# Infiltration Reduction Plan

## Pan Parishes covering:

Kimpton
Fyfield
Thruxton
Monxton
Amport
Quarley
Abbots Ann
Upper Claitford

September 2021

Version 5.3


from Southern Water

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# Glossary

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
PE - polyethylene
RPS - Regulatory Position Statement
SW – Southern Water
WaSC - Water and Sewerage Companies
WC – Water Closet
WPS - Wastewater Pumping Station
WTW - Wastewater Treatment Works

# 1. Background

The original Infiltration Reduction Plan for this area was titled Fifield and covered the villages Fyfield, Kimpton, Thruxton and Monxton. The revised edition now includes the parishes forming the Pan Parish areas of Kimpton (including Fyfield), Thruxton, Monxton, Quarley, Amport, Abbots Ann and Upper Claitford.
The original format of these plans included a lot of general information relating to infiltration reduction approach that was applicable to all areas in the South East region plus specific details for the area of concern. In 2021 it was agreed with the Environment Agency, that plans would be revised such that a generic plan is held as a general over-arching document to which all detailed Infiltration Reduction Plans would refer.

The generic plan can be found at the Southern Water website or by following the link here.

This document is the detailed plan for the Pan Parish area. All Infiltration Reduction Plans (IRP) have been prepared in response to the Environment Agency's (EA) Regulatory Position Statement (RPS). Southern Water has been carrying out work for many years to survey and repair sources of infiltration in the catchment for Fullerton Wastewater Treatment Works (WTW) in Hampshire.

The villages making up the Pan Parish as listed above are near Andover in Hampshire have been combined into a single IRP because they are on the same sewerage network. The Parishes concerned are shown in Figure 1.0 below.

The map in Figure 1.1 shows that gravity flows from Fyfield and Kimpton villages are pumped from Stanbury Road wastewater pumping station (WPS) to Thruxton and then to Mullen's Pond WPS. The flows are then pumped to Furzedown Lane, Amport WPS, where it is joined by flows from Quarley WPS, Grateley Village and Grateley Station WPS. The resultant flows are pumped to Monxton WPS and onwards to Fullerton wastewater treatment works (WTW) south of Andover. Groundwater infiltration into the sewerage system in any of these villages contributes to an increase in the potential for flooding in the villages downstream.

The map also shows the villages of Appleshaw and Penton Mewsey which are also in the Fullerton WTW catchment, but are on a separate branch of the sewerage network and therefore are covered in a separate IRP.

The repairs carried out by Southern Water improve the integrity of the sewerage system. Southern Water has been working with the following organisations and is dependent on their support to achieve the objective of reducing non-sewage flows into the sewers.

- Environment Agency,
- Hampshire County Council,
- Test Valley Borough Council,
- Fyfield Parish Council
- Kimpton Parish Council
- Thruxton Parish Council
- Monxton Parish Council
- Amport Parish Council
- Quarley Parish Council
- Abbots Ann Parish Council
- Upper Claitford Parish Council

SW also communicates regularly with:

- Campaign to Protect Rural England
- Federation of Small Businesses
- Hampshire Wildlife Trust
- Hampshire Constabulary
- Monxton Neighbourhood Watch
- Natural England
- Monxton Flood Action Group

Southern Water has consulted with representatives of these parties in the meetings of the Pan Parish Multi-agency Group which includes representatives from the EA and the local Parishes.

