

Infiltration Reduction Plan

Chilbolton

September 2021
Version 2.2



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Document Control

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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
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

This Infiltration Reduction Plan (IRP) for Chilbolton in the Chilbolton catchment has been prepared in response to the Environment Agency's (EA) Regulatory Position Statement (RPS). SW has been carrying out work for many years to survey and repair sources of infiltration in the catchment for Chilbolton Wastewater Treatment Works (WTW) in Hampshire.

Figure 1.1 shows the extent of the catchment between Wherwell and Chilbolton WTW. Flow gravitates to Wherwell Wastewater Pumping Station (WPS) and is then pumped to Chilbolton, where it joins gravity flows and enters Chilbolton Village WPS. Chilbolton Village WPS then pumps the resultant flow to Chilbolton Wastewater Treatment Works (WTW) in the south. Branksome Close Chilbolton WPS takes gravity flows from the west of the village and passes them forward to the WTW.

The repairs carried out by SW improve the integrity of the sewerage system. SW 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
- Chilbolton Parish Council
- Natural England and the Campaign to Protect Rural England

Southern Water has consulted with representatives of these parties as part of meetings with the local councils.

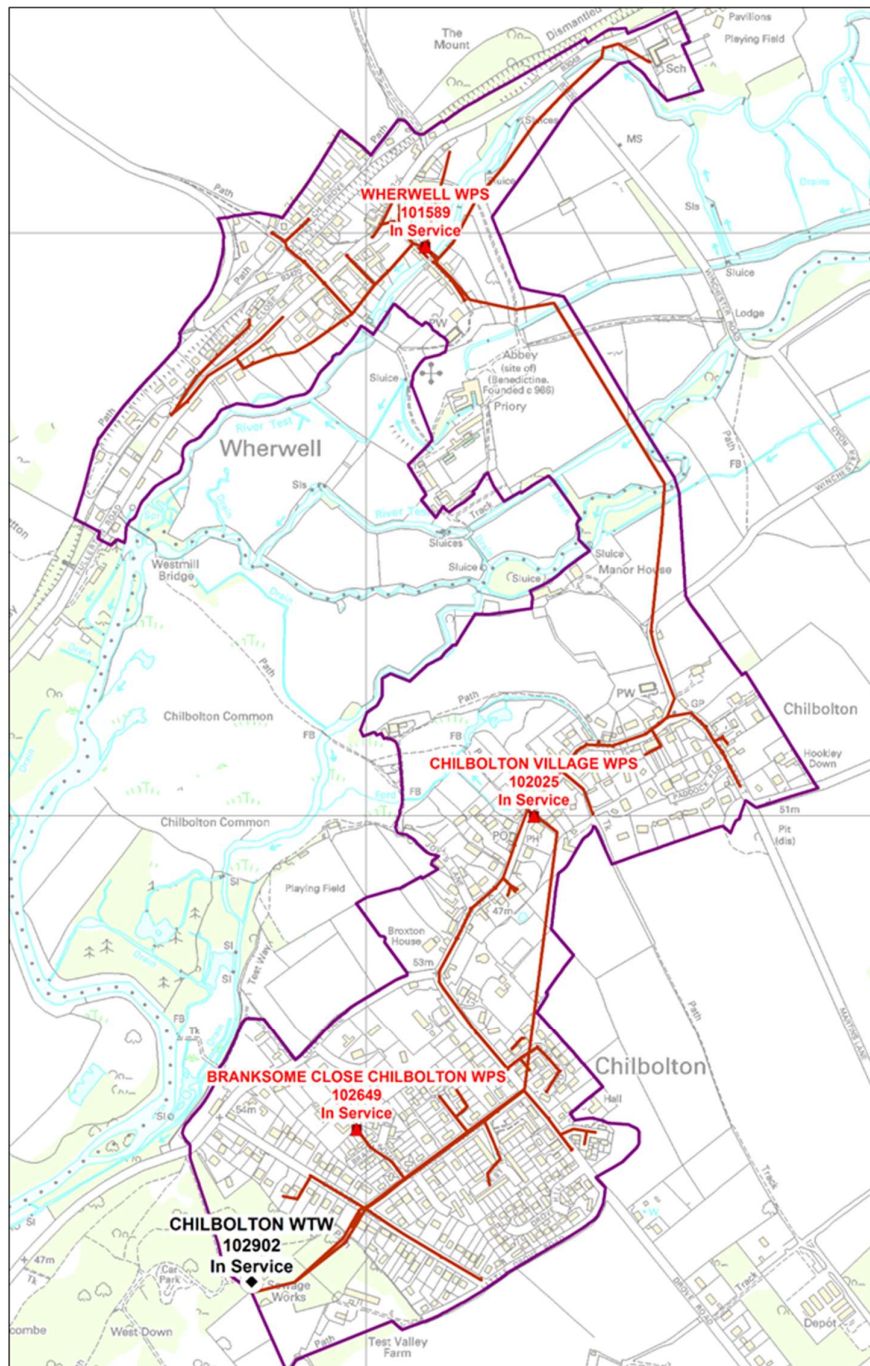


Figure 1.1 - Representation of the Chilbolton and Wherwell sewerage system in the Chilbolton WTW catchment

2. Groundwater Infiltration in Chilbolton

2.1. The significance of groundwater infiltration.

