WASP REVIEW OF UNPERMITTED SPILLS FROM SEWAGE TREATMENT WORKS

PART1: 735 "illegal" discharges of untreated sewage from 13 Thames Water STWs 2018-2020

Peter Hammond, Windrush Against Sewage Pollution (WASP), October 2021

SUMMARY

If a wastewater treatment works discharges untreated sewage when there is no rainfall it is a "dry" spill. If it discharges sewage before reaching its obligatory minimum treatment rate, it is an "early" spill. "Dry" and "early" spills breach Environment Agency (EA) permit conditions and should be considered illegal.

In EA records covering 11 years (2010-2020) and thousands of STWs, there are 174 "dry" or "early" breaches, 33 of them by Thames Water. In contrast, WASP has uncovered 735 such breaches in 3 years (2018-2020) at 13 Thames Water STWs. So, 95% (702/735) of "dry" and "early" spills at these STWs may go unrecorded by the EA.

WASP's review provides clear evidence that operator self-monitoring by the water industry and regulation by the EA are not working. Furthermore, it suggests that the annual Environment Performance Assessment of sewerage providers, a key element of OFWAT's and DEFRA's financial regulation of the water industry, is based on incomplete data and is like a house built on sand.

BACKGROUND

Thames Water is the major sewerage provider in WASP's home territory of West Oxfordshire and the Cotswolds where watercourses are badly hit by spills of sewage. In 2019, of 533 parliamentary constituencies, the Witney and Cotswolds seats of MPs Robert Courts and Sir Geoffrey Clifton-Brown, were respectively 6th (13,295 hrs) and 12th (10,086 hrs) worst for total hours of spilling sewage to watercourses. These totals were provided to the EA by the water companies concerned - primarily Thames Water, but also Severn Trent Water and Wessex Water in Gloucestershire. Some spills of untreated sewage are first reported by the public to a water company or to the EA whose role is to investigate potential breaches of discharge permits to watercourses and in serious cases initiate criminal proceedings.

DATA

In response to an Environment Information Regulation (EIR) request by WASP, the EA provided details of 174 breaches of discharge permits relating to "dry" and "early" spills from STWs operated by the 9 water companies in England between 2010 and 2020. "Dry" spills involve discharges of sewage being made during dry weather or minimal rainfall, or as the EA records suggest, "no rainfall falling in previous two days" or "minimal rain for seven days". "Early" spills relate to the discharge of untreated sewage to watercourses before an obligatory minimum flow to full treatment rate has been achieved.

Of these 174 "dry" and "early" permit breaches recorded by the EA across all 9 sewerage operators in England, 33 occurred at STWs operated by Thames Water (Fig. 1). The EA did not declare which breaches were prosecuted but said "*Typically, where there isn`t a prosecution, civil sanction or formal caution, the breach will be minor and will have normally resulted in a warning".*

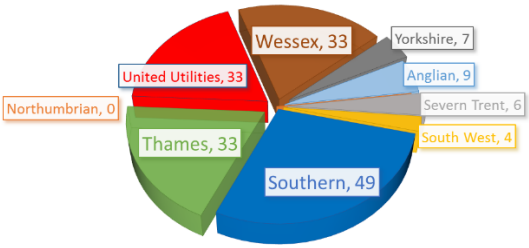


Figure 1: 174 "early" and "dry" illegal spills of untreated sewage by Water Companies according to EA records for 2010 to 2020; 33 were made by STWs operated by Thames Water

Source: Environment Agency EIR: THM184412

Further EIR requests to Thames Water asked for details of sewage flows receiving full treatment, treated effluent flows and the start/stop times of sewage spills for 14 STWs from 2018 onwards. The STWs considered here in Part 1 of WASP's review were selected because they measure and record flow receiving full treatment. The data provided for one STW was unusable. The 13 reviewed treat the sewage for 17% (2.89 million) of the population served by Thames Water. Other STWs that measure only treated effluent will be considered in Part 2 of the review. Rainfall data were obtained from public online sources. STW permits for discharging to watercourses were requested via the EA's Public Register (https://environment.data.gov.uk/public-register/view/index).

ANALYSIS

Each year, water companies report treatment flow and event duration monitoring (EDM) of untreated sewage spills to the EA, but only **daily total** flow and **yearly total** hours of spilling. In contrast, WASP asks STW operators for flow data recorded every 15 minutes (96 times each day) and start/stop times of each spill. The EA requires this detailed information to be measured and recorded but does not request it unless, as the EA have said, there is suspicion of a permit breach.

Unfortunately, daily total of sewage treated masks evidence of unpermitted spills that is detectable from 15-min flow data. Therefore, EA suspicion is less likely to be aroused and spills at STWs are missed. Similarly, annual spilling hours mask the frequency and length of individual spills or groups of STWs spilling for long periods at multiple points along a watercourse.

In short, WASP reviews 100 times finer grained data than the EA typically analyses.

WASP uses 100 times more data than the EA to detect illegal spills of untreated sewage

WASP believes that 95% of illegal "dry" and "early" spills at Thames Water STWs may go unrecorded by the EA

The analysis employed simple yearly spreadsheets with automated monthly charting of flow, spill start/stop times and rainfall. Days where a spill occurred with no rainfall on the day or the day before were labelled as "dry" and as "early" if the sewage flow receiving full treatment did not remain above the permitted minimum rate, often referred to as the pass forward flow rate or storm overflow setting, for the entire spill. In all, 806 "dry" or "early" spilling days were detected and of those 735 occurred between 2018 and 2020.

WASP believes that its review shows that at least 95% of "dry" or "early" spills from the Thames Water STWs it has reviewed may go unreported by the company or undetected by the EA. The review has also uncovered examples of spills occurring for as long as six months without respite and major spills of untreated sewage within the boundary of a sewage works due to malfunction that inevitably overflowed to an adjacent watercourse. Thames Water has also demonstrated poor record keeping and an inability to oversee the installation of EDM (event duration monitoring) devices that record spills of sewage from storm tanks used temporarily to hold untreated sewage while adverse weather is causing the extra inflow to a sewage works.

The results of the review are a shocking indictment of Thames Water's poor management of these works, their disregard for the environment and the low rate that such permit breaches are reported to, or are detected by, the EA. Operator self-monitoring is not working and neither is the regulation of STW permit compliance.

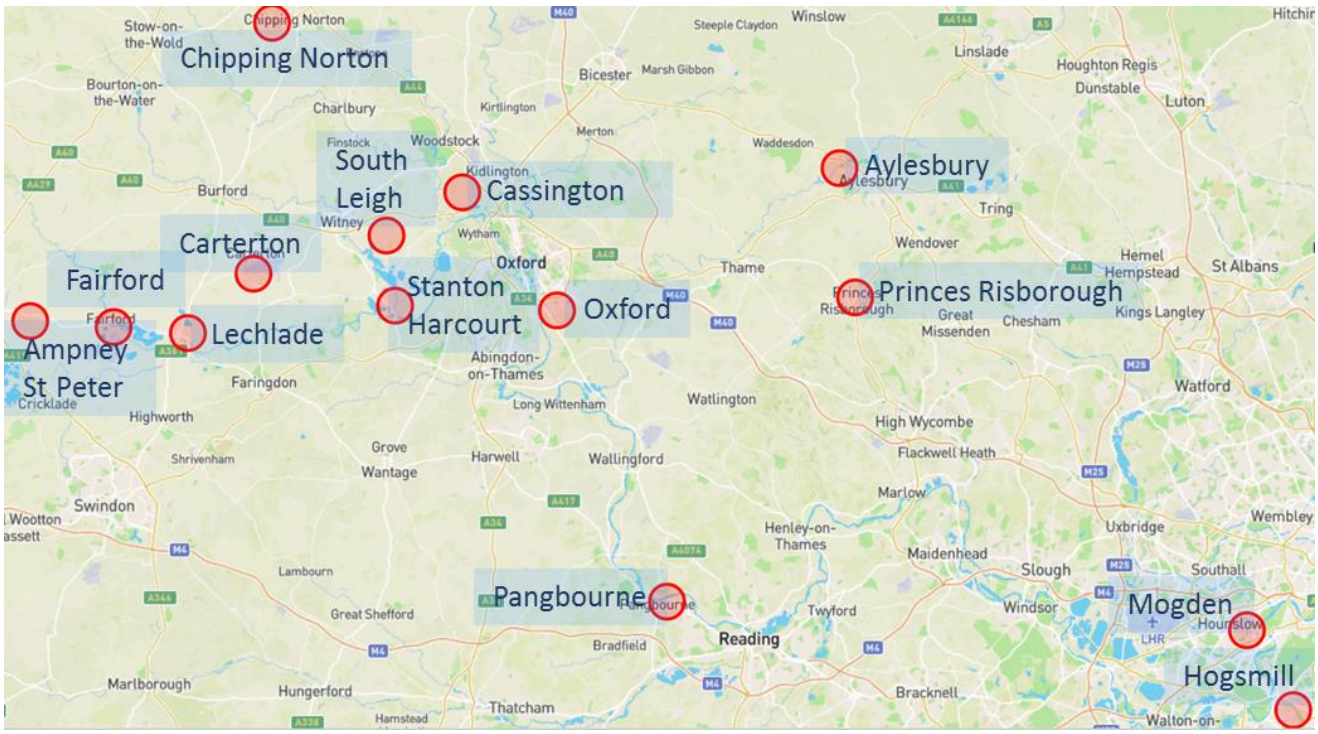
WASP's review is summarised below in a league table of total days when it believes "dry" and "early" spills occurred. Highlights for each of the STWs is followed by fourteen annexes focusing on the individual STWs with examples and dates of illegal spills and/or a discussion of overall performance.

Table 1: Number of days WASP believes there were illegal spills based on EDM and flow to treatment data

Thames Water STW	PE (k)	Watercourses affected as well as River Thames	TOTAL	2021 limited	2020	2019	2018
Stanton Harcourt	0.9	Harcourt Brook, Chil Brook	**266**	18	114	86	48
Oxford	195.3	R Thames	**157**	DNS	77	44	36
South Leigh	0.3	Limb Brook, Chil Brook	**75**	24	18	24	9
Mogden	2,100	R Thames	**75**	2	33	32	8
Fairford*	4.6	R Coln	**45**	DNS	17	23	5
Chipping Norton	8.6	Blue Brook/R Evenlode	**44**	8	18	18	0
Carterton	17.1	Shill Brook	**44**	3	23	14	4
Hogsmill	407.1	Hogsmill Stream**	**33**	DNS	13	20	0
Princes Risborough	15.3	Horsenden Brook** / R Thame	**21**	13	3	5	0
Ampney St Peter	2.4	R Coln	**20**	DNS	13	2	5
Cassington	16.5	R Thames	**17**	DNS	9	8	0
Aylesbury	99.3	R Thame	5	DNS	5	DNS	DNS
Lechlade	2.9	R Leach	**4**	3	1	0	0
Pangbourne	PDQ	R Sul	PDQ	PDQ	PDQ	PDQ	PDQ
	2,870	**TOTAL**	**806**	**71**	**344**	**276**	**115**

* inlet flow **Chalk stream DNS = full data not supplied PE(k) = Population Equivalent in thousands PDQ=poor data quality
The STWs in Part 1, selected because they measure flow to full treatment, account for 17% of the population that Thames Water serves.

Location of the 14 Thames Water STWs considered in Part 1 of WASP's review



Brief summary of the findings for each Thames Water STW considered in Part 1 of WASP's review

Ampney St Peter	Within Cotswolds AONB. A frequent "dry" spiller due to groundwater infiltration. Discharges into the Ampney Brook which is following the same deteriorating trajectory as the River Windrush.
Aylesbury	10 year-old storm discharge permit. **Criminal conviction in 2016 for flow clipping in 2013**. Using finer grained data than the EA typically employs, WASP has shown the flow clipping was detectable in 2011 and maybe the 2013 fish kill was avoidable.
Carterton	Thames Water has failed to provide correct and consistent data to WASP, the EA and to a member of Carterton Council.
Cassington	10 year-old storm discharge permit. Poor quality data limited analysis which was disappointing given the potential 30% load increase when the Eynsham/Salt Cross Garden Village is connected.
Chipping Norton	Within Cotswolds AONB. Made at least 26 illegal spills January 2020 to April 2021. Inadequacy and/or lack of data pre-empted full analysis of 2018 and 2019.
Fairford	Five-month continuous spill involving an estimated 370 million litres of sewage being dumped into the River Coln over the autumn/winter period of 2019/2020.
Hogsmill	Spills into a chalk stream. **Criminal conviction in 2021**. Suspicious losses of sewage in the early hours on at least 4 occasions in 2018 totalling 61.5 million litres of sewage.
Lechlade	Does not appear to be a significant "early" or "dry" spiller but does at times have unusual flow to treatment patterns that need further investigation.
Mogden	Seven-fold increase in spilling billions of litres of sewage: 0.5 in 2015 to 7.5 in 2020. Spilled 1 billion litres of sewage (400 Olympic pools) on each of 2 days in 2020.
Oxford	10 year-old storm discharge permit. The design capacity that the works should cope with suggests it has made "early" or "dry" spills on more than 150 days between 2018 and 2020.
Pangbourne	Another lost opportunity to monitor an STW because of Thames Water's poor record keeping and oversight of subcontracted installation and monitoring of EDM.
Princes Risborough	**Criminal conviction in 2016 for offences in 2013**. Groundwater infiltration at Princes Risborough continues to be a major problem.
South Leigh	Five and a half months of unbroken spilling over autumn-winter of 2019-2020. Its spills find their way to the same watercourse, Chil Brook, also affected by Stanton Harcourt STW.
Stanton Harcourt	Chaotic spilling to adjacent watercourse and on site involving an estimated 28 million litres of sewage in 2020. Worst spiller in terms of frequency and illegality of all STWs reviewed. Its receiving watercourse, the Chil Brook, once hosted a crystal moss with IUCN "Red Book" threatened species status.

AMPNEY ST PETER STW

Ampney St Peter STW does not spill early but is subject to significant groundwater infiltration and "dry" spills resulting in a dramatic difference between the state of the Ampney Brook upstream and downstream of sewage sources.

Ampney Brook above sewage sources (30/06/21)

Ampney Brook below sewage sources (10/07/20)

Figure 1 Ampney Brook upstream and downstream of the STW outfall Images: WASP founder Ashley Smith

2020

Ampney St Peter STW spilled for 2,316 hours over 112 spilling days of which 13 occurred with no rainfall on the day or day before and 39 occurred with no more than 2 mm of rainfall on the day or its eve. Examples in **Fig**. 2.

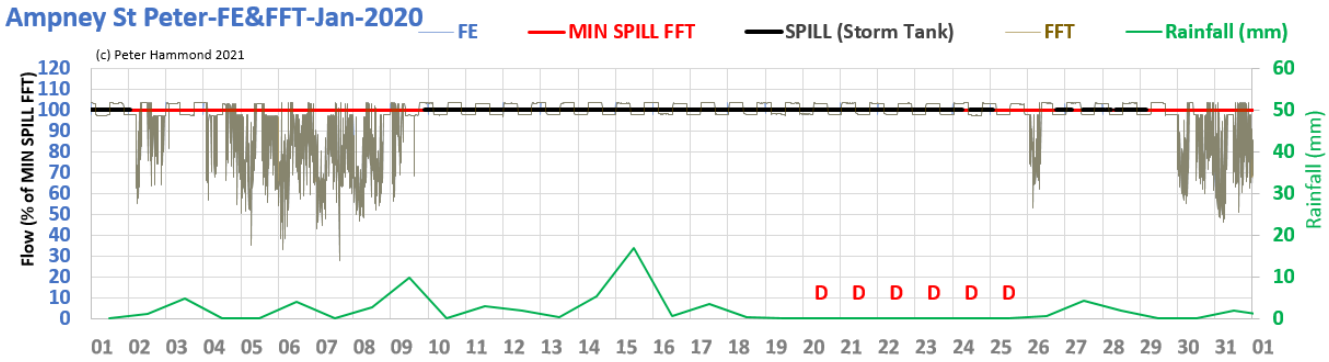


Figure 2: 20 days of spilling in January 2020 including 6 with no rain on the day or the day before

2019

Ampney St Peter STW spilled for 1,854 hours over at least 86 spilling days of which 2 occurred with no rainfall on the day or its eve and 21 occurred with no more than 2 mm of rainfall on the day or its eve. The treatment flow data suggest it spilled an additional 290 hours before the EDM device was installed (**Fig**. 3).

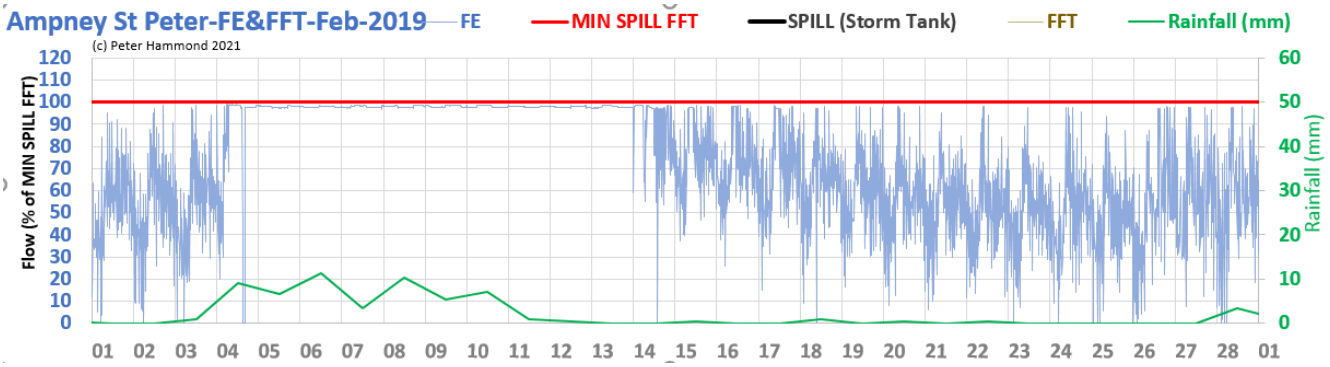


Figure 3: flattened flow curve on 9 putative spilling days in Feb 2019 before EDM was introduced at the works

2018

There was no EDM device installed, but the flow data suggest that it spilled for at least 1,000 hours over more than 45 spilling days, some of which involved no or minimal rainfall (**Fig**. 4).

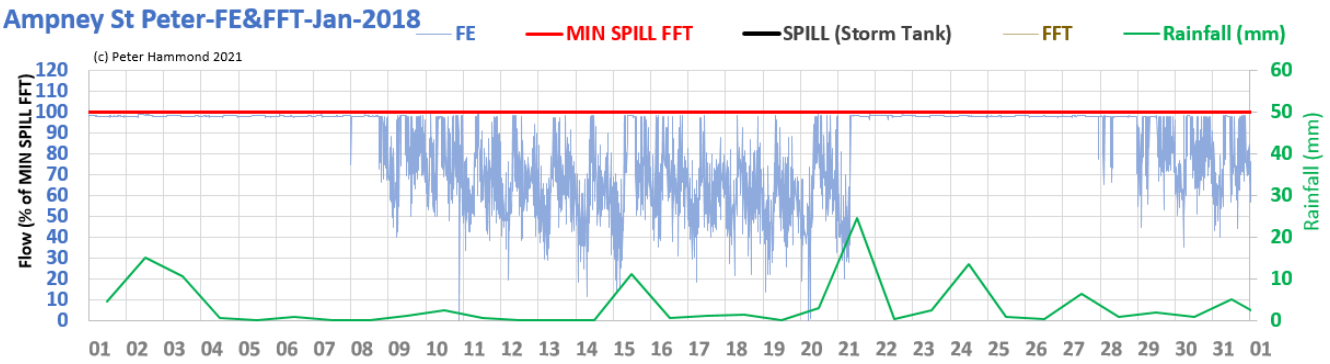


Figure 4: flattened flow curve suggesting 16 spilling days (Jan 1-8; Jan21-28) with 50% involving no or low rainfall

AYLESBURY STW

Aylesbury, Cassington and Oxford STWs are different from the other sewage works considered in this report because their storm discharge permits do not require minimum continued treatment during a spill. Their permits include the usual condition about the cause being due to "rainfall or snowmelt". Instead of clauses related to continuing to treat above an overflow setting before diversion to a storm tank or spill to a river, they require that "as far as reasonably possible" a storm discharge should not result in detectable solid deposits on river banks or bed nor result in growth of sewage fungus. Each of these three STWs have had such a "temporary" storm discharge permit for over 10 years.

When asked for information about storm overflow rates and storm tank sizes for all sewage works in England, the EA provided a large table for Thames Water STWs with the following entry for Aylesbury STW (20/05/20):

STW Nameless	Settled Storm (Storm Tank) Permitted Pass Forward Flow Rate / Overflow Setting (L/S)	Storm Tank Permitted Volume (M3)	Storm Tank Capacity Required To Meet 68 L/H (At Permitted Dwf) (Based On Thames Water Pe Methodology Re Separate Sewers)	Current Storm Tank Volume (M3)
Aylesbury	715	8862	3229	8862

Table 1: Aylesbury STW storm overflow rate and storm tank size specified by Environment Agency

In 2016, Thames Water received a criminal conviction for flow-clipping at Aylesbury STW for several months in 2013 i.e. deliberately spilling untreated sewage. It was shown that up to 50% of incoming waste was by-passing treatment before being illegally discharged. The presiding judge, Francis Sheridan, agreed with the EA that flow to full treatment (FFT) / specified design capacity should be met before storm discharges are made. WASP demonstrates below how flow-clipping at Aylesbury STW might have been detected years earlier if the EA had had quick access to 15-min flow data rather than daily flow data they ask water companies to provide.

