Infiltration Reduction Plan

The Green, Southwick

October 2024
Version 3.2

from
Southern
Water

Contents

Document Control

Version	Date
D1	June 2014
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V1.1	November 2017
V1.2	October 2021
V2	January 2024
V3	July 2024
V3.1	September 2024
V3.2	October 2024

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 The Green, Southwick in the Shoreham catchment has been prepared in response to the Environment Agency's (EA) Regulatory Position Statement (RPS). Southern Water (SW) has been carrying out work for many years to survey and repair sources of infiltration in the catchment for Shoreham Wastewater Treatment Works (WTW) in Sussex.

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,
- West Sussex County Council,
- Adur and Worthing Council
- Adur District Council

Southern Water will continue to consult with representatives of these parties as part of the IRP development and implementation.

2. Groundwater Infiltration at The Green, Southwick

2.1. The significance of groundwater infiltration.

The Green, Southwick 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 groundwater treatment. Such mitigation measures are not sustainable and are disruptive to communities, so since 2014 SW has invested in carrying out major improvements to the integrity of the sewers and manholes in the vicinity of The Green, Southwick in order to minimise the occasions on which mitigation measures are required.

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

Despite the significant groundwater flow through the catchment during these conditions, incidents of sewer flooding have been relatively infrequent. This is due to the mitigation provided during times of high groundwater. Flooding incidents would be higher if no tankering or mitigation measures were carried out. Table 2.1 below shows reported incidents of sewer flooding since 2011. For context, until the winter of 2023/24, 2012/13 was the wettest year on record and 2013/14 was the wettest winter on record.

Table 2.1 – Reported Flooding Incidents by Category at The Green, Southwick

Year	External Flooding (properties/gardens)	External Flooding (highways/other)	Internal Flooding	Restricted Toilet Use	Total
2011	0	0	0	0	0
2012	0	1	0	0	0
2013	5	6	0	2	7
2014	3	5	0	2	5
2015	0	0	0	0	0
2016	0	1	0	0	0
2017	0	0	0	0	0
2018	0	3	0	0	0
2019	0	0	0	0	0
2020	0	22* (storm)	0	0	22
2021	0	0	0	0	0
2022	0	1	0	0	1
2023	0	8	0	0	8
2024	4	17	1	0	22
Total	**12**	**64**	**1**	**4**	**65**

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 The Green, Southwick 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 at The Green, Southwick

Groundwater infiltration into sewers has been a long-running issue for The Green, Southwick. SW has been making significant investments over many years to minimise infiltration in groundwater affected systems and the need for interventions such as tankering and groundwater treatment.

SW completed a major programme of survey and repairs to the sewers in The Green, Southwick catchment following the high groundwater event in 2013/14. This appears to have reduced the risk of flooding from the sewerage system in most winter conditions. However, in the winter of 2023/24 the highest groundwater levels were recorded for a prolonged period and this caused major issues for the system at the Green and mitigation measures were required to reduce flood risk. At times of very high groundwater there are still significant challenges with the drainage system and there is more work to do. The investigations and repairs followed the process set out in the Generic Plan. The timing and status of each step is shown in Table 3.1 below.

Table 3.1 – Summary of Survey and Repairs at The Green, Southwick

Step.	Description	Approx Date	Status
1.	manhole lifting followed by CCTV Investigation	Spring 2013, Spring 2014 and October 2018	Completed
3.	Determination of required repairs (700m of sewer identified for repair)	Summer 2014	Completed
5a.	Dry Weather Flow Survey	July 2013	Completed
4.	Repairs	January 2015 – April 2015: part completed. Remainder completed April 2018. Further work undertaken in October & November 2018	Completed
5b.	Wet Weather Flow Survey	N/A	Not carried out
6.	Targeted follow-up survey	N/A	No CCTV surveys for

