Staplehurst Surface Water Management Plan

Final Report

January 2017

Kent County Council
County Hall
MAIDSTONE
Kent
ME14 1XQ

JBA Project Manager

Jennifer Hill
35 Perrymount Road
Haywards Heath
RH16 3BW

Revision History

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Final v2 / August 2016	Addressed comments from Max Tant	Project partners
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Contract

This report describes work commissioned by Max Tant, on behalf of Kent County Council. Kent County Council's representative for the contract was Max Tant. Jennifer Hill and Christopher Matthias of JBA Consulting carried out this work.

Prepared by ..... Jennifer Hill BSc MSc
Senior Analyst

Reviewed by ..... Paul Eccleston BA CertWEM CEnv MCIWEM C.WEM
Technical Director

Purpose

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Acknowledgements

JBA would like to thank Kent County Council, Maidstone Borough Council, Staplehurst Parish Council, Southern Water, the Environment Agency and the Medway IDB for their contributions throughout the project.

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Executive Summary

A Stage 1 Surface Water Management Plan (SWMP) for the Maidstone Borough was commissioned after the Preliminary Flood Risk Assessment (PFRA) for Kent found that Maidstone was the settlement most at risk from surface water flooding in the county. The Stage 1 SWMP for the Maidstone District found a history of flooding in the village of Staplehurst. Common sources of the flooding were found to be highway flooding from exceeded drains and sewer flooding.

This Stage 2 SWMP, focussing specifically on Staplehurst, was commissioned in 2014 as a detailed assessment of local flood risk, following Defra (2010) guidance. The aim of this study was to provide a detailed understanding of the causes and consequences of surface water flooding and to test the benefits and costs of mitigation measures.

Understanding the causes of surface water flooding was achieved by;

- updating the flood history to include recent incidents and understanding the source and pathway of the flooding; and
- creating an integrated model of flood risk and analysing the results to understand the flood mechanisms.

Understanding the consequence of the flooding was achieved by;

- understanding the receptor of recorded flood incidents;
- counting the dwellings and critical infrastructure predicted to flood; and
- calculating the economic damages of predicted flooding to dwellings and critical infrastructure.

Hotspots were defined as areas with repeated flood history or predicted risk from the Integrated Urban Drainage Model and the updated Flood Map for Surface Water. The hotspot areas in Staplehurst were: Marden Road, Clapper Lane, Offens Drive and Fishers Road. The cost of flooding at each of these hotspots was assessed using the model results and the Multi-coloured Manual of flooding damage curves.

At each hotspot, a long list of potential flood risk mitigation measures was drawn up. The feasibility of these options was assessed on a site visit and against known restrictions to develop a short list of options. The effectiveness of each option was tested in the hydraulic model. These included storage, flap valves and culvert upsizing at Clapper Lane, raising Plain Road and increasing drainage on Offens Drive.

The revised cost of flooding was then calculated using the options model results and the Multi-coloured Manual of flooding damage curves. The benefit of the option was then contrasted with the estimated cost of construction using Cost-Benefit Analysis but none of the options were found to be cost beneficial. Therefore, KCC would not be able to secure funding for these proposed schemes via the Flood Grant in Aid process.

As a result, the action plan focuses on low cost measures to manage the risk such as maximising existing drainage features with regular cleansing, and improving flood resilience with use of Property Level Protection. One high priority action is to clear the blocked highway drainage outfall on Offens Drive. A second, high priority action to ascertain the owner, condition and connections of a surface water storage tank at Marden Road. Investigations as part of this study have not concluded how the tank drains and there is an opportunity that this asset could be better utilised to help manage the flood risk in the area.

There is significant development planned for Staplehurst. There is a risk than inappropriate drainage design could exacerbate the existing flooding issue. However, if MBC and KCC drainage policies are followed, this risk can be avoided. Therefore, the development could provide an opportunity to help manage local flood risk. For example, the proposed development at Duck and Henhouse farm could impact flood risk at Marden Road and Clapper Lane hotspots. If drainage is considered at master planning stage, there may be an opportunity to reduce the existing risk.

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Abbreviations

AEP ..... Annual Exceedance Probability
CCTV ..... Close Circuit Television
CEP ..... Communication and Engagement Plan
DA ..... Drainage Area
GiA ..... Grant in Aid
DTM ..... Digital Terrain Model
IDB ..... Internal Drainage Board
IUD ..... Integrated Urban Drainage
JBA ..... Jeremy Benn Associates
KCC ..... Kent County Council
LLFA ..... Lead Local Flood Authority
MBC ..... Maidstone Borough Council
mAOD ..... metres Above Ordnance Datum
NPPF ..... National Planning Policy Framework
NRD ..... National Receptors Database
RMA ..... Risk Management Authority
SFRA ..... Strategic Flood Risk Assessment
SHLAA ..... Strategic Housing Land Availability Assessment
SuDS ..... Sustainable Drainage Systems
SWMP ..... Surface Water Management Plan
uFMfSW ..... updated Flood Map for Surface Water

1 Introduction

This surface water management plan (SWMP) has been undertaken to explore the local flood risks in the Parish of Staplehurst. It has been prepared by a partnership of Kent County Council, the Environment Agency, Maidstone Borough Council, Upper Medway Internal Drainage Board (IDB), Southern Water and Staplehurst Parish Council.

1.1 What is a Surface Water Management Plan?

A Surface Water Management Plan (SWMP) is a study to understand the flood risks that arises from local flooding, which is defined by the Flood and Water Management Act 2010 as flooding from risk from surface runoff, groundwater, and ordinary watercourses.

SWMPs are led by a partnership of flood risk management authorities who have responsibilities for aspects of local flooding, including the County Council, Local Authority, Sewerage Undertaker and other relevant authorities.

The purpose of a SWMP is to identify what the local flood risk issues are, what options there may be to prevent them or the damage they cause and who should take these options forward. This is presented in an Action Plan that the partners agree.

Kent County Council (KCC) often takes a two-stage approach to SWMPs. Initially, a Stage 1 SWMP is undertaken which collects all the available flood risk and flood history data in the catchment. Where this process identifies a flood prone area a Stage 2 SWMP can be required to make a more detailed assessment of flood risk and focus the resulting action plan of flood mitigation measures.

1.2 Stage 1 SWMP: key findings

Kent County Council in partnership with the Environment Agency, Maidstone Borough Council, Upper Medway Internal Drainage Board (IDB) and Southern Water prepared the Stage 1 Maidstone SWMP to investigate the local flood risks to the Maidstone borough, published in 2014.

The Maidstone SWMP study area was subdivided into Drainage Areas to allow more in depth analysis. A list of all the drainage areas in the Maidstone SWMP is available in Table 1-1.

Table 1-1 Maidstone Stage 1 SWMP Drainage Areas (DA)

Drainage Area	Location
DA01	Maidstone Rural North
DA02	Maidstone Rural Mid
DA03	Maidstone Rural West
DA04	Maidstone Rural East

The Staplehurst Surface Water Management Plan falls within DA04, Maidstone Rural East. The Stage 1 SWMP stated that there were numerous flooding issues identified in Staplehurst, and that these arose from a variety of sources. Therefore, one of the conclusions of the study was that an integrated catchment model was needed for Staplehurst.

1.3 Stage 2 SWMP: drivers

The preparation of a Stage 2 SWMP was driven in response to the following primary considerations:

- The need to manage local flood risk as a consequence of assessments performed under the Flood Risk Regulations, 2009 or the Flood and Water Management Act 2010;
- The need to inform spatial planning and development control, develop a strategy for flood risk management, and provide evidence that future new development can be implemented and local flood risk safely managed; and
- The need to build on the understanding of high risk areas highlighted within the Stage 1 SWMP and to develop feasible options for improving local flood risk within known hot spot areas.

1.4 Study objectives

The objectives of the Staplehurst Stage 2 SWMP as set out in the scope of work are:

1. The establishment of a local partnership as a steering group;
2. The collation and mapping of a comprehensive flood history for all relevant local flood risk sources which may include collecting data from residents of Staplehurst;
3. The preparation of source pathway receptor models for all the risks and sources that are identified;
4. The preparation of a hydrodynamic flood model
5. The predicted flooding, including depth, velocity and hazard, to from the 1 in 2, 5, 20, 30, 75, 100, 100 +CC and 1000 events
6. Determine the areas at risk of flooding
7. Identification of the causes of flooding and/or constraints to drainage
8. Estimate the economic impact of flooding to the Staplehurst and to assess mitigation options for the flood risk identified
9. Identify potential mitigation options for the flood risks identified
10. Identification of opportunities to deliver flood risk management benefits through local planning documents, including neighbourhood plans
11. Set out a clear plan for further work that may be necessary to manage or better understand the risks identified.

1.5 Study area

The SWMP focuses on the village of Staplehurst within the Maidstone Borough. This area includes the entire parish and is shown in Figure 1-1. This includes Cross-at-Hand to the north and Bowling Alley Wood to the south.

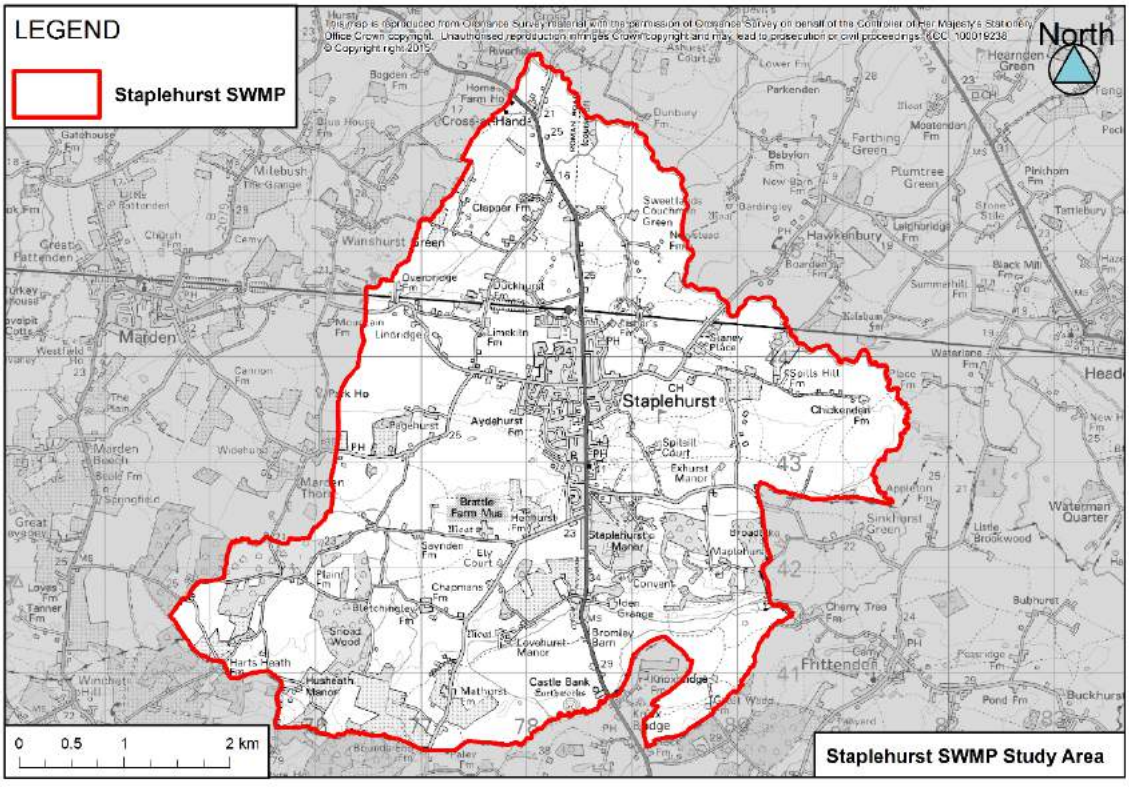


Figure 1-1 Staplehurst SWMP study area

2 Partnership and Communications

2.1 Partnership approach

Surface water cannot be effectively managed by a single authority, organisation or partner; all the key organisations and decision-makers must work together to plan and act to manage surface water across Staplehurst. Many organisations have rights and responsibilities for management of surface water. Although Kent County Council commissioned this project, the key partners have been consulted at appropriate stages in the study. Working in partnership encourages co-operation between different agencies and enables all parties to make informed decisions and agree the most cost effective way of managing surface water flood risk across Staplehurst in the long term. The partnership process is also designed to encourage the development of innovative solutions and practices and improve understanding of surface water flooding.

2.2 Partners

Partners are defined as organisations with responsibility for the decision or actions that need to be taken to manage surface water flooding. The partners involved in this project are listed in Table 2-1.

Table 2-1 Partners involved in the Staplehurst SWMP

Partner Organisation	Representative(s)
Kent County Council (Flood Risk Management)	Max Tant Joe Williamson
Kent County Council (Highways)	Adam Murdin
Maidstone Borough Council (Drainage) Maidstone Borough Council (Planning)	Bill Axel Chris Berry
Southern Water Services Ltd	Mike Tomlinson
Environment Agency	Peter Waring
Medway Internal Drainage Board	Michael Watson
Staplehurst Parish Council	Andrew Watson

The project partners have supplied the data to inform this SWMP and have been attributed as action owners in the SWMP action plan. Staplehurst Parish Council have been involved throughout the preparation of this SWMP. The Parish Council have supported the production of the SWMP by passing on their detailed local knowledge of flood incidents that have occurred in Staplehurst and explaining the impact of flooding on the community.

