Drainage and Wastewater Management Plan

Bosham
Wastewater System Plan

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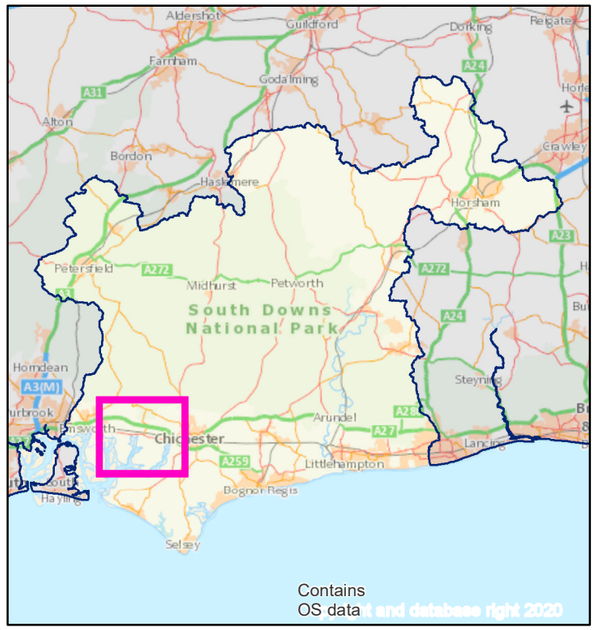
Bosham wastewater system: map and key facts



Population Equivalent (PE)	3,922
Discharge Waterbody	Chichester Harbour
Number of Pumping Stations	9
Number of Overflows	2
Length of Sewer (km)	53.2
Catchment Reference	BOSH

BRAVA Results Table (BOSH)			
	Planning Objective	2020	2050
1	Internal Sewer Flooding Risk	0	
2	Pollution Risk	2	
3	Sewer Collapse Risk	0	
4	Risk of Sewer Flooding in a 1 in 50 year storm	1	1
5	Storm Overflow performance	0	1
6	Risk of WTW Compliance Failure	0	1
7	Risk of flooding due to Hydraulic Overload	1	2
8	Dry Weather Flow Compliance	0	1
9	Good Ecological Status / Potential	0	
10	Surface Water Management	0	
11	Nutrient Neutrality	1	1
12	Groundwater Pollution	1	
13	Bathing Waters	0	
14	Shellfish Waters	1	

Drivers of Risks

- Customer
- Hydraulics
- Operational
- Quality
- Unknown

Catchment Strategy: IMPROVE

BOSHAM WTW

0 0.3 0.6 1.2 1.8 2.4 Kilometers

Problem Characterisation
Bosham (BOSH)

This document describes the causes of the risks identified by the Baseline Risk and Vulnerability Assessment (BRAVA). The BRAVA results for this wastewater system are summarised in Table 1. The results indicate that flooding, pollution and water quality are the main concerns in this wastewater system. We have completed risk assessments for 2050 where we have the data and tools available to do so. For the other planning objectives, we will explore how we can predict future risks for the next cycle of DWMPs. All the risk assessment methods need to be reviewed after the first DWMPs have been produced with a view to improve the methods and data for future planning cycles.

Table 1: Results of the BRAVA for Bosham wastewater system

Planning Objectives		2020	Driver	2050
1	Internal Sewer Flooding Risk	0	-	
2	Pollution Risk	2	Operational	
3	Sewer Collapse Risk	0	-	
4	Sewer Flooding in a 1 in 50-year storm	1	Hydraulic	1
5	Storm Overflow Performance	0	-	1
6	WTW Water Quality Compliance	0	Quality	1
7	Flooding due to Hydraulic Overload	1	Hydraulic	2
8	WTW Dry Weather Flow Compliance	0	-	1
9	Good Ecological Status / Good Ecological Potential	0	-	
10	Surface Water Management	0	-	
11	Nutrient Neutrality	1	Unknown	1
12	Groundwater Pollution	1	Operational	
13	Bathing Waters	0	-	
14	Shellfish Waters	1	Unknown	

Key

BRAVA Risk Band	
NA	Not Applicable*
0	Not Significant
1	Moderately Significant
2	Very Significant

*No issues relevant to planning objective within Wastewater System

Investment Strategy

The risks identified in this wastewater system mean that we have assigned the following investment strategy:

Improve

This means that we consider that the current performance of the drainage and wastewater system needs to be improved to reduce the impacts on our customers and/or the environment. We will plan investment to reduce the current risks by actively looking to invest capital funding in the short term to address current performance issues (and consider future risks when implementing improvements).

