

APPENDIX 1 TO STATEMENT OF EVIDENCE OF JOHN PATON

**TMS24 ENHANCEMENT CASE: SEWAGE TREATMENT GROWTH, THAMES WATER
(EXTRACTS)**



TMS24 Enhancement case: Sewage Treatment Growth

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1 Summary

Table 1 - Summary table.

Reference	PR24 Wastewater Treatment Growth
Description	<p>This Enhancement Case addresses the cost of providing additional capacity at our sewage treatment works in AMP8, to meet the forecast growth in population across our wastewater supply area.</p> <p>This enhancement investment is vital for us to remain compliant with our treated effluent discharge permits. Continued compliance with our discharge permits in the face of a growing population will ensure that we achieve our 2050 vision and outcome of cleaner rivers.</p> <p>We are submitting this Enhancement Case on the basis that sewage treatment growth is removed from the Botex+ modelling for the wastewater network plus price control, as indicated by Ofwat in the PR24 final methodology and cost assessment consultation.</p> <p>The majority of our sewage treatment works can accommodate growth in AMP8 within their respective existing design headroom and treatment capacities. This Enhancement Case focuses on only those works where enhancement investment is forecast to be needed.</p>
Outputs	<p>In AMP8, we will invest at 15 specific sewage treatment works, providing treatment capacity for known growth up to 2036. This equates to a population equivalent of 96,700 people or 40,292 new homes.</p> <p>To protect customers, we propose to implement a time incentive PCD related to late delivery of PE capacity delivered. Customers are also protected by our common Performance Commitment 'Discharge Permit Compliance', as well as preventing deterioration to storm overflows and pollution performance.</p>
Cost	<p>Totex - £355.15m</p> <p>Capex - £354.82m</p> <p>Opex - £0.33m</p>
Spend apportionment	100% wastewater network +
Delivery year	2025-2030
DPC	Not suitable for DPC. The programme does not pass the scalability assessment as each project within the programme fails to reach the minimum threshold. For more detail, please refer to TMS38 Direct Procurement for Customers.

Table 10 - Enhancement site details.

Sewage Treatment Works	2023 PE	% Growth in AMP8	Biological capacity increase required?	DWF increase required?	FFT increase required?	Storm Tank volume increase required?	Capex (£m) (22/23)
Culham	3,987	46%	Yes	Yes	Yes	Yes	4.37
Chalgrove	3,248	74%	Yes	Yes	Yes	Yes	4.27
Chipping Norton	9,363	23%	Yes	Yes	Yes	No	9.56
Andoversford	732	21%	No	No	Yes	No	6.27
Arborfield	20,208	33%	Yes	Yes	Yes	Yes	48.07
Didcot	45,269	36%	No	Yes	Yes	Yes	99.36
Cassington	19,091	24%	No	No	Yes	No	5.22
Wheatley	6,065	8%	No	No	Yes	Yes	4.12
Bicester	54,868	28%	No	Yes	Yes	Yes	50.28
Wantage	30,846	22%	No	Yes	Yes	No	41.13
Highworth	8,688	20%	Yes	Yes	No	Yes	12.15
Thame	13,284	21%	Yes	Yes	Yes	Yes	37.94
Stansted Mountfitchet	12,550	61%	Yes	Yes	Yes	Yes	35.27
Moreton in Marsh	5,952	7%	Yes	Yes	Yes	Yes	8.20
Blunsdon	2,222	37%	Yes	Yes	Yes	Yes	11.78

Note: a timing adjustment of £23.16m has been applied to enhancement total but has not been applied to the bottom-up Totex in the table above

Figure 12 shows the geographic spread of our high-risk growth sites which are included in this Enhancement Case. A large cluster around Oxford is linked to the Oxford to Cambridge Partnership (formally OxCam Arc), which is a cross-government initiative supported by local partners that aims to deliver sustainable growth between Oxford, Milton Keynes and Cambridge.