The flow clipping is detectable from the flattening of the FFT curve (**Fig**. 1): at 80% of the 715 l/s design capacity in January and February and often at only 40% in March and April. **Fig**. 1 charts FFT for 2013 when measured every 15 minutes to give 96 values per day.

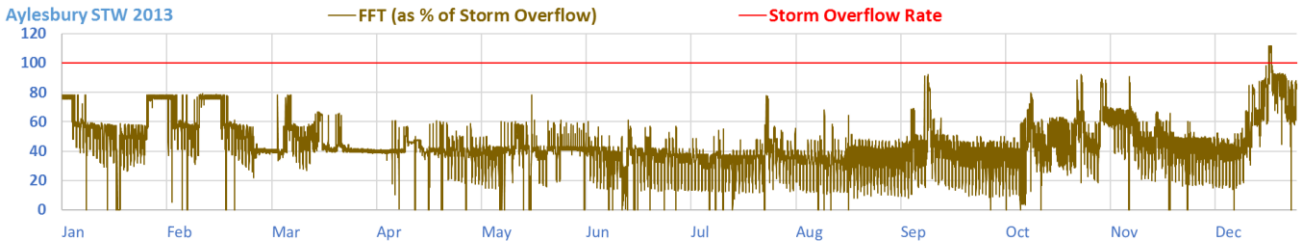


Figure 1: flow clipping detectable in flattening of flow to treatment (FFT) curve to 80% of the storm overflow setting/design capacity in January and to 40% in March and April 2013

When viewed as the EA receive the same data (**Fig**. 2), a single total flow value per day, it looks less rectilinear and less flattened, and therefore less suspicous. Whereas **Fig**. 1 arouses suspicion of anomalous and unnatural flow, **Fig**. 2 does not.

Figure 2: total daily flow curve for 2013 smoothing out the rectilinear, clipped edges of 15-min flow curve in Fig 1

In fact, flow clipping was already happening in the first 3 months of 2012 and was detectable by the flattened highest daily flow values in January to April, generally peaking at about 50%, as well as the unnatural, rectilinear shape of the flow May to July and Nov to Dec (**Fig**. 3).

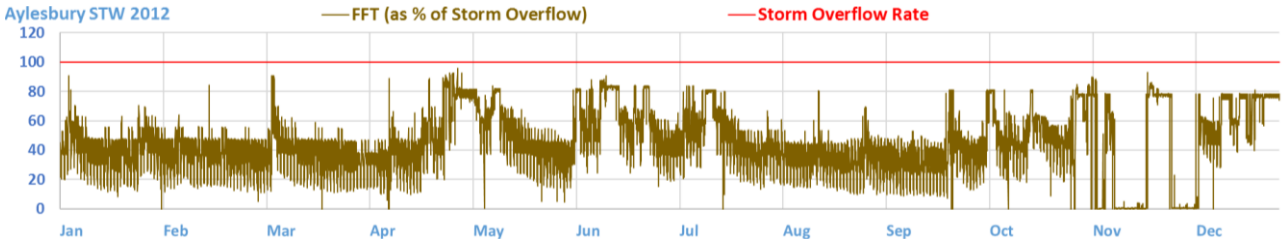


Figure 3: flow clipping already detectable in the flattened FFT curve in early and autumn 2012

As with 2013, the equivalent total daily volume curve for 2012 (**Fig**. 4) masks the flow clipping in that:

a) in January to April it introduces fluctuation that hides the constant, clipped look of the upper flow values;
b) in May to July and November to December 2012 it smooths the clipped, rectilinear curve edges.

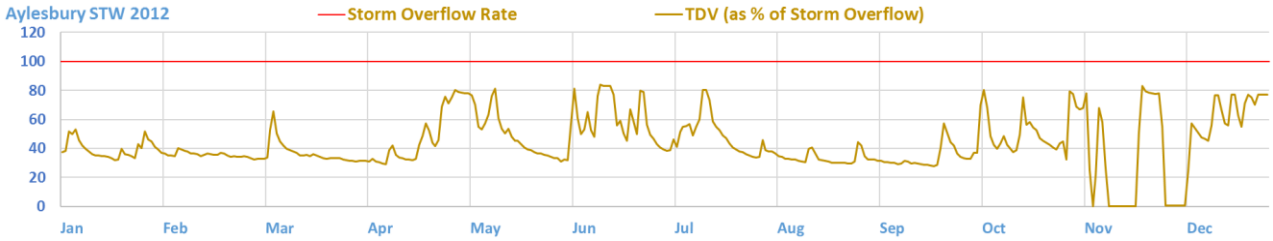


Figure 4: total daily volume flow curve for 2012 which smooths out rectilinear edges of Fig. 3 and "corrugates" the flattened, clipped curve of January to March of the 15-min flow data in Fig. 3

In 2011, there was a five and a half month gap in flow records (**Fig**. 5) - itself a permit breach - that could have alerted the EA to suspicious activity at the works almost 2 years before the prosecuted flow clipping.

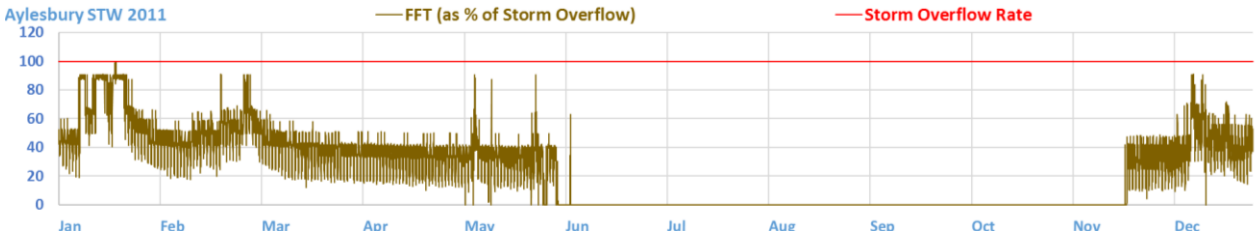


Figure 5: five and a half months' gap in 2011 flow at Aylesbury STW which itself is a permit breach

Even in 2011, the highest or peak values of the 15-min flow curve (**Fig**. 5) look frequently clipped to 40% for March to May before the long hiatus in the flow records. Once again, this is lost in a daily volume curve (**Fig**. 6).

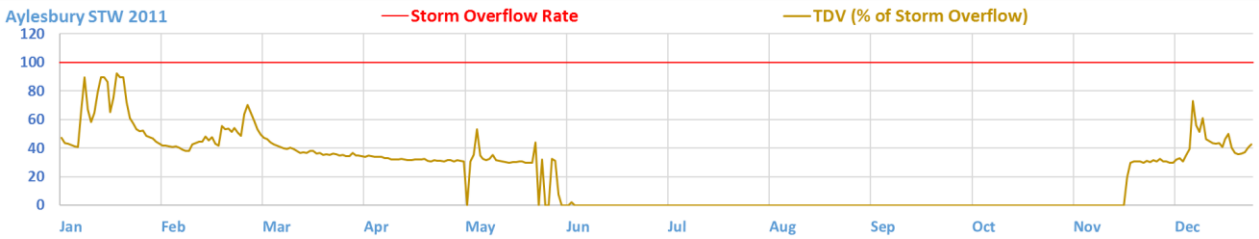


Figure 6: total daily volume curve once again introduces variation that hides peak flow clipping March to May

Earlier detection and intervention of the flow clipping might have avoided the catastrophic spills from Aylesbury STW in 2013 that killed many fish and damaged other riverine species. WASP believes that the EA should stop focusing on total daily flow, basically an average flow, employ finer grained flow data and incorporate automated analysis to identify suspicious flattening of peak flow over long periods.

Following the criminal conviction of 2016, and judging by the flow and spill data WASP has obtained by EIR request, Aylesbury STW has since been better managed or at least has not been criminally manipulated to spill earlier than permitted. However, there are still occasional aberrations and anomalies that need highlighting.

In February 2021, Thames Water submitted its 2020 EDM spill data to the EA. For Aylesbury STW , it reported 152 spilling hours and that the EDM device was in place for 100% of the 12 month monitoring period. The first spill detected according to the detailed EDM start/stop times received by WASP was in June. But the flow data pattern suggests there were spills throughout the first half of 2020 that presumably were not detected by the EDM device (examples ringed in red in **Fig**. 7).

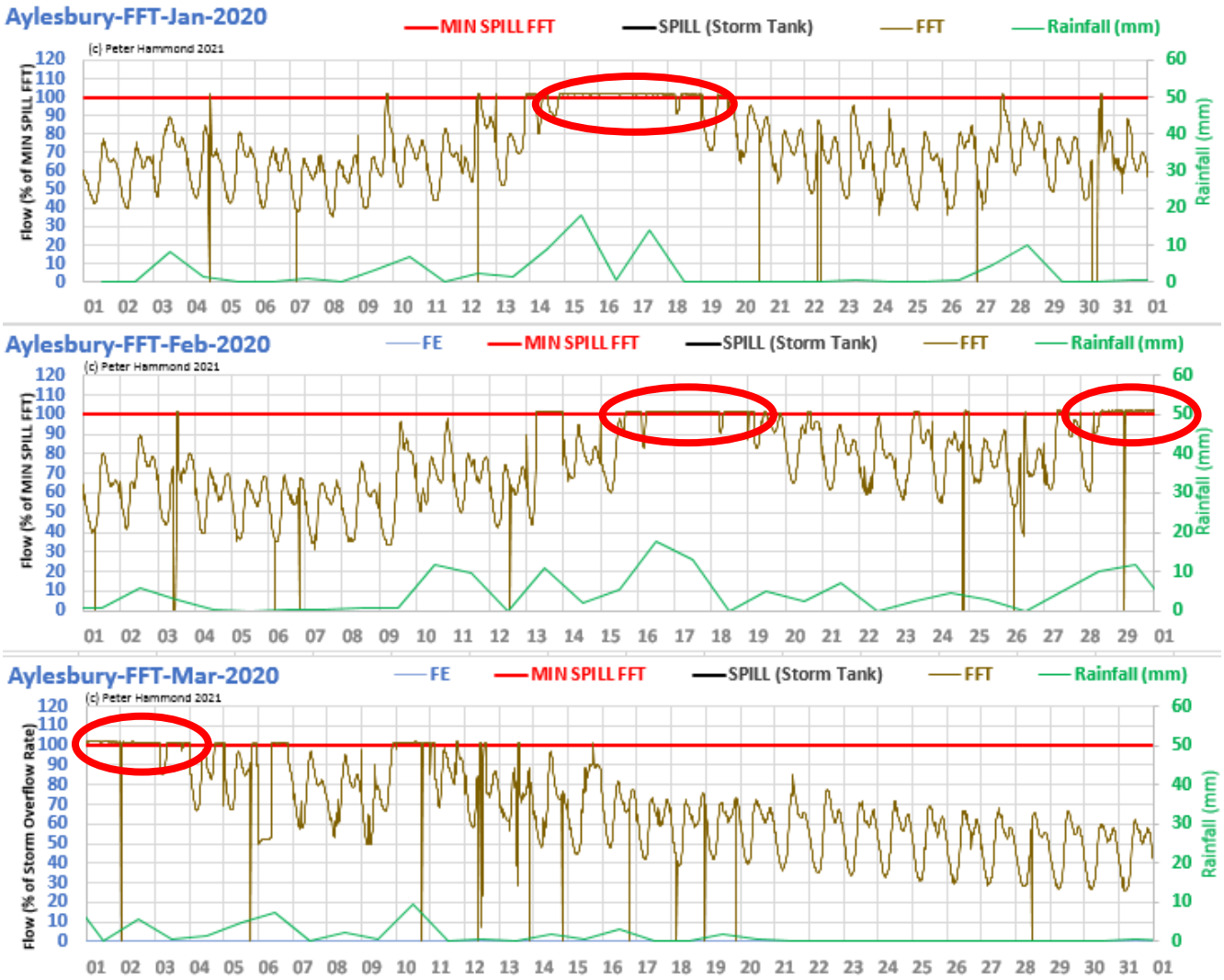


Figure 7: flow to treatment data in 2020 suggesting spills in mid-Jan and late Feb/early Mar not detected by EDM

Later in 2020, following very heavy rainfall on October 3rd/4th the works obviously had some difficulties. There were two "early" spills over 5 spilling days and between 5th and 8th October there were 3 zero flows (**Fig**. 8)

where 46 million litres of untreated waste water are unnacounted for (equivalent to about 18 Olympic sized swimming pools). Another pair of “early” spills occurred over the two days November 15th and 16th.

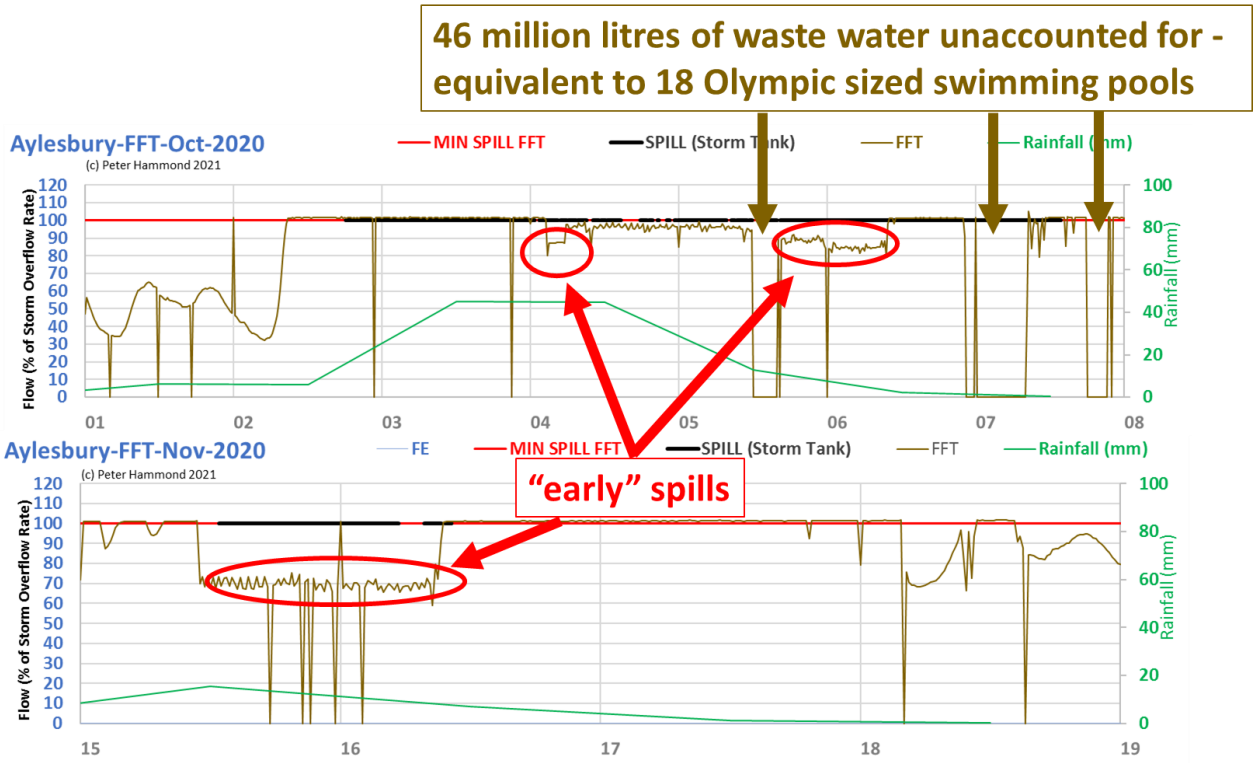


Figure 8: “early” spills and “zero” flows on several days in October and November 2020

CARTERTON STW

Summary

Carterton STW serves a population of over 17,000. Given its loading history (**Table** 1) and local housing development, it has probably been working at full capacity for over 5 years. It discharges into the Shil Brook whose poor state has been well documented in underwater video footage both upstream and downsteam of the Bampton and Carterton STWs. https://twitter.com/windrushwasp/status/1371117417745768448?lang=en-gb

Entering load vs Physical Capacity			
Year	**Entering**	**Capacity**	**Load rate**
2012	15,000 p.e.	16,100 p.e.	**93.2 %**
2014	15,500 p.e.	16,100 p.e.	**96.3 %**
2016	17,176 p.e.	17,176 p.e.	**100.0 %**
2018	17,177 p.e.	17,177 p.e.	**100.0 %**

(p.e. = population equivalent)

Table 1: loading of Carterton STW (2012-2018)

Source: https://uwwtd.eu/United-Kingdom/treatment-plant/ukenthtwutp000034/history

WASP's analysis of Carterton STW's performance has been significantly hindered by Thames Water's inability to provide complete, correct and consistent data. Even corrected flow data provided after a formal complaint remains inconsistent with similar data provided separately to a Carterton Councillor.

2021: **Jan to May** 381 spilling hours over 24 days of which **3 involved illegal "early" spills**;

2020: 698 spilling hours over 44 days of which **23 involved "early" spills** and **3 at most 2 mm of rainfall** on the day and day before;

2019: 854 spilling hours over 51 days of which **14 involved "early" spills**. On 20 (40%) of the spilling days, Thames Water did not provide flow data so it is impossible to say if the spills were compliant or illegal.

EIR-21-22-007 WASP request (03/04/2021) to Thames Water for data and their response (30/04/2021)

WASP made an EIR request for sewage treatment and EDM spill start/stop times to Thames Water (TW) who replied with effluent flow data for 2009 onwards and EDM spill data for 13/06/2019 to 08/02/2021. The EDM spill data provided to WASP was the same as that provided to the Councillor apart from the omission of 54 spilling hours in February 2019.

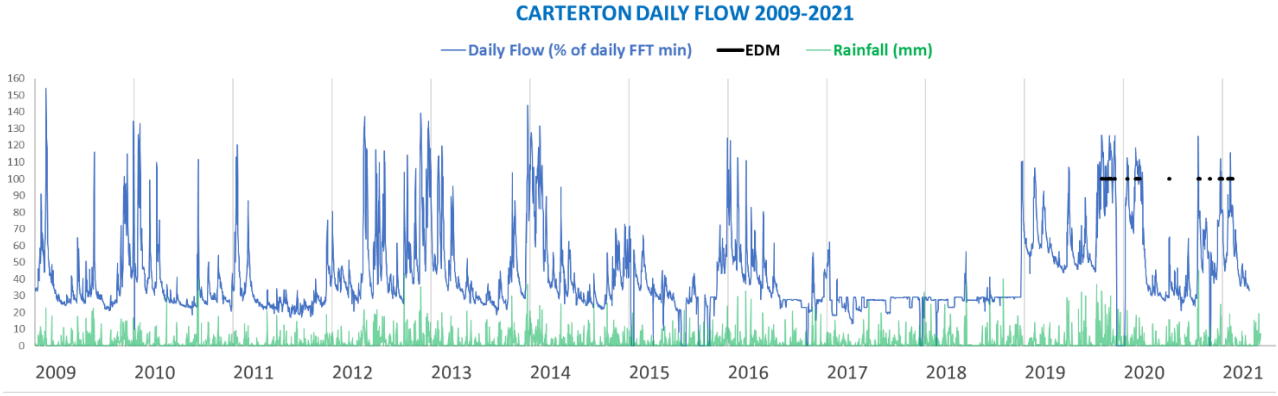


Figure 1: total daily effluent flow from 1/1/2009 with flat anomalous flow mid-2016 to 2018

The daily effluent flow data provided by TW (**Fig**. 1) looked so anomalous from mid-2016 to the end of 2018 that WASP asked the EA on 23/05/2021 if they had also noticed this and had undertaken any investigations. The EA responded with a telephone call on 23/06/2021 and an email on 30/06/2021 which said:

"We have previously not investigated discharges from Carterton Sewage Treatment Works during 2017 and 2018. We had no incidents reported to us that could be attributed to the sewage works during this period, and the data we routinely receive – total daily flows – did not highlight any issues of concern."

This response is extraordinary given the obvious anomaly – unless, of course, the EA did not review the data thoroughly or had received different data.

WASP request (08/06/2021) to TW for an explanation of effluent flow anomalies and TW reply (18/08/2021)

WASP's request to TW for an explanation of the anomalous flow data was eventually passed to the EIR Team on 20/06/2021. TW provided a new set of flow data and the following emailed response:

"We discovered some time ago that - in our previous reporting system – at some point an incorrect, non-certified meter was being called to provide the final effluent discharge data at Carterton (which does have a certified, final effluent, flowmeter). This was corrected as part of a reporting upgrade, and recent reporting uses the correct data source. Unfortunately, to facilitate your earlier request for data back to 2009, we used an earlier reporting template for which the correction had not been made, and hence inadvertently supplied incorrect data."

