St Mary Bourne

Infiltration Reduction Plan

September 2018

Southern Water

Document Title: St Mary Bourne Infiltration Reduction Plan

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Contents

GLOSSARY OF TERMS

AMP – Asset Management Programme

CCTV - Closed-circuit television

EA - Environment Agency

GW – Ground Water

IRP - Infiltration Reduction Plans

l/s - litres per second

MH – Manhole

RPS - Regulatory Position Statement

SW – Southern Water

WaSC - Water and Sewerage Companies

WC – Water Closet

WPS - Wastewater Pumping Station

WTW - Wastewater Treatment Works

BACKGROUND

The Environment Agency's (EA) Regulatory Position Statement (RPS) requires Water and Sewerage Companies (WaSC) which are aware of sewerage systems in their area which are vulnerable to infiltration, to submit Infiltration Reduction Plans (IRPs) to the EA for approval. This document is produced in response to the Regulatory Position Statement (RPS).

The IRP is required to be regularly reviewed and if appropriate, to be updated. The St Mary Bourne IRP was conditionally approved by the EA on 30 May 2014. This updated version was conditionally approved on 29 June 2018.There will not be a 'final issue' of the plan; it is a working document. Regular updates on progress are provided to the EA and, when appropriate, the IRP will be updated.

During the current infiltration reduction programme, commenced in 2013, Southern Water has been working to identify the sources of groundwater infiltration into sewers in the St Mary Bourne catchment and repair them.

The Bourne Valley is home to a significant food processing facility which relies heavily on local water sources from its own boreholes. There are also various fishing interests downstream which equally rely on an excellent water quality being maintained.

Southern Water (SW) has invested significant sums to reduce groundwater infiltration and the need to dispose of surplus flows in time of persistently severe rainfall. SW has also investigated alternative ways to control the effects (during high groundwater levels) on the remaining infiltration to the sewer network. The measures are described in this IRP.

SW has been communicating with other agencies, in particular during winter flooding, working closely to minimise inconvenience to residents. During 2013 and 2014, SW worked closely with the Technical Steering Group, which included representatives of the organisations listed below. Communications have continued since then, particularly SW is dependent on the support of the following organisations to help achieve the objective of reducing non-sewage flows into the sewers.

- Environment Agency
- Hampshire County Council
- St Mary Bourne Parish Council
- Basingstoke & Deane Borough Council
- Test Valley Borough Council

The main benefit however, is derived from the repairs carried out by SW which have improved the integrity of the sewerage system.

EXECUTIVE SUMMARY

In recent years SW has invested in excess of £1m carrying out major improvements to the integrity of the sewers and manholes in the vicinity of St Mary Bourne in order to minimise any reduction in service to customers during periods of exceptionally high groundwater. The improvements in St Mary Bourne and villages upstream formed a significant part of the Southern Water's investment during AMP 5 (2010 – 2015) and AMP 6 (2016 – 2020), during which SW invested in excess of £10m in each of those AMP periods to improve the performance of the sewers in sixty towns and villages affected by high groundwater levels across the company's region.

The sections of the IRP follow the current version of the Environment Agency's Regulatory Position Statement (December 2016), leading the reader through the steps taken to reduce infiltration.

Section 1 explains which IRP sections address which sections of the RPS.

A significant number of unusually wet winters in recent years, resulted in exceptionally high flows in the Bourne Rivulet and record groundwater levels. During the winters of 2012/13 and 2013/14 (the wettest winter on record), flows in the sewers exceeded their capacity and unfortunately, in both years, it was necessary to make discharges from the sewers to the Bourne Rivulet in order to maintain sewerage services to customers. The history of recent flooding is quantified in Section 2, together with an acknowledgement by SW, that infiltration was sufficiently significant that action was required to reduce it.

The generic approach adopted by SW for their Infiltration Reduction Programme is explained in Section 3, together with a description of each activity. A table of key dates for surveys and repairs is included in Section 3.

Benefits of the sewer rehabilitation work are explained in Section 4, together with a description of the steps that SW is taking to prevent discharges needing to be made to the watercourse during high groundwater conditions. The pros and cons of the use of tankers to maintain sewerage services to customers are included.

Following the main sewer rehabilitation work in 2013, SW re-laid a length of main south of the village in 2014, to help ensure that flows are efficiently removed from the village. During the winter 2015/16, a number of minor, but nevertheless important, repairs were completed; following survey of 7km of sewers (over half the village's sewerage network). Maintaining Southern Water's commitment to investment in the area, further repairs to sections of both public and some private laterals were also completed in 2016/17.

Whilst there are clear benefits of the rehabilitation work carried out, it has been difficult to quantify. This is partly due to the lack of high groundwater conditions following the 2016 repairs. It is SW's intention to develop the monitoring as more post-repair data becomes available.

Southern Water has also improved the resilience of the St Mary Bourne Wastewater Pumping Station (WPS) by changing the two pumps which operate on a duty/standby basis, to new larger versions complete with new control panels, following a successful trial period, so that more flows can be handled by the WPS. This, along

with a new standby generator, means the WPS is well positioned to tackle current and future demands made of the sewer network.

Southern Water has improved forecasting and developed a proactive approach to responding to flood incidents. Since January 2014, SW has been running a winter groundwater monitoring programme. Weekly reports are shared with the EA and the information is used to help plan responses should flooding occur.

Section 6 includes a conclusion and tables of actions to reduce infiltration and the impact of remaining infiltration. SW has participated in a multi-agency approach to make improvements, and will continue to work with other agencies.

Appendix A includes a plan showing the potential location for an over-pump at Longparish in the event that discharging flow here would be needed to prevent sewer flooding in St Mary Bourne.

1 REPORT STRUCTURE AND SUMMARY

This IRP is arranged in six sections, as summarised below: Report Structure, Situation, Investigation and Repairs, Recent and Current Activities, Future Actions and Conclusion/ Action Plan. These headings have been used in order to cover, in a logical structure, the information required by the current Regulatory Position Statement (RPS) Version 3 published by the Environment Agency (EA) dated December 2016.

Section 1 - Report Structure & Summary (this Section)
Southern Water has embarked on a programme to reduce the effects on customers, and the environment, of groundwater infiltration. Progress, current activities and potential future activities are recorded in Infiltration Reduction Plans (IRPs) that SW is producing. **This IRP covers the villages of St Mary Bourne, Stoke, Hurstbourne Tarrant and Ibthorpe.** The villages of Longparish and Forton are covered by a separate IRP.