Planning Objective 1: Internal Sewer Flooding Risk

The number of internal sewer flooding incidents reported during the three years considered by the risk assessment are shown in Figure 1. The total number of connections in this wastewater system means there have been less than 1.68 incidents per 10,000 connections per year (a threshold set by Ofwat) so the risk is in the 'not significant' band.

Figure 1: Number of internal flooding incidents per annum and causes

Blockage 0%
Pumping Station/ Treatment Work issue 0%
Sewer / Rising Main issue 0%
Hydraulic Overload 100%
Cause could not be Identified 0%

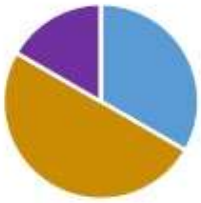
2017/18	2018/19	2019/20
0	0	1

Planning Objective 2: Pollution Risk

The number of pollution incidents reported during the three years considered by the risk assessment are shown in Figure 2. The length of sewer in this wastewater system means there have been more than 49.01 incidents per 10,000km per year (a threshold set by Ofwat) so the risk is in the 'very significant' band.

The primary driver for pollution is 'Operational' due to asset operational issues. Asset operational issues at our pumping stations and treatments works are the main cause of incidents, contributing to 50% of all incidents recorded in this wastewater system.

Figure 2: Number of pollution incidents per annum and causes



Blockage 33%
Pumping Station/ Treatment Work issue 50%
Sewer / Rising Main issue 0%
Hydraulic Overload 17%
Cause could not be Identified 0%

2017	2018	2019
1	2	3

Planning Objective 3: Sewer Collapse Risk

The number of sewer collapses reported during the three years considered by the risk assessment are shown in Table 2. The length of sewer in this wastewater system means there have been less than 5.72 incidents per 1,000km per year (a threshold set by Ofwat) so the risk is in the 'not significant' band.

Table 2: Sewer collapses and rising main bursts

Sewer Collapse	2017/18	0
	2018/19	0
	2019/20	0
Rising Main Bursts	2017/18	0
	2018/19	0
	2019/20	1

Planning Objective 4: Sewer Flooding in a 1 in 50 Year Storm

The risk of flooding in a 1 in 50 year storm is moderately significant in 2020 and 2050. This is because our computer model of the sewer network indicate for 2020 that approximately 70 - 70 properties within this wastewater system are in areas that could flood by water escaping from sewers. This model prediction increases the number of properties in areas at risk from flooding to approximately 400 - 500 by 2050.

Our wastewater networks are generally designed with capacity for up to a 1 in 30 year storm, hence flooding is expected to occur during more severe storms such as a 1 in 50 year event. Flooding will occur due to insufficient capacity of the drainage system either on the surface before it enters the drainage system, and/or from manholes, in people's homes or at a low point elsewhere in the system.

Planning Objective 5: Storm Overflow Performance

The storm overflow performance risk has been assessed as not significant in 2020, however network modelling results indicated that the risk will increase to moderately significant by 2050. Table 3 shows the overflows that discharge above the low threshold set for storm overflow discharges to Shellfish Water, Bathing Water and inland rivers.

Table 3: Overflows exceeding discharge frequency threshold per annum

	Number of overflows		Threshold for number of discharges per annum		
	2020	2050	Low	Medium	High
Shellfish Waters	0 Medium	0 Medium	Less than 8	Between 8-10	10 or more
Bathing Waters	0 Medium	1 Medium	Less than 3	Between 3-10	10 or more
Freshwater	0 Medium	0 Medium	Less than 20	Between 20-40	40 or more

Planning Objective 6: Wastewater Treatment Works Water Quality Compliance

The risk of non-compliance with our wastewater quality permit has been assessed as not significant for 2020 but is predicted to increase to moderately significant by 2050. This is because the wastewater treatment works has no record of compliance failure during the last three years (2018-2020). However it was assessed to not have adequate capacity to cope with future growth in the wastewater system.