Subsequently, it came to WASP's notice that a Carterton Councillor had separately requested similar data on 25/05/2021 which was provided to him on 23/06/2021. **Fig**. 2a shows the flow data provided to WASP by TW and the subsequent TW corrected flow data. **Fig**. 2b shows the corrected data alongside that provided to the Councillor.

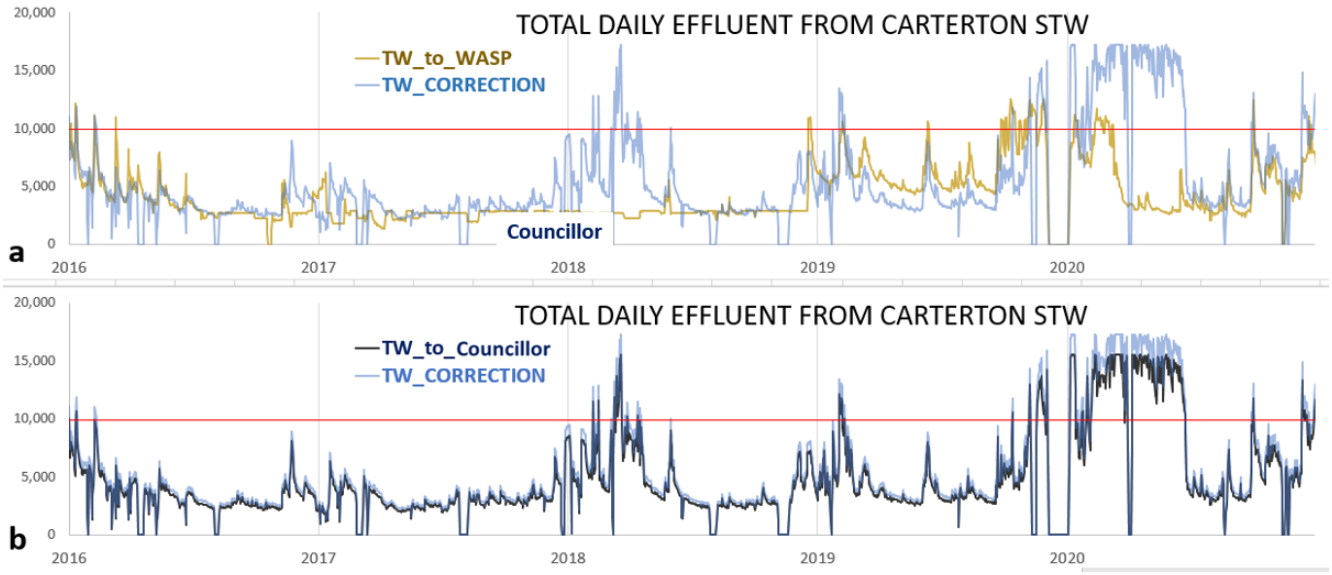


Figure 2: flow data provided to WASP, corrected flow data and flow data provided to Councillor

a) Comparison of flow data sent to WASP and that corrected by Thames Water;

b) Comparison of corrected flow data and that sent to Councillor.

For some years, there is a similarity (apart from scale) between the flow data provided to WASP and the corrected data – especially in 2019 and early/late 2020 (**Fig**. 2a). Otherwise, the datasets are very different. The corrected effluent flow data has the same shape as the Councillor's data but it is persistently 11.11% larger (**Fig**. 2b). By inflating flow data, illegal "early" spills can appear to be compliant.

Inconsistencies in effluent flow and flow to treatment data provided by Thames Water

WASP had also asked TW in its original EIR request for flow to full treatment (FFT) data for Carterton STW for the period 2009 to the present. Unfortunately, TW only provided FFT data for 2020 and even then only starting on January 21st. There appear to be major discrepancies in this flow to treatment data and the effluent flow data provided to the Councillor (**Fig**. 3). They are only reconcilable from June onwards and less so towards the

end of the year. The FFT data given to WASP respond to rainfall as one would expect. The final effluent (FE) data sent to the Councillor from Jan to June looks totally anomalous and out of step with rainfall for the first half of the year (rainfall data was obtained from nearby Brize Norton through public sources).

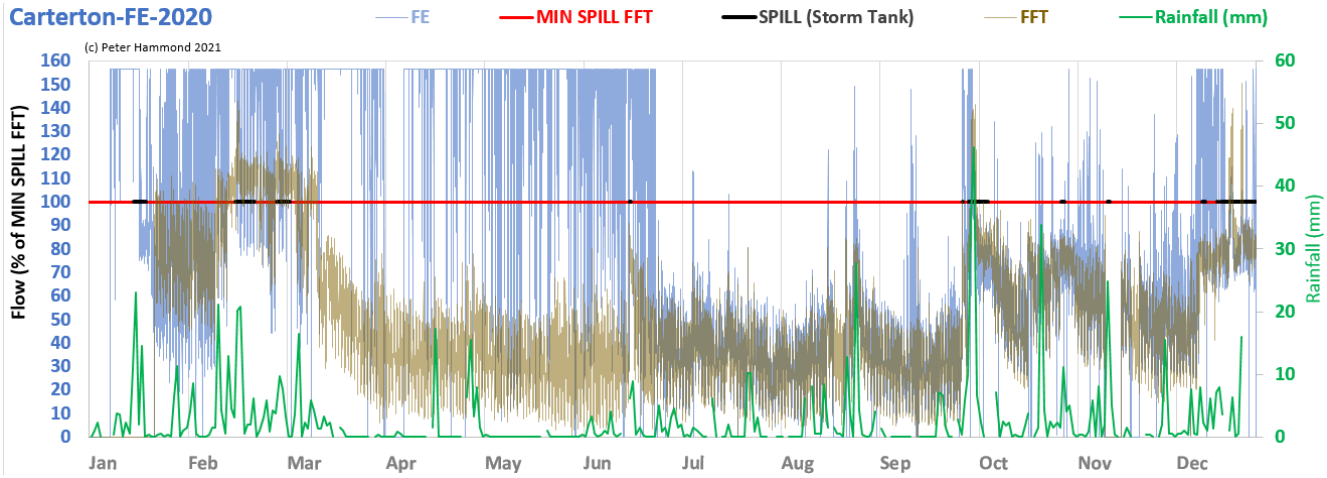


Figure 3: flow to treatment (FFT) provided to WASP and final effluent flow (FE) data provided to the Councillor

It is rather tedious to do so, but these inconsistencies in the data provided by Thames Water are best understood by inspecting them at a monthly level of detail.

January 2020

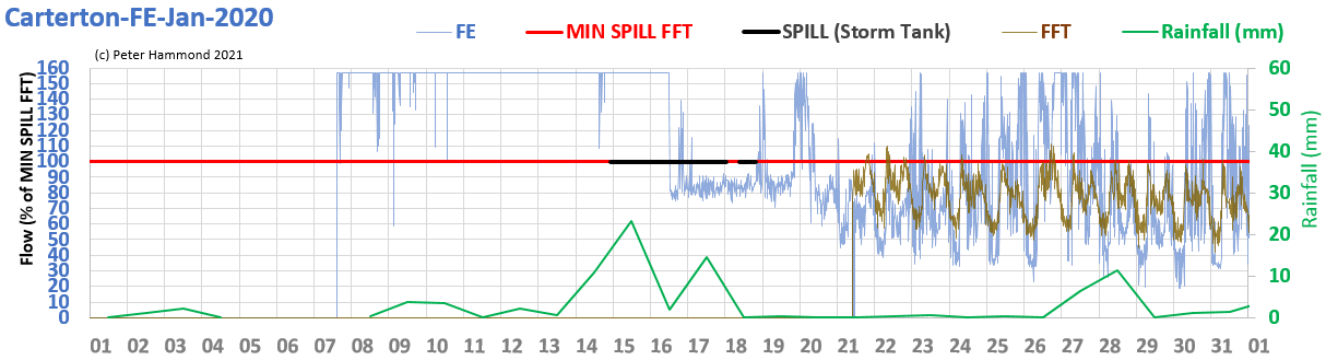


Figure 4: Rainfall, Flow and EDM spill data for Carterton STW for January 2020

TW failed to provide effluent data for the first 7 days of January and flow to treatment data for the first 20 days. The effluent flow (blue curve) for Jan 7th-16th looks strange compared to the rainfall pattern. The spills (black horizontal segments) fit with the rainfall and the flattened flow to treatment data (Jan 16th-18th).

February 2020

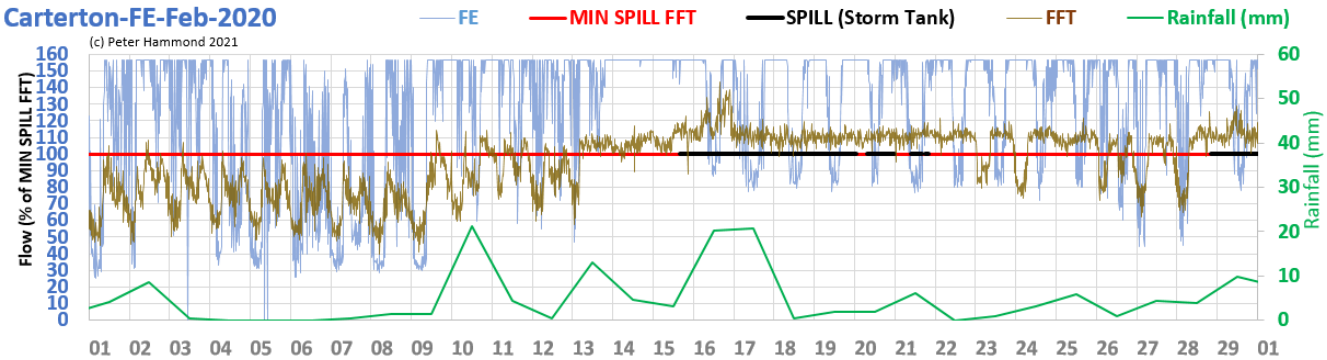


Figure 5: Rainfall, Flow and EDM spill data for Carterton STW for February 2020

Once again, the final effluent flow (**blue** curve) has a strange cut-off at almost 160% of the storm overflow setting and bears little resemblance to the rainfall pattern or the EDM detected spills (**black** horizontal segments). In contrast, the flow to treatment (**brown** curve) looks consistent with both the rainfall pattern and the EDM spill intervals. Such flow to treatment values during a spill suggest the detected spills are within permit i.e. the flow to treatment during the spill is above the storm overflow setting (**red** line).

March 2020

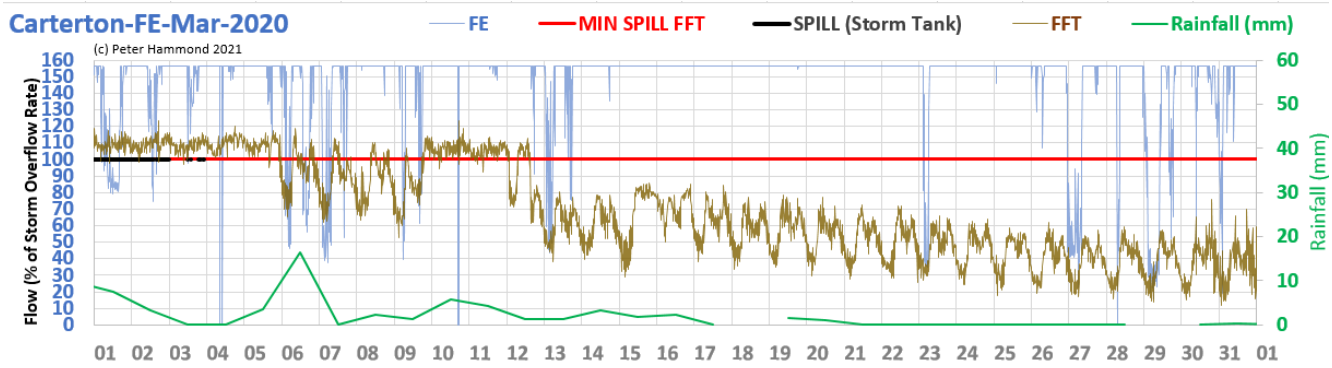


Figure 6: Rainfall, Flow and EDM spill data for Carterton STW for March 2020

The final effluent curve in March continues to display the unexplained cut-off and appears to be inconsistent with the rainfall pattern. In contrast, once again, the flow to treatment is consistent with both the rainfall pattern and EDM spill detection. The return of the flow to treatment to a regular diurnal pattern is totally consistent with the diminution of rainfall towards the end of the month. The spills at the beginning of the month appear to be within permit as the flow to treatment is above the storm overflow setting (red line). The EDM device may have missed a spill between March 9th and 11th.

April and May 2020

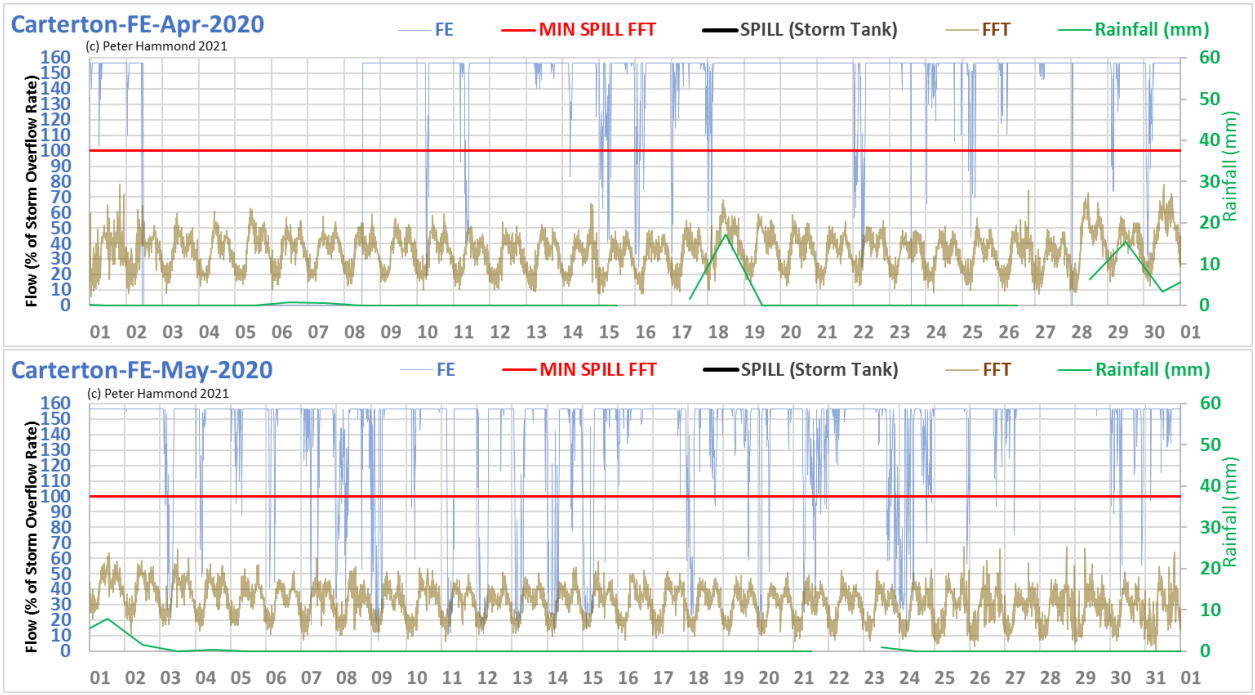


Figure 7: Rainfall, Flow and EDM spill data for Carterton STW for April and May 2020

There is very little rainfall in April and May 2020 and the flow to treatment continues to be very consistent with low rainfall by displaying an expected regular, diurnal flow pattern.

June 2020

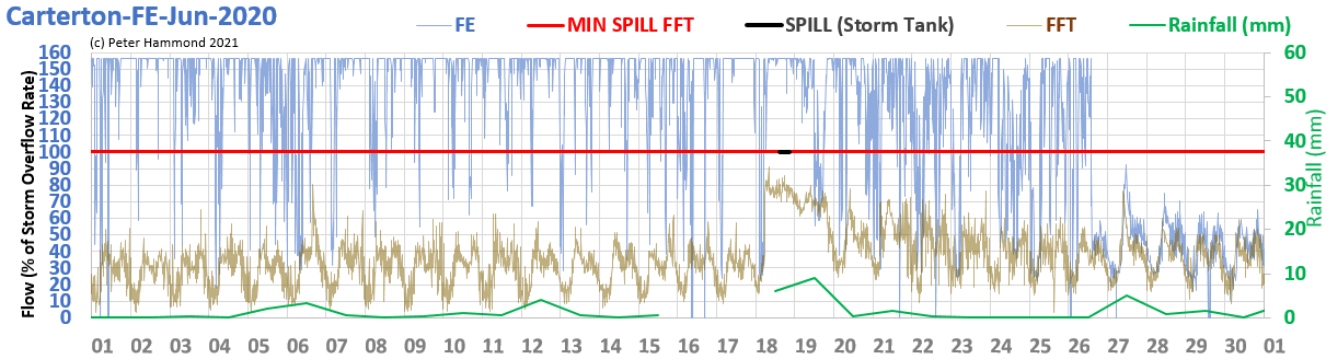


Figure 8: Rainfall, Flow and EDM spill data for Carterton STW for June 2020

The effluent flow pattern continues to have an unusual fibrillating variation with the same cut-off up and until the last 4 days when it begins to behave just like the flow to treatment which as before is consistent with the rainfall throughout and also the single spill on June 18th. This spill is clearly illegal as the flow to treatment is well below 92% of storm overflow setting (100% minus the 8% allowance for meter error). The effluent pattern does not appear to respond to this spill in any way.

July, August and September 2020

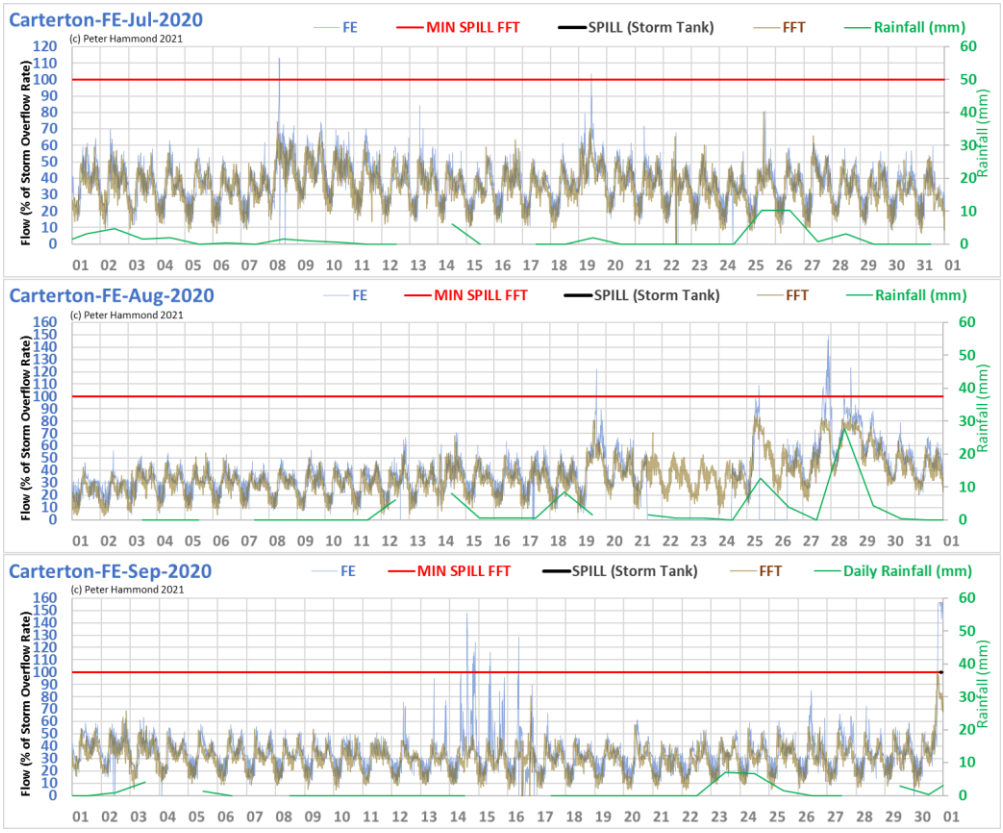


Figure 9: Rainfall, Flow and EDM spill data for Carterton STW for July, August and September 2020

The coincidence of effluent flow and the flow to treatment and rainfall continues throughout July, August and September, apart from some short, eccentric bursts of the effluent flow.