At each stage, the options are screened to remove those options that are not considered feasible for inclusion in the final basket of options. The approach to screening options focused effort on defining options, screening out at each stage those options assessed as disproportionately costly, technically infeasible or having significant and unacceptable environmental impacts.

4.2 Generic option development and screening

We've undertaken a comprehensive exercise as part of DWMP to identify and develop a wide range of generic options that could address the risk to our sewage treatment works posed by population growth. We combined an industry derived list and our knowledge of our catchments with the feedback we received from our stakeholders to help us identify the options.

Our structured approach resulted in the identification of 12 generic options that are listed in Table 11. Expanding on the generic options, a range of linked sub-options have been developed. These provide a more granular level of option definition.

Table 11 - Generic Options.

Generic option title	Description	Option viable?
Treat wastewater in the network	<p>Treating the wastewater in the network either to relieve load transferred to existing treatment works or by removing contaminants that cause problems in the network and/or at the STW.</p> <p>Sub-options:</p> <ol style="list-style-type: none"> 1. Screening in the network 2. Remove fats, oils and grease in the network 3. Primary Settlement in the network 4. Chemical treatment in the network 5. Biological treatment in the network 6. Other within-sewer treatment 	Yes
Increase level of performance in existing STWs	<p>These options are about measures that could increase the efficient use of the existing capacity of the works with the existing assets.</p> <p>Sub-options:</p> <ol style="list-style-type: none"> 1. Optimising maintenance performance 2. Real time control implementation 	Yes
Increase treatment intensity at existing STWs	<p>These options are concerned with increasing the available treatment capacity on the existing footprint of the site.</p>	Yes
Expand existing STWs	<p>These options cover purchasing land adjacent to an existing STW and expanding them. The expansion could be with conventional treatment or with a more intensive treatment option.</p> <p>Sub-options:</p> <ol style="list-style-type: none"> 1. Buy land and expand STW 2. Buy land, relocate sludge treatment and expand effluent stream on remaining land 	Yes

Construct new/additional STWs	These options consider the construction of additional STWs e.g., in catchments where the existing STW capacity is constrained. This can include new STWs for the purpose of treating storm discharges.	Yes
Increase treatment centralisation	This option considers the development of one or more 'mega' treatment works that would take flow and load from a number of existing STWs.	Yes
Catchment management treatment initiatives	These options are concerned with treating either diffuse or point-source non-domestic elements of wastewater before they enter the sewer system, or by treating and controlling the other contributors to the environment. Sub-options: <ol style="list-style-type: none"> 1. Treatment of diffuse pollution sources (inputs to river) 2. Treatment of diffuse pollution sources (inputs to sewer) 3. Treatment of point pollution sources (inputs to sewer) 4. Control of chemicals at source 	Yes
Customer education and awareness	Customer engagement and involvement in the provision of wastewater and drainage services. Over time, customers may become more active participants which could help to reduce the demand on existing wastewater assets by influencing customer behaviour. Sub-options: <ol style="list-style-type: none"> 1. Wastewater awareness campaigns 2. Educational programme for kids and schools 3. Build partnerships for wastewater education and awareness 4. Increase visibility of wastewater operations 	Yes
Influence where growth can occur	Influence where growth can occur and hence mitigate impact on its assets.	No

The only generic option that has been assessed as not currently viable is 'influence where growth can occur'. We have a statutory obligation under Section 94 of the Water Industry Act to both extend public sewers and make the necessary provision for emptying them through sewage treatment works. Delaying growth investment in our treatment assets over the medium to longer term would result in us being in breach of the Water Industry Act and could be seen as abuse of a dominant position under competition law. Short-term restrictions may be applied using planning conditions. However, these would need to be discharged within the life of the planning application.

4.3 Customer and stakeholder engagement

Different investment options relating to sewage treatment growth regulations have been tested with customers as part of our latest Enhancement Case research¹⁶.

