# Infiltration Reduction Plan

## Sidlesham

September 2021
Version 1.2


from
Southern
Water

# Contents

# Document Control

| Format | Version | Date | Prepared by (Author) | Checked by | Reviewed by | Approved by |
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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 Sidlesham in the Sidlesham 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 Sidlesham Wastewater Treatment Works (WTW) in Sussex.

The affected part of the catchment is shown in the map in Figure 1.1. Flow gravitates to Fletchers Lane WPS, from where it is pumped to Rotton Row WPS. After being pumped through several more pumping stations, flow is treated at Sidlesham 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,
- Chichester District Council,
- West Sussex District Council
- Sidlesham Parish Council

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

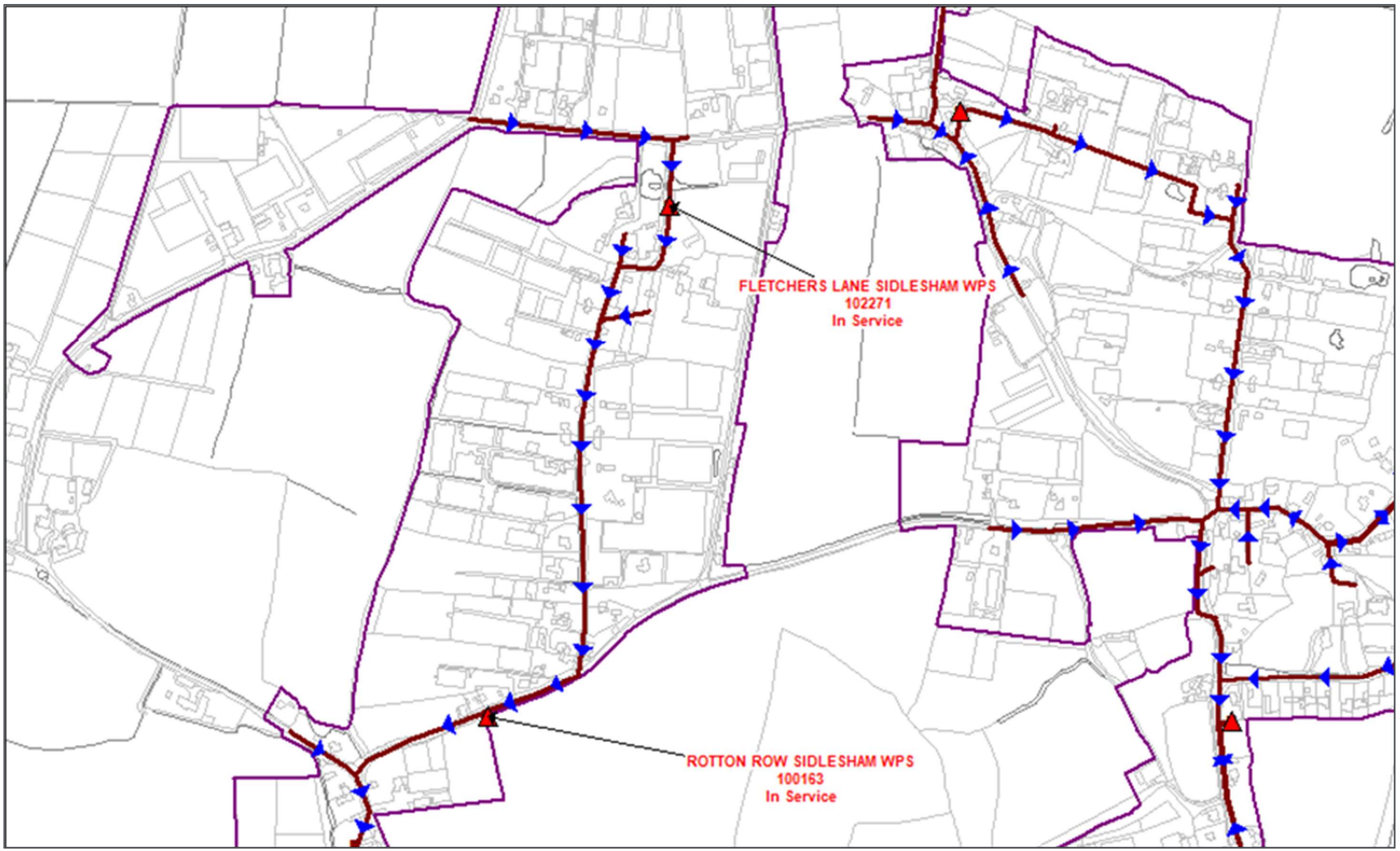


**Figure 1.1 - Representation of the sewerage system in the vicinity of Sidlesham**

# 2. Groundwater Infiltration at Sidlesham

## 2.1. The significance of groundwater infiltration.

The Sidlesham catchment 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. 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 eight years SW has invested in carrying out major improvements to the integrity of the sewers and manholes in the vicinity of Sidlesham 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 show reported incidents of sewer flooding since April 2010.