Section 2 - Situation

- Acknowledgement that for St Mary Bourne, groundwater infiltration is significant enough to have necessitated the previous use of over-pumping to protect customers against sewer flooding (RPS Section 2.2)
- Explanation of what would happen if SW were not to actively prevent groundwater getting into the sewers or use mitigation measures to protect customers when flooding does occur. Provide details and locations of infiltration and other likely impacts. (RPS Section 2.3 i)

Section 3 - Investigation and Repairs

- Outline the plans for investigation of the problems caused by groundwater getting into the sewers, (RPS Section 2.3 ii)
- Explanation of repair techniques used and a summary of work at St Mary Bourne to reduce infiltration.

Section 4 – Recent and Current Activities

- Explains what SW is doing to avoid the need for over-pumping (RPS Section 2.4 a.)

Section 5 – Future Actions

- Explains what SW is doing to minimise the requirement for discharges. This will include planned work to reduce groundwater getting into sewers and also work that could be considered in future if the work being carried out and the planned work are not adequate. (RPS Section 2.3 v)

Section 6 – Conclusion/Action Plan

- A review date (RPS Section 2.3 vi)

2 SITUATION

2.1 The significance of Groundwater Infiltration at St Mary Bourne.

St Mary Bourne is one of a number of areas in Southern Water's operating area where, during wet winters, customers have been inconvenienced by the effects of groundwater infiltration. Excess groundwater which gets into the sewers prevents sewage from customers' properties being able to be conveyed satisfactorily to the treatment works. During these conditions, some customers suffer restriction in use of their facilities. Southern Water strives to maintain services for customers by a programme of investigation, repair, maintenance and mitigation. Mitigation measures include the use of tankers.

Such measures are not popular, so during recent years SW has invested in excess of £1m carrying out major improvements to the integrity of the sewers and manholes in St Mary Bourne and upstream villages, in order to minimise the occasions on which intervention is required to maintain sewerage services to customers.

The sewerage network only suffers from excess flows during some winter and spring periods; at other times the system operates as designed conveying normal dry weather flows to the WPS and onward for treatment. Structurally the network is in a satisfactory condition and over the previous years most sections have been renovated to a greater or lesser degree. When considering the most appropriate maintenance strategy for this catchment the benefits of on-going maintenance have to be measured against the costs and disruption of installing a totally new sewer system up the valley, which has been estimated at around £9.6m, but the actual costs could be considerably higher. Currently the strategy to continue to renovate the existing system is considerably more cost beneficial.

2.2 What would happen if Southern Water did not take Action?

The sewerage catchment upstream of the St Mary Bourne Wastewater Pumping Station includes the villages of St Mary Bourne, Stoke, Hurstbourne Tarrant and Ibthorpe. The total catchment of the Bourne Rivulet and the River Swift (the upstream continuation of the Bourne Rivulet, in the vicinity of Ibthorpe and Hurstbourne Tarrant), also contains the villages of Upton and Vernham Dean at the head of the valley. It should be noted that the watercourses through these villages are, in fact, bourns that only flow during periods of high groundwater.

Despite the significant groundwater flow through the valley, following prolonged heavy rain, incidents of sewer flooding have been relatively infrequent. Table 2.1 below shows reported number of incidents of each category of sewer flooding since April 2000. The total number of reported flood incidents each year, together with average daily winter rainfall, is plotted in Figure 2.1.

Sewers are designed to accommodate normal flows, which includes an allowance for groundwater. However, during particularly wet winters, the capacity of the sewers is exceeded, resulting in spillages and potentially sewer flooding. In addition to repairs to the sewers, Southern Water follows a standard process each autumn/winter to ensure sewers are flowing freely. Consequently, it is difficult to assess what the effects of groundwater infiltration would be if no actions were taken. If SW did not carry out the pre-winter checks and rehabilitation of the sewers, it is likely that more customers would suffer loss of sanitation and more manholes would spill.

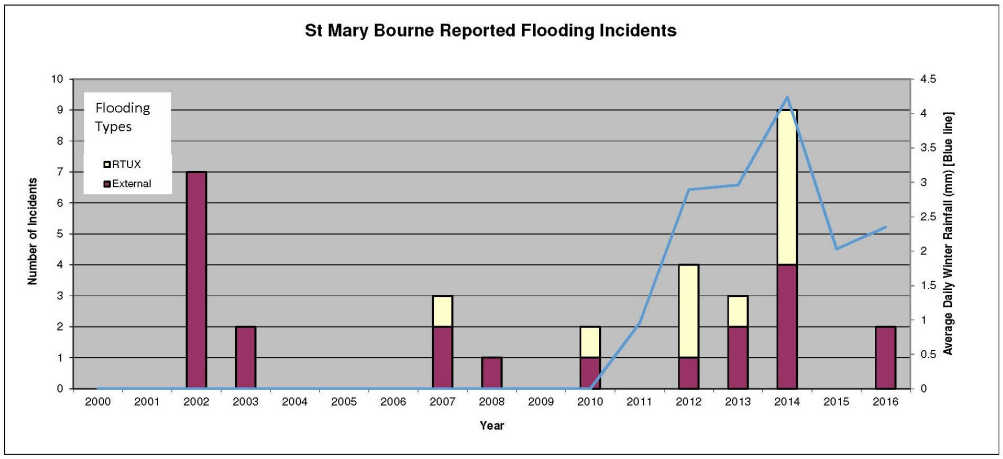


Figure 2.1 – Historic Flooding Records

Year	External	RTUX	Total
2000 - 2001	0	0	0
2001 - 2002	0	0	0
2002 - 203	7	0	7
2003 - 2004	2	0	2
2004 - 2005	0	0	0
2005 - 2006	0	0	0
2006 -2007	0	0	0
2007 -2008	2	1	3
2008 - 2009	1	0	1
2009 - 2010	0	0	0
2010 - 2011	1	1	2
2011 - 2012	0	0	0
2012 - 2013	1	3	4
2013 - 2014	2	1	3
2014 - 2015	4	5	9
2015 - 2016	0	0	0
2016 -2017	2	0	2

Table 2.1 - Reported Flooding Incidents by Category.

The data show that there have been no reported instances of internal sewer flooding since 2000. However, incidents of External Flooding (EXTC) and Restricted Toilet Use (RTUX) occurred more frequently. Lack of reported RTU incidents prior to 2007, might be due to a change in recording, or more frequent reporting in recent years.

Average daily winter rainfall figures are provided to show the influence of rainfall on incidences of sewer flooding. Records were not readily available before 2005.

