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Cambridge Waste Water Treatment Plant Relocation Project
Anglian Water Services Limited

Appendix 20.10: Storm Model Report

Application Document Reference: 5.4.20.10
PINS Project Reference: WW010003
APFP Regulation No. 5(2)a

Revision No. 01
April 2023

Cambridge WWTP Relocation Project

Document No: 00000-100006-CAMBST-ZZZ-BOD-P-0004

Project Name:	**Cambridge WWTP Relocation Project**
Project No:	**CAM-00001**
Sub Programme:	**-**
Subject:	**Storm Model Report**

	Project	Cambridge WWTP Relocation Project
	Subject:	Storm Model Report

HISTORY SHEET

REV	DATE	DESCRIPTION	AUTHOR	CHECKER	APPROVER
01	30.01.23	DCO Submission	-	-	-

CONTENTS

EXECUTIVE SUMMARY

This document presents a summary of the design input that drives the storm management design components of the Cambridge Wastewater Treatment Plant Relocation Project or CWWTPRP. The project is to relocate the Cambridge WRC and STC from the Milton location to the site selected during the site selection process: Site 3.

Although a storm storage equal to the existing WRC storm storage was indicated in the pre-application response, the EA has at a meeting on the 4th October 2021 indicated that they would consider alternative arrangements, including considering part tunnel storage and storm treatment. These options will be further discussed and agreed with the EA during follow up meetings in December 2021. This report aims to collect the information to present to the EA prior to these meetings.

The CWWTPRP design team have taken the following approach for network infrastructure, wastewater treatment plant and discharge infrastructure design:

1. Used a Design Basis population equivalent (PE) set by AWS for the design of the CWWTPRP.
2. Used existing flows and loads to the Milton WRC to calibrate and then design the new flows and loads arriving at the CWWTPRP, in accordance with the EA methods for amongst others: DWF and FFT (www.gov.uk).
3. Used a calibrated sewer catchment network model to predict the storm events for various storm intensities, taking consideration of climate change impacts, and define the capacity of the catchment infrastructure, including the sewer tunnel extension to the new CWWTP. Maintain no detriment to the flooding in the catchment.
4. Learn from the operation of the existing Milton WRC storm management: frequency and volume of storm discharges.
5. Pursue a storm management solution that would satisfy or outperform the EA storm management requirements (UPM compliant), including the no deterioration objective.
6. Regular communication with the EA and other key stakeholders to establish alignment of understanding and desired outcome.

With the data sets prepared in line with the EA's methodology for I_{max} determination, significant differences were seen year on year for infiltration numbers. Although no seasonal pattern could be identified, very high infiltration was seen in 2018 for the period January to May, most probably attributed to the 'Beast from the East' weather phenomena that occurred in February – March 2018. Direction is to be sought from the EA on which FFT is to be used.

The information about the historical storm operation at the existing Milton WRC, as well as the network modelled equivalent for the existing Milton WRC and the future operation of the proposed CWWTPRP have been determined, along with the available tunnel storage. The CWWTPRP storm management solution, including FFT, storm solution and CSO location and inclusion/exclusion is to be discussed with the EA at the meeting in December 2021.

1.0 INTRODUCTION

This document presents a summary of the design input that drives the storm management design components of the Cambridge Wastewater Treatment Plant Relocation Project or CWWTPRP. The project is to relocate the Cambridge WRC and STC from the Milton location (referred to in this report as the Milton WRC) to the site selected during the site selection process: Site 3 - an area north of the A14 between Fen Ditton and Horningsea.

Although a storm storage equal to the existing Milton WRC storm storage was indicated in the pre-application response, the EA has at a meeting on the 4th October 2021 indicated that they would consider alternative arrangements, including considering part tunnel storage and storm treatment. These options will be further discussed and agreed with the EA during follow up meetings in December 2021. This report aims to collect the information to present to the EA prior to these meetings.

2.0 BACKGROUND TO THE PROJECT

Anglian Water is proposing to relocate its Cambridge Wastewater Treatment Plant (Milton WRC) to enable the regeneration of North East Cambridge. The relocation will make way for more than 5,600 new homes, one million square feet of commercial space and thousands of new jobs.

Unlocking the potential for the regeneration of North East Cambridge and providing a new, modern, low carbon waste water treatment facility for Cambridge and Greater Cambridge.

The relocation project is a Nationally Significant Infrastructure Project (NSIP). Anglian Water will therefore submit a Development Consent Order (DCO) application to the Planning Inspectorate.

Further information can be found on the project website: www.cwwtpr.com.

3.0 PRE-APPLICATION RESPONSE

The Milton WRC is currently operating under the EA permit number ASCNF/1033. The table below displays a summary of the current Milton WRC and the response in October 2020 from the EA from the enhanced level of pre-application advice sought in July 2020 for the CWWTPRP:

PARAMETER	CURRENT PERMIT LIMITS	EA PRE-APPLICATION RESPONSE
BOD	15mg/l	11mg/l
AMMONIA	5mg/l Based on 37,330 m^3/d DWF	3mg/l Based on 55,000 m^3/d DWF
PHOSPHOROUS	1mg/l (UWWTD limit)	0.4mg/l Focused on achieving moderate status
STORM STORAGE	23,000 m^3	23,000 m^3

Table 1: Existing Permit and Pre-application Permit Response

The pre-application advice also confirmed general acceptance of the change in discharge location, associated with the CWWTPRP being on the opposing bank of the River Cam than the current Milton WRC, but largely in the same general area of the River Cam – upstream of Baits Bite Lock.

4.0 CWWTPRP DESIGN APPROACH TO STORM MANAGEMENT

Included in Anglian Water's (AWS) aspirations of constructing a modern treatment facility, of low carbon construction, is the commitment to provide vital services for the community and environment, recycling water and nutrients, producing green energy and helping Cambridge to grow sustainably.

