Infiltration Reduction Plan

Upper Nailbourne

September 2025
Version 6.1

from Southern Water

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Document Control

Format	Version	Date
Nailbourne Upper and Lower	D1	Sept 2013
Nailbourne Upper and Lower	2	6 January 2014
Nailbourne Upper and Lower	2.1	21 February 2014
Nailbourne Upper and Lower	3.0	24 March 2014
Nailbourne Upper and Lower	4.0	August 2014
Nailbourne Upper and Lower	5.0	8 October 2014
Nailbourne Upper and Lower	6.0	21 November 2014
Nailbourne Upper and Lower	6.1	4 December 2014
Nailbourne Upper and Lower	6.2	8 December 2014
Nailbourne Upper and Lower	7.0	10 February 2016
Nailbourne Upper and Lower	7.1	February 2017
Nailbourne Upper and Lower	8.0	January 2020
Upper Nailbourne	1.0	June 2021
Upper Nailbourne	2.0	July 2021
Upper Nailbourne	3.0	August 2021
Upper Nailbourne	4.0	December 2023
Upper Nailbourne	5.0	July 2024
Upper Nailbourne	6.1	September 2025

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
ODI – Customer Outcome delivery Incentive
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 Upper Nailbourne and Elham Valley in the Hythe 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 Hythe Wastewater Treatment Works (WTW) in Kent.

Figure 1 shows flow to Hythe WTW. Here the villages south of Barham including Elham and Ottinge lie within the catchment of Hythe WTW. Flows from Elham are pumped southwards from The Orchards WPS to Ottinge WPS. Flows from Lyminge also gravitate to Ottinge WPS from where the resultant flow is pumped southwards to Etchinghill and on to Hythe 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,
- Kent County Council,
- Canterbury City Council
- Shepway District Council
- Little Stour & Nailbourne River Management Group

Southern Water has consulted with representatives of these parties in the meetings of the Little Stour & Nailbourne Multi-Agency Group and, through the river management group, with all the local parish councils.

Up to June 2021 there has been one published Infiltration Reduction Plan for the Nailbourne area covering both the Nailbourne and Elham Valleys. In discussion with the Environment Agency, it was agreed that from June 2021 the Nailbourne IRP would be split to two documents Upper and Lower

The Lower Nailbourne covers the wastewater catchment draining to Newnham Valley wastewater treatment works (WTW) whilst the upper Nailbourne covers the wastewater catchment draining to Hythe WTW to the south.

