

Chesham Drainage Strategy

Stage 1 - Initialise/Prepare



At the heart of daily life

Introduction

Why sewer flooding

Britain's first sewerage systems were constructed 150 years ago in the Victorian era, and have served us well for generations. The sewer network Thames Water operates today has been much improved and vastly extended over the years; yet it remains under increasing pressure.

Everyday our network manages the demands of one of the world's busiest and most densely populated capital cities, and its urbanised surrounding areas; together with the equally complex

challenges arising in our predominantly rural catchments in the Thames Valley, Surrey and Kent.

A number of factors including population growth, less frequent but heavier rainfall, the urbanisation of green spaces and changes in agricultural land practices, and utilised machinery, occasionally overwhelm our sewer network. The result can be unwanted sewer flooding for customers and our neighbouring natural environments.

This document contains:

- an Introduction to the work we are undertaking to alleviate sewer flooding in our region
- a Feedback: Q&A section addressing key questions from customers and stakeholders
- the Chesham Drainage Strategy technical document.

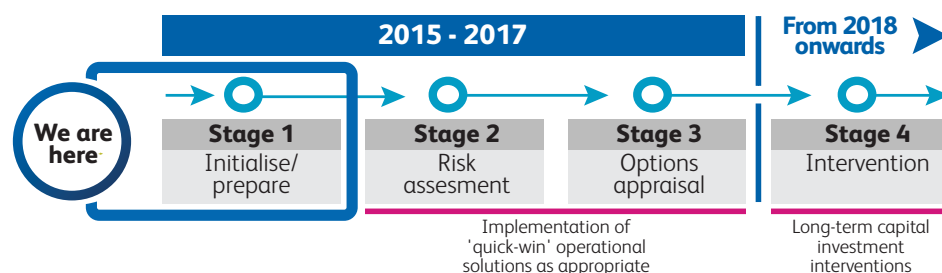
What can be done and when?

Sewer flooding is unacceptable. We have undertaken extensive customer research and initiated a programme of work to improve drainage and alleviate sewer flooding issues across our region.

We are adopting the good practice Drainage Strategy framework* developed by the Environment Agency and Ofwat, the water industry economic regulator,

to produce a drainage strategy for our affected catchments with a primary focus on our sewerage network. As outlined in Figure 1, the strategies will develop throughout the 4-stage framework to define how we intend to alleviate sewer flooding or to address growth related issues in each area sustainably, and economically, over the next few years.

Figure 1 High-level Drainage Strategy framework* and estimated delivery and intervention timeline**



* The detailed 4-stage Drainage Strategy framework can be found in the following Drainage Strategy document. ** The estimated delivery timeline is dependent on factors including weather conditions and is, therefore, open to change. The intervention timeline includes the implementation of 'quick-win' operational solutions throughout Stage 2 & 3, and long-term capital investment interventions in Stage 4.

Who will resolve the sewer flooding?

There are a number of stakeholders who, like us, have important drainage responsibilities and therefore, play an essential role in resolving sewer flooding in our region. These stakeholders include customers, private land owners and the Environment Agency; to name but a few. We are seeking to work in partnership with all stakeholders to ensure that together, we implement and maintain the most effective and sustainable drainage strategies.

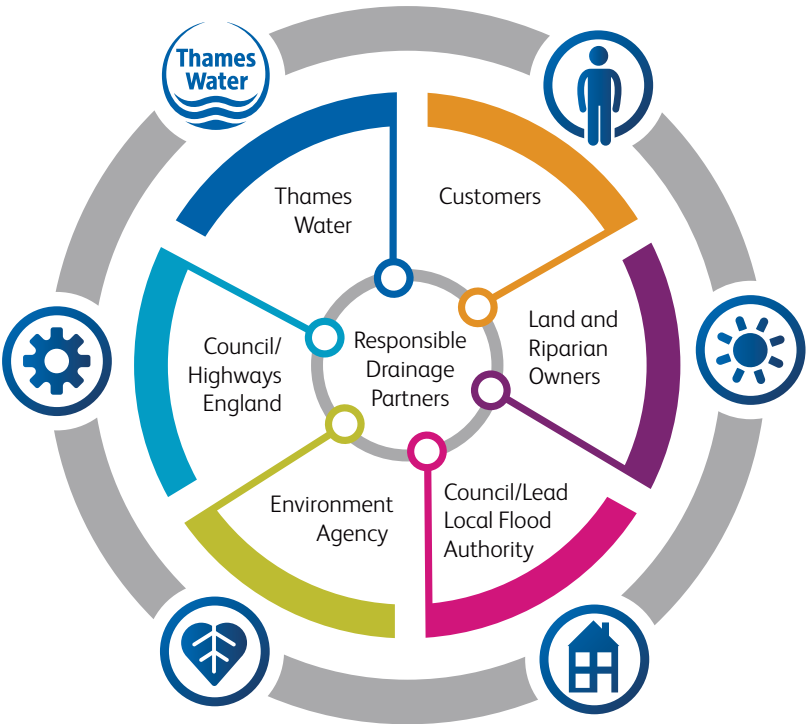
Just as our responsibilities to improve drainage and alleviate sewer flooding focus on removing and treating wastewater; other stakeholders' responsibilities include managing local flood risk on riverbanks, ground water,

land and highways, utilising appropriate agricultural practices and maintaining private drains.

We take full responsibility for resolving all drainage and sewer flooding issues that fall within our remit. If the causes of sewer flooding sit outside of this, we will support the responsible stakeholder to resolve the issue and to reduce the impact on customers.

Figure 2 provides a high-level view of the stakeholders responsible for drainage in each catchment area, more detail regarding responsibilities can be found in Section 1 of the following Drainage Strategy document.

Figure 2 Partners with Drainage Responsibilities



Next steps

Over the coming months we will undertake the following activities as this drainage strategy develops:

2015 - 2017



Customer Focus Actions

- Continue to consult with customers during this stage and every stage, through meetings, communications and surveys. We have gained important customer feedback during this first stage, which we are using to shape our activities
- Publish strategy documents for comment and contribution, throughout this framework process.



Partnership Actions

- Continue to establish partnership working with the regional drainage stakeholders, and agree ongoing consultation processes.



Other Key Actions

- Define catchment flooding uncertainties
- Prepare flooding risk data
- Undertake ongoing repair work to our sewer network, as the strategy develops and our investigations identify reparation work linked to drainage and flooding issues.

We will **regularly consult with customers and stakeholders, update and republish** this document throughout this 4-stage framework process.

Feedback: Q&A

Your questions answered

We are committed to listening to, consulting and collaborating with customers and stakeholders on our sewerage network activities and plans. We have addressed key feedback and questions raised by customers and stakeholders in the Chesham catchment, and customers affected by flooding throughout the region, in this Feedback Q&A section. As far as possible, and as is relevant to Stage 1 in the framework process, we have incorporated feedback from customers and stakeholders into our network strategy development. More detail can be found throughout the following Drainage Strategy document.

Q1 Will undertaking this Drainage Strategy framework process defer essential work in our area?

Answer

It is essential for us to complete this drainage strategy process, which has been developed and recommended by the water industry economic regulator Ofwat, and the Environment Agency. This will enable us to better understand the root cause of the sewer flooding issues affecting the catchment, before any major investment can be considered. However, we may carry out some repair works as this strategy develops, in the event that our investigations identify faults or problems with the sewerage network that are highly likely to have caused flooding, as outlined

in Section 7 of the Drainage Strategy document. Our previous investigations have identified some sources of inflow, such as the misconnection of surface water to foul sewers. However, as stated in the following strategy, we are not yet able to say how much this impacts on flooding and will update this as our plan develops through Stage 2 to Stage 3 –Option Appraisal. Therefore, this more detailed approach is required to ensure that the most effective and sustainable drainage strategies are implemented in the Chesham catchment.

We are committed to **listening to, consulting and collaborating** with customers and stakeholders on our sewerage network activities and plans.

Q2 What drainage actions are you undertaking in our area, and when will they be happening?

Answer

As stated above, we are developing our plan for this area and will provide further details as our plan develops through Stage 2 to Stage 3 – Option Appraisal. The following drainage actions have already been undertaken, or are underway, in the Chesham catchment:

Actions completed include: (For more information please see Table 2)

1. Sewage treatment works maintenance
2. Sewage pumping station refurbishment
3. Installation of sewer depth monitors.

Actions underway or planned include: (For more information please see Table 4)

1. Stakeholder engagement activities
2. Chesham sewage treatment works upgrade
3. Permanent monitoring of pumping station
4. Sewage treatment works storm discharge monitoring
5. Sewer manhole survey
6. Repair works to our sewer network
7. Customer surveys
8. Innovative solution analysis.

Q3 Are you renovating the sewers in our area?

Answer

We will renovate sewers which have been damaged, either as they have aged or through other streetworks activities. Therefore, as per Question 2 above, we will continue to target and repair

localised sewer defects identified through our investigations as contributing to, or causing, drainage and flooding issues in the catchment.

Q4 What are the improvement plans for Chesham's sewage treatment works to manage capacity?

Answer

To meet changing performance requirements and regulatory measures the Chesham sewage treatment works has undergone a number of upgrades over the past 10 years, including aerator refurbishment and screens replacement. There is a proposal to tighten the final effluent consent by the end of March

2018, and a study will be undertaken to determine the upgrade required to achieve this, and any necessary actions will be implemented. This upgrade will also cater for the projected population growth in the catchment, to a 2026 design horizon.

Q5 How are you ensuring that our local pumping stations are operating effectively?

Answer

The catchment's pumping stations are supported by 24-hour diagnostic monitoring so that we can tightly control their operation through a flow of real-time information. Based on this performance data we can respond quickly through site visits by our engineers, and both project and rectify potential issues before they occur. For example, last year the pumps at Church Street sewage pumping station within the catchment were replaced to

improve its capacity to accept greater flows, and to improve its performance.

As we move through this 4-stage framework process and further develop our Drainage Strategy for this catchment, we will review the operational control options of these pumping stations, particularly during wet weather, carefully avoiding increasing the risk of sewer flooding in doing so.

Q6 Are growth and urban creep minor factors in these rural catchments?

Answer

Whilst the growth and urban creep rate for Chesham is fairly average across the Thames area, relatively small population increases in these smaller rural catchments can be influential on sewer flows, hence the need for us to closely monitor planning applications. Similarly urban creep, and in particular misconnection of surface water and change of land use, can have a significant impact on sewer flooding;

particularly when permeable areas such as grass are replaced with hard-standings and driveways.

We are engaging with both Chiltern District Council and Dacorum Borough Council regarding their plans and more growth and urban creep information can be found in Section 5 of the following Drainage Strategy document.

Q7 How are you planning for future development in the catchment?

Answer

As per Section 5 below, our strategy considers the impact of population growth and new housing on the capacity and performance of our operations within the catchment, in the short-long term. We are monitoring development and planning applications through our ongoing stakeholder engagement activities, including assessments of Council development plans and third-party enquiries. Furthermore, our engagement with a number of local projects are also

informing our drainage strategy, such as the Hertfordshire Water Project, which is examining the impact of potential new housing and population growth on infrastructure across the catchment.

We will continue to work with all involved stakeholders and to incorporate current and projected developments into our business planning cycle, to ensure that our service is maintained for customers throughout the catchment's development.

Q8 Are you working with the Highway Authority to resolve blocked gullies, sewers and ditches, and with landowners to reduce field run-off, as both affect drainage and our sewers?