To ensure this commitment can be realised, we have taken the following approach:

1. Used a Design Basis population equivalent (PE) set by AWS for the design of the CWWTPRP.
2. Used existing flows and loads to the Milton WRC to calibrate and then design the new flows and loads arriving at the CWWTPRP, in accordance with the EA methods for amongst others: DWF and FFT (www.gov.uk).
3. Used a calibrated sewer catchment network model to predict the storm events for various storm intensities, taking consideration of climate change impacts, and define the capacity of the catchment infrastructure, including the sewer tunnel extension to the new CWWTPRP. Maintain no detriment to the flooding in the catchment.
4. Learn from the operation of the existing Milton WRC storm management: frequency and volume of storm discharges.
5. Pursue a storm management solution that would satisfy or outperform the EA storm management requirements (UPM compliant), including the no deterioration objective.
6. Regular communication with the EA and other key stakeholders to establish alignment of understanding and desired outcome.

4.1 What Population is Included in the Design Basis?

The current Design Basis is for a 300,000 PE[1] wastewater treatment facility and a 16,000 TDS/annum sludge treatment facility. The site also allows further space for extensions beyond this Design Basis, with the intention that the facility would be reintegrated into the normal OFWAT asset management periods (AMP) upon completion and commissioning, (c. 2028) towards the end of AMP 8.

This reintegration of the facility allows for future changes in effluent compliance (e.g. WFD reviews or new policies) to be implemented in a known/processed manner.

The Design Basis includes for the flows from the Cambridge and Waterbeach catchments, with growth allowances in line with methods for OFWAT's pricing reviews and AMP funding applications, and includes an allowance on top of that to align with the population figures published in the latest Greater Cambridge Local Plan (August 2021).

4.2 What Flows are we using in the Design Basis?

The flow formulae prescribed by the EA for wastewater treatment works design, published by the UK Government (www.gov.uk), were used.

1. DWF formula

$DWF = PG + I_{DWF} + E$

Where:

DWF = total dry weather flow (l/d)
P = catchment population (number)
G = per capita domestic flow (l/hd/d)
I_{DWF} = dry weather infiltration (l/d)
E = trade effluent flow (l/d)

The flow and load information in Appendix A, prepared by AWS Process Scientists (we updated infiltration to dry weather infiltration), comprise historic PE numbers, TSFR flow measurement flows and urban wastewater treatment directive (UWWTD) raw sewage sample data. This data set has in the past been used in discussions with OFWAT to align population equivalent and influent into the Cambridge works and is deemed a robust set of data on which to base per capita flow and load figures as part of the design of this works.

[1] The 300,000PE includes 22,932PE equivalent from trade contributions and PE aligns with the October 2021 Greater Cambridge Local Plan allowances.

Source:
EA Guidance - Calculating dry weather flow (DWF) at waste water treatment works
Published 8 May 2018

4.2.1 Per Capita Flow

The per capita flow used in the design flow calculations for dry weather flow (DWF)[2], flow to full treatment (FFT) and storm design (Formula A) is 145 l/PE/d. This aligns with AWS' minimum asset standards and aligns well with historic information, aligning population, flows and loads (refer Appendix A).

4.2.2 Flow to Full Treatment

Flow to full treatment settings at waste water treatment works

You must design WWTW to treat peak dry weather flow (DWF) and additional flows from light rainfall.

The normal minimum setting is:

Flow to full treatment (FFT) = 3PG + I_{max} + 3E

Where:
P = catchment population (number)
G = per capita domestic flow (l/head/day)
E = trade effluent flow (l/d)

This FFT setting is also known as 3DWF. I_{max} is the maximum infiltration rate over the whole year. In certain circumstances you will need to consider the infiltration for summer and winter separately.

Source:
EA Guidance - Water companies: environmental permits for storm overflows and emergency overflows
Updated 13 September 2018

Infiltration calculations for the Cambridge catchment contributing to the CWWTPRP were done by Mark Taylor of AWS consents team, to confirm both I_{DWF} and I_{max} in line with the EA's calculation methods.

With the data sets prepared in line with the EA's methodology, significant differences were seen year on year for infiltration numbers. Although no seasonal pattern could be identified, very high infiltration was seen in 2018 for the period January to May, namely 97.35% average for the period, with I_{max} 125.67% on 18th April 2018. The 'Beast from the East' weather phenomena that occurred in February – March 2018 impacted on the infiltration figures, with the catchment taking a while to return to lower levels. From June to December 2018 the infiltration remained below 73.8%, with I_{max} average for the year 2018 as 59.25%. For 2019 I_{max} was calculated as 86.75%, with I_{max} average for the year 2019 as 51.9%. I_{DWF} was calculated as 40.4%. (Graphs included in Appendix B).

Flow to full treatment (FFT) based on I_{max} 125.7%	171,723 m^3/d	1,988 l/s
Flow to full treatment (FFT) based on I_{max} 86.75%	159,192 m^3/d	1,842 l/s
Flow to full treatment (FFT) based on $I_{max\ average}$ 59.25%	150,336 m^3/d	1,740 l/s
Flow to full treatment (FFT) based on I_{DWF} calculation (3DWF)	144,279 m^3/d	1,670 l/s

Table 2: Flow to Full Treatment figures based on various infiltration allowances

Direction is to be sought from the EA on FFT figure to be used.

For the infiltration associated with future growth, the EA methods[3] allow half of the current infiltration to be used, as new developments should provide less infiltration than existing.

[2] LINK: DWF - https://www.gov.uk/government/publications/calculating-dry-weather-flow-dwf-at-waste-water-treatment-works/calculating-dry-weather-flow-dwf-at-waste-water-treatment- .
[3] LINK: https://www.gov.uk/government/publications/water-companies-environmental-permits-for-storm-overflows-and-emergency-overflows/water-companies-environmental-permits-for-storm-overflows-and-emergency-overflows

For the Waterbeach catchment, where an uncalibrated catchment model was available and with a small PE contribution (2021 only 7,040 PE connected, increasing to 20,913 PE by 2041), 25% has been utilised for the infiltration from both current and future developments.

4.3 What about Storm Flows?

The EA's requirement for the minimum retained flow in the sewer is to be at least Formula A, prior to any storm overflows in/on the sewer network and for unsettled storm overflows at the inlet to the WWTP.