In addition to the above, the Maidstone Borough Council (MBC) Planning department was also involved in the SWMP. As the authority responsible for setting local planning policy, it sets the development strategy for the area which will have a direct impact on how surface water is managed in new developments and redevelopments in the study area.

2.3 The Communication and Engagement Plan

A Communications and Engagement Plan (CEP) was developed and maintained to;

- Illustrate internally and externally the importance of communicating honestly and transparently with our delivery partners, stakeholders and communities;
- Support the project team in spending time and resources wisely, informing and involving the right people about the right things, at the right time; and

- Act as an overarching umbrella plan which ensures co-ordination between stakeholder engagement activities, media communications, internal/external communications, external funding and stakeholder support, other consultations.

2.4 Partnership meetings

Meetings have been held at key points throughout the project to consult the project partners and incorporate the knowledge of local issues.

The first project steering group focused on knowledge capture. The recorded flood incident data provided by the partners was presented and early identification of flooding hotspots were discussed. The project partners also shared information on their assets which could impact flood risk and any proposed schemes. This meeting was also used to develop the survey needs and modelling strategy based on the flooding mechanisms observed in Staplehurst. Here it was identified which drainage systems would be included in the model. This included representing the highway drainage and several ordinary watercourses, particularly around Clapper Lane. Key outcomes from the first steering group meeting were:

- selection of watercourses to be included in the hydraulic model
- the identification of Clapper Lane as a potential flooding hotspot and therefore the inclusion of these drainage ditches in the survey extent and hydraulic model
- planned survey of the highway drainage assets by KCC for inclusion in the model.

The second project steering group meeting focused on review of the draft model results. The hydrological analysis and model build process were explained and the draft outputs shared with the partners as animations and maximum depth results. Key outcomes from the second steering group meeting were:

- the decision for Southern Water to undertake a CCTV survey of foul sewerage at Marden Road to ascertain if the surface water attenuation tank drained into foul sewerage (now complete - surface water tank is not connected to foul sewerage)
- understanding that the predicted flooding at Clapper Lane was an underestimate, suggesting the model needed to be refined
- provision of old maps (dating back from 1876) by Maidstone Borough Council to allow the identification of any historic watercourses and ponds.

The third and final project steering group meeting focused on review of the options modelling, cost benefits analysis and discussed the way forward for Staplehurst. Key outcomes from the third steering group meeting were:

- the conclusion that none of the proposed capital schemes would be cost effective in Staplehurst because of they all had low benefits and high costs
- the understanding that flood risk to Clapper Lane is complex and originates from surface water, ordinary watercourses and main rivers. There are at least six flood mechanisms operating in total, therefore any scheme to further manage the flood risk here would have to include a co-ordinated effort between agencies to design multiple interventions to manage the flood risk from all sources (further discussed in Section 5.2)
- understanding that development at the Hen and Duckhurst Farm could impact flood risk at Clapper Lane
- promotion of a condition survey of the surface water tank at Marden Road as a next step although there has been no reported flooding upstream of the tank
- Staplehurst Parish Council agreed to arrange for the clearance of the highway drainage outfall from Offens Drive.

In addition to full partnership meetings, two meetings have been undertaken between JBA, KCC and Southern Water to align ongoing studies in the area and look for opportunities for collaborative working.

3 Risk Assessment

The risk assessment chapter of this report outlines the approach taken to assess the flood risk and summarises the results of the assessment.

3.1 Levels of assessment

The Maidstone Stage 1 SWMP highlighted the drainage area covering Staplehurst as having a significant history of flooding, particularly on the highways. Therefore, in line with the Defra guidance[1], a detailed assessment has been undertaken for this Stage 2 SWMP. This level of assessment aims to provide a detailed understanding of the causes and consequences of surface water flooding, and to test the benefits and costs of mitigation measures. This will be achieved through the modelling of surface and sub-surface drainage systems. The results of the detailed analyses have then been used to prepare an action plan.

The risk assessment carried out used the Source > Pathway > Receptor approach:

- Source - the origin of flood water
- Pathway - a route or means by which a receptor can be affected by flooding
- Receptor - something that can be adversely affected by flooding

Having applied the Source-Pathway-Receptor model it is possible mitigate the flood risk by addressing the source (often very difficult), block or alter the pathway and even remove the receptor e.g. steer development away.

3.2 Catchment characteristics

Both the natural and built environment impacts the risk of flooding from local sources. This section characterises the catchment including the fluvial network, geology and drainage network from urban areas.

3.2.1 Physical features

The SWMP study area has several watercourses, which drain towards the River Beult which flows along the north eastern edge of the study area or towards the Lesser Teise, which lies to the west of the study boundary beyond the village of Marden. The Beult and Lesser Teise are classified as Main River and falls under the jurisdiction of the Environment Agency.

There are also several ordinary watercourses that are adopted and managed by the Internal Drainage Board (IDB). Other ordinary watercourses are the responsibility of riparian owners. The watercourses within the Staplehurst SWMP study area have been highlighted in Figure 3-1. Main Rivers are shown in dark blue, Ordinary Watercourses as light blue and IBD drains as light blue, dark blue checks.

[1] Defra (2010) Surface Water Management Plan Technical Guidance. Defra: London

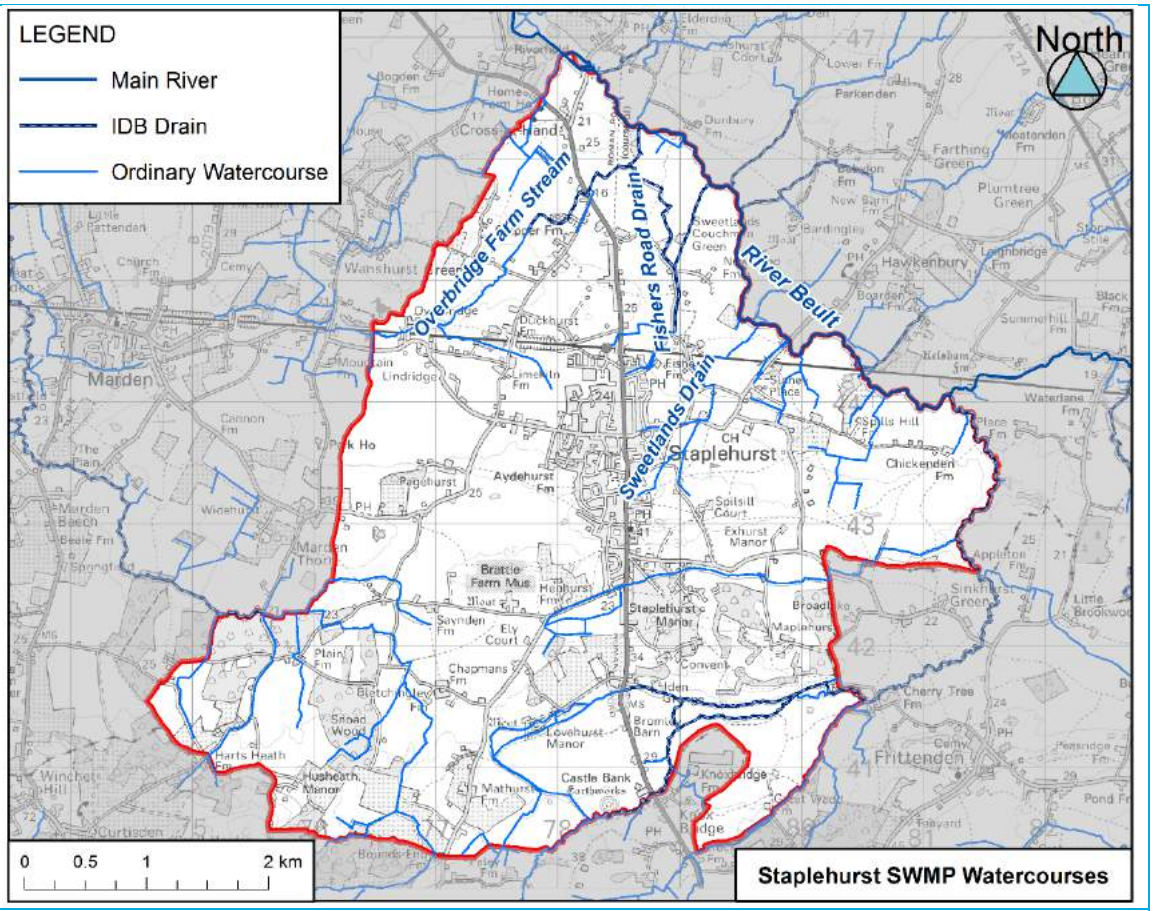


Figure 3-1 Staplehurst watercourses

Staplehurst is a predominately underlain by the Weald Clay formation which has a spatially variable composition of mudstones and siltstones with intermittent limestones. It is the Weald Clay Formation which underlies Staplehurst village. In the south western corner of the SWMP study area, the bedrock geology changes to Wadhurst Clay and Tunbridge Wells Sands formations. These consist of sandstones, siltstones, clays, mudstones and limestones.

Periodic flood events throughout geological time have facilitated the deposition of alluvium and river terrace superficial deposits, which overlay a small proportion of the SWMP study area. Where these overlay impermeable bedrock, such as clays, localised perched water tables may occur. The distribution of bed rock and superficial deposits, in reference to the study area, is shown in Figure 3-2**Error! Reference source not found.**.

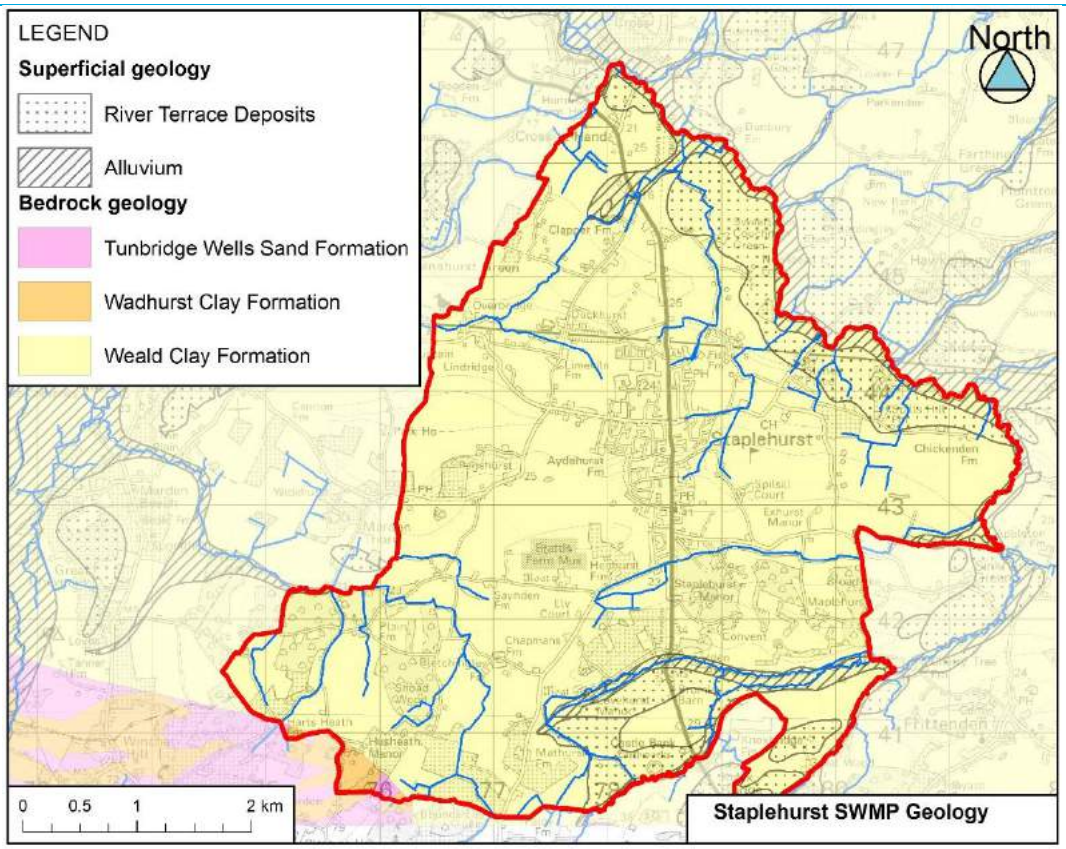


Figure 3-2 Staplehurst geology

Clays and Mudstones are typically low in permeability and porosity due to their fine grain size, but this varies. Large fractures, cavities or increased grain size may cause the geology to act as a conduit for groundwater and allow for surface water to infiltrate more quickly to the sub-surface in areas; this can cause a reduction in overland flow and consequently flood risk.