The impact of this on the customers with respect to flooding and restricted toilet use is much less in the last 5 years. This may demonstrate the effectiveness to date of the sewer sealing work undertaken in the network.

**Table 2.1 - Reported Flooding Incidents in Sidlesham**

| Year | External Flooding | Restricted Toilet Use | Total |
|---|---|---|---|
| 2010_2011 | 0 | 1 | 1 |
| 2011_2012 | 0 | 0 | 0 |
| 2012_2013 | 1 | 0 | 1 |
| 2013_2014 | 2 | 2 | 4 |
| 2014_2015 | 0 | 2 | 2 |
| 2015_2016 | 1 | 0 | 1 |
| 2016_2017 | 0 | 0 | 0 |
| 2017_2018 | 0 | 0 | 0 |
| 2018_2019 | 0 | 0 | 0 |
| 2019_2020 | 1 | 0 | 1 |
| 2020_2021 | 0 | 0 | 0 |
| **Totals** | **5** | **5** | **10** |

Figure 2.1 provides a comparison of total incidents against average rainfall. As would be expected, there appears to be a correlation between higher rainfall and an increased numbers of incidents.

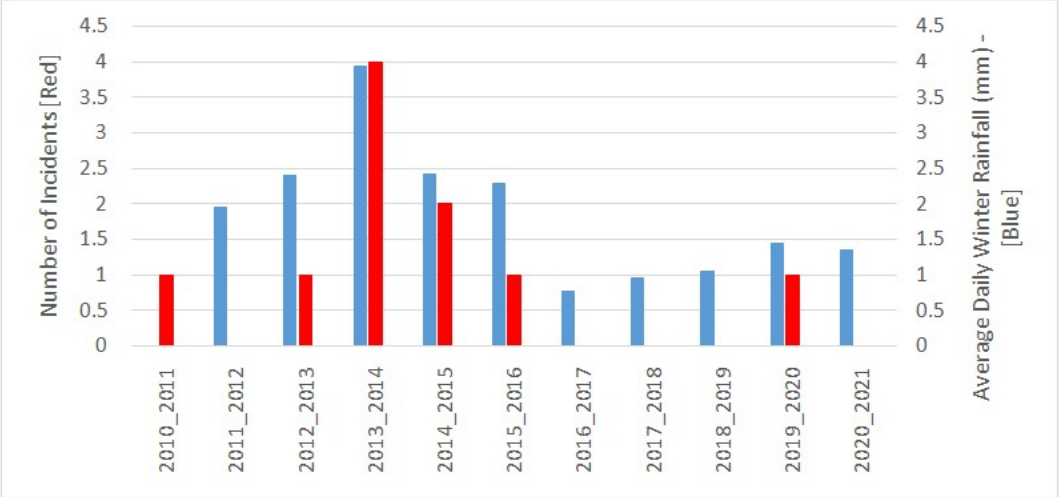


**Figure 2.1 – Comparison of incidents and rainfall**

# 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 at Sidlesham are captured in Section 3.2 below, and includes 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 in Sidlesham