In 2013, and again in 2016, SW set up a weekly drop-in session at the village hall to allow customers to communicate issues directly. This proved very successful. Consequently, some potential incidents may have been averted by intervention and thus not reported as incidents. Whilst SW is working to improve the integrity of the

sewerage system, and had made a significant investment, it should be noted that 2012 was the wettest year on record in the UK and 2013/14 was the wettest winter on record in the UK. In those winters, groundwater infiltration is likely to have accounted for up to 95% of sewer flow.

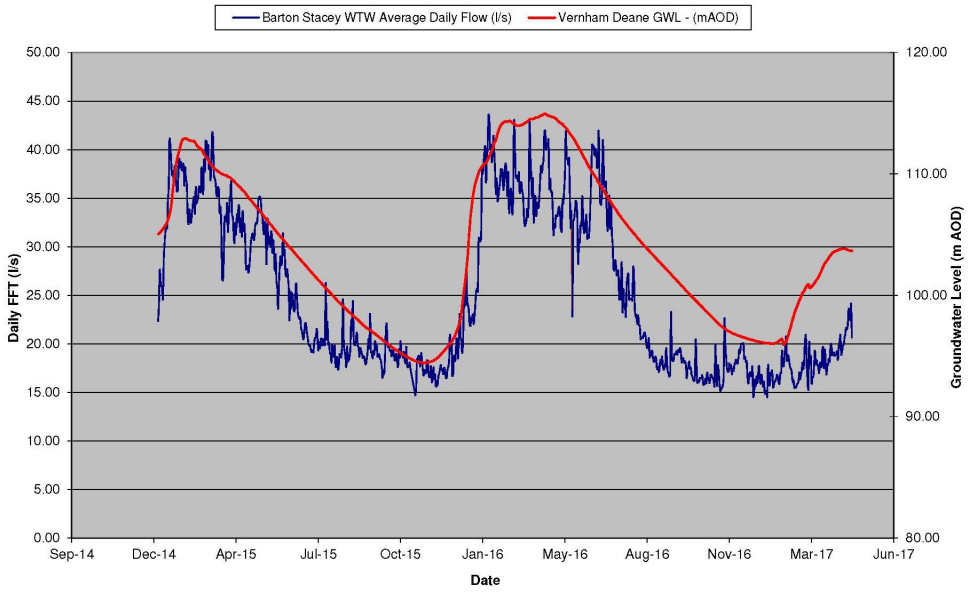


Figure 2.2 - Barton Stacey WWTW Daily FFT and groundwater levels (Sept 2014 – June 2017)

Jetting of sewers is carried out by SW to ensure sewers are flowing freely. In March 2013 extensive sewer jetting work was regularly carried out at Gangbridge Lane. Also jetting was regularly carried out south of the village prior to the relaying of a length of sewer there in 2014. Additionally, sewer repair works have been carried out in the catchment in both 2013, 2014 and 2016. Since the most recent repair work in 2014/15, there have been only two reported incidents of flooding (both external).

Definitions of Categories of Flooding

External flooding [EXTC] at a property is defined as flooding to external areas within the curtilage of the property, due to sewers becoming surcharged. The flooding will normally be from a surcharged manhole, or gully. External flooding can be contaminated surface water entering the grounds of the property. There are two other categories of external flooding: Highway flooding refers to flooding on roads or footpaths. 'Other' external flooding refers to non-residential buildings and public open spaces.

Restricted Toilet Use [RTUX] may be experienced by customers as the sewers become surcharged. Toilet facilities still function but effluent will be slow to drain away and sometimes facilities can only be used for limited periods – for instance after a tanker has removed dilute effluent from the local sewers.

Internal Flooding [INTL] occurs when sewers either back-up to such an extent that dilute effluent floods inside dwellings from low connections to the drains. (for example

through WCs or shower drains), or when contaminated surface water enters the building.

3 INVESTIGATION & REPAIRS

3.1 Outline Plans to Investigate Sources of Infiltration

This section (3.1) describes the generic process to reduce infiltration, developed by Southern Water for the Infiltration Reduction Programme in 2013. The steps are shown in Figure 3.1 below. The specifics of the investigations and repairs at St Mary Bourne are in Section 3.2.

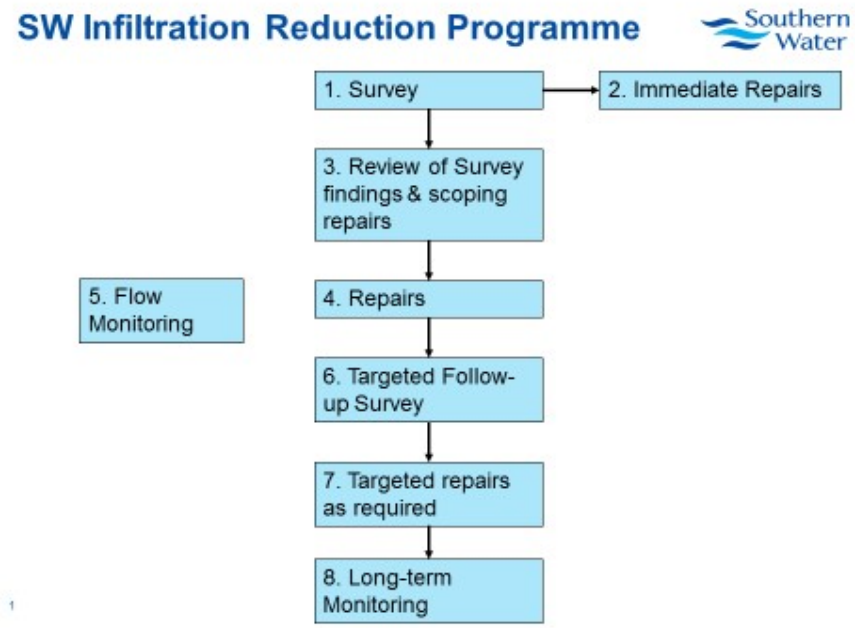


Figure 3.1 – Infiltration Reduction Process

1. survey (manhole lifting followed by CCTV)
2. immediate repairs of major points of infiltration.
3. review of data and commercial arrangements for repairs
4. carrying out repairs
5. flow monitoring in wet and dry weather conditions
6. Targeted follow up survey
7. repairs as required
8. ongoing monitoring

Steps 1 to 7 are described below. Step 8 is covered in Section 5.3.