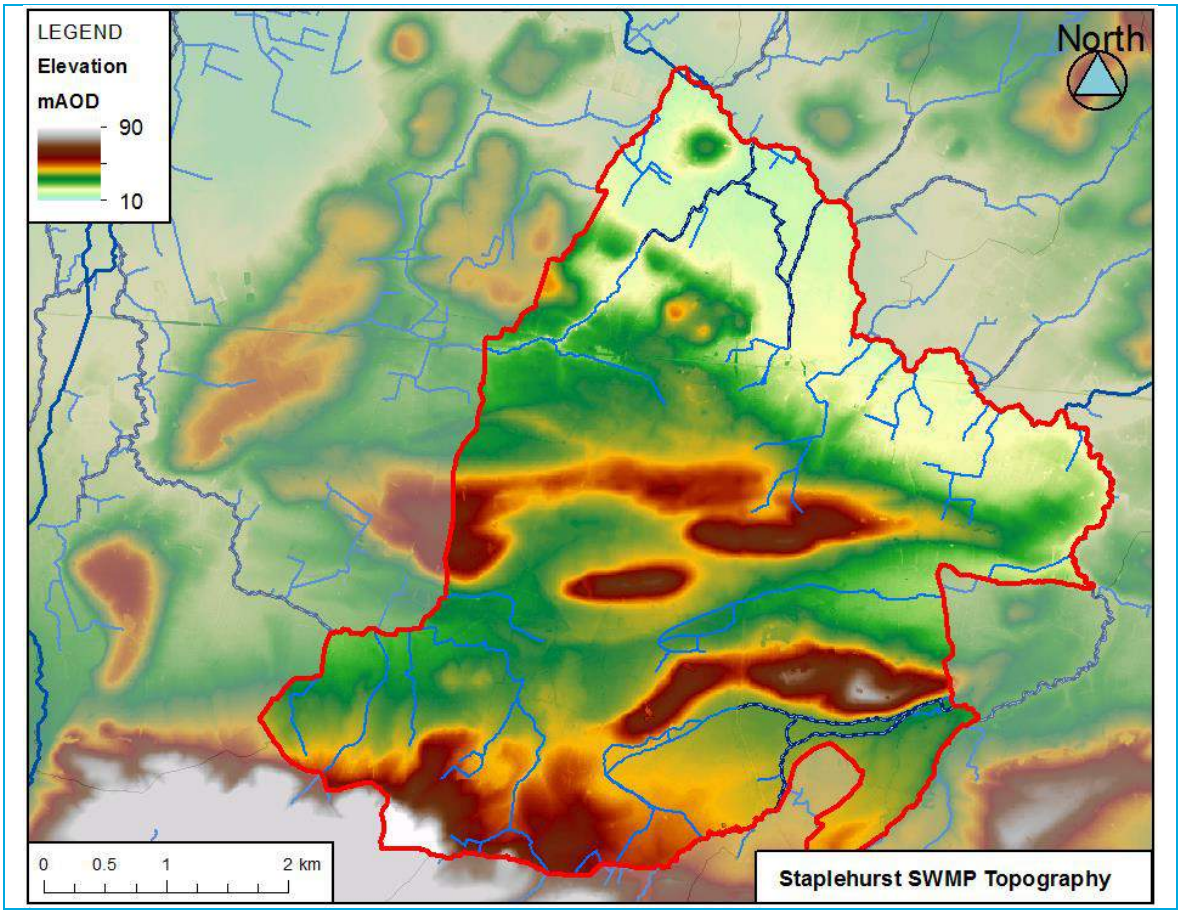


Figure 3-3 Staplehurst topography

The ground elevation varies by 80 metres across the SWMP area. The River Beult valley bottom is the lowest point in the catchment at around 10 mAOD. The village of Staplehurst sits on one of the highest point of the catchment at 80 mAOD.

The topography between the highest and lowest point is generally gently sloping. These shallow slopes are less likely to encourage runoff as water velocities are likely to be low, enabling time for more infiltration into the subsurface.

3.2.2 Land use

Maidstone Borough Council provided historic mapping of Staplehurst from the years 1876, 1896, 1908 and 1938 for use in the project. These maps showed how the village has grown from a small community around All Saints church northward to meet the railway line. Analysis of these maps highlights the number of surface waterbodies, particularly small ponds, across the parish. Some of these ponds remain in the village today. However, some have now been filled and build over. Most notably at Lodge Road, Jeffery Close and Iden Crescent. No historic watercourses were identified from old maps which are not shown on current day mapping.

Staplehurst village is an urban centre situated in a rural parish. The plans for the area involve significant residential growth to the village. The current land use within the village is predominately residential with industrial areas, railway station and large station car park in the north, but there are also areas of green space, such as parks and school playing fields. The current land use and potential future growth areas are shown in Figure 3-4 which includes aerial photography as it clearly demonstrates predominately rural land use in the parish.

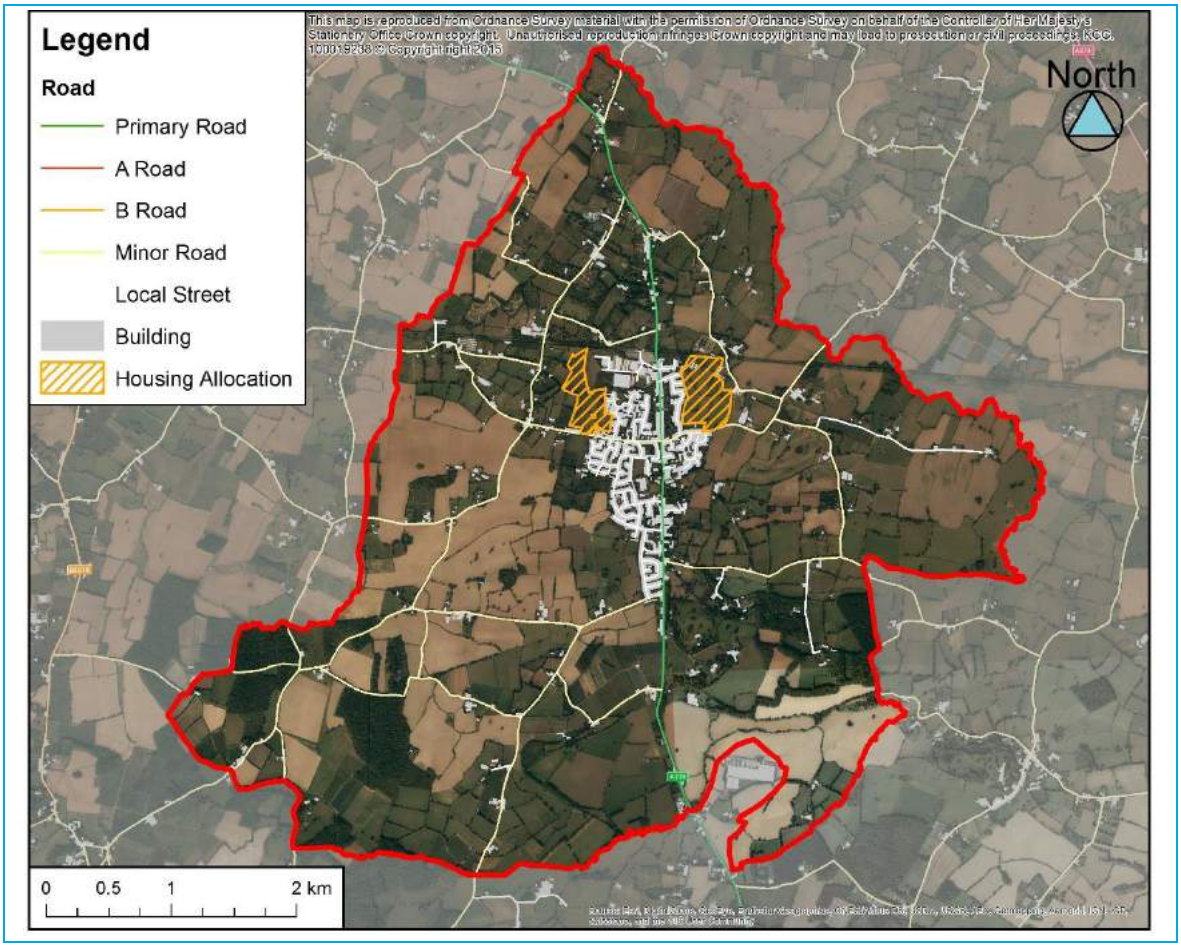


Figure 3-4: Staplehurst Land Use

3.2.3 Urban drainage

In Staplehurst, there are areas of separate sewerage and areas of foul only sewer. Separate systems are generally in the newer estates in Staplehurst such as Oliver Road and Lime Trees. In areas which have foul only drainage, such as Offens Drive, there is often a separate highway drainage network. The known drainage assets are mapped in Figure 3-5. The assets have been divided into foul (brown) and surface water (blue) sewers and highway drainage (black).

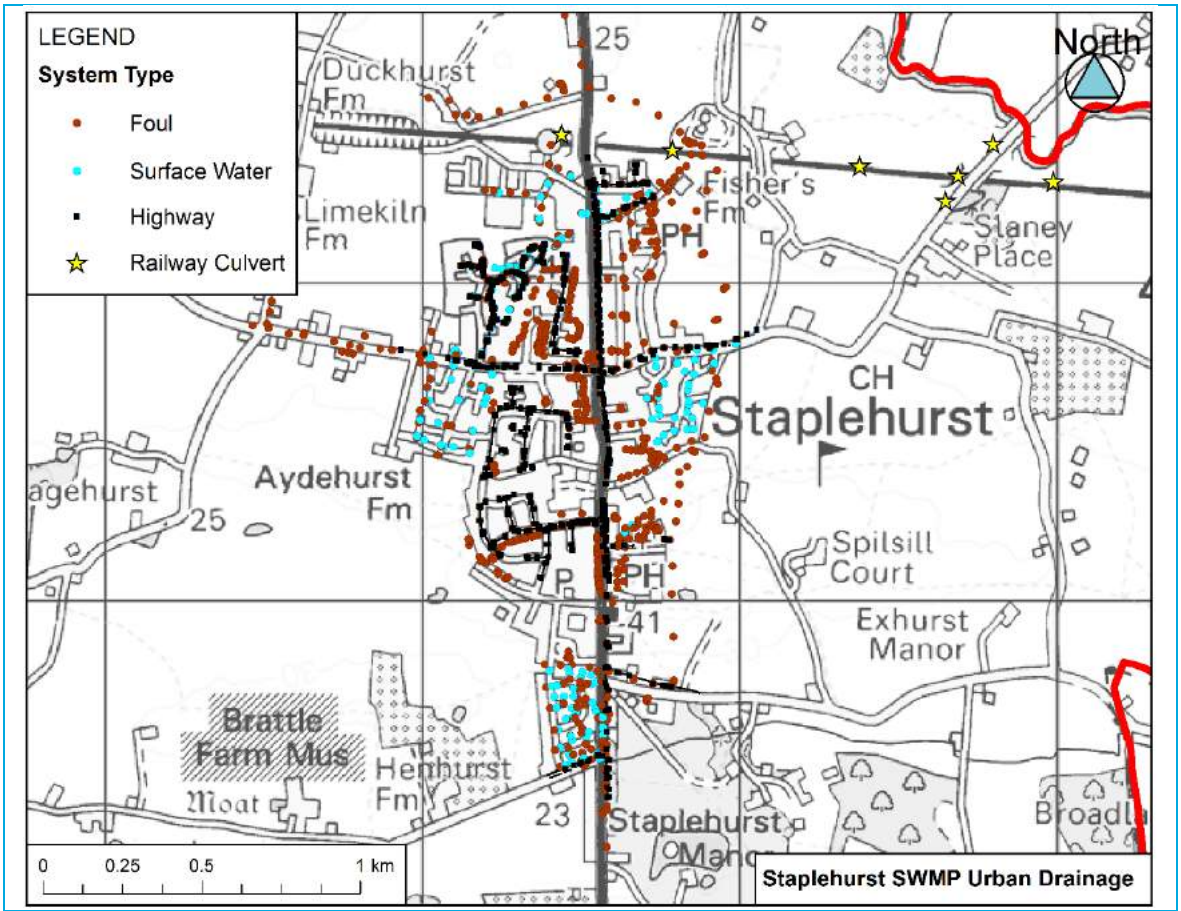


Figure 3-5 Staplehurst urban drainage network

Highway drainage exists across Staplehurst, operated by Kent County Council. Sections of this drainage network have been surveyed to inform this study. Elsewhere, it has been assumed that the highway gullies drain to a Southern Water surface water sewer when one is available. Otherwise the highways drain to soakaway. This assumption was, where possible, tested and verified when on site.

From the inspection records provided by Network Rail, eight railway culverts conveying watercourses have been identified, as summarised in Table 3-1. The inspection records also summarise the culvert condition at last survey. The last surveys concluded that all though there were no structural defects to be aware of, number of the culverts had reduced capacity due to sedimentation or overgrown vegetation. The remedial actions were all given a timeframe for completion, but the records show that not all these recommendations have been completed.

Table 3-1: National Rail structures

Asset Reference	National Grid Reference	Description	Comments	Suggested action
324	TQ76754458	Rectangular culvert	No defects observed which impact flood risk	None relevant
326	TQ76774458	Circular culvert	Water level is mid height of the barrel	Culvert and ditch de-silt
328	TQ77434454	Circular culvert	Standing water in the culvert and watercourse. Vegetation overgrown at downstream	Vegetation clearance and culvert and ditch de-silt

Asset Reference	National Grid Reference	Description	Comments	Suggested action
331	TQ78444447	Circular culvert	No defects observed which impact flood risk	None relevant
333	TQ78794442	Circular culvert	Culvert submerged in water	Pump out water and survey
335	TQ79384437	Circular culvert	No defects observed which impact flood risk	None relevant
336	TQ79694434	Circular culvert	No defects observed which impact flood risk	None relevant
338	TQ79994432	Circular culvert	No defects observed which impact flood risk	None relevant

3.3 Flood history

Flood incident data provided geographical information on where flooding had been recorded. The data provided by the partners was standardised using the Source-Pathway-Receptor model.

