

Infiltration Reduction Plan

Lavant Valley

September 2021
Version 4.1



from
**Southern
Water** 

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Document Control

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Glossary

AMP – Asset Management Programme
CCTV - Closed-circuit television
CSO – Combined Sewer Overflow
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 Lavant Valley in the Lavant 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 Lavant Wastewater Treatment Works (WTW) in Sussex.

This IRP covers the villages of East Dean, Charlton, Singleton, Binderton, West Dean, Mid Lavant and East Lavant.

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 (EA),
- West Sussex County Council
- Chichester District Council
- Lavant Parish Council
- Singleton Parish Council
- East Dean Parish Council
- West Dean Parish Council

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

2. Groundwater Infiltration at Lavant Valley

2.1. The significance of groundwater infiltration.

The Lavant Valley 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 since 2014 has invested in carrying out major improvements to the integrity of the sewers and manholes in the vicinity of Lavant Valley 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.

The villages worst affected are: East Dean, Charlton, Singleton and West Dean. Sewer flooding in Lavant is less frequent.

For the record, as of 2012/13 was the wettest year on record and 2013/14 was the wettest winter on record. It is noted that despite the daily average being 3.33mm in 2019/20 the total number of incidents is significantly lower than 2013/14 (daily average of 2.27mm) as seen in Table 2.1 and Figure 2.1.

Table 2.1 - Reported Flooding Incidents by Category, in Lavant Catchment

Year	External Flooding	Internal Flooding	Restricted Toilet Use	Total
2010_2011	0	0	0	0
2012_2013	7	0	1	8
2013_2014	16	4	13	33
2014_2015	0	0	2	2
2015_2016	3	0	1	4
2016_2017	0	0	0	0
2017_2018	1	0	0	1
2018_2019	0	0	0	0
2019_2020	9	0	1	10
2020_2021	3	0	1	4
Totals	39	4	19	62