Answer

In Section 1 of the following Drainage Strategy document, we outline the other stakeholders who, like us, have important drainage responsibilities and therefore, play an essential role in resolving sewer flooding issues in this catchment area. As Highways maintenance activities and agricultural land maintenance practices sit outside of our remit we will work with the responsible stakeholders, to highlight these issues where this is found to have a major influence and impact on our

sewerage network.

We will continue to work closely with the Council and Highways England to understand the extent to which flood waters may be escaping from highway or land drainage systems; and impacting the foul sewer network. An update on this issue will be shared with customers and featured in the later stages of this Drainage Strategy document.

Q9 Is an Infiltration Reduction Plan (IRP), required for this catchment?

Answer

Ensuring that our drainage strategies fully meet the requirements of an Infiltration Reduction Plan, as set out in the Environment Agency's Regulatory Position Statement, is a fundamental consideration in their development. Therefore, to maintain our service to customers during future wet weather events, if we need to discharge to watercourses through temporary overflows, a dedicated section will be included in each affected strategy, providing details of their location and

intended use. This section will be included and /or revised when each strategy is updated.

In the event that temporary overflows are required, as stated above, we will describe their location and the circumstances under which we would use them. Together with plans to reduce infiltration, this drainage strategy would then fully meet the requirements of an Infiltration Reduction Plan.

Q10 Why are costs a consideration within your Wastewater outcomes?

Answer

The service we provide is the most fundamental of all – at the heart of daily life for the 15 million customers we serve. Getting it right is our focus every day, and we never forget it is paid for by customers.

As a regulated company we have to carefully balance service and cost in order to keep customer bills affordable, whilst delivering our outcomes and customer service commitments.

Q11 Are best practice techniques already used by other water companies being considered?

Answer

We are constantly reviewing and improving our business to meet and exceed industry standards, to implement best practice and to drive innovation. We lead and participate in a large number of industry forums both in the UK and worldwide, to share and expand our learning; with the ultimate aim of improving services for customers.

We are deploying industry best practice techniques throughout our drainage strategy work, and also trialling new technology that is innovative within our industry, to achieve the best possible drainage outcomes for customers and their local environment.

Q12 Why are you collecting climate change data rather than 'climate proofing' assets?

Answer

We are committed to responding to climate change and to reducing our contribution to it by reducing emissions in accordance with government policy. Our voluntary target is to achieve a challenging 20 per cent reduction in emissions (compared to 1990 levels), for our Scope 1 and 2 emissions*. We

continue to assess and collect climate change data and its impact on assets across our region, to ensure that we are fully informed and can prioritise our plans, targeted actions and investments. For more information please see the Climate Change section on the Homepage of our website.

*Scope 1 emissions refer to greenhouse gas emissions associated with the operation of our assets. Scope 2 emissions are emissions associated with the use of grid electricity.

Q13 What is the impact on local rivers of overflow points?

Answer

During extreme weather conditions foul sewers may become overwhelmed through a combination of surface water or ground water, resulting in a much diluted sewage. The impact on local rivers is dependent on the nature and size of the river, and on the overflow.

To reduce the environmental impact on local watercourses we will only use overflow points when groundwater and

river levels are high, and therefore sewage dilution rates are also high. Additionally, we are also investigating deploying mobile biological filters to prevent litter and other matter from entering local rivers. If during the development of our Drainage Strategy we consider that temporary overflow points are necessary in the local network, we will update the Drainage Strategy document to reflect this position.

Chesham Drainage Strategy

Technical Document



At the heart of daily life

Stage 1: Initialise / Prepare

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About this document

Based on customer research

Undertaking extensive customer research has been a fundamental step in our business plan preparation for 2015-20. Our research findings have informed our business planning activities, and contributed to the development of a set of long-term customer 'outcomes'.

The water industry economic regulator, Ofwat, defines 'outcomes' as "High-level objectives that company actions, activities and achievements are intended to help deliver..[they] represent what customers and society value". As a company, we are committed to achieving our customer outcomes, a number of which are focussed

on alleviating sewer flooding issues within our region, through effective, economic and sustainable drainage. This document describes the strategy that we will follow in delivering our long-term customer outcomes for drainage, specifically in the Chesham catchment, in a sustainable and economic manner.

Approved approach

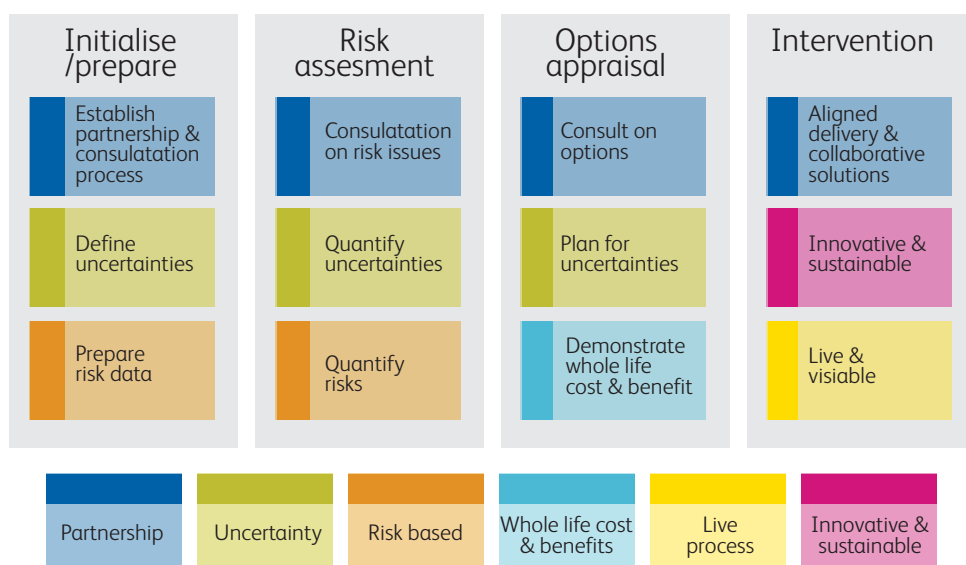
We have adopted the Drainage Strategy Framework¹ outlined in Figure 1 below, developed by the Environment Agency and Ofwat. It identifies 4 key stages to producing a good-practice drainage strategy. Drainage strategies typically focus on the sewerage network, and not the performance of sewage treatment

works. However, in the case of Chesham, we acknowledge that there have been operational issues at Chesham sewage treatment works, and so this drainage strategy will include our plans to resolve these problems.

The Chesham drainage strategy is

currently at the first stage of this framework - the Initialise/Prepare stage. In this document, we describe the activities that we plan to undertake to address current issues and future challenges facing the catchment, and the data that we need to gather to complete the risk assessment and options appraisal stages.

Figure 1 The Drainage Strategy Framework



¹ http://www.ofwat.gov.uk/future/sustainable/drainage/rpt_com201305drainagestrategy.pdf

Consultation and publication

We will update and republish this document to provide the results of our risk assessment, options appraisal and our selected strategy for intervention, once data from instrumentation and other

fieldwork has been collected and analysed.

Throughout this process we will attend local flood forums for ongoing communication and consultation with

customers and stakeholders. We will also make the Drainage Strategy documents available on the Drainage Strategies webpage of our website.

Meeting the Infiltration Reduction Plan (IRP)

To ensure that this Drainage Strategy meets the requirements of an Infiltration Reduction Plan, as set out in the Environment Agency's Regulatory Position Statement on discharges made from

groundwater surcharged sewers, we have included a section in this document which defines if, how and when we propose to operate temporary overflows. This is in addition to our plans to reduce infiltration

over time, where it has been identified as a root cause of sewer flooding. Please see Section 8 in the Drainage Strategy document below.

Executive summary

The foul sewerage system in Chesham has become overwhelmed in some locations for weeks at a time in recent years following prolonged heavy rainfall, resulting in sewer flooding. We believe that the system has surcharged because of a combination of groundwater infiltrating into public sewers and private drainage, surface water run-off from saturated fields and surface water misconnected into the foul sewerage system (such as downpipes from roofs), and also that floodwater from the River Chess has also entered the sewers through manholes.

The root causes of sewer surcharges are therefore numerous and the resolution of the issues complex, requiring all stakeholders responsible for drainage in the catchment to work together to resolve them. There have also been operational problems at Chesham sewage treatment works, which are in part linked to very high flows entering the works following wet weather, but also due to the operation of screens that have resulted in litter entering the River Chess.

The Floods and Water Management Act 2010 places a responsibility on lead local flood authorities (LLFAs), to manage flood risk from surface and groundwater, plus a duty on all risk management authorities (RMAs), to cooperate regarding flood risk. In our role as a RMA, Thames Water will work with Buckinghamshire County Council

and Hertfordshire County Council as Lead Local Flood Authorities, Chiltern District Council, Dacorum Borough Council as Planning Authorities, and the Environment Agency to ensure that a collaborative approach can be developed to address the problems.

In response, this Drainage Strategy follows the Environment Agency and Ofwat's 4-stage framework. The Chesham strategy is currently at Stage 1 (Initialise/Prepare). We describe in this document the actions that we plan to carry out to complete the following risk assessment and options appraisal stages. We will update and republish this document once this work has been completed.

In preparing our company business plan for the 5 year period 2015 to 2020 we have listened very carefully to the views of customers. Beyond being able to maintain the current service that we provide, customers have told us that they would like to see a reduction in instances of sewer flooding and odour nuisance and an improvement in river water quality. Our research indicates that customers are willing to pay for these improvements to service²; a summary of our related customer research can be found on our website via the hyperlink below.

We have therefore developed a set of company outcomes that we are committed

to working towards over the next 5 years and beyond. The outcomes relevant to the Chesham drainage strategy are:

- Asset health - a composite range of measures against which we will manage the health of our sewerage network and sewage treatment works
- Properties and public areas protected from sewer flooding
- River water quality meets customer's expectations and regulatory requirements.

This drainage strategy must also address future challenges to the Chesham catchment. We assess these to be:

- Climate change – analysis of the latest data suggests that rainfall could become 15 % more intensive by 2080 increasing the likelihood of flooding. Longer wetter winters may also mean groundwater levels are high more often; this could also exacerbate fluvial flooding from local watercourses
- Urban creep – paving over of front gardens and loss of green space results in more strain on the sewerage network when it rains heavily. Modelling we have undertaken suggests urban creep rates in Chesham are about average for the Thames Operational Area
- Population growth – the population in the South East is set to grow rapidly. A number of possible developments have

² <http://www.thameswater.co.uk/cr/Howwedobusiness/Engagingwithourstakeholders/Publicconsultationresearch/index.html>

been identified within the Chesham catchment, and we will continue to track these, and any other emerging applications for this catchment, in the future.

Our strategy is to understand the relative impact of overland flow from saturated fields, groundwater infiltration and surface water misconnections. We will then try to identify cost beneficial enhancements to the network to reduce the risk of sewer flooding using customer willingness to pay research. We may carry out some sewer rehabilitation works as the

strategy develops, in the event that our investigations identify faults or problems with the sewerage network that are highly likely to have contributed to sewer flooding.

Monitors have been installed within the sewerage network and our next steps are to continue to gather data so that we can understand where and how surface and groundwater is making its way into the foul sewerage network. The depth monitors will remain in place as we move through this 4-stage framework and develop our plans. We will also be gathering information from customers affected by sewer flooding.

These network activities need to be combined with planned enhancements to the sewage treatment works to address the requirement to comply with the tightening of the ammonia consent.