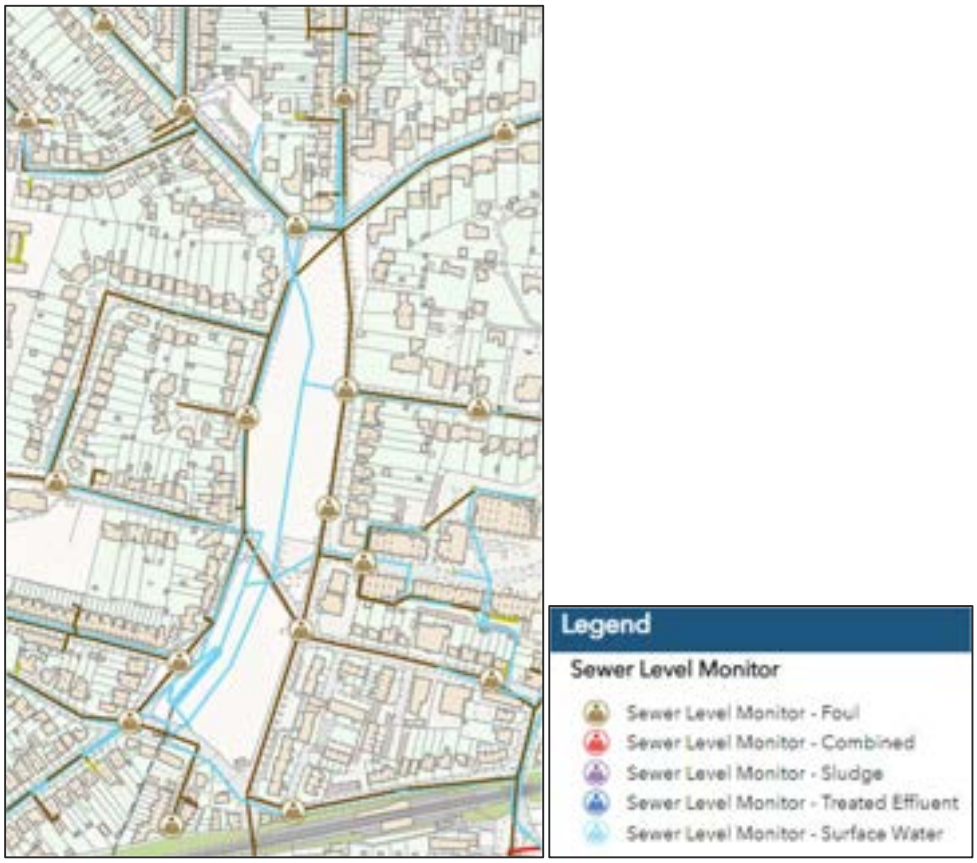
Step.	Description	Approx Date	Status
			infiltration since 2018
7.	Further Targeted Repairs	N/A	No infiltration repairs since 2018
8.	Ongoing monitoring	Commenced December 2015	Ongoing
9.	Installation of sewer level monitors at strategic points (see Figure 3.2)	2023	Completed
11.	Review of sewer level data to identify blockages and infiltration areas to target	Post 2023	Ongoing
12.	Electroscan surveys of 3.5 km of public sewers upstream of The Green to identify any further sewer sealing work	From April 2025	Planned

Despite the repairs, significant mitigation measures were required in winter 2023/24 due to the high groundwater levels recorded. The interventions included the deployment of a number of tankers to extract excess flow from the system and to transport this to East Worthing WTW for treatment. We also installed green tanks and COPA foam technology to allow flow to be discharged into the surface water system without compromising the quality of the receiving watercourse.

Historically we have been dependent on waiting for groundwater to rise and leak into the system to allow us to find leaks. This gives a very small window of opportunity between leaks starting and pipes running full and this caused repairs to be undertaken reactively or after the groundwater had subsided. To overcome this during 2021/22 a new survey technique called Electroscan was introduced to the business. This method of surveying is advantageous over traditional cctv inspection as it allows surveys to be undertaken during dry and wet conditions and also identifies leaking joints in pipes that a visual survey would not pick up. We plan to undertake electroscan surveys in Southwick in 2025.