¹⁶ PR24-15 PR24 Enhancement Case Deep Dive Research

Insights: Sewage Treatment Growth	
Support for the solution	<ul style="list-style-type: none"> • Customers believe that building new treatment facilities and installing new equipment will effectively mitigate the issue of sewage entering rivers in these high-risk areas. They also appreciate that the bill impacts to customers are negligible (PR24-15) • However, customers want to better understand how nearby residents will be impacted by the works (the amount of extra noise and traffic that will ensue) • Some customers also want to understand how much the issue of sewage entering rivers will be prevented by this enhancement, so they can better judge if they feel Thames Water is doing enough or needs to do more to prevent storm overflows (PR24-15) • When shown our proposed plans to upgrade the sewage network across 13 sites between 2025 and 2030. All different customer groups almost unanimously support Thames Water's plan. (PR24-15)

4.4 Unconstrained / constrained option development and screening

The next step in the process was to assess the unconstrained and constrained list of generic sub-options, to further screen out those that would perform poorly when addressing the AMP8 sewage treatment growth risk.

This task was a qualitative assessment undertaken by our system planners, who have an in-depth knowledge of the challenges faced within individual catchments. Together with consideration of the views and priorities expressed by our stakeholders and customers, this enabled informed decisions to be made as to which options to progress to the feasible option development stage.

The remaining options were reviewed considering the following key screening themes:

- **Deliverability** – does the option remain technically feasible and implementable noting any location specific constraints e.g., land availability, infrastructure suitability, ground conditions
- **Environment** – are the potential/likely effects of the option on the environment considered mitigatable and/or acceptable noting any location specific constraints
- **Resilience** – is there an acceptable likelihood of the option providing sufficient future resilience e.g., climate change, growth
- **Promotability** – does the option comply with policy requirements local to the area over which it will be implemented e.g., does the option give rise to an acceptable risk of it obtaining planning approval? Are customers, regulators, and stakeholders likely to accept the option when considering the area over which it will be implemented?
- **Social** – are potential effects of the option on our customers and their communities considered acceptable, when considering the area which it will be implemented?

4.5 Feasible option development and screening

Having identified the types of options that can be used to address long-term challenges, we undertook research to understand our customers preferences, to find out, for example, if any options were more or less acceptable to them and why.

Key findings from the customers research were:

Table 12 below summarises the main option types that were considered to meet our need at the 15 sites. The options in green were retained for fine screening, and those in red were discounted.

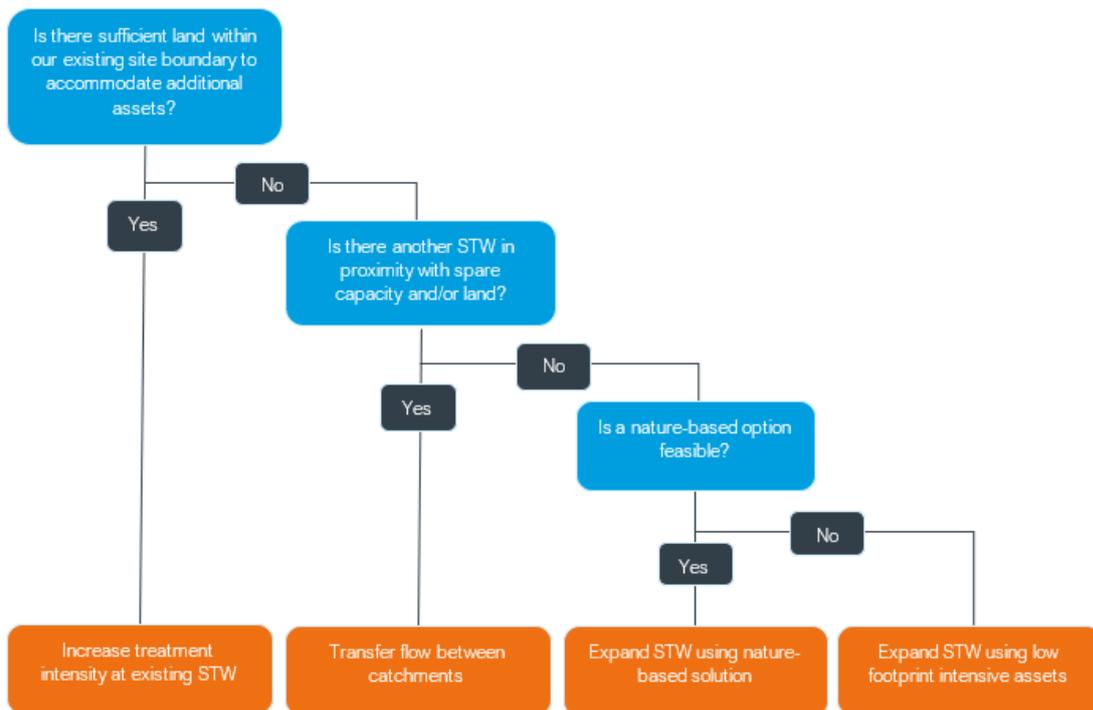
Table 12 Main Option types.

