



Groundwater Impacted System Management Plan

South Moreton, Mill Brook

December 2024



It's everyone's water

Version control

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Introduction

This document sets out Thames Water's approach to the management of groundwater infiltration in sewerage systems where the influence of groundwater infiltration is viewed as being significant and likely leading to the sewerage system, on occasions, becoming overwhelmed.

All sewerage systems combined and separate will experience some groundwater infiltration¹ and a nominal allowance in design will be made for this. However, in some catchments the impact of groundwater infiltration can be considerable leading to impacts on service during periods of high groundwater, typically during the winter.

Groundwater can enter the sewerage system through the pipes and manholes, this may occur at a defect (crack, hole, displaced joint) or on a normal joint on the sewer or in the manhole. A key point to note is that where infiltration occurs it is not necessarily an indicator that the sewer is in poor structural state simply that jointing techniques used are not completely watertight.

Ingress of groundwater is not limited to the public system that Thames Water owns and maintains but potentially the private drains, manholes and sewers that connect to our system.

Preventing and reducing the impact of groundwater infiltration is predominately achieved through the lining of sewers and

sealing of manholes. This entails the application of a synthetic liner within the pipe that creates a contiguous membrane for the length of the pipe or possibly section if the source of ingress can be narrowed down. For manholes it will typically entail sealing in a similar manner.

To line all sewers and manholes within most catchments would be prohibitively expensive to do so. Our approach to date has been centred on a 'find and fix' basis which has involved monitoring and investigating the networks in periods of high groundwater to identify sources of ingress and fix as we find them. This approach is constrained for the reason that investigations are typically limited to periods of high groundwater and when high groundwater occurs there are limited windows of time in which investigations can be successfully undertaken before flows either subside or the system is fully surcharged meaning CCTV surveys are not possible². Once sections of sewers have been lined, it will be a case of waiting until high groundwater levels reoccur to assess the effectiveness of the work undertaken, which may not be the subsequent winter but several years later.

It is recognised that the 'find & fix' approach to date lacks a degree of certainty of resolution and for this reason Thames Water in 2020 undertook a different approach for the medium to long-term management of groundwater, which is covered within this

¹ Construction Guidance" Guidance makes an allowance for 10% of peak wastewater flow to allow for unaccounted flows such as groundwater infiltration.

² On occasions it is possible to over-pump between manholes to isolate sections of sewer to survey, this is not always feasible when the flows involved are simply too great to over-pump or the location prohibits this approach.

document under the plan section. These plans require significant investment which Thames Water will seek to secure through the price review process as service enhancement. In the meantime, we will continue to investigate sources of infiltration when it occurs and where feasible, undertake the work through our capital maintenance budgets. We refer to these as 'quick win' opportunities i.e. where we have high degree of certainty of reducing point sources of infiltration and can do so with reasonable costs and time.

The structure of this document has been created with input from the Environment Agency. Sections covered in this document include our 'Outline Plan' with timescales, Mitigation i.e. how we intend to manage the risk until our plan is fully implemented and when we will publish future updates on progress against this plan.