3.1.1 Manhole Inspections and CCTV Surveys

Steps 1 to 4 follow a process of elimination. Initially SW identifies an area where infiltration is either known, or expected, to exist. This is generally based on local knowledge of the area. Then 'strategic manholes' within that area are identified. When the groundwater levels are high but falling and the sewers are no longer

surcharged, flow in those manholes is checked. Manholes at the downstream end of the run are inspected first, then the next one upstream, until the flow is down to normal. Any sewer runs where there is a reduction in flow between downstream and upstream manhole, are noted. The increase in flow indicates infiltration. The manholes are also checked for infiltration. As soon as possible after this inspection, the sewer lengths are inspected using CCTV units which are moved through the sewers working upstream between manholes until the flow has returned to normal. If significant flow is seen from lateral connections, these are also surveyed by CCTV (subject to gaining access from customers' properties – where required).

The CCTV cameras are mounted on a wheeled unit which measures the distance along the sewer. A report of the CCTV inspection is prepared noting the location of any defects (e.g. displaced joints), or leakage of groundwater into the pipe. Still photos of these are captured from the video and included in the report.
The report is reviewed by Southern Water. The most appropriate repair technique for each location is determined and specified and an order for the work is placed with SW's framework networks maintenance contractor.

3.1.2 Flow Monitoring Surveys

In addition to the surveys noted above, carrying out flow monitoring in dry weather, and also in weather conditions, can also be used to assist with identifying areas of high levels of infiltration.

3.1.3 Generic Repairs

When the repairs are instructed, the contractor will then return to the site and prior to starting the repair, will rerun the CCTV inspection to ensure there are no material changes since the initial survey was done. This is particularly relevant if the repair is not carried out until a significant period of time after the initial inspection. The repairs specified by SW would be from the list below. After completing the repairs, a further CCTV survey of the pipes is carried out to demonstrate the effectiveness of the repairs. This information is retained by SW, which updates its sewer records. The lengths of sewers surveyed by CCTV and the results are also included in the sewer records database.

Where rehabilitation is required, the appropriate repair technique is selected from the following:

- Sewer lining – fitting a new lining to sewers from one manhole to another or to sections of sewer to repair several leaks, by forming a leak-tight pipe within the existing sewer.
- Excavations to repair leaking joints where no-dig techniques are not possible.
- Quick-Locks – metal 'sleeves' which are inserted remotely into damaged pipe sections and, once located correctly, are expanded via compressed air against the inner walls of the pipe to instantly seal leaks.
- Joint Test and Seal – each joint between sewer pipes is air tested and if it does not hold the pressure, the joint is injected with a gel to seal it. Sealed joints are retested.
- Capping of leaking unused connections.

- Top Hats – fibreglass inserts which form a leak-tight bond at the point where a lateral sewer connects to the main pipe.
- Ground Stabilisation – an alternative technique which involves the injection of gel into the ground around a leak.
- Manhole chamber sealing – a non-excavation method to repair manholes.

3.1.4 Follow-Up Survey and Repairs

If there is evidence of remaining infiltration following repairs, further targeted investigation and repairs may be carried out if required.

3.2 Investigation and Repairs at St Mary Bourne

Groundwater infiltration into sewers has been a long-running issue at St Mary Bourne. SW has been making significant investments over many years to minimise infiltration and thus the need for over-pumping. SW recently completed a major programme of survey and repairs to the sewers in St Mary Bourne. The investigations and repairs followed the process set out in Section 3.1 above. The status of each step is summarised in Table 3.1 below.

Summary

Step.	Description	Approx Date	Status
1.	Manhole lifting followed by CCTV Investigation (11km of sewers and 119 manholes surveyed)	Spring 2013	Completed
3.	Determination of required repairs	Spring 2013	Completed
5a.	Dry Weather Flow Survey	7th July to 14th August 2013	Completed
4a.	Repairs – 923m of sewers repaired and 30 manholes sealed [refer previous issues of the IRP]	October 2013 – July 2014	Complete
5b.	Wet Weather Flow Survey	9th April to 6th May 2014	Completed. for the upstream end of the catchment.
4b.	Relaying of sewer south of St Mary Bourne village (25m length)	October 2014	Complete
6.	Targeted follow up survey	June 2014	Complete

Step.	Description	Approx Date	Status
7.	Targeted Repairs	Autumn 2015/ Spring 2016	Substantially complete
8.	Ongoing monitoring	Commenced Jan 2015	Ongoing.

Table 3.1 – Summary of Infiltration Reduction Activities at St Mary Bourne and Environs

The investigations in 2013 at St Mary Bourne identified most of the infiltration at manholes. This is not surprising because the previous rehabilitation work had focussed on sealing sewers, 7km of which were sealed in 2007/08.

Following the CCTV surveys in Spring 2013, repairs commenced in October 2013 and were completed in July 2014. The planned repair programme was completed in October 2014 when a length of sewer south of St Mary Bourne village was re-laid. Completion of this work improved flows to St Mary Bourne pumping station. The extent of these repairs is shown in earlier versions of the IRP. A further 7km of sewers was surveyed in 2015/16, and the majority of the repairs were carried out in 2016/17. The only outstanding repairs are two cable ducts to be resealed.

Date	Summary of Repair
December 2015	Repair of the junction between the lateral serving a property in St Mary Bourne and the main sewer, where gushing infiltration was identified.
	In Hurstbourne Tarrant: 76m of public sewers: 5 sewer length and 2 manholes in the vicinity of Church Road and the Dean were sealed.
	At Ibthorpe, in the vicinity of the main road, 68 metres of sewers were repaired. One is a main sewer, the other three are on customers' lateral drains.
May 2016	CCTV survey of approx. 3km of sewer between the Bourne Valley Inn and the Pumping Station in St Mary Bourne. Four tankers were used to artificially create optimum conditions for survey and sealing work to take place immediately instead of waiting for groundwater levels to drop. This survey which centred on St Mary Bourne and the area to the north of the village, covered 7km of sewers.
June 2016	Jetting the sewers in the village to remove the road grit followed by a further 4km of CCTV survey in SMB village.
	In total nearly 20 locations of major infiltration, were identified

Date	Summary of Repair
	and quickly repaired.
Autumn 2016	With Vitacress, SW made a joint donation to the Parish Council to allow weed to be cleared from the Bourne to help improve the carrying capacity of the bourne.
April 2017	SW completed a £150,000 refurbishment of the Pumping Station. See Section 4.1

Table 3.2 – Recent Survey and Repairs in St Mary Bourne (2015 and 2016)

Apart from remaining repairs noted above, the work listed in Tables 3.1 and 3.2 above, completes Steps 1 to 7 of the of sewer infiltration reduction programme described in Section 3.1. Whilst infiltration reduction is an on-going journey, priorities have to be set; having completed over £1m of repairs in the St Mary Bourne area in the last few years, SW is now focussing on other catchments where infiltration also needs to be reduced. Whilst no further work is scheduled at St Mary Bourne, SW will monitor performance of the sewers each winter (see below), and if infiltration remains an issue, the requirement for further investigation and repairs will be considered in relation to other locations in SW's area which are experiencing sewer flooding.