Category	Option considered	Option retained ?	Reasons	Sites where option is feasible
Capital investment	Increase treatment intensity at existing STWs	Yes	Efficient use of existing Thames Water owned land.	<ul style="list-style-type: none"> ➤ Arborfield ➤ Wheatley ➤ Bicester ➤ Didcot ➤ Cassington ➤ Stansted ➤ Mountfitchet ➤ Wantage ➤ Blunsdon ➤ Chipping Norton ➤ Highworth ➤ Moreton in Marsh ➤ Thame
	Expand STWs	Yes	Where available is limited it will be necessary to expand our footprint. This option keeps sewage treatment in one locality and utilises existing infrastructure e.g., roads and power.	<ul style="list-style-type: none"> ➤ Culham ➤ Chalgrove
	Construct new/additional STWs	No	New sites may impact on neighbouring communities during construction and in the longer term. Land availability, environmental impact and permit granting needs to be carefully considered.	
	Transfer flow between catchments	Yes	Create new connections between existing catchments. These connections could be used to optimise capacities and to find the best balance of flow and load.	<ul style="list-style-type: none"> ➤ Chalgrove
	Increase treatment centralisation	No	Close multiple smaller STWs and centralise treatment at a larger STW. This option would require significant planning, both in terms of locating appropriate land and assessing the environmental impact.	
Nature-based	Expand existing STWs	Yes	It is possible that in some locations nature-based solutions could be used to treat additional flow after it has had partial treatment by the existing STW assets.	<ul style="list-style-type: none"> ➤ Andoversford
Operational measures	Increase level of performance in existing STWs	N/A	This will always be our first option and any enhancement spend will be layered on top of base spend to ensure our STWs are performing as designed.	
Modular or adaptive options	Treat wastewater in the network	No	Apart from the screening of sewage debris this is not typically used in the UK and therefore the technology needs further investigation and trials.	
Partnership working	Influence where growth can occur	No	Delaying growth investment in our treatment assets over the medium to longer term would result in us being in breach of the Water Industry Act and could be seen as abuse of a dominant position under competition law.	

			Short-term restrictions may be applied using planning conditions. However, these would need to be discharged within the life of the planning application.	
Catchment management	Catchment management treatment initiatives	No	This option is more important as part of the WINEP as it can play an important role in improving river quality. However, it will not reduce the treatment load arriving at the STW due to population growth.	
Behavioural change	Customer education and awareness	No	Using less water will reduce the amount of flow that is required to be treated at the STW. However, it will not reduce the pollution load of the wastewater that requires treatment. It is therefore a long-term option.	

We then developed a methodology to determine the possible option types that were feasible for each of the 15 STW sites in scope. The flow chart (Figure 17) has been used to determine the main option types.

Figure 17 Main option type selection flow diagram



Where there is more than one feasible option type at a site, we have undertaken a robust assessment to determine the best mix of options for customers.