Brief description of the South Moreton catchment

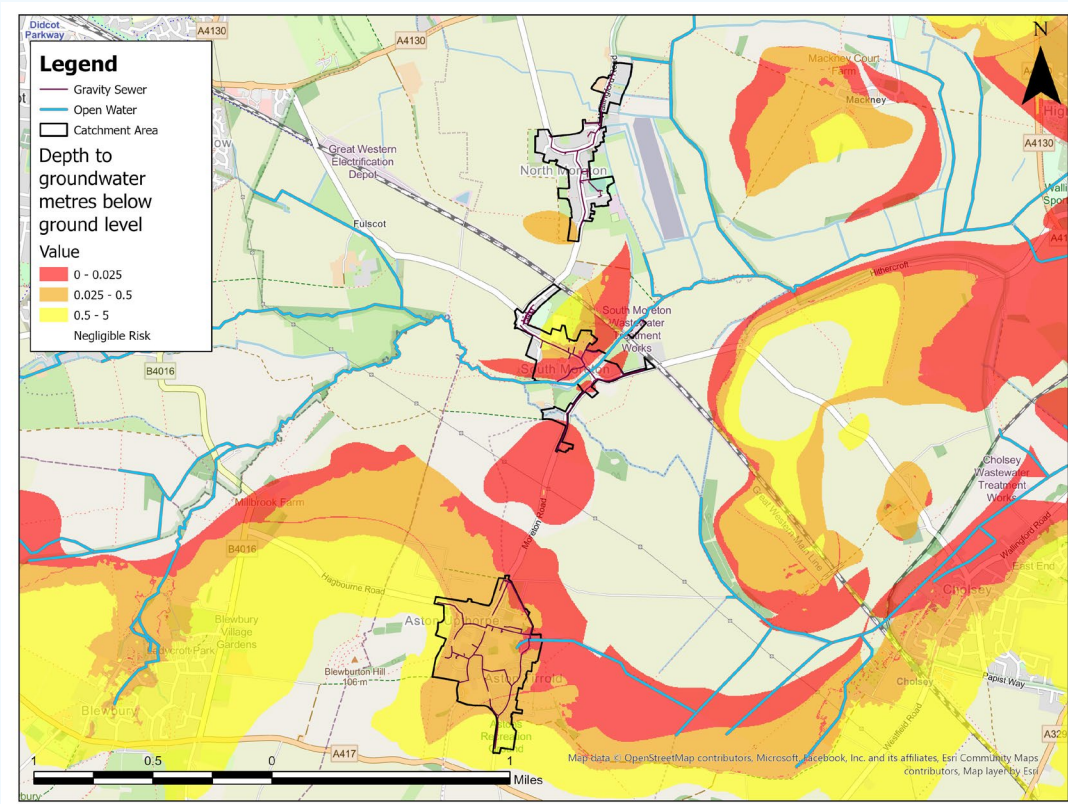


Figure 1.0 – South Moreton catchment

South Moreton is located in South Oxfordshire, England, 3 miles east of Didcot and 4 miles west of Wallingford. South Moreton serves a population equivalent³ of 1,264 with a predominantly separate sewerage network totalling some 9 km in length excluding private drains and sewers. The extent of the catchment is shown in Figure 1.0 above.

Problem characterisation

During the winter months, often following prolonged heavy rainfall, we experience increased rates of flow arriving at the STW which on occasions may impact the performance of the STW. Furthermore, groundwater can enter our sewers when groundwater levels are high and a positive head above the soffit of the sewer is created. Significant groundwater ingress can impact sewer capacity and increase the risk of the sewerage system becoming overwhelmed.

³ Population equivalent based on unit per capita loading, (PE), in waste-water treatment is the number expressing the ratio of the sum of the pollution load produced during 24 hours by industrial facilities and services to the individual pollution load in household sewage produced by one person in the same time.

In recent years the foul sewerage system in the South Moreton catchment has become overwhelmed, following prolonged and heavy rainfall and high groundwater levels. The sewerage system is identified on the public sewer records as being a separate foul system, rather than a combined system. It should therefore, in theory, only be accepting foul drainage rather than a combination of foul and surface water.

The analysis of Event Duration Monitor (EDM) spill data between 2022 and 2023 has indicated the presence of unwanted flows within the foul sewerage network (see Table 1 and Figure 2). This is likely to be a contributor of spills occurring at South Moreton sewage treatment works (STW). There have been several recorded spills at the sewage treatment works during summer 2023. Assessment of the groundwater levels in this area showed lower groundwater typical for this time of year, which suggests that there are potential surface water misconnections (i.e. downpipes from roofs), into the foul sewerage network which cause spills at the sewage treatment works during high intensity rainfall.

It has been identified that power outages at the STW may have contributed to EDM spill counts historically.

We therefore have a perceived understanding of the possible root causes of spills within the South Moreton foul sewerage network, which we are in the process of investigating, monitoring, and verifying over the forthcoming winter periods.