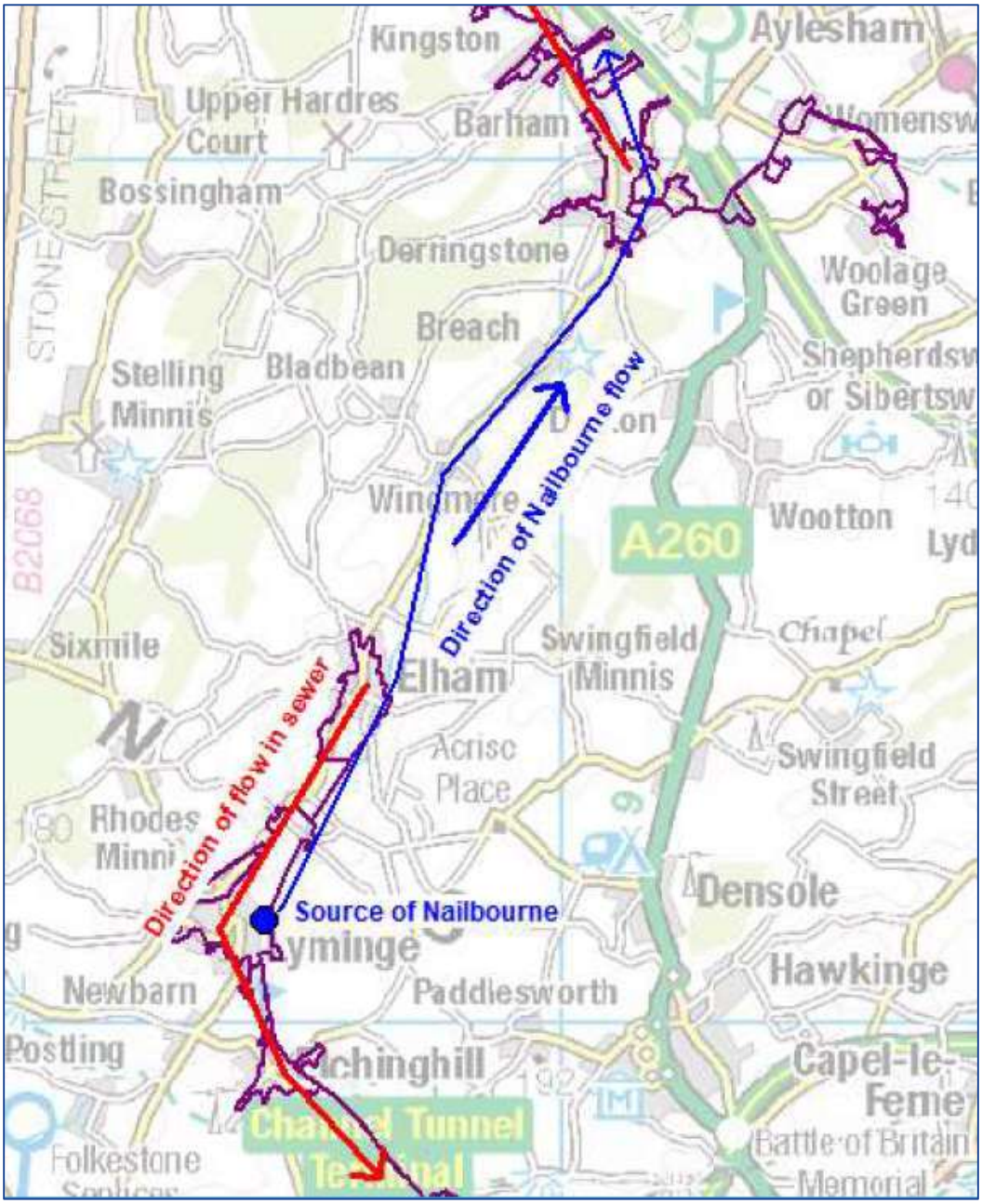

Figure 1 - Representation of the sewerage system for the Upper Nailbourne and Elham valley draining towards Hythe

2. Groundwater Infiltration at Nailbourne and Elham Valley

2.1. The significance of groundwater infiltration.

Nailbourne and Elham are 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. Such mitigation measures are not sustainable, so during the last three years SW has invested in excess of £2m carrying out major improvements to the integrity of the sewers and manholes in the vicinity of the Nailbourne and Elham Valley in order to minimise the occasions on which mitigation 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 restricted toilet use, internal and external curtilage sewer flooding since April 2009.
The benefit of tanker mitigation can be seen in the reduced restricted toilet usage numbers since the wet winter of 2013/14.
Flooding affecting public spaces and highways does occur in addition to the flooding noted in table 2.1, this is reported separately but not captured in the table as the OFWAT specific flooding ODI is only relevant for flooding within property boundary.

A hydraulic model of the Hythe catchment was developed to understand the performance of the system and determine options to address risks. However, SW is aware from historical reports of the villages and properties which are likely to be the first to suffer from the effects of flooding. It is noted that despite the groundwater levels in 2020, 2021 and 2023 being comparable to those experienced in 2013/14 (see Figure 4.1).

Year	External Flooding (properties / gardens)	External Flooding (Highway & Other)	Internal Flooding	Restricted toilet use	Total
2009	0	0	0	0	0
2010	1	0	0	2	3
2011	0	0	0	0	0
2012	0	0	0	0	0
2013	4	0	2	7	13
2014	10	4	0	1	15
2015	2	0	0	0	2
2016	0	0	0	0	0
2017	0	0	0	0	0
2018	0	0	0	0	0
2019	0	0	0	0	0
2020	3	2	0	1	6
2021	8	7	0	0	15
2022	0	0	0	0	0
2023	0	1	0	0	1
2024	1	2	0	0	3
2025	0	0	0	0	0
Totals	**29**	**16**	**2**	**11**	**42**

Table 2.1, Impact of Groundwater on customers

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 Nailbourne 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 Newnham Valley

Groundwater infiltration into sewers has been a long-running issue for the villages by the Nailbourne. SW has been making significant investments over many years to minimise infiltration and the need for mitigation.