The option scenarios are outlined below:

APPENDIX 2 TO STATEMENT OF EVIDENCE OF JOHN PATTON

PR24 OUR BUSINESS PLAN 2025-2030, THAMES WATER (EXTRACTS)



PR24

Our Business Plan

2025-2030



It's everyone's water

Contents

Over the last 18 months, we've developed our AMP8 plan through extensive engagement with our customers, our communities, our Customer Challenge Group, our supply chain and the active involvement of our Board.

1.0	A message from our CEOs	01	4.0	We have a robust approach to assurance	14
2.0	Snapshot of our plan	02	4.1	We have designed and implemented a robust assurance and governance process	15
3.0	Executive summary	03	4.2	Our Board has been involved in all aspects of our plan	18
3.1	While our performance is generally in line with industry average, we need to improve	03	4.3	We have provided assurance to the Board in line with Ofwat's expectations	19
3.2	We face rising expectations from our customers	05	4.4	Our Board assurance statements	20
3.3	We need to invest more than ever before	06	Appendix TMS48: Our Assurance framework		
3.4	We also need to do things differently	07	Appendix TMS05: CCG Report		
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3.8	During AMP8 we will focus on what matters most to our customers, our communities and the environment	11	6.0	We have listened to our customers and communities	26
3.9	Our ambitious 2050 vision	13	6.1	We engage with customers to improve our performance and to develop our plans	27
			6.2	We tested our plan with customers	34
			Appendix TMS03: Customer engagement		
			Appendix TMS04: What customers, communities and stakeholders want		
			Appendix TMS07: Bill impact, affordability and vulnerability		
			Appendix TMS05: CCG Report		



Our plan delivers **for our customers**



for our communities



for the environment



7.0	We are turning around our business for the long term	36	9.0	Our plan delivers for our communities	82	12.0	We are confident we can deliver our plans	153
7.1	We have an ambitious long-term vision	37	9.1	We will have a positive impact on the community	83	12.1	We understand the root cause of our shortcomings	154
7.2	How we will achieve our vision for 2050	39	10.0	Our plan delivers for the environment	92	12.2	We are refocusing our turnaround	155
7.3	Our Long-term Delivery Strategy sets us on a trajectory to deliver our vision for 2050	40	10.1	We will stop polluting rivers and improve their quality	93	12.3	We have been working to considerably expand our capital delivery capacity	156
7.4	Right now, we are performing in line with industry average in some areas, but we need to do more	42	10.2	We will fix leaks and ensure there is enough water in the future	102	12.4	We are enhancing our digital capabilities	160
7.5	We understand the root cause of our poor performance	43	10.3	We will reduce our carbon emissions and reach net zero by 2050	107	12.5	We have clear plans to develop the workforce we need to succeed	161
7.6	We are refocusing our turnaround to deliver faster improvements	46	Appendix TMS40: Accounting for past delivery and deliverability			Appendix TMS40: Accounting for past delivery and deliverability		
7.7	We have carefully prioritised our activities in AMP8	47	Appendix TMS11: Our Customer strategy			13.0	We will integrate the Thames Tideway Tunnel and start realising its full benefits	165
7.8	Our AMP8 plan is aligned with our Vision 2050	53	Appendix TMS08: Our AMP8 water outcome delivery strategy			13.1	The Thames Tideway Tunnel will address customer needs	166
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Appendix TMS40: Accounting for past delivery and deliverability			Appendix TMS21–29: Our Enhancement Cases			13.3	Our plan for AMP8 is to integrate the new asset and start considering opportunities to enhance the way we use it	168
8.0	Our plan delivers for our customers	54	Appendix TMS97: Thames Water performance commitment levels			13.4	AMP8 performance commitments	169
8.1	We will provide an easy customer experience and tailored support	55	Appendix TMS49: Our AMP8 Carbon Delivery strategy			Appendix TMS47: Thames Tideway		
8.2	We will propose fair and affordable bills	61	Appendix TMS10: Bioresources and AMP8 Market strategy			14.0	Risk and return	170
8.3	We will provide safe, high quality drinking water	67	11.0	Our proposed expenditure	112	14.1	Overview	171
8.4	We will provide a reliable supply with minimum disruption	72	11.1	Our proposed totex	113	14.2	Risk	172
8.5	We will prevent sewer flooding and take waste away safely	77	11.2	We have submitted nine enhancement cases	117	14.3	Return	173
Appendix TMS40: Accounting for past delivery and deliverability			11.3	We have submitted three cost adjustment claims	132	14.4	Financeability	175
Appendix TMS11: Our Customer strategy			11.4	We are requesting additional funding to cover the costs of our asset health deficit, and to start addressing it	137	14.5	Financial resilience	175
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Appendix TMS09: Our AMP8 wastewater outcome delivery strategy			Appendix TMS40: Accounting for past delivery and deliverability					
			Appendix TMS18–20: Cost Adjustment Claims					
			Appendix TMS17: Response to Cost Adjustment Claims					
			Appendix TMS15: Asset deficit					
			Appendix TMS14: Cost and efficiency					
			Appendix TMS38: Direct Procurement for Customers (DPC)					