In addition to physical investigations on site, SW has instigated a programme of monitoring flows in critical catchments, including the St Mary Bourne catchment. Details are given in Section 5.3.

Flow Monitoring

In addition to the surveys noted above, flow monitoring (Step 5 in Figure 3.1) was carried out both in dry weather conditions to establish baseline flows, and in wet weather conditions at the upstream end of the catchment. The 'Wet' and 'Dry' flow monitoring data can, on occasions, help identify areas of infiltration if it has not been found by other survey methods. However, in the case of St Mary Bourne, because the levels dropped very quickly when the sewers in the village were no longer surcharged, it was not possible to obtain a comprehensive set of data. But in Stoke and Hurstbourne Tarrant, the comparison between wet weather and dry weather flow data helped to identify areas for targeted CCTV investigation.

4 CURRENT ACTIONS

4.1 Pumping Station Upgrade

The St Mary Bourne Pumping Station is a two pump (working on duty/standby mode) station which receives flows from St Mary Bourne, Stoke, Hurstbourne Tarrant and Ibthorpe. During winter times when the flow arriving at the station is in excess of its historic output (around 18 – 20 litres/sec), it was necessary to supplement this with tankers or over-pumping from specific locations further upstream. In the 2016/17 winter, after a successful trial period, both pumps were replaced with new larger pumps capable of increasing flows up to around 30 litres/sec. These pumps are now controlled by a modern sophisticated control panel which can vary the speeds of the pumps to control flows better. The pumps' more sophisticated inverters have a soft-start facility allowing them to be brought up to capacity gradually (when required); gradually increasing the flow; this avoids rapid pressure build-up in the rising main to Longparish. This technology was not available when the previous pumps were installed. As the new larger pumps draw more power, a new larger backup generator has also been installed on site. There is also a new spare pump on site to provide further back-up resilience.

4.2 CCTV surveys and sewer repairs

During the winter period 2015/16, an extensive programme of CCTV surveys were carried out on the sewer network, totalling more than 7 km of sewer (more than half the entire network) in and around St Mary Bourne. The survey identified nearly 20 points of infiltration, some major, all of which were quickly repaired. This resulted in a significant reduction in flows in the main public sewer (refer Figure 2.2). A substantial proportion of the infiltration (80%) was found coming from customers' private laterals. Although property owners are legally liable for repair of their drains, on this occasion, SW carried out repairs, to terminate the use of tankers more quickly.

4.3 Tankers

The use of tankers is an appropriate response to small-scale sewer flooding, typically for up to four or five houses. Southern Water will always use this as the preferred option whilst maintaining customers' toilet, bathroom and kitchen facilities during times of high groundwater and sewer surcharge. However, if the flooding becomes more widespread, tankers become less effective and more disruptive, and other options may need to be considered. There is no clear rule for the exact point where tankers become ineffective and other approaches need to be considered, but the following factors are taken into account.

1. Use of the appropriate equipment to maintain services to customers (e.g. minimising restricted toilet use).
2. Avoidance of imminent internal or external sewer flooding to protect public health.
3. Forecast of sudden increase in groundwater levels due to severe or prolonged rainfall that would significantly increase risk of sewer flooding.

4. Minimising health and safety risks or disruption to residents due to tanker movements, particularly where tankers are required at night or where tankers restrict access to properties.
5. Whether there are isolated properties suffering RTU/ flooding or whether the disruption is more widespread.
6. Traffic congestion, noise, exhaust fumes pollution and potential road damage caused by tankers.
7. As flood conditions worsen, determining whether tankers remain a practical and economically viable solution.
8. The proximity of local watercourses and the potential for pollution routes if tankering is not sufficient. For instance the greater pumping capacity at St Mary Bourne WPS, might offer the potential for over-pumping at Longparish, at the downstream end of the rising main.
9. With appropriate screening over-pumping at an appropriate location, could be a less unsatisfactory option than allowing MHs to spill uncontrolled.
10. Demand for tankers elsewhere. During the exceptional high rainfall experienced in 2014, in responding to sewer flooding events, Southern Water exhausted the available supply of tankers in the SE of England.

4.3.1 Pros and Cons of Tankers

Tankering

Benefits:

- dilute sewage is discharged at a treatment works for treatment,
- quick response time,
- convenience – suitable for response to short duration localised flooding.

Disadvantages

- the flow rate is low (approx. 2l/s per tanker over a 24 hour period*, compared to 20 – 30 l/s for over-pumping)
- usually 2 or 3 tankers are required as a minimum for each tankering point, to enable effective draining of the sewers
- there are traffic issues associated with large vehicles using narrow roads
- rural roads are not designed to take the load of repeated visits by tankers – resulting in damage to the road,
- tankers are noisy causing disturbance to local properties, particularly at night.
- High cost and carbon footprint compared to over-pumping.

*Tankers operating at St Mary Bourne discharge at Portway Industrial Estate, Andover, - a round trip of approximately 2 hours including loading and discharging.

4.4 Flow Balancing

Sometimes there can be sewer flooding in St Mary Bourne village centre, but spare capacity in the upstream sewers above Stoke. In situations like this, one possible

option is to install a temporary flow restricting device (throttle), to utilise the full capacity of the existing sewer and manhole network. This reduces the flows downstream, thereby creating working capacity in areas where there is sewer flooding or restricted toilet use (RTU). Throttles placed in an upstream manhole hold back flows where there is spare capacity in the sewers and manholes, but not so that it causes problems upstream. In recent years, a throttle has been used in the sewer network between Stoke and Hurstbourne Tarrant to good effect.

Once levels have reduced, the restriction is removed and normal gravity flows then continue, draining down the upper areas.

4.5 Over-pumping Option

As previously highlighted a significant amount of improvement work has been completed in St Mary Bourne sewer network (both public and private) to reduce infiltration down to a workable level. This work, coupled with improvements to St Mary Bourne WPS, should reduce the likelihood of sewer flooding issues caused by high groundwater. The rehabilitation work will continue through SW's cyclical planned maintenance programme.