SW recently completed a major programme of survey and repairs to the sewers in the Nailbourne 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 Nailbourne Villages and Elham

Step.	Description	Approx Date	Status
1.	Manhole lifting followed by CCTV Investigation	Spring 2013	Completed
3.	Determination of required repairs	Spring/ Summer 2013	Completed
4.	Repairs – [refer to plans in Appendix A]	September 2013 - January 2014	Complete
5a.	Dry Weather Flow Survey	July 2013 – August 2013	Complete
5b.	Wet Weather Flow Survey	May 2014 – June 2014	Complete
6a.	Further Targeted Survey	April 2015	Complete
6.b	Targeted follow up survey (Elham)	Spring 2014	Complete
7a.	Property Level Protection	October 2014	Complete
7b.	Targeted Repairs (Elham)	Autumn 2014	Complete
7c.	Further Targeted Repairs: repair of sewers at Elham	December 2015/ April 2016/Autumn 2019	Complete
8.	Annual groundwater monitoring	Commences each year	Ongoing
9.	Electroscan surveys	Autumn 2024 / Spring	Complete

Step.	Description	Approx Date	Status
10	Repairs as required following surveys	Summer 2026	Planned
11	Review of sewer level data to identify blockages and infiltration areas to target	From 2023	Ongoing

Following the CCTV surveys in spring 2013, during which 10.7km of sewers were surveyed and 263 manholes were inspected, repairs commenced in September 2013 and were completed in January 2014. The extent of these repairs is shown in the plans in Appendix A.

Within the Newnham Valley catchment, 3.6km of sewers and 10 manholes were repaired. In the Hythe catchment, CCTV surveys revealed that sewer repair works were not required, with the exception of two manholes. Root cutting also took place to maintain appropriate flow along the sewage network.

In addition to physical investigations on site, SW has instigated a programme of monitoring flows in critical catchments, including the Nailbourne catchment. Further details are given in Section 5.6.

Flow monitoring (Step 5 in Figure 3.1 of the Generic Plan document) was carried out both in dry weather conditions (18th July to 15th August 2013) to establish baseline flows, and in wet weather conditions (21st May to 18th June 2014). Good data was obtained from these surveys which was subsequently used for validation of a hydraulic model of the Nailbourne catchment.

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. This method was tested during 2021/22 and proved to be highly successful. In 2023 we surveyed a further 10 km of sewer in Elham, Etchinghill, Ottinge and Lymnge, 2.5km of further surveys is still pending with access difficulties being the main reason for incomplete lengths. Maps showing those sewers to be surveyed are included in Appendix A. All defects identified in these surveys will be rectified though the 10km currently completed showed minimal defect.

Due to the ongoing issues in this and other networks which are impacted by high groundwater and that data appears to show that high groundwater events are becoming more frequent, Southern Water included in its business plan for the period 2025 to 2030 an increased allowance specifically for the sealing of public and private sewers at risk of infiltration. The funding case was approved by OFWAT as a pilot study to trial and report the effectiveness of new sealing techniques delivered at scale. One of the systems included in the pilot study is the Upper Nailbourne. It is proposed that a high proportion of private and public sewers in the IRP area will be sealed in the period 2025 – 2027 with the anticipation that this will be effective in reducing the risk of the system becoming overwhelmed in wet winters and that tankering of flow in winter is only required in the most extreme conditions

4. Mitigation Measures

4.1 Circumstances that lead to mitigation

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.

In January 2013, prior to the start of the major reinstatement work, pumps needed to be turned on when the groundwater level measured at Little Bucket reached 78.5m. In January 2014, after completion of major repairs, ground water treatment was only required when the groundwater level reached 81.3m. In February 2015, when the level reached 84.7m, tankers needed to be deployed at Bishopsbourne, but ground water treatment was not required despite the Little Bucket groundwater level being more than 5m higher than when pumps were required in Jan 2013 and over 3m higher than when pumps were required in Jan 2014. This demonstrates the effectiveness of SW's investment to reduce infiltration and thus to reduce the requirement for discharges.

Despite the investment, following prolonged wet weather, to maintain services and avoid significant spills, SW expects that there will continue to be an occasional need to remove excess flow from the network.