Chilbolton is one area within 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).

SW 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 seven years SW has invested in carrying out major improvements to the integrity of the sewers and manholes in the vicinity of Chilbolton 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 and Figure 2.1 below show reported incidents of sewer flooding since April 2010.

Whilst there is no hydraulic model for the Chilbolton catchment; from experience, 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 three reported instances of external flooding since 2010; one occurred in 2013/2014 and the other in winter 2019/20. 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 5th wettest winter on record as per the [Met Office](#).

Table 2.1 - Reported Flooding Incidents in Chilbolton

Year	External Flooding	External Flooding	Total
2010_2011	0	0	0
2011_2012	0	0	0
2012_2013	0	0	0
2013_2014	1	0	1
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	2	1	3
2020_2021	0	0	0
Totals	3	1	4

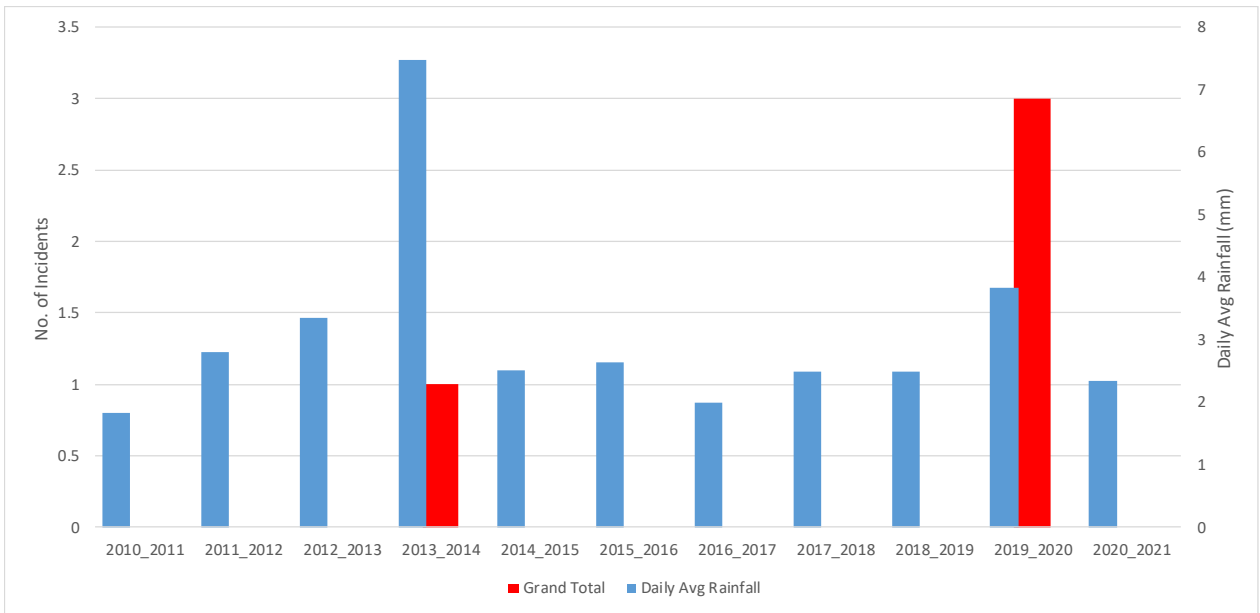


Figure 2.1 - Historic Flooding Records

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 at Chilbolton are captured in Section 3.2 below, and includes the following elements:

- Manhole Inspections and CCTV Surveys
- Ongoing monitoring
- Manhole and Sewer Repairs
- Follow-Up Surveys and Repairs

3.2. Investigation and Repairs in the Chilbolton

Groundwater infiltration into sewers has been a long-running issue in Chilbolton, which also suffers from surface water problems. SW has been making significant investments over many years to minimise infiltration and the need for over-pumping.