The South Moreton catchment is generally made up of siltstone and sandstone. This is predominantly overlaid with loamy and clayey soils with impeded drainage. This catchment is situated in an area that is prone to significant seasonal fluctuations in groundwater levels.

There are a number of springs within the catchment that feed a network of small watercourses. These are generally designated as Ordinary Watercourses.

The root causes of sewer surcharges and STW performance are therefore numerous and resolution of issues complex, requiring all stakeholders responsible for drainage in the catchment to work together to resolve them.

The Flood and Water Management Act 2010 places a responsibility on Lead Local Flood Authorities (LLFAs), to manage flood risk from surface and groundwater, plus a duty on all Risk Management Authorities (RMAs), to cooperate regarding flood risk. In our role as an RMA, Thames Water will work with Oxfordshire County Council as Lead Local Flood Authority and as the planning authority, and the Environment Agency to ensure that a collaborative approach can be developed to address the problems.

Thames Water also has a statutory obligation to comply with environmental legislation. The Water Framework Directive (2017) establishes a strategic approach to managing the water environment, which the Environment Agency achieves through River Basin Management Plans and setting environmental objectives for groundwater and surface water. The environment is also protected from adverse effects of discharges of urban wastewater through the Urban Wastewater Treatment Directive (1994), which requires us to improve and extend the sewerage system according to section 94 of the Water Industry Act (1991).

A number of our sewerage systems also contain permitted overflows within the sewerage network. The function of these structures is to protect against sewer flooding due to rainfall and infiltration or equipment failure where appropriate.

The impact of the groundwater infiltration and surface water flows in the catchment can overload the gravity sewers, sewage pumping stations in the system and the STW; impacting the performance of the STW.

Our permit conditions for South Moreton STW state:

“A discharge from the storm tank shall consist of storm sewage effluent resulting from rainfall or snowmelt into the sewerage system. The discharge from the storm tank shall not so far as reasonably practicable cause significant visual or aesthetic impact due to deposit of solids on the bed or banks of the receiving watercourse, or growth of sewage fungus on the bed of the receiving watercourse”.

Anticipated unavoidable discharges

In the network, whilst we experience increased flow in winter, we are not aware of any escapes or flooding as a result, the impact is focused/centred solely at the STW.

No mitigation in the form of temporary overflows has been undertaken in the system.

Event Duration Monitoring Data

Event Duration Monitors (EDM) are utilised within the South Moreton catchment to capture data relating to spill occurrences and durations when the sewage network becomes overwhelmed. The EDM data for 2022 and 2023 can be seen below.

A critical part of the assessment of EDM performance and its relation to groundwater infiltration is to review the month-on-month spill performance, against previous years and the monthly total rainfall values to give context to the performance

Table 1 and Figure 2 below details the last 2 years performance for the overflow at South Moreton STW.

Overflow	2022		2023	
	Spills	Duration (Hours)	Spills	Duration (Hours)
South Moreton STW	11	53	162	2568

Table 1 – Event Duration Monitoring (EDM) spill counts and durations for 2022 and 2023 at South Moreton.