There may be exceptional times, however, during particularly wet winters when the groundwater levels rise to such an extent that the sewer levels start to impact on customers' use of their facilities. Should tankers or other options not be sufficient to control excessive flows, some alternative, or concurrent, approach would be required. In the past SW has used over-pumping as a way to reduce sewer levels just enough to avoid RTU or flooding. As described in Section 5.2 and shown in Figure 5.2, not only have the repairs reduced the flow into the sewers (for a given groundwater level), but also the installation of the higher capacity pumps allow greater flow to be removed from St Mary Bourne through the rising main to discharge into the gravity sewers at Longparish. Those sewers and the pumps at Longparish are designed to accommodate the flows that had been received from St Mary Bourne WPS. The higher flows which are now capable of being pumped, increase pressure at Longparish. Longparish WPS is very close to the River Test. In the event of high flows from St Mary Bourne WPS, exceeding the capacity of Longparish WPS, over prolonged periods of high groundwater, action would be needed there to prevent sewer flooding. An option shown in Appendix A, would be to over-pump from Longparish WPS into the main channel of the River Test by running the discharge hose along the bed of the subsidiary which passes the WPS site. This arrangement would only be considered if a practical and economic level of tankering in St Mary Bourne and Longparish were unable to prevent sewer flooding in the villages.

Whilst over-pumping is not an ideal solution because of the introduction of a low concentration of effluent into the flow in the receiving watercourse it would only occur at times when the flow in the River Test would be high. Consequently the diluted effluent, which would pass through a settling tank and filter before discharge, would be further diluted by the flow in the river. Water quality of the discharge would be monitored by SW and the quality of the receiving water would be monitored by both the EA and SW.

SW has mitigated against the option of over-pumping by having completed the following:

- Extensive sewer survey and repairs over the last decade as detailed in Section 3
- Relaying one length of sewer to improve the hydraulics
- Upgrading the pumps at St Mary Bourne Pump Station
- Throttling flows upstream of the village at times of very high flow.
- Contribution to the cost of weed clearance in the bourne to improve carrying capacity which helps avoid elevated water levels.
- Pre-winter preparations (Section 4.5.1)
- Use of tankers to prevent sewer flooding locally

If despite the work carried out, the sewers are inundated by groundwater, surface water, or the combination of the two, some other measure will need to be taken to maintain sewerage services to customers. Over-pumping at Longparish would only be used if all other options have been exhausted, as protecting residents from direct flooding and harmful effects of sewage flooding remains SW's top priority.

4.5.1 Steps to prevent discharges and prior alternatives to over-pumping

In addition to the eight steps outlined above, SW also carries out other activities to minimise the requirement for discharges to watercourses. During the Winter 2014/15 SW followed the steps in the following list. These activities supplemented the rehabilitation programme. The approximate timescales for each step are included in brackets.

1. Carry out scheduled maintenance visits to key pumping stations prior to winter weather. [Autumn]
2. Ensure that sewers prone to silt deposition or fat build-up have been jetted as per SW's Scheduled Maintenance Tasks. [Autumn]
3. Monitor groundwater levels in relevant local boreholes. [from mid-September]. This can be supplemented by well levels supplied by two local residents.
4. When groundwater levels start to rise, monitor WPS performance as groundwater level approaches trigger levels based on previous flood events. [Late autumn , increase frequency of monitoring to weekly as levels rise]
5. Determine forecast dates for trigger levels based on previous dry, average and wet winters. [from mid-September]
6. Hold weekly calls with the EA and share forecasts for potential over-pumping [from late autumn , dependent on groundwater levels]
7. As each trigger level is approached, check sewer levels at selected manholes in the catchment. Continue to monitor and record sewer levels. [from late autumn, dependent on groundwater levels]

8. If levels continue to rise, lift manhole covers, record sewer levels and share data with the EA. [as required. Share data weekly]
9. Monitor customer calls. Seek to establish whether there is a common cause for the lack of capacity to maintain sewage disposal services. [ad-hoc analysis, as and when required during flood events]
10. Respond to customer calls with targeted sewer jetting, tankering or over-pumping as appropriate. [as required]
11. Keep EA informed about potential tankering and other flow control / discharge activities, appropriate communication strategy and agree course of action with the EA. [from late autumn, through weekly reports and calls]
12. Continue to monitor levels. [weekly through the winter/ spring]
13. Keep EA informed about tankering, jetting and other flow control activities in weekly calls. [from late autumn, through weekly reports and calls]
14. Following the flooding event, as levels in the sewers return to normal, lift manhole covers in catchment to identify the locations of sudden increases in flow. [Spring, but only if there was flooding during the Winter]
15. Instigate survey and repairs if required. [Spring, but only if there was flooding during the Winter]

4.6 3rd Party Communications about over-pumping

Since the start of the Infiltration Reduction Programme in 2013, and before then, Southern Water has been proactive in communicating with stakeholders and customers in the St Mary Bourne area about planned and completed work to improve the integrity of the sewerage system. Stakeholders have been kept informed of progress on survey and sealing work via emails and face-to-face meetings, while customers have been kept up to date via letters, notices on the parish council's website and social media. During the flooding of 2012/13 & 2013/14 and during the major work in 2016 SW had representatives who held customer drop-in sessions once or twice a week and visited customers where appropriate.

SW attends and convenes meetings with a number of local groups. In particular, during 2013-15 SW worked closely with the Technical Steering Group (TSG) and regularly attends meetings of the St Mary Bourne Flood and Emergency Group.

If over-pumping at Longparish were to be required, SW would liaise with the local EA team, the EA National Incident Communication Service, local public and local authorities prior to, during and at the end of over-pumping.

During the winters since 2014/15, SW and the EA have held weekly conference calls to discuss the groundwater flooding situation.

From time to time, SW updates stakeholders about completed and planned work.

The latest version of the IRP approved by the EA, will be published on SW's website.

5 OPTIONS TO REDUCE INFILTRATION AND MINIMISE THE REQUIREMENT FOR DISCHARGES TO WATERCOURSES

5.1 Sewer Rehabilitation Programme

SW acknowledges that infiltration reduction is an on-going process. In recent years, SW has invested in excess of £1m in surveys and repairs at St Mary Bourne; over £400k of this was spent in the infiltration reduction programme instigated early in 2013. That work was completed except for a few repairs at St Mary Bourne, Hurstbourne Tarrant and Ibthorpe which were carried out during by December 2016..

Apart from the minor outstanding repairs, no further repairs are currently planned at St Mary Bourne. On a company-wide basis, to ensure that benefit continues to be gained from the work that has been done, SW is continuing the programme of infiltration reduction with proposed investment of a further £10m across its region for AMP6 (2015 – 2020).