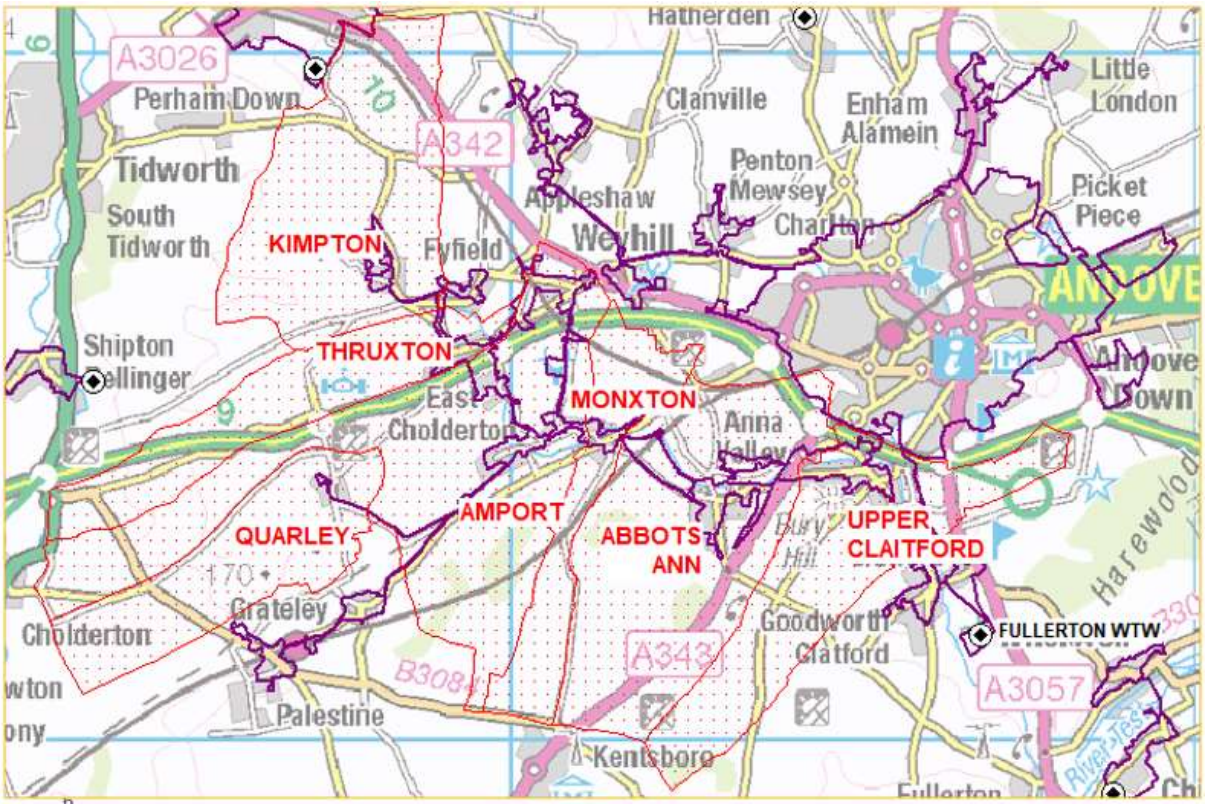



Figure 1.0 – Parishes included in the Pan Parish IRP

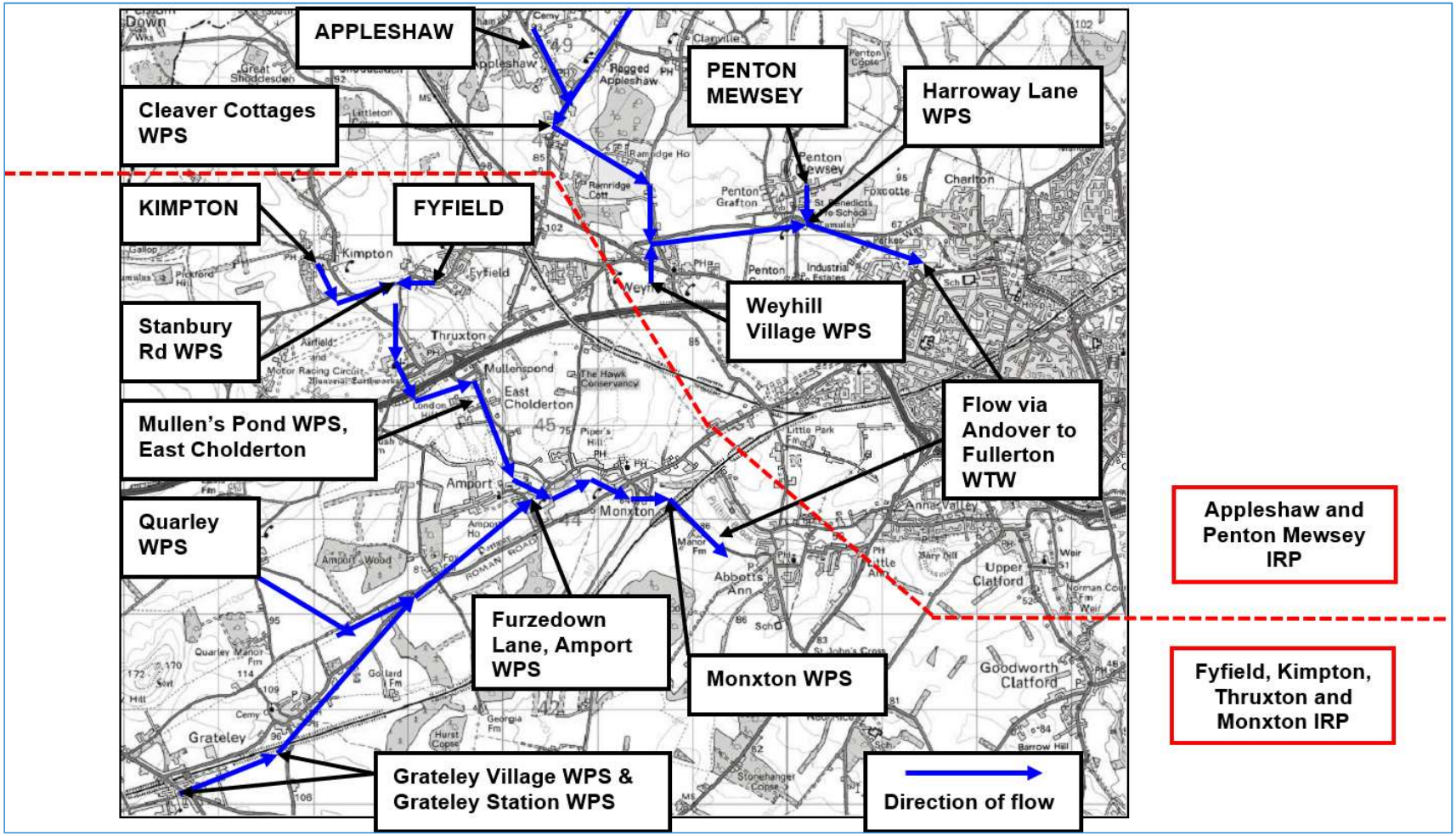



**Figure 1.1 - Representation of the sewerage system serving the villages west of Andover in the Fullerton WWTW catchment**

# 2. Groundwater Infiltration in the Parishes

## 2.1. The significance of groundwater infiltration

The villages forming the Pan Parish area to the west of Andover is one of a number of areas in Southern Water's operating area where, during excessively wet winters, customers have been inconvenienced by the effects of groundwater infiltration into sewers. Such effects can include flooding and restricted toilet use (RTU).

Southern Water strives to maintain services for customers by a programme of investigation, repair, maintenance and mitigation. Mitigation measures include the use of tankers and over-pumping. Such mitigation measures are not sustainable, so during the last three years SW has invested in surveys and improvements to the integrity of the sewers and manholes in the Pan Parish area in order to minimise the occasions on which over-pumping is required.

## 2.2. What would happen if Southern Water did not take action?

Despite the significant groundwater flow through the valley during these conditions, incidents of sewer flooding have been relatively infrequent. Table 2.1 below shows reported incidents of sewer flooding since April 2010.

A hydraulic model of the Fullerton treatment works catchment can help SW to understand the performance of the system and determine options to address risks. Furthermore, SW is aware of the locations which are likely to suffer first from the effects of flooding.

Table 2.1 shows that there have been 17 incidents (14 external flooding and 3 Restricted Toilet Use) since 2010; six occurred in both of the years 2013/2014 and 2019/2020. Indeed, of the rainfall values recorded, 2013/14 and 2019/20 were the wettest, with an average daily winter rainfall of 7.47 mm and 3.83 mm respectively as shown in Figure 2.1. It should also be noted however that February 2020 was the wettest February on record and the winter the 5$^{th}$ wettest winter on record as per the Met Office.

**Table 2.1 – Reported Flooding Incidents by Category, In Fyfield Catchment**

| Year | External Flooding | Restricted Toilet Use | Total |
|---|---|---|---|
| 2010_2011 | 0 | 0 | 0 |
| 2011_2012 | 0 | 0 | 0 |
| 2012_2013 | 5 | 0 | 5 |
| 2013_2014 | 5 | 1 | 6 |
| 2014_2015 | 0 | 0 | 0 |
| 2015_2016 | 0 | 0 | 0 |
| 2016_2017 | 0 | 0 | 0 |
| 2017_2018 | 0 | 0 | 0 |
| 2018_2019 | 0 | 0 | 0 |
| 2019_2020 | 4 | 2 | 6 |
| 2020_2021 | 0 | 0 | 0 |
| **Totals** | 14 | 3 | 17 |

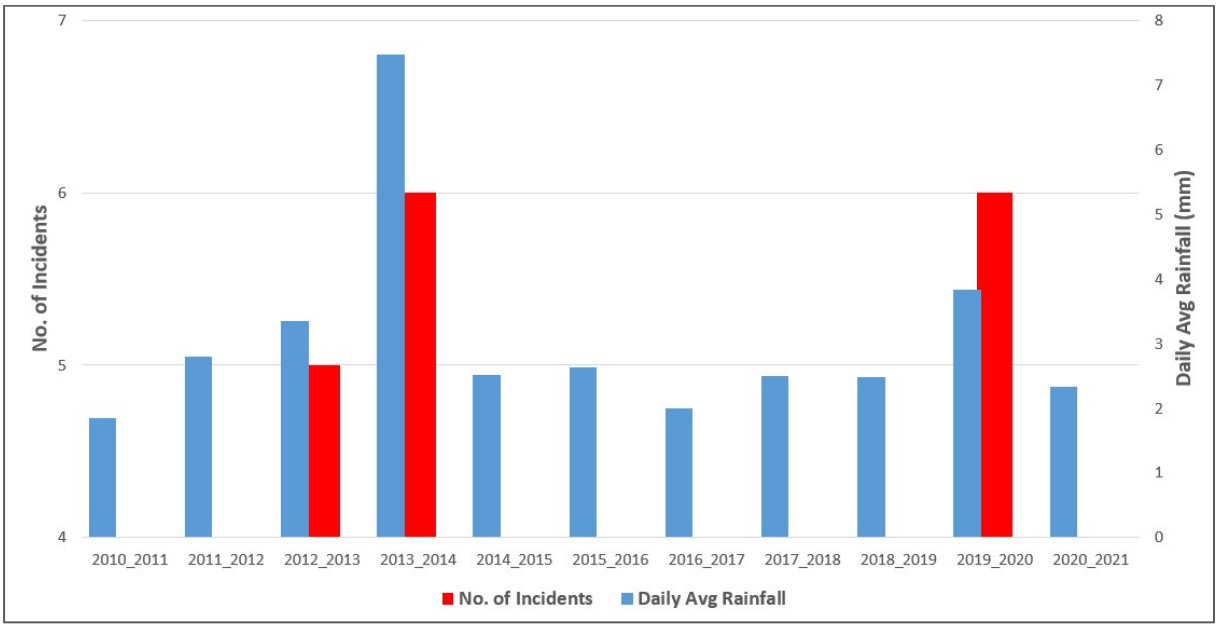



**Figure 2.1 – Comparison of annual flooding incidents and daily average rainfall**

# 3. Investigation & repairs

## 3.1. Outline Plans to Investigate Sources of Infiltration

The Generic Plan describes Southern Water's Infiltration Reduction process. The specifics of the investigations and repairs in the Pan Parish are captured in Section 3.2 below, and include the following elements:

- Manhole Inspections and CCTV Surveys
- Flow Monitoring Surveys
- Manhole and Sewer Repairs
- Follow-Up Surveys and Repairs

## 3.2. Investigation and Repairs

Groundwater infiltration into sewers has been a long-running issue in the Pan Parish villages. Southern Water has been making significant investments over many years to minimise infiltration and reduce the need for over-pumping.