October 2020

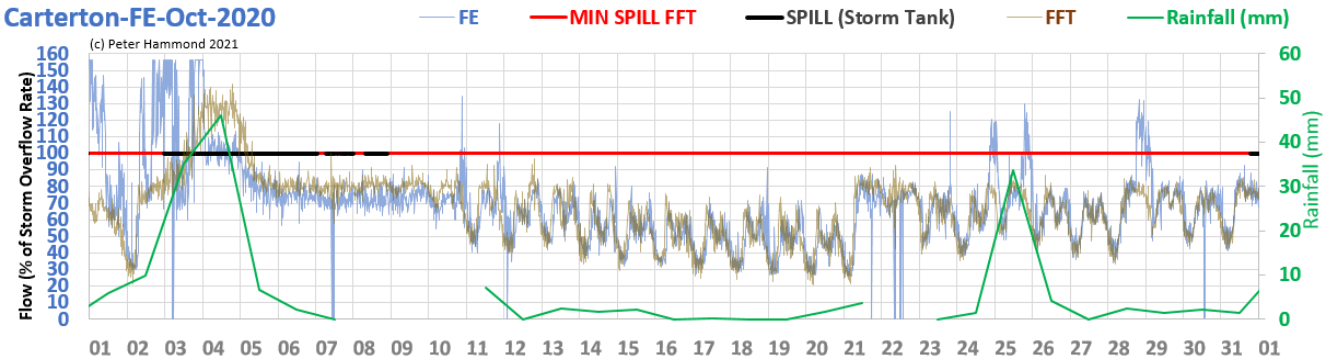


Figure 10: Rainfall, Flow and EDM spill data for Carterton STW for October 2020

For most of October, the flow to treatment and effluent flow curves coincide or are closely in agreement. The flow to treatment responds to rainfall as expected and is consistent with the six days of spilling detected by the EDM device. The spilling on October 5th to 8th is clearly "early" as the flow to treatment rate does not reach the minimum required.

November 2020

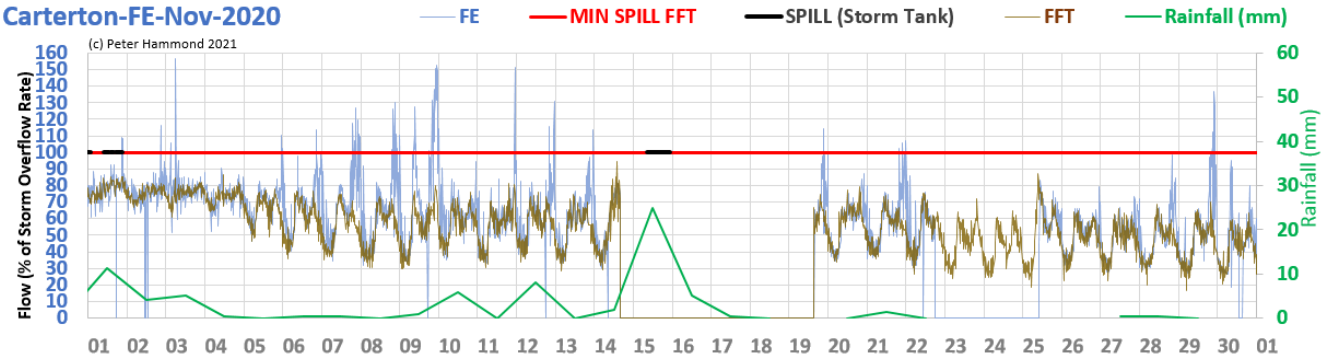


Figure 11: Rainfall, Flow and EDM spill data for Carterton STW for November 2020

TW's provision of data for November 2020 is marred by a 5-day gap for both effluent flow and flow to treatment. During this period, the EDM device detected a spill of nearly 15 hours in length but the absence of flow data means its permit compliance cannot be checked. Effluent flow data is also missing for Nov 22nd to 25th. The spills on Nov 1st are clearly illegal as the flow to treatment is below the permit requirement.

December 2020

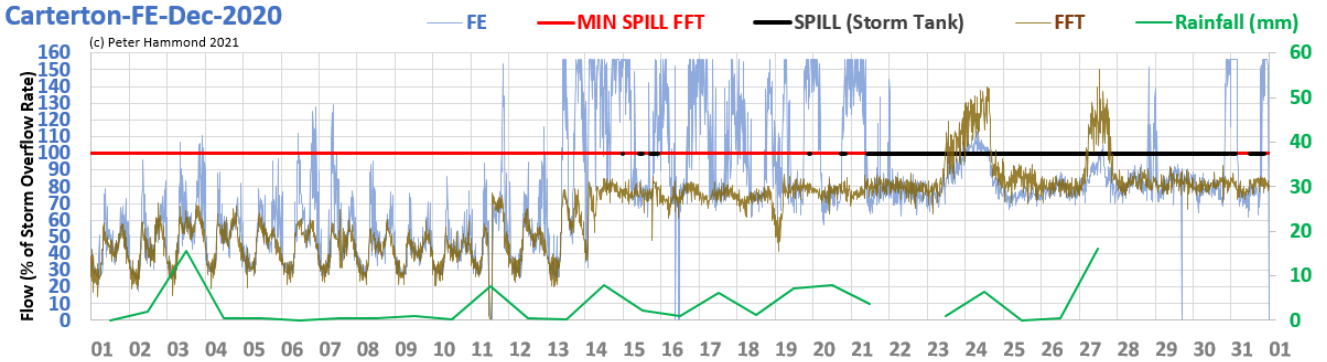


Figure 12: Rainfall, Flow and EDM spill data for Carterton STW for December 2020

December 2020 contains a mix of consistency and inconsistency between flow to treatment and effluent flow with the latter returning briefly to its fibrillating pattern while the flow to treatment maintains consistency with rainfall and EDM spill detection. Of the 15 spilling days detected, **13 are illegal** as with previous spills.

This final month by month scrutiny of the data provided by TW totally undermines the corrected effluent flow data for 2020 but also has identified a further 40 illegal spills of untreated sewage by Thames Water.

CASSINGTON STW

Cassington STW has only one outlet for both its spilled, untreated sewage and its treated effluent. The outlet is located some 2 km away from the works on the banks of the River Thames and upstream of one of Oxford's favourite river bathing areas at Wolvercote (https://www.youtube.com/watch?v=hGIRmpvpROQ). The population it serves has grown from 14,300 in 2012 to 16,528 in 2018 with load (population/capacity) as 96.1%, 100%, 95.7% and 100% every 2 years. So, Cassington STW is typically working at full stretch. The planned Salt Cross Garden Village located at nearby Eynsham will add 5,500 to the population served.

Cassington STW is one of the 41 STWs belonging to Thames Water where the storm discharge permit has not been amended since 2010 and has no mention of a storm tank size/location or a storm overflow setting. Therefore, Cassington STW cannot be an "early" spiller since it has no official storm overflow setting. However, in response to an EIR (THM160685) requesting storm tank sizes for all STWs in England, the EA did provide a table with an entry defining an overflow setting and a storm tank size for Cassington (**Fig**. 1). WASP believes that, as with Oxford STW which is in a similar position, the EA is planning to introduce a revised permit with tighter control on the use of storm tank storage and minimum flow to treatment rate while spilling. Interestingly, the suggested storm tank volume entry (1112 cu m) is more than 50% greater than that required to hold diverted untreated sewage flow for two hours at the suggested rate of 98 l/s (705.6 cu m).

STW NAME	FINAL EFFLUENT PERMIT NO.	SETTLED STORM (Storm Tank) PERMITTED PASS FORWARD FLOW RATE / OVERFLOW SETTING (l/s)	STORM TANK PERMITTED VOLUME (m3)	Storm tank capacity required to meet 68 l/h (at permitted DWF) (Based on Thames Water PE Methodology re Separate Sewers)	Current Actual Storm Tank Volume m3
CASSINGTON STW	CTCR.1749	98	1112	437	1112

Figure 1: storm discharge related parameters provided by the Environment Agency for Cassington STW

The permit cited in **Fig**. 1 covers effluent flow with no mention of storm overflow etc. Indeed, in contrast to the historical overflow setting of 3 times DWF (dry weather flow), the suggested overflow setting of 98 litres/sec in **Fig**. 1 is only 2.1 times the equivalent dry weather flow defined in the permit. This would allow spills to occur at lower treatment flows, and hence more frequently, than would have been permitted in the past. In fact, during a 20-day dry spell of September 2019, the average equivalent flow to treatment rate was about 32 litres/sec which is more or less one third of the storm overflow setting. The following analysis of Cassington STW's is undertaken as if the definitions of **Fig**. 1 were in place.

2020

Thames Water declared 213 spilling hours over 27 spilling days: 13 were "early"; 2 involved no rainfall on the day or the day before; and, 5 up to 2 mm of rain on the day or the day before. In fact, **Fig.** 1 suggests that Cassington STW behaves as if it has an overflow setting at the rate suggested by the EA. **Fig**. 1 also includes a dubious spill detected by EDM on Feb 6th. There are other EDM errors of spill omission and commission.

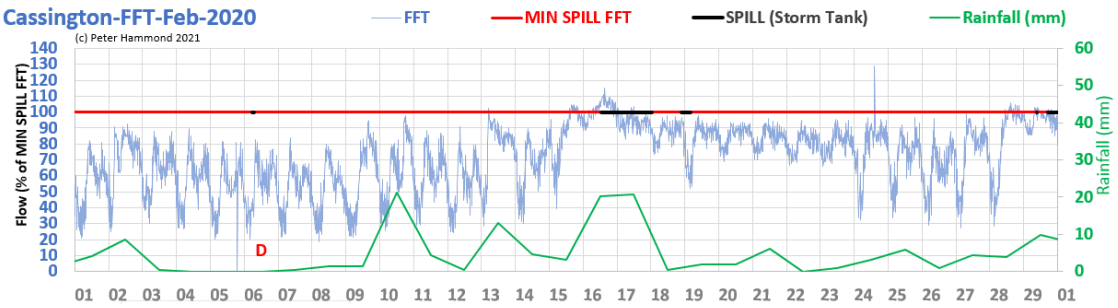


Figure 1: flow to full treatment and EDM data suggesting an overflow setting at the EA suggested rate

2019

Thames Water declared 494 spilling hours over 41 spilling days with 8 reliable looking "early" detected spills but once again, judging by the flow pattern, a number of unreliable spill detections as in the first 3 days of December 2019 (**Fig**. 2). Indeed, the 2019 EDM return includes the phrase *"Data prior to 22/01/2019 is missing due to historical installation issues".*

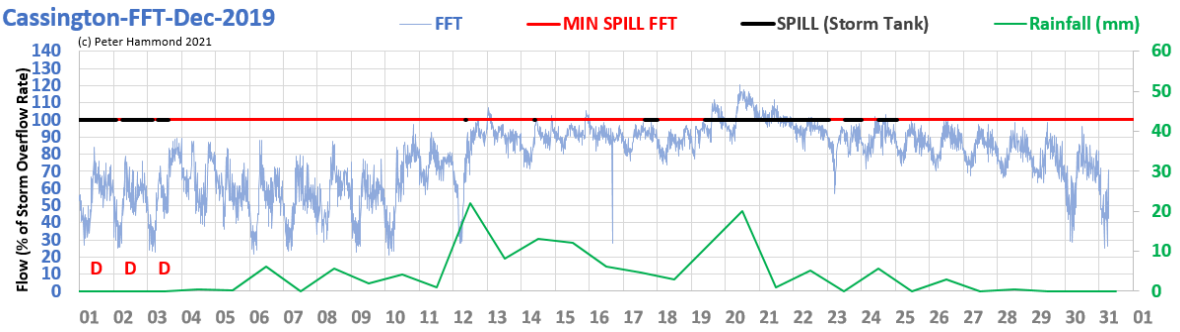


Figure 2: a mix of unlikely (Dec 1-3) and likely (Dec 19-22) EDM spill detections at Cassington STW

So, an opportunity has been lost to provide accurate and reliable spill detection at yet another of Thames Water's STWs because of poor overseeing of third party EDM installation and monitoring of its reliability. With a planned increase of one third to Cassington STW's load it would have provided town planners and Thames Water with a much more accurate picture of its ability to cope in the future.

CHIPPING NORTON STW Peter Hammond, Windrush Against Sewage Pollution (WASP)

Summary

WASP believes that Thames Water made at least 26 illegal discharges of untreated sewage from Chipping Norton STW between January 2020 and April 2021. The inadequacy and/or lack of data provision significantly hampered the analysis for the years 2018 and 2019.

Background

Chipping Norton STW serves a population equivalent of over 9,000 and discharges treated effluent into the Blue Brook, a small stream that eventually joins the River Thames via the Cornwell Brook and River Evenlode. Given the loading history (**Table** 1) and recent housing expansion, Chipping Norton is working at full capacity.

Year	Entering	Capacity	Load rate
2012	7,820 p.e.	8,192 p.e.	**95.5 %**
2014	8,750 p.e.	8,750 p.e.	**100.0 %**
2016	8,595 p.e.	8,750 p.e.	**98.2 %**
2018	8,914 p.e.	8,914 p.e.	**100.0 %**

Table 1 Loading rate of Chipping Norton STW
(p.e.=population equivalent)
Source: https://uwwtd.eu/United-Kingdom/treatment-plant/ukenthtwutp000042/history

The works is permitted to divert excess sewage, if overwhelmed "due to rainfall or snowmelt", to a storm tank (**Fig**. 1a) which itself is permitted to overflow onto a "storm land treatment area" adjacent to the Blue Brook and drain into the brook at the same point as the treated effluent (**Fig**. 1a).

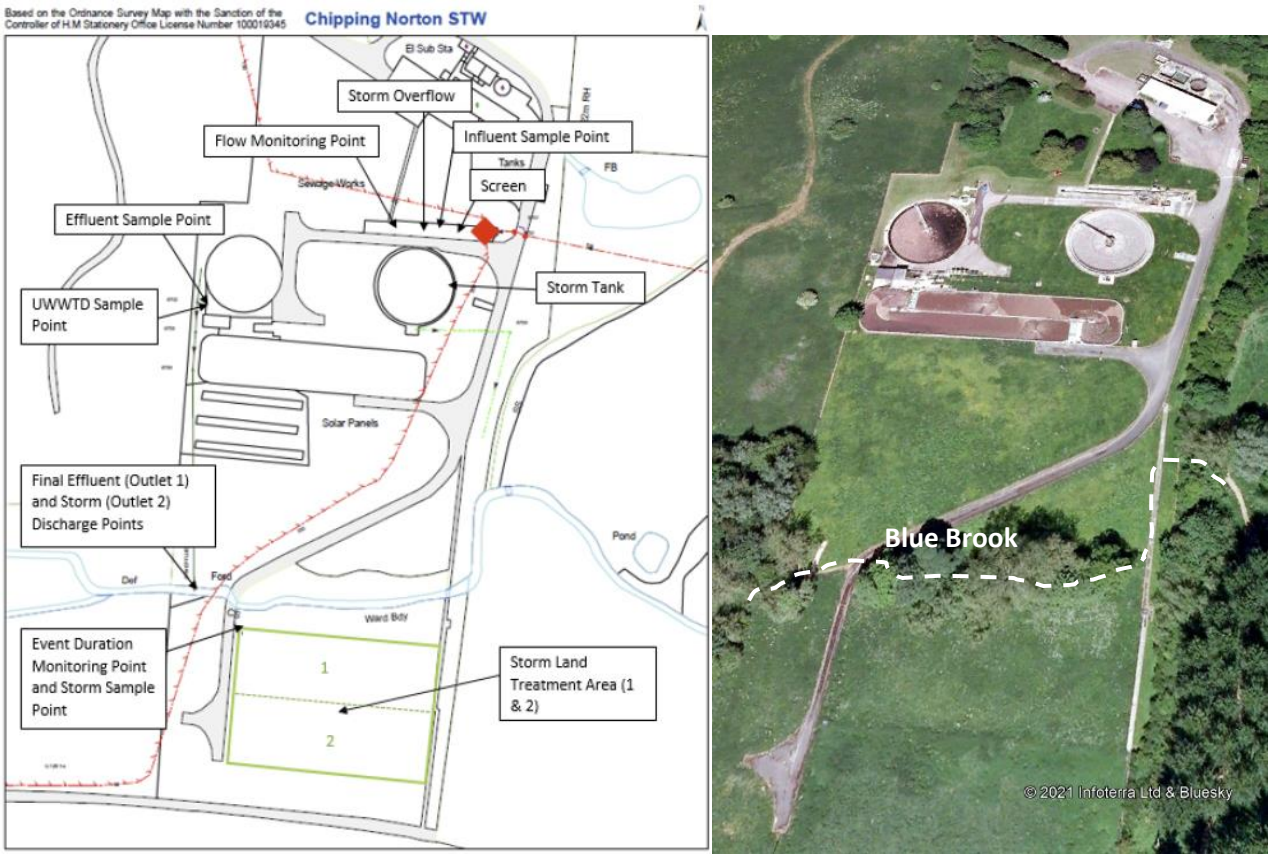


Figure 1 a) Chipping Norton STW plan from EA permit; **b)** aerial view from Google Earth image (30/05/2009)

The “storm sewage discharge settings” for Chipping Norton STW are summarised in its Environment Agency (EA) permit as follows

Table S3.3 Storm sewage discharge settings				
Effluent(s) and discharge point(s)	**Description of discharge**	**Overflow setting l/s**	**Maximum size of solid matter**	**Minimum storage capacity m^3 (off-line)**
Settled storm sewage via Outlet 2	Settled storm sewage	64	No greater than 6 mm in more than 1 dimension	1095

A storm tank should be large enough to hold 2 hours’ worth of sewage at its overflow setting. In fact, Chipping Norton STW’s storm tank is more than twice as big as it need be to satisfy that requirement. Other conditions on discharging untreated sewage are stated in the EA permit as follows:

2.3.2 For the discharge(s) specified in table S3.3:

(a) The discharge shall only occur when and only for as long as the flow passed forward is equal to or greater than the overflow setting indicated due to rainfall and/or snow melt.

(b) Off-line storm storage must be fully utilised before a discharge occurs. It shall only fill when the flow passed forward is equal to or greater than the overflow setting indicated due to rainfall and/or snow melt and shall be emptied and its contents returned to the continuation flow as soon as reasonably practicable. The minimum off-line storm storage required is specified in table S3.3.

(c) The discharge shall not be comminuted or macerated and shall not contain a significant quantity of solid matter with a particle size greater than any indicated. All screenings shall be removed from the discharge.

Figure 2: permit conditions for discharging untreated sewage from Chipping Norton STW

If a sewage treatment works discharges untreated sewage when there is no rain we call it a “dry” spill. If it discharges untreated sewage before it reaches its overflow setting, we call it an “early” spill. “dry” and “early” spills are in breach of EA permit conditions and hence should be considered illegal.

Data and analysis

In the charts below, a brown curve represents the rate at which sewage flow is passed forward for full treatment (FFT) and a blue curve represents effluent flow rate leaving the works, both as a % of the overflow setting. The red horizontal at 100% (left vertical axis) represents the overflow setting. The black segments represent spill intervals defined by the start/stop times detected by Even Duration Monitoring (EDM) equipment. The green curve represents daily rainfall at Little Rissington weather station available online. Flow and spill interval data were provided by Thames Water.

At small STWs with a simple treatment process, effluent rate is a reasonable surrogate measure of flow to full treatment. A difference of 10% is typical at uncomplicated works but the analysis here allows 25%. The EA allows an 8% error for meters so spill days are flagged as “early” with an **E** when the effluent rate does not remain above 67% of the overflow setting for the entire spill. For Chipping Norton STW, this is a generous allowance as the flow to treatment and effluent flow rates are typically very close. For flow to full treatment the minimum is 92% (100% - 8% error allowance). A **D** annotation denotes a “dry” spill when there is no rainfall on the spilling day or the day before. Flow to full treatment data (FFT) was available for each year considered except 2021 when final effluent (FE) was used in the analysis.

2021

Already, by mid-April, Chipping Norton had spilled for 372 hours over 24 spilling days of which **8 were “early”** because the effluent flow rate did not remain above 67% of the overflow setting while spilling (**Fig**. 3).

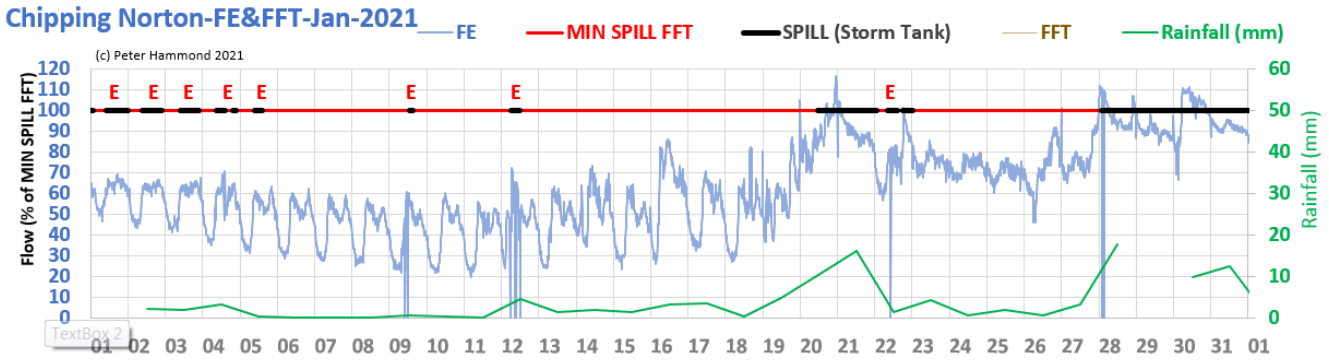


Figure 3: some "early" spills of untreated sewage at Chipping Norton STW in January 2021

2020

Chipping Norton discharged untreated sewage for 596 hours over 45 spilling days of which **18 were "early"** because the flow to treatment data did not remain above 92% of the overflow setting while spilling. **Fig**. 3 shows some "early" spills in Oct and Nov 2020.