Based on experience in 2014 and 2015, ground water treatment could be expected to be required when the groundwater level at Little Bucket borehole exceeds 85m (in Feb/ March 2015, groundwater levels peaked at 85.0m and groudwater treatment was not required). However, to allow time for investigation and preparation, SW has historically retained a ‘trigger level’ of 78.5m in the winter planning report.

Due to the success of the repairs, tankering is now only required at higher groundwater levels, therefore the trigger level has been raised to 80.0m. Whilst SW would not expect to start physical measures such as tankers at that level, the purpose of the 'trigger level' is to trigger actions to prepare for an appropriate response. This held true in the winter of 2023-2024 where tankering was started, at groundwater level of >78.5m.

Figure 4.1 shows the groundwater levels recorded at Little Bucket since 2012. Groundwater treatment was required in 2012/13 and 2013/14, and tankering in 2014/15 with some repair activities in 2013/14 and 2014/15. Tankering was used for one day in February 2016, but only as a precautionary measure.

It can be seen for Figure 4.1 that the maximum groundwater level in 2022 was around 15m below that recorded in 2020 and 2021, tankering of flows was not required in the winter of 2022. It can also be seen that due to the wet winter of 2022/23 the groundwater recharge has commenced and levels in January have recovered to the normal range for the time of year despite the low starting point. Due to the wet summer and autumn of 2023 groundwater levels in the winter of 2023/2024 are similar to the levels recorded in the high groundwater seasons of 2014.

In the 23/24 season, levels were exceptionally high which caused manholes to discharge and AFDs to become compromised. As a result, tankers were deployed at the beginning of December when groundwater levels approached the trigger in the village of Peene and then in March at Duck Street to relieve the spills at Ottinge WPS as this is unable to be tankered due to access issues. The 2024/2025 season has been dry with no need for mitigation .

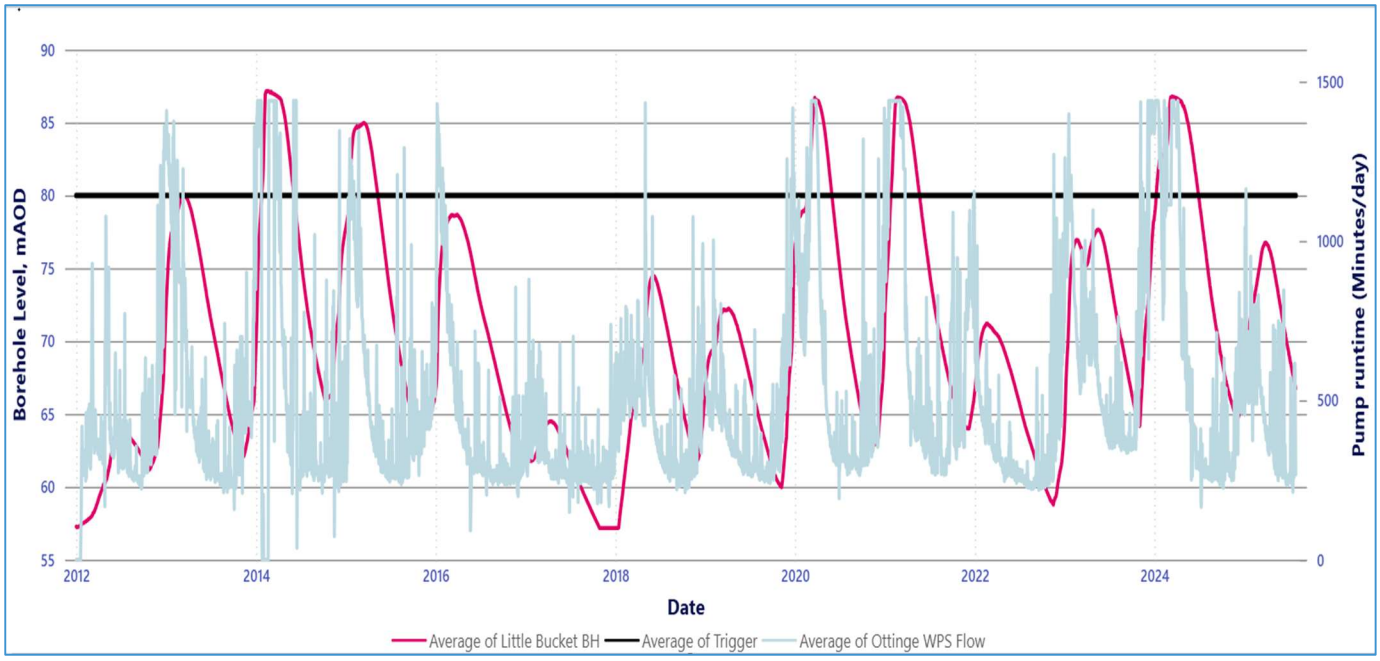

Figure 4.1 - Groundwater levels from 2012 to 2025

The details of where tankering 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 mitigation is 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 additional measures are required.