Additionally, our strategy considers the impact of population growth and new housing within the catchment. We will continue to monitor development and planning applications through our ongoing stakeholder engagement activities, assessments of Council development plans and third-party enquiries; throughout this framework process.

1 Thames Water and drainage

1.1 Our statutory responsibilities

Thames Water is a regulated Water and Sewerage Company. We supply water to 9 million customers in London and the Thames Valley and provide wastewater services to 15 million customers across an area that stretches from Gloucestershire to Essex. We operate 108,000km of sewer through which an average of more than 4.4bn litres of wastewater is collected and treated every day at our 350 sewage treatment works.

The primary legislation that sets out our role and responsibilities is the Water Industry Act (1991), which describes the duties and services that we are responsible for and the powers that we have to connect, operate, maintain and extend the sewerage network. We are regulated by the Water Services Regulation Authority

(Ofwat). The original 1991 Act has been amended by further legislation in recent years, transferring some drains and sewers that were hitherto in private ownership to Thames Water's responsibility³.

Other recent pieces of legislation relevant to this Drainage Strategy are the Flood & Water Management Act (2010) and the Water Act (2014). These set out new responsibilities for Thames Water to manage flood risk in partnership with local councils and the Environment Agency, with more emphasis on Sustainable Drainage Systems (SuDS), such as swales and permeable paving to mimic natural drainage.

Thames Water also has a statutory obligation to comply with environmental

legislation, including European Directives. The Water Framework Directive establishes a strategic approach to managing the water environment, which the Environment Agency achieves through River Basin Management Plans and setting environmental objectives for groundwater and surface water. The environment is also protected from adverse effects of discharges of urban wastewater through the Urban Wastewater Treatment Directive, which requires us to improve and extend the sewerage system according to section 94 of the Water Industry Act (1991).

A comprehensive and detailed list of all legislation relevant to Thames Water can be found in the 'statement of obligations' published by Defra⁴.

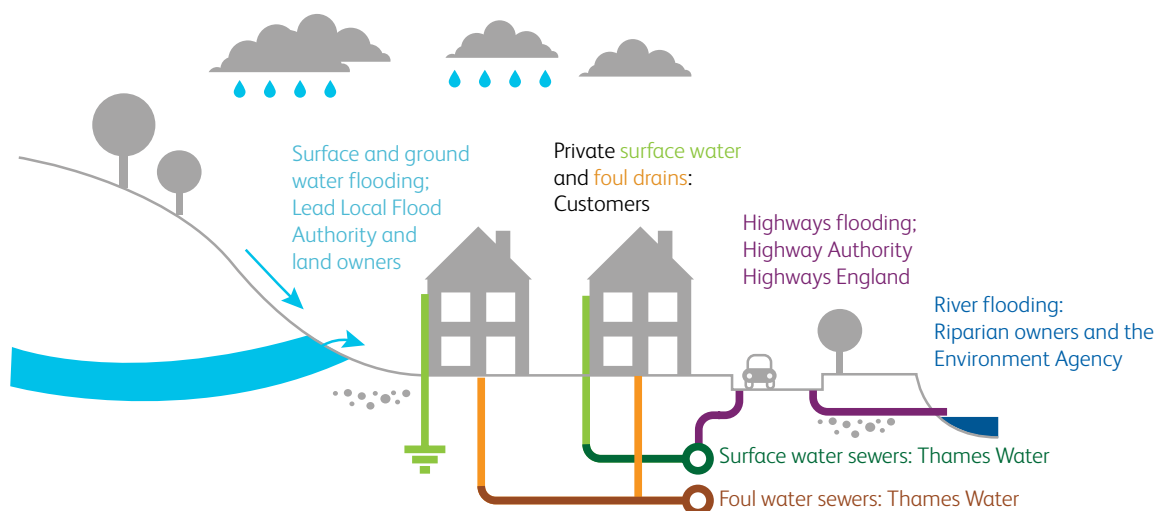
³ See <http://www.thameswater.co.uk/help-and-advice/8654.htm> for more information.

⁴ See <https://www.gov.uk/government/publications/statement-of-obligations>.

1.2 Working in partnership with other stakeholders

Other stakeholders responsible for managing various forms of drainage need to work together with us to reduce the risk of flooding. Each has specific responsibilities as summarised in Figure 2 below.

Figure 2 Stakeholder responsibilities for drainage



Thames Water

We are responsible for removing and treating wastewater, which includes the foul sewers, and in some areas the combined sewers that are in some of the older large urbanised areas, such as London⁵. We also manage and maintain surface water sewers where they exist, these will typically discharge to a watercourse or river. In some cases, the cause of sewer flooding may not fall under our responsibility. In these circumstances, we will explain what we can do to help and continue supporting the relevant authorities or third parties to reduce the impact for customers.

Environment Agency

The Environment Agency is responsible for main rivers and part of its remit includes monitoring and informing the levels of ground and river water. The Environment Agency also investigates pollution incidents and monitors the quality of the water in rivers.

Lead Local Flood Authority and District Council

Buckinghamshire County Council and Hertfordshire County Council are the lead local flood authorities and have the

responsibility under the Flood & Water Management Act for managing the local flood risk from groundwater and surface water runoff e.g. local watercourses and culverts. They work with landowners to maintain privately owned ditches, drainage and watercourses, keeping them clear of blockages. They are also responsible for managing the risk of groundwater flooding, both inside and outside of properties. Water from these local authority gullies and drains and privately owned ditches can also impact Thames Water's sewers, therefore, we work with all responsible stakeholders to resolve the excess flow. Chiltern District Council and Dacorum Borough Council are the Planning Authorities responsible for approving new development, but equally may have responsibility for ensuring maintenance of watercourses; particularly on council-owned land.

Highway Authority

Buckinghamshire County Council and Hertfordshire County Council are the Highway Authorities and are responsible for highway maintenance and highway drainage and for clearing roadside gullies. Highways England is responsible for the drainage of motorways and certain trunk roads.

Customers

Customers own, and are responsible for, the maintenance of private drains within the curtilage of their property, which did not transfer to Thames Water ownership in October 2011⁶.

Riparian Owners

Riparian Owners are landowners who own land with watercourses or land adjacent to watercourse (i.e. road side ditches)⁷. The responsibility for the operation and maintenance of ditches, local watercourses and general land drainage lies mostly with riparian owners.

Land Owners

Land owners include farmers and both residential and commercial customers, but includes trusts etc. They are responsible for ensuring the adequate drainage of their land, such that it is not a nuisance to others.

⁵ Thames Water is responsible for the collection and treatment of commercial and domestic sewage. Typically this will be the foul sewerage. Domestic or commercial roof and paved drainage will often go to a soakaway or directly to a water course/river, which if so is not the responsibility of Thames Water.

⁶ See <http://www.thameswater.co.uk/help-and-advice/8654.htm> for more information.

⁷ Some local watercourses and/or culverts are termed as 'Riparian' meaning that a land owner, possibly adjoining or owning the land containing the watercourse/culvert is responsible for the maintenance and free-flowing of the watercourse/culvert.

2 Catchment description

2.1 Geology and topography

The catchment served by Chesham sewage treatment works is located in the Chiltern Hills, Buckinghamshire, 10km to the north west of High Wycombe. The sewage catchment is mainly in the county of Buckinghamshire and the Chiltern District Council area. The treatment works predominantly serves the town of Chesham and includes the villages of Bellingdon, Botley, Buckland Common, Chartridge, Chesham Bois and Cholesbury. Additionally, the works also serves the villages of

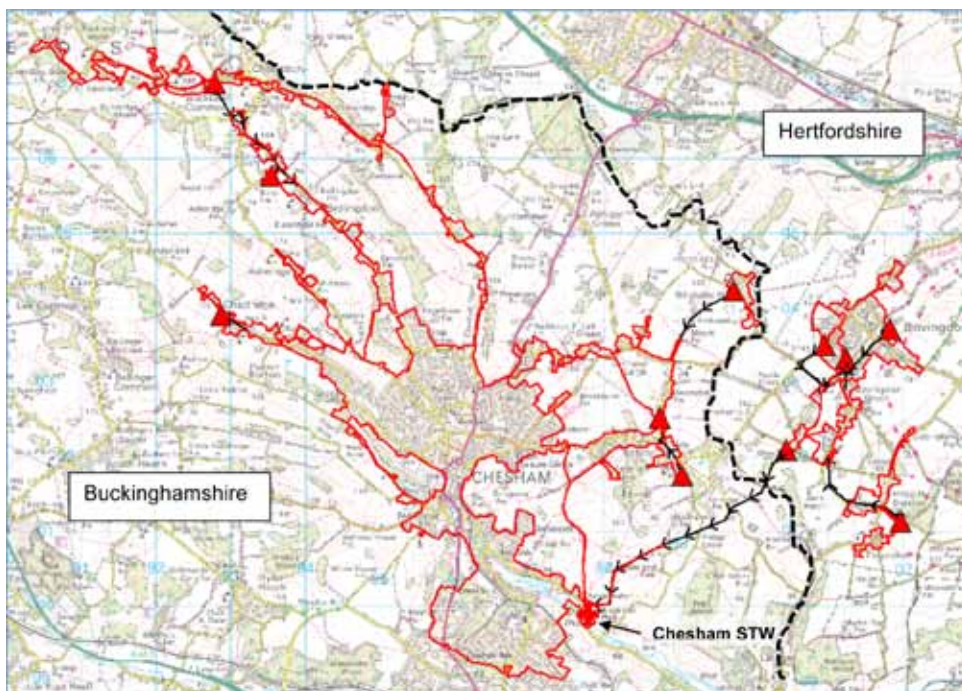
Bovingdon and Flaunden in the county of Hertfordshire, and Dacorum Borough Council area. Figure 3 below, outlines the extent of the sewerage catchment.

The catchment is generally made up of chalk and very permeable soils and is situated in an area that is prone to significant seasonal changes in groundwater levels, with the added likelihood of rainfall induced infiltration⁸ owing to its permeable soils.

Appendix B includes maps showing the geology and fluvial, pluvial and groundwater flood risk areas in the catchment.

The river Chess runs through the catchment and the Environment Agency states that the current ecological status of the River Chess is 'Moderate'⁹.

Figure 3 Chesham sewerage catchment



⁸ Rainfall Induced Infiltration is the term given to sewer infiltration that occurs as a result of rainfall percolating into the ground impacting the sewer on route to recharging the groundwater table.

⁹ Environment Agency website, interactive map, Basin Management Plans.

2.2 Sewage treatment works

The Chesham sewage treatment works serves the area surrounding Chesham and the village of Bovingdon via a number of sewage pumping stations, serving a population equivalent of approximately 35,100 through 121km of gravity foul sewers. It typically treats a dry weather flow of 8,400m³/day, with a flow to full treatment capacity of 330 litres/second, but during storm conditions flows can be in excess of 25,000 m³/day.

All raw sewage that flows into Chesham sewage treatment works goes through an inlet pumping station. After passing through the inlet pumping station, the raw sewage is screened (for litter and rag), and biologically treated using an activated sludge plant. Effluent then flows into one of two final settlement tanks, with the treated effluent discharged into a lagoon before discharging into the River Chess.

Flow above the full treatment capacity is screened and diverted to storm tanks. Dilute sewage in the storm tank can then be returned to the inlet sewage pumping station for treatment, once the storm has subsided. If the storm tank becomes full, excess flow passes over a weir, through a screen (known as a Copasac), and is then discharged into the River Chess.