SW recently completed a major programme of survey and repairs to the sewers in the area. The investigations and repairs followed the process set out in the Generic Plan. The timing and status of each step is in Table 3.1 below.

**Table 3.1 – Summary of Survey and Repairs in in Pan Parish Villages**

| Step. | Description | Approx. Date | Status |
|---|---|---|---|
| 1. | Manhole lifting followed by CCTV Investigation | Spring 2013 | Completed |
| 2. | Determination of required repairs | Summer 2013 | Completed |
| 3 | Dry Weather Flow Survey (Fyfield and Kimpton) | 07 August 2013 – 04 September 2013 | Completed |
| 4 | Dry Weather Flow Survey (Mullen's Pond/Thruxton) | 08 August 2013 – 18 September 2013 | Completed |
| 5a. | Repairs at Mullen's Pond/Thruxton (543m of sewer and 7 manholes repaired) | 28 October 2013 – 24 January 2014 | Complete |
| 5.b. | Repairs at Fyfield and Kimpton (892m of sewer and 3 manholes repaired) | 14 August 2014 – 23 October 2014 | Complete |
| 6. | Wet Weather Flow Survey | | Not carried out |
| 7. | Limited follow up CCTV survey | Spring 2014 – Autumn 2014 | Complete |
| 8. | Further Targeted Repairs in Kimpton and Monxton | Winter 2015/16 | Complete |

| Step. | Description | Approx. Date | Status |
|---|---|---|---|
| 9. | Ongoing monitoring | Commenced January 2015 | Ongoing. Positive results: see below and Section 5.3. |
| 10 | Electroscan surveys | November 2020 | Complete |
| 11. | Further surveys and subsequent repairs | Summer 2021 – Spring 2022 | Planned |
| 12. | Cover lifting on private laterals – Mullen's Pond area | Summer 2020 – Spring 2021 | Completed with results showing some locations of lateral drains leaking and further surveys identified |

Repairs carried out at the end of 2013 and in 2014 were successful in reducing infiltration; the initial planned repair programme was completed in October 2014. Completion of this work reduced flows to Monxton pumping station. The extent of the repairs is shown in the plans in Appendix A.

SW acknowledged that some infiltration remained, and therefore further targeted repairs were carried out in 2018 at points along the sewer network. This completed the second phase of sewer rehabilitation. Further work recently undertaken are CCTV surveys at Little Ann Bridge in 2019 and surveys of parts of Kimpton and Fyfield in 2020 using a technique called Electroscan. This innovative technique allows leaking sewers to be detected outside of a high groundwater season and has great potential to better understand the integrity of sewer networks.

In addition to physical investigations on site, SW has instigated a long-term monitoring programme in critical catchments, including the Pan Parish villages'. In the winter periods of 2014/15 to 2018/19 inclusive groundwater levels have not risen to the levels that they did in the winter of 2013/14. However, analysis of the flows and groundwater levels before and after the repairs, showed that in this catchment, for a given groundwater level, flows within the sewer network are lower than before the repairs. Indeed, the repairs appear to provide resilience against an additional 2-3m of groundwater (as measured at Clanville Gate borehole). Refer to Section 5.5 for details.

## 3.3. Private Drainage

It is important to note that infiltration into the sewerage system will occur where the groundwater level is above the invert level of sewers in the holistic drainage system. This is regardless of sewer ownership and may apply equally to the private lateral drainage system as to the public sewer network. However, the consequence of the infiltrating flow is most often manifest in the public network particularly at low points and where there are flow controls such as pumping stations. From a legal point of view it is the responsibility of property owners to ensure that private laterals are maintained in an adequate state of repair to avoid infiltration. As part of this sewer rehabilitation programme where privately owned lateral drains are found to be leaking discussion will be held with the Parish and District Council to agree the process whereby these issues are addressed and

rectified. It may in some circumstances be preferable for Southern Water to undertake these repairs on a non-prejudicial basis.

# 4. Over-pumping

## 4.1. Circumstances that lead to over-pumping

Since 2013, SW has made significant investment to reduce infiltration and to protect specific properties at risk of flooding, with the objective of improving the service to customers at times of high groundwater and reducing the frequency of discharges to watercourses.

If flows continue to increase, as groundwater levels rise, mitigation measures at certain locations will be required. Using previous experience, areas likely to be the first affected, are identified. The requirement for tankering or pumping will be driven by levels in the manholes locally. Based on experience in 2013 and 2014, over-pumping could be expected to be required when the groundwater level at Clanville Gate BH reaches 89m (as illustrated in Figure 4.1.1). However, to allow time for investigation and preparation, SW is using lower 'trigger levels' as part of planning operational response. Trigger levels of 82m in Thruxton, and 82m in Fyfield, Kimpton and Monxton are to be used. Figure 4.1.1 also shows the levels at which over-pumping was required during the 2013-14 period. The major part of the repair programme was completed in autumn 2014.