Based on everything you told us, here's what we plan to do

INVESTMENT

A record level of investment



£18.7bn

Total spend across our business



£4.7bn

To improve the quality of our services



£1.59

Average daily water and wastewater bill



530k

Households getting help with their bills

FOR CUSTOMERS

A safe and reliable service for you



£12.1bn

To improve your service



17%

Reduction in the number of times sewage floods into properties



75%

Of eligible customers on the priority services register



500km

Of replaced water mains

FOR COMMUNITIES

Having a positive impact on your community



600

Apprentices, graduate scheme applicants and summer interns on placements



27

Wetlands and nature reserves open to the public



1

Key commitment to cut down disruption caused by our streetworks

FOR THE ENVIRONMENT

Improving the environment



£6.6bn

To improve the environment



£885m

Investment in reducing storm overflows



30%

Drop in pollution incidents



22%*

Reduction in leakage

*AMP8 reduction based on a 2019/20 baseline

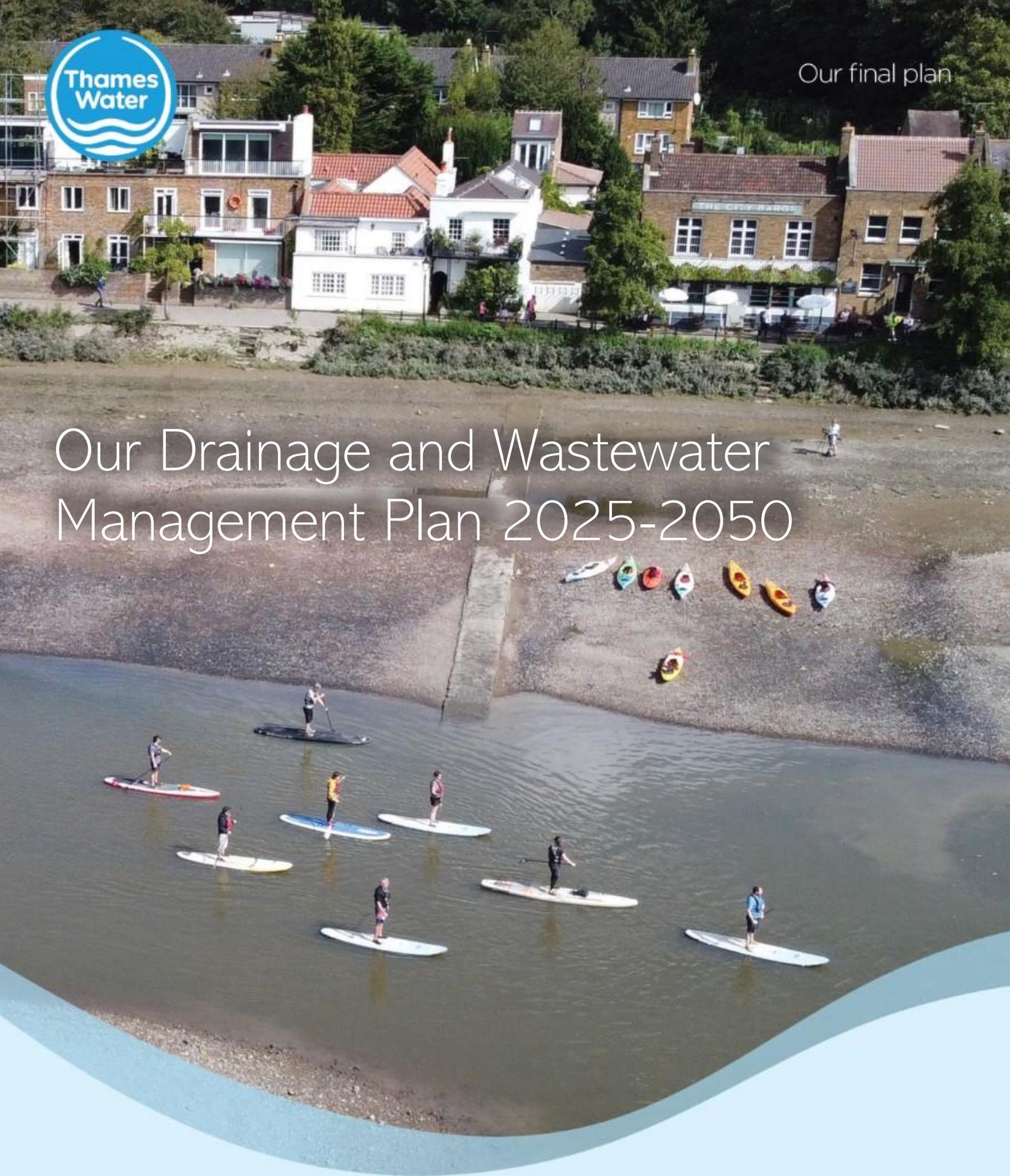
All £ are in 2022/23 prices

APPENDIX 3 TO STATEMENT OF EVIDENCE OF JOHN PATTON

OUR DRAINAGE AND WASTEWATER MANAGEMENT PLAN 2025-2030, TECHNICAL APPENDICES, APPENDIX D – OPTION DEVELOPMENT AND APPRAISAL, THAMES WATER (EXTRACTS)



Our Drainage and Wastewater Management Plan 2025-2050





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1 Our Drainage and Wastewater Management Plan (DWMP)

Our DWMP vision

- 1.1 Working in partnership to co-create a 25-year plan for drainage and wastewater that sustainably benefits communities and the natural environment in our region.

Our DWMP aim