Groundwater infiltration into sewers has been a long-running issue for Sidlesham. 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 Sidlesham 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 Sidlesham Village and Environs**

| Step. | Description | Approx. Date | Status |
|---|---|---|---|
| 1. | Manhole lifting followed by CCTV Investigation [990m of sewer surveyed] | April 2013 | Completed |
| 3. | Determination of required repairs | Autumn 2013 | Completed |
| 4.a. | Repairs<br><br>[refer plans in Appendix A] | October 2013 – November 2013 | Completed |
| 5a. | Dry Weather Flow Survey | N/A | Not appropriate for small sub-catchments. |
| 5b. | Wet Weather Flow Survey | N/A | Ditto |
| 6. | Targeted follow up survey | 2017/18 | Scheduled |
| 7. | Targeted Repairs | As required | Scheduled |
| 8. | Ongoing monitoring | As required | Ongoing. |
| 9. | Further surveys and subsequent repairs | Summer 2021 – Spring 2022 | Planned |

Further investigation work in Sidlesham village, was carried out in 2017/18. If infiltration remains an issue, the requirement for further repairs will be considered in relation to other locations which experience sewer flooding. Repair of a lateral drain with significant infiltration was also carried out during the year 2017/18. A further package of investigations and repairs is planned for 2021/22.

# 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.

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 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 Chilgrove House reaches 74.9m. However, to allow time for investigation and preparation, SW used a lower 'trigger level' in the 2015/16 winter planning report. A trigger level of 70m was used.

The locations where over-pumping equipment has been set up 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. Over-pumping was undertaken in both 2014 and 2016. Pumps were set-up in 2015, but ultimately were not used. Tankering was however used on selected dates between December 2020 and February 2021. 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.

Figure 4.1 shows the groundwater levels recorded at Chilgrove House borehole between 2013-2021. It can be seen that the groundwater level appears to have risen after the sewer repairs towards the end of 2013.