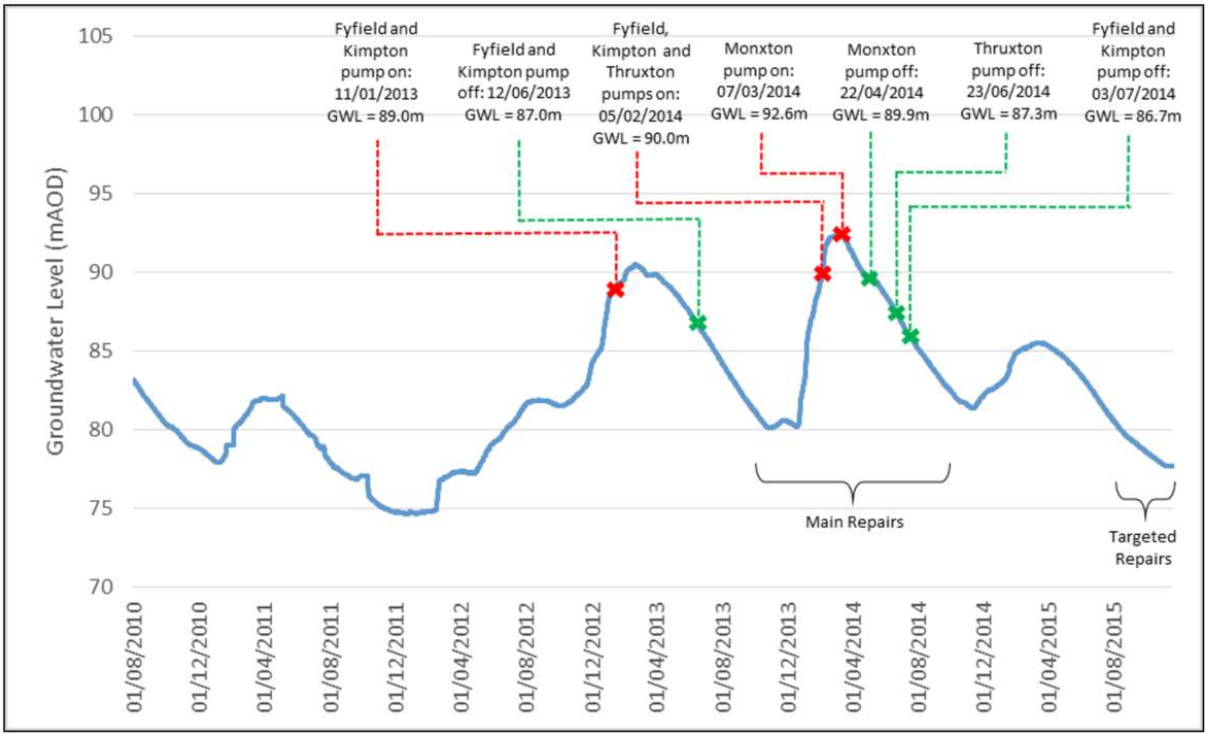



**Figure 4.1.1 – Groundwater levels from 2010 to 2015**

Figure 4.1.2 below shows the groundwater level at Clanville Gate BH since 2009. This illustrates that groundwater levels only reached similar levels to 2013-14 in the winter of 2019/20.

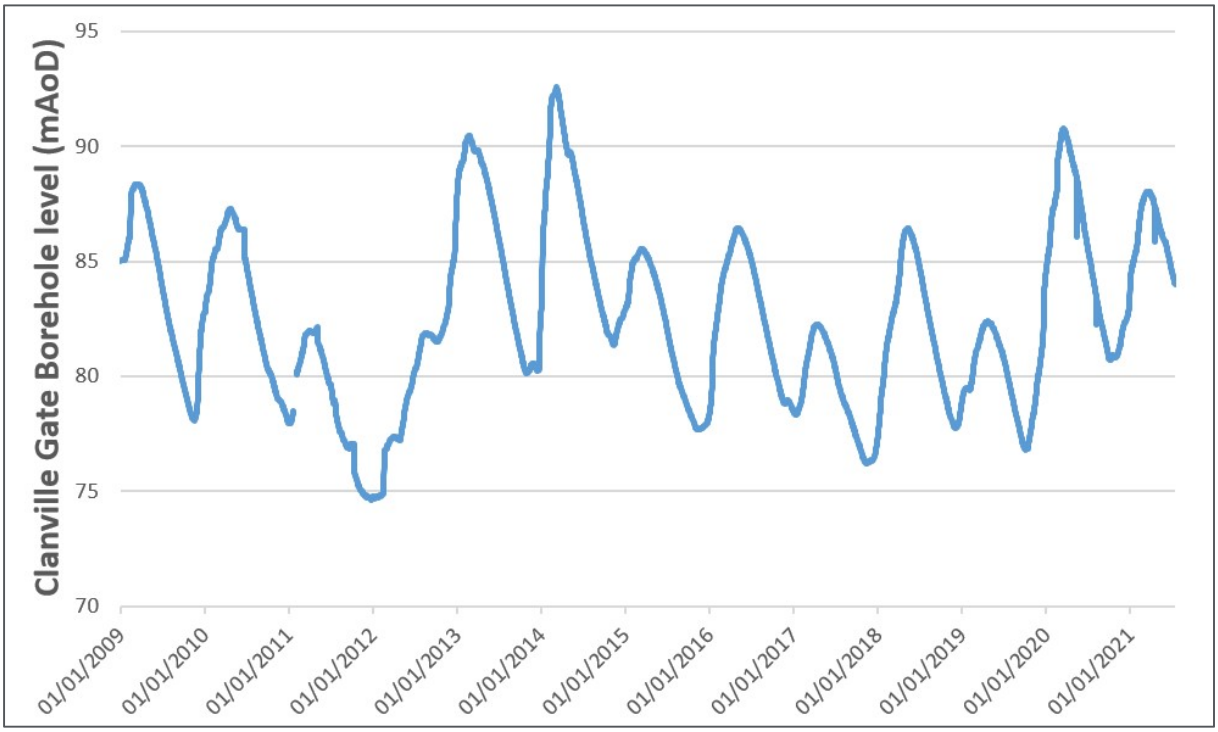



**Figure 4.1.2 Borehole levels at Clanville Gate**

Table 4.1 shows the dates for tankering and number of tankers deployed for the 2020-2021 period over-pumping was not utilised during this time..

**Table 4.1 – Dates and locations for tankering for the 2020-2021 period**

| Location | Approximate Date | Amount of Tankers used |
|---|---|---|
| Kimpton | 15th February 2021 – 2nd April 2021 | 2 |
| Fyfield | 5th January 2021 – 28th April 2021 | 2 |
| Mullen's Pond | 4th December 2020 – 12th April 2021 | 4* |
| Little Ann Bridge | 12th December 2020 – 27th April 2021 | 6 |

* Note: - The ultraviolet (UV) treatment plant was switched on at Mullen's Pond on the 9th April 2021 but the tanker was kept on site for the weekend to ensure SW had confidence in the UV plant which was turned off on the 25th May 2021.

Further details of where tankering and over-pumping has been necessary in the past are given in Appendix B. The repairs carried out, combined with the winter preparation checks, are expected to minimise the number of locations where over-pumping would be required. However, as a consequence of repairs and potentially other factors outside SW's control (such as the severity of the weather), the hydraulics may dictate that over-pumps are required at other locations either in place of, or in addition to, the sites described in Appendix B. If over-pumping is required in the future flows will pass through UV light equipment prior to discharge to ensure disinfection to minimise risk of contamination to the watercourse.

## 4.2. Steps to prevent discharges and alternatives to over-pumping

The Generic Plan details the typical activities that Southern Water undertakes to minimise the requirement for discharges to watercourses. Since 2013, SW has undertaken extensive surveys and repaired sewers and manholes where infiltration had been found (the extent of the work is shown in Appendix A). This built on the repairs that had been carried out in previous years (listed at the end of Appendix A).

Following the main repairs, further targeted repairs were completed. In addition to this work, SW also carries out other activities to minimise the requirement for discharges to watercourses.

## 4.3. Over-pumping arrangements (flow rates and minimisation of effect on watercourse)

A typical arrangement of an over-pumping setup is provided in the Generic Plan.

The locations where tankering and over-pumping has been used in recent years are shown in Appendix B. These locations were effective in restoring service to customers and are the default locations should the situation re-present itself. Dates of historic tankering and over-pumping are also provided in Appendix B.

In addition to the measures described above to remove solid matter, SW invested in ten portable biological treatment units in January 2014 for use at flooded areas throughout its area. Several units were trialled in Fyfield. They were trialled to enhance the quality of the water discharged to the watercourse. However the units were deemed as ineffective and unreliable. It should be noted that there were no biological treatment units at the following sites:

- Mullen's Pond WPS
- Stanbury Road WPS
- Fyfield WPS
- Kimpton Green

The main benefit of the biological treatment units was that the biochemical oxygen demand (BOD) on the receiving water was reduced.
To minimise the impact of flows discharged to local watercourse all future discharges will pass through ultra violet light to allow disinfection in addition to screening and settlement prior to discharge.

## 4.4. Steps to minimise the volume and duration of over-pumping

The Generic Plan outlines a detailed rationale behind the use of tankers and over-pumping, and summarises the benefits and disadvantages. Some specific issues in relation to the Pan Parish catchment are captured below.

### 4.4.1. Tankering

Benefits:

- See Generic Plan.

Disadvantages

- The flow rate is low (approx. 2l/s per tanker over a 24 hour period).

*Tankers operating in the Pan Parishes catchment discharge at Fullerton WTW, Andover - round trips of an average of approximately 2 hours including loading and discharging.