The earliest foul sewers in the catchment are believed to date from the 1890s, when the local authority incumbent at the time drained Chesham to the original sewage works, located just to the west of the current site. In the 1960s, Chesham Urban District Council upgraded the works and relocated it to its current site. Since that time, other major upgrades have been undertaken. Significant changes in the network and catchment include the closure of the Bovingdon sewage

treatment works and its diversion into the Chesham catchment in the mid-1990s. This work also included further upgrades at Chesham sewage treatment works.

As above, to meet changing performance requirements and regulatory measures the Chesham sewage treatment works has undergone a number of upgrades over the past 10 years, including aerator refurbishment and screens replacement. There is a proposal to tighten the final effluent consent by the end of March 2018, and a study will be undertaken to determine the upgrade required to achieve this, and any necessary actions will be implemented. This upgrade will also cater for the projected population growth in the catchment to a 2026 design horizon, for a predicted population of 36,557.

2.3 Foul sewers

The sewerage system in Chesham is recorded as a separate foul sewage system, rather than as a combined system designed to serve both foul and surface water. As above, the earliest foul sewers in the catchment are believed to date from the 1890s and the sewerage system has grown in the intervening period to serve additional areas and new developments.

The foul sewers in Chesham drain under gravity to the sewage treatment works via a 975mm diameter trunk sewer, however there are a number of sewage pumping stations in the surrounding villages that pump to the gravity system in the town of Chesham. Additionally, flow from Bovingdon and Botley to the north east of the catchment drains or pumps directly to the sewage treatment works, arriving at the downstream end of the trunk sewer. All flow is then lifted into the sewage treatment works via a pumping station at the end of the trunk sewer. In total, there are 11 sewage pumping stations within the catchment. Figure 4 below provides a schematic diagram of the sewerage catchment.

The design of the sewerage network ensures that pipes are appropriately sized and laid at a gradient to maintain a satisfactory self-cleansing characteristic.

The capacity of foul sewers is typically set to cater for a maximum of six times Dry Weather Flow and a 10% allowance for infiltration¹⁰.

A 225mm diameter sewer laid at a gradient of 1 in 225 has sufficient capacity to cater for the foul sewage from 1,000 to 1,500 houses or 3,000 to 4,500 people. Problems in small diameter sewers tend to be as a result of blockages in the pipes. However, occasionally surface water can be misconnected into the foul sewerage network – problems then arise when it rains heavily.

In Chesham, 81km out of the 121km of gravity foul sewers are less than 225mm in diameter. These smaller diameter sewers drain the peripheral areas of the catchment towards the sewage treatment works where the diameter increases up to 975mm approaching the works. The capacity of the foul sewers has been assessed to be adequate under normal design flow conditions.

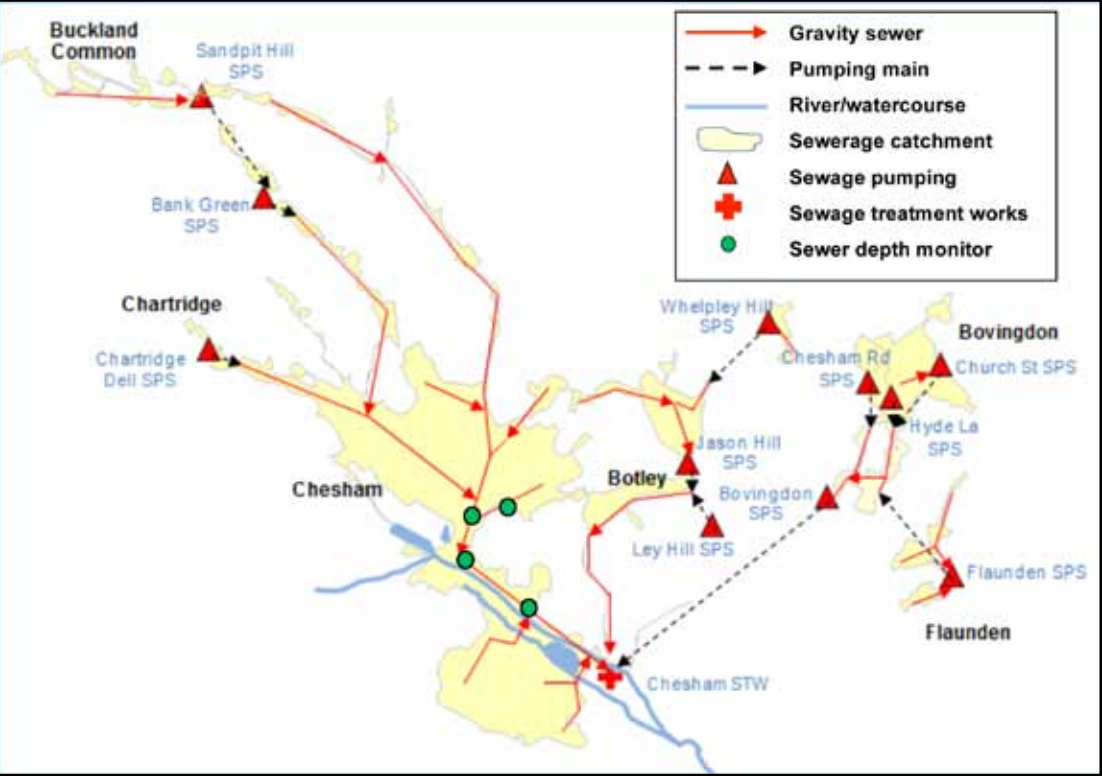
Materials used in the construction of the sewerage system are typical of the time, with vitrified clay pipework for smaller diameters, concrete pipes for larger diameters and brick and concrete manholes. The pipework can have a very

long service life, but sometimes the joint seals deteriorate over time. The 1950/60s pipes were typically laid on bedding material such as pea shingle, with the trenches likely to have been backfilled with 'as dug' excavated material. More recent drains and sewers, i.e. since the 1980s, are typically surrounded with pea shingle. This protects the pipe but can also act as a good conduit for groundwater.

The layout of the catchment suggests that most properties are likely to have their own foul drains that connect directly into the public sewer, though there are likely to be a number of former private sewers in the town. The private foul water drains within the property boundaries in Chesham are generally the responsibility of the property owners. We often undertake customer information and education activities to raise awareness of the implications of individual behaviour on flooding, and we are supportive of similar initiatives undertaken by other stakeholders, such as the Chesham Flood Smart project.

¹⁰ Dry Weather Flow is the term given to the average flow rate observed over a 24 hour period and based on Sewers for Adoption, the industry standard, includes an allowance for infiltration of 10% of the calculated flow rate.

Figure 4 Chesham sewerage schematic



2.4 Surface water sewers

There are no significant public surface water sewer systems in the Chesham catchment. The catchment is a mixture of rural and urban and incorporates a network of highway drainage and minor watercourses that are intended to take the non-property related surface water in the area.

The surface water from the majority of properties is likely to drain to soakaways. Soakaways can only function satisfactorily when ground conditions allow soakage and may be completely ineffective at times when groundwater levels are high.

In some areas, we have seen examples of customers draining surface water through their foul drains when their soakaways do not work. This exacerbates capacity problems for other customers connected further downstream in the sewerage network. The responsibility for the operation and maintenance of the local watercourses and general land drainage lies mostly with riparian owners.

The extent of highway drainage is uncertain, but is likely to drain through a mixture of ditches, soakaways and highways drainage systems to the River

Chess. Buckinghamshire County Council and Hertfordshire County Council are responsible for the highway drainage and culverts crossing the highway. Buckinghamshire County Council and Hertfordshire County Council as Lead Local Flood Authorities have overall responsibility for managing groundwater.

The Environment Agency has the duty and the authority to ensure that the River Chess is maintained appropriately. The responsibility for the maintenance lies with the riparian owners.

3 Long-term outcomes

We have listened very carefully to the views of customers before developing our plan for the Asset Management Period 6 (AMP6), regulatory period. Between 2009 and 2013 we carried out over 50 separate customer research and engagement activities.

Beyond being able to maintain the current

service that we provide, customers have told us that they would like to see a reduction in instances of sewer flooding and odour nuisance and an improvement in river water quality. These are areas where customers are prepared pay for an improvement to the current level of service.

In response to this, we have developed 4 company outcomes and 11 service outcomes for our wastewater service that we are committed to working towards over the next 5 years and beyond, further details can be found in Table 1 below and on our website¹¹.

Table 1 Wastewater outcomes

Company outcome	Wastewater service outcome	Why is this service outcome chosen
We will provide a safe and reliable wastewater service that complies with all necessary standards and is available when our customers require it.	Asset health: maintaining our assets to ensure we can provide a safe and reliable service in the long-term.	We must ensure an appropriate balance between reducing costs today and not compromising our future service.
	Properties and public areas protected from flooding.	Flooding is one of the worst service failures for customers.
	Resilient sewage treatment service that minimises the impact of extreme events on river water quality.	We need to be able to provide service against a variety of pressures such as climate change and population growth.
Our customers and stakeholders can trust us, we are easy to do business with and we care.	Do the basics excellently by getting things right first time.	This service outcome ensures our wholesale activity is completely aligned to our objective to improve our Service Incentive Mechanism (SIM) scoring.
We will provide the level of customer service our customers require, in the most economic and efficient manner, to ensure that bills are no more than necessary.	Reduced dependence on energy from the grid.	Reducing dependence on energy from the grid is one of a range of measures across our entire plan to keep costs down to an affordable level for customers.
We will limit our impact on the environment and achieve a socially responsible, sustainable business for future generations, including reducing levels of leakage.	Minimising our carbon footprint.	There is an expectation from society that we will play our part in reducing carbon emissions.

¹¹ See http://www.thameswater.co.uk/tw/common/downloads/about%20us%20-%20corporate%20responsibility/AMP6_-_Outcomes_Reporting_Policy.pdf for more information.

Company outcome	Wastewater service outcome	Why is this service outcome chosen
	River water quality meets customers' expectations and regulatory requirements.	We must meet environmental regulations, and river quality is a visible indicator to citizens of our environmental stewardship.
	Satisfactory sludge disposal.	Sludge is a resource that we should manage effectively to keep bills down.
	Corporate responsibility.	We will act as a responsible company, meeting expectations from wider society.
	Reduced odour from wastewater operations.	Odour is a problem for some of our customers.
	Compliance with new environmental regulations.	We must meet environmental regulations, and river quality is a visible indicator to citizens of our environmental stewardship.

Below we provide more information about our asset health, properties and public areas protected from flooding and river water quality service outcomes, as these are relevant to the Chesham drainage strategy.

3.1 Asset health

Our Asset Health performance commitment encompasses a composite range of measures against which we will manage the health of our sewerage network and sewage treatment works. This commitment underpins our outcome of a safe and reliable wastewater service. For the network, it includes sewer collapses,

blockages, unconsented category 1 to 3 pollution incidents and properties internally flooded due to operational problems (such as blockages, collapses or equipment failures). For the treatment works, this commitment includes reducing the risk of pollution and odour.

3.2 Properties and public areas protected from flooding

There are two performance commitments that underpin the delivery of this service outcome:

1. We commit to protecting properties from flooding due to rainfall. We estimate that our plan for 2015-20 will result in over 2,100 properties being alleviated from internal flooding, external flooding and also from restricted toilet use (for example when groundwater levels are high following

prolonged periods of wet weather). Our customer research indicates that our sewer flooding programme will deliver £20m of benefit to customers every year by 2020.