Figure 3.2 shows the location of sewer level monitors that we have installed at strategic points around The Green, Southwick. The monitors enable us to detect sewer issues such as high infiltration, blockages or sewer collapses. We are currently piloting the approach to understand how we can use that data to inform our sewer sealing programme. This is likely to include the use of Storm Harvester to target inspections to find infiltration.

Figure 3.2 – Location of Sewer Level Monitors in the vicinity of The Green, Southwick



4. Mitigation measures

4.1. Circumstances that lead to mitigation

Since 2013, SW has made significant investment to reduce infiltration into the public sewerage system and to protect specific properties at risk of flooding. The objective is to reduce the frequency of discharges to watercourses and the disruption caused by the need for mitigation.

Once groundwater levels have risen to a point where the sewerage system is below the water table groundwater will enter the system through leaking joints in both the public and private pipes and manholes. To ensure the sewerage system continues to function, this excess flow must be removed from the network. Initially this is done by deploying tankers to extract flow and to tanker this, primarily groundwater, to larger WTW sites with capacity to treat the flow. We tankered from three locations in Southwick last winter as shown in Appendix B.

If flows continue to increase, as groundwater levels rise, groundwater mitigation measures at certain locations will be required. Using previous experience, areas likely to be the first affected, are identified. The requirement for mitigation will be driven by levels in the manholes locally. When groundwater mitigation is in place the discharges are initially to an adjacent foul sewer though if flow cannot be managed by this method the discharges will be to a surface water sewer, which discharges into the harbour as a last resort measure to prevent flooding. The locations for groundwater treatment is given in Appendix B.

Based on experience in 2013 and 2014, groundwater mitigation could be expected to be required when the groundwater level at Whitelot Bottom BH reaches 40.3m. However, to allow time for investigation and preparation, SW is using a lower groundwater 'trigger level' in the winter planning report. A trigger level of 35m is being used. Mitigation has only been needed at this site twice in 10 years, in winter 2013/14 and winter 2023/24.

Figure 4.1 shows the groundwater level at Whitelot Bottom BH from 2014 to 2024.

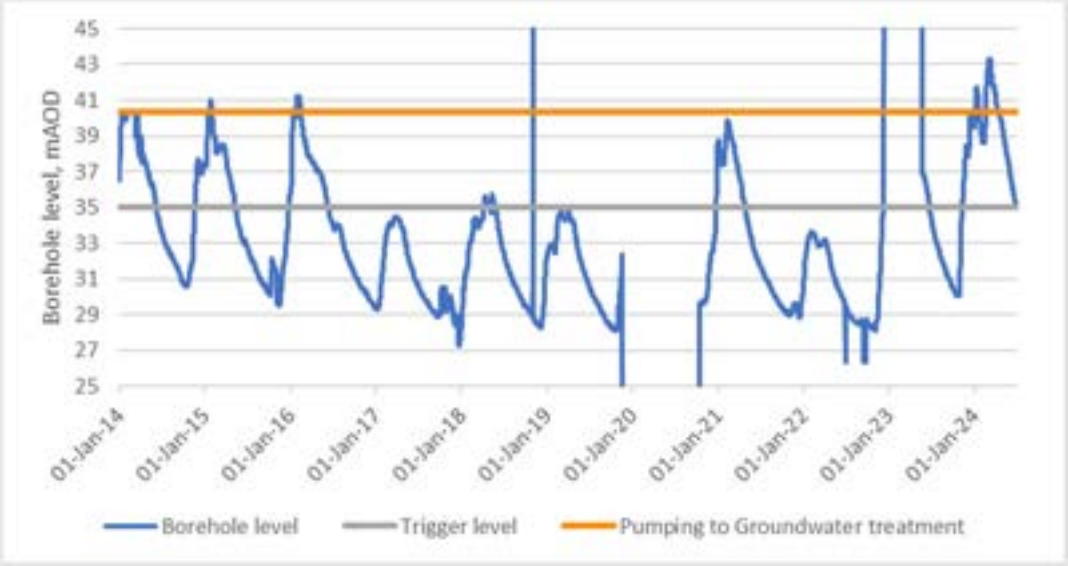


Figure 4.1 - Groundwater levels from 2014 to 2024 at Whitelot Bottom BH

4.2. Steps to prevent discharges to the environment

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.