### 4.4.2. Over-pumping

Benefits:

- Typical pump fuel consumption is 85% of the fuel that one tanker would use in a day.
- The discharge rate is significantly greater. A 100mm pump will discharge typically 30 l/s; the equivalent of a fleet of 15 tankers.
- See also the Generic Plan.

Disadvantages

- See Generic Plan.

The graph in Figure 4.2 shows the estimated carbon emission per $m^3$ of dilute effluent removed by tanker and by pump. In this example, data has been used for the 3,000 gallon tankers and 6 inch pump at Fyfield in 2014.

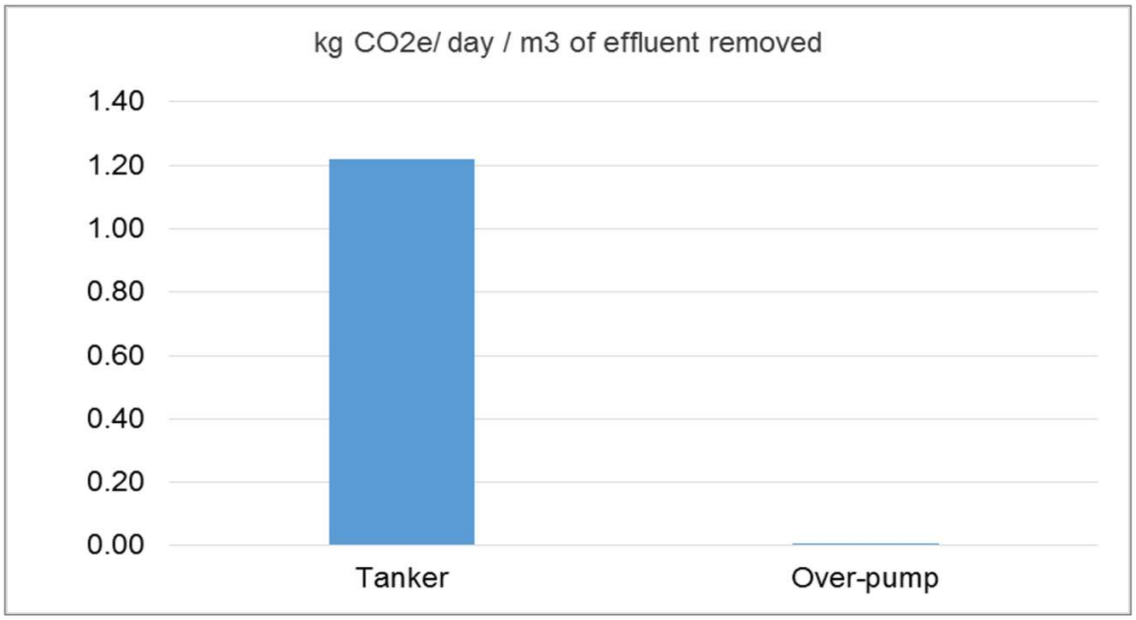



**Figure 4.2 – Carbon Footprint figures for Tankers and Over-pumps per $m^3$ of effluent removed.**

## 4.5. 3rd Party Communications about over-pumping

Since the start of the Infiltration Reduction Programme in 2013, Southern Water has been proactive in communicating with stakeholders and customers 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 or face-to-face meetings.

SW attends and convenes meetings with a number of local groups. In particular the Pan –Parish Multi-Agency Group which has recently been active in co-ordinating the issues in the catchment. During the winters of 2014/15 and 2015/16, SW and the EA held weekly conference calls to discuss locations where total flows in

the sewers were reaching the point where SW would need to respond imminently with tankering or over-pumping..

Despite the repair work being undertaken it may be that higher groundwater levels than have been recorded may trigger the need for further over-pumping. In the event of this being required, the location of advisory signs near the over-pumps is provided in Appendix B. The Generic Plan provides general arrangements around over-pumping.

From time to time, SW updates stakeholders about completed and planned work. The most recent meeting was held in August 2021 with the chair of the Pan Parish multi agency Group.

## 4.6. Monitoring quality of the downstream watercourse

Refer to the Generic Plan for details of water quality monitoring that will be undertaken, should over-pumping be required.

# 5. Options to Reduce Infiltration

## 5.1. Sewer Rehabilitation Programme

SW acknowledges that infiltration reduction is on-going and iterative process. In recent years, SW has surveyed 9.1km of sewers and sealed 1.9km which were found to be allowing groundwater into the system. In addition 18 manholes where groundwater was leaking in through brickwork or concrete rings have been sealed. See Appendix A for the location of repairs completed.

In 2021 surveys by a technique called electro-scanning will be undertaken. A further 7.1km of sewer will be surveyed using this technique and any defects identified will be repaired prior to the next groundwater season, weather permitting. The sewers where electroscanning will be undertaken are shown in figure 5.1 below. These sewers have been selected due to their proximity to the watercourse and elevation relative to groundwater table and are the most likely to be susceptible to infiltration. On completion of these surveys and review of results it might be necessary to expand the surveys further into the villages and potentially including parts of the private drainage system.
There are some 1.9km of sewer identified for repair work following survey work undertaken in 2020 of which 350m is high priority to complete by end October 2021. See Appendix C for the location of repairs planned.

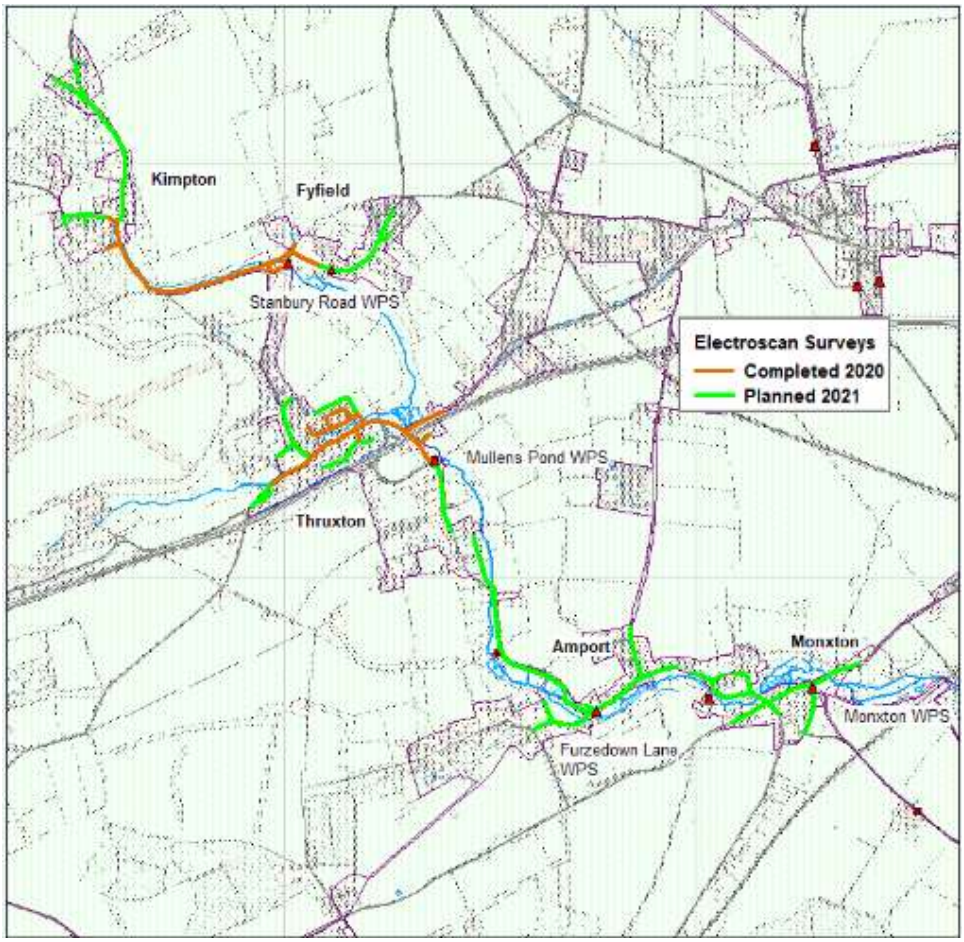


Figure 5.1 locations of planned electroscanning

## 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. In December 2013, a micro-pumping station incorporating a non-return valve was installed to protect a group of properties near Stanbury Road WPS. This has provided successful property level protection for the local residents.

