rank By: Max. Depth**

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Junctions Summary<br>Storm Phase: Phase | Company Address: | | |

| Junction | Storm Event | Cover Level (m) | Invert Level (m) | Max. Level (m) | Max. Depth (m) | Max. Inflow (L/s) | Max. Resident Volume (m³) | Max. Flooded Volume (m³) | Max. Outflow (L/s) | Total Discharge Volume (m³) | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SWMH1.00 | FEH: 30 years: +35 %: 30 mins: Summer | 46.100 | 44.860 | 45.117 | 0.257 | 32.2 | 0.290 | 0.000 | 31.0 | 27.856 | OK |
| SWMH1.01 | FEH: 30 years: +35 %: 30 mins: Summer | 46.000 | 44.770 | 45.093 | 0.323 | 61.9 | 0.366 | 0.000 | 57.9 | 54.617 | OK |
| SWMH1.02 | FEH: 30 years: +35 %: 15 mins: Summer | 45.510 | 44.640 | 45.097 | 0.457 | 89.9 | 0.517 | 0.000 | 78.2 | 55.189 | Surcharged |
| SWMH2.00 | FEH: 30 years: +35 %: 15 mins: Summer | 45.600 | 44.730 | 45.155 | 0.425 | 92.0 | 0.481 | 0.000 | 67.7 | 40.004 | OK |
| SWMH2.01 | FEH: 30 years: +35 %: 15 mins: Summer | 45.600 | 44.640 | 45.147 | 0.507 | 98.8 | 0.574 | 0.000 | 79.7 | 53.475 | Surcharged |
| SWMH1.03 | FEH: 30 years: +35 %: 15 mins: Summer | 45.600 | 44.510 | 45.094 | 0.584 | 172.0 | 0.661 | 0.000 | 167.6 | 130.941 | Surcharged |
| SWMH1.04 | FEH: 30 years: +35 %: 15 mins: Summer | 45.500 | 44.460 | 45.046 | 0.586 | 200.2 | 0.663 | 0.000 | 194.5 | 144.969 | Surcharged |
| SWMH1.05 | FEH: 30 years: +35 %: 15 mins: Summer | 45.550 | 44.390 | 44.962 | 0.572 | 258.0 | 0.647 | 0.000 | 243.7 | 171.794 | Surcharged |
| SWMH3.00 | FEH: 30 years: +35 %: 15 mins: Summer | 46.000 | 44.720 | 45.287 | 0.567 | 98.2 | 0.642 | 0.000 | 95.4 | 42.614 | Surcharged |
| SWMH3.01 | FEH: 30 years: +35 %: 15 mins: Summer | 45.850 | 44.570 | 45.073 | 0.503 | 112.2 | 0.569 | 0.000 | 106.2 | 49.908 | Surcharged |
| SWMH4.00 | FEH: 30 years: +35 %: 15 mins: Summer | 45.500 | 44.900 | 45.161 | 0.261 | 73.1 | 0.295 | 0.000 | 60.1 | 31.747 | OK |
| SWMH4.01 | FEH: 30 years: +35 %: 15 mins: Winter | 45.500 | 44.600 | 45.008 | 0.408 | 74.9 | 0.461 | 0.000 | 76.4 | 39.999 | Surcharged |
| SWMH1.06 | FEH: 30 years: +35 %: 15 mins: Summer | 45.760 | 44.330 | 44.869 | 0.539 | 455.5 | 0.610 | 0.000 | 502.2 | 274.448 | Surcharged |
| SWMH5.00 | FEH: 30 years: +35 %: 15 mins: Summer | 45.800 | 44.900 | 45.561 | 0.661 | 58.7 | 0.748 | 0.000 | 57.7 | 24.269 | Flood Risk |
| SWMH5.01 | FEH: 30 years: +35 %: 15 mins: Summer | 45.700 | 44.840 | 45.537 | 0.697 | 57.7 | 0.788 | 0.000 | 56.9 | 22.733 | Flood Risk |
| SWMH16 | FEH: 30 years: +35 %: 15 mins: Summer | 45.700 | 44.770 | 45.511 | 0.741 | 76.5 | 0.838 | 0.000 | 75.7 | 30.709 | Flood Risk |
| SWMH6.00 | FEH: 30 years: +35 %: 15 mins: Summer | 45.700 | 44.730 | 45.610 | 0.880 | 24.2 | 0.996 | 0.000 | 23.0 | 9.812 | Flood Risk |
| SWMH6.01 | FEH: 30 years: +35 %: 15 mins: Summer | 45.870 | 44.630 | 45.596 | 0.966 | 94.0 | 1.092 | 0.000 | 92.8 | 38.738 | Flood Risk |
| SWFCC1.07 | FEH: 30 years: +35 %: 1440 mins: Winter | 44.900 | 44.200 | 44.740 | 0.540 | 5.9 | 0.611 | 0.000 | 5.5 | 764.908 | Flood Risk |
| Outfall | FEH: 30 years: +35 %: 1440 mins: Winter | 44.150 | 43.340 | 43.381 | 0.041 | 5.5 | 0.000 | 0.000 | 5.5 | 764.728 | OK |