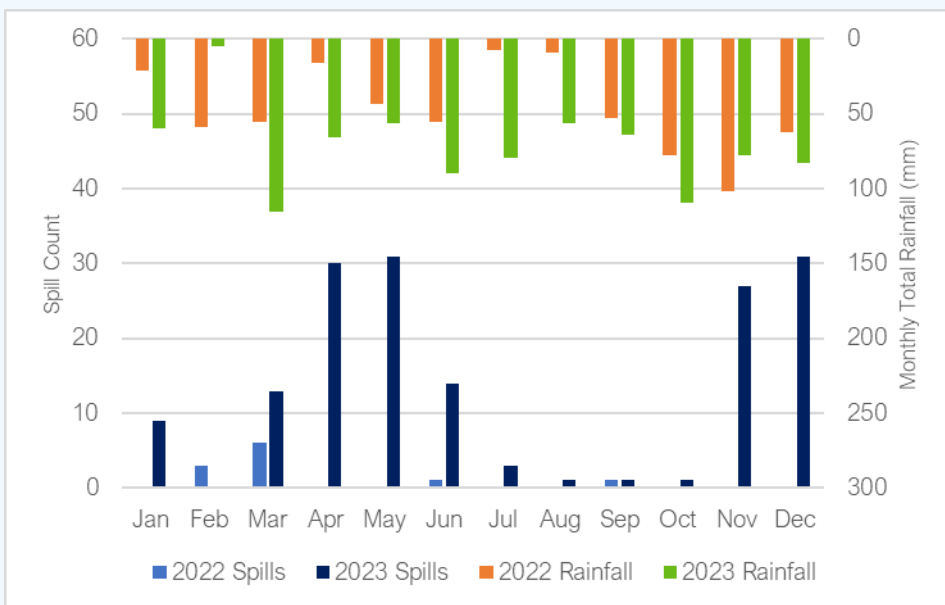
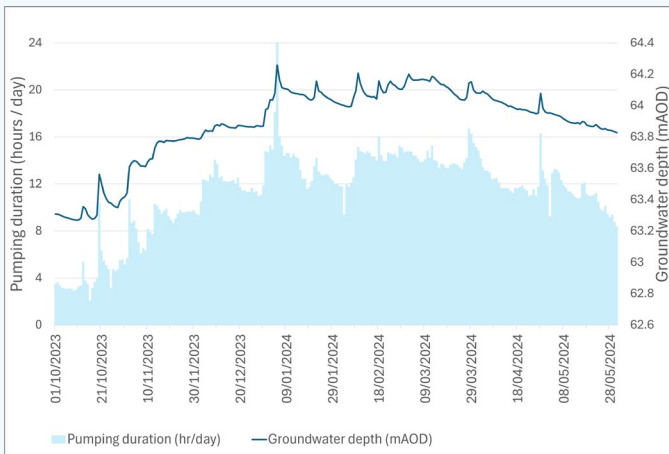
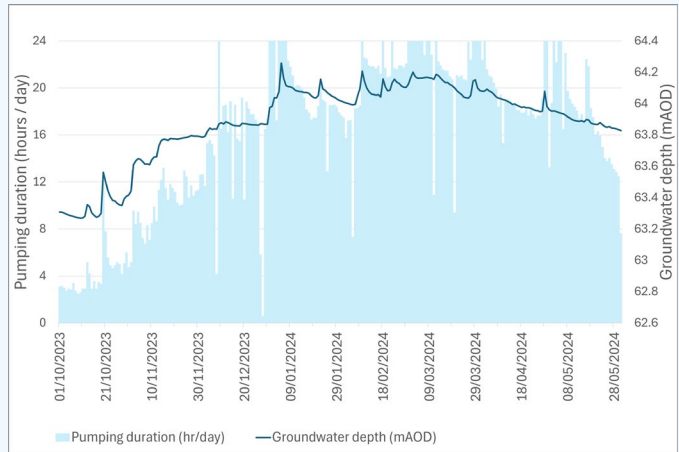
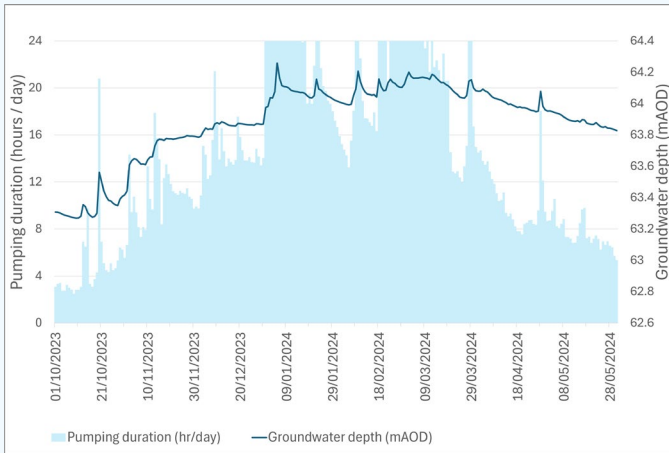