SW recently completed a major programme of survey and repairs to the sewers in the Chilbolton catchment. 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 at Chilbolton

Step.	Description	Approx. Date	Status
1.	Manhole lifting followed by CCTV Investigation	June 2014	Completed
2.	Repairs – [refer to plans in Appendix A]	2014	Completed
3.	Anti-FOG campaign	2014	Completed
4.	Scheduled maintenance visits to key pumping stations prior to winter weather		
5.	Further CCTV survey	Spring 2015	
6.	Tankering	March 2014 (Single Day)	Completed
7.	Overpumping	February 2014 – April 2014	Completed
8.	Repairs	March 2016	Completed
9.	Ongoing monitoring	Commences each year	Ongoing

Step.	Description	Approx. Date	Status
10.	Further surveys and subsequent repairs	Post 2022	Planned

In June 2014, a CCTV survey of 150m of sewer between the Village Club and Church Farm House led to the replacement of a faulty patch liner which was causing a blockage.

Heavy jetting in various parts of the village in 2014 discovered fat build up, leading to sewer blockages. Shortly after this discovery, Southern Water launched an anti-FOG campaign in Chilbolton – the first of its type in Hampshire. With the help of the Parish Council and the Village Shop, fat funnels were made available to every household in the village. These blue plastic funnels screw into used plastic bottles so that fat, oil and grease (FOG) - from a fried breakfast or roast dinner – can be easily stored for recycling or disposed of with household waste.

SW also investigated the performance of the wastewater pumping station and, early in 2014, raised the status of the alarm, in order to provide faster response times.

A further CCTV survey in the spring of 2015 led to a 33m section of sewer being repaired - refer to the plan in Appendix A.

In addition to physical investigations on site, SW has instigated a long-term monitoring programme in critical catchments, including the Chilbolton catchment.

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 reducing the frequency of discharges to watercourses.

Using previous experience, areas likely to be the first affected, are identified. The requirement for tankering or over-pumping will be driven by levels in the manholes locally. Based on experience in 2014, over-pumping could be expected to be required when the groundwater level at Clanville Gate borehole reaches 91.9m. However, to allow time for investigation and preparation, SW is using lower ‘trigger levels’ in the winter planning report. A trigger level of 88.0m is currently being used.

Figure 4.1 shows the groundwater level at Clanville Gate borehole since 2013. Tankering was required for a single day on 31/03/2014; pumping was required from 13/02/2014 to 11/04/2014 with repairs being completed in March 2016. Since 2014 no over-pumping has been required, however, the plan is retained and the system monitored in case of a future need due to high groundwater reaching levels similar to those in 2014. Due to the rainfall in 2020 there was a requirement for tankering in March 2020 but no interventions were required in the winter 2020/21.