5.2 Property Level Protection

Non-return valves have always been part of Southern Water's armoury for dealing with infiltration, but they are only effective if infiltration is under control on both the lateral and the main sewer. Whilst there are no plans currently to install non-return valves, the potential benefit of property level protection will be investigated, if it is deemed appropriate following completion of the current repairs. A micro pumping station (MPS) was installed in 2015 to protect a number of properties in the centre of St Mary Bourne village. This has proved successful.

5.3 Monitoring

SW has set up a monitoring programme using current electronic data (e.g. EA borehole level data via telemetry links). In January 2015, SW commenced a weekly review of the ten locations in their region which are most prone to sewer flooding. St Mary Bourne was one of those locations. The monitoring uses 'real time' groundwater levels from local boreholes to predict when it might be necessary to respond to mitigate the effects of flooding. The trigger levels are not the levels at which tankering or over-pumping started historically. When a trigger level is breached SW increases activity to ensure that the sewers are running clearly. Levels in the manholes are also checked, as it is this, not groundwater levels, that determine when surplus effluent needs to be removed from the sewers.

The graph below, Figure 5.1, is an example of those used for predicting the earliest, average, and latest dates for when the trigger levels are forecast to be breached. This graph shows groundwater levels and an indication of flows.

SW will repeat this monitoring each winter. In 2015, the reporting commenced mid-September, running reports at monthly intervals initially, increasing to fortnightly, then weekly to suit the rise of groundwater levels. The forecast dates for reaching trigger levels is shared with the EA when it is produced.

The above approach can only be used during periods of rising groundwater. However it is important for SW to continue to monitor the integrity of the sewers through the drier months of the year.

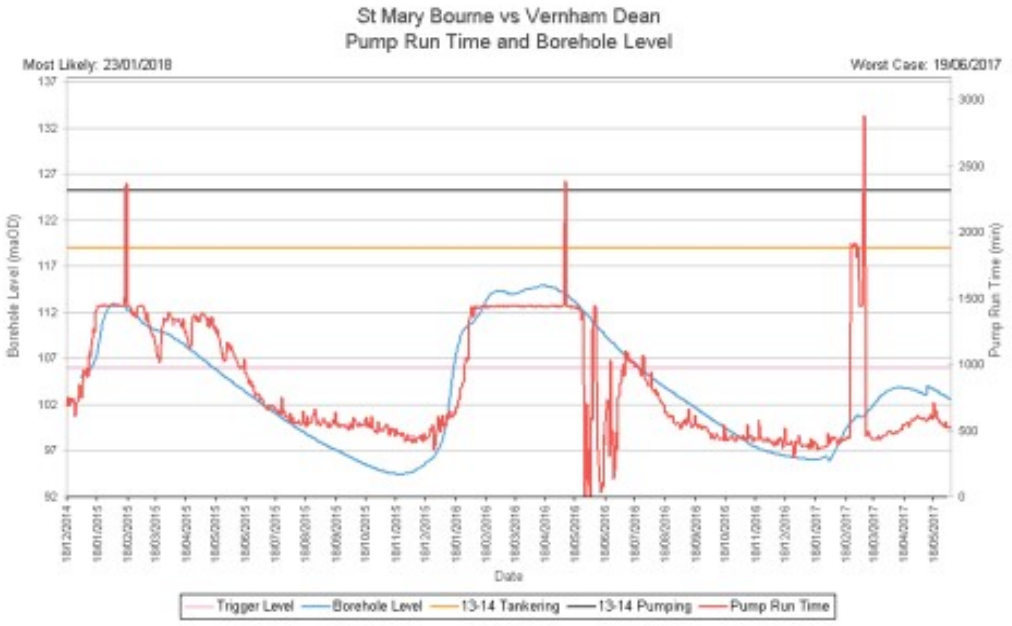


Figure 5.1 – Forecasting of Trigger Dates

In addition to the groundwater flooding forecasts explained above, SW is also looking at longer-term trends to monitor the effectiveness of the completed rehabilitation work. The graph in Figure 2.2 shows groundwater levels and flows to Barton Stacey treatment works over the last two years. Whilst Figure 2.2 is not conclusive, analysing the data points separately for prior to June 2016 and after June 2016 in Figure 5.2., shows the benefit more clearly. The benefit does not show for higher flows/ groundwater levels (above flows of 28 l/s). This is partly due to there being less high groundwater points since June 2016, but also with increased capacity pumps at St Mary Bourne are pumping higher flow rates at higher groundwater levels. The same data is also used in Table 5.1 showing the benefit of the repairs in reducing flows up to groundwater levels of approx. 106mAOD. As noted above improved pump capacities may explain the apparent dis-benefit of the repairs at higher groundwater levels.

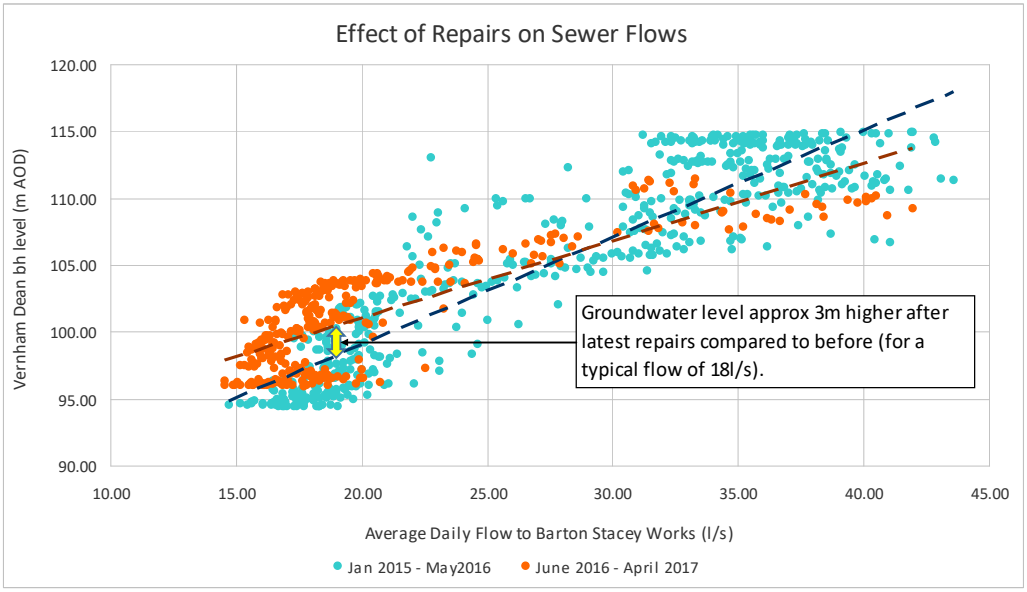


Figure 5.2 – Long Term Monitoring Graph

Vernham Dean bh level (m. AOD)	Flow to Barton Stacey (l/s)	
	Jan 2015 – May 2016	June 2016 – April 2017
100 m	21 l/s	18 l/s
105 m	27.5 l/s	27.5 l/s
110 m	33 l/s	35.5 l/s

Table 5.1 – Flows Before and After Repairs for Selected Groundwater Levels

6 CONCLUSIONS/ ACTION PLANS

6.1 Conclusions

SW carried out extensive survey and repairs between April 2013 and Autumn 2014. Whilst flows at the pumping station increased in winter 2014/15 (due to relaying a length of sewer between the village and the WPS), over-pumping was not required that winter. Further extensive investigations and repairs were carried out in Spring 2016.