2. We commit to reducing the risk of sewer flooding and pollution from combined sewers (i.e. those that convey both foul and surface water), by slowing down surface water run-off and re-routing the flow through sustainable

drainage measures such as water butts, permeable paving, rain gardens and green roofs. We aim to retrofit over 20 hectares of sustainable drainage measures by 2020. We may also apply this commitment to areas where the network was designed to take foul flow only, but investigation shows that a substantial amount of surface water is in the foul sewer.

3.3 River water quality meets customers' expectations and regulatory requirements

An upgrade to Chesham sewage treatment works was included in our business plan for 2015 to 2020 to ensure continued compliance following a planned tightening of the ammonia consent for the works. The Environment Agency is not due to finalise its National Environment Programme until 2016, however at this

stage it looks likely that an upgrade scheme for Chesham will be included in this programme.

We also have a performance commitment to reduce the number of pollution incidents as a result of discharges from our sewerage network and treatment

works. Pollution can occur as a result of blockages, collapses or failure of our equipment and also following heavy rainfall when our sewers have insufficient capacity to cope with the flow. All pollution incidents are reported to the Environment Agency's National Incident Recording System (NIRS).

4 Current issues

4.1 Recent wet weather events

The foul sewerage system in the Chesham catchment has become overwhelmed for weeks at a time in recent years following prolonged heavy rainfall. We believe that the system has surcharged due to a combination of groundwater infiltration, surface water run-off from saturated fields, surface water inundation from highways, public spaces and properties, surface water misconnections and river water overflowing from the River Chess.

We are confident that this is a comprehensive list of factors that have caused flooding.

During the winters of 2012/13 and 2013/2014, the following incidents have been observed with respect to the sewerage network:

- External flooding and restricted toilet use in the Hepstead Way and Church Street, Bovingdon
- External flooding and restricted toilet use in Manor Way and Latimer Road, Chesham area.

Other sources of flooding have also been observed:

- Highway drainage overwhelmed causing highway flooding
- River flooding in the High Street area of Chesham
- Land drainage issues with water running off fields and onto highways.

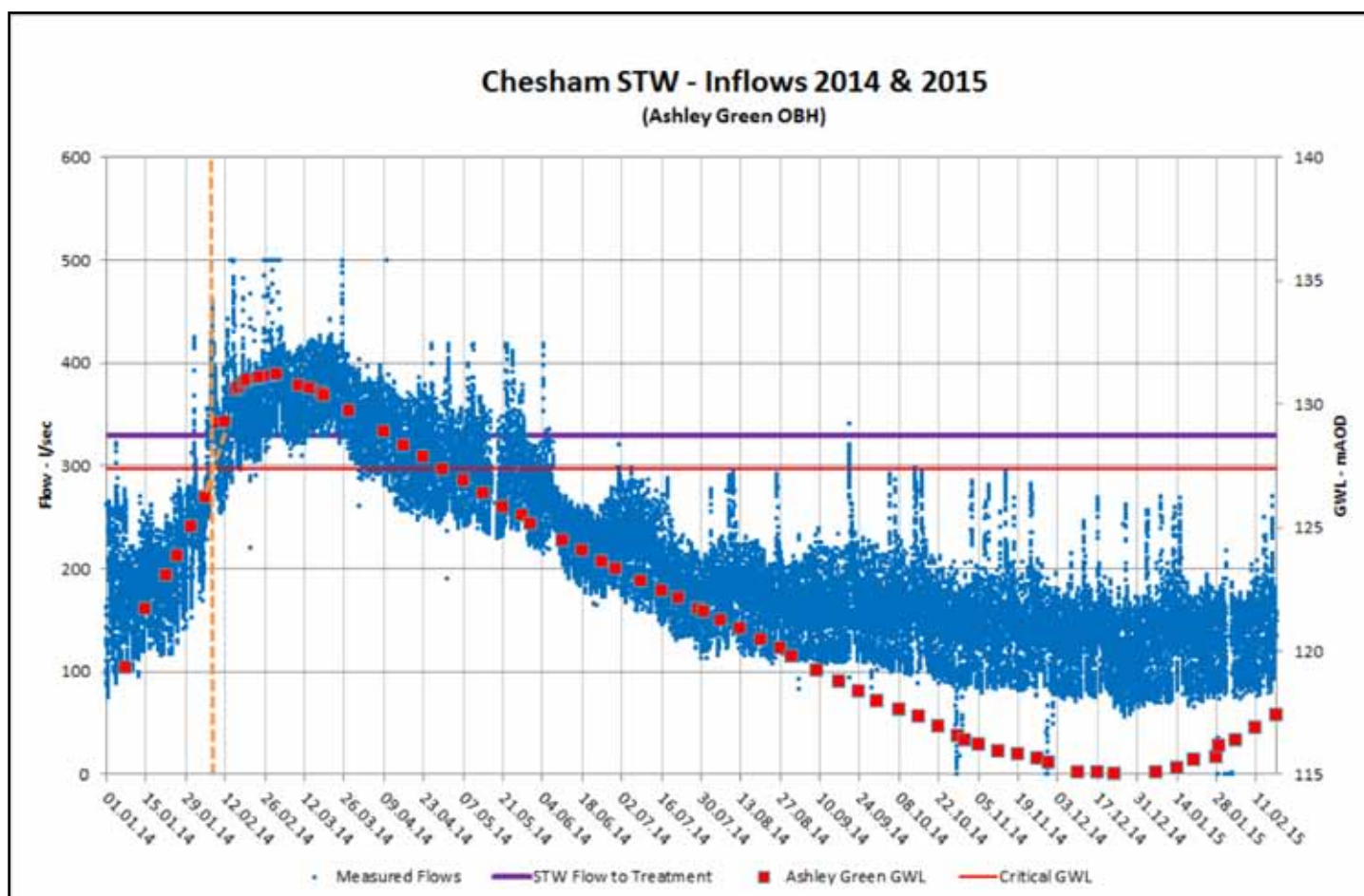
Recent wet winters have also resulted in very high flows being received at Chesham sewage treatment works. There have also been several mechanical failures of equipment resulting in operational difficulties at the site:

- High flows have resulted in long periods of storm discharge from the storm tanks
- The filters on the discharge from the storm tanks (known as Copasacs) have allowed litter and other material to pass through into the River Chess, because of the high and continuous storm flows

- There have also been mechanical failures on the aerators used during biological treatment.

During extended wet periods, treated flows at the sewage treatment works can be in excess of 28,000 m³/day, which is around three times greater than the measured dry weather flow of 8,400m³/day. Figure 5 below, compares the treated flows at Chesham sewage treatment works with groundwater levels recorded at a nearby borehole at Ashley Green. It can be seen from this graph that periods of high flow to the sewage treatment works correlate well with high groundwater levels. However, pluvial and fluvial flooding following heavy rainfall will also contribute to high flows.

Figure 5 Chesham sewage treatment works (STW) inflows and groundwater levels



4.2 Our operational response

To manage excess flows and to maintain service to customers, tankers were used in the wet winter of 2012/13 in the Chesham area. Tankers have limited capacity and can only draw off water at a relatively low rate, and we acknowledge that they can also cause considerable noise and disruption to local communities.

Due to the significant impacts of fluvial and groundwater flooding across our region during the winter event of 2013/14, we mobilised our tanker fleet of nearly 100 vehicles to protect customers most at risk of flooding from sewers inside their homes. For this reason, and recognising the limited effectiveness of tankering following more extreme weather

conditions, tankering was not extensively utilised in the catchment at this time, however, tankers were used to prevent internal property flooding in Bellingdon Road and Red Lion Street, Chesham.

4.3 Investigations and activities completed to date

Table 2 below, details the investigations and actions that we have completed in recent years within the Chesham catchment. These form the extent of our current understanding of issues within the catchment.

Table 2 Investigations and activities completed

Activity	Purpose	Date complete	Outcome
Sewage treatment works inlet maintenance	Screenings handling plant was undersized and unreliable resulting in rag passing through downstream treatment processes. A new screenings plant was installed.	2010/11	Less rag entering sludge lagoons and final effluent.
Drainage Area Plan	Data gathering, update of hydraulic model and identification and prioritisation of catchment needs.	2012	Identification of catchment needs.
Short-term depth monitoring	Identifying the cause and onset of operational issues in the area.	Nov 2012	No significant inflows identified upstream of the monitors.
Sewage treatment works maintenance	Maintenance of the aerators on biological treatment process.	2012/13	Maintain works consent compliance.
Sewage Pumping Station Refurbishment	Replacement of the Pumps at Church Street sewage pumping station to improve capacity.	2014	Pumping station can now accept greater flows, improving its performance.
Permanent monitoring of sewer levels	Installation of permanent depth monitors into the foul sewers at key locations in Chesham. The plan is for the monitors to remain in situ for at least 5 years, and to capture the next wet weather event as a minimum. Analysis of the recorded depths and comparison with other catchment variables, such as rainfall events and changes in groundwater levels.	Dec 2014	Information used to identify additional actions for inclusion in the drainage strategy for Chesham. Share information with other agencies.

In summary, various maintenance activities have been completed at the sewage treatment works to address operational performance issues - notably with the aeration equipment and with the inlet screenings plant. However, the sewage treatment works has continued to struggle during the very high flows

that were received in the wet winters of 2012/13 and 2013/14.

Permanent depth monitors were installed in the catchment in 2014, and further monitoring is required to understand where and how surface and groundwater is making its way into the foul sewerage

network, and these activities need to be combined with enhancements to the sewage treatment works to address the planned tightening of the ammonia consent. We will continue to monitor and utilise this data as our strategy develops through this 4-stage framework process.

4.4 Activities carried out by drainage partners

Table 3 below, details the activities carried out by other stakeholders with drainage responsibilities within the Chesham catchment, to reduce the risk of flooding in the area. For more detail on the other organisations responsible for managing various forms of drainage within the catchment, please see Section 1 of this Drainage Strategy document.

Table 3 Actions by other stakeholders to prevent flooding

Activity	Purpose	Impact on sewerage
Routine maintenance of River Chess, water-courses and local ditches.	Riparian owners ensure free flow of river and ditches.	Less risk of surface water inundation into the foul sewers and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Routine maintenance of private surface water drainage and soakaways.	Land owners ensure adequate surface water drainage from properties.	Less risk of surface water inundation into the foul sewers and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Routine maintenance of highway drainage.	Highway Authority ensure adequate highway drainage.	Less risk of surface water inundation into the foul sewers and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Routine maintenance of land drainage.	Land owners ensure effective land drainage.	Less risk of surface water inundation into the foul sewers and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Strategy for infiltration through private drains*	Consider a strategy for reducing infiltration into the sewer network via private drains if investigations and permanent monitoring identifies this as a significant cause for concern.	Less risk of groundwater infiltration into private drains and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Monitoring and control of construction standards for private drains	Local Authority Building Control to ensure private drainage is fit for purpose.	Less risk of groundwater infiltration into private drains and hence less risk of sewer flooding, pollution incidents and storm tank overflows at the sewage treatment works.
Sharing of information	Agencies to share information to ensure collaborative approach to groundwater infiltration, surface water inundation, pluvial and fluvial flooding. Use forums as appropriate, e.g. River Chess flood forum.	Identification of most cost beneficial solutions and quicker resolution of issues.

*Thames Water does not have powers to compel customers to repair defective private drains at their cost. At this stage, we do not know how significant infiltration from private drains is within the Chesham catchment, but we will develop an appropriate strategy as part of stage 2 risk assessment, when information becomes available and this document is updated. We note that local authorities are only able to instigate action under Section 59 of the Building Act where evidence is provided of a defective private drain.