Additional to the Formula A requirement, the CWWTPRP philosophy has been to pursue a "no detriment" position in the catchment – i.e. no increase in flooding in the catchment.

We ensured no flood detriment in the upstream catchment by using a verified network model (2019) and design storms. The design storm event creation is based on the FEH13[4] parameters for rainfall frequency and intensity, which is industry standard method for ensuring no flood detriment (further explanation in Appendix C). The Cambridge catchment network model was updated and calibrated in 2019. This model was extended to include the extension of the tunnel to the CWWTP terminal pumping station (TPS).

The current tunnel design is progressing with 1:100 year design storm event as the design basis. This allows for Climate Resilience.

The results of the network modelling prove that flows in excess of the Formula A (5.05 m^3/s) requirement would have to be lifted out of the network at the TPS, to prevent flooding in the catchment. Typically, the difference between these modelled peak flows and Formula A would be discharged at a CSO.

Formula A

A minimum retained flow in the sewer of formula A is the normal minimum requirement for storm overflows on the sewer network and for unsettled storm overflows at the inlet to WWTW. It's calculated as:

Formula A (l/d) = DWF + 1360P + 2E

Where:
DWF = total dry weather flow (l/d) calculated from PG + I + E
P = catchment population (number)
G = per capita domestic flow (l/head/d)
I = infiltration (l/d)
E = trade effluent flow (l/d)

Source:
EA Guidance - Water companies: environmental permits for storm overflows and emergency overflows
Updated 13 September 2018

Design event	Peak Flow in catchment (m^3/s)	Formula A (m^3/s)	Required discharge at CSO (m^3/s)
DWF	1.4	Less than Formula A	No discharge
5 year	4.97	Less than Formula A	No discharge
10 year	5.5	5.05	0.45
20 year	5.92	5.05	0.87
30 year	6.13	5.05	1.08
100 year	7.01	5.05	1.96

Table 3: Peak flows to prevent flooding detriment

The storm management, including CSO location and inclusion/exclusion is yet to be finalised. This is to be discussed with the EA.

[4] Flood Estimation Handbook 2013 edition - data and rainfall model outputs that are required to apply the UK flood frequency and rainfall estimation procedure.

4.3.1 How much storm storage/treatment is required at the CWWTP?

The EA's standard requirement for storm storage is "a minimum capacity of 68 l/head served or a storage equivalent of 2 hours at the maximum flow rate to the storm tanks".

- 68 l/head for the 300,000PE[5] served equates to **20,400 m³**.
- "storage equivalent of 2 hours at the maximum flow rate to the storm tanks" was not calculated at this stage due to the uncertainties with FFT (refer Table 2).

During a meeting with the EA on the 4th October 2021, they indicated that in-tunnel-storage could be considered to achieve a suitable storm management solution. Agreement is to be sought on the acceptable reduction of the above storage, based on tunnel storage utilisation (refer section 4.3.2).

4.3.2 Terminal pumping station design

A pumping station was added at the downstream end of the tunnel, referred to here as the terminal pumping station (TPS). Firstly, DWF and FFT pumps (refer Table 2 above) were added at "free discharge" equivalent stop/start levels – as the sewage arrives, it is lifted to the CWWTP. This approach minimises risks for septicity to occur and/or sediment to build up in the TPS. This was achieved through adding a sump below the tunnel invert level, to separate the tunnel operation from the TPS operation for DWF and FFT – the blue zone in Figure 1 below.

Preliminary sized storm pumps were also added in the TPS and the catchment model was used to determine how much tunnel storage was available, prior to impacting on the "no detriment" position in the catchment (refer 4.3 above). The storage volume that was taken into consideration for this tunnel storage volume was only the new additional tunnel section (c.2.4km). Furthermore, storage in the TPS was also calculated. Figure 1 illustrates the static levels in the TPS, whereas the storage volume in the tunnel is the dynamic volume determined through the catchment model.

[5] 300,000PE includes 22,932PE equivalent from trade contributions.