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Junctions Summary<br>Storm Phase: Phase | Company Address: | | |

**FEH: 100 years: Increase Rainfall (%): +40: Critical Storm Per Item: Rank By: Max. Depth**

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Junctions Summary<br>Storm Phase: Phase | Company Address: | | |

| Junction | Storm Event | Cover Level (m) | Invert Level (m) | Max. Level (m) | Max. Depth (m) | Max. Inflow (L/s) | Max. Resident Volume (m³) | Max. Flooded Volume (m³) | Max. Outflow (L/s) | Total Discharge Volume (m³) | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SWMH1.00 | FEH: 100 years: +40 %: 15 mins: Winter | 46.100 | 44.860 | 45.750 | 0.890 | 62.0 | 1.007 | 0.000 | 72.9 | 28.658 | Surcharged |
| SWMH1.01 | FEH: 100 years: +40 %: 15 mins: Winter | 46.000 | 44.770 | 45.613 | 0.843 | 132.4 | 0.954 | 0.000 | 136.5 | 56.342 | Surcharged |
| SWMH1.02 | FEH: 100 years: +40 %: 15 mins: Summer | 45.510 | 44.640 | 45.513 | 0.873 | 183.0 | 3.903 | 2.919 | 112.7 | 73.916 | Flood |
| SWMH2.00 | FEH: 100 years: +40 %: 15 mins: Summer | 45.600 | 44.730 | 45.601 | 0.871 | 123.3 | 1.731 | 0.747 | 91.8 | 53.573 | Flood |
| SWMH2.01 | FEH: 100 years: +40 %: 15 mins: Summer | 45.600 | 44.640 | 45.572 | 0.932 | 133.5 | 1.055 | 0.000 | 127.1 | 71.656 | Flood Risk |
| SWMH1.03 | FEH: 100 years: +40 %: 15 mins: Winter | 45.600 | 44.510 | 45.507 | 0.997 | 274.7 | 1.128 | 0.000 | 278.4 | 175.569 | Flood Risk |
| SWMH1.04 | FEH: 100 years: +40 %: 15 mins: Winter | 45.500 | 44.460 | 45.409 | 0.949 | 319.4 | 1.073 | 0.000 | 320.1 | 193.976 | Flood Risk |
| SWMH1.05 | FEH: 100 years: +40 %: 15 mins: Summer | 45.550 | 44.390 | 45.233 | 0.843 | 398.3 | 0.953 | 0.000 | 399.6 | 229.384 | Surcharged |
| SWMH3.00 | FEH: 100 years: +40 %: 15 mins: Summer | 46.000 | 44.720 | 45.729 | 1.009 | 131.6 | 1.141 | 0.000 | 124.2 | 57.068 | Flood Risk |
| SWMH3.01 | FEH: 100 years: +40 %: 15 mins: Summer | 45.850 | 44.570 | 45.371 | 0.801 | 146.7 | 0.906 | 0.000 | 142.4 | 66.851 | Surcharged |
| SWMH4.00 | FEH: 100 years: +40 %: 15 mins: Summer | 45.500 | 44.900 | 45.500 | 0.600 | 98.0 | 1.072 | 0.394 | 77.0 | 42.450 | Flood |
| SWMH4.01 | FEH: 100 years: +40 %: 15 mins: Summer | 45.500 | 44.600 | 45.268 | 0.668 | 102.6 | 0.756 | 0.000 | 102.2 | 53.613 | Flood Risk |
| SWMH1.06 | FEH: 100 years: +40 %: 15 mins: Summer | 45.760 | 44.330 | 44.994 | 0.664 | 684.8 | 0.751 | 0.000 | 682.9 | 365.175 | Surcharged |
| SWMH5.00 | FEH: 100 years: +40 %: 15 mins: Summer | 45.800 | 44.900 | 45.659 | 0.759 | 78.6 | 0.858 | 0.000 | 77.4 | 32.902 | Flood Risk |
| SWMH5.01 | FEH: 100 years: +40 %: 15 mins: Summer | 45.700 | 44.840 | 45.617 | 0.777 | 77.4 | 0.878 | 0.000 | 76.3 | 31.364 | Flood Risk |
| SWMH16 | FEH: 100 years: +40 %: 15 mins: Summer | 45.700 | 44.770 | 45.571 | 0.801 | 102.6 | 0.906 | 0.000 | 101.8 | 42.213 | Flood Risk |
| SWMH6.00 | FEH: 100 years: +40 %: 15 mins: Summer | 45.700 | 44.730 | 45.700 | 0.970 | 32.4 | 1.189 | 0.092 | 24.9 | 13.367 | Flood |
| SWMH6.01 | FEH: 100 years: +40 %: 15 mins: Summer | 45.870 | 44.630 | 45.694 | 1.064 | 120.0 | 1.203 | 0.000 | 119.5 | 52.740 | Flood Risk |
| SWFCC1.07 | FEH: 100 years: +40 %: 1440 mins: Winter | 44.900 | 44.200 | 44.858 | 0.658 | 6.1 | 0.744 | 0.000 | 6.1 | 854.703 | Flood Risk |
| Outfall | FEH: 100 years: +40 %: 1440 mins: Winter | 44.150 | 43.340 | 43.383 | 0.043 | 6.1 | 0.000 | 0.000 | 6.1 | 854.508 | OK |