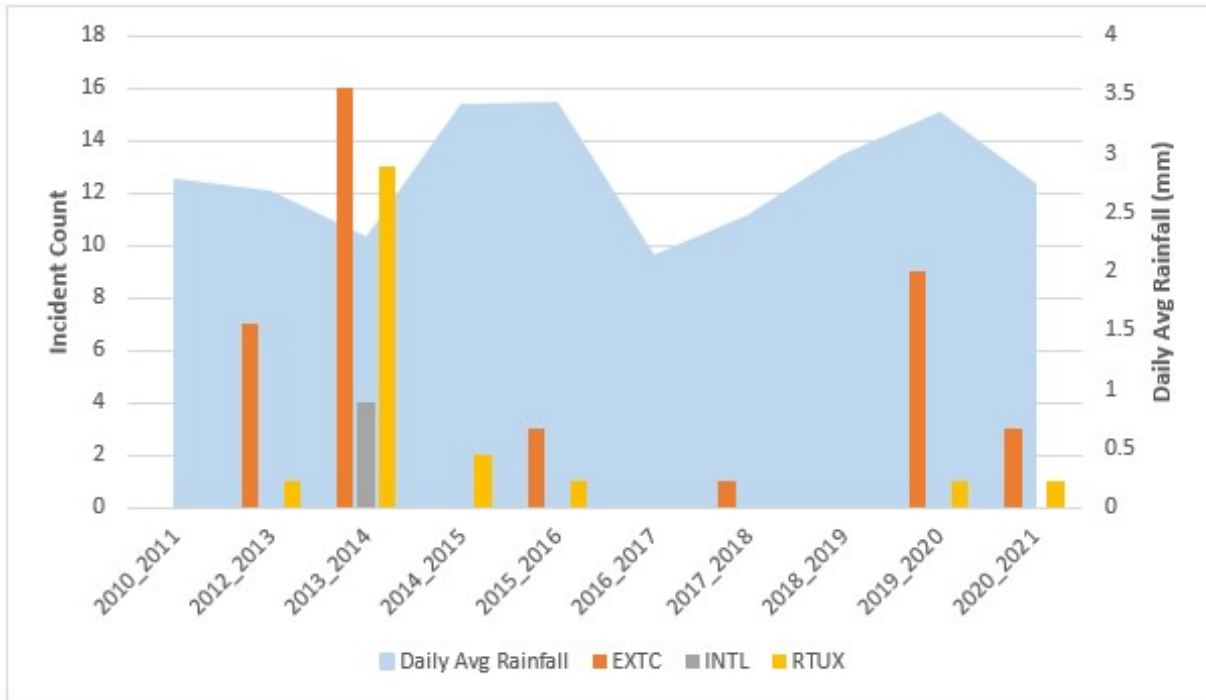


Figure 2.1 - Historic Flooding in the Lavant Valley

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 Lavant Valley 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 the Lavant Valley

Groundwater infiltration into sewers has been a long-running issue for Lavant Valley. SW has been making significant investments over many years to minimise infiltration and the need for interventions such as tankering and over-pumping.

SW recently completed a major programme of survey and repairs to the sewers in the Lavant Valley 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 Lavant Villages and Environs

Step.	Description	Approx. Date	Status
1.	CCTV of East Dean, Charlton, Singleton, West Dean and Lavant villages. Inspection of sewers between villages.	Spring 2014 and 2015	Completed
2.	Dry Weather flow Monitoring.	Summer 2013 (17 July – 2 Sept)	Completed
3.	Repairs in East Dean, Charlton, Singleton, West Dean and Lavant villages as shown in Appendix A.	Spring 2014 - Spring 2015	Completed
4.	Investigate potential for property level protection	Autumn 2015 onwards	Completed
5.	Monitor flows in sewers with regards to groundwater levels.	Throughout 2016	Completed
6.	Planned: Follow up Surveys Completed	2016 / 2017	Completed
7.	Follow up Surveys Completed	2018/2019	Completed

Step.	Description	Approx. Date	Status
8.	CCTV Investigation	September 2016 – November 2018	Completed
9.	Sewer Rehabilitation	November 2016 – February 2019	Completed
10.	Further surveys and subsequent repairs	Summer 2021 – Spring 2022	Planned

The majority of the repairs were carried out in 2014, following initial repairs completed in 2013. Despite the repairs, limited over-pumping was required at two locations in Charlton in Feb 2015. Subsequent investigations revealed the presence of a major source of infiltration in East Dean, which has been successfully sealed.

The investigations showed that the locations where the main concentrations of infiltration occurred were in the villages. This was not surprising as there are many junctions in the pipework in villages and many connections from houses. SW has now completed the repairs identified from these surveys (details are in Appendix A.)

Any isolated leaks were not included in the repairs but were instead included in the repair programme for 2016/17. Further CCTV Investigations were carried out from September 2016 to November 2018, which led to Sewer rehabilitations from November 2016 to February 2019.

Flow monitoring was carried out in dry weather conditions (17th July to 2nd September 2013) to establish baseline flows, but due to the success of finding infiltration in the CCTV and MH surveys, flows were not monitored in wet weather conditions.

In the case of Lavant Valley, because of the need to over-pump, after the flooding receded, SW undertook further investigation at East Dean, where the presence of a major source of infiltration was known, but not the exact location. A major 'gusher' in Chapel Row, was located and subsequently sealed on 24 April 2015. Addition investigations have located several further sources of infiltration in both sewers and laterals in East Dean, Charlton and Singleton which have been sealed between 2016 and 2019.

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.

As sewer levels rise, the Singleton Relief CSO will operate. If flows continue to increase, measures at other locations will be required. From previous experience, the villages of Charlton and Singleton are likely to be the first affected. The requirement for tankering or pumping will be driven by levels in the manholes locally but based on previous experience, over-pumping is likely to be required if the total flow to the Lavant Wastewater Treatment Works is above about 38l/s.

The locations where tankering or 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 or, in addition to, the sites described in Appendix B.