Whilst there are no plans currently to install further non-return valves, the potential benefit of property level protection will be investigated, if it is deemed appropriate following completion of the current repairs.

## 5.3. Local Flow Control

As noted in Section 4.1, pumping was required in Fyfield and Kimpton from 11/01/2013 to 12/06/2013. Pumping was then required at Fyfield, Kimpton and Thruxton from 05/02/2014, and at Monxton on the 07/03/2014. Pumping stopped at Monxton on the 22/04/2014; at Thruxton on the 23/06/2014; and at Fyfield and Kimpton on the 03/07/2014.

For the 2020-2021 period, tankering was required from December 2020 to April 2021 in Mullen's Pond and Little Ann Bridge; from January 2021 to April 2021 in Fyfield and February 2021 to April 2021 in Kimpton.

## 5.4. Pumping Stations

In order to minimise the effects of infiltration, SW is continuing to ensure that design discharge rates are maintained at pumping stations. At Monxton WPS, the pumps were replaced in spring 2014 with a greater output flow and later in the year a bund was constructed around the pumping station to contain spillage from the station in the event of spills occurring.

A number of additional modifications have been carried out to the pumping station in order to reduce problems of vibration which have been felt nearby. A number of specialist contractors have assessed the site along with further technical consultation with pump manufacturers. Trials of installing baffles, changes to the pump impellors, and installing variable speed drives, and other acoustic measures are on-going in an effort to reduce this effect to an acceptable level.

The rising main from Monxton WPS was replaced in 2001 with a 280mm outer diameter (OD) SDR17 polyethylene (PE) pipe. It is 814m long, then drops into a gravity 355 mm OD PE sewer which was laid at the same time as a 'pressure sewer' from Manor Farm onward. The capacity for the rising main is 82 l/s with a design velocity of 1.8m/s and the capacity for the gravity 355 OD sewer is just over 200 l/s max. However, there is a valve to control the flow rate in the gravity section at Little Ann. This is essentially a service valve to ensure access can be gained to the vacuum main but it can also be used to regulate flows transitioning between the vacuum main and the gravity system below by partially opening the second valve to allow more flow through. The normal position of the valve is partially closed as allowing too much flow through significantly increases the risk of flooding downstream.

## 5.5. Monitoring

The Pan Parish area is one of ten locations, where groundwater levels have been monitored via electronic data since January 2015. This monitoring helps inform SW's response, in terms of when tankering and over-pumping are required. The Generic Plan has more detail on the overall monitoring strategy.

The graph below, in Figure 5.5.1, 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.

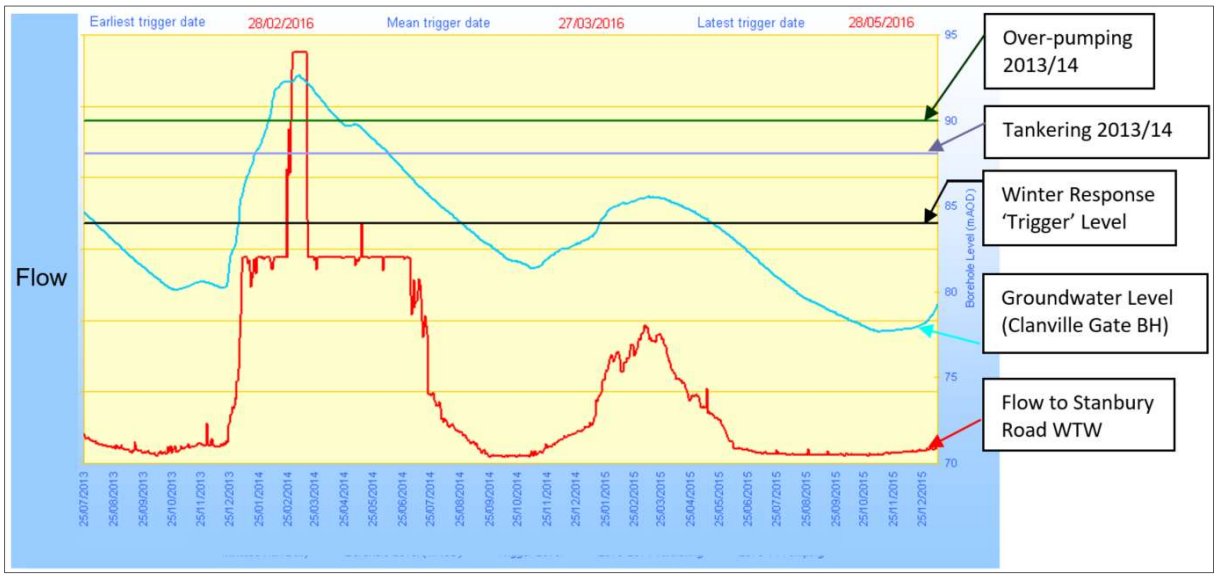
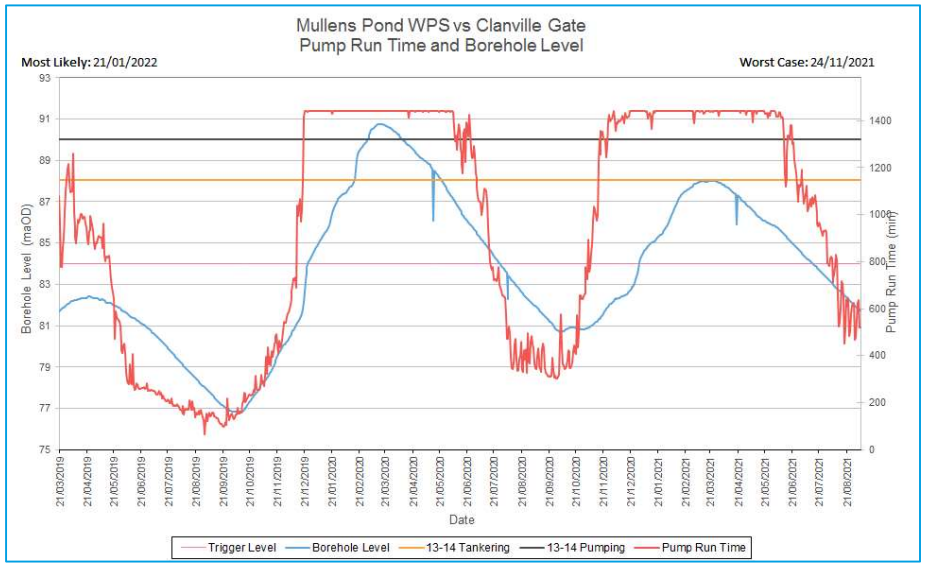



**Figure 5.5.1 – Forecasting of Trigger Dates**

The current groundwater position and forecast are given in the figure 5.5.2 below. It can be seen that the groundwater level is currently at a similar level to that recorded 12 months previously. The profile of reduction in levels is also similar to last year. Whether an operational response is required this winter period is dependent on autumn and winter rainfall and the effectiveness of the planned sewer sealing programme.