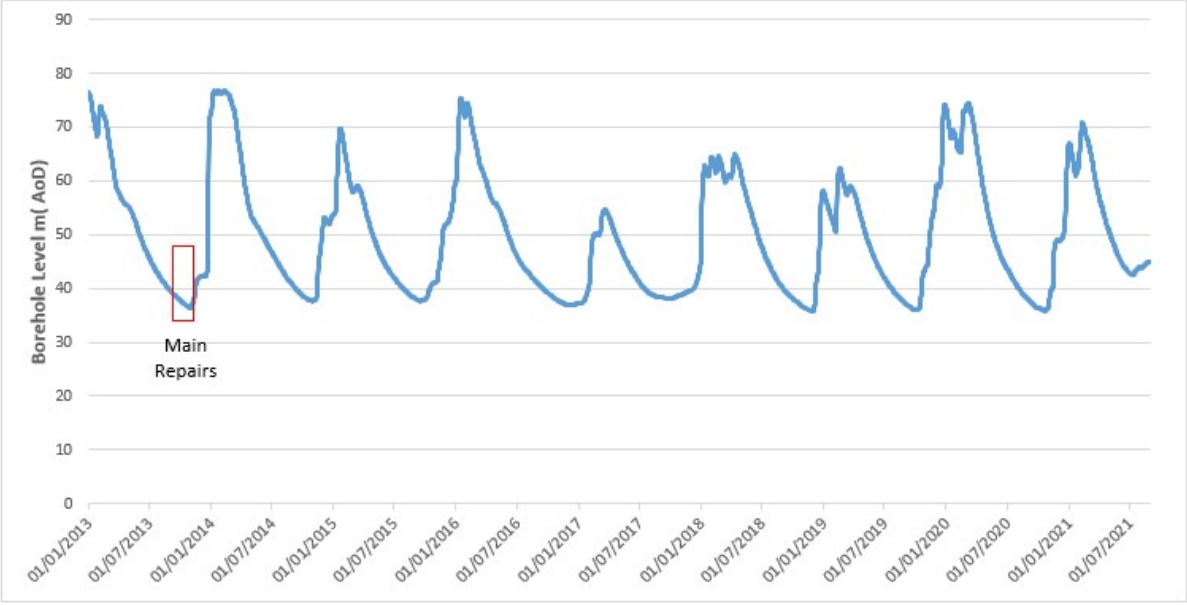


**Figure 4.1 - Groundwater levels from 2013 to 2021**

## 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 2014/15, 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 (as shown in 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.

SW invested in ten portable biological treatment units in January 2014 for use at flooded areas throughout its area. The units were trialled but found to be unreliable, so UV units have been used instead when over-pumping is required.

## 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 Sidlesham 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 Sidlesham catchment discharge at Sidlesham WTW - a round trip of approximately half an hour, including loading and discharging.

### 4.4.2. Over-pumping

Benefits:

- See Generic Plan.
- Typical pump fuel consumption is 37% 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 11 tankers.

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.

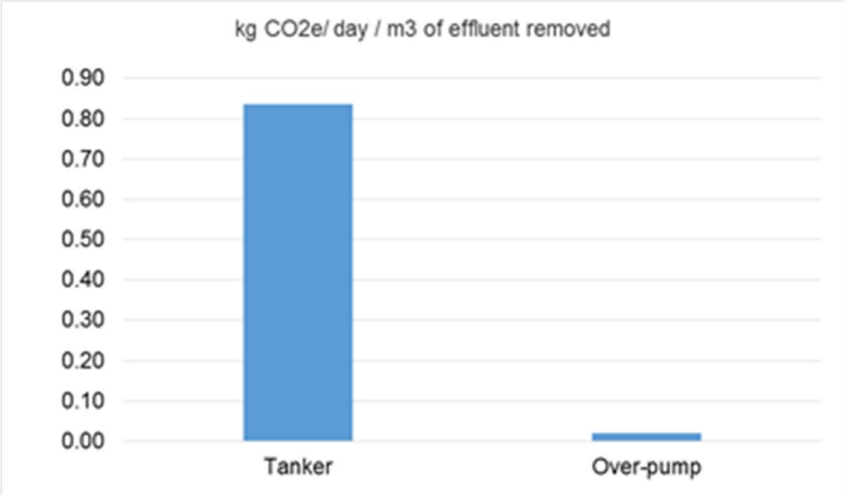


**Figure 4.2 – Carbon Footprint figures for Tankers and Over-pumps per $m^3$ of effluent removed.**

Irrespective of the method of removing excess infiltration, it is clearly preferable to prevent it entering the system in the first place.

## 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. Dialogue with representatives of these groups was influential in helping to shape the IRP. 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 locations are shown 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 on-going process. Since 2013, SW has undertaken surveys and repairs at Sidlesham. The major repair work was completed in 2013. Repair of a lateral drain with significant infiltration was also carried out during the year 2017/18.

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 CCTV Investigations were carried out from March 2016 to August 2018, which led to Sewer rehabilitations from March 2016 to January 2019. Further investigations are planned across the 2021-22 period.

## 5.2. Property Level Protection

Non-return valves (NRV's) 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. There are no NRV's currently installed in Sidlesham, and no plans currently to install any, but 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, over-pumping was undertaken on selected dates between February and March 2014 and in February 2016. Tankering was used on selected dates between December 2020 and February 2021.