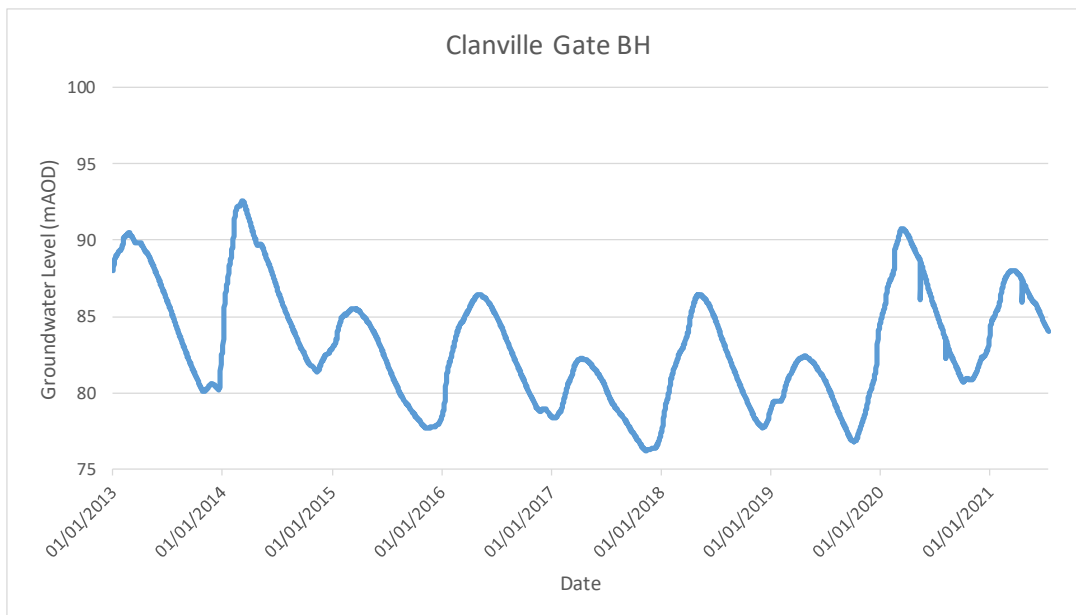


Figure 4.1 - Groundwater levels from 2013 to 2021

The 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.

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 (shown in Appendix A).

Following the main repairs, further targeted repairs were completed, with a further package of survey work and repairs planned for 2021-22. 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.

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 Chilbolton catchment are captured below.

4.4.1. Tankering

Benefits:

- See Generic Plan.

Disadvantages

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

*Tankers operating in the Chilbolton catchment discharge to Fullerton WTW - a round trip of approximately 1 hour including loading and discharging.

4.4.2. Over-pumping

Benefits:

- See Generic Plan
- Typical pump fuel consumption is 27% 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.

Disadvantages

- See Generic Plan

The graph in Figure 4.2 shows the estimated carbon emission per m³ of dilute effluent removed by tanker and by pump. In this example, data has been used for a 4,000 gallon tanker and 100mm pump at Chilbolton in 2014.

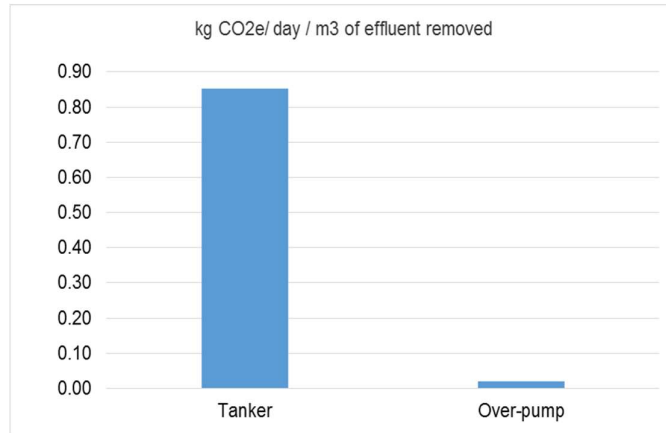


Figure 4.2 – Carbon Footprint figures for Tankers and Over-pumps per m³ of effluent removed.

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, as part of meetings with local councils. 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 work being undertaken, if over-pumping is required, the location of advisory signs near the over-pumps is also provided in Appendix B. The Generic Plan provides more detailed arrangements around over-pumping.

From time to time, SW updates stakeholders about completed and planned work, as part of stakeholder meetings with the local councils.

4.6. Monitoring quality of the downstream watercourse

The Generic Plan provides 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 an on-going process. Since 2013, SW has undertaken surveys and repairs at Chilbolton. The major repair work was completed in March 2016. A further CCTV survey in the spring of 2015 led to a 33m section of sewer being repaired.

However, on a company-wide basis, to ensure that benefit continues to be gained from the work that has been done, SW continued the programme of infiltration reduction investment across its region for AMP6 (2015 – 2020). Further surveys and investigation will be undertaken dependent on the performance in future high groundwater seasons.

In addition to physical investigations on site, SW has instigated a long-term monitoring programme in critical catchments, including the Chilbolton catchment.

5.2. Property Level Protection

Non-return valves have always been part of SW'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.

5.3. Local Flow Control

As noted in Section 4.1, tankering was required for a single day on 31/03/2014; pumping was required from 13/04/2014 to 11/04/2014. Tankering was also required between 11th and 20th March 2020.