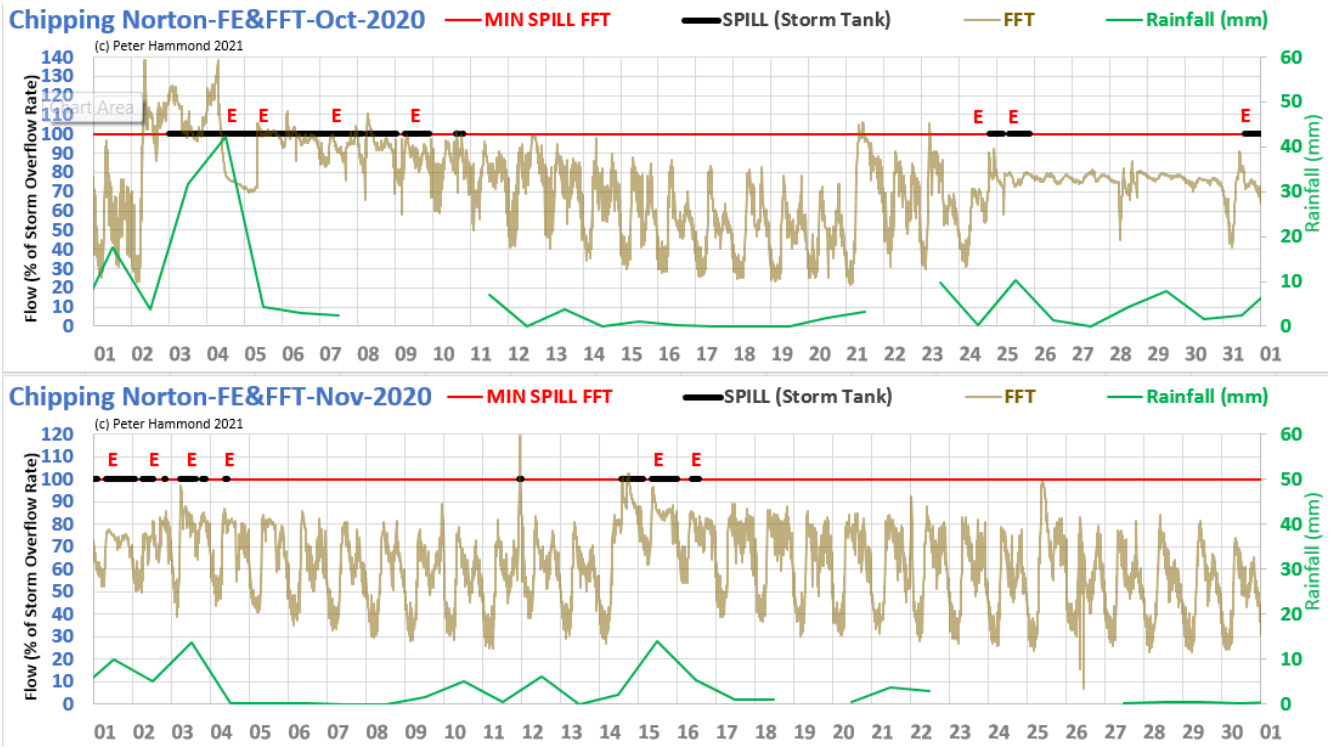


Figure 3: "early" and low rainfall spills of untreated sewage at Chipping Norton STW in Oct and Nov 2020

2019

In 2019, Thames Water spilled untreated sewage for 80 hours with an "excuse" that *data prior to 19/12/2019 missing due to historical installation issues*. There do not appear to be breaches between Dec 19th and Dec 31st.

2018

In 2018, Thames Water declared 1.3 hours of spilling untreated sewage. In response to an EIR request Thames Water failed to provide any EDM spill data for Chipping Norton.

pre-2018

There is evidence of "early" spills pre-2018 but the lack of EDM data makes it difficult to detect historical spills. Previously, WASP used machine learning to detect historical "early" and "dry" spills at Church Hanborough and Witney STWs. Such an analysis has yet to be completed for Chipping Norton STW.

FAIRFORD STW

Fairford STW has two meters which measure flows into the site from terminal pumping stations (Horcott Road and Moor Farm). They are not MCERT standard and were only connected to Thames Water's central SCADA system in 2018. During spills, the difference between their sum and the effluent flow is a reasonable estimate of what is discharged to the River Coln, especially over a significant time period when travel through the site and return flows have negligible effect. Between October 12th 2019 and 24th March 2020, the Event Duration Monitor (EDM) at Fairford STW recorded 165 days of almost continuous spilling (**Fig**. 1). During this time, the works received 870 million litres of untreated sewage and discharged 500 million litres or so of treated effluent, so as many as **370 million litres of sewage may have been spilled to the River Coln**.

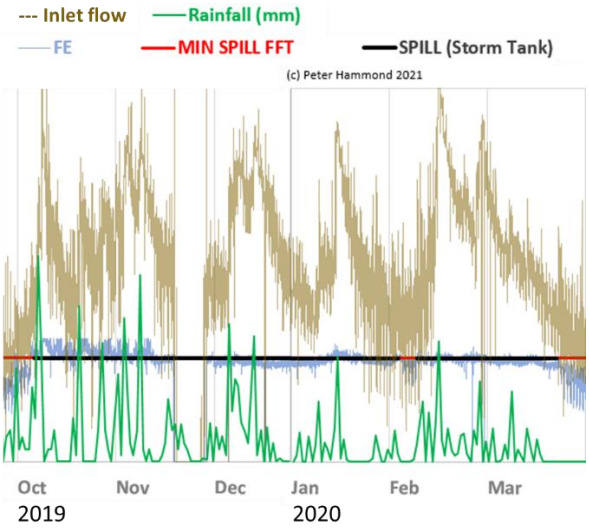


Figure 1: untreated sewage flow (brown curve) into and treated effluent (blue curve) out of Fairford STW during 165 days of almost continuous spilling of untreated sewage (black horizontal segments)

No flow data was provided by Thames Water for part of November 2019 when it is unclear how much sewage was treated and how much was discharged untreated to the River Coln

According to data provided by Thames Water through an EIR request, when spills of untreated sewage were detected, the effluent flow at Fairford STW was close to, or greater than, the storm overflow rate for flow to treatment. It is likely, therefore, that Fairford did not spill "early" during the period (2019-2020) when spill monitoring was in place. However, the works does suffer badly from groundwater infiltration and spills frequently during dry weather and during low rainfall. The EA considers groundwater infiltration to be an unpermitted reason for discharging untreated sewage to watercourses from STWs.

2020

Fairford STW spilled for 2,492 hours over 130 spilling days of which **17 (13%) involved no rain on the day or day before** and similarly 45 (35%) involved at most 2 mm of rainfall on the day or day before.

2019

Fairford STW spilled for 2,207 hours over 108 spilling days of which **23 (21%) involved no rain on the day or day before** and similarly 38 (35%) involved at most 2 mm of rainfall on the day or day before.

2018

Thames Water reported to the EA that Fairford STW spilled for 714 hours during 39 counted spills. Unfortunately, despite an EIR request, Thames Water failed to provide EDM data for 2018. WASP estimates at least **5 spilling days involved no rainfall on the day or day before** and 12 at most 2 mm of rainfall on the day or day before.

HOGSMILL STW AND EWELL AND EPSOM STORM TANKS

Hogsmill STW and the nearby sewage network storm tanks at Epsom and Ewell regularly discharge untreated sewage into a chalk stream, the Hogsmill River, which should receive much greater respect from Thames Water. When WASP first asked for EDM and flow data from Thames Water, a request was made for over £500 to cover costs. This is the only time that any Water Company has requested payment for the provision of data under EIR legislation. The request was withdrawn after WASP made an appeal to Thames Water.

At Aylesbury Crown Court on 26th May 2021, Thames Water were fined £4 million and ordered to pay the EA's costs of £84,669 after pleading guilty to a range of offences. Around 27th January 2016, sewage sludge was discharged into the Hogsmill River. Between 13th and 16th October 2018, sewage and sewage debris was discharged onto Green Lane Recreation Ground and into California Road Ditch and the Hogsmill River via manholes. Finally, around 24th September 2019, raw untreated sewage and sewage debris escaped onto Green Lane Recreation Ground via a manhole.

The September 24th 2019 offence coincided with an **illegal early spill** from Hogsmill STW, clearly seen in **Fig**. 1 when the EDM device picked it up (but not the similar event on September 29th). The horrendous spill from the network storm tanks was filmed on the day by Brian Angus, the chair and secretary of the local residents' association (https://www.youtube.com/watch?v=GIyFjGFL8rA).

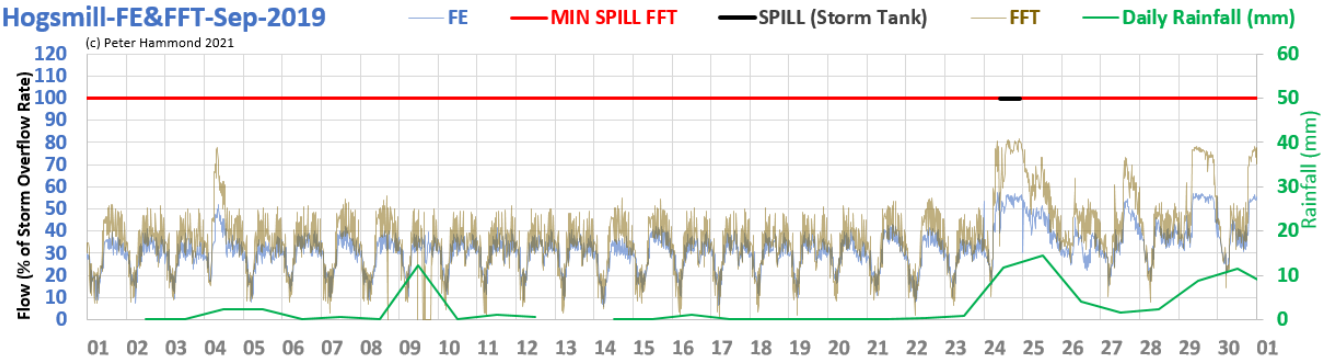


Figure 1: the illegal "early" spill on September 24th 2019 when FFT was less than 80% of the storm overflow rate

The offence in 2018 can be detected in **Fig**. 2 when, in the early hours of October 15th, the effluent flow drops to zero suggesting that although treatment continued there was a spill on site of approximately 4M litres which then likely found its way into the River Hogsmill.

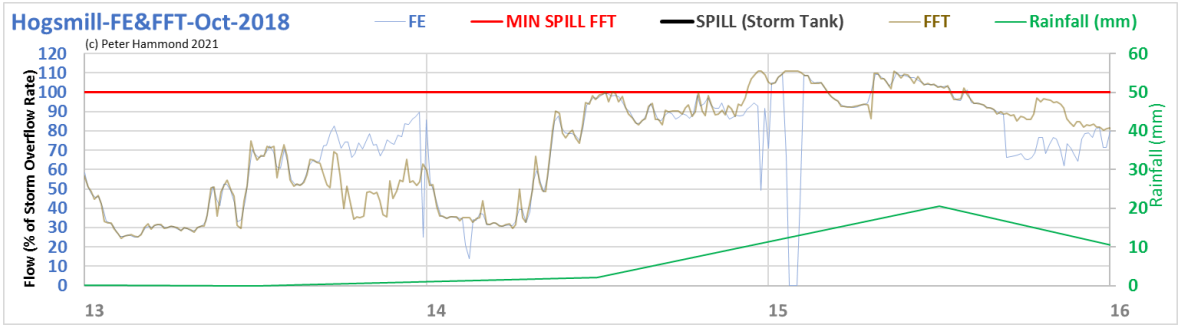


Figure 2: loss of 4M litres of effluent (FE) on October 15th 2018 at Hogsmill STW indicated by sudden drop to zero flow

Such "holes" in effluent flow data appear to happen quite frequently at Hogsmill STW and often, like the one in **Fig**. 2, in the early hours. In 2019, WASP identified fives gaps in effluent data at Hogsmill STW and reported them, by email and in person, to both the EA and OFWAT (former CEO Rachel Fletcher and Director of

Enforcement Sally Irgin). As far as WASP is aware, no further action has been taken. The gaps are documented in **Fig**. 3 and identify the apparent loss of 61.5 million litres of effluent, always in the early hours.

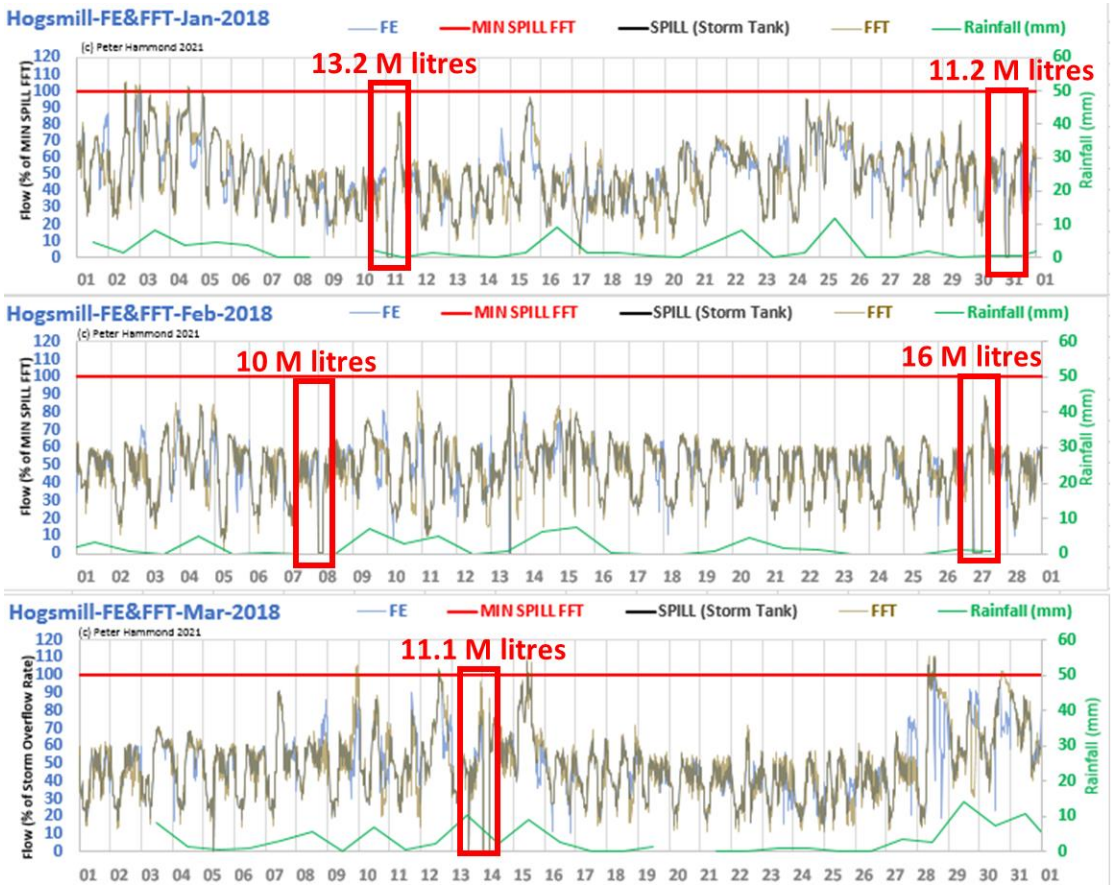


Figure 3: five "mysterious" losses of 61.5 M litres of effluent from Hogsmill STW in the early hours of five days in 2018

2020

Hogsmill STW discharged untreated sewage for 257 hours over 33 spilling days of which **12 were "early"**, 1 occurred with no rain on the day or day before and 2 with no more than 2 mm of rain on the day and day before.

2019

Hogsmill STW discharged untreated sewage for 225 hours over 24 spilling days of which **18 were "early"**. There clearly were other spills early in 2019 but Thames Water's EDM was only in place for 54% of the reporting period with the usual excuse of "Data prior to 20/06/2019 missing due to historical installation issues".

LECHLADE STW

Lechlade STW serves a population equivalent of 2,908 and discharges to the River Leach shortly before it joins the River Thames. It does not appear to be a significant "early" or "dry" spiller but it does at times seem to have had unusual flow to treatment patterns.

2020

Lechlade STW spilled for 698 hours over 40 spilling days of which **1 involved no rainfall on the day or the day before** (Fig. 1, March 4th). This "dry" spill occurred during 19 consecutive days of spilling (Fig. 1, March 1st-19th) which was followed by six weeks where the flow appears to fibrillate rapidly even during dry weather. This eventually settles into a regular diurnal pattern in September. Thames Water will be asked to explain whether the fibrillating flow pattern is a flow meter error or some other equipment failure

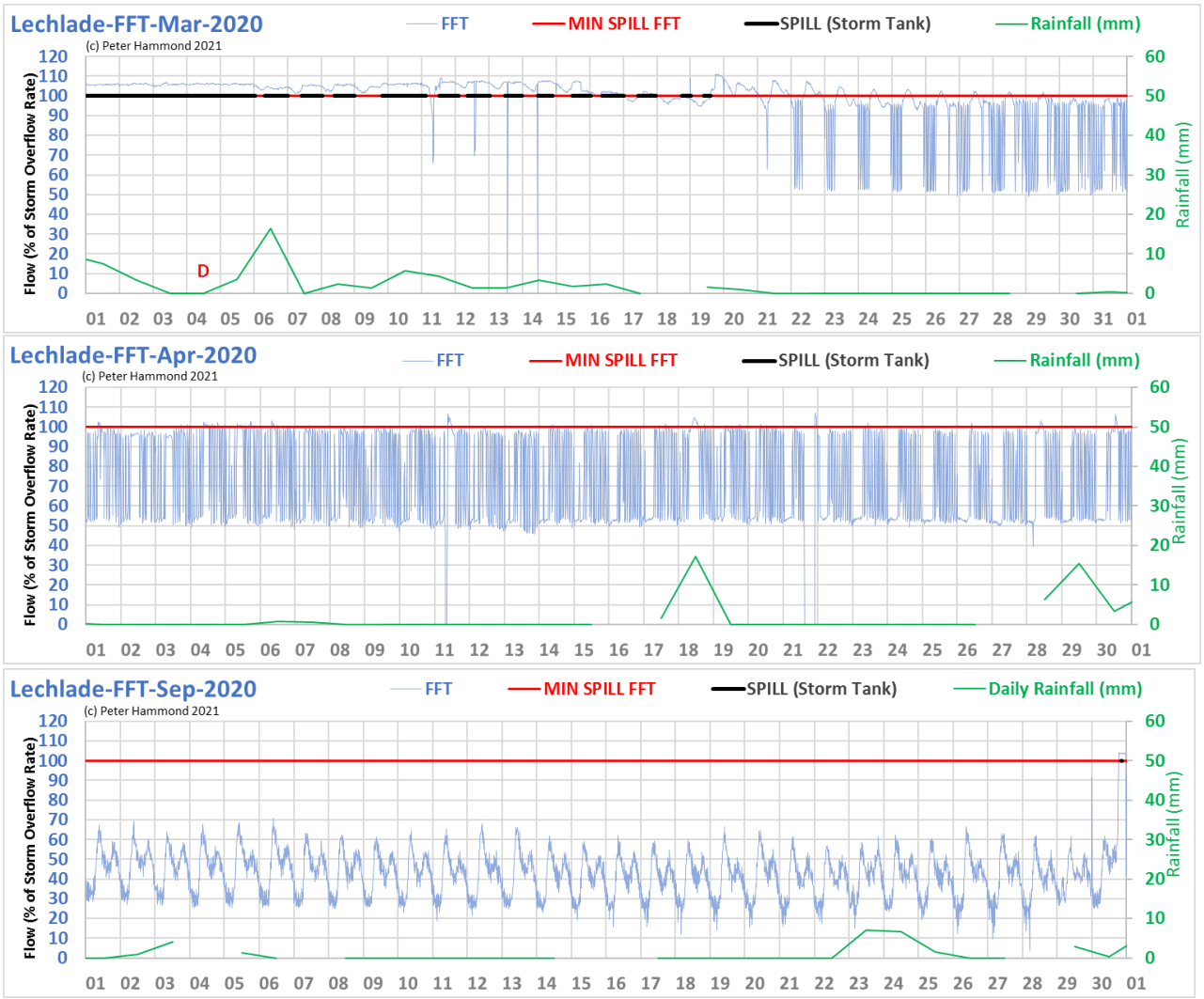


Figure 1: flow to treatment in 2020 reflecting 19 consecutive spilling days in March followed by six+ weeks of fibrillating flow which later in the year (September) stabilises to a regular diurnal pattern

2019

Lechlade STW spilled for 246 hours over 13 spilling days. Thames Water's EDM return for 2019 also included a statement that 2 months of EDM data had been lost with "Data between 31/07/19 - 01/10/19 missing due to comms issues".

MOGDEN STW

This section summarises the analysis of untreated sewage spills from Mogden STW to the River Thames[1] by Thames Water. It addresses the following specific concerns:

a) the efficacy of spill warnings issued to advise rowers and other recreational users;
b) the increasing volume of untreated sewage that Mogden STW spills;
c) the accuracy and reliability of records of spills from Mogden STW;
d) the completeness and correctness of sewage treatment records to support scrutiny of permit compliance;
e) the compliance of the untreated sewage spills with Mogden STW's discharge permit.