Planning Objective 7: Flooding due to Hydraulic Overload

This is an assessment of the risk of flooding from sewers during a 1 in 30 year storm, and more frequent rainfall, to understand where flooding could occur. The risk of sewer flooding due to hydraulic overload is moderately significant in 2020. The risk The annualised number of properties in areas at risk of flooding is shown in Table 4.

Table 4: Annualised number of properties at risk per 10,000 connections.

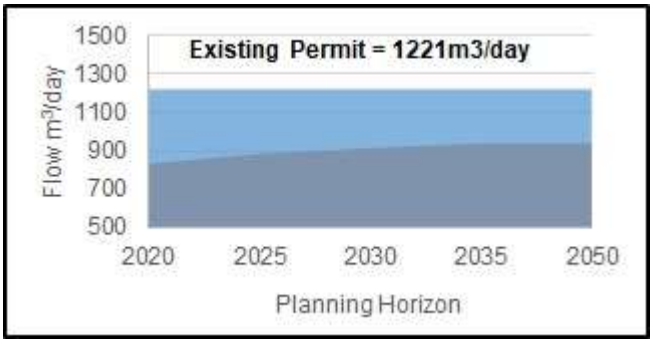
Rainfall Return Period (yr)	Number of Properties at Risk		Annualised per 10,000 connections	
	2020	2050	2020	2050
1 in 1	3	462	2	292
1 in 2	3	469	1	185
1 in 5	27	477	5	86
1 in 10	47	477	4	45
1 in 20	51	484	2	24
1 in 30	54	488	2	16
Total Annualised			**17**	**648**

This indicates that the existing capacity of the wastewater network can be exceeded during 1 in 30 year storms (or more frequent events), and that the risk will increase due to future growth, creep and/or climate change by 2050.

Planning Objective 8: Wastewater Treatment Works Dry Weather Flow Compliance

The risk of Wastewater Treatment Works Dry Weather Flow Compliance is not significant for 2020 but is predicted to increase to moderately significant in 2050, shown in Figure 3. This is because the predicted DWF in 2050 is expected to be between 80% and 100% of the current permit.

Figure 3: Recorded and predicted dry weather flow with existing permit



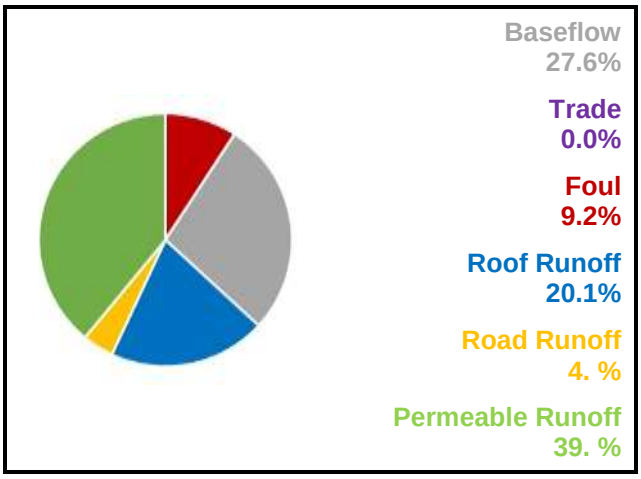
Planning Objective 9: Good Ecological Status / Good Ecological Potential

This wastewater system is not hydraulically linked to a waterbody where wastewater operations are contributing to not achieving GES/GEP, therefore the risk is not significant.

Planning Objective 10: Surface Water Management

Figure 4 illustrates the sources of water flowing in the wastewater system during a 1 in 20 year storm. It shows that surface water runoff from roofs, road and permeable surfaces constitutes more than 63.1% of the flow in the sewers. The total contribution of foul water from homes is 9.2%. The baseflow is infiltration from water in the ground and makes up 27.6% of the flow in the system.