3.3.1 Source-Pathway-Receptor model

The Source-Pathway-Receptor model is a concept that can provide an understanding of all sources of flood hazard. It is particularly useful in this context as it can be used to generalise the data gathered from numerous sources.

- Source - the origin of flood water
- Pathway - a route or means by which a receptor can be affected by flooding
- Receptor - something that can be adversely affected by flooding

Having applied the Source-Pathway-Receptor model it is possible to mitigate the flood risk by addressing the source (often very difficult), block or alter the pathway and even remove the receptor e.g. steer development away.

3.3.2 Historic sources of flooding

The flood history showed that the most common cause of flooding recorded in Staplehurst was attributed to highway drainage related issues. The locations of these incidents are distributed across the village, but there are several issues reported clustered in some locations. It is likely that the infrastructure related to the flooding incidents have subsequently been cleaned or replaced in most cases.

There is a high frequency of fluvial flooding reports on Clapper Lane. The reported receptors to flooding here include residential properties, commercial properties and highways. There are also several foul sewer flooding incidents reported the Clapper Lane area.

Across the parish there are isolated reports of flooding from drainage ditches or flooding from pluvial runoff. However, there are no clusters of flood history or repeated mechanisms to report.

Records of these flood incidents are depicted by coloured points in Figure 3-6. The Source-Pathway-Receptor model was applied to each point and the total number of repeated flood incidents was tallied. This enabled the point to be thematically mapped. The colour of the flood point depicts the flood source and asset affected, whereas the size of the flood point depicts the frequency of the flood incidents recorded at that location, from the same source.

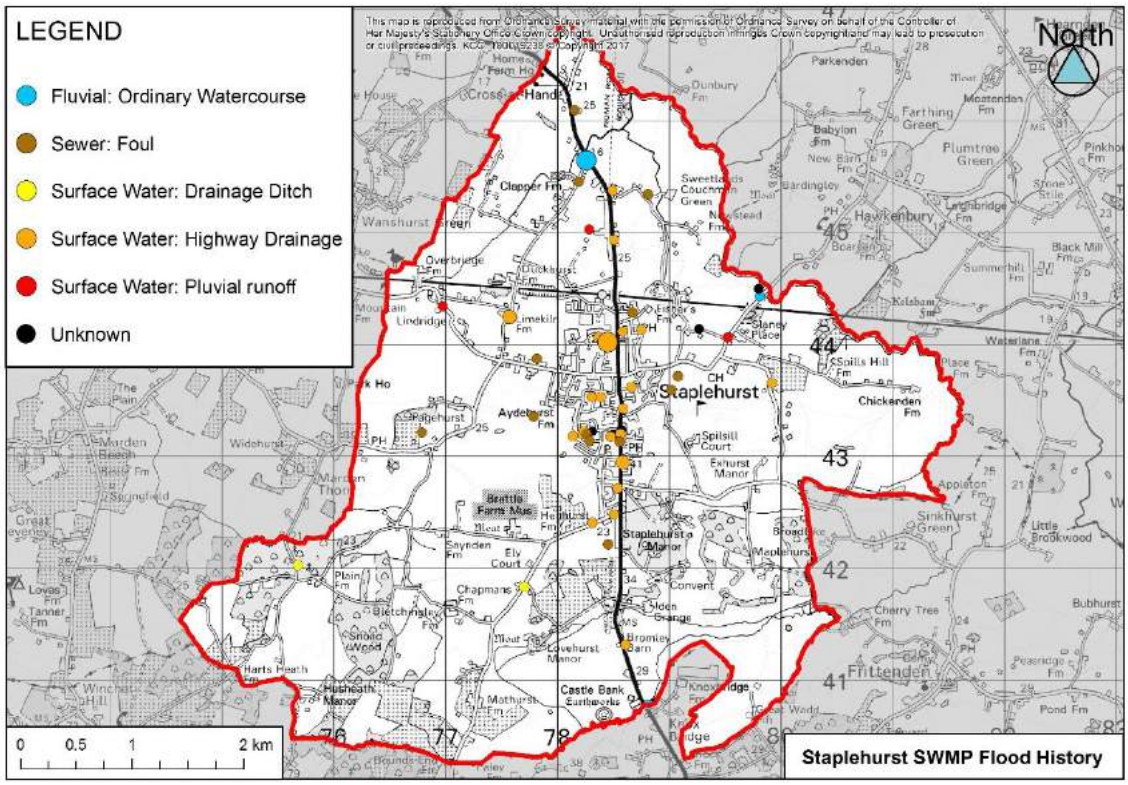


Figure 3-6: Recorded flooding incidents in Staplehurst

The recorded incidents of flooding highlights that some areas of Staplehurst have previously been susceptible to flooding. This information was considered when identifying flooding hotspots. Some of these flood incidents occurred due to blocked or broken drainage which has now been fixed, such as Offens Drive and the High Street.

Analysis of the flood incident data reveals that flooding is often from a single source; because of exceeded drainage systems. However, on Clapper Lane both fluvial and sewer flooding has been recorded on several instances suggesting these flood mechanisms are integrated.

3.3.3 Patterns that lead to flooding

Analysis of past events was undertaken to understand the patterns that lead to flooding in Staplehurst. A full report is available in Appendix B.

As Staplehurst is underlying by impermeable geology and urbanisation has created impervious areas, the catchments within Staplehurst should be sensitive to short intense rainfall events which typically occur in summer. However, most the reported flood events were in the winter months. The reported flood events within Staplehurst generally coincide with elevated Main River levels and high flows in the River Beult. However, there is no reported flooding within Staplehurst for some of the major Main River events; October 2000 and December 2013. Therefore, it is likely that a particular combination of factors is required for flooding to occur in Staplehurst; wet antecedent conditions prior to intense rainfall events. In addition, elevated Main River levels have been shown to exacerbate the surface water flooding as the excess surface water is unable to be cleared from the surface water drainage network.

3.4 Predicted flood risk

This section discusses surface water flood risk mapping from both the national dataset and the local modelling undertaken as part of this study.

3.4.1 Updated Flood Map for Surface Water (uFMfSW)

National surface water flood risk mapping, known as the uFMfSW exists for England and Wales and has been published by the Environment Agency. The uFMfSW for a 1 in 30, 1 in 100 and 1 in 1000-year rainfall events in the Staplehurst area is shown in Figure 3-7.

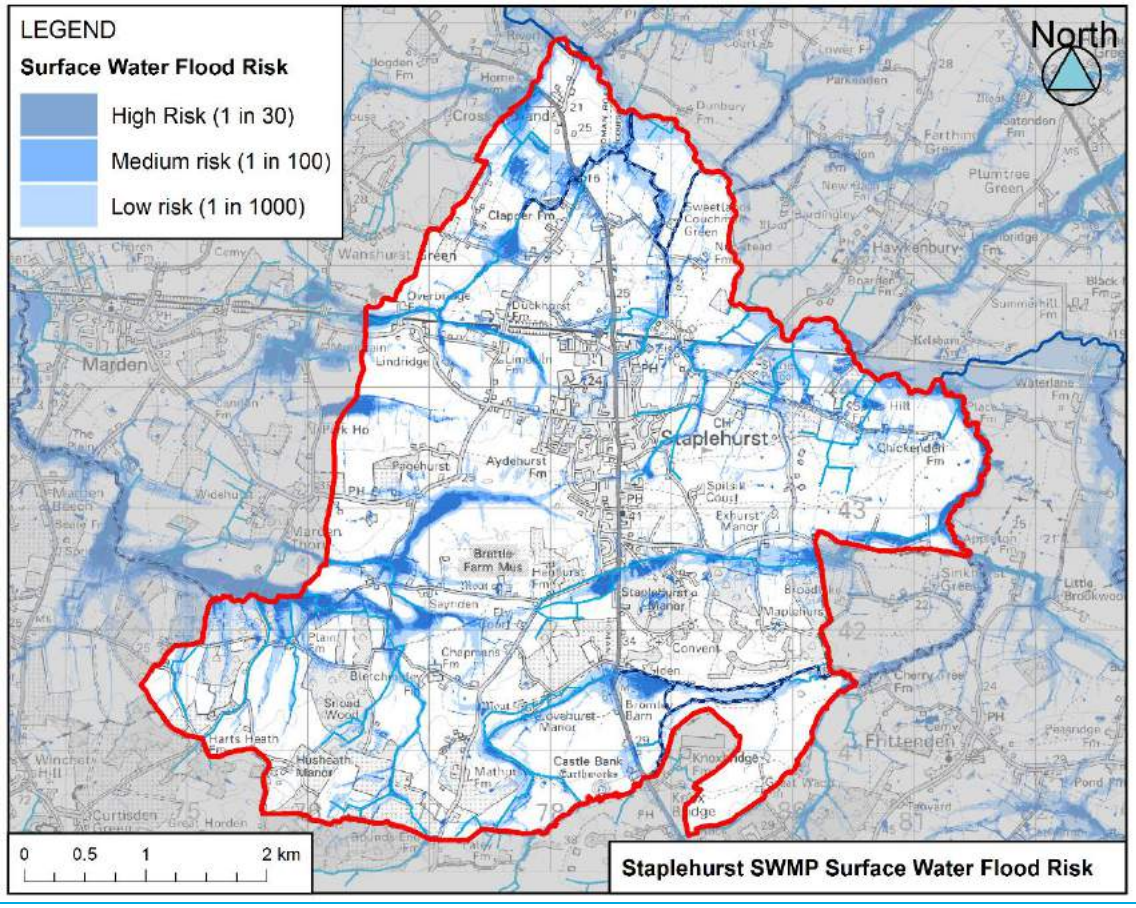


Figure 3-7 High, medium and low surface water flood risk in Staplehurst according to the uFMfSW

The uFMfSW illustrates how flow paths radiate in all directions from Staplehurst village centre. The flow accumulates in topographic low points which includes watercourses. The uFMfSW model did not include watercourses and as a result, the surface water flood risk can sometimes be over stated along rivers.

Within the village of Staplehurst, high surface water flood risk is predicted at Fishers Road, Corner Farm Road and Pinnock Lane. In the wider parish, there are large areas of high surface water flood risk along Overbridge Farm Stream and the ordinary watercourses draining towards Pattenden Farm Drain. However, the consequence of surface water flooding in the wider parish is lower than in the village centre as the receptors are mainly woodland or agricultural land.

The areas at medium surface water flood risk follow the same patterns as the areas at high risk but there is greater connectivity between ponding. This demonstrates that the flow path predicted at Corner Farm Road, continues onto Fishers Road and eventually drains into the Fishers Road Drain. The medium risk layer also shows that surface water collected on Marden Road near the Hen and Duckhurst Farm drains to Overbridge Farm Stream.

The area at low risk of surface water is considerably more extensive than the medium risk area. The flow path draining towards Fishers Road drain is the most urban and therefore likely to have the highest consequence of flooding. The area at low risk of surface water flooding also highlights how the railway embankment could impound surface water flows and the importance of drainage culverts to permit forward flow.

3.4.2 Integrated Urban Drainage (IUD) model

An integrated modelling approach was selected, which includes all drainage systems and overland flows. A full technical report describing the Integrated Urban Drainage (IUD) model is available in Appendix D. This section provides an overview of the IUD model and outputs.

The IUD model represents overland flow, public urban drainage network (highways and sewerage) and watercourses. Each of the model elements is dynamically linked to allow the exchange of flows.

Overland flow has been modelled across the parish of Staplehurst. A digital terrain model (DTM), consisting of high resolution Lidar data supplemented with medium resolution photogrammetric data to fill gaps, has been used to inform the bare-earth topography of the catchment. Some surface features such as buildings, roads and wooded areas have also been represented as these have a direct impact on overland flow paths and velocities.

The drainage systems modelled include Southern Water's surface water sewers and Kent County Councils Highway drainage, which drain to the sewer network. The Southern Water foul sewer network has been imported from an existing Southern Water model. The surface water sewers model has been built from Southern Water asset data. The highway drainage model has been built from survey data collected for this study and supplemented with existing asset data.

There are several ordinary watercourses in Staplehurst. Many of these watercourses have been modelled, as selected by the steering group as posing a flood risk or receiving surface water drainage. The watercourses modelled are shown in Figure 3-8 and include Overbridge Farm Stream, Clapper Lane Drain, Fishers Road Drain and Sweetlands Drain.

The watercourses marked with blue lines in Figure 3-7 have been modelled in 1D from survey data commissioned by Kent County Council as part of this study. A 1D representation of watercourses is the best way to estimate both channel capacity and in channel velocity. The 1D river model has also been connected to a 2D flood plain model at the banks of the watercourses. This allows the exceedance flows to be routed under gravity over land. Figure 3-7 also shows watercourses marked with green lines. These have been modelled in 2D only. A 2D representation still collects and conveys channel flows but the capacity of the channel is estimated from topographic data rather than survey, and can underestimate channel capacity. However, as these are low priority watercourses the steering group decided a 2D representation was sufficient.