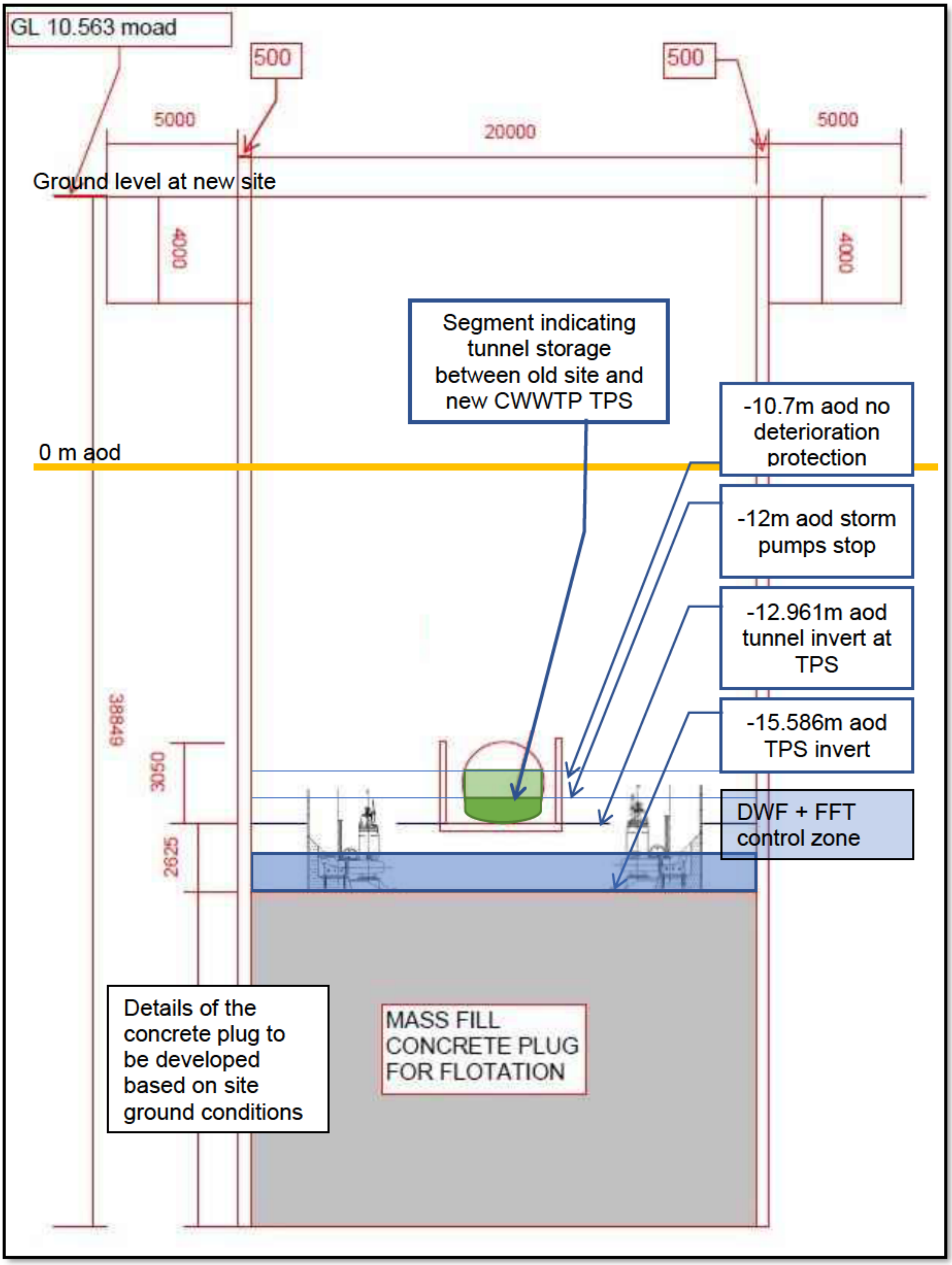


Figure 1: Indicative Terminal Pumping Station illustration showing tunnel storage segment (all tunnel and TPS levels TBC during detail design)

The results are as follows:

	Pump rates, start and stop level to utilise the tunnel									
	CBARSM.1	CBARSM.2	CBARSM.3	CBARSM.4	CBARSM.5	CBARSM.6	CBARSM.7	CBARSM.8	CBARSM.9	CBARSM.A
Pump type	FFT				STORM			CSO		
On Level (mAOD)	-13.64	-13.44	-13.24	-13.22	-11.7	-11.6	-11.3	-11	-11	-10.7
Off Level (mAOD)	-13.94	-13.94	-13.64	-13.52	-12	-12	-12	-11.3	-11.3	-11
Pump Rate (m^3/s)	0.49	0.49	0.49	0.49	1.08	1.08	1.08	1.08	0.26	0.53

Table 4: TPS start/stop levels and pump rates

Tunnel Storage Used in NEW Tunnel						
		CBARSM.5	CBARSM.6	CBARSM.7	CBARSM.8	CBARSM.9	CBARSM.10
Storage location	FFT	STORM PUMPS			CSO PUMPS		
In tunnel (m^3)	No storage utilized	1,542	1,807	2,744	3,881		5,182
Further Storage in TPS (m^3)	226[6]	829.5 (603[7] added)			1,018 (189[8] added)		
Total (cumulative)	226	3,573			6,200		

Table 5: Total tunnel storage per storm pump

A 10 year continuous timeseries modelling set (just like in an urban pollution management - UPM - study) was run to understand the frequency of the operation of storm pumps, whilst using the available storage in the tunnel. Table 5 and Figure 2 below summarises the results:

Storm Pump No.	Times used in 10 years
1	29
2	5
3	0

Table 6: Storm pump utilisation over 10 year time series modelling set - CWWTPRP

[6] Storage in TPS between low water level (pumps off) and FFT control (-13.22 m aod to -13.94m aod = 0.72m)
[7] Storm Storage in TPS (-11.3m aod to tunnel invert of -12.961m aod = 1.661m depth) + (-12.961m aod to FFT control of -13.22m aod = 0.259m)
[8] Total Storm Storage in TPS (-11.3m aod to -10.7m aod = 0.6m)

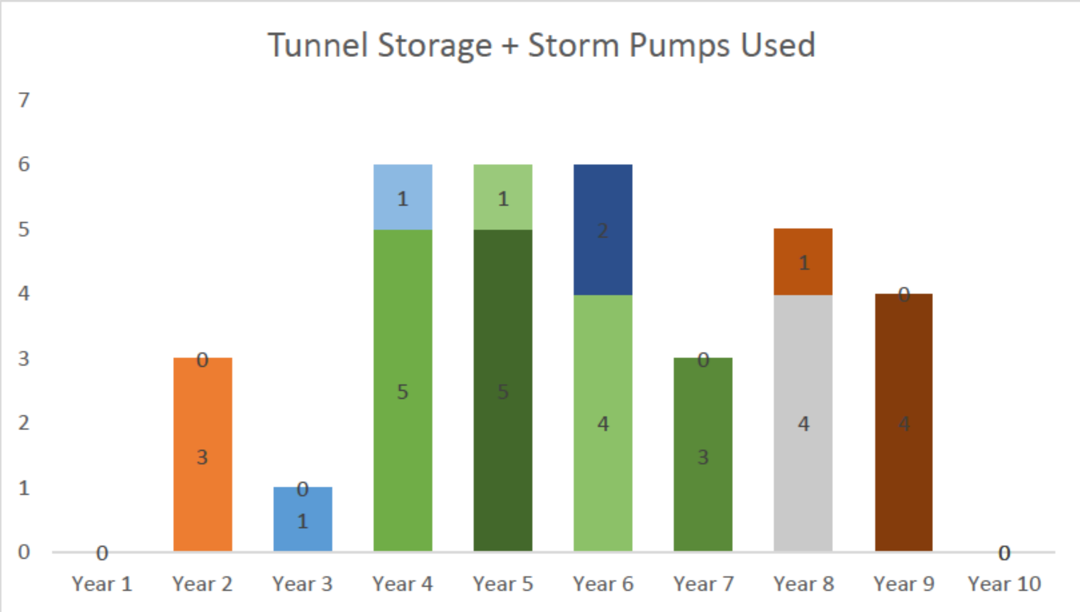


Figure 2: Storm pump utilisation in time series modelling

During this 10 year continuous modelling set, the largest storm volume forwarded to the CWWTP happened over the course of an 8hrs event, namely: **13,873 m^3**. This illustrates the effective use of the storm storage in the tunnel, reducing the frequency and capacity requirement at the CWWTP for storm storage – refer Table 4. No storm discharge to the River Cam is expected with storm storage/treatment up to this volume.