Figure 4: Sources of water flowing in sewers during a 1 in 20 year storm



Planning Objective 11: Nutrient Neutrality

The risk to internationally designated habitat sites from this wastewater system is moderately significant in 2020 and 2050. This is because Natural England have advised that there is a risk to condition for the habitat sites that are hydraulically linked to our wastewater system, listed in Table 5.

Table 5: Habitat Sites hydraulically linked to wastewater system

Habitat Sites	
Chichester and Langstone Harbours	Phosphate permit review required
Solent and Dorset Coast	Phosphate permit review required
Solent Maritime	Phosphate permit review required

Planning Objective 12: Groundwater Pollution

The risk of Groundwater Pollution is moderately significant. The wastewater system network of sewers extends across geographical areas that are designated as a Source Protection Zone (SPZ) for water supply. An estimated 14% of the sewer network crosses SPZ 1 or SPZ 2 and infiltration in the wastewater system is estimated to be of concern, based on infiltration equation used in the Wastewater Treatment Works Dry Weather Flow Compliance planning objective.

The primary driver is 'Operational' due to condition of our assets.

Planning Objective 13: Bathing Waters

Table 6: Bathing Water annual results

Bathing Waters	Annual Results		
	2017	2018	2019
West Wittering	Excellent	Excellent	Excellent

The designated bathing waters that could be affected by discharges from this wastewater system are shown in Table 6, along with the current classification from the Environment Agency. The risks from this wastewater system on these bathing waters is not significant. This is because all the designated bathing waters affected by this wastewater system have passed annual inspections..

Planning Objective 14: Shellfish Waters

Table 7: Shellfish Waters linked to wastewater system

Shellfish Waters
Chichester Harbour (Chichester)

The discharges from this wastewater system can affect the designated shellfish waters shown in Table 7. The risk of not achieving the faecal standards for shellfish in these designated waters from this wastewater system is moderately significant. This is because the CEFAS classification for the shellfish waters is Long Term Class B.

Generic Options Assessment for: Bosham (BOSH)

Planning Objectives		2020	Driver	2050
PO1	Internal Flooding	0	-	-
PO2	Pollution Risk	2	Operational	-
PO3	Sewer Collapse	0	-	-
PO4	Risk of Sewer Flooding in 1 in 50 yr	1	Hydraulic	1
PO5	Storm Overflow Performance	0	-	1
PO6	Risk of WTW Compliance Failure	0	Quality	1
PO7	Annualised Flood Risk/Hydraulic Overload	1	Hydraulic	2
PO8	DWF Compliance	0	-	1
PO9	Achieve Good Ecological Status	0	-	-
PO10	Improve Surface Water Management	0	-	-
PO11	Secure Nutrient Neutrality	1	Unknown	1
PO12	Reduce Groundwater Pollution	1	Operational	-
PO13	Improve Bathing Water Quality	0	-	-
PO14	Improve Shellfish Water Quality	1	Unknown	-

Type of Measures	Generic Option Categories	Icon	Take Forward?	Reasons	Examples of Generic Options
Source (Demand) Measures (to reduce likelihood)	Control / Reduce surface water run-off		Y	-	Natural Flood Management; rural land management and catchment management; SuDS including blue and green infrastructure; storm management
	Reduce groundwater levels		N	Reducing groundwater levels would reduce the risks from infiltration into the network. However, in practice, reducing groundwater levels will be detrimental to the environment, ground conditions and is prohibitively too costly to implement. For these reasons, this generic option has been discounted.	Reduce leakage from water supply pipes; pump away schemes to locally lower groundwater near sewer network
	Improve **quality** of wastewater		N	None of the significant risks are caused by the quality of wastewater entering the wastewater system.	Domestic and business customer education; incentives and behaviour change (reduce Fats, Oils & Grease, wet wipes etc.); monitoring trade waste at source; on-site black water and/or greywater pre-treatment
	Reduce the **quantity** / demand		Y	-	Water efficient appliances; water efficient measures; blackwater and/or greywater re-use; treatment at source
Pathway (Supply) Measures (to reduce likelihood)	Network Improvements		Y	-	Asset optimisation; additional network capacity; storage; separate flows; structural repairs; re-line sewer pipe and manholes; smart networks.
	Improve Treatment Quality		Y	-	Increase treatment capacity; rationalisation of treatment works (centralisation / de-centralisation); install tertiary plant; UV plant or disinfection facilities; innovation; improve Technical Achievable Limits; new WTWs
	Wastewater Transfer to treatment elsewhere		N	The causes of risk are not due to where our systems discharge to the environment or our ability to increase the capacity to connect more homes. Transferring wastewater for treatment elsewhere will not reduce any of the significant risks in this catchment.	Transfer flow to other network or treatment sites; transport sewage by tanker to other sites
Receptor Measures (to reduce consequences)	Mitigate impacts on Air Quality		N/A	Not included in first round of DWMPs	Carbon offsetting; noise suppression /filtering; odour control and treatments
	Improve Land and Soils		N/A	Not included in first round of DWMPs	Sludge soil enhancement
	Mitigate impacts on receiving waters		Y	-	River enhancement, aeration
	Reduce impact on properties		Y	-	Property flood resilience; non-return valves; flood guards / doors; air brick covers
Other	Study / Investigation		Y	-	Additional data required; hydraulic model development; WQ monitoring and modelling