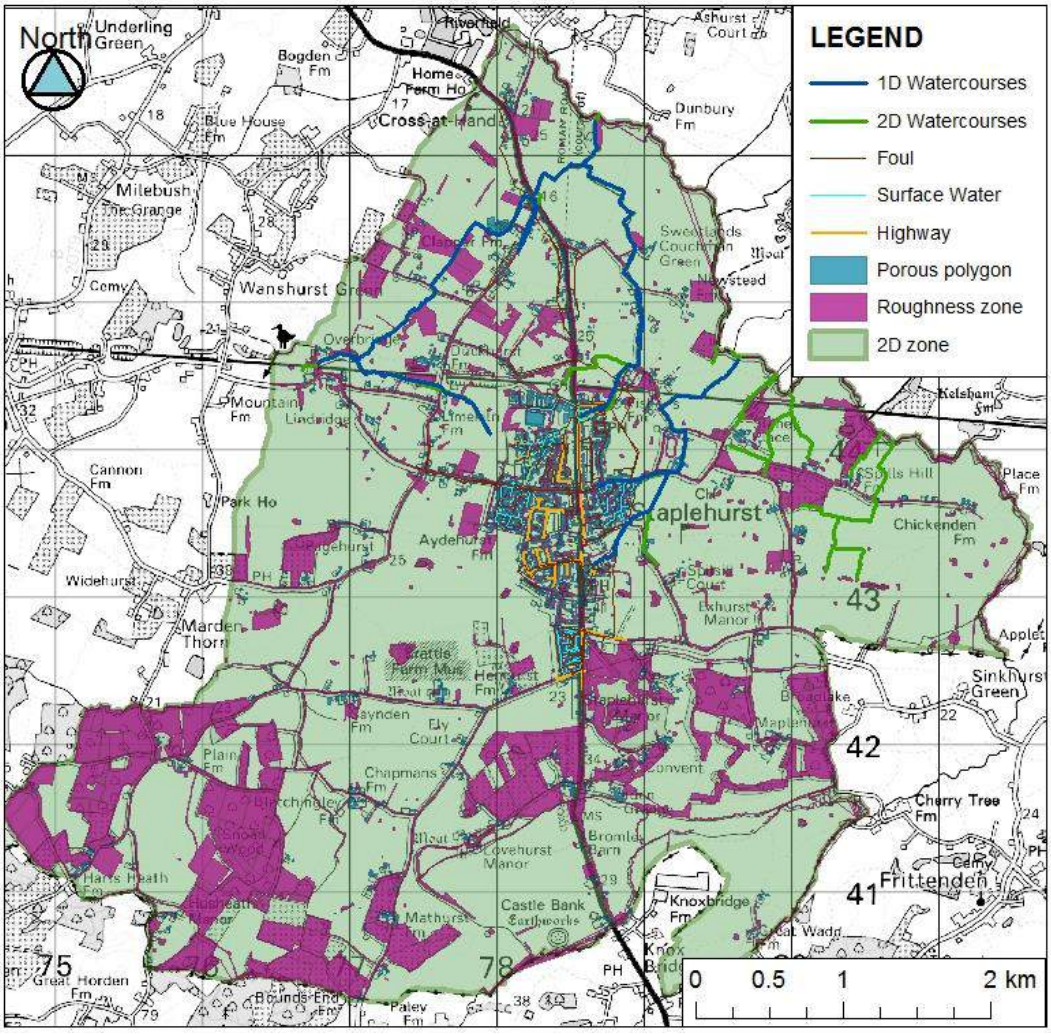


Figure 3-8: Staplehurst IUD model schematic

The results of the model are presented in Appendix E for the 1 in 2, 10, 20, 30, 75, 100, 100 +20% allowance for climate change, and 1000-year rainfall events. The maps show depth of flooding and the hazard to people rating, which uses a combination of depth and velocity of flow to assess health and safety hazards to people.

3.5 Flood risk metrics

Metrics have been used to quantify the impact of flooding at each modelled return period. Metrics consider a count of properties predicted to be at risk and an estimate of damages due to flooding based on the Multi-Coloured Manual[2].

3.5.1 Property count

Property counts were based on the results from the Integrated Urban Drainage Model as this was considered the best representation of flood risk in the catchment. The analysis was undertaken using Frism, a JBA GIS-based tool for analysing flood impact and damages. A detailed count was undertaken which utilises the Master Map building footprints in conjunction with the NRD property points. A property point is counted as flooded if its corresponding building footprint is within the flood outline, even if the property itself may not fall within the flood outline.

The total number of properties counted at each return period is shown in Table 3-2.

[2] Middlesex University (2013) Flood and Coastal Erosion Risk Management: A Manual for Economic Appraisal.

Table 3-2: Baseline property count at each Annual Exceedance Probability (AEP) event

Flood Event Return Interval	Residential Properties Flooded	Commercial Properties Flooded	Total
50% AEP event	24	7	31
10% AEP event	43	13	56
5% AEP event	52	21	73
3.33% AEP event	58	22	80
2% AEP event	75	24	99
1.33% AEP event	83	26	109
1% AEP event	93	27	120
0.1% AEP event	157	35	192

The model results show that an increasing number of properties are flooded at each return period, as would be expected. There are considerably more residential properties at risk of flooding than commercial properties, which again is expected as the properties in Staplehurst are predominately residential.

The number of properties at risk does not increase significantly between 2% between the 1% AEP events but then increased by 50% during the 0.1% AEP event illustrating a significant increase in flood extent for the 0.1% event.

3.5.2 Damage calculation

Internal flooding of properties has an economic impact. Most financial cost is due to the damage incurred to the property (direct damages) but there are also secondary costs such as the emergency response (indirect damages) and the impact to health (intangible damages).

The damage calculation includes all of these costs. The Multi-Coloured Manual (MCM) 2013 provides a methodology for calculating damages, as well as cost versus flood depth curve which has informed this assessment.

A property threshold level of 0.15 metres has been assumed. This means that if a property is intersected by a flood depth less than 0.15m, it has been assumed that no direct damage will be incurred as the flood water could not access the property.

The damages curve for each of the properties was adjusted to account for inflation. This was done by using the monthly variation of the Customer Price Index (CPI) which was inputted at 132.6. The CPI uses the prices of a representative sample to statistically estimate the variation in the real property value whilst accounting for the changes in the rate of inflation.

The economic damages estimated for the baseline scenario for each Annual Exceedance Probability (AEP) is shown in Table 3-3.

Table 3-3: Baseline damage calculation at each Annual Exceedance Probability (AEP) event to the nearest £k

Return period	Residential (£)	Commercial (£)	Total Damage (£)
50% AEP event	322,000	608,000	930,000
10% AEP event	810,000	1,125,000	1,935,000
5% AEP event	932,000	1,480,000	2,412,000
3.33% AEP event	984,000	1,575,000	2,559,000
2% AEP event	1,094,000	1,605,000	2,699,000
1.33% AEP event	1,199,00	1,712,000	2,911,000
1% AEP event	1,269,000	1,778,000	3,047,000
0.1% AEP event	2,301,000	2,037,000	4,338,000

At the lower return periods tested the commercial damages are calculated to be higher than the residential damages, despite the smaller number of properties to be at risk. This is because the commercial properties predicted to be a risk have a large floor plan and locally the flooding can be quite deep, despite not inundating the entire building. During the higher return period events, the residential damages become costlier than the commercial damages. This is due to the increasing number of properties predicted to be at risk.

3.6 Flooding hotspots

A flooding hotspot is an area identified as prone to flooding according to local knowledge, flood history or flood risk mapping. These include Marden Road, Clapper Lane, Offens Drive and Fishers Road.

3.6.1 Marden Road

Marden Road in Staplehurst (Figure 3-9) has a history of flooding from surface water and foul sewers. The uFMfSW shows properties to be at medium risk of surface water flooding. IUD model results shows properties to be at low risk of flooding.

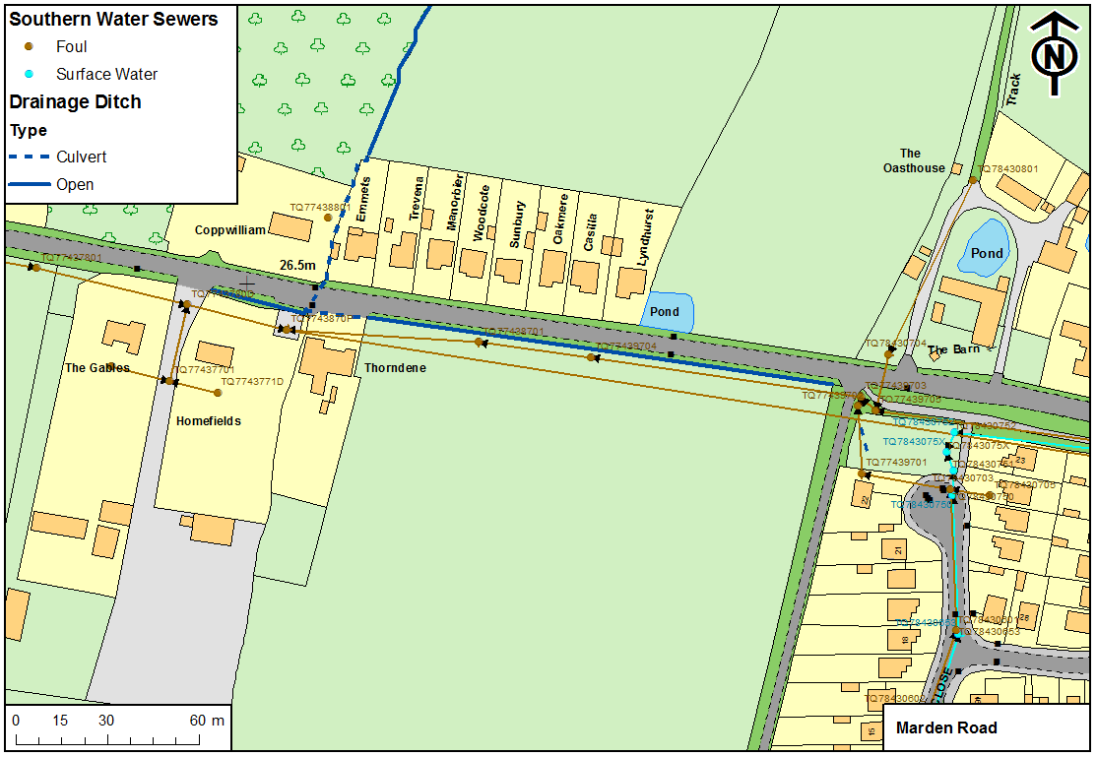


Figure 3-9: Marden Road, Staplehurst

Within the Marden Road hotspot there are several drainage assets. The key assets are listed in Table 3-3.

Table 3-4: Drainage assets at Marden Road

Asset	Owner	Condition
Separate surface water and foul sewerage system	Southern Water	A CCTV survey of the foul drainage from October 2015 showed foul network in Acceptable Structural Condition. Condition of the surface water system is unknown.
Foul water pumping station known as Marden Road WPS	Southern Water	Subject to recent upgrade works including a new macerator.

Asset	Owner	Condition
There is few highway gullies	KCC highways	On the site visit in November 2014 the highway drainage was surcharged. The pipework was not included in the September 2014 survey.
Drainage ditch between Jeffery Close and 'Thorndene'	Riparian owner	On the site visit in November 2014 the ditches were holding water. These were excavated in 2015.
Surface water attenuation tank at Jeffery Close.	Unknown	Unknown although recent photos by Southern water suggest it is structurally sound.
Headwaters of the Royston Drain	Riparian owner	No survey to confirm condition but culverts were running during the site visit in November 2014.

The drainage assets on Marden Road are key to managing the flood risk at this location. Through the course of this study, steps have been taken to understand the connectivity and improve the condition of these assets to more effectively manage risk.

For example, the foul sewer flooding was understood to be as a result of the Southern Water pumping station becoming overwhelmed during storm conditions. The cause of this was twofold; surface water entering the foul sewerage and the pumping station becoming blinded by debris. To increase the station's ability to process solid waste, Southern Water undertook works to upgrade the macerators. Although this work reduced the risk of flooding due to an operation defect, it did not solve the issue of a storm response on the foul network and so flood risk from hydraulic overload remained.

As part of the SWMP multiple potential causes for the storm response on the foul sewerage network at Marden Road has been identified. These include:

- Inundation of foul manholes located in the drainage ditch
- Direct connection from the surface water tank to the foul sewerage (however, subsequent investigations by Southern Water has ruled this out)
- Diffuse miss connections, infiltration and inundation of the network upstream of Marden Road.

Removing the inundation of manholes and the ditch was identified as a quick win. Therefore, the riparian owner of the drainage ditch undertook clearance works including de-sedimentation. As a result of this work, the manholes sat proud of the normal water level, reducing the chance of inundation. In addition, Southern water sealed the chambers and installed bolt-down manhole covers to improve the flood resilience of their network. Although this work reduced the risk of flooding due to hydraulic overload, the foul system was still found to have a storm response during rainfall. The extent of this storm response is being further investigated by Southern Water.

Because the quick win intervention was not found to solve the problem, the possibility of a direct connection of the surface water attenuation tank to the foul sewerage was investigated by Southern Water via a CCTV survey of the foul sewer. The report found no unexpected connections therefore this cause of the storm response has been discounted.

Therefore, it was concluded that the storm response on the foul sewerage is caused by diffuse sources of surface water and potentially groundwater. As a result, it will be more difficult to make a single intervention to manage the problem.