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. Figure 5.5.3 shows the groundwater levels at Clanville Gate borehole plotted against flows at Mullen's Pond WPS.

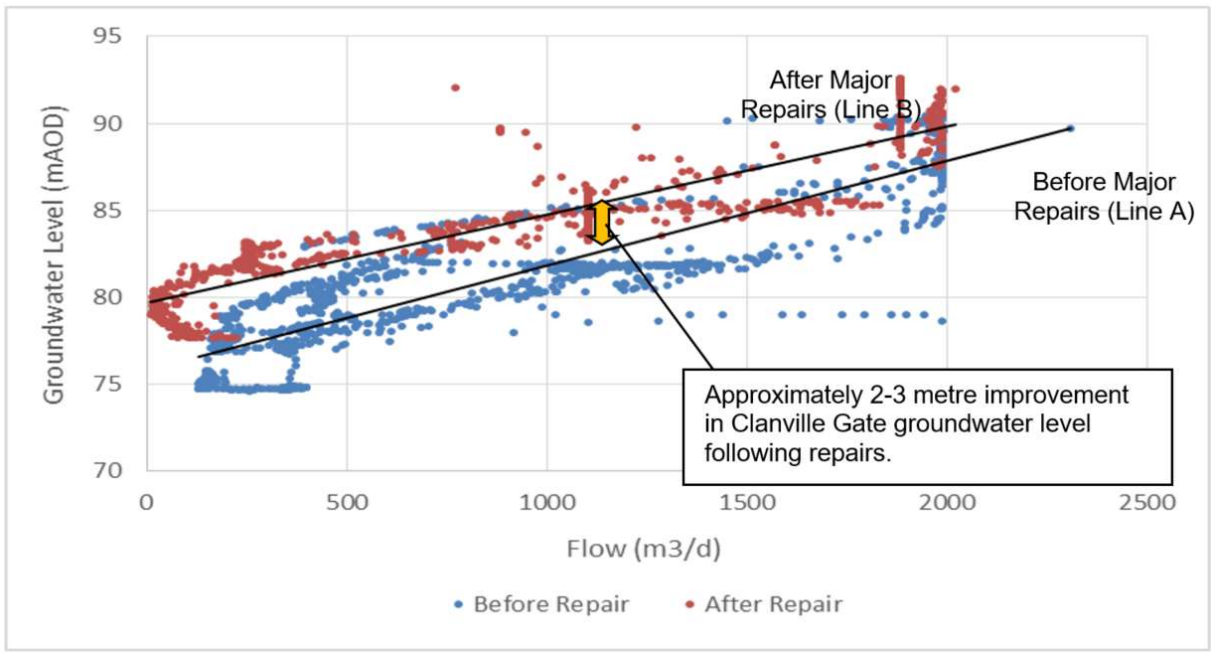



**Figure 5.5.3 – Long Term Monitoring (Aug 2010 to Nov 2015)**

Figure 5.5.3 quantitatively illustrates how flow varies with groundwater levels, based on data between August 2010 and November 2015. There is a reasonable correlation that as groundwater levels increase, the rate of infiltration increases. Therefore Figure 5.5.3 can be used to assess how effective the repairs have been. In Figure 5.5.3 two distinct periods are outlined: Aug 2010 – Oct 2013 (before the major repairs at Mullen's Pond), and Feb 2014 – Nov 2015 (after the major repairs).

Lines A and B in Figure 5.5.3 show how values of flow for a given groundwater level vary before and after the repairs. The difference in groundwater level between Lines A and B is approximately 2-3m. In other words, for a given groundwater level, the corresponding flow is lower after the repairs. This further suggests that the repair work has been effective. A similar graph to that of Figure 5.5.3 was produced for Stanbury Road WPS. It shows a similar trend; the difference in groundwater level between Lines A and B is approximately 1.5-2.0m.

Over the last few years, average groundwater levels have risen slightly in several locations in SW's area. For Clanville Gate the average groundwater level before repairs took place (Aug 2010 – Oct 2013) was 81.1mAOD, and after repairs (Feb 2014 – Nov 2015) is 84.4mAOD. Despite this general increase in groundwater level, the range of flows from Mullen's Pond WPS have remained approximately the same. Analysis of groundwater levels in Figure 4.1.2 between 2015 and 2021 suggests that the 2014-2015 period was a period of high groundwater levels, and groundwater returned to a lower level in the 2016-2018 period.

This analysis will be repeated in 2022 to determine the effectiveness of the repairs which are to be completed during 2021.

# 6. Action Plans

A significant amount has been achieved in the Pan Parish area in the last eight years. Some actions are ongoing which reflects the continuous improvement process for dealing with infiltration due to groundwater. To make it easy to track progress, the following tables set out the actions to reduce infiltration and also to mitigate the effects of it, if the infiltration cannot be controlled at economic cost. Tables 6.1 and 6.2 cover the actions by SW and by other parties, respectively, to reduce infiltration. Tables 6.3 and 6.4 cover mitigation of the effects of flooding (Communication and other activities).

Southern Water is committed to continuing to pursue infiltration to reduce the frequency of over-pumping. 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.

Colour coding of actions in tables:

- Green – completed
- Orange – imminent action required
- Red – overdue
- White – on-going actions with no specific end dates.

**Table 6.1 – Southern Water Current Activities to Reduce Groundwater Infiltration**

| Ref. | Item | Actions | Timescale and Status | Outcomes |
|---|---|---|---|---|
| 1.1 | Develop an approach for reduction of infiltration and maintenance of reduced levels of infiltration. | Refer to Section 3 above and the report in Appendix A. | Summer 2013, Complete | The steps are being followed to deliver results. |
| 1.2 | 'Dry weather' flow surveys (to measure background levels of infiltration during low groundwater periods) | Identify suitable measurement points, carry out survey over four week period in Summer, match rainfall records with flow data. | August/September 2013 - Complete | Groundwater infiltration is greater than would be expected for summer conditions. |
| 1.3 | CCTV etc. survey of sewers | Identify Strategic Manholes, survey manholes to identify clear flow and infiltration. Carry out CCTV survey where clear flow was identified. | Spring 2013 - Complete | Identify major sources of infiltration to determine scope of rehabilitation work. |
| 1.4 | Carry out sewer rehabilitation work | Use various techniques to seal infiltration points in manholes and sewers | Mullen's Pond/Thruxton October 2013 – January 2014 – Completed<br><br>Fyfield and Kimpton | Structural integrity of sewers restored. |

| Ref. | Item | Actions | Timescale and Status | Outcomes |
|---|---|---|---|---|
| | | | 14 August 2014 – 23 October 2014 Completed | |
| 1.5 | Further surveys (CCTV or alternative techniques), if required, where 'wet weather' flow surveys show areas of high infiltration remaining | Further surveys in areas where high infiltration flows remain. | Spring 2014 – Autumn 2014 | Determine scope and carry out further rehabilitation if identified as required from the survey results. |
| 1.6 | Further sewer rehabilitation work, if required, in areas where surveys carried out. | As above, use various techniques to seal infiltration points in manholes and sewers | Kimpton and Monxton<br><br>Winter 2015/16 – Completed | Reduced infiltration, leading to reduced requirement for tankers. |
| 1.7a | Maintain IRP as a live document | Review text of the IRP and update if appropriate to describe work carried out and/or developments | Annually | To be issued by 30 September each year |
| 1.7b | Maintain IRP as a live document | Review Tables 6.1 to 6.5 and as appropriate amend to show progress on individual activities. | Quarterly | Up to date tables of Actions. To be issued every 3 months following the annual update. End each December, March, June, September |
| 1.8 | Consider alternative solutions that involve some risk | Investigate unconventional options such as vacuum sewers or consider conventional combined sewer overflows | 2020 | Ongoing. |