Year of simulation	Maximum event volume (m^3) utilising tunnel storage	Maximum event volume (m^3) not utilising tunnel storage
Year 1	0	574
Year 2	13,873	14,507
Year 3	1,332	8,390
Year 4	10,148	8,815
Year 5	7,478	9,306
Year 6	11,035	7,458
Year 7	8,632	8,444
Year 8	10,498	4,790
Year 9	4,485	7,664
Year 10	0	1,741
Maximum volume	**13,873**	**14,507**

Table 7: Storm event discharges to CWWTP (not the river)

Storm solutions will be discussed and agreed with the EA.

4.3.3 What about "no deterioration"?

The catchment model was utilised to simulate the same storm events at the existing Milton WRC, with the CURRENT PE and the FFT set to 1,273l/s (current setting). This provides insights into the current impacts at the Milton WRC and the impacts on the river.

Table 8 below includes the 10 year continuous timeseries modelling set (just like in an urban pollution management - UPM - study) run to understand the frequency of the operation of storm pumps (comparable table to Table 6).

Storm pump No.	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Times used in 10 years
1	64	87	90	117	112	106	90	97	102	116	981
2	0	7	8	11	8	7	5	6	8	8	68
3	0	7	8	11	8	7	5	6	8	8	68
4	0	0	0	0	1	0	0	1	0	0	2
5	0	0	0	0	0	0	0	0	0	0	0
6 (stdby)	0	0	0	0	0	0	0	0	0	0	0

Table 8: Storm pump utilisation over 10 year time series modelling set – Milton WRC

This 10 year continuous modelling set was further utilised to determine the total volumes of storm flow discharged into the Milton WRC (not the river), summarised in Table 9 (comparable to Table 7).

Year of simulation	Year total volume to storm tanks (m^3)	Maximum event volume (m^3) (not utilising tunnel storage)
Year 1	65,496	2,130
Year 2	143,677	28,834
Year 3	133,273	10,625
Year 4	175,166	16,167
Year 5	160,810	14,556
Year 6	154,317	19,770
Year 7	125,223	17,718
Year 8	135,339	16,354
Year 9	136,331	12,751
Year 10	158,567	15,478
Maximum volume	**175,166**	**28,834**

Table 9: Storm event discharges to Milton WRC (not the river)

The reduced storm volumes discharged at CWWTP compared to Milton WRC can be explained through the attenuation and storage achieved in the extra 2.4km tunnel length to the CWWTP.

Furthermore, additional to the discharges to the existing storm tanks (c.7,000 m^3), the model was used to determine how often the lagoon (c.16,000 m^3) and discharges to the river would take place.

Discharge to	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Times used in 10 years
Storm tanks	64	87	90	117	112	106	90	97	102	116	981
Lagoon	1	14	14	13	11	12	9	9	9	12	104
River	0	1	0	0	0	0	0	0	0	0	1

Table 10: Storm discharges over 10 year time series modelling set – Milton WRC

Year of simulation	Maximum storm event volume from storm tanks to the lagoon (m³)	Maximum storm spill to the river (m³)
Year 1	184	0
Year 2	19,941	3,941
Year 3	5,616	0
Year 4	7,236	0
Year 5	12,767	0
Year 6	10,844	0
Year 7	13,443	0
Year 8	7,428	0
Year 9	11,431	0
Year 10	6,553	0
Maximum volume	**19,941**	**3,941**

Table 11: Storm event discharges to Milton WRC (not the river)

The modelled results compare well with the information available from the past few years record data:

Discharge to	2020	2019	2018	2017	2016
Storm tanks[9]	148	148	106	26	81
Lagoon[10]	4	3	6	Not known	Not known
River[11]	0	0	0	Before EDM	Before EDM

Table 12: Storm discharges recoded – Milton WRC

Additional to the above WRC information, the following summarises the catchment position associated with permitted and un-permitted CSOs:

- The Riverside CSO is the only permitted CSO in the catchment.

Discharge to	2020	2019	2018
Riverside CSO[11]	15	3	2

Table 13: Storm discharges recoded – Riverside CSO

- There are no further known un-permitted CSOs in the catchment, although localised flooding in areas of the catchment are known.

From the above information it can be seen that the modelling is conservative compared to the actual storm impacts seen at the Milton WRC.

[9] Telemetry data used as data source.
[10] Operator comments – no telemetry or other recorded data available.
[11] EDM reports used as data source.

4.3.4 Storm management options considered:

Ideally an UPM study would be carried out to simulate the impact of the discharges on the River Cam. However, due to the optioneering nature of the storm management comparison at this stage, it was agreed with the EA at the meeting on the 4th October 2021 that the UPM equivalent 10 year time series modelling would be utilised to determine the frequency and volume of discharges into the CWWTP. This information would then be used in Excel calculations to predict the flows and loads into the River Cam for the various options for comparison.

The following options were considered for comparison:

I. Pre-app storm storage volume of 23,000m^3
II. Calculated storm storage based on 68l/h and 2hrs at max storm flows
III. Storm storage including in tunnel storage, as modelled
IV. Storm treatment including in tunnel storage, as modelled

The following quality parameters were assigned to the flows:

- The final effluent quality of flows up to FFT were taken to be compliant with the proposed pre-application quality requirements.
- Traditional settled storm: Storm durations less than 2hrs were returned to the WRC and treated to FFT quality requirements.
- Traditional settled storm: Storm durations greater than 2hrs were discharged as settled storm.
- Storm treatment options could consider a variety of methods. The FlexFilter solution was utilised in these illustrations, as the technology for which best reliability and performance has been achieved and in alignment with information provided to the EA to date.