The surface water storage tank was identified on Marden Road near Jeffery Close during the site visit in November 2014. It is understood from Southern Water asset data that the surface water sewerage from the Oliver Road estate discharges into this tank. However, neither the asset owner, condition or discharge mechanism of the tank is documented.

Records from March 1989, provided by Maidstone District Council indicates that the outlet from the storage tank is a 225 mm pipe running under the highway verge. The report states that the tank discharges to Pit 'A'[3], although it is not clear where Pit A is located. To better understand

[3] Maidstone Borough Council (1989) Surface Water Investigation, Marden Road, Staplehurst

the connectivity of surface water drainage on Marden Road, Maidstone Borough Council undertook dye testing. The results of the dye testing were inconclusive as although the dye was traced to the drainage ditch, the volume was much reduced from that input to the tank.

It is not currently known who owns this asset, although it has been established that the tank sits on Maidstone Borough Council land. Establishing ownership and effective maintenance of this asset should be addressed as a priority as further discussed in the action plan, Section 6.

3.6.2 Clapper Lane

Clapper Lane (Figure 3-10) has a history of frequent flooding which prevents vehicle access and has caused internal flooding of local properties. Flooding here can also inundate the foul sewerage upstream of Clapper Lane pumping station.

The uFMfSW shows a high risk of surface water flooding which is corroborated by the IUD model results. The IUD model also shows Clapper Lane to be at risk of flooding from the River Beult and the IDB watercourse, Overbridge Drain.

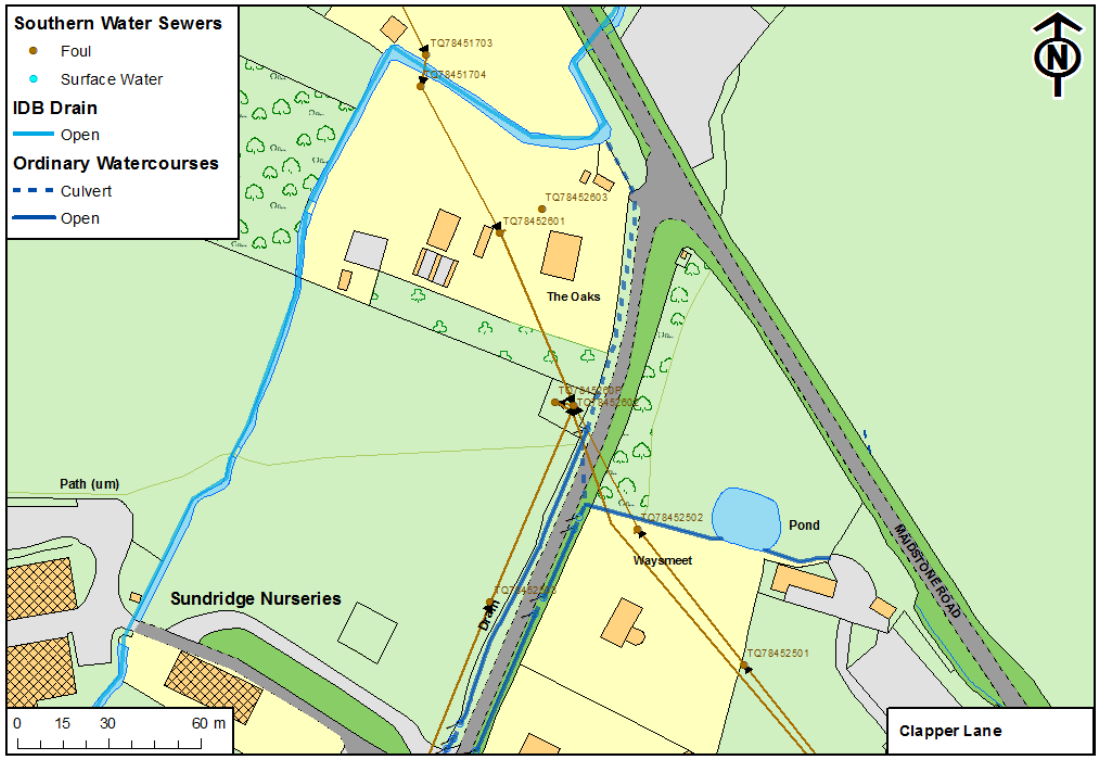


Figure 3-10: Clapper Lane, Staplehurst

Within the Clapper Lane hotspot there are several drainage assets. The key assets are listed in Table 3-4.

Table 3-5: Drainage assets at Clapper Lane

Asset	Owner	Condition
High capacity drainage ditches on both sides of the road	KCC highways	On the site visit in November 2014 the ditches were holding water.
Foul sewerage system	Southern Water	Not highlighted by Southern Water as a concern.
Foul water pumping station known as Clapper Lane WPS	Southern Water	Not highlighted by Southern Water as a concern.
Overbridge Drain	Medway IDB	Unknown as a visual inspection was not completed as part of the SWMP. This watercourse is subject the IDBs general maintenance regime.

The IUD model identified that the source of flooding to Clapper Lane is not just surface water runoff. Fluvial flooding from the River Beult is predict to impact the Lane in a 1 in 20 % AEP event and flooding from the Overbridge Drain is predicted.

3.6.3 Offens Drive

Residents of Offens Drive have reported that in recent years a persistent groundwater flooding issue impacting residential properties and curtilage.

The uFMfSW shows very low risk of surface water flooding on Offens Drive which is corroborated by the IUD model results.

Figure 3-11: Offens Drive, Staplehurst

The key drainage assets that have been identified in Offens Drive are listed in Table 3-6.

Table 3-6: Drainage assets at Offens Drive

Asset	Owner	Condition
Land drainage pipe (route	Riparian	Condition is unknown but it suspected to

Asset	Owner	Condition
unconfirmed)		be fractured at the junction of Offens Drive and Fletcher Road.
Foul sewerage system	Southern Water	Not highlighted by Southern Water as a concern.
Surface water soakaways	Riparian	Unknown
Highway drainage gullies	KCC highways	Outfall to SPC owned pond is blocked causing backing up in highway drainage.
Water mains	South East Water	Extensive testing has confirmed that mains leaks water mains leaks are also not contributing to the flooding issue

Investigations have identified that the source of flooding to Offens Drive is likely to be rainwater which infiltrates into the soil surface but cannot pass through the clay geology, causing the water to resurface at topological low points. Private soakaways may also contribute to this causing locally elevated water tables.

3.6.4 Fishers Road

Fishers Road (Figure 3-12) has only one reported incident of flooding and this was not reported to have impacted properties. However, the uFMfSW predicts an area of high risk therefore, the IUD model was detailed in this area. The IUD model predicts medium flood risk as it considers the surface water drainage at the ordinary watercourse to the rear of the properties.

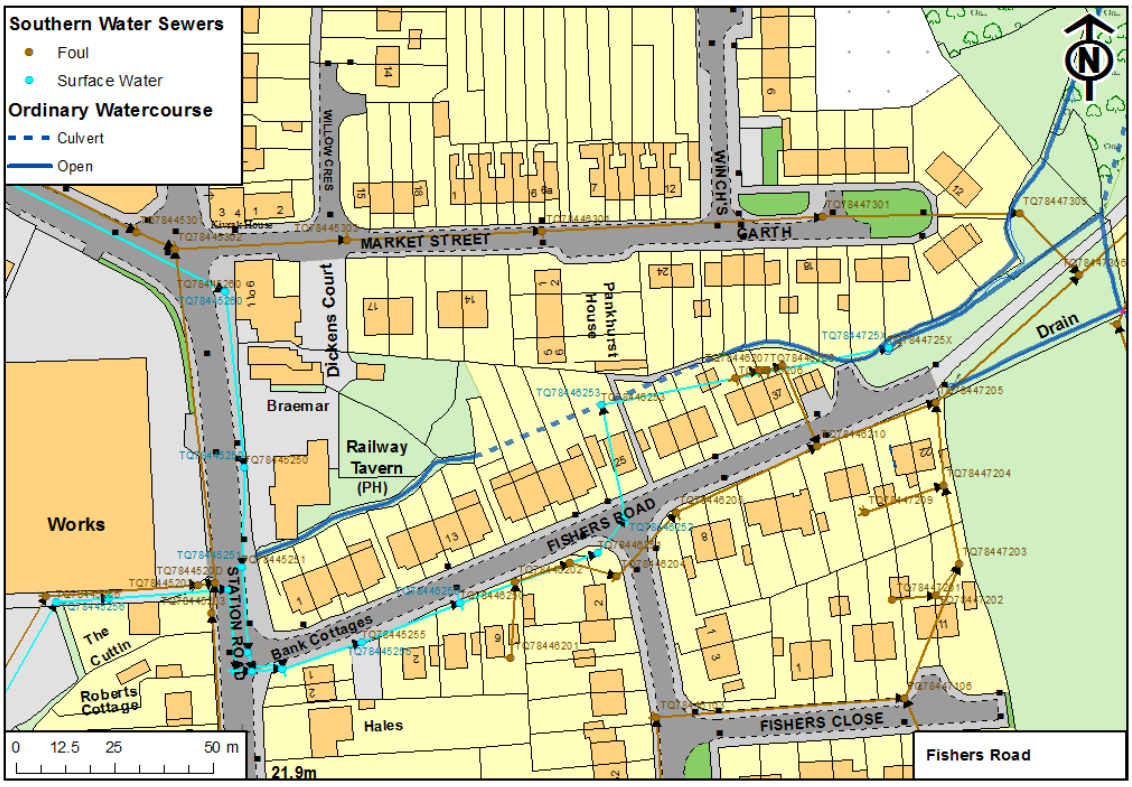


Figure 3-12: Fishers Road, Staplehurst

Within the Fishers Road hotspot there are several drainage assets. The key assets are listed in Table 3-7.

Table 3-7: Drainage assets at Fisher Lane

Asset	Owner	Condition
Separate surface water and	Southern Water	Not highlighted by Southern Water as a

Asset	Owner	Condition
foul sewerage system		concern.
Ordinary watercourse (Fishers Road drain)	Riparian owners	On the site visit in November 2014 the watercourse was partially built over with garden furniture but no significant blockages were observed
Highway drainage gullies	KCC highways	During the survey in September 2014 no defects were noted. The connecting pipework is high capacity (600 mm diameter)

3.7 Validation of the risk assessment

A variety of approaches have been taken to validate this risk assessment, as outlined in the following sections.

3.7.1 Model verification against hydrometric data

To verify sewer flow models, Water Companies undertake in-pipe flow and level surveys accompanied by a network of rain gauges. These are often temporary and remain in the ground long enough to record three storms of sufficient depth and intensity with which to verify the model against. This detailed verification process compensates for not being aware of the condition of the piped network or the exact contributing areas. The model parameters can be adjusted to produce results representative of what occurred in the catchment. However, temporary flow surveys are expensive and therefore are prioritised towards key assets; which for a water company are rarely surface water sewerage networks. As a result, there is no in pipe flow data to verify this model against.

Therefore, the verification has focussed on surface water flow paths and pooling areas.

3.7.2 Model review meeting

The baseline model results were presented to the project steering group for their approval based on local knowledge of flood mechanisms as discussed in Section 2.4. This meeting found the model to under predict the frequency of flooding seen in Staplehurst. This led to model revisions such as using water levels from the River Beult as a downstream condition and changing the surface water runoff mechanism from fixed to time varying to account for increased runoff during an event as soils become saturated.

3.7.3 Historic events

Southern Water records flood events from sewers. The data they have provided for this project is a count of flooding incidents within a seven-digit postcode. The data has been supplied in this format to respect their customer's confidentially. Therefore, its uses for model validation are limited, as we do not know where the incident occurred exactly.

Kent County Council highways keep a log of flooding incidents in Staplehurst. This highlights stretches of road that have had flooding and occasionally, points data of where the flooding has occurred. This more precise data is more useful for model validation. As a result, this data set has been the primary source of information for model validation. Each of the pluvial flooding incidents reported are predicted by the IUD model however, some of the flood incidents reported due to operation issues such as blocked gullies or collapsed culvert are not recreated in the model as it is assumed that all assets are free of obstruction. For example, no surface water flooding is predicted on the High Street but two incidents have been reported due to blocked drainage. The model does however predict flooding at Corner Farm Road where flooding has been reported five times due to blocked drainage. This suggests the drainage could be hydraulically inadequate, but flooding may be exacerbated by blockages.