4.2. Steps to prevent discharges to the environment

Since 2013, SW has undertaken extensive surveys and repaired sewers and manholes where infiltration had been found (the extent of the work is shown in Appendix A). This built on the repairs that had been carried out in previous years (listed at the end of Appendix A). Following the main repairs, property level protection was installed in 2014, and further targeted repairs were completed.

During the 2020/21 winter period options were considered to optimise flow in the sewerage system by transfer of flow from part of the catchment that was heavily overloaded due to groundwater to parts of the network that were less surcharged. Two options were considered for the Ottinge/Elham system. The first was to intercept flows which would normally drain to Ottinge pumping station at Elham and to ground water treat this flow to Lyminge. This would relieve the pressure on the Ottinge system and potentially allow tankering to be reduced. However, it was determined that the sewer in Lyminge was already overloaded due to the flow it receives from other parts of the network and that the ground water treatment to this point would not provide benefit and would simply move the problem from one part of the system to another.

A second option considered along the same lines was to treat the system from Lyminge and to lay an overland pipe over a distance of 5km southwards to the sewerage system at Newington. The system here is a larger diameter sewer where the system flows under the M20. However, the cost, disruption, and logistics of installing an overland main over this distance and the technicalities of mobile pumps capable of delivering this flow caused this option to not be viable.

The current plan is to therefore continue to address the root cause of the issue by surveying and sealing the public sewer network whilst identifying other potential methods of reducing the reliance on tankering. Tankering will always be the means in which we manage excess flows in the short term.

4.3 3rd Party Communications about mitigation

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 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. Options to reduce infiltration

5.1 Sewer Rehabilitation Programme

Southern Water has been actively working to reduce infiltration in the Nailbourne area since 2013, investing over £2 million in surveys and repairs. Major works were completed between 2013 and 2016, with additional repairs in Elham from 2017 to 2019. SW continues its infiltration reduction efforts as part of its AMP8 programme (2025–2030), including ongoing electroscan surveys of 12.5 km of sewer to identify and plan repairs for potential leaks.

Table 5.1 below summarises the work undertaken in the system since 2014. The survey from 2025 is still to be analysed.

Action	Km of sewer
Length Surveyed	29.5
Length with no work required	17.3
Length Sealed	3.3
Length to be sealed	0.9
Manholes sealed	0
Manholes to be sealed	0

Year	Length surveyed (km)	Length repaired (km)
2013	3.5	0.7
2014	2.0	0.2
2015	0.6	0.3
2016	0.6	0
2017	0.5	0.5
2018	0.5	0.7
2019	0.5	0.1
2020	0.5	0.1
2021	0.3	0.5
2022	12.5	0
2023	0	0.1
2024	0	0.1
2025	8.0	0

Table 5.2 – annual summary of work completed, 8km to be reviewed in 2025

5.2. Property Level Protection

During 2014, SW installed six NRVs protecting seven properties. There are no plans currently to install any more NRVs, but the potential benefit of further property level protection will be considered if it is considered to be required for any further vulnerable properties.

5.3 Local Flow Control

As noted in Section 4.1 despite groundwater levels having risen higher in early 2015, than they had in early 2013, ground water treatment was not required. Localised tankering was required in February and March 2015 to remove the groundwater from the sewerage system to protect services for a few customers. SW has identified that whilst the sewers were significantly surcharged, levels in manholes further upstream were not. In the winter of 2023, further investigations were carried out and flow control used effectively in Elham to prevent heavily infiltrated sewers upstream causing flooding at low lying areas downstream.

5.4 Pumping Stations

In order to minimise infiltration, SW is continuing to ensure that design flow rates and pump capacity is maintained at pumping stations. This will help to ensure that the design discharge flow continues to be reliably delivered. Pumping stations at The Orchards Elham and Ottinge receive a pre Groundwater season health check to ensure they are in good working order prior to the onset of infiltration.