August 2021
Version 1

Bosham Wastewater System - Outline Options Appraisal

Generic Option	Location of Risk	Planning Objective and Description of Risk	Option Reference	Description	Further Description	Unconstrained Option?	Constrained Option?	Feasible Option?	Net Benefits	Estimated Cost	Preferred Option	Best value / Least cost or Reasons for Rejection
Control/ Reduce surface water entering the sewers												
Control / Reduce groundwater infiltration												
Improve quality of wastewater entering sewers (inc reducing FOG, RAG, pre-treatment, trade waste)	Taylor Lane	PO2- Pollution Risk	BOSH.SC03.1	Customer Education Programme	Customer education programme on Taylor Lane to reduce the risk.	Yes	Yes	Yes	Minor Positive +	£115K	No	Best Value
Control / Reduce the quantity / flow of wastewater entering sewer system	BOSHAM WTW	PO8 (2050)- Dry Weather Flow	BOSH.SC04.1	Water Efficient Appliance / Measures	Southern Water aims to reduce water consumption to 100 l/h/d by 2040.	No						Deliver the required outcome and Risk and uncertainty - future resilience
Network Improvements (eg increase capacity, storage, conveyance)	Taylors Lane Bosham WPS	PO2- Pollution Risk	BOSH.PW01.1	Maintenance Programme WPS	An efficient maintenance programme for pumping stations.	Yes	Yes	Yes	Minor Positive +	£235K	No	Best Value
Network Improvements (eg increase capacity, storage, conveyance)	Taylor Lane	PO2- Pollution Risk	BOSH.PW01.2	Additional Storage	Additional Storage.	No						Risk and uncertainty - future resilience
Network Improvements (eg increase capacity, storage, conveyance)	Catchment Wide	PO8 (2050)- Dry Weather Flow	BOSH.PW01.3	Pipe Rehabilitation Programme	Relining/improving structural grades of sewers across the catchment.	No						Cost Effective and Risk and uncertainty - future resilience
Network Improvements (eg increase capacity, storage, conveyance)	West Ashling	PO12- Ground Water Pollution	BOSH.PW01.4	Pipe Rehabilitation Programme	Total length of sewer within protection zones- 4.	Yes	Yes	Yes	Minor Positive +	£270K	Yes	Best Value
Network Improvements (eg increase capacity, storage, conveyance)	Taylor Lane	PO2- Pollution Risk	BOSH.PW01.5	Jetting Programme	Jetting Programme.	Yes	Yes	Yes	Minor Positive +	£710K	Yes	Best Value
Network Improvements (eg increase capacity, storage, conveyance)	BOSH FC01 Bosham catchment	PO4 & PO7 - Growth	BOSH.PW01.6	Drain all flows from the proposed developments to a new pumping station via a new gravity network. (BOSHGR001 Option 2)	DAP Option.	Yes	Yes	Yes	Major Positive +++	£TBC - With Partners	Yes	Best Value
Improve treatment (capacity and quality at existing works or develop new WTWs)	BOSHAM WTW	PO6 (2050)- WTW compliance	BOSH.PW02.1	Increase Capacity	Catchment was banded 0 in 2020 (however should be Band 1).	Yes	Yes	Yes	Minor Positive +	£5,665K	Yes	Best Value
Improve treatment (capacity and quality at existing works or develop new WTWs)	BOSHAM WTW	PO8 (2050)- Dry Weather Flow DWF Permit=1221m3 14m3/day removal is required to achieve below 80% permit. It is expected the DWF will be between 80-100% of the current permit in 2050	BOSH.PW02.2	Permit Review	Proposed permit-1239m3.	Yes	Yes	Yes	Minor Positive +	£1,135K	No	Best Value