## 5.4. Pumping Stations

Due to the flatness of the terrain, there is an abundance of wastewater pumping stations in the village of Sidlesham. Indeed, 15 pumping stations are required to convey the flows to Sidlesham Wastewater Treatment Works, located just to the north of Selsey. In order to minimise the effects of infiltration, SW is continuing to ensure that design discharges are maintained at pumping stations, by carrying out some major work at key stations.

At Rotton Row WPS, in the north of the village, the pumps were replaced in August 2014. At Fletchers Lane WPS, also in the north, both pumps were replaced in January 2013, followed by improvements to pipework and controls in 2015. At Highleigh Road WPS, both pumps were replaced in 2013. As part of SW's monitoring programme, regular checks are carried out to ensure that pumps are operating at design flows; indeed, maintenance visits have been enhanced for several of the stations, with quarterly visits increased to monthly visits.

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## 5.5. Monitoring

In addition to their programme of rehabilitation works, SW set up a monitoring programme in January 2015, using telemetry data. SW started with a weekly review of the ten locations in their region which are most prone to sewer flooding. The monitoring used 'real time' data e.g. groundwater levels from local boreholes to predict

when it might be necessary to respond to mitigate the effects of flooding. Trigger levels were identified for each location. The trigger levels are not the levels at which tankering or over-pumping started historically. When a trigger level is reached, 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.

Whilst Sidlesham is not one the locations monitored, the forecasting identifies areas which are likely to flood before Sidlesham.

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 levels at a sewer level monitor (SLM). There appears to have been a data issue with the SLM in 2020, which led to some erroneously high readings.

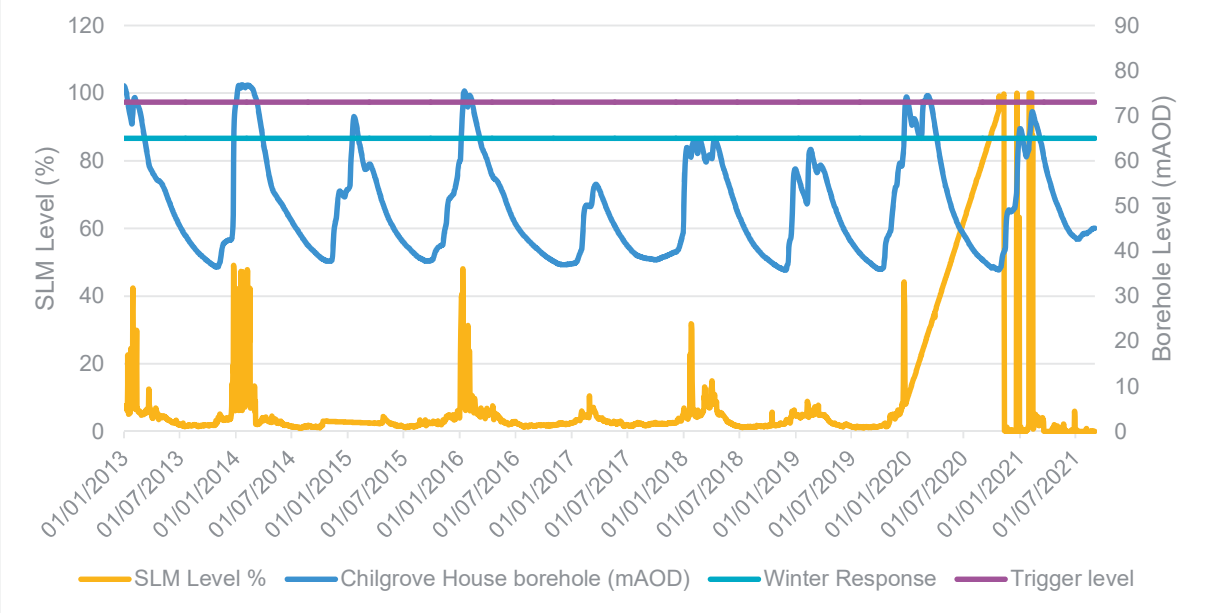


**Figure 5.1 – Forecasting of Trigger Dates**

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.