Issues not addressed here are problems that local residents have with odour control and mosquito nuisance. More details of these can be found on the TW website[1].

Warnings of sewage spills from Mogden STW

TW issues warnings of spills of untreated sewage on a non-statutory basis as emails to rowers using the River Thames. These warnings are distributed through Twitter and published online[1] and typically are of the form:

> *Following the recent rainfall, Mogden Sewage Treatment Works will in the next hour discharge* ***heavily diluted storm water*** *into the River Thames. Storm water is screened, settled in tanks and* ***mixed with fully treated wastewater*** *before it reaches the river. Work has been carried out at Mogden to increase the treatment capacity during and after* ***heavy rain*** *in our catchment. Regrettably, there are still times that this capacity is exceeded, and with nowhere else for the excess storm sewage to go,* ***these discharges to the river are legal and consented***.

A variation uses "*has in the past hour*" instead of *"will in the next hour"*. In response to EIR 20-21-331, TW said

> *Rower warnings are indicative and are based on the weather forecast and* ***should be given in advance of any possible discharge****, so shouldn't be taken as indicating the actual discharge from site*

and subsequently in response to EIR 20-21-581, TW said

> *The rower notifications were intended to be helpful to the river users and were established in advance of the EDM provision. Unfortunately, the predictive value was undermined by external criticism that they did not match EDM data (they generated 'false alarms' of discharge) so* ***we have since largely stopped this and now tend to notify post-discharge****.*

After an hour, sewage spilled from Mogden can travel as far as Hammersmith Bridge where there is another source of sewage spills, Hammersmith Pumping Station, for which TW also issue rower warnings. In future, then, spill warnings will be less effective in protecting the health of rowers and other River Thames users.

Dilution (or not) of spills of untreated sewage on leaving Mogden STW

The example rower warning described above suggests that spills of untreated sewage are ***mixed with fully treated wastewater before it reaches the river***. This appears to contradict Mogden's EA permit which clearly states that separate outlets be used for treated and untreated storm discharges from Mogden STW (Fig. 1):

Table S1.1 Activities		
Activity reference	**Description of activity**	**Limits of specified activity**
A1	Discharge of secondary treated sewage effluent via Outlet 1	N/A
A2	Discharge of settled storm sewage via Outlet 2	N/A

Figure 1 Extract of EA Permit describing separate outlets for treated effluent and untreated storm discharge

[1] Rainfall data pre-2018 from UKCEH https://nrfa.ceh.ac.uk/; spill volumes from https://www.thameswater.co.uk/about-us/performance/mogden ; rower warnings from Thames Anglers Conservancy (TAC) http://sdn.rivertac.org/.

The location of the separate outlets on Isleworth Ait in the River Thames are shown in Fig. 2a. The Google Earth satellite images (Figs. 2b & 2c) show two historical discharges discolouring the river. Interestingly, the discharge on 08/04/2017, assuming the Google Earth dates are accurate, does not coincide with a rower warning nor a record of a spill on TW's website. Both images predate the installation of EDM devices.

a) discharge outlets; b) 27/06/2010; c) 08/04/2017

Figure 2: discharge outlet locations and Google Earth satellite images showing discharges taking place.

Increasing volume of untreated sewage spills discharged from Mogden STW

Unlike the vast majority of STWs, Mogden STW measures the volume of sewage spills. The total volume discharged on each day where spills occur is published on TW's website in the form of monthly graphs. The annual volume of sewage spilled between 2015 and 2020 at Mogden STW, in **billions of litres** (**Fig**. 3) shows a seven-fold growth over 6 years from 0.5 billion to 7.5 billion. By August 2021, Mogden STW had spilled 6.2 billion litres of sewage to the River Thames.

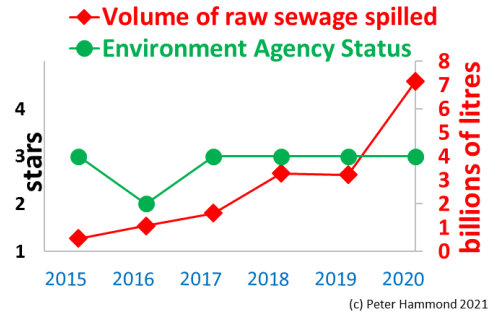


Figure 3: Sewage spilled from Mogden STW annually and Environmental Agency 4 star performance rating

The worst spills in this period occurred on each of two successive days in October 2020, when Mogden STW illegally spilled more than a billion litres of sewage (**Fig**. 4). This is equivalent to 800 Olympic sized swimming pools in 48 hours, or 16 Olympic pools per hour.

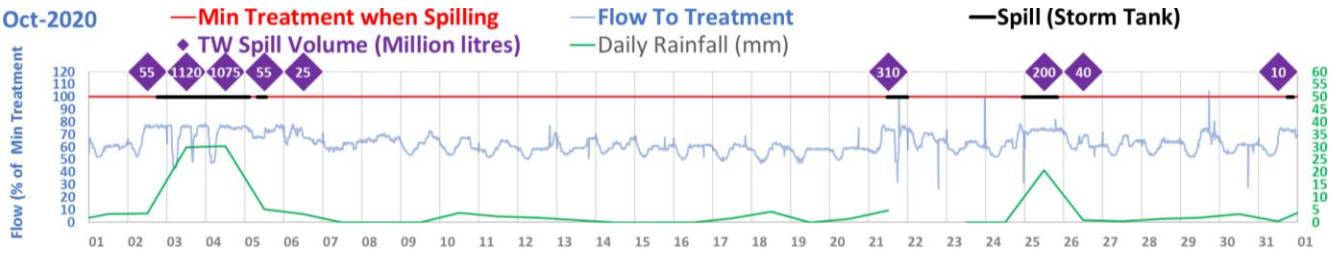


Figure 4: illegal spills of over 1 billion litres on October 3rd and 4th 2020 at Mogden STW

Despite the clear evidence of illegal spilling, the EA's classification of Thames Water's environmental performance was 3 stars out of 4 ("above average") for 5 of 6 years. This classification system is based on incomplete and inaccurate data.

The reliability of the EDM device to record spills of untreated sewage from Mogden STW (and elsewhere)
TW's 2019 return to the EA of its EDM data reported the device to be operational for 62% of the reporting period and "*Data prior to 20/05/2019 missing due to historical installation issues*". Similar missing data excuses were given for 162 (43%) of TW's sites reported in the same return. This suggests surprising incompetence for the installation of a simple device by a company who in May 2020 advertised a vacancy for *Head of Operational Technology* to be

> *accountable for ensuring very high availability (24/7/365) and effective service operation of Thames Water's Operational Technology (OT) comprising of (sic) network infrastructure, applications, data management and cybersecurity*.

The total hours of untreated sewage spilling from Mogden for 2019 was 254.54 covering 25 spills (according to an EA method for counting spills). In the 2019 reporting period when the EDM device was not operational, Mogden's spill volume meter recorded 7 further days of spilling with a total of 132 million litres of untreated sewage being discharged.

In response to EIR 19-20-312, TW reported 104 hours of spills in the first 50 days of 2020 on 10 days when more than 400 million litres of untreated sewage were spilled.

On just one day, February 16th 2020, the EDM failed to detect a spill of **600 million litres of untreated sewage** from Mogden, equivalent to 240 Olympic sized swimming pools. This was 40% of the day's output. When this EDM failure was disclosed in a Times article by Rhys Blakely, TW responded as follows

> *EDMs are like any other monitoring equipment and are prone to occasional failure or incorrect reporting. In these instances in February, we believe a fault with either the sensor or the internal processing prevented us registering that the water level was above the threshold level, and hence spilling. Other equipment nonetheless recorded an estimate of the volume involved, so there was no attempt or intention to mislead or hide the fact."*

This reply and the apparent greater reliability of the spill volume meter suggests it should be rolled out across all STWs as the mechanism for recording the volume of untreated sewage spills. The existing EDM devices which, when they work, simply record the times when spills occur. Volumes of spills will enable much better estimates of pollution and damaging effects on invertebrates, plants, fish and mammals in watercourses.

Completeness and correctness of TW's sewage treatment records for checking permit compliance

A requirement of the permit discharges from Mogden STW is that TW provide annual summaries of daily volumes of treated effluent flow to the EA within 2 months of the end of the reporting period. The works is also required by the permit to use a certified meter (MCERTS) to record average effluent flow every 15 minutes, although this need only be reported to the EA when they request it. The daily total volume (TDV) record inevitably hides the detail of the circumstances under which spills occur.

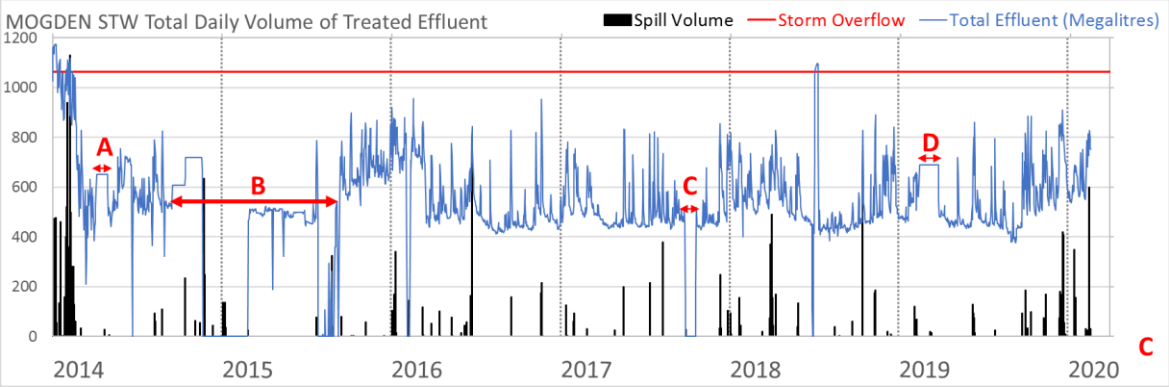


Figure 5: Total daily volume of treated effluent and spill volume of untreated sewage discharged 2014-20

In response to EIRs, TW supplied 15-min effluent flow from Mogden STW from which it is straightforward to derive total daily volume (TDV). Fig. 5 shows TDV (blue curve) and daily spill volume (black columns). The four red annotations label intervals where the TDV data is missing or appears anomalous:

A	April 3rd 2014 – April 30th 2014	28 days
B	September 16th 2014 – September 12th 2015	363 days
C	September 27th 2017 – October 21st 2017	25 days
D	February 13th 2019 – March 28th 2019	44 days

The EA stipulate the number of missing or suspicious TDV values in a year as follows:

> (c) There shall be no more than 37 days and/or no more than 14 consecutive days with 'suspect' or 'missing' Total Daily Volumes in a calendar year, unless otherwise agreed in writing by the Environment Agency.

Each of these four intervals appear to be in breach of the EA's data reporting requirements.

Example showing "permitted" spilling of untreated sewage compliant with the permit to discharge

The chart in Fig. 6 describes how permitted sewage spills are reflected in the flow, rain and EDM data. It shows 18 days of total treated effluent flow (blue curve) leaving Mogden STW at the beginning of January 2014. The effluent flow has been scaled relative to the minimum flow that the permit says must be treated throughout a spill of untreated sewage "due to rainfall". The horizontal red line shows this minimum level of treatment at 100%. The grey ghost-like curve shows the average effluent flow for Mogden STW that occurs during dry weather. It has a typical diurnal shape: decreasing overnight, increasing during the morning rush; decreasing during the afternoon; and, peaking later in the evening.

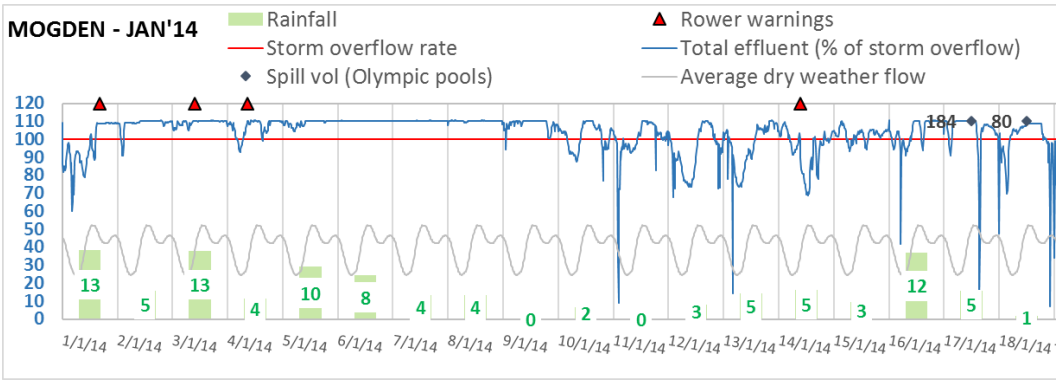


Figure 6: effluent flow from Mogden overlaid with spill volumes and rower warnings

A spill of untreated sewage occurred on 15 of the first 18 days of February 2015 (Fig. 7) and once again the rate at which effluent left the works was always about the permit minimum treatment level during a spill. The total volume of raw sewage spilled into the River Thames was estimated by Thames Water as equivalent to 1,774 Olympic sized pools. The total rainfall was less than 2mm on 10 of these spill days.

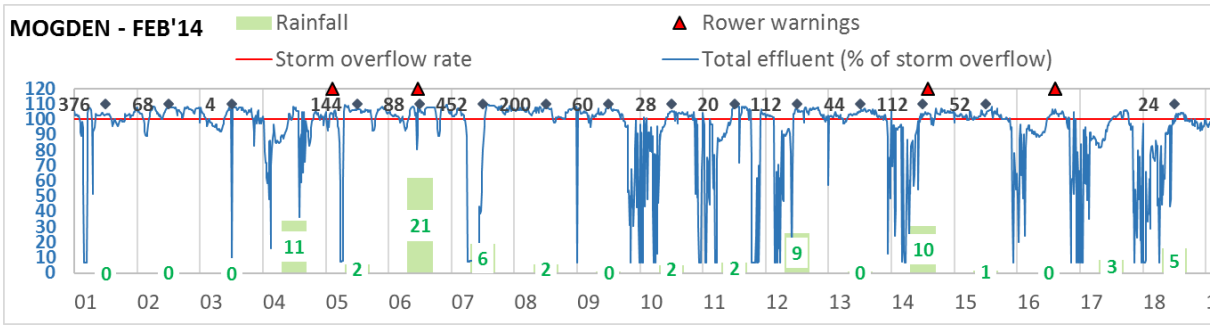


Figure 7: example of spills of untreated sewage within permit

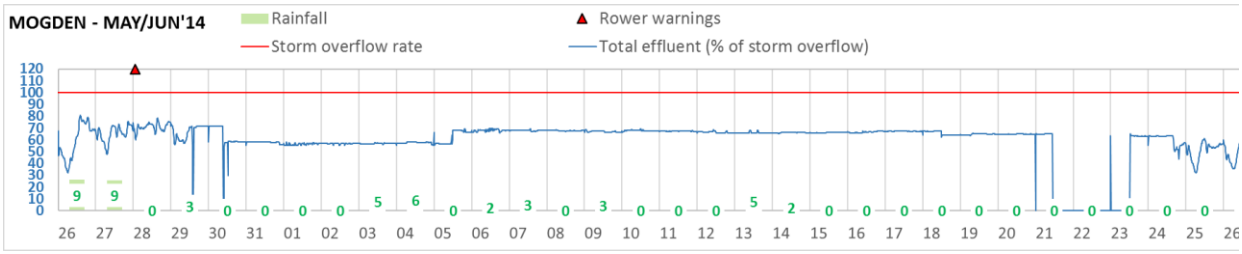
The red triangles indicate when TW sends out "rower" warnings of imminent or very recent spills of untreated sewage from Mogden STW. The green columns show the daily rainfall (mm) that has caused the increased sewage flow resulting in these spills - starting about 2 pm on January 1st and almost unbroken to January 9th. The change from the diurnal dry weather flow to an almost horizontal flow curve reflects the spilling of excess untreated sewage from the works to the River Thames. Clearly, the treated effluent flow is well above the minimum level (red line) and suggests that the amount of sewage passed though the treatment process (the flow to full treatment (FFT)) is compliant with the permit requirement.

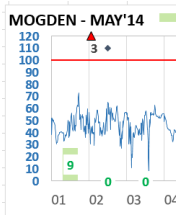
There are occasions, however, subsequent to this example where it appears that an insufficient flow of sewage has continued to be treated while untreated sewage has been spilled from the works to the River Thames. Examples are provided below.

Spills that may have breached the continued treatment permit requirement during spills

1. 2014: May 29th to June 25th

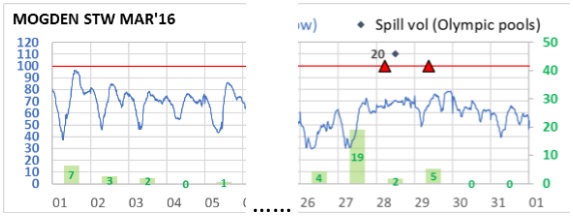
The flatline flow between May 29th and June 25th suggests one or more spills of untreated sewage occurred while the effluent flow rate was below 71% of the permit minimum for continued treatment. Hence, there may have multiple permit breaches even accepting the 8% error margin allowed.





2. 2016: March 28th; April 15th&16th; June 8th, 9th, 12th, 20th, 21st, 23rd & 24th

On March 28th 2016, a rower warning was issued and TW recorded a spill equivalent to 20 Olympic sized swimming pools while the effluent flow was between 60% and 70% of the permitted minimum treatment rate. This suggests the continued treatment rate may have breached the permit. Similar incidents occurred on April 15th, 16th 2016 involving a total of 44 Olympic pools of raw sewage.



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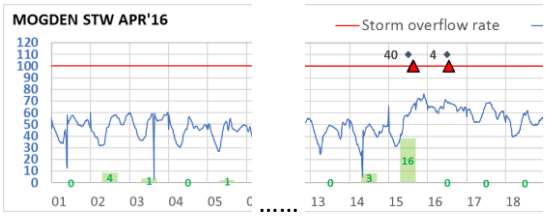

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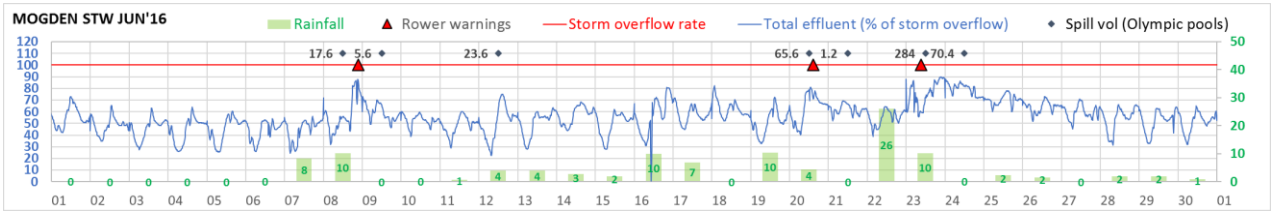

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Missing or suspect data provided in response to EIR for flow data 2014-2020

The EA expect that for flow data records reported to them to satisfy a discharge permit, an individual STW must at most a total of 37 days and at most 15 consecutive days of missing or suspicious data in any single year. The table below details consecutive days of missing or suspicious sewage treatment flow data for Mogden STW. Years when the annual total or the maximum length limits were not breached are omitted. It appears that this aspect of Mogden STW's permit were breached in 2014, 2015, 2017 and 2019.

	Apparent breaches of permit in relation to flow data records				
	Start of series	**End**	**Length**	**Annual Total**	**Longest**
2014	April 5th	April 30th	26	94	41
	May 29th	June 24th	27		
	September 16th	December 31st	41		
2015	January 1st	July 16th	197	237	197
	July 27th	September 9th	40		
2017	September 9th	October 20th	42	42	42
2019	February 13th	March 28th	44		

OXFORD STW

Aylesbury, Cassington and Oxford STWs are different from the other sewage works considered in this report because their storm discharge permits do not require minimum continued treatment during a spill. Instead, they include the following conditions (**Fig**. 1)

> **1. Discharge from Combined Sewer Overflow or Storm Tank**
>
> 1.1 A discharge from a Combined Sewer Overflow ("CSO") or storm tank shall consist of storm sewage effluent resulting from rainfall or snowmelt into the sewerage system.
>
> **2. Restrictions on Discharges from Combined Sewer Overflow or Storm Tank**
>
> 2.1 The discharge or discharges from a CSO or 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, estuary or a beach, or growth of sewage fungus on the bed of the receiving watercourse.