This IRP describes the work that has been done by SW to improve the situation. In addition, it also describes what is being done to monitor flows, the 'winter preparation' work to be carried out to ensure assets are operating correctly, and the work to be developed with other agencies to improve an integrated plan to address flooding.

As noted previously, reducing infiltration is an ongoing journey. In 2013, SW prioritised 17 areas – including St Mary Bourne – which were identified as priority sites for reducing infiltration.

Having reduced infiltration in those priority catchments – including St Mary Bourne and villages upstream - SW is now focusing on improving other catchments that have significant infiltration. However, the St Mary Bourne catchment is not being ignored by SW. After completion of the outstanding repairs, the potential for property level protection by use of non-return valves will be investigated, if still relevant. SW is currently monitoring the flows (see Figure 5.1), and continuing with 'winter preparation' work. If further work is identified as being required, this will be scheduled into the infiltration reduction programme, taking account of the needs of other catchments.

6.2 Action Plans

A significant amount has been achieved in the St Mary Bourne catchment in the last few years. Table 6.1 below summarises the key actions by SW and other agencies, and the status of actions. Apart from the minor outstanding work, SW has completed its current planned actions and achieved reasonable success. The multi-agency actions are to be carried out as required.

In line with the objectives of the EA's Regulatory Position Statement, SW is committed to continuing to pursue infiltration to reduce the requirement for any discharges to watercourses, by taking actions to reduce infiltration and mitigate the effects of it, if the infiltration cannot be controlled at economic cost.

Colour coding of actions in tables: Green – completed, Amber – imminent action required, Red – overdue, White – on-going actions with no specific end dates.

6.3 IRP Updates

The IRP records SW's commitment to continuously strive for the long-term objective of reducing the need to over-pump. As required by the RPS, SW will report progress quarterly to the EA and will review the IRP annually. It will be updated as required – such as if significant changes occur. Approved IRPs are published on SW's website.

SW Actions		Status
Infiltration Reduction		
Activities to investigate infiltration and carry out repairs	Refer Tables 3.1 & 3.2 in Section 3.2 and Section 4.1. Minor repairs outstanding	
Annual IRP reviews and quarterly reporting to EA	All quarterly updates for 2016 and to date in 2017 submitted and discussed with the EA	
Preparation and making suitable arrangements for maintaining services to customers in the event of inundation of the sewerage system by ground and/or surface water.	Arrangements discussed with EA at Winter weekly calls. (Not required winter 2016/17)	
Developments	Respond to planning applications as required	
Flood Mitigation		
EA communications	Monitoring groundwater levels and communicate with EA	
Stakeholder Engagement	Communications with stakeholders and the public as appropriate.	

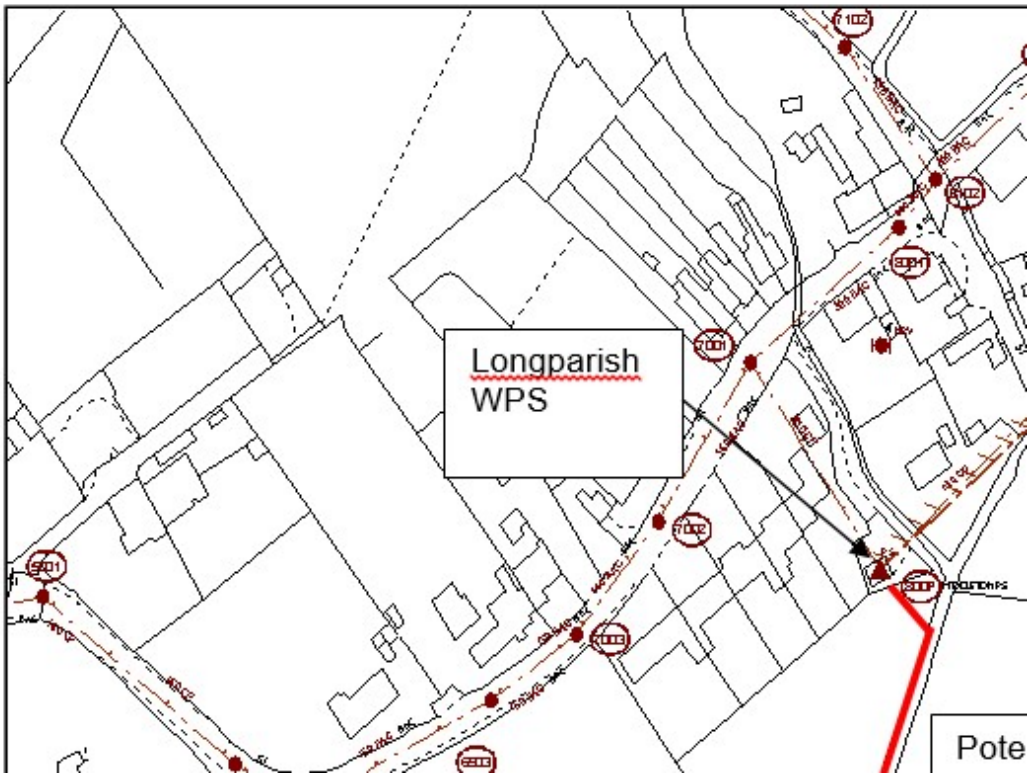
Table 6.1 – Summary of Key Actions.

Multi-agency activities

Infiltration Reduction

- Misconnections - HCC (for highways) and Test Valley Borough Council (for domestic connections) to investigate and pursue as required.
- Groundwater Flooding Strategy - HCC with input by other agencies as appropriate

APPENDIX A POTENTIAL OVER PUMP LOCATION AT LONGPARISH



Refer Longparish IRP for further details of potential overpumping arrangement.