5.5 Monitoring

The Upper Nailbourne catchment is one of 18 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 on a previous page, in Figure 4.1, 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. The only borehole currently available (with long term trends) in the area is at Little Bucket Borehole, Petham. It shows that groundwater levels have risen steeply during the winter of 2022 though the pump activity in the sewerage system appears shows slight variation and perhaps demonstrates some benefit of previous sewer sealing activity in the system.

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 Little Bucket Farm borehole plotted against flows to Newnham Valley WTW. Note that Newnham Valley WTW is in the Nailbourne catchment, downstream of the major repair works. However, it also processes sewage discharged from two adjacent sub-catchments. (Refer to the Background section for a description of the catchments feeding Newnham Valley WTW). Thus, the flows from the Nailbourne sub-catchment, form a part of the total flows to Newnham Valley WTW. The flow from Ottinge and Elham is a much smaller proportion of total flow to Hythe WTW and graph of the flow to treatment at Hythe is not currently available. Production of a similar graph for upper Nailbourne was considered however the fluctuation in total flow was not apparent.

Figure 5.2 quantitatively illustrates how flow varies with groundwater levels. It is reasonable that as groundwater levels increase, the rate of infiltration increases. Data points prior to the major repairs are plotted in blue: (Dec 2009 – Aug 2013). The data points for the period after major repairs (Jan 2014 – Jun 2021) are plotted in orange. 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.

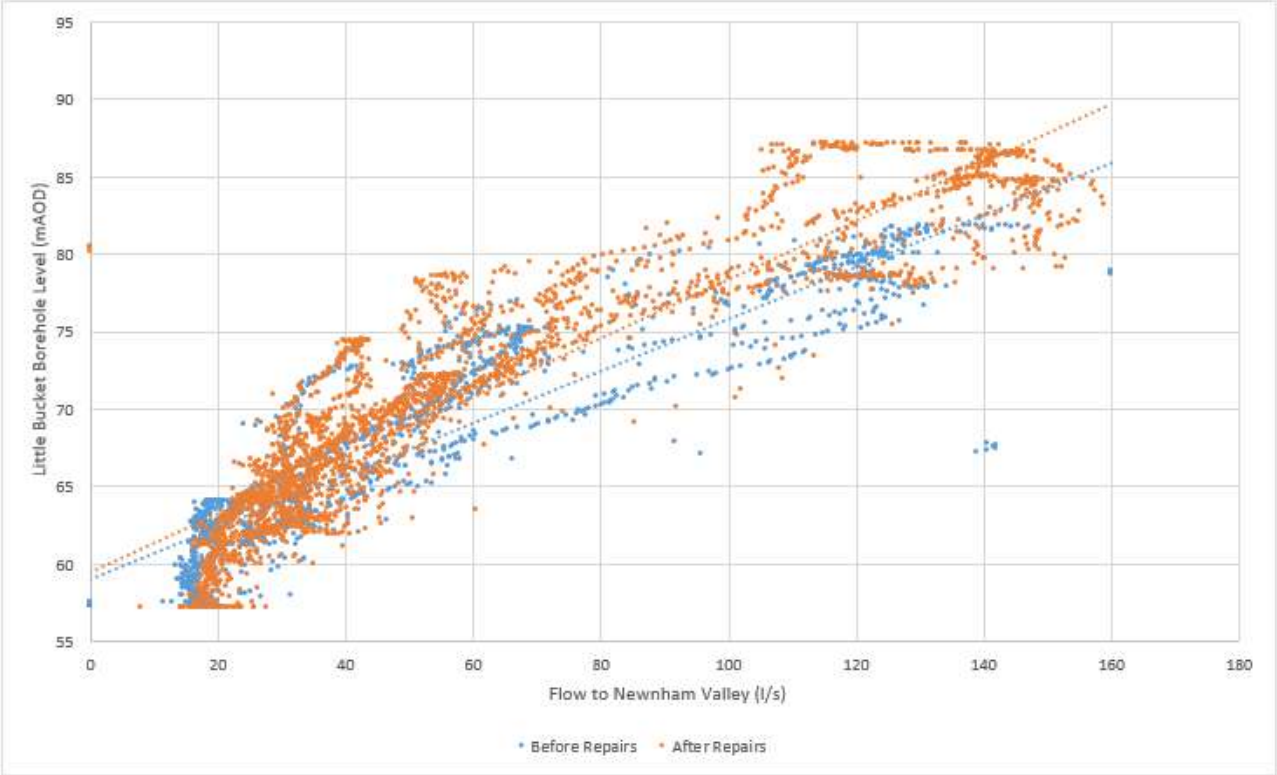

Figure 5.2 – Long Term Monitoring (Dec 2009 to Feb 2021)