5 Future challenges

In 2011, Ofwat commissioned Mott MacDonald to look at factors likely to affect sewerage networks in the future. The report 'Future impacts on sewer systems in England and Wales' (June 2011)¹², looked at the likely relative impact of climate change, population growth and impermeable areas up to around 2040. In preparing our plan for 2015-2020, we have also carried out research into these factors across the Thames Water region. We summarise our findings for the Chesham catchment in this section.

5.1 Urban creep

Urban creep is defined as the transformation of a catchment by the paving over of previously permeable areas and includes extensions to existing properties and other land use changes. Rather than surface water soaking into the ground when it rains heavily, more water runs off into the sewerage network and can cause the sewers to surcharge and flood. It is therefore important to understand the rate at which urban creep is occurring.

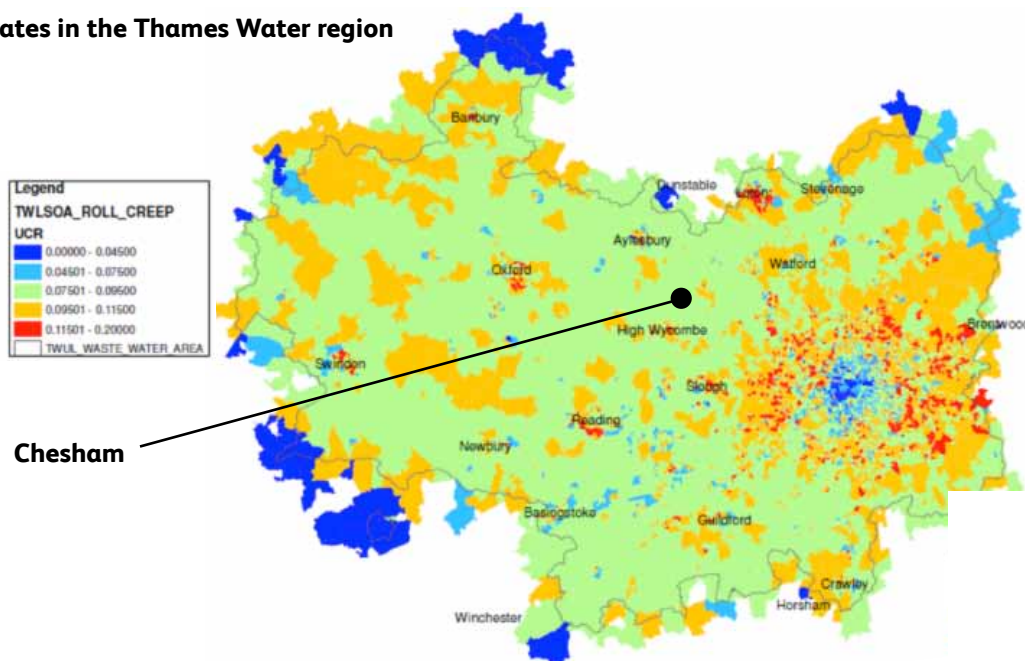
We have studied aerial photography and satellite imagery across 11 catchments across the Thames Water region using data from two periods in the late 1990s and mid-2000s to determine the rate at which urban creep is occurring. We then carried out a statistical analysis and built

a model to predict the rate of urban creep for the entire Thames Water region, taking account of factors such as property age, land use, demographics such as family sizes and financial income, need and available space. We found that affluent suburban areas with detached and semi-detached properties, where families have young children, are most likely to have high urban creep rates.

The results for the Thames Region are presented in Figure 6 below. The urban creep rate for Chesham is 0.095 %. In other words, this is the increase in impermeable area per year as a percentage of the total area connected to the sewerage network. When compared against the rest of the Thames Water region, Chesham is about average and

not as high as suburban areas around central London and major towns. Whilst the immediate issues in Chesham appear to be strongly related to groundwater, we will continue to monitor change in impermeable area as the strategy continues to develop. If we observe an increase in urban creep, we will raise the issue with the Lead Local Flood Authorities, Buckinghamshire and Hertfordshire County Councils, who are responsible for managing surface water. We may then also seek to work with other partners to retrofit sustainable drainage measures in the catchment (such as permeable paving and water butts), to counter the increased run-off following rainfall in order to reduce the risk of flooding.

Figure 6 Urban creep rates in the Thames Water region



¹² Mott MacDonald, Future impacts on sewer systems in England and Wales, June 2011.

5.2 Climate change

We have analysed the 2009 UK Climate Projections (UKCP09), to determine the likely increase in rainfall intensity due to climate change in 15 catchments across our region¹³. More intensive rainfall in the future will increase the peak flow in sewerage networks and with it the likelihood of sewer flooding.

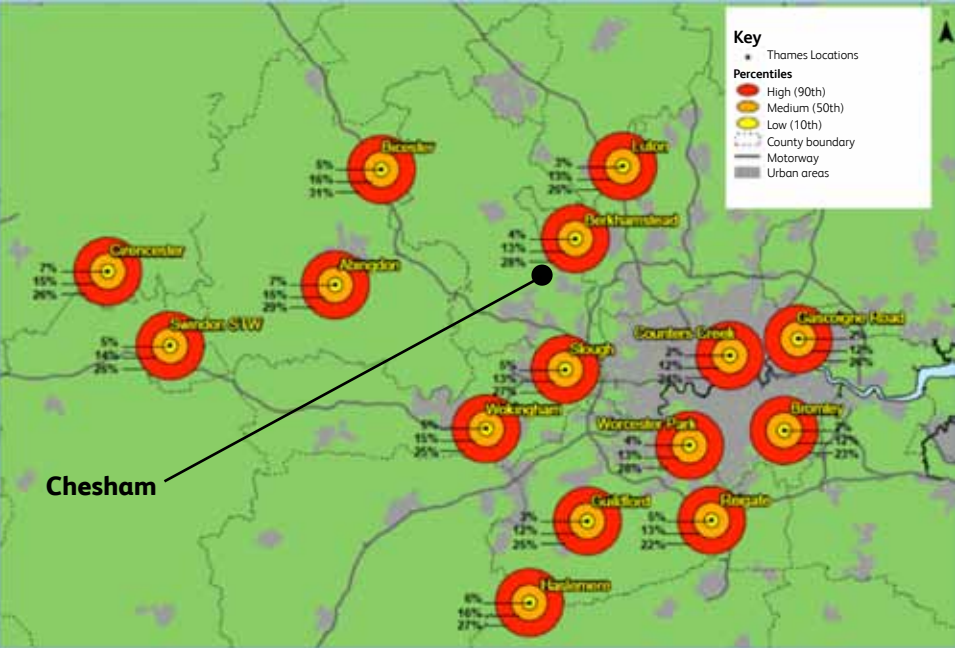
Fifteen catchments across our region were

selected to give a representative sample of inner London, outer London and more rural areas in the Thames Valley. A number of these catchments are also areas which experience sewerage related issues like pollution, flooding and urban creep.

We assessed different combinations of emission scenarios and climate change percentiles for each of the 15 catchments.

The nearest catchment to Chesham that was analysed for climate change was Berkhamstead. The results show a central estimate of an increase of 13 % in rainfall by 2080, but in some scenarios this could be as high as 28 % or as low as 4 %, as shown in Figure 7 below. We will ensure that our strategy takes account of these potential increased peak flows as it develops.

Figure 7 Locations assessed for increased rainfall intensity by 2080



Increased rainfall intensity may not be the only consequence of climate change. UKCP09 data also suggests that the UK is likely experience longer wetter winters in future. Further research is needed to understand whether high groundwater levels, such as those observed in the winters of 2012/13 and 2013/14 are

likely to become more frequent in future. As the recent experience of prolonged rainfall and high groundwater levels have been shown to be the principal factors, this research will be very significant in informing any risk assessment and appraisal of costs and benefits of solutions.

¹³ Atkins, Thames UKCP09 Rainfall Intensity Assessment Revised Report, October 2012.

5.3 Population growth and new development

We use a combination of top-down and bottom-up information to ensure that our forecast of population and new development is as robust as possible to keep costs down, in order to minimise the bill impact of any investment that may be necessary.

Our forecast of the number of new households is taken directly from Experian data. We have used the 'Plan-Based' projection which uses information provided by local authorities about planned numbers of new dwellings in their respective areas. During the period 2015 to 2020 we expect to see an increase in new development across the Thames Water region and are forecasting a total of 263,000 new connections to the sewerage network during this time.

Our Development Tracker System (DTS), is used to track developer enquiries through the planning process to construction. When we are contacted by a developer, we typically carry out preliminary modelling to determine whether our network or treatment works has the capacity to accommodate the increase in flow. Where it does not, we propose planning conditions for consideration by the Planning Authority, although we encourage developers to contact us as early as possible in the planning process to avoid this.

The independent review into the causes of the 2007 floods (The Pitt Review), concluded Sustainable Drainage Systems (commonly known as SuDS), are an effective way to reduce the risk of 'flash-flooding' which occurs when rainwater rapidly flows into the public sewerage and drainage systems, causing overloading and back-up of water. Typically, SuDS slow the rate of surface water run-off entry into the drainage system and improve the percolating feature, ie rainfall recharging the groundwater system, thus mimicking natural drainage processes. In April 2015, the Government made changes to the planning process effecting planning policies and decisions on planning applications of 10 dwellings or more (or equivalent non-residential or mixed development), to ensure that sustainable drainage systems are put in place, unless demonstrated to be inappropriate. This requires that when considering planning applications, local planning authorities should consult the relevant Lead Local Flood Authority (County Council or Unitary Authority), on the management of surface water, to satisfy themselves that the proposed standards of operation are appropriate and ensure, through the use of planning conditions or planning obligations, that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

In the case of Chesham, whilst SuDS might help to reduce the risk of flooding following rainfall when groundwater levels are low (i.e. typically during summer months), they may not be as effective in reducing the flood risk when groundwater levels are high (typically during the winter months). We will therefore take account of the potential influence of groundwater when we come to assess any options as part of this drainage strategy framework process.

The majority of the Chesham catchment falls within the Chiltern District Council planning area, they list 265 dwellings with outstanding planning permission in the Chesham Parish as of March 2015. The Council is currently preparing its new Local Plan which will run from the period of 2014 to 2036.

The area around Bovingdon falls within Dacorum Borough Council. The Council's adopted Core Strategy (September 2013), includes a commitment to deliver a total of 130 new homes in Bovingdon over the plan period up to 2031, as set out within the Bovingdon Place Strategy.

Our engagement with a number of local projects will also inform our drainage strategy. Such as the Hertfordshire Water Project, which is examining the impact of potential new housing and population

growth on infrastructure capacity and performance. This involves both Chiltern District Council and Dacorum Borough Council and will form part of the evidence-base for future local plans.