Figure 2 – Event Duration Monitor (EDM) spill counts and monthly rainfall totals for 2022 and 2023 in the South Moreton catchment

Sewage pumping station (SPS) running durations

One method used to assess groundwater infiltration within the South Moreton catchment is exploring sewage pumping system's (SPS) activity against changes in groundwater levels. Brookside Blewbury is the nearest groundwater reference station to the South Moreton catchment and SPS activity here can be seen to coincide with elevations in groundwater levels as shown in Figures 3.

Figures 3.0 A-C – Sewage pumping stations (SPS) daily run durations across the South Moreton catchment and groundwater levels at Brookside Blewbury groundwater reference station for the period 01/10/23 – 31/05/24



The above SPS run durations gives an indication as to the location of unwanted flows in the foul sewerage network. This data will be used in conjunction with available flow data at South Moreton STW, rainfall data, river level data, and groundwater level data to create a full picture of movement and source of flows around the catchment.

General outline plan

Zones of Groundwater Risk

We engaged with JBA Consulting to develop plans for South Moreton that identify zones of groundwater risk. This was informed by GIS analysis considering the depth to groundwater level, see Figure 1.0. These zones are modelled areas where the groundwater has been determined to be above the sewer and hence pose a potential risk for groundwater ingress.

If excessive infiltration is still being experienced in the network following the proposed sealing in part or wholly⁴ of the high-risk zones. We would then look to potentially seal 'private' laterals and/or drains along with starting to seal the medium to low risk zones.

This document sets out an unconstrained approach to resolving the impact of groundwater infiltration within the system. Investment to address infiltration will be assessed and prioritised against other drivers e.g. STW upgrades, both in the catchment and across the region at each price review.

With this plan we remain committed to minimising the impact of groundwater on the sewerage system in South Moreton catchment.

Our general medium to long term plan is therefore to apply a hierarchy to sealing the sewer as follows:

Activity	Description
Model Zones	JBA have been engaged to undertake modelling activities to identify the areas to be targeted for sealing in the systems identified as being impacted by infiltration.
Look & Lift	The look & lift surveys have two purposes, firstly to confirm the presence of infiltration in the catchment as per the SPS data and secondly to identify 'quick fixes' that we would address through our normal capital maintenance.
CCTV	Required to confirm sewer condition and provide information to assist with costing any sewer lining.
Minor works	As mentioned, if we detect minor works being required, we would look to resolve these as and when we find them.

⁴ Decision regarding the extent of sealing will be based on outcomes of works undertaken to date, results of monitoring and successful submission of our plans for investment.

Activity	Description
PR29 / Price review	In the absence of evidence justifying the need not to undertake sealing of the high-risk zone this is to be included as part of PR29 investment plan. This work will be subject to Cost Benefit Analysis and Best Technical Knowledge Not Entailing Excessive Cost (BTKNEEC) assessments.
High risk zone sealing	Sealing of high-risk zone undertaken subject to need being demonstrated.

South Moreton Infiltration Management Plan

As detailed above the impact of infiltration is experienced at the STW but the exact mechanisms involved are still to be confirmed through investigation of the network. If the mechanisms are confirmed to be as a result of groundwater ingress into the network, our approach to the resolution of infiltration impacting the South Moreton sewerage system is outlined below.

High level approach statement

For South Moreton our approach to tackling infiltration will be undertaken as follows:

1. To deal with the infiltration experienced we will investigate the network with a view to identifying sources of ingress of infiltration that are cost effective⁵ to address. To investigate the network, we/will
 - Have undertaken a desktop analysis to determine infiltration high to low risk zones (October 2024);
 - Undertake sample CCTV in the high to low risk zones to assess the general asset health of the sewers and manholes (ongoing).
2. Where interventions can be undertaken as part of normal sewer maintenance activities these will be communicated and progressed.