The following table summarises the discharge quality assumptions:

Parameter	FFT (Pre-app response)	Settled storm	Treated storm
Total Suspended Solids	14 mg/l	200 mg/l	150 mg/l
BOD	11 mg/l	150 mg/l	120 mg/l

Table 14: Quality parameters utilised for discharge comparison

Option	Pre-app	68 l/PE and 2hrs	Storm storage, (including 6,200m^3 tunnel storage)	3,000 l/s storm treatment (Formula A-FFT)
Storm tank size	23,000m^3	20,400m^3	14,200m^3	None (treatment only)
No. of storm events	29[12]	29[12]	29[12]	29[12]
No. of storm discharges to river	0	0	0	29 treated flow discharges
Quality/Impact on River	FFT only	FFT only	FFT only	Above FFT

Table 15: Results of comparison of different storm management options

The CWWTPRP storm management solution, including FFT, storm solution and CSO location and inclusion/exclusion is to be discussed and agreed with the EA.

[12] Refer to Table 6

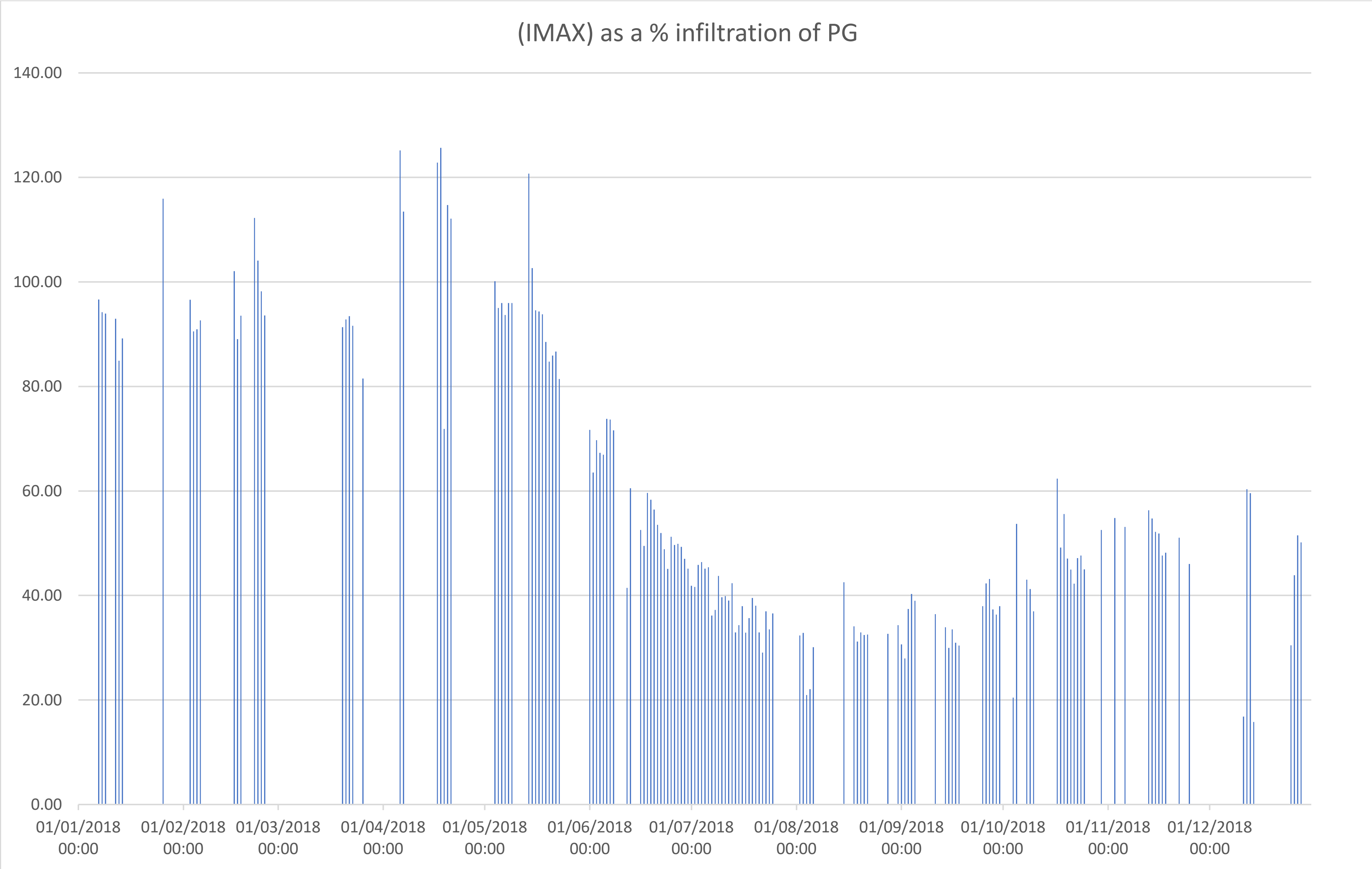
5.0 REFERENCES

1. I max calcs – *Cambridge WRC U_IMP5 Calculations – V4 AB edits.xlsx*
2. Time series modelling report (new works pumps info) - *123239-BUK-ZZ-00-RP-NM-00005.docx*
3. Storm pump levels (existing works pumps info) - *123239-BUK-ZZ-00-RP-NM-00004.docx*
4. Network modelling (peak flows in catchment details) - *122971-BVL-Z0-00-RP-N-00001_P02_v3.doc*
5. Modelled discharges through the existing Milton WRC – *Existing max volume to the storm and lagoon.xlsx*
6. AWS EDM Return Reports for 2018/2019, 2019/2020, 2020/2021 (actual spills reported from Milton WRC and Riverside CSO)
7. Historic telemetry data from site – *CAMBRIDGE STW.Screening.Inlet High Level To Storm.High Level.xlsx*
8. Historic flow and load info – *Ian Evans AWS 2020 Cambridge – PE Calculations.xlsx*