4.3. Groundwater treatment arrangements

A typical arrangement of a groundwater treatment setup is given in Appendix B.

The locations where groundwater treatment 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. It is proposed that these groundwater treatment mitigation measures are a last resort once the tankering mitigation steps have been exhausted. Appendix B shows the location where groundwater treatment will be installed should it be required in the future. As the discharge from the groundwater treatment process is Shoreham Harbour the quality standards stated in Appendix B will be relaxed as the environment impact is lower than a watercourse. However, the equipment will still operate to the same standard and inspection of the receiving water will be undertaken daily.

5. Steps to minimise the volume and duration of groundwater treatment

5.1. 3rd Party Communications about groundwater treatment

Since the start of the Infiltration Reduction Programme in 2013, Southern Water has been active 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. However, we recognise there is more to do in this area to keep everyone informed of the mitigation measures that may be required and informing when we have deployed the measures.

SW will attend and convene meetings with local groups to ensure progress against the plan and the on-site mitigation activity is clearly communicated. Meetings that have been held over the last 10 years with local council and EA representatives have been influential in helping to shape the IRP. The latest version of the IRP approved by the EA, will be published on SW's website.

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

5.2. Monitoring quality of the downstream watercourse

The Generic Plan provides details of water quality monitoring that will be undertaken, should groundwater treatment be required.

6. Options to Reduce Infiltration

6.1. Sewer Rehabilitation Programme

Infiltration reduction is an on-going and iterative process. Since 2013, SW has undertaken surveys and repairs to the public sewers at The Green, Southwick. In recent activity, in systems prone to high groundwater in Hampshire and Sussex we have undertaken more investigation into the contribution of flows from the private sewer network. We have established through the Pathfinder projects that groundwater is just as likely to be entering the system through leaking private pipes and manholes as the public system. This is probably not surprising as the systems would have originally been laid at the same time using the same techniques. The only difference is that as a rule the private sewers are likely to be at a shallower depth and groundwater has to rise slightly higher for infiltration to start. Once the leaks on the public system have been addressed we will need to start sealing sewers in the private system. Appendix A contains details of all sewer inspection and remedial work undertaken to date.

Table 6.1 below summarises the work undertaken in the system since 2014.

Action	Km of sewer
Length Surveyed by CCTV	2.47
Length Surveyed by Electroscan	0.0
Length with no work required	1.79
Length Sealed	0.68
Length to be sealed	0.52
Manholes sealed	5
Manholes to be sealed	1

Table 6.1 - Work undertaken since 2014 at The Green, Southwick

Reporting Year	Surveyed (km)	Sewers Sealed (km)	Manholes Sealed
2014	0.93	0	0
2015	1.45	0.3	0
2016	0	0.08	0
2017	0	0	0
2018	0.09	0	0
2019	0	0.21	0
2020	0	0	0
2021	0	0	0
2022	0	0	0
2023	0	0	0
2024	0	0.09	0
Post 2024	0	0	0
Total	2.47	0.68	5 (Yr unknown)

Table 6.2. below details the work undertaken in the system since 2014.

6.2. Property Level Protection

Non Return Valves (NRVs) have always been part of our method for dealing with the consequences of infiltration, but they are only effective if infiltration is under control on both the lateral and the main sewer.
Two NRVs are currently in use in The Green, Southwick. Having completed the current phase of rehabilitation work, which has improved the integrity of the main sewers, the potential for using more property level NRVs to isolate individual properties or groups of properties is being investigated, with the objective of reducing the requirement for groundwater treatment.