Figure 1: extract from Oxford STW's temporary permit TEMP_2827

Oxford STW has had a "temporary" storm discharge permit for more than 10 years. When asked for information about storm overflow rates and storm tank sizes for all STWs in England, the EA provided a large table for Thames Water STWS with the following entry for Oxford STW (20/05/20):

STW Name	Settled Storm (Storm Tank) Permitted Pass Forward Flow Rate / Overflow Setting (L/S)	Storm Tank Permitted Volume (M3)	Storm Tank Capacity Required To Meet 68 L/H (At Permitted Dwf) (Based On Thames Water Pe Methodology Re Separate Sewers)	Current Storm Tank Volume (M3)
Oxford	1040	9093	9607	9093

Table 1: Oxford STW storm overflow rate and storm tank size specified by Environment Agency

In response to an EIR request about the permit, the EA said:

> *"This permit does not specify an exact amount of sewage that must be passed forward prior to making a storm sewage discharge. However,* ***if a discharge from storm tanks occurred at a time when flow to full treatment / specified design capacity was not being met (e.g. due to an inlet pumping failure, diversion of flow or any other issues that were not rainfall or snowmelt) this would be deemed a breach of condition 1.1 even if there was also rainfall / snowmelt simultaneously present****."* EA THM208600 24/03/21

and about the values in Table 1:

> *This is not yet confirmed and is still being reviewed, but it is what we anticipate.* EA THM208600 24/03/2021

and, in the same response, the EA made the following comment about Aylesbury STW:

> *In the Aylesbury Crown Court case of 2017* ***HH Judge Sheridan agreed with the Environment Agency position that flow to full treatment / specified design capacity should be met prior to making any discharge from storm tanks****.*
> EA THM208600 24/03/2021

In an EIR request, Thames Water were asked by WASP to provide a copy of the site operating manual and its design capacity. Thames Water refused to supply the site operating manual on the grounds that it was not environmental data but did offer the following comment on design capacity:

> *In AMP 2 (1995-2000)* ***Oxford STW was designed to treat flows of no more than 1040 l/sec*** *(in line with its previous 90,000m^3/d maximum permitted discharge limit in the consent).* ***This limitation has not changed since****.*
> Thames Water EIR-21-22-042 24/05/2021

Therefore, WASP has decided to complete the analysis of Oxford STW using the specified design capacity to guide a storm overflow setting of 1040 l/s. In summary, 18 of the spilling days between 2018 and 2020 appear

not to be due to rainfall and 157 appear to be "early" using HH Judge Sheridan's verdict that, before spilling, a works should treat its design capacity. Examples are shown below.

2018

Oxford STW spilled for 691 hours over 51 spilling days of which, WASP believes, **1 involved no rain on the day or day before**; 10 involved up to 2 mm on the day and day before; and, **35 were "early"** using the 1040 l/s specified design capacity to guide a storm overflow setting.

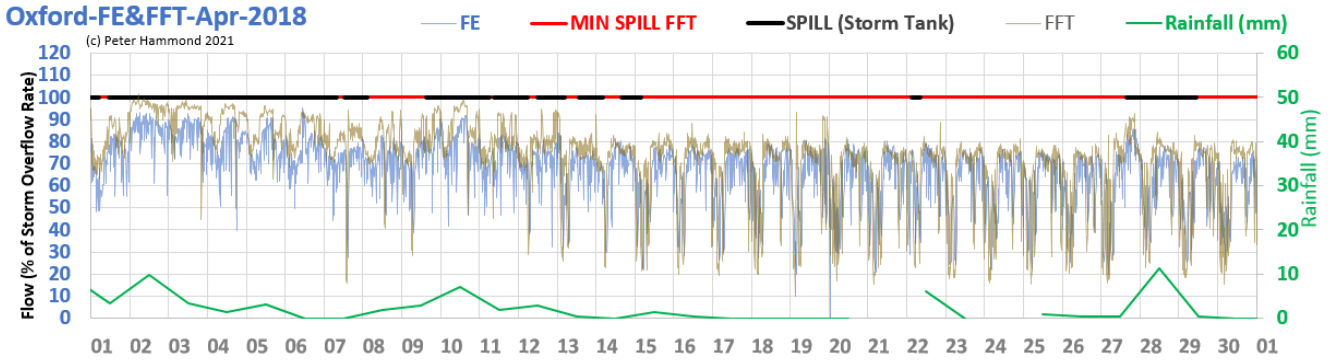


Figure 1: apparently permitted spills (April 2nd**) and potentially "early" spills (**April 13th, 14th, 22nd, 28th, 29th**)**

2019

Oxford STW spilled for 1,332 hours over 84 spilling days of which WASP believes **5 involved no rain on the day or day before**; 27 involved up to 2 mm of rain on the day or day before; and, **44 were "early".**

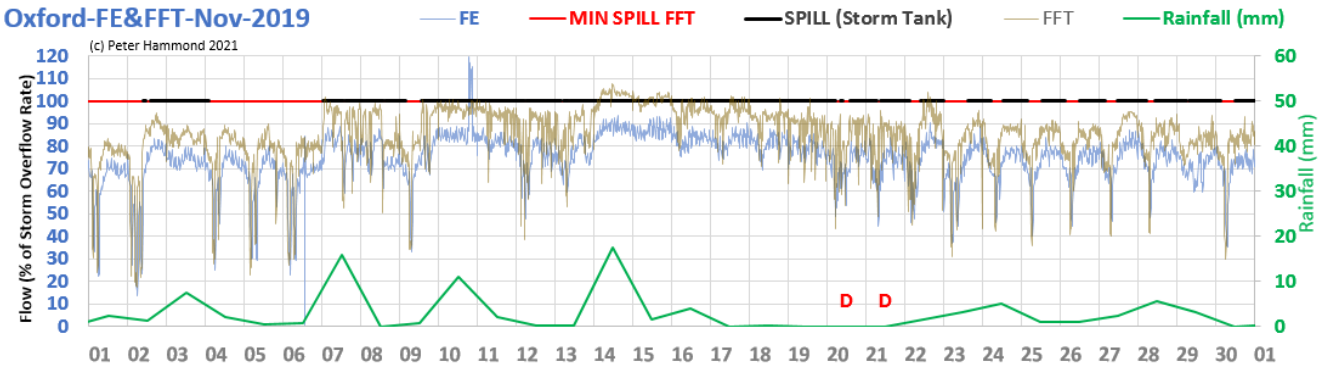


Figure 2: apparently permitted spills (Nov 10th,14th, 15th**) and potentially "early" spills (**Nov 24th, 25th, 26th, 29th**)**

2020

Oxford STW spilled for 1,822 hours over 128 spilling days of which WASP believes **12 involved no rain on the day or day before**; 35 involved up to 2 mm of rain on the day or day before; and, **77 were "early".**

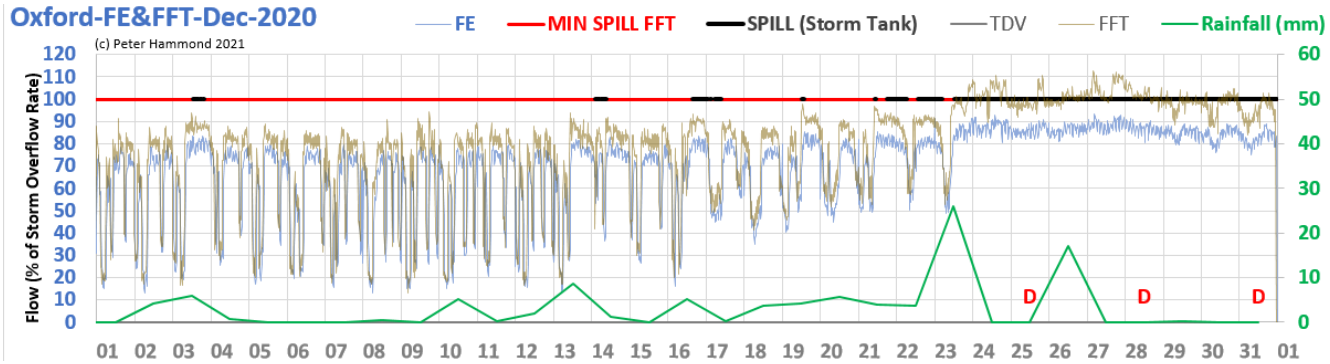


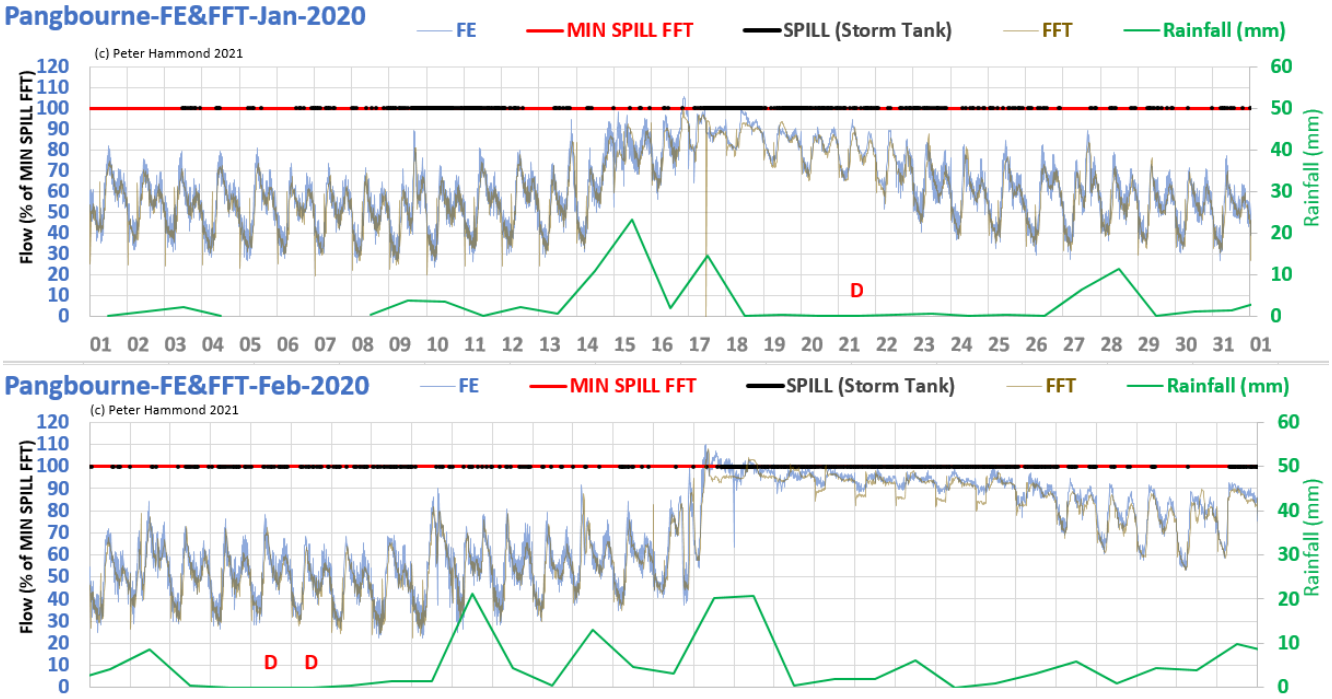
Figure 3: apparently permitted spills (Dec 19th, 25th to 28th**) and potentially "early" spills (**Dec 3rd, 14th, 17th**)**

PANGBOURNE STW

Pangbourne STW discharges into the River Sul which later joins the River Thames. It is one of the Thames Water STWs that has come under the scrutiny of a wild swimming campaign. Indeed, EDM data obtained through an EIR by the swimming group was provided to WASP without flow data. WASP's first response was that Pangbourne STW was a frequent spiller given that, in 2020, Thames Water reported 1707 spilling hours over 99 spilling days. Informal feedback to the swimming group was that the EDM device was faulty.

When flow data was obtained from Thames Water, it was provided in a 700Mb .csv file of over 5 million lines - too large to load into Excel. So, it had to be split up into separate, smaller files. These files turned out to be random mixes of different years' resulting in yet more file manipulation before the data was even viewable.

The combined analysis of flow and EDM data confirmed that the recording device was misfiring and giving a misleading impression of spilling frequency (**Fig**. 1). The shape of both effluent flow and flow to treatment curves for the first 10 days of January are not consistent with diversion of flow to a storm tank or overflow from a storm tank, yet the EDM device appears to raise the alarm on most of those days. For January 17th and 18th, the flow is more consistent with a detected spill. A similar pattern occurs in February with erroneous spill detection in the first half of February but seven or so days spilling after the middle of February.



Unfortunately, Thames Water have frequently cited malfunctioning of EDM devices or their incorrect positioning at many STWs reported on in their EDM returns to the EA. In this case, it is disappointing for all parties that faulty equipment should be left uninspected and malfunctioning for almost 4 months.

In 2019, no EDM related spilling hours were returned and Thames Water made the following comment *"Data unavailable due to installation issues"*. So, the malfunctioning had already been noticed the previous year. In 2018, no spills were recorded and the EDM was declared as in place for only 67% of the monitoring period.

WASP would claim that yet another opportunity to properly monitor an STW has been lost because of Thames Water's poor oversight of the subcontracted installation and subsequent monitoring of the efficacy of the EDM device.

PRINCES RISBOROUGH STW

Princes Risborough STW serves a population equivalent of over 15,000 and discharges to a chalk stream, the Horsenden Brook, which joins the Lyde and Cuttle Brook before joining the River Thame. The loading on the works increased significantly in 2018 (Table 1) and will have increased since then given recent housing development in the area - 2,500 new homes were planned for Princes Risborough a few years ago.

Entering load vs Physical Capacity			
Year	**Entering**	**Capacity**	**Load rate**
2012	12,100 p.e.	15,306 p.e.	**79.1 %**
2014	12,400 p.e.	15,306 p.e.	**81.0 %**
2016	12,312 p.e.	15,306 p.e.	**80.4 %**
2018	13,383 p.e.	15,306 p.e.	**87.4 %**

(p.e. = population equivalent)

Table 1: loading of Princes Risborough STW (2012-2018)

Source: https://uwwtd.eu/United-Kingdom/treatment-plant/ukenthtwutp000119/history

In 2016, Thames Water received a criminal conviction for illegally discharging untreated sewage from Princes Risborough STW into the Horsenden Stream over several months for which they were fined £380,000 and order to pay the EA's costs:

> *Between February and July 2013 the site was poorly managed and there were ongoing problems. Storm discharges into the stream were either observed or recorded in the log book on 21 occasions. The inlet screens, designed to prevent debris from entering the works and causing blockages, were not working and the storm tank pump was broken. The site's storm weir was also set too low which meant that discharges were happening when the effluent should have been passing through the works for treatment.*
> https://www.wired-gov.net

This period of spilling is clearly visible in the first 3 or 4 months of 2013 (**Fig**. 1) where the effluent flow is flattened by the diversion of flow to storm tanks and then into the Horsenden Stream. Its illegality is corroborated by the effluent flow rate remaining well below 70% of the storm overflow setting.

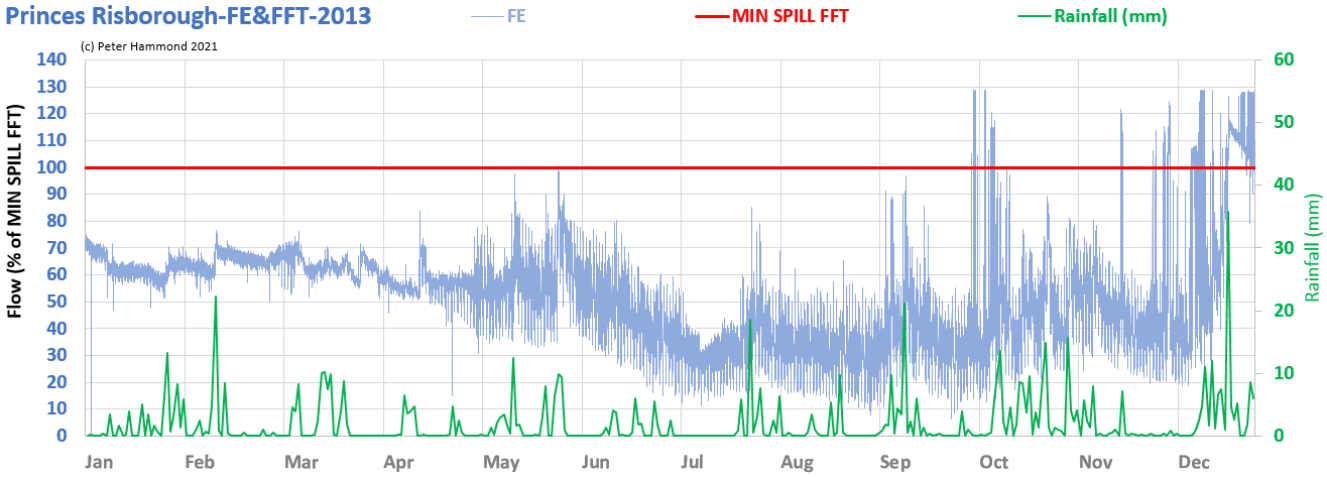


Figure 1: illegal discharge of untreated sewage from Princes Risborough STW for first 3-4 months of 2013

The early spilling probably started in 2012 and continued, after the criminally convicted spilling in 2013, well into 2014 as can be seen by the flattened effluent flow in the last two months of 2012 and first three months of 2014 (**Fig**. 2). The **D** annotations indicate where the spilling occurred when the rainfall was at most 2mm on the day and the day before.

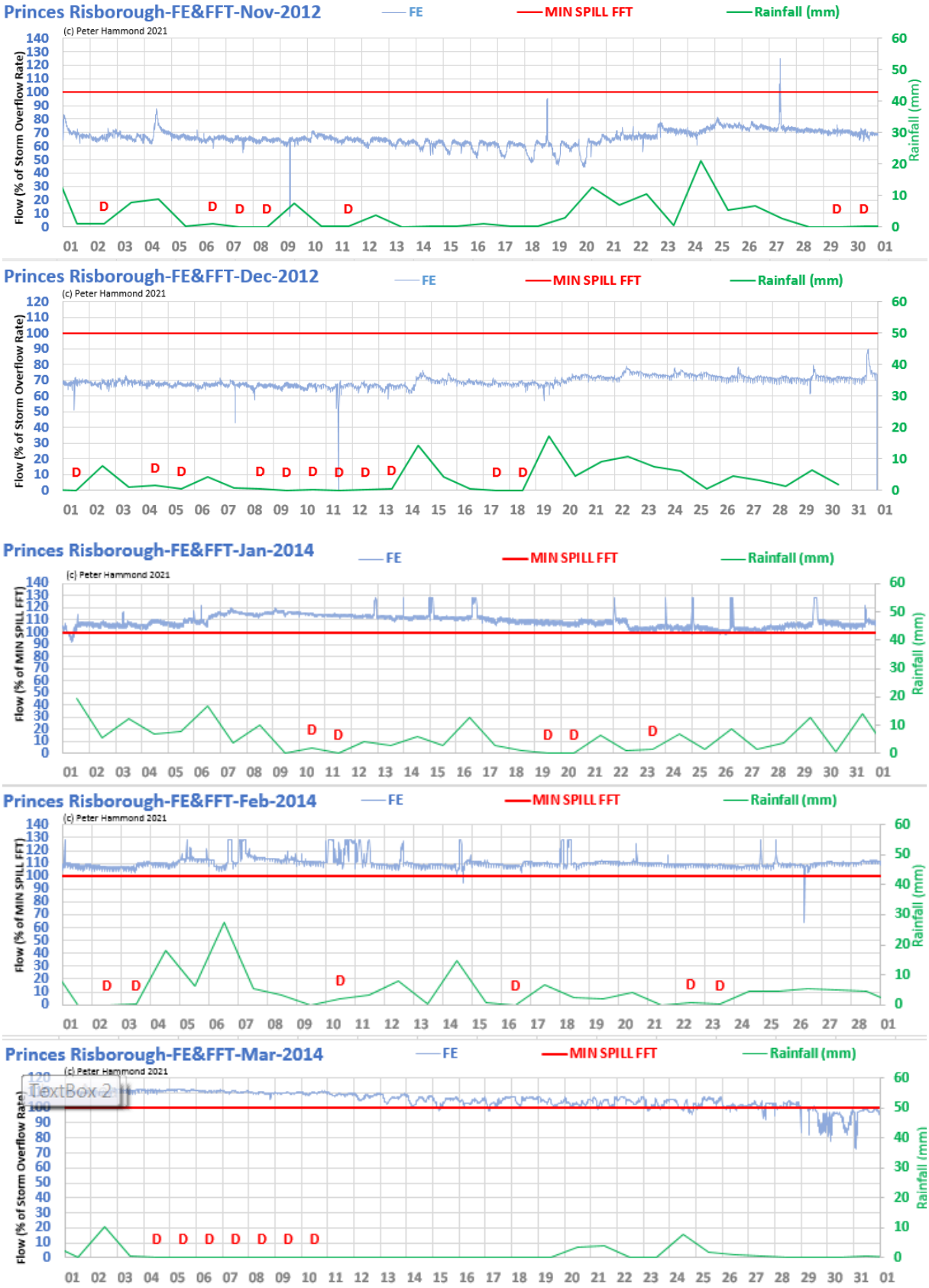


Figure 3: evidence of continuous discharge of untreated sewage from Princes Risborough STW for last 2 months of 2012 and first 3 months of 2014 when rainfall was at most 2mm

Since the court case in 2016, Thames Water have obviously improved their management of Princes Risborough STW with no strong evidence of illegal discharges of untreated sewage between 2015 and 2019.

2020

Princes Risborough discharged for 1707 hours over 113 spilling days of which WASP believes **3 involved no rainfall on the day or day before** and 27 no more than 2mm of rainfall on the day or day before (**Fig**. 4).