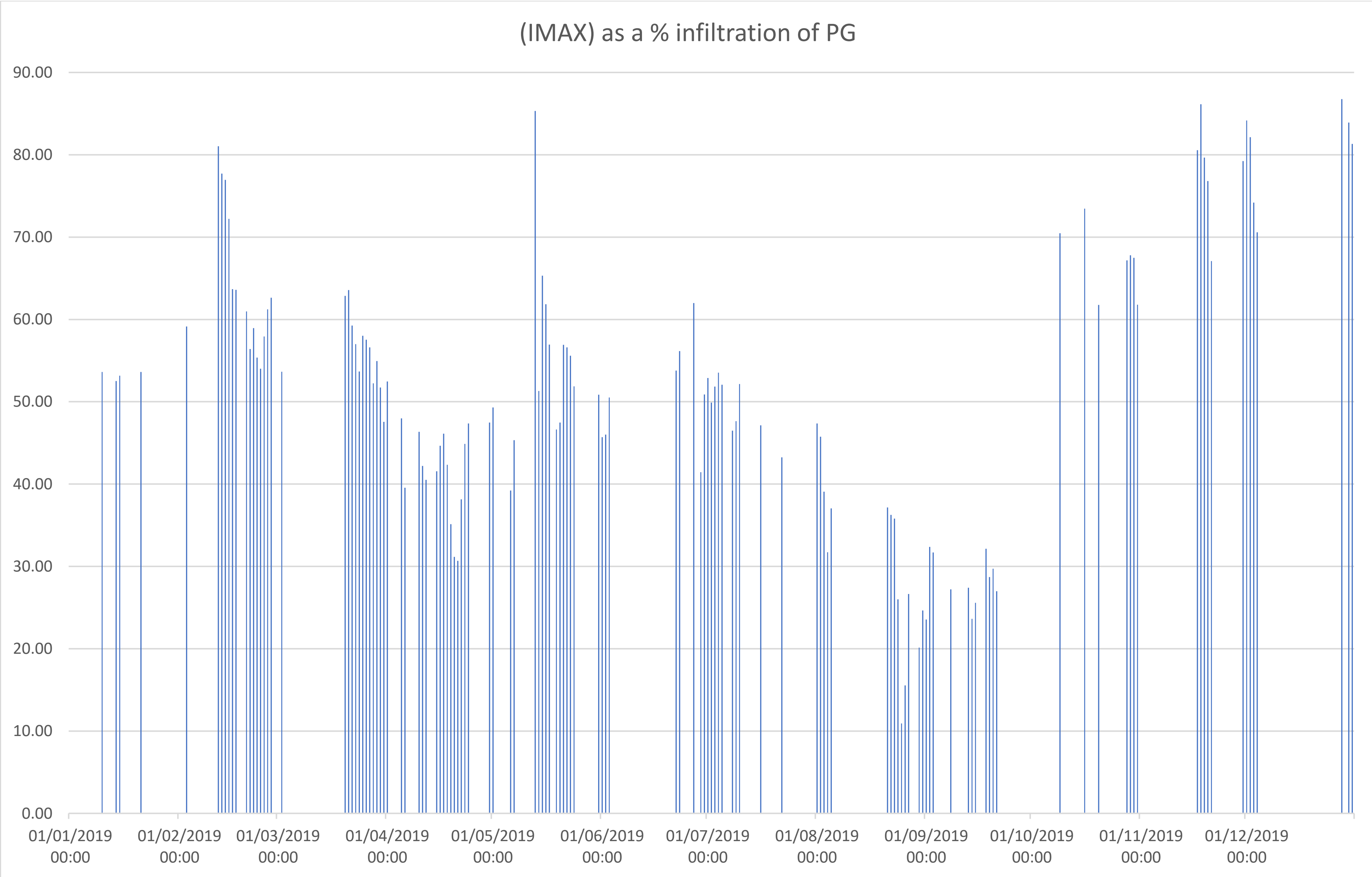
APPENDIX A: HISTORIC MILTON WRC FLOW AND LOAD DATA

June Return/APR PE data											
	2009	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
PE Total	155709	149489	155444	145310	143927	164281	163600	172242	166206	167768	183884
Loads											
	2009 (Part)	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Flow (m3/d)	45383	47902	44976	63300	60976	57822	53454	52215	48284	51982	49939
TSS (kg/d)	11641	11271	15565	17167	16824	18571	14591	19217	18924	16702	14667
BOD (kg/d)	11589	10471	12889	12565	12928	12775	12417	14232	13300	12724	12344
COD (kg/d)	25173	23223	30778	33620	30750	33604	31283	36296	33140	32946	29195
NH3 (kg N/d)	1411	1428	1597	1897	2050	1875	1794	1874	1659	1666	1706
Ptot (kg P/d)	305	287	349	402	435	451	430	437	418	342	324
Per Capita loads used:											
Flow	145	l/h/d	254	average l/h/d							
TSS	70	g/h/d	(Note Average calculated assuming 40% infiltration and 1.25 factor i.e. per capita flow X 1.25 X 1.4)								
BOD	60	g/h/d									
COD	135	g/h/d									
NH3	8	g/h/d									
Ptot	2.3	g/h/d									
PE equivalents from loads											
	2009 (Part)	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Flow (m3/d)	178851	188777	177246	249459	240298	227869	210655	205774	190283	204854	196804
TSS (kg/d)	166306	161013	222356	245243	240341	265299	208441	274532	270348	238597	209529
BOD (kg/d)	193151	174514	214816	209417	215464	212924	206945	237193	221661	212068	205731
COD (kg/d)	186466	172025	227982	249037	227778	248922	231724	268860	245482	244043	216258
NH3 (kg N/d)	176330	178529	199622	237147	256277	234435	224297	234291	207377	208229	213207
Ptot (kg P/d)	132690	124574	151694	174781	189059	196041	187149	189996	181733	148624	140739
PE equivalents compared to JR											
	2009 (Part)	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Flow (m3/d)	115%	126%	114%	172%	167%	139%	129%	119%	114%	122%	107%
TSS (kg/d)	107%	108%	143%	169%	167%	161%	127%	159%	163%	142%	114%
BOD (kg/d)	124%	117%	138%	144%	150%	130%	126%	138%	133%	126%	112%
COD (kg/d)	120%	115%	147%	171%	158%	152%	142%	156%	148%	145%	118%
NH3 (kg N/d)	113%	119%	128%	163%	178%	143%	137%	136%	125%	124%	116%
Ptot (kg P/d)	85%	83%	98%	120%	131%	119%	114%	110%	109%	89%	77%