Wastewater Transfer	BOSHAM WTW	PO8 (2050)- Dry Weather Flow 14m3/day to achieve below 80% permit	BOSH.PW03.1	Construct New WPS & Rising Main	Within 10km radius of BOSH is LAVA which in 2050 will have approximately 903m3day of headroom.	No						Cost Effective
Mitigate impacts on Air Quality (e.g. Carbon neutrality, noise, odour)												Not included in the first round of DWMPs
Improve Land and Soils												Not included in the first round of DWMPs
Mitigate impacts on Water Quality												
Reduce consequences Properties (e.g. Property Flood Resilience)	Watery Lane	PO1- Internal Flooding	BOSH.RC04.1	Property Flood Mitigation / Resistance	Short-term property level protection.	No						Risk and uncertainty - future resilience
Study/ investigation to gather more data	Catchment Wide	PO8 (2050)- Dry Weather Flow	BOSH.OT01.1	Infiltration Reduction Plan Investigation already planned for: Q1-2023	Relining/improving structural grades.	No						Cost Effective and Risk and uncertainty - future resilience
Study/ investigation to gather more data	Chichester and Langstone Harbours Solent and Dorset Coast Solent Maritime	PO11 - Nutrient Neutrality	BOSH.OT01.2	Nutrient Budget	Catchment is Hydraulically linked to; Chichester.	Yes	Yes	Yes	Minor Positive +	£75K	Yes	Best Value
Study/ investigation to gather more data	West Ashling	PO12- Ground Water Pollution	BOSH.OT01.3	Study and Investigations	Total length of sewer within protection zones- 4.	No						Risk and uncertainty - future resilience
Study/ investigation to gather more data	Catchment Wide	PO4- 1 in 50 year PO5- Storm Overflow PO7- Hydraulic Overload	BOSH.OT01.4	Improve Hydraulic Model	Improve Hydraulic Model.	Yes	Yes	Yes	Minor Positive +	£405K	No	Best Value
Study/ investigation to gather more data	BOSH FC02 Bosham WTW	PO4, PO5, PO7, PO13 and PO14- Growth and Spill Assessments	BOSH.OT01.5	Study/ Modelling Investigation	DAP Option.	Yes	Yes	Yes	Major Positive +++	£1,000K	No	Best Value
Study/ investigation to gather more data	BOSH FC01_1 - Ratham Lane,	PO4 and PO7 Flooding	BOSH.OT01.6	Study/Model investigation	DAP Option.	No						

DWMP Investment Needs

1. The options listed in the DWMP Investment Needs below are the preferred options in our DWMP. They will need further refinement as we implement the DWMP to confirm the exact location and scope of action needed, and the cost.

2. The costs are indicative costs for planning purposes only. The basis for the cost estimates, including assumptions and uncertainties, are explained in our DWMP Investment Plans.

3. The table of Investment Need provides an indicative cost so we know what level of funding is needed to reduce the risks. It is not a commitment to fund or deliver any option.

4. The Indicative Timescale is when the investment is needed. Some options may take several investment periods to achieve the desired outcomes.

5. Potential Partners have been identified in the table of Investment Needs. This is to indicate where there may be opportunities for us to work with these partners when developing and delivering these options. It is not a commitment by any of the partners to work with us.

6. These options will inform our future business plans as part of the Ofwat periodic review process to secure the finance to implement these options.