Figure 5.2 shows the groundwater levels at Chilgrove House borehole plotted against flows to Bremere Lane, Highleigh. Linear regression lines are also included for each set of data. These give an indication of the difference between average conditions for 'before' and 'after' repairs.


**Figure 5.2 – Long Term Monitoring (Dec 2009 to Feb 2021)**

For a given groundwater level, the corresponding flow is lower after the repairs. This confirms that the repair work has been effective.

The analyses outlined above is supported by the information displayed in Figure 4.1.

# 6. Action Plans

A significant amount has been achieved in the Sidlesham 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 summarise 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. | N/A | Not appropriate for small sub-catchments. |
| 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. | N/A | Not appropriate for small sub-catchments. |
| 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. | April 2013 | Identify major sources of infiltration to determine scope of rehabilitation work. |
| 1.5 | Carry out sewer rehabilitation work | Use various techniques to seal infiltration points in manholes and sewers | Autumn 2013 | Structural integrity of sewers restored. |
| 1.8 | Maintain IRP as a live document | Review text of the IRP and update if appropriate to describe work carried out and/or developments | Annually | Reviewed/Updated IRP. Last issued for review 2017. Re-issued 2020. |

| Ref. | Item | Actions | Timescale and Status | Outcomes |
|---|---|---|---|---|
| 1.8a | Maintain IRP as a live document | Review Tables 6.1 to 6.4 and as appropriate amend to show progress on individual activities. | Quarterly | Up to date tables of Actions |
| 1.9 | Consider alternative solutions that involve some risk | Investigate unconventional options such as vacuum sewers or consider conventional combined sewer overflows | 2020 complete | Complete – no alternative means of addressing the infiltration |
| 1.10 | 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. |
| 1.11 | Identification of lengths of sewer to survey or resurvey in the period 2021-25 | Review sewer records with available ground water profile date | Summer 2021 | In progress |
| 1.12 | Surveys by CCTV or Electro Scan lengths of sewer potentially at risk | Compare historical survey coverage with results of 1.15 and produce a survey schedule. | Autumn/Winter 2021 | Planned - dependent on approval in 1.11 |
| 1.13 | Survey results review | Review results of surveys undertaken in 1.16 to determine sewer sealing work. | Autumn/winter 2021 | Planned - dependent on approval in 1.11 |

| Ref. | Item | Actions | Timescale and Status | Outcomes |
|---|---|---|---|---|
| 1.14 | Undertake required sewer sealing | Seal sewers and manholes by most appropriate technique | From Autumn 2021 as conditions allow | Planned - dependent on approval in 1.11 |
| 1.15 | Review effectiveness of any sealing work | Analyse monitoring data and groundwater data to determine benefit of investment | From winter 2021 | Planned - dependent on approval in 1.11 |
| 1.16 | Review further options for property protection and alternative tanker points | Consider further improvements | From Summer 2021 | Planned - dependent on approval in 1.11 |

**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 | Local councils 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 local councils 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 Councils to continue to consult with SW on development applications. | District Councils, Ongoing. | Developments in areas which would be detrimental to sewer flooding, to have conditions recommended by SW and applied, as appropriate, by the Parish and District Councils. |
| | | SW to determine threshold above which they require to be consulted. | District Councils, Ongoing. SW wish to be consulted on all proposed development. | |
| | | Sewerage materials for new developments | SW & District Councils, 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 | Communication from SW to stakeholdersabout 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 |

** 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. | District Councils with inputs from SW, EA, and Parish Council. | Plan including actions for participating authorities that 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. |
| 4.6 | Review of utilisation of a control structure | Investigate the possible use of a fixed control structure to relieve hydraulic overloading of sewers. | SW | No current plans to progress this option. |

# Appendix

A Survey Findings and Rehabilitation Scope

B Emergency Discharge Sites