APPENDIX B: IMAX AS A PERCENTAGE OF PG GRAPHS
2018

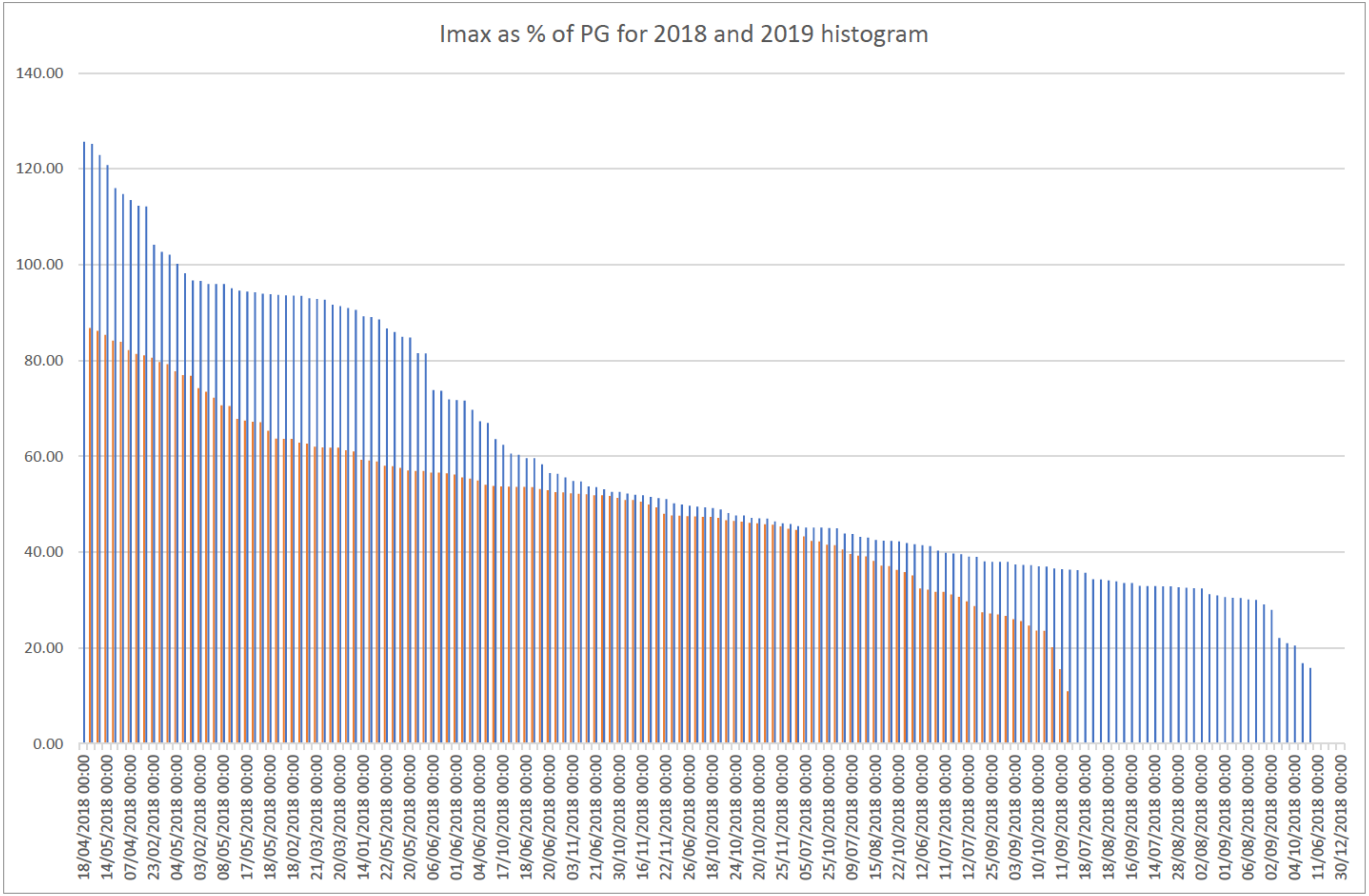


2019



(IMAX) as a % infiltration of PG
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
01/01/2019 00:00
01/02/2019 00:00
01/03/2019 00:00
01/04/2019 00:00
01/05/2019 00:00
01/06/2019 00:00
01/07/2019 00:00
01/08/2019 00:00
01/09/2019 00:00
01/10/2019 00:00
01/11/2019 00:00
01/12/2019 00:00

Histogram of Imax as percentage of PD for the 2018-2019 period



APPENDIX C: DESCRIPTION OF DESIGN STORMS AND TIME SERIES MODELLING

Design storms:

These are synthetic profiles which follow a bell shape. The rainfall is calculated using a set of parameters which are defined by the flood estimation handbook. We would use this rainfall to assess for flooding in the catchment. It can be used for spills for overflows but only at the low return periods. They are normally fairly quick to run as they only have one event. For dry weather flows we assume the worst case for the whole event.

Time series modelling:

These can any length but are normally 10 years. They are derived either using historic data or they can be generated for any time period. They are mainly used to assess spill frequency and volumes from overflows. They are used when we are doing water quality assessments including UPM studies. The time series modelling take a lot longer to run depending on how long people want the results for. For dry weather we use the diurnal pattern and account for the variation in that between week days and weekends as well as any commercial flows which might not operate at certain times of the year.

-END-

Get in touch

You can contact us by:

- Emailing at **info@cwwtpr.com**
- Calling our Freephone information line on **0808 196 1661**
- Writing to us at **Freepost: CWWTPR**
- Visiting our website at [redacted]

You can view all our DCO application documents and updates on the application on The Planning Inspectorate website:

https://infrastructure.planninginspectorate.gov.uk/projects/eastern/cambridge-waste-water-treatment-plant-relocation/