Whilst SW would not expect to start physical measures such as tankers or pumps at that level, the purpose of the 'trigger level' is to trigger actions to prepare for an appropriate response. Refer to Section 4.2 below - 'Steps to prevent discharges and prior alternatives to over-pumping'.

Figure 4.1 shows the groundwater levels recorded at Chilgrove House BH since 2010 alongside average daily sewer flows and rainfall.

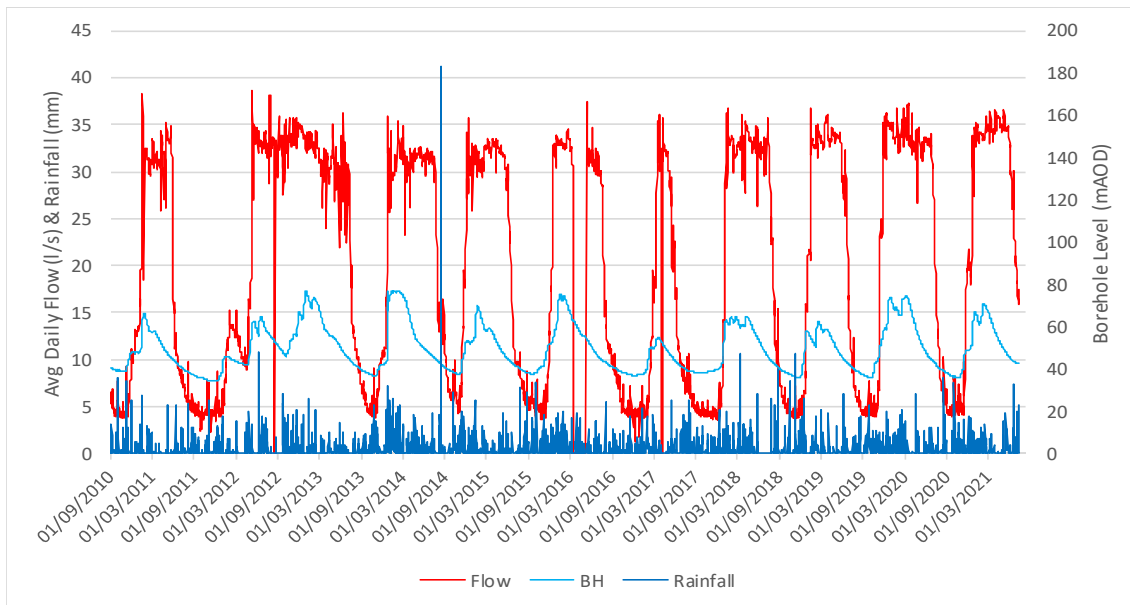


Figure 4.1 - Groundwater levels from 2010 to 2021

In the winter 2013/14 SW used tankering at four locations and overpumping at five locations. In 2014/15, SW operated overpumps at one location in Charlton. Over-pumping was required on selected dates between March and April 2020. Tankering and over-pumping were required on selected dates between February and

March 2021, and the over-pumping continued into April 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.

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.

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 Lavant Valley catchment are captured below.

4.4.1. Tankering

Benefits:

- See Generic Plan.

Disadvantages

- The flow rate is low (approx. 1l/s per tanker over a 24 hour period). *Tankers operating in the Lavant Valley discharge at Chichester Works - a round trip of an average of approximately 4 hours including loading and discharging.
- See also the Generic Plan.

4.4.2. Over-pumping

Benefits:

- Typical pump fuel consumption is about half of the fuel that one tanker would use in a day.

- The discharge rate is significantly greater. A 4 inch pump will discharge typically 30l/s; the equivalent of a fleet of 30 tankers.
- See also the Generic Plan.

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 (CO₂ equivalent for tankering and pumping).