4 Development

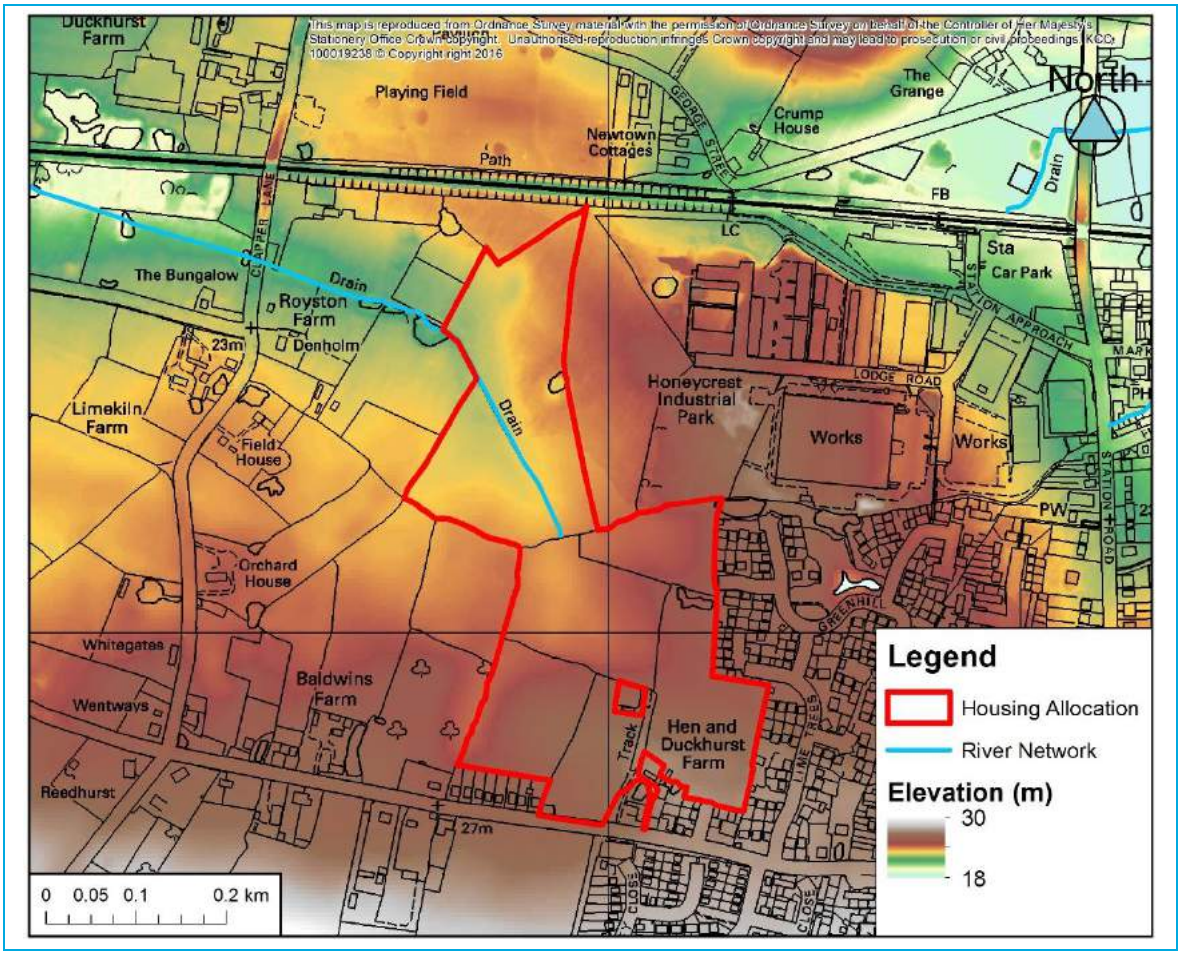
There is significant growth planned for Staplehurst. Surface water flooding is exacerbated by urbanisation when natural, permeable land uses are replaced with impermeable surfaces. However, the impact can be mitigated if KCC and Maidstone Borough Council guidance on the management of surface water is followed in the design of new developments. The guidance recommends the use of sustainable drainage systems (SuDS) which mimic natural systems and reduce surface water runoff and pollution. National Planning Policy Framework (NPPF) recommends that where possible development should be an opportunity to reduce flood risk. Therefore, there is an opportunity that new development could provide the funds needed to manage surface water in an effective and sustainable way. Developers are not required to solve existing flooding problems off their site, though they are encouraged to provide betterment through NPPF, and appropriate management of runoff at a development site could reduce flood risk elsewhere.

This section examines the location of allocated development sites in relation to known hotspots and considers how development could change flood risk in Staplehurst.

4.1 Hen and Duckhurst Farm

Hen and Duckhurst Farm is allocated for development of approximately 250 dwellings at an average density of 30 dwellings per hectare. The area allocated is illustrated in Figure 4-1.

Figure 4-1: Hen and Duckhurst Farm allocated development site



The development site is directly adjacent to Marden Road which is one of the flooding hotspots identified in Staplehurst. Due to the lie of the land, surface water from the development would drain away from Marden Road and should not increase surface water flooding, but the site itself could be at risk of flooding from Marden Road.

It is important the any foul drainage on the site considers the existing issues with the sewer system at Marden Road. As part of the application, Southern Water will make an independent

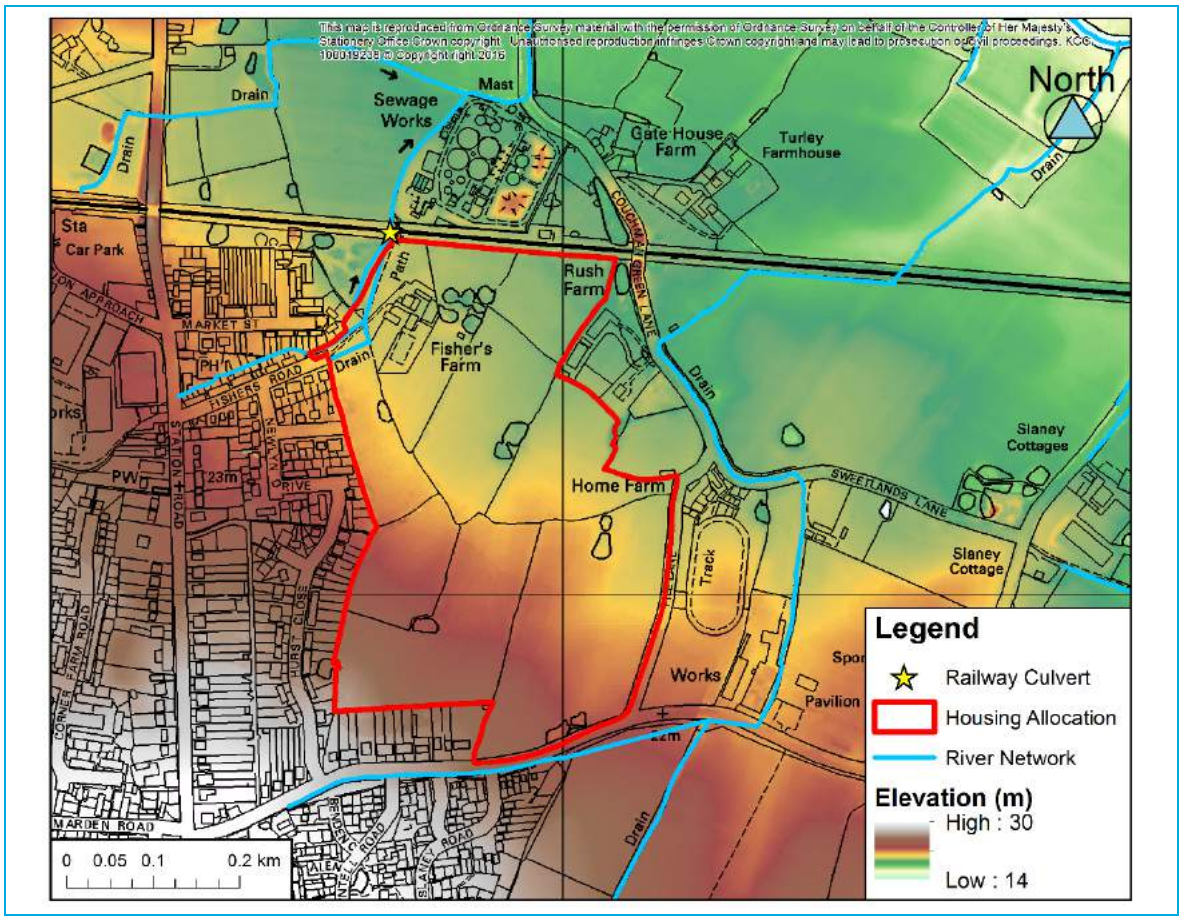
assessment of the capacity to prevent any detriment to the existing level of service. One option could be to keep any new sewerage independent of the existing network.

The site includes a field drain which contributes to the Overbridge Farm Stream. Therefore, increased runoff from this site would exacerbate the flooding problem at Clapper Lane. Conversely, limiting discharge from this site could help manage the flood risk at Clapper Lane. Therefore, it is recommended that the drainage strategy for the Hen and Duckhurst Farm site aims to reduce post development runoff rate below greenfield rate. This is reinforced in the Generic Action Plan and the Site Specific Action Plan.

4.2 Fishers Farm

Fishers Farm is allocated for development of approximately 400 dwellings at an average density of 30 dwellings per hectare. The area allocated in illustrated in Figure 4-2.

Figure 4-2: Fishers Farm allocated development site

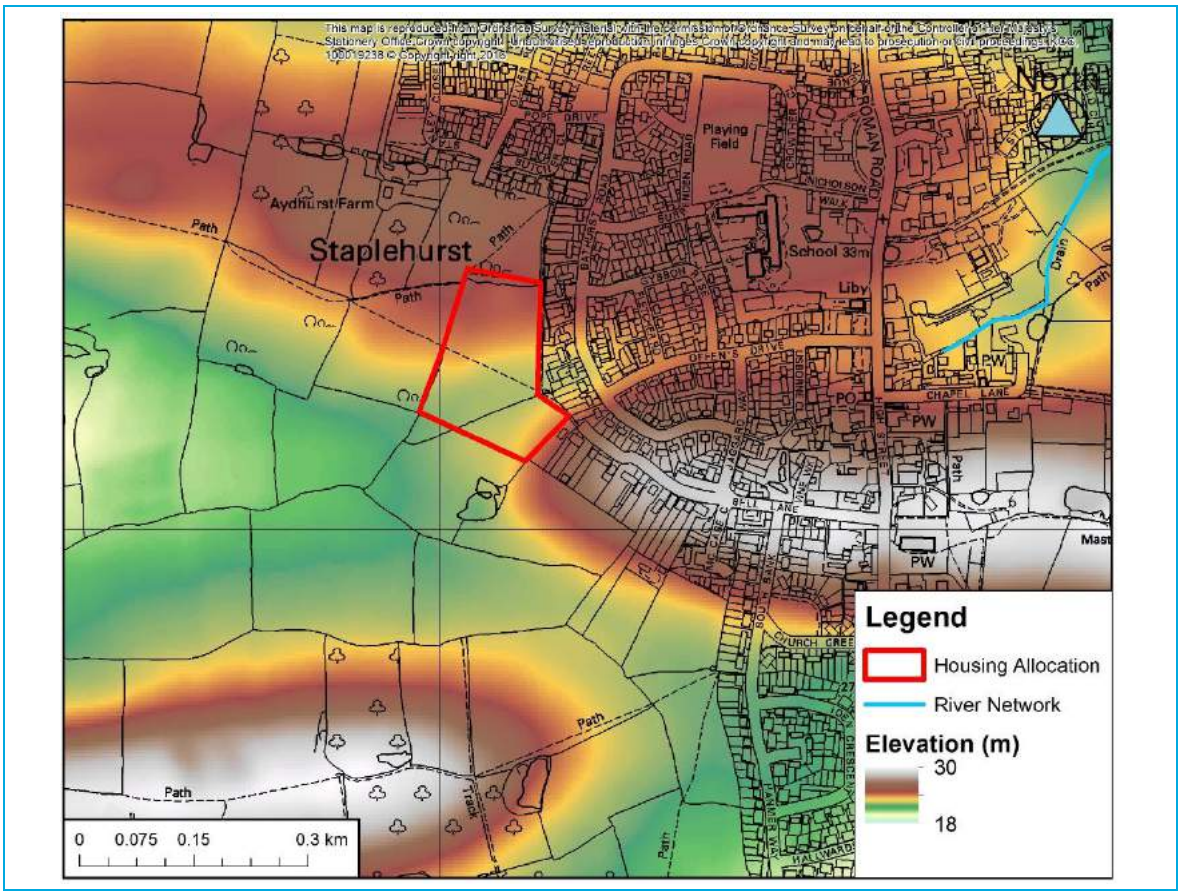


The development site is directly east of Fishers Road, which has been identified as a flood risk hotspot. Due to the local topography, it is likely that development on the site will drain to the Fishers Road Drain downstream of the existing hotspot, but upstream of the existing railway culvert (marked in Figure 4-2). The rate of discharge from the site could be limited by the railway culvert and any increased flows could cause backing up and impede drainage at Fisher Road. Therefore, it is important that the drainage strategy from this site limits runoff to a greenfield rate and maintains the existing flow in each of the catchments it discharges to avoid increasing flood risk at Fishers Road. This is reinforced in the Generic Action Plan.

4.3 Henhurst Farm

Land north of Henhurst Farm is allocated for development of approximately 60 dwellings at an average density of 24 dwellings per hectare. The area allocated in illustrated in Figure 4-3.

Figure 4-3: Henhurst Farm allocated development site



The Henhurst Farm site is located near the Offens Drive hotspot, but development here would not impact Offens Drive as the development site is downstream and none of the drainage assets passes through it. Development of this site should consider that the drainage outlet at Bathurst Road is due for clearance by Staplehurst Parish Council, which would enable more flow into the pond than recently observed. This increased discharge should be considered as part of a Flood Risk Assessment for the site.

Runoff from this development would eventually drain towards The Plain in the parish of Marden. This has been identified as a high flood risk area. Therefore, discharge from the site should be limited to greenfield runoff to avoid exacerbating an existing issue.