The difference in groundwater level between the lines is approximately 1.5 - 3m. In other words, for a given groundwater level, the corresponding flow is lower after the repairs. This confirms that the repair work has been effective.

For the period Dec 2009 to Jun 2021, the graph shows that groundwater levels rose higher after the repairs than they had before. This was due to natural variations in the weather. The maximum groundwater level before the repairs was 81.9 mAOD. After the repairs, groundwater levels at Little Bucket reached 87.2m. Despite these higher groundwater levels, flows to Newnham Valley WTW generally did not increase. Indeed, for the period of time after the repair works, the groundwater levels have been higher than 81.9 mAOD for approximately 18% of the time, yet flows have remained in a similar range to that which existed before.

6.0 Action Plans

A significant amount has been achieved in the Nailbourne and Elham catchments 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 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. Multi-Agency 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 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/ August 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.	Elham Summer 2014 - Complete	Identify major sources of infiltration to determine scope of rehabilitation work.

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	Elham Summer/Autumn 2014 – Complete Autumn 2018 - Complete Autumn 2019 - Complete	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	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	Summer/Autumn 2015 - Completed	Reduced infiltration, leading to reduced requirement for tankers.
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	Ongoing
1.8a	Maintain IRP as a live document	Review Tables 6.1 to 6.5 and as appropriate amend to show progress on individual activities.	Annually	Ongoing
1.10	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.

Ref.	Item	Actions	Timescale and Status	Outcomes
1.14	Action Plans	Develop SW action plans documenting set up of 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.
1.15	Further survey and sealing work proposed for the public sewerage system	SW to gain approval to undertake necessary work	July 2021	Complete
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	Complete
1.17	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.	October 2024	Complete
1.18	Survey result review	Review results of surveys undertaken in 1.16 to determine sewer sealing work.	Autumn 2025	Pending
1.19	Undertake required sewer sealing	Seal sewers and manholes by most appropriate technique	Pending completion of 1.18	To be completed summer 2026

Ref.	Item	Actions	Timescale and Status	Outcomes
1.20	Review effectiveness of any sealing work	Analyse monitoring data and groundwater data to determine benefit of investment	Pending	Pending
1.21	Seal private drains and public sewers in the approved AMP8 Pilot scheme	Identify, communicate and deliver sewer sealing work to create a watertight system	SW – 2025 - 2027	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 'misconnections'	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	Kent 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 Canterbury City 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
3.4	Implement local campaign to discourage misconnections	Publicise through parish councils. Include article in Parish magazines. **	District and Parish Councils, Summer 2014 Complete	Article included in Canterbury City Council magazine.

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

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

Ref.	Item	Actions	Owner, Timescale and Status	Outcomes
4.1	Early Warning system	Joint continuous monitoring of groundwater levels and sewer levels/flows.	SW, EA, 2014. Ongoing. Commenced Jan 2015. Re-commenced annually	Develop trigger levels by comparing historic customer complaints and tankering with BH levels (or other reference). Note: due to the success of the rehabilitation work, the trigger level has been raised from 78.5m to 80.0m at Little Bucket borehole.
4.2	Tankering arrangements	Investigate options for improving location of tankers and ground water treatment 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	Investigate the carrying capacity of the sewerage system north of Littlebourne	SW, July 2014 for capacity determination. Trial - if and when - the sewers are surcharged	Not applicable to Upper Nailbourne
4.4	Flooding Management Plan	Develop plan to address the flooding issues caused by high groundwater. Implement recommendations. This is being addressed by the Little Stour, Nailbourne and Petham Bourne Flood Management Group Action Plan.	Kent County Council & Canterbury City Council, Shepway District Council with inputs from SW, EA, and Parish Councils	Plan to include 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 Completed and Planned Rehabilitation

B Mitigation measures