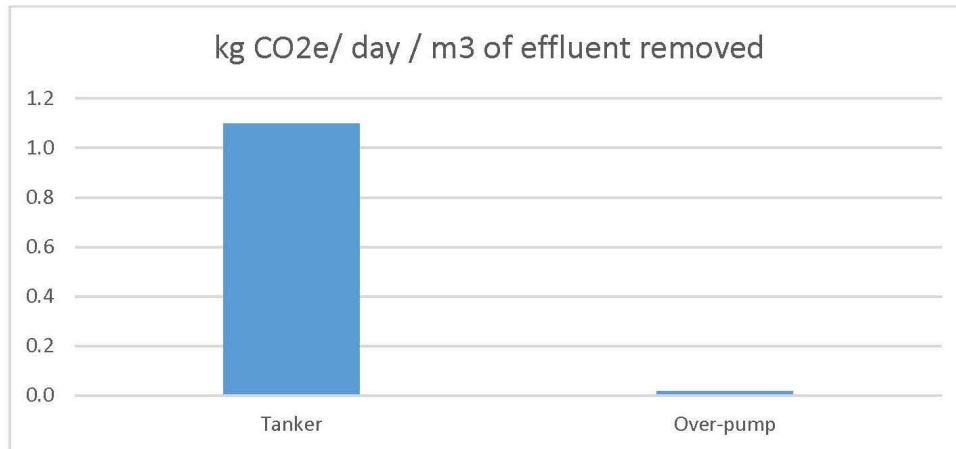


Figure 4.2 – Carbon Footprint figures for Tankers and Over-pumps per m³ of effluent removed.

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. In particular meetings with local council and EA representatives has 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.

Despite the work being undertaken, if over-pumping is required, the location 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 on-going process. Since 2013, SW has undertaken surveys and repairs at Lavant Valley. Majority of the repairs were carried out in 2014, following initial repairs completed in 2013. SW undertook further investigation at East Dean, where the presence of a major source of infiltration was known, but not the exact location. A major 'gusher' in Chapel Row, was located and subsequently sealed on 24 April 2015.

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. Further CCTV Investigations were carried out from September 2016 to November 2018, which led to Sewer rehabilitations from November 2016 to February 2019. Further surveys and sealing work are to be undertaken in 2021/22 these can be seen in Appendix C.

5.2. Property Level Protection

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. 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 over-pumping.

5.3. Local Flow Control

As noted in Section 4.1, in the winter 2013/14 SW used tankering at four locations and overpumping at five locations. In 2014/15, SW operated overpumps at one location in Charlton. Over-pumping was required on selected dates between March and April 2020. Tankering and over-pumping were required on selected dates between February and March 2021, and the over-pumping continued into April 2021. Full details are given in Appendix B.

5.4. Pump 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.

5.5. Monitoring

The Lavant Valley 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 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.