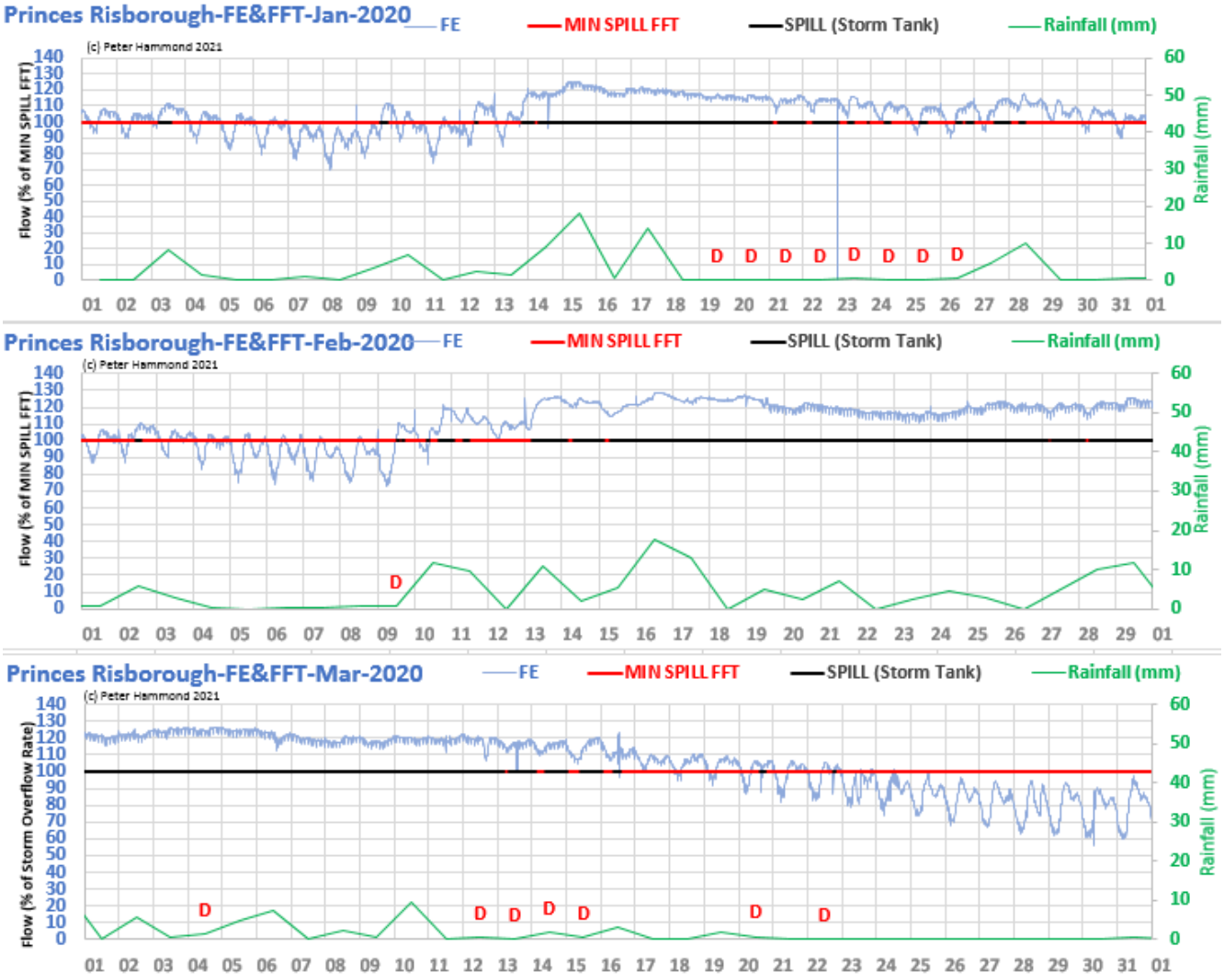


Figure 4: extensive periods of spilling untreated sewage in the first 3 months of 2020 including 16 days where there was no more than 2 mm of rain on the day and the day before

2021

Already in the first six months, Princes Risborough STW has discharged untreated sewage for 2017 hours over 107 spilling days of which, WASP believes, **13 occurred with no rainfall on the day or day before** and 33 with at most 2 mm of rainfall on the day and day before.

Groundwater infiltration at Princes Risborough is obviously a major problem and despite the illegal practices identified in 2013 and convicted in 2016, Princes Risborough STW continues to make illegal discharges of untreated sewage.

SOUTH LEIGH AND STANTON HARCOURT STWs

Summary

South Leigh STW and Stanton Harcourt STW in West Oxfordshire serve population equivalents of about 338 and 1865 respectively. These neighbouring villages are located in MP Robert Courts's Witney constituency which in 2019 was 6th worst of 533 constituencies for spilling untreated sewage with 13,295 spilling hours from 18 STWs. In 2020, South Leigh (3,342 hrs) and Stanton Harcourt (2,484 hrs) were respectively the 3rd and 10th worst spillers of untreated sewage out of 403 of Thames Water's STWs, sewage pumping stations and network CSOs.

An analysis by WASP of the performance of these STWS has established evidence for the following findings:

a. **South Leigh STW** spilled untreated sewage to the Limb Brook for six months almost continuously: on 160 of the 182 days between 24/09/19 and 23/03/20;

b. **Stanton Harcourt STW** spilled untreated sewage to the Stanton Harcourt/Chil Brooks for five and a half months almost continuously: on 168 of the 171 days between 13/10/19 and 31/03/20;

c. 15 of the 160 spilling days at **South Leigh STW** involved no rain on the day of the spill or day before, and 41 involved no more than 2 mm of rain on the day or day before suggesting many to be due to groundwater ingress which is considered illegal;

d. 28 of the 168 spilling days at **Stanton Harcourt STW** involved no rain on the day of the spill or day before, and 63 involved no more than 2 mm of rain on the day or day before; these spills should also be considered due to groundwater ingress; to be unpermitted; and, illegal;

e. **all** 168 spilling days at **Stanton Harcourt STW** identified above occurred while the flow to treatment did not reach the minimum level required by its permit and hence should be considered illegal;

f. during 2020, the management of **Stanton Harcourt STW** appears to have been chaotic with major spills both to the adjacent brook but also to the site itself; the latter involved an estimated 28,000 tonnes of untreated sewage over a 30 day period in Nov/Dec which is unlikely to have been contained on such a small site; Thames Water could not confirm if the brook had been affected.

g. in 2021, **Stanton Harcourt STW** has discharged untreated sewage on 32 days of which 18 should be considered illegal; explanation of **a similar second potential spill to site** in Feb/March was explained by Thames Water by "*contractors reconfiguring internal works return flow pipework. Unfortunately, due to an error, valves were left in the incorrect position resulting in excessive flow being recirculated*".

h. **South Leigh STW**, by the end of May 2021, has already spilled untreated sewage for 1,934 hrs on 75 days of which 25 involved no or little rain on the day of the spill or its eve; South Leigh STW is well on its way to a record breaking number of annual spilling hours and is likely to retain a high ranking in Thames Water's "top of the poops" league table;

i. the Limb and Chil Brooks were graded in 2019 by the EA with poor ecological and failed chemical status respectively;

j. a rare crystal moss animal, with IUCN "Red Book" threatened species status was found in the Chil Brook in 2002; it would be interesting to know if it is still there.

Detailed evidence

The EA requires all water companies to record the start and stop times of individual spills of untreated sewage but only report the annual totals. WASP used Environmental Information Regulation (EIR) requests, like freedom of information requests, to obtain the details of individual spills. During WASP's investigation of Standlake STW, it became clear that because of the substantial tankering of sewage from the works and feeder pumping stations in nearby villages, its spilling performance is best considered separately from that of Stanton Harcourt and South Leigh STWs and will be covered by a separate report.

Figure 1A shows the individual spills (thick black horizontal lines) for Stanton Harcourt and South Leigh STWs for 2020, a useful indication of when spills occur during a year. More informative, still, is to highlight the "spilling season" from September 2019 to March 2020 by moving the 12-month viewing window back 4 months (Fig. 1B).

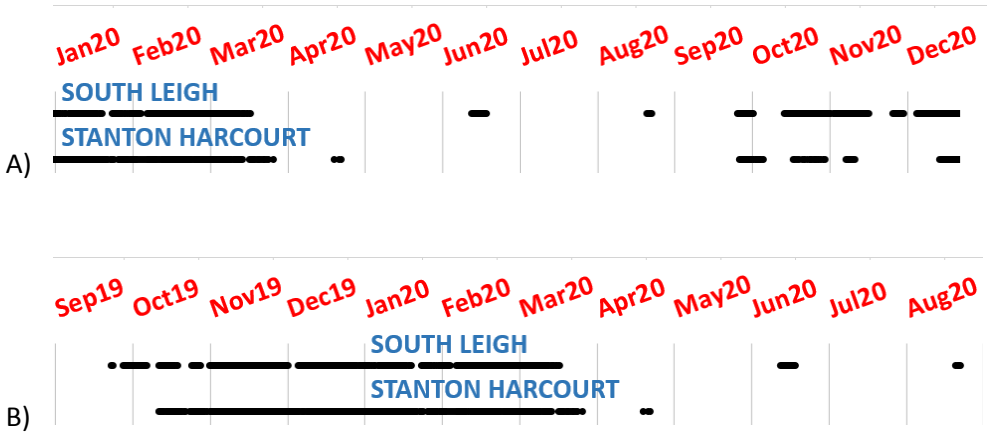


Figure 1: overview of individual spills from South Leigh and Stanton Harcourt STWs for **A)** 2020; **B)** 2019-2020

The EA should consider moving its period for annual assessment of spilling of untreated sewage from a calendar year to one that accommodates a September-March spilling season that is evident at tens of STWs in England and Wales.

It is now abundantly clear that South Leigh STW spilled for 6 months with minor breaks and Stanton Harcourt STW for 5 and a half months with only a brief respite. More specifically, between September 24th 2019 and August 23rd 2020 (182 days), South Leigh STW spilled untreated sewage on 159 days and of those 14 involved no rain on the day of the spill or day before, and 41 involved no more than 2 mm of rain on the day or day before. South Leigh STW clearly suffers from groundwater ingress into leaky sewerage pipes and joints. Since the EA considers groundwater ingress to be an unpermitted excuse for discharging untreated sewage, the spills during little or no rainfall on these 41 days should be considered in breach of permit and hence illegal.

Similarly, between October 13th 2019 and March 31st 2020 (171 days), Stanton Harcourt STW spilled untreated sewage on 168 days and of those 28 involved no rain on the day of the spill or day before, and 63 involved no more than 2 mm of rain on the day or day before. Stanton Harcourt's groundwater ingress looks even worse than that at South Leigh STW. Once again, these spills during little or no rainfall should be considered in breach of permit and hence illegal. Indeed, **they are potentially doubly in breach of permit** since **all 168 spilling days at Stanton Harcourt breached a second permit requirement** that even when spilling, the rate at which sewage continues to be treated is above a specified level (identified in the chart in Figure 2 as the horizontal at 100% on the left hand axis). The flow to treatment, represented by the brown curve, does not remain above even the 92% marginal level that the EA allows to cover a potential 8% metering error.

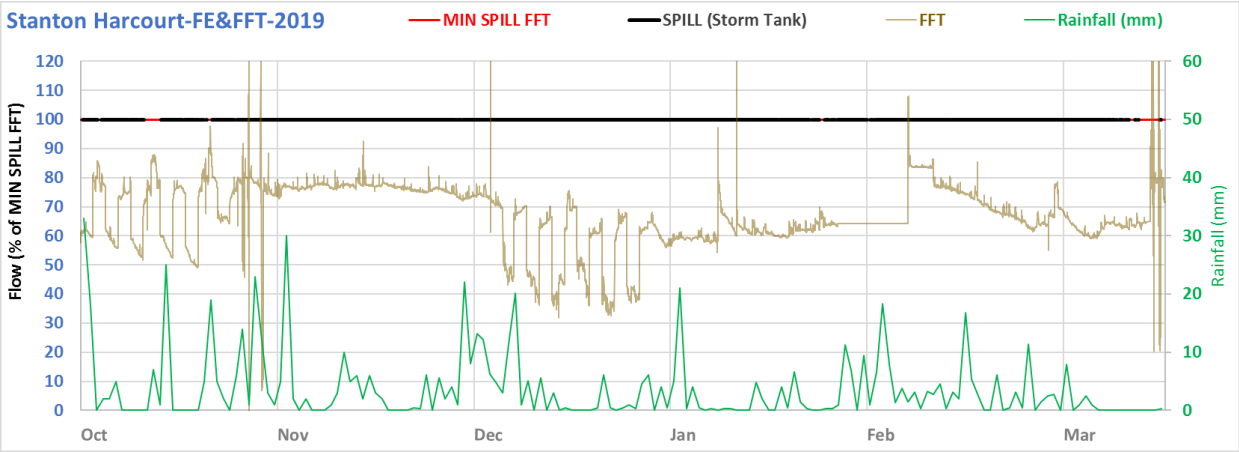


Figure 2: 168 days of almost continuous illegal spilling of untreated sewage from Stanton Harcourt STW where the flow to treatment fails to reach the minimum specified in its permit

In 2021, a Senior Process Scientist at Thames Water, in response to an EIR request, confirmed that between January and February 2020 there was equipment failure at Stanton Harcourt which resulted in a serious spill of untreated sewage to the adjacent Brook that required reporting to the EA. He also explained that in an attempt to correct the extended periods of unpermitted spills at Stanton Harcourt, some site "plumbing" changes were undertaken. These worked for a brief period. However, in late September, there was a catastrophic leak for some 30+ days resulting in approximately 28,000 tonnes of untreated sewage spilling within the site. This admission was provided in response to a request for an explanation of how much more sewage appeared to be being treated than was exiting the works as effluent. The Stanton Harcourt STW site is relatively small and to retain such a volume of untreated sewage would require a perimeter wall approximately 8 m high. Figure 3 shows this chaotic management of Stanton Harcourt STW during 2020.

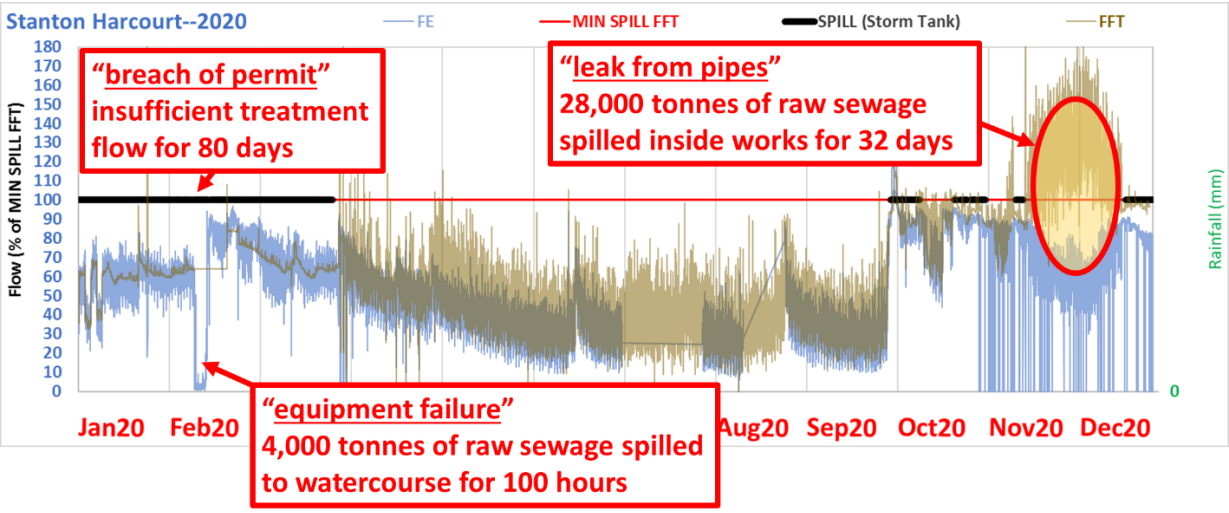


Figure 3: chaotic sewage flow management by Thames Water at Stanton Harcourt STW in 2020

Most of the above was presented to Thames Water's CEO Sarah Bentley in July 2021 at the Warwick Hall in Burford when she made a visit to WASP and the River Windrush.

2021

Stanton Harcourt STW has made untreated sewage discharges on 32 days of which **14 were "early"** and **9 involved little or no rainfall on the day of the spill or the preceding day**. In addition, an EIR request is pending with regard another potential spill to the site in March 2021 similar to that in the autumn of 2020. Figure 4 illustrates a second period of 32 days, in Feb/March 2021, when the flow to treatment is much higher than the

rate of effluent leaving the works. Where did this excess of treated sewage end up? Thames Water is still looking into this through EIR 21-22-474as of September 2021.

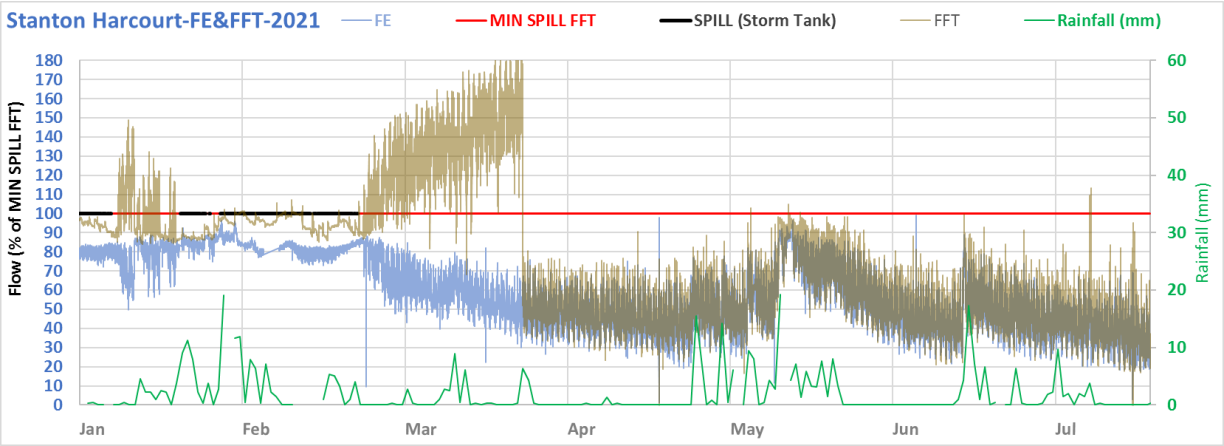
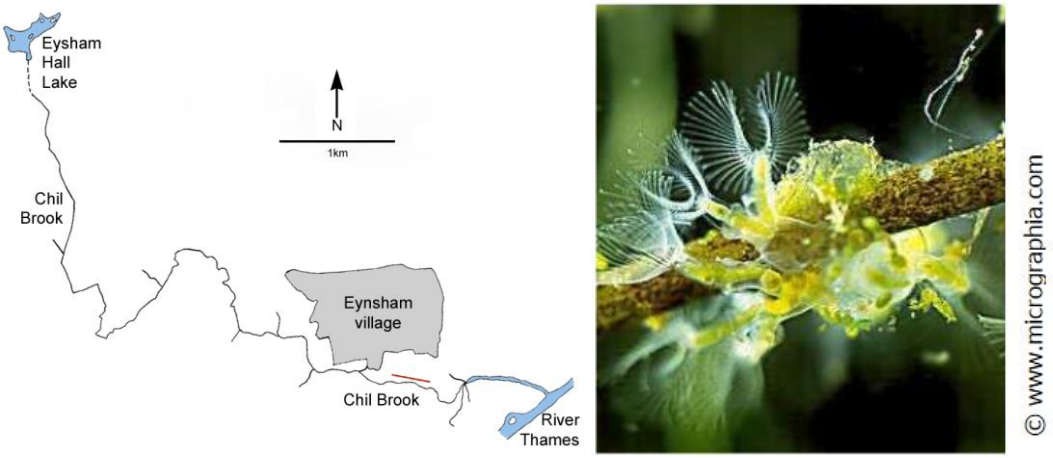


Figure 4: spill intervals and treatment and effluent flows at Stanton Harcourt illustrating more potentially illegal discharges of untreated sewage and also a possible spill to site in February/March 2021

So far in 2021, South Leigh STW has made untreated sewage discharges on 75 days (for 1,934 hrs) of which 25 days involved little (up to 2 mm) or no rainfall on the day of the spill or its eve.

At South Leigh STW, Thames Water have said that only the effluent meter is certified in terms of accuracy and reliability (known as MCERTS) and that the flow to treatment which is subject to permit requirements cannot be used to identify unpermitted spills. In contrast, at Stanton Harcourt STW, the flow to treatment meter is MCERTS certified and hence has been used here to identify breaches of the minimum treatment condition.

Finally, it is worth noting that the Chil Brook (Fig. 5) was once host to a freshwater "crystal moss" *Lophopus Crystalinus* rare enough to have been included in the IUCN Red List of Threatened Species. Having been exposed to the untreated sewage pollution from Thames Water's STWS over so many years, it may have disappeared.



Map of Chil Brook from Eysham Hall Lake to its confluence with the River Thames. Red Line indicates extent of Brook surveyed for *Lophopus*.
https://www.researchgate.net/publication/336150280_Conservation_of_the_freshwater_bryozoan_Lophopus_crystallinus

Figure 5: Sketch map of location of Lophopus Crystalinus in the Chil Brook identified in 2002