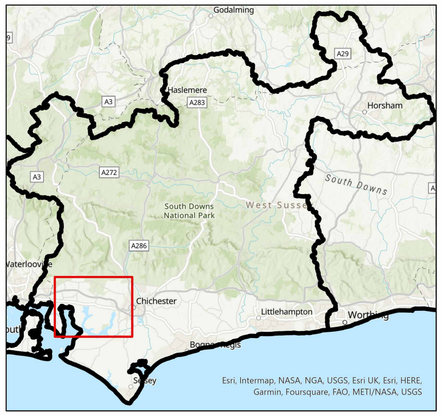
7. The options listed are prioritised by the method stated in the Programme Appraisal Technical Summary.

Date : May 2023
Version : 1.0

Reference	River Basin (L2)	Wastewater System (L3)	Location	Option	Indicative Cost	Indicative Timescales	Potential Partners	Applicable Planning Objectives
Arun and Western Streams								
Bosham								
BOSH.SC03.1	Arun and Western Streams	Bosham	Taylor Lane	Customer Education Programme: Targeted campaign to reduce the amount of FOG (fats, oils and grease) and unflushables discharged into the sewer network	£115K	AMP8 onwards	West Sussex County Council Chichester District Council	PO2
BOSH.PW01.1	Arun and Western Streams	Bosham	Taylors Lane Bosham WPS	Improve the operational resilience of wastewater pumping station (WPS) to reduce pollution incidents	£235K	AMP8 onwards	-	PO2
BOSH.PW01.4	Arun and Western Streams	Bosham	West Ashling	Sewer Rehabilitation: Targeted CCTV or electroscan surveys to check the integrity of sewers and reline or renew them to reduce the risk of groundwater pollution	£270K	AMP9	-	PO12
BOSH.PW01.5	Arun and Western Streams	Bosham	Taylor Lane	Enhanced Sewer Maintenance: Increase targeted sewer jetting to reduce the number of blockages in the network	£25K	AMP8 onwards	-	PO2
BOSH.PW01.6	Arun and Western Streams	Bosham	Bosham Centre	Growth scheme from our Drainage Area Plan (DAP): Drain all flows from the proposed developments to a new pumping station via a new gravity network to reduce risk of flooding.	£710K	AMP9	-	PO4 PO7
BOSH.PW02.1	Arun and Western Streams	Bosham	Bosham WTW	Increase treatment capacity to allow for planned new development	£5,665K	AMP9	Environment Agency	PO6
BOSH.PW02.2	Arun and Western Streams	Bosham	Bosham WTW	Increase capacity to allow for planned new development	£820K	AMP9	Environment Agency	PO8
BOSH.OT01.4	Arun and Western Streams	Bosham	System Wide	Improve the Hydraulic Model: Surveys and reverification of model to improve confidence and accuracy	£175K	AMP8	-	PO4 PO5 PO7
BOSH.WINEP01.1	Arun and Western Streams	Bosham	TAYLORS LANE BOSHAM PUMPED SSO	New or improved screen to reduce aesthetics impacts from storm discharges at TAYLORS LANE BOSHAM PUMPED SSO	£130K	AMP11	-	PO5
BOSH.WINEP01.2	Arun and Western Streams	Bosham	BOSHAM SSO	Reduce impact from storm spills from BOSHAM SSO through wetland creation and/or sewer lining to reduce infiltration of groundwater	£3,940K	AMP8	-	PO5 PO14
BOSH.WINEP.PO2.1	Arun and Western Streams	Bosham	Bosham WTW	Action to reduce total phosphorus and/or total nitrogen levels from discharges which drain to internationally designated sites where there is a risk from nutrients	£2,655K	AMP10	-	PO9 PO11

Drainage and Wastewater Management Plan: Location of Potential Options BOSHAM Wastewater system in Arun and Western Streams River Basin Catchment

(i) This map should be read in conjunction with the list of Investment Needs for this wastewater system
(ii) The areas shown on this map are the potential locations for the options. The location of the risk may be elsewhere in the system.
(iii) Labels for each location are the option references in the list of Investment Needs
(iv) Drainage Area Plan (DAP) options on flooding and growth are not shown.



- Customer Education
- Pipe Rehabilitation
- Asset Resilience
- Wastewater Treatment
- WINEP Nutient Neutrality
- WINEP Storm Overflows