6.3. Local Flow Control

Groundwater treatment has been required on selected dates during all winters where groundwater levels have impacted levels of service. Full details are given in Appendix B

6.4. Pumping Stations

In order to minimise infiltration, SW is continuing to ensure that design discharges are maintained at pumping stations. This will help to ensure that the design discharge continues to be reliably delivered.
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6.5. Monitoring

The Southwick catchment 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 groundwater treatment are required. The Generic Plan has more detail on the overall monitoring strategy.

The graph in Figure 4.1, is used to predict the timing of an operational mitigation activity to reduce the risk of flooding and pollution incidents.

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 Shoreham Catchment. The relationship between groundwater levels from Whitelot Bottom borehole and flows to Albion Street, Portslade WPS was analysed. Whitelot Bottom is the closest borehole for which data is readily available, but it should be noted that groundwater levels at observation boreholes (which tend to be on higher ground) are not always good indicators of groundwater levels at coastal locations such as Southwick.

Based on the groundwater data available, there appears to be no clear relationship amongst the data, and therefore it has not yet been possible to conclude how effective the repairs have been. SW will continue to obtain data so that further analyses can be performed in the future, as repairs progress.

7. Action Plans

A significant amount has been achieved in The Green, Southwick catchment in the last ten 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 7.1 and 7.2 cover the actions by SW and by other parties, respectively, to reduce infiltration. Tables 7.3 and 7.4 cover mitigation of the effects of flooding (Communication and other activities).

SW is committed to continuing to pursue infiltration to reduce the frequency of service impacts and mitigation measures. 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 7.1. 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 1 above and the report in Appendix 1.	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/ August 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, 2014 and Autumn 2018 - 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	January - April 2015. Remainder completed April 2018. Further work undertaken in October and November 2018.	Structural integrity of sewers restored.
1.5	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.

Ref.	Item	Actions	Timescale and Status	Outcomes
1.5a	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
1.6	Install Property Level Protection to Vulnerable properties.	Survey and install NRVs at vulnerable properties.	Autumn 2014 - Complete	The aim is that protection to vulnerable properties restricts tankering to those properties only as opposed to more significant sewer pumping.
1.7	Groundwater Treatment 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.
1.8	Groundwater Treatment 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.
1.9	Standards for emergency discharges	SW to discuss with EA about best practice set up for groundwater treatment arrangements.	SW, 2014, included in this IRP	Agree with EA acceptable treatment for discharges and acceptable flow rates.
1.10	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, West Sussex CC, Adur DC and local Parish Councils acceptable arrangements for future emergency discharges.

Ref.	Item	Actions	Timescale and Status	Outcomes
1.11	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.
1.12	Review effectiveness of any sealing work	Analyse monitoring data and groundwater data to determine benefit of investment.	From Spring 2025	Planned
1.13	Identify further sewer leakage locations	Undertake electroscan surveys on 3.5km of sewer	From Spring 2025	Planned

Table 7.2. Multi-Agency Activities to Reduce Groundwater Infiltration

Ref.	Item	Actions	Owner, Timescale and Status	Outcomes
2.1	Strategy for infiltration via private drains	Southern Water to propose a strategy for dealing with infiltration via private drains*	SW supported by EA and local Parish Councils, Summer/ Autumn 2014. Completed 2014.	Southern Water 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. We will consider repeating the private drain infiltration awareness campaign as ten years have elapsed since the last campaign.
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	West Sussex 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 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 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 County 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.	

Ref.	Item	Actions	Owner, Timescale and Status	Outcomes
		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 7.3. 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	Letters from SW to stakeholders about reducing groundwater infiltration into the sewerage system	Send letters 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, Discussed and actions agreed in 2013 and 2014. To be discussed in future as required.	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	Complete

** 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 7.4. 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 groundwater treatment 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.
4.3	Maximise the capacity of the sewerage system and pumping stations	Ensure foul system is clear of obstruction	SW, July 2014 for capacity determination. Trial - if and when - the sewers are surcharged	Sewer cleaning undertaken where required
4.4	Flooding Management Plan	Develop plan to address the flooding issues caused by high groundwater. Implement recommendations.	West Sussex Council and local councils with inputs from SW, EA, and Parish Councils	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