Using sources that include the Chiltern District Council adopted Local Plan 1997, allocated sites in their adopted Core Strategy 2011 and outstanding planning permissions, along with the Dacorum Core Strategy and third party planning enquiries, we are currently tracking the following key development sites in the Chesham catchment:

- 54 dwellings at the Vale, Chesham
- 9 dwellings at the former W Durston Ltd site, Hospital Hill
- 80 dwellings at former Chesham Community Hospital, Hospital Hill
- 45 dwellings Amersham and Wycombe

College, Chesham campus, Lycrome Road

- 8 dwellings Asheridge Road
- 5 dwellings Sherwood House Stones Courtyard High Street
- 5 dwellings 40 and land rear of 28 34 Addison Road
- 14 dwellings on land rear to Lowndes Avenue and Bellingdon Road
- 14 dwellings Copsham House, Broad Street
- 6 dwellings 33-35 Red Lion Street
- 6 dwellings First and Second floors Buck House, Sunnyside Road
- 10 dwellings Nashleigh Court 188 Severalls Avenue
- 6 dwellings Ground floor & Upper floors Coughtrey House, Broad Street
- Land off Chesham Road/Molyneaux Avenue for the construction of 60 new homes.

- Possible redevelopment of Bobsleigh Inn, Hempstead Road, Bovingdon for a 100 bedroom hotel
- Third party planning enquiry for 130 units at Grange Farm, Bovingdon.

Other applications exist but relate to developments of less than 5 properties or in which detailed numbers have not been confirmed. We will continue to monitor future plans for the catchment through our stakeholder engagement work. A key element of our assessments will be to establish the extent to which these developments may be significant in the context of challenges currently experienced. This assessment work will be undertaken and findings shared in an update to this Strategy document.

6 Strategy development

The Drainage Strategy for the Chesham catchment is currently at Stage 1 (Initialise/prepare), of the 4-stage framework process. The following activities in Table 4, are planned and ongoing, in order to carry out the risk assessment and development of our strategy options.

Table 4 Activities planned and ongoing to enable strategy development

Activity	Purpose	Date planned	Outcome
Stakeholder engagement	This document will be circulated to the Environment Agency, Buckinghamshire and Hertfordshire County Councils as Lead Local Flood Authorities, Chiltern District Council and Dacorum Borough Council before being published on our website. The Local Flood Forum will continue to be used as the primary route for stakeholder engagement. All third party data will contribute to drainage strategy development.	Ongoing	Stakeholders informed about progress and timing of works to reduce the risk of flooding. Work carried out by Thames Water is coordinated with activities of other partners involved with drainage.
Permanent monitoring of sewer levels	Continue to monitor sewer depth monitors installed into the foul sewers. Plan is for monitors to remain in situ for at least 5 years and to capture the next wet weather event as a minimum. Analyse the recorded depths and compare with other catchment variables, such as rainfall events and changes in groundwater levels.	Ongoing	Use information to identify additional actions for inclusion in the drainage strategy for Chesham. Share information with other agencies.
Sewage treatment works storm discharge monitoring	Monitor the discharges from the storm tanks.	From spring 2016	Use information to identify additional actions for inclusion in the drainage strategy for Chesham. Share information with other agencies.
Sewer and manhole surveys	Ascertain sewer and manhole condition and evidence of infiltration via CCTV survey and manhole "lift and look" surveys when appropriate.	From spring 2016	Use information to identify additional actions for inclusion in the drainage strategy for Chesham. Share information with other agencies.
Customer surveys	Validate the historical records of flooding and restricted toilet use in the catchment to enable a detailed benefits assessment of potential further intervention options that	From spring 2016	Use information to help test the cost benefit of options to improve drainage and reduce the risk of sewer flooding in Chesham.
Permanent monitoring of pumping station	could be implemented by Thames Water Install permanent monitor on rising main to establish pumped flows from Chesham pumping station to the sewage treatment works.	From spring 2016	Use information to identify additional actions for inclusion in the drainage strategy for Chesham. Share information with other agencies

Activity	Purpose	Date planned	Outcome
Update drainage strategy	Improve the drainage strategy based on the initial results from the permanent monitoring, customer surveys, misconnection surveys and feedback from stakeholders.	2017	Risk assessment, options appraisal and preferred strategy to be completed, subject to capturing weather events through monitoring and surveys.
Pilot trials of mobile treatment plant	As part of our wider approach to managing high groundwater levels, we have trialled the use of biological filters elsewhere. Our findings will inform and may influence our strategy plans for Chesham. If successful, these could be used to abstract dilute sewage from surcharged sewers and discharge it safely to a watercourse.	Ongoing	Service may be restored for customers without the need for tankering.
Consider innovative solutions	Identify quicker / cheaper / collaborative options that improve the benefit to cost ratio in order to keep customers' bills down to prioritise investment to ensure greatest benefit to customers.	Ongoing	Enhanced toolkit available to reduce the risk of sewer flooding and then apply this once data becomes available.
Chesham sewage treatment works upgrade	Design and construct upgrades to the sewage treatment works processes.	Operational by March 2018	Compliance with tightened ammonia consent and flow to full treatment revised to accommodate growth.

7 Preferred strategy and plan

We believe that the foul sewerage system in Chesham has surcharged and flooded predominantly due to a combination of groundwater infiltration, surface water run-off from saturated fields, surface water inundation from highways and public spaces and surface water misconnections. Our network strategy is to understand the relative impact that each of these factors has on the risk of flooding and then to develop a plan comprising cost beneficial solutions using customer willingness to

pay research. In parallel, we will assess the extent to which new developments may be significant in the context of the challenges currently experienced and, where necessary, we will develop solutions to accommodate the proposed development in the catchment.

We may carry out some repair works on the network as this strategy develops, in the event that our investigations identify faults or problems with the sewerage

network that are highly likely to have caused flooding.

Additionally, Chesham sewage treatment works is likely to require an upgrade when the Environment Agency's National Environment Programme is finalised in 2016.

Table 5 below details the activities that we have identified to date.

Table 5 Activities identified in preferred plan to date

Activity	Purpose	Date planned	Outcome
Permanent monitoring of sewer levels	Continue to monitor sewer depth monitors installed into the foul sewers. Plan is for monitors to remain in situ for at least 5 years and to capture the next wet weather event as a minimum. Analyse the recorded depths and compare with other catchment variables, such as rainfall events and changes in groundwater levels.	Ongoing	Use information to identify additional actions for inclusion in the drainage strategy for Chesham. Share information with other agencies.
Localised sewer rehabilitation	Undertake localised sewer rehabilitation to include lining, patch repairs, localised pipe replacement and manhole repairs identified through survey work and where considered cost effective in reducing ingress of ground water.	When identified	Reduce infiltration into the public sewers.
Manhole cover replacement	Replace manhole covers with leak tight covers where identified through survey work.	When identified	Stop ingress of surface water through manholes located in flood plain.
Upgrade of Chesham sewage treatment works	Address tightening of the ammonia consent and increased growth in flows in Chesham.	By March 2018	Works continues to comply with discharge consent. Flow to full treatment is revised to accommodate growth.

Our plan will be updated once the Risk Assessment and Options Appraisal sections have been completed in accordance with the Drainage Strategy framework.

8 Temporary overflows

We have not installed temporary pipework and pumps in the sewerage network during wet weather events in Chesham to maintain service, but we would consider doing so to prevent the backup of sewerage into customers' properties and uncontrolled spilling from the sewer system into the environment.

As part of the stage 2 risk assessment and stage 3 options appraisal, we will be

investigating the circumstances under which emergency discharges may be required in future, such as the use of temporary overflows, to pump out from the sewerage network through biological filters to maintain service to customers and prevent homes from flooding. As this Drainage Strategy develops, in this section we will describe the location of any proposed temporary overflows and the circumstances under which we would use

them, in order that this Drainage Strategy, together with our plans to reduce infiltration, fully meets the requirements of an Infiltration Reduction Plan as set out in the Environment Agency's Regulatory Position Statement. We will continue to identify sewer rehabilitation and other permanent works to reduce groundwater infiltration alongside refining the use of temporary overflows.

Appendix A

Glossary of terms

Term	Definition	Term	Definition
Blockages	Obstacles or the build-up of fat and grease, block or obstruct our sewerage pipes. This is normally caused by things which should not be flushed, or poured, into drains and sewers.	Inundation	the brickwork or defects in manhole structures. Accumulated surface water from rain and/or river floodwater that has resulted in localised flooding, finds its way into the sewerage system through manhole covers and drains. These may be public or private. See definition for Foul drain.
Combined sewer	A pipe conveying the combined rainwater and contaminated wastewater from two or more properties. A combined sewer is designed to carry wastewater to a sewage works for treatment but during periods of heavy rainfall or snowmelt, the volume in a combined sewer system can exceed the capacity of the sewer system or treatment plant. For this reason, combined sewer systems are designed to overflow occasionally and discharge excess wastewater directly to nearby streams, rivers, or other water courses.	Lateral drain Misconnections (surface water to foul water)	Property owners have connected rainwater and/or land drainage to our sewers (e.g. roof drainage, paved driveways drains, soakaway overflows), and can cause major issues for the performance of the sewerage system.
Dry weather flow	The average flow rate observed over a 24 hour period in dry weather and based on Sewers for Adoption, the industry standard, includes an allowance for infiltration of 10% of the calculated flow rate.	Misconnections (foul water to surface water) Private sewers Rainfall induced infiltration	A plumbing mistake resulting in wastewater appliances being misconnected to the surface water system. See definition for Foul sewer. Sewer infiltration that occurs as a result of rainfall percolating into the ground impacting the sewer on route to recharging the groundwater table.
Foul drain	A pipe conveying the contaminated wastewater from a single property. If the pipe extends beyond the property boundary, the portion of the pipe outside of the boundary is termed a lateral drain. The portion of the pipe inside the boundary is a private drain. On 1 October 2011 water and sewerage companies in England and Wales became responsible for lateral drains, which were previously the responsibility of property owners. Private drains remain the responsibility of property owners.	Riparian owner	If you own land adjoining, above or with a watercourse running through it, you have certain rights and responsibilities. In legal terms you are a 'riparian owner'. If you rent the land, you should agree with the owner who will manage these rights and responsibilities.
Foul sewer	A pipe conveying the sewage from two or more properties. On 1 October 2011, water and sewerage companies in England and Wales also became responsible for private sewers, which were previously the responsibility of property owners. A foul sewer is designed to carry contaminated wastewater to a sewage works for treatment. It disposes of wastewater from sources including toilets, baths, showers, kitchen sinks, washing machines and dishwashers.	Soakaway	Surface water from a roof and driveway of a property is piped to an underground pit, usually filled with gravel or similar material. Some soakaways are situated within the boundary of the property.
Infiltration	Groundwater finds its way into the sewerage system (including private drains), via defective pipes or pipe joints and through	Surface water drain Surface water sewer	A pipe conveying uncontaminated rainwater from a single property. A pipe containing uncontaminated rainwater from two or more properties. A surface water sewer is designed to dispose of rainwater from roofs, driveways, patios, roads, etc to a local watercourse.
		Sustainable Drainage Systems (SuDS)	Measures designed to attenuate and slow down surface water before it enters sewers to reduce the risk of flooding following heavy rainfall. Includes green infrastructure such as raingardens, green roofs as well as other measures, such as permeable paving and water butts.

Appendix B

Supporting figures

Figure B1 Fluvial flood risk for Chesham based on Environment Agency plans

This flood risk map information has been sourced from the Environment Agency website. For more detailed flood map information for this catchment, please access the Environment Agency website.