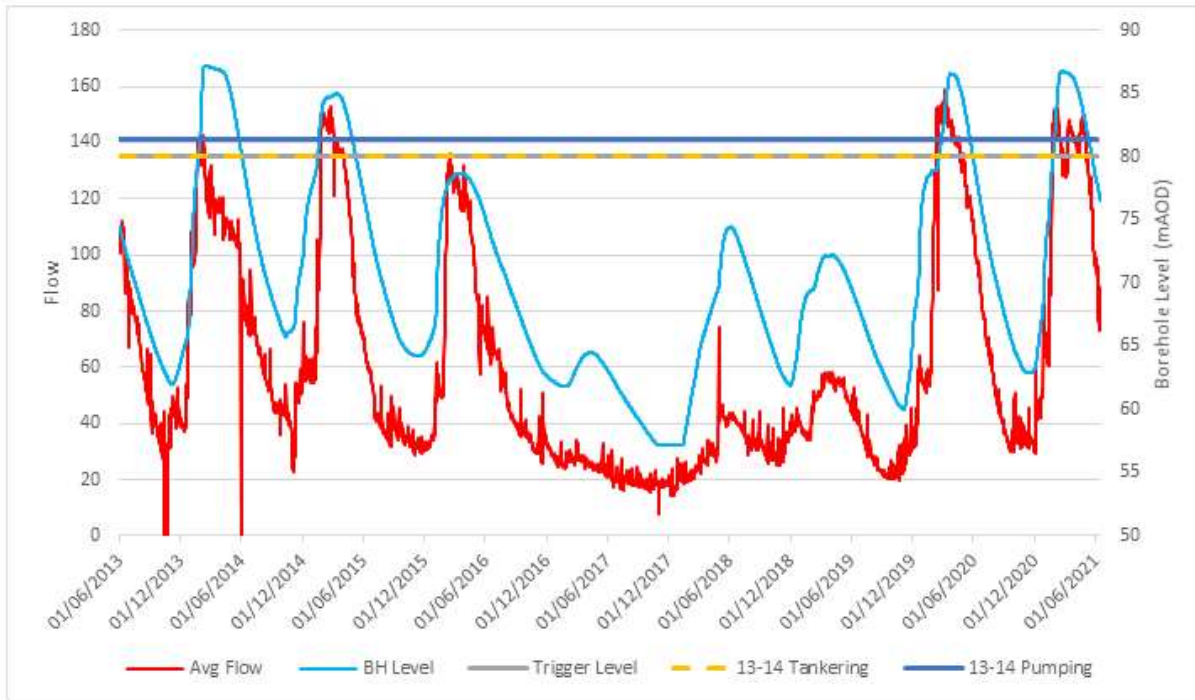


Figure 5.1 – Forecasting of Trigger Dates

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.

6. Action Plans

A significant amount has been achieved in the Lavant Valley catchment 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).

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.	Summer 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 – Survey complete Analysis - complete	Wet Weather and Dry Weather flow monitoring data used in hydraulic model completed in December 2014.
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.	Summer 2014 - Complete	Identify major sources of infiltration to determine scope of rehabilitation work.

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Ref.	Item	Actions	Timescale and Status	Outcomes
1.5	Carry out sewer rehabilitation work	Use various techniques to seal infiltration points in manholes and sewers	Initial Repairs – Completed in 2013 Majority of repairs – Completed in 2014	Structural integrity of sewers restored.
1.6	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.	2015 – Completed September 2016 – November – Completed	Determine scope and carry out further rehabilitation if identified as required from the survey results.
1.7	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	2016/17 – Completed November 2016 – February 2019 – Completed	Reduced infiltration, leading to reduced requirement for tankers.
1.8	Property level protection	Investigate potential for property level protection	Complete	Determine scope and carry out further protection if identified as required as per investigation results.
1.9a	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.
1.9b	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

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Ref.	Item	Actions	Timescale and Status	Outcomes
1.10	Consider alternative solutions that involve some risk	Investigate unconventional options such as vacuum sewers or consider conventional combined sewer overflows	2020	Ongoing.
1.11	Install Property Level Protection to Vulnerable properties.	Survey and install NRVs at vulnerable properties.	Complete	The aim is that protection to vulnerable properties restricts tankering to those properties only as opposed to more significant sewer pumping.
1.12a	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.
1.12b	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.
1.13	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.
1.14	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, Chichester DC and local Parish Councils acceptable arrangements for future emergency discharges.

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Ref.	Item	Actions	Timescale and Status	Outcomes
1.15	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.
1.16	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	Sewers to be surveyed identified. Detailed programme being determined
1.17	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.	Summer/Autumn 2021	Planned
1.18	Survey result review	Review results of surveys undertaken in 1.16 to determine sewer sealing work.	Autumn/winter 2021	Planned
1.19	Undertake required sewer sealing	Seal sewers and manholes by most appropriate technique	From Autumn 2021 as conditions allow	Planned – detailed plans in Appendix C
1.20	Review effectiveness of any sealing work	Analyse monitoring data and groundwater data to determine benefit of investment	From winter 2021	Planned

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Ref.	Item	Actions	Timescale and Status	Outcomes
1.21	Review further options for property protection and alternative tanker points	Consider further improvements	From Summer 2021	Planned

Table 6.2. 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.
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	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 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	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

** 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.

Appendix

- A Survey Findings and Completed Rehabilitation
- B Emergency Discharge Sites
- C Planned Investigations and Rehabilitation