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Stormwater Controls<br>Storm Phase: Phase | Company Address: | | |

**FEH: 2 years: Increase Rainfall (%): +0: Critical Storm Per Item: Rank By: Max. Resident Volume**

| Stormwater Control | Storm Event | Max. US Level (m) | Max. DS Level (m) | Max. US Depth (m) | Max. DS Depth (m) | Max. Inflow (L/s) | Max. Resident Volume (m³) | Max. Flooded Volume (m³) | Total Lost Volume (m³) | Max. Velocity (m/s) | Max. Outflow (L/s) | Total Discharge Volume (m³) | Half Drain Down Time (mins) | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pond | FEH: 2 years: +0 %: 960 mins: Winter | 44.469 | 44.469 | 0.169 | 0.169 | 31.5 | 571.974 | 0.000 | 0.000 | | 3.8 | 340.445 | | OK |
| Swale | FEH: 2 years: +0 %: 60 mins: Summer | 45.335 | 44.640 | 0.141 | 0.050 | 50.2 | 25.047 | 0.000 | 0.000 | 0.3 | 31.8 | 55.769 | | OK |

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Stormwater Controls<br>Storm Phase: Phase | Company Address: | | |

**FEH: 30 years: Increase Rainfall (%): +35: Critical Storm Per Item: Rank By: Max. Resident Volume**

| Stormwater Control | Storm Event | Max. US Level (m) | Max. DS Level (m) | Max. US Depth (m) | Max. DS Depth (m) | Max. Inflow (L/s) | Max. Resident Volume (m³) | Max. Flooded Volume (m³) | Total Lost Volume (m³) | Max. Velocity (m/s) | Max. Outflow (L/s) | Total Discharge Volume (m³) | Half Drain Down Time (mins) | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pond | FEH: 30 years: +35 %: 1440 mins: Winter | 44.740 | 44.740 | 0.440 | 0.440 | 55.7 | 1563.400 | 0.000 | 0.000 | | 5.9 | 765.777 | | OK |
| Swale | FEH: 30 years: +35 %: 15 mins: Summer | 45.475 | 44.706 | 0.281 | 0.116 | 305.3 | 75.807 | 0.000 | 0.000 | 0.5 | 150.8 | 115.454 | | OK |

| Trowes Lane, Swallowfield:<br>159-2025-CM_M-P1 | Date:<br>19/09/2025 | | |
|---|---|---|---|
| | Designed by:<br>BAF | Checked by:<br>JAH | Approved By: |
| Report Details:<br>Type: Stormwater Controls<br>Storm Phase: Phase | Company Address: | | |

**FEH: 100 years: Increase Rainfall (%): +40: Critical Storm Per Item: Rank By: Max. Resident Volume**

| Stormwater Control | Storm Event | Max. US Level (m) | Max. DS Level (m) | Max. US Depth (m) | Max. DS Depth (m) | Max. Inflow (L/s) | Max. Resident Volume (m³) | Max. Flooded Volume (m³) | Total Lost Volume (m³) | Max. Velocity (m/s) | Max. Outflow (L/s) | Total Discharge Volume (m³) | Half Drain Down Time (mins) | Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pond | FEH: 100 years: +40 %: 1440 mins: Winter | 44.858 | 44.858 | 0.558 | 0.558 | 70.5 | 2029.118 | 0.000 | 0.000 | | 6.1 | 855.685 | | OK |
| Swale | FEH: 100 years: +40 %: 30 mins: Summer | 45.493 | 44.721 | 0.299 | 0.131 | 273.9 | 96.533 | 0.000 | 0.000 | 0.5 | 215.6 | 226.987 | | OK |