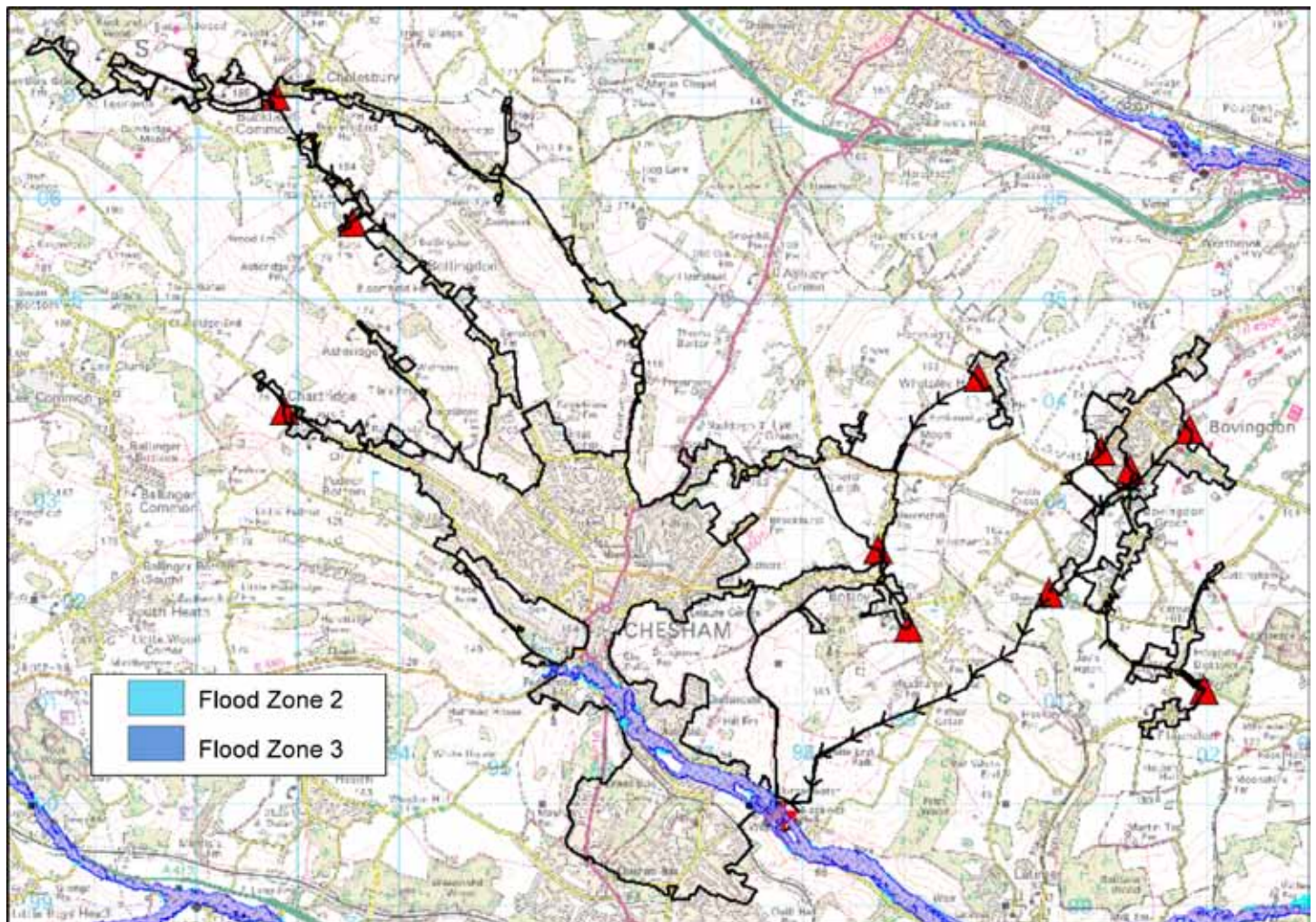


Figure B2 Surface water flood risk for Chesham from Environment Agency plans

This flood risk map information has been sourced from the Environment Agency website. For more detailed flood map information for this catchment, please access the Environment Agency website.

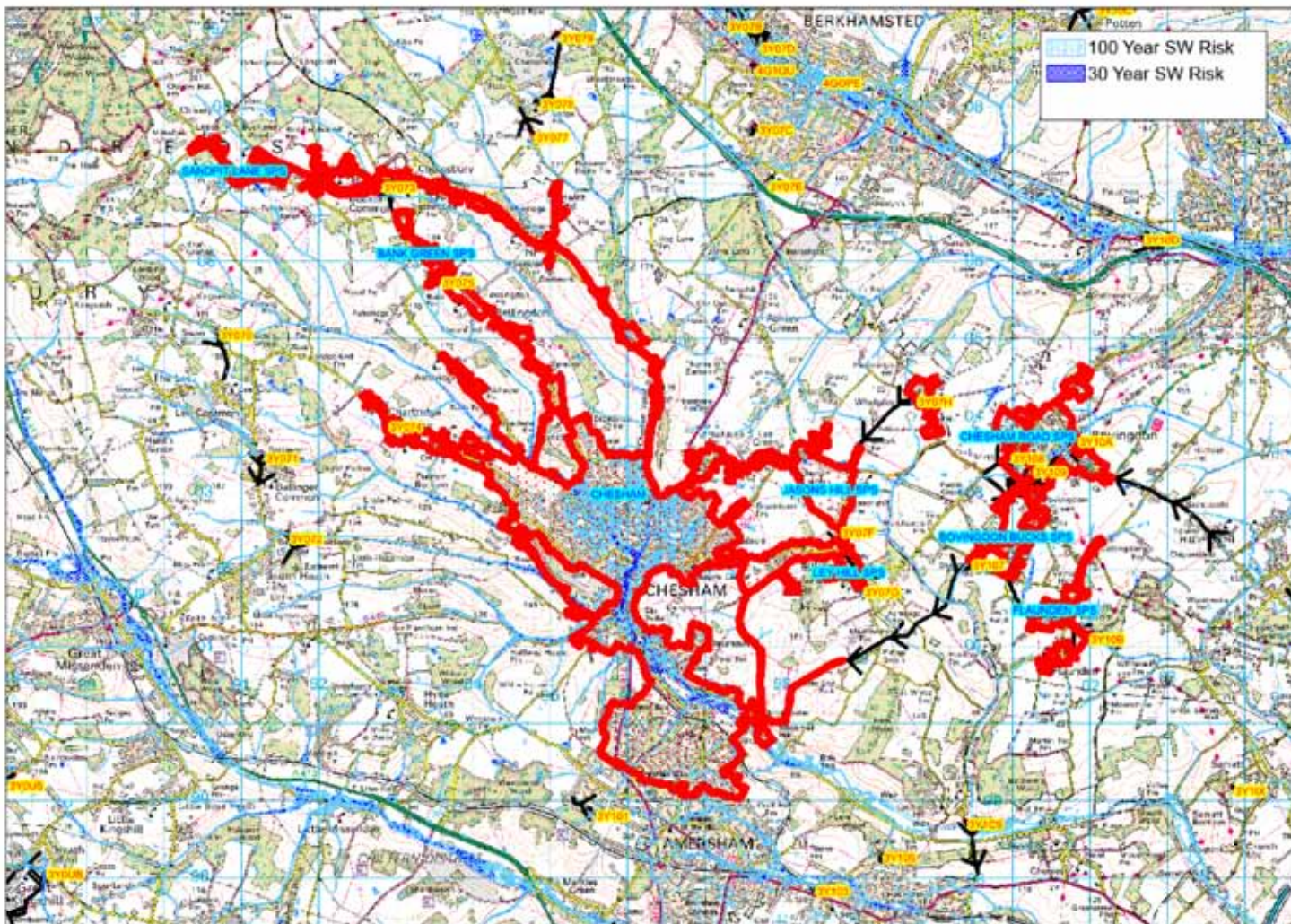
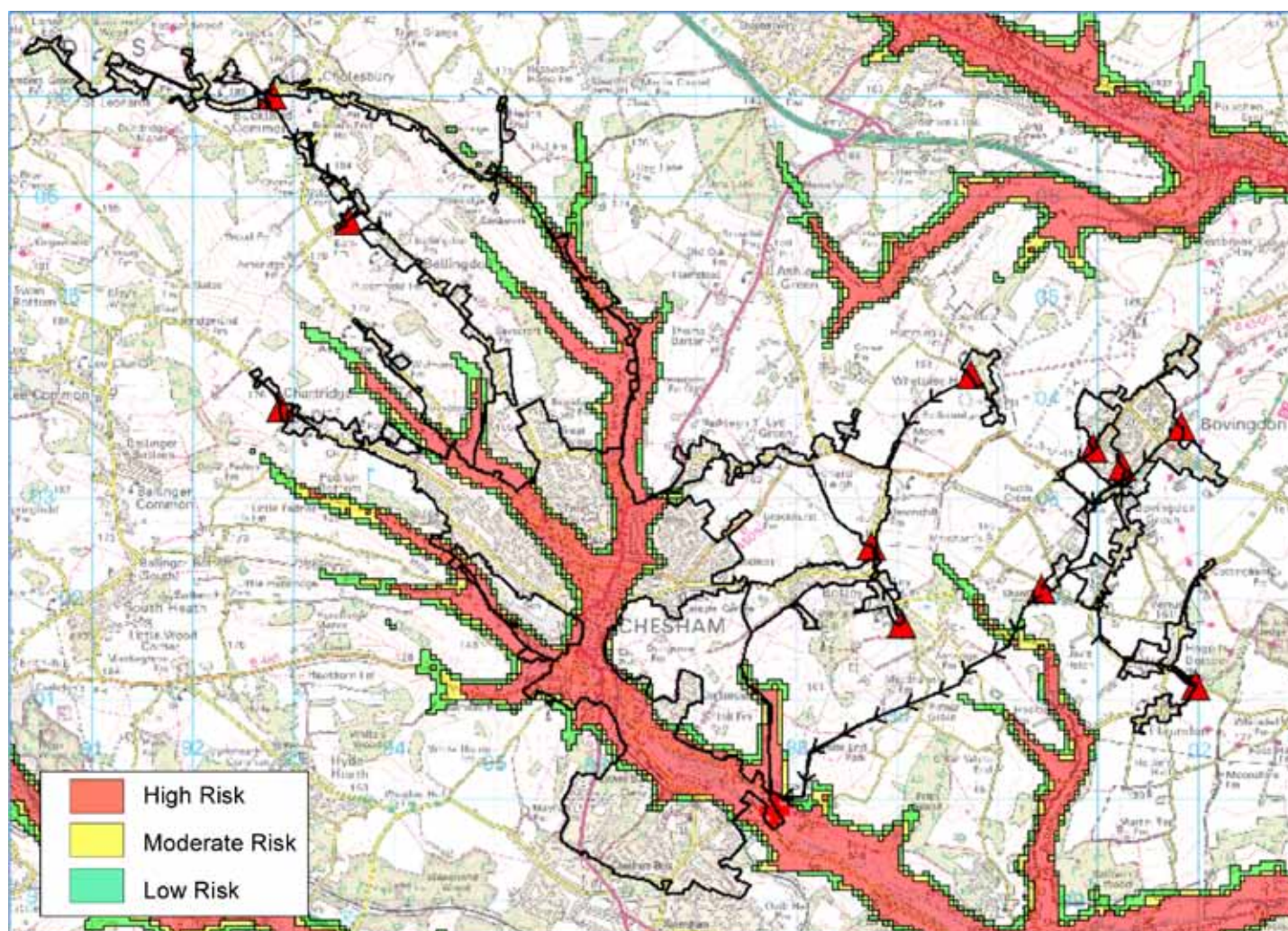


Figure B3 Groundwater flood risk for Chesham

This groundwater flood risk map information has been sourced from ESI Ltd.



ESI Groundwater Flood Risk Map of England and Wales © www.esinternational.com



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