5.4. Pumping Stations

In order to minimise the effects of infiltration, SW is continuing to ensure that design discharges are maintained at pumping stations. As part of SW's monitoring programme, regular checks are carried out on Chilbolton WPS to ensure that pumps are operating at design flows. A second pump was installed on the 23rd of December 2016 at Chilbolton Village WPS. This will help to ensure that the design discharge continues to be reliably delivered.

5.5. Monitoring

The Chilbolton catchment is one of ten locations, where groundwater levels have been monitored via electronic data. 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 5.1, 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.

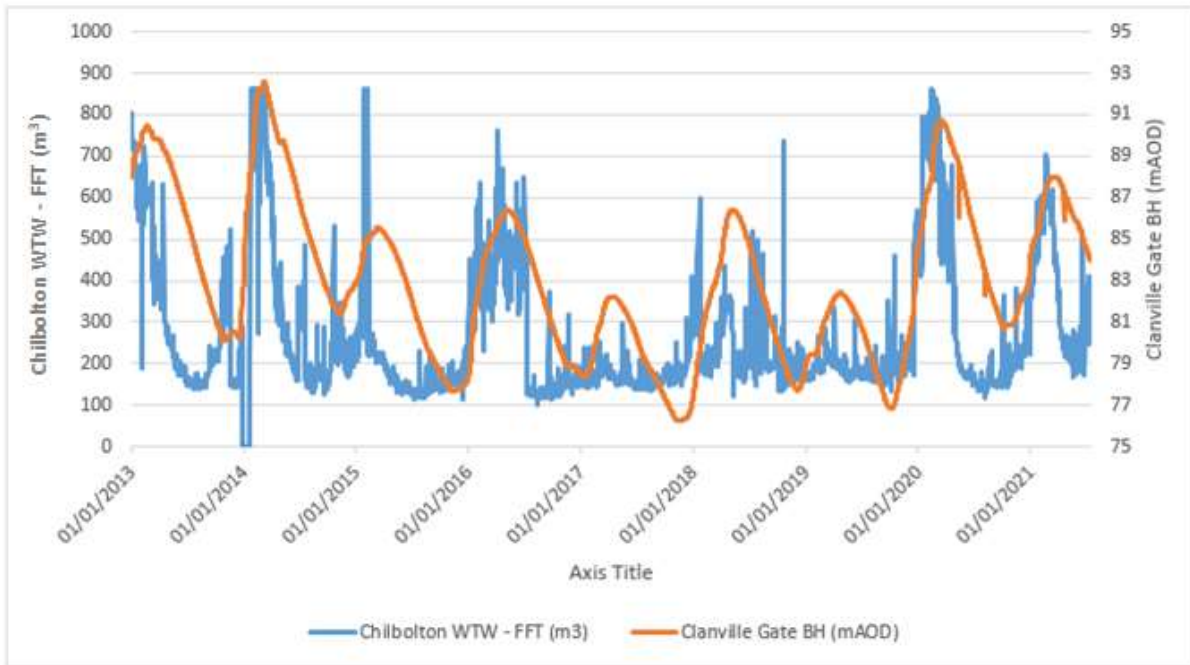


Figure 5.1 - Forecasting of Trigger Dates (trigger at 88mAOD)

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.

An analysis was performed using long term data obtained from the Chilbolton catchment. Specifically, the relationship between groundwater levels from Clanville Gate borehole and flows to Chilbolton WTW was analysed. Higher groundwater levels can be expected to result in greater infiltration, and therefore flows in the sewerage system. This analysis indicated that the repairs carried out in 2013/14 have had some effect in reducing infiltration. But the relationship is not strong enough in order to confidently conclude this.

SW will continue to obtain data so that similar analyses can be performed in the future.

6. Action Plans

A significant amount has been achieved in the Chilbolton catchment in the last 8 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).