3. If significant investment is identified as being required, then this will need to be considered in terms of relative need compared to other systems being investigated for infiltration reduction. However, where viable opportunities are identified these will be included in our AMP9 (2030-35) programme of investment. Significant investment needs may need to be included in our future investment planning cycles.

Investigations

As mentioned above JBA Consulting have been supporting by undertaking an exercise involving assessing groundwater elevation data to determine which areas of the network are potentially below the groundwater table during high groundwater periods.

Site investigations, undertaken by Dene-Tech and our Customer Field Services (Thames Water Operations) have included 'look & lift' surveys, CCTV and where necessary dye tracing to confirm connectivity.

A table of the work undertaken is included in the appendix to this report.

⁵ Assessment of cost effectiveness is based on assessment of the ratio of the cost of a solution to the monetised benefit gained from implementing the solution i.e. reduction in flood/pollution risk and/or reduced operating costs.

Mitigation

On occasions to avoid flooding of properties or to manage the risk of damage to the environment we may undertake tankering from points (manholes) on the network, making use of pumps to manage flows or deploy settlement tanks to part treat sewage before release to the environment.

Updates

Work on the Groundwater infiltration management plan will continue, and we will aim to provide updates annually by the end of October each year.

Appendix

Investigations & remedial work undertaken and future plans

The table below presents a summary of the JBA groundwater infiltration analysis which identifies the sewers and manholes which are likely to be vulnerable to groundwater infiltration.

Sewer Length by Groundwater Infiltration Risk Zones

Risk category	Description	Length (km)	Percentage
High	Predicted groundwater extreme >1m above pipe invert	4.88	54.0
Medium	Predicted groundwater extreme 0-1m above pipe invert	0.24	2.7
Low	Predicted groundwater extreme 0-1m below pipe invert	0.79	8.7
Very Low	Predicted groundwater extreme >1m below pipe invert	3.13	34.6
Total		9.04	100.0

Manholes by Surface Water Inundation Risk Category

Risk category	Description	No. of manholes	Percentage
High	Inundation risk in 3.3% AEP fluvial or pluvial event	26	9.6
Medium	Inundation risk in 1% AEP fluvial or pluvial event	28	10.3
Low	Inundation risk in 0.1% AEP fluvial or pluvial event	12	4.4
Very Low	All other manholes	205	75.7
Total		271	100.0

Investigations & remedial work undertaken and future plans

CCTV surveys have been undertaken in Winter/Spring 2024 to identify the presence of infiltration in the foul sewerage network. The purpose of the surveys is to identify priority locations for remediation and to help verify the sewer risk zones. The system will continue to be monitored, and investigations/ interventions carried out as appropriate and when conditions allow.

Works Undertaken in the 2023/24 Hydrological Year

*Total length of network across sewers surveyed in areas predicted to be at high/ medium and low risk of groundwater infiltration

Investigation/remediation type	Description
CCTV survey	0.34 kilometres*
Look and lift survey	N/A
Sewer lining	N/A
Patch lining	N/A
Manhole sealing	N/A
Manhole sealing plates	N/A
Manhole covers and frames replaced	N/A

The below tables summarise the CCTV surveys undertaken for South Moreton in the 2023-24 Hydrological Year and gives details of the infiltration identified.

Summary of CCTV surveys undertaken

CCTV Results	Length (m)
Total length of sewer surveyed using CCTV	336
Total surveyed with clear flow	254

Summary of infiltration identified and severity

Infiltration Severity	No. of sections of pipework
Gushing	1
Running	0
Dripping	0
Seeping	0
Total	1

Glossary of terms

AEP – Annual Exceedance Potential

AMP – Asset Management Plan

CCTV – Closed Circuit Television

EA - Environment Agency

IRP – Infiltration Reduction Plans

MH – Manhole

STW – Sewage Treatment Works

WINEP – Water Industry National Environment Programme