5 Options

A full discussion of the potential flood mitigation measures and preferred option has been included in Appendix F. These information packs include a consideration of the potential cost of the flood measure and calculation of any benefits provided. This section has been included as a summary of the option development and results.

5.1 Objectives

The objective of the options assessment process was to identify, shortlist and assess a suite of measures (individual actions or procedures to manage current and future surface water flood risk, or to meet other SWMP objectives) for mitigating surface water flooding and agree preferred options (a single measure or combinations of measures) across the study area. The preferred options are then included in the Action Plan.

5.2 Option appraisal

The options appraisal first looked at opportunity and needs in the Staplehurst parish. It was agreed during the options workshop that the areas in greatest need of intervention were the flooding hotspots and these were the focus of the options assessment. The opportunities considered current land use and planned activities as explained in 5.2.1. A preliminary 'long list' of options was developed which considered multiple methods to manage the flood risk. The options were then whittled down to a short list which were considered the most effective and feasible. These were then tested in the hydraulic model.

5.2.1 Opportunities

Opportunities have been identified where there may be opportunities for retrofit SuDS (such as large flat roofs and open green spaces) or where work is already planned and efficiencies could be realised by combining programmes.

There are currently no planned schemes in Staplehurst. However, this SWMP has aligned with preparation of the Southern Water Drainage Area Plan which has allowed for effective sharing of information and survey data (for example KCC's gully survey and Southern Water's CCTV survey).

As discussed in Section 4, the proposed development could be an opportunity to manage flood risk in Staplehurst and the surrounding area. Intelligent use of SuDS should enable surface water to be managed at the site and avoid increasing runoff elsewhere. Suitable drainage strategies should be prepared by the developer, noting the potential constraints listed above.

Opportunities to retrofit green infrastructure in Staplehurst village were limited due to narrow footpaths, buried services or need for parking. As a result, many of the surface water management techniques tested revert to hard engineering options. However, as the Clapper Lane area of the parish is more rural, there where greater potential for green solutions, including maximising the existing assets such as the drainage ditches and a pond.

5.2.2 Needs

The area of greatest need for flood management from local sources in Staplehurst have been identified as:

- Marden Road
- Clapper Lane
- Offens Drive
- Corner Farm Road

5.2.3 Short list of options

The short listed options have been summarised in Table 5-1.

Table 5-1: Shortlisted options for Staplehurst

Hotspot	Option	Purpose
Clapper Lane	Flap valves on culverts from Clapper Lane drains to Overbridge Farm Drain	Prevent backing up of the Overbridge Farm Drain and River Beult therefore increasing available storage in Clapper Lane drains.
	Upsize existing pond	Intercept overland flow from the south east before reaching Clapper Lane.
	Upsize culverts on Clapper Lane drains	Increase conveyance of drainage ditches
Offens Drive	Five additional gullies near the junction with Usborne Close	Provide additional drainage of surface water.
Corner Farm Road	Raised kerb	Manage surface water flow route and retain on road, away from residential receptors.

The options were then tested and refined in the hydraulic model. The performance of each model was tested against the baseline model.

5.2.4 Results

The results found that none of the options were sufficient to remove flood risk from receptors in Staplehurst at the 1% AEP which was the design standard aimed towards.

None of the three options for Clapper Lane worked to reduce the flooding to the 27 properties predicted to be at risk in the area. This was because there are several mechanisms that cause the flooding and as a result, no one solution significantly alleviated the flood risk. When the options were combined, the volume of flood water during a 1% AEP event overwhelmed the combined alleviation measures and no betterment was achieved. For each of the options tested, the number of receptors at risk from a 1% AEP event remained 27. As each of these options were ineffectual, none of these options are recommended to be taken forward. Property Level Protection (PLP) may be a more appropriate scheme in this area and some properties have already taken steps to improve their own resilience.

The increased drainage on Offens Drive near the junction with Usborne Close was predicted to reduce the flood risk to five residential properties during the 2% AEP event. However, at the 1% AEP the drainage system became overwhelmed and so only one property was predicted to benefit from the additional drainage. During the project partner meeting it was identified that the properties in this area have not reported flooding previously and it was thought that the locally high threshold levels could elevate them out of the predicted flood depths. Therefore, this option is not a priority to take forward.

The exceedance route at Corner Farm Road was the most effective option as the number of properties at risk reduced from 11 to 3 in the 1% AEP event. As a results this is a strong option to consider if flooding is still frequently recorded at this location while the drainage network is known to be clear. However, the raised kerb also acted to impound a secondary flow path which caused an increase in risk to some properties. Therefore, this constraint should be considered during the detailed design process.

6 SWMP Action Plan

This section sets a plan for managing the flood risk identified in this SWMP. The action plan uses all the information collated during the SWMP process to recommend measures to reduce or mitigate the flood risk in Staplehurst and:

- Outlines the actions required and where and how they should be undertaken;
- Sets out which partner or stakeholder is responsible for implementing the actions and who will support them;
- Provides indicative costs; and
- Identifies priorities.

The action plan is divided into two components; the generic action plan and the site specific action plan.

Table 6-1: List of action plans

Geographic area	Action plan	Purpose
Study area wide	Generic action plan (Section 6.1)	Outline broad scale actions applicable across the study area
Hotspots	Hotspots action plan (Section 6.2)	Recommend strategic actions to manage the flood risk in hotspots

6.1 Generic Action Plan

Some of the actions derived during this SWMP are applicable to the whole SWMP area of Staplehurst. Actions to mitigate these issues are listed in the generic action plan.

Table 6-2: Generic action plan for Staplehurst

Reference	Action	Action owner	Priority
GAP01	*Maintain the partnership* The ongoing partnership will discuss the implementation of the proposed actions, review opportunities for operational efficiency and to review any legislative changes.	All	High
GAP02	*Sustainable development* It is recommended that the planning authority incorporate the findings of this SWMP, thereby raise issues to developers through its local plan to allow for pre-emptive flood risk reduction during the planning process.	MBC	High
GAP03	*Asset maintenance* Optimise the routine asset inspection and maintenance to prevent flooding occurring as a result of malfunctioning highway drainage or sewerage.	KCC highways/ Southern Water	High
GAP04	*Groundwater* New development including basements should manage the risk of groundwater ingress appropriately.	Developers	High

6.2 Location specific Action Plan

Table 6-3 describes the action plan for specific locations. The site specific action plan phases work, to provide a step by step guide for implementation. Some of the later actions will only be required if earlier actions do not resolve the flooding issue. Ongoing monitoring of flood incidents is essential to assess the impact of these actions.

Table 6-3: Site specific action plan for Staplehurst

Ref	Area of benefit	Problem	Action	Benefits	Action Owner	Supporter	Priority	Indicative Cost*
STAP01	Marden Road	Foul sewer flooding has regularly impacted properties on Marden Road. Recent works by Southern Water included upgrading a pumping station and alongside this the owner has dredged a ditch. However, the flooding problem remains. A surface water tank has been identified but its function is not fully understood.	1. Agree on which authority owns the tank and who will take on maintenance duties. 2. Survey the surface water tank to understand connections, function and condition. 3. Consider the existing problems when reviewing applications of the Duck and Henhouse development site.	Alleviate an existing flooding issue and understand H&S implications of the tank.	MBC	KCC, SW	1. Mid 2. High 3. Mid	1. Low 2. Low 3. Low
STAP02	Clapper Lane	Flooding impacts 27 residential property and a Southern Water pumping station. Flood sources include River Beult, Clapper Lane Drain and Surface Water	1. Communicate with residents – inform them of the output of the study 2. Improve resilience to the Southern Water sewerage network at this location 3. Maintain drainage ditches on Clapper Lane to a high standard 4. Consider the existing problems when reviewing applications of the Duck and Henhouse development site.	Improve resilience to flooding of existing receptors and potential to reduce greenfield runoff from new development.	1. SPC 2. SW 3. KCC Highways 4. KCC and MBC	KCC	1. High 2. Mid 3. High	Low
STAP03	Offens Drive	Groundwater flooding has recently impacted a property on Offens Drive. This has now been solved with private drainage. Highway drainage discharges to a SPC pond. The outfall is blocked, impeding drainage.	1. Remove sediment build up at highway drainage outfall	Allow free discharge of highway drainage	1.SPC	KCC	High	Low

Ref	Area of benefit	Problem	Action	Benefits	Action Owner	Supporter	Priority	Indicative Cost*
STAP04	Corner Farm Road	Surface water flooding from	1. Maximise conveyance by the maintaining the highway drainage 2. Consider managing exceedance if flooding continues to be an issue locally	Optimise existing drainage network to manage flood risk	KCC Highways		Low	Low
STAP05	Fishers Road	Surface water and fluvial flood risk.	1. Maximise conveyance by the maintaining the watercourse and removing current blockages.	Optimise existing drainage network to manage flood risk	Riparian owners	KCC	Low	Low
STAP06	Hen and Duckhurst Farm	Large development draining towards Sweetlands Drain (which impacts Clapper Lane)	1. Design a foul drainage system which causes no detriment to the existing system draining to Marden Road pumping station and avoid connection at this point if possible. 2. Produce a suitable surface water drainage strategy at master planning stage in consultation with MBC, KCC and SW 3. Aim to reduce runoff from greenfield rate	Create green living spaces with higher value and manage flood risk	Developer	SW, KCC, MBC	High	High

Ref	Area of benefit	Problem	Action	Benefits	Action Owner	Supporter	Priority	Indicative Cost*
STAP07	Fishers Farm	Large development draining towards Fishers Drain	1. Produce a suitable surface water drainage strategy at master planning stage in consultation with MBC, KCC and SW 2. Aim to match runoff from greenfield rate	Create green living spaces with higher value and manage flood risk	Developer	SW, KCC, MBC	High	High
STAP08	Henhurst Farm	Large development draining towards The Plain, Marden	1. Produce a suitable surface water drainage strategy at master planning stage in consultation with MBC, KCC and SW 2. Aim to match runoff from greenfield rate 3. Produce a Flood Risk Assessment for the site which considers the free discharge of Offens Drive drainage.	Create green living spaces with higher value and manage flood risk	Developer	SW, KCC, MBC	High	High

** Indicative Cost: Low = Up to 50k, Mid = 50-150k, High = 150-250k or 250+k*

MBC: Maidstone Borough Council	*KCC: Kent County Council*	*EA: Environment Agency*	*SW: Southern Water*	*KCC Highways: Kent County Council Highways*	*SPC: Staplehurst Parish Council*

6.3 Review timeframe and responsibilities

High priority actions identified in the 'Action Plan' are likely to be those addressed first. However, this report can only consider relative priorities within Staplehurst. Some partner organisations, including the Environment Agency, Southern Water and Kent County Council have flood risk management responsibilities beyond the geographic scope of this study, and therefore the priority of actions within Staplehurst will have to be assessed against actions in other areas. Kent County Council is currently undertaking SWMPs in several other settlements across the county and delivering existing Action Plans.

It is recommended that an annual review of the High and Medium Priority actions is undertaken by the action owner. This will allow for forward financial planning in line with external partners and internal budget allocations. Low priority actions should be reviewed on a three-year cycle.

6.4 Sources of funding

None of the schemes identified for Staplehurst have sufficiently strong cost-benefit ratios to attract 100% funding from Defra Flood Defence Grant in Aid (GiA) and would therefore require a portfolio of funding to be developed from various sources, including funding sources available for delivering other objectives such as improvements to highways, public open spaces and bio-diversity.

Funding for local flood risk management may come from a wide range of sources. In Staplehurst these may include:

- Defra (Flood Defence Grant in Aid)
- Kent County Council (highways)
- Southern Water
- Industrial estate owners and businesses
- New developments (directly through the developer or through CIL)
- Local communities
- Maidstone District Council

6.5 Ongoing monitoring

The partnership arrangements established as part of the SWMP process should continue beyond the completion of the SWMP to discuss the implementation of the proposed actions, review opportunities for operational efficiency and to review any legislative changes.

The SWMP Action Plan should be reviewed and updated once every six years as a minimum, but there may be circumstances which might trigger a review and/or an update of the Action Plan in the interim, for example:

- Occurrence of a surface water flood event;
- Additional data or modelling becoming available, which may alter the understanding of risk within the study area;
- Outcome of investment decisions by partners is different to the preferred option, which may require a revision to the Action Plan, and;
- Additional (major) development or other changes in the catchment which may affect the surface water flood risk.

The Action Plan should act as a live document that is updated and amended on a regular basis, and as a minimum this should be as agreed in the Local Flood Risk Management Strategy for Kent, although individual partners may wish to review their actions more regularly.

Appendices

A Appendix A - Watercourse Map

B Appendix B - Patterns that lead to flooding

C Appendix C - FEH Calculation Record

D Appendix D - Model Operation Manual

E Appendix E - Model Results

F Appendix F - Cost Benefit Analysis

Offices at

Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Haywards Heath
Limerick
Newcastle upon Tyne
Newport
Saltaire
Skipton
Tadcaster
Thirsk
Wallingford
Warrington

Registered Office
South Barn
Broughton Hall
SKIPTON
North Yorkshire
BD23 3AE

t:+44(0)1756 799919
e:info@jbaconsulting.com

Jeremy Benn Associates Ltd
Registered in England
3246693

Visit our website
www.jbaconsulting.com