SW 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.	July - September 2013 – Complete	Groundwater infiltration is greater than would be expected for summer conditions.
1.3	'Wet weather' flow surveys (to identify remaining areas of infiltration following initial sewer rehabilitation/repair).	Identify suitable measurement points, carry out survey over four week period, match rainfall records with flow data.	May/June 2014 - Complete	The wet and dry weather flow survey results were compared to identify potential areas of infiltration.
1.4	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 and Spring 2014 - Manhole surveys and CCTV survey of sewers - Complete	Sources of infiltration were identified to determine scope of rehabilitation work.
1.5	Carry out sewer rehabilitation work	Use various techniques to seal infiltration points in manholes and sewers	Summer/Autumn 2014: - Completed in 2014/15, apart from one repair scheduled to be undertaken in January 2016.	Rehabilitation will restore structural integrity of sewers restored
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	As required dependent on survey results; none currently scheduled.	Rehabilitation will restore structural integrity of sewers restored

Chilbolton Infiltration Reduction Plan

Ref.	Item	Actions	Timescale and Status	Outcomes
1.7A	Maintain IRP as a live document	Update IRP as appropriate to describe work carried out and/or developments	Annually – on anniversary of submission to EA for approval	Up-to-date IRP
1.7B	Quarterly progress reports	A progress report on infiltration reduction work related to this catchment will be submitted to the Environment Agency	Quarterly (December, March, June, September)	Keep the Environment Agency informed of progress on a regular basis
1.8	Strategy for inflows via private drains	Southern Water to propose a strategy for dealing with infiltration via private drains*	SW 2014. Complete	Southern Water's objective is to improve awareness of the significance of infiltration into private drains and the importance for customers to ensure infiltration is repaired when it is discovered.
1.9	Long-term monitoring	SW will monitor sewer flow to identify significant increases in inflows.	SW, 2014 onwards	Early identification of areas where infiltration has increased.
1.10	Over-pumping Sites: improve effluent quality	Investigate potential for improved screening and biological treatment at points of discharge into watercourse.	SW, 2014, Complete	Improved arrangements for discharges when required.
1.11	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.
1.12	Standards for emergency discharges	SW to discuss with EA about best practice set up for over-pumping arrangements.	SW, 2014, Complete	Agree with EA acceptable standards for discharges and acceptable flow rates.

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Ref.	Item	Actions	Timescale and Status	Outcomes
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	Consider alternative solutions that involve some risk	Investigate unconventional options such as vacuum sewers or consider conventional combined sewer overflows	2020	Ongoing.
1.15	Identification of lengths of sewer to survey or resurvey in the period 2021-25	Review sewer records with available ground water profile date	Post 2022	To be progressed as required
1.16	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.	Post 2022	To be progressed as required
1.17	Survey result review	Review results of surveys undertaken in 1.16 to determine sewer sealing work.	Post 2022	To be progressed as required
1.18	Undertake required sewer sealing	Seal sewers and manholes by most appropriate technique	Post 2022	To be progressed as required

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Ref.	Item	Actions	Timescale and Status	Outcomes
1.19	Review effectiveness of any sealing work	Analyse monitoring data and groundwater data to determine benefit of investment	Post 2022	To be progressed as required
1.20	Review further options for property protection and alternative tanker points	As required	Post 2022	To be progressed as required

Table 6.2 - Multi-Agency Activities to Reduce Groundwater Infiltration

Ref.	Item	Actions	Owner, Timescale and Status	Outcomes
2.1a	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	HCC (for highways) and Test Valley Borough Council (for domestic connections) to investigate and pursue as 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 Borough 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.	Parish Council to continue to consult with SW on development applications.	Parish Council, Ongoing.	Developments in areas which would be detrimental to sewer flooding, to have conditions recommended by SW and applied, as appropriate, by the Borough and Parish Councils.
		SW to determine threshold above which they require to be consulted.	Parish Council, Ongoing. SW wish to be consulted on all proposed development.	
		Sewerage materials for new developments	SW & Parish 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. Parish Council 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.	Regular meetings are not planned, but SW will attend with other agencies as required.	Inform the local population of progress and planned activities and receive feedback.
3.2	Liaise with other agencies as appropriate.	Discuss and agree actions to reduce requirements for tankering and emergency discharges to watercourses.	On-going – further liaison as required	Improved understanding of issues and appreciation of issues. Agreement to actions to help reduce the need for tankering and emergency discharges to watercourses

** 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). Note trigger levels should vary as a consequence of rehabilitation. Also they will need to reflect groundwater reaction times.
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.
4.3	Integrated Flood Risk Management	Develop a multi-agency approach to the management of flood risk within catchments as it relates to the impact on public sewers.	County Council/Parish Council, with inputs from SW, EA, Parish Council and local flood action groups.	Actions for participating authorities that in unison will reduce the extent of flooding and the impact of flooding.

Appendix

A Survey Findings and Rehabilitation Scope

B Emergency Discharge Sites