| Ref. | Item | Actions | Timescale and Status | Outcomes |
|---|---|---|---|---|
| 1.9 | Over-pumping Sites: improve effluent quality | Investigate potential for improved screening and basic treatment at points of discharge into watercourse. | SW, Summer/Autumn 2014 | Improved arrangements for discharges when required. |
| 1.10 | Over-pumping Sites: minimise flow | Add level control to pumps to reduce durations for pumping | SW, 2014, Complete | Establish whether seasonal discharge (s) will be necessary in order to maintain use of sewerage services for customers during periods of very high groundwater levels. |
| 1.11 | Standards for emergency discharges | SW to discuss with EA about best practice set up for over-pumping arrangements. | SW, 2014, included in this IRP | Agree with EA acceptable treatment for discharges and acceptable flow rates. |
| 1.12 | Flow, location, screening arrangements for emergency discharges | Determine potential flow rates and screening arrangements and most appropriate locations, | SW, included in this IRP | Agree with EA, Hampshire CC, Test Valley Borough Council and local Parish Councils acceptable arrangements for future emergency discharges. |
| 1.13 | Action Plans | Develop SW action plans documenting set up of pumps, tankers, etc. for emergency situations. | SW, Summer 2014- Complete | Action Plan available for planning sessions with other authorities in preparation for repeat flooding events. Engagement with the local community about the potential arrangements for dealing with excess flows into sewers to mitigate disruption to customers. |
| 1.14 | Identification of lengths of sewer to survey or resurvey in the period 2021-25 | Review sewer records with available ground water profile data | Summer 2021 | Complete surveys to take place from September 2021 |

| Ref. | Item | Actions | Timescale and Status | Outcomes |
|---|---|---|---|---|
| 1.15 | Surveys by CCTV or electroscan lengths of sewer potentially at risk | Compare historical survey coverage with results of 1.15 and produce a survey schedule. | Summer/Autumn 2021 | To commence 20 September 2021 |
| 1.16 | Survey result review | Review results of surveys undertaken in 1.16 to determine sewer sealing work. | Autumn/winter 2021 | Planned to follow 1.16 |
| 1.17 | Undertake required sewer sealing | Seal sewers and manholes by most appropriate technique.<br>Phase 1 - committed repairs – 350m by end Oct 21<br>Phase 2 – to be completed end Dec 21<br>Phase 3 – to follow on from surveys | From Autumn 2021 as conditions allow | Phase 1 to commence end September 21<br><br>Phase 2 to progress on completion of phase 1 |
| 1.18 | Review effectiveness of any sealing work | Analyse monitoring data and groundwater data to determine benefit of investment | From winter 2021 | Planned |
| 1.19 | Review further options for property protection and alternative tanker points | Consider improvements at Water Farm | From Summer 2021 | Planned |
| 1.20 | Holistic drainage review as a Pathfinder project approach | Consider the whole drainage system and interactions to identify opportunities to improve drainage and resilience | From summer 2021 | Planned |

**Table 6.2 – Multi-Agency Activities to Reduce Groundwater Infiltration**

| Ref. | Item | Actions | Owner, Timescale and Status | Outcomes |
|---|---|---|---|---|
| 2.1 | Long-term Monitoring | SW will monitor sewer flow to identify significant increases in inflows. | Ongoing | Early identification of areas where infiltration has increased |
| 2.2a | Investigate highway 'mis-connections' | Where non-sewage flow is identified, check highway drainage relative to sewers to ensure road drainage is not a source of flow into the SW sewers | Hampshire County Council with support from SW, 2014 onwards. To be pursued as and when required. | Reduced flow of surface water (if connections are found). |
| 2.2b | Investigate groundwater infiltration on domestic drains | Where non-sewage flow is identified from domestic properties, investigate to identify source of flow into SW sewers | SW, with assistance from Test Valley County Council where required, 2014 onwards. To be pursued as and when required. | Reduced flow of surface water (if connections are found). |
| 2.3 | Consider effects of proposed new developments on infiltration. | District Council to continue to consult with SW on development applications. | District Council, Ongoing. | Developments in areas which would be detrimental to sewer flooding, to have conditions recommended by SW and applied, as appropriate, by the City and District Councils. |
| | | SW to determine threshold above which they require to be consulted. | District Council, Ongoing. SW wish to be consulted on all proposed development. | |
| | | Sewerage materials for new developments | SW & District Council, when developments are at planning approval stage. Ongoing. | |

*Note: Southern Water does not have powers to require residents to repair private drains. Hence the support of the other agencies is required. It is acknowledged that customers may not be aware of infiltration in their private drains, so SW will consider ways of obtaining information to demonstrate the presence of infiltration. District Councils would only be able to instigate action under Section 59 of the Building Act where proof/evidence is provided of the defect.

**Table 6.3 – Publicity / Communication Activities to Reduce / Mitigate the Effects of Groundwater Infiltration.**

| Ref. | Item | Actions | Owner, Timescale and Status | Outcomes |
|---|---|---|---|---|
| 3.1 | Public meetings about reducing groundwater infiltration into sewerage system | Attend public meetings with other agencies as appropriate. | SW, as required | Inform stakeholders of progress and planned activities and receive feedback. |
| 3.2 | Comms from SW to stakeholders about reducing groundwater infiltration into the sewerage system | Send comms at regular intervals to communicate progress and planned activities | SW, as required | Inform stakeholders of progress and planned activities |
| 3.3 | Multi-Agency Group meetings | Discuss and agree actions to reduce requirements for tankering and emergency discharges to watercourses. | All Parties now as part of the Pan Parish multi Agency meeting | Improved understanding and appreciation of issues. Agreement to actions to help reduce the need for tankering and emergency discharges to watercourses |
| 3.4 | Implement local campaign to discourage misconnections | Publicise through parish councils. Include article in Parish magazines. ** | District and Parish Councils, Summer 2014 Complete | Article included in Hampshire County Council magazine. |

** SW can provide base information to councils to include in articles publicising the role that everyone can play in minimising non-sewage flows into sewers, and the importance of doing so to reduce the incidence of restricted toilet use during periods of high groundwater.

**Table 6.4 – Activities to Mitigate the Effects of Groundwater Infiltration/ Other Flood Protection Mechanisms**

| Ref. | Item | Actions | Owner, Timescale and Status | Outcomes |
|---|---|---|---|---|
| 4.1 | Early Warning system | Joint continuous monitoring of groundwater levels and sewer levels/flows. | SW, EA, 2014. Ongoing. Commenced Jan 2015. Re-commenced annually | Develop trigger levels by comparing historic customer complaints and tankering with BH levels (or other reference). |
| 4.2 | Tankering arrangements | Investigate options for improving location of tankers and over-pump units for future events. e.g. by use of longer hoses/ pumping | SW, Spring 2014, Complete | Potentially less disruption to residents when tankering / pumping is essential. |
| 4.4 | Flooding Management Plan | Develop plan to address the flooding issues caused by high groundwater. Implement recommendations. | Hampshire County Council & Test Valley Borough Council with inputs from SW, EA, and Parish Councils | Plan including actions for participating authorities, which in unison will reduce the extent of flooding and the impact of flooding. |
| 4.5 | Maintenance of watercourses | Riparian owners to carry out their responsibilities to maintain adequate flow through watercourses by clearing vegetation, desilting, etc. | Riparian owners with input from District and Parish Councils – ongoing responsibility | Maximise the flow along watercourses in order to minimise surface flooding, which results in inundation of manholes to the sewerage system. |

# Appendix

A Survey Findings and Rehabilitation Completed

B Emergency Discharge Sites

C Sewer rehabilitation planned 2021