- 1.2 To identify future catchment risks to our drainage and wastewater treatment systems and develop sustainable, efficient solutions to address them.

What we're trying to achieve

Protection of our environment, looking after the health of our rivers (aiming for zero harm from spills), being resilient to the risks of flooding and generating wider benefits to the communities we serve. DWMP outcomes for:

- Customers and communities – fair charges, improved health and wellbeing, increased amenity, and a resilient service
- Drainage and wastewater services – reduce sewer flooding and achieve 100% Sewage Treatment Works (STW) compliance
- The environment – increase biodiversity, zero harm from storm overflow spills, and environmental net gain

Description of the plan

- 1.3 A DWMP is a long-term costed plan that is focused on partnership working, which sets out the future risks and pressures for our drainage and wastewater systems. It identifies the actions that are required to make sure we can continue to deliver our services reliably and sustainably, whilst also achieving positive outcomes for our customers, communities and environment.
- 1.4 Our long-term, collaborative plan aims to ensure a resilient and sustainable wastewater service for the next 25 years and beyond.

Framework

- 1.5 This is the first iteration of a long-term plan for our drainage and wastewater business following a consistent industrywide framework.
- 1.6 Our DWMP creates a roadmap for how we adapt our wastewater service to cope with future challenges based on:
 - The national DWMP Framework that was developed jointly by regulators and industry bodies including Ofwat, Defra, the Environment Agency, Water UK, Welsh Government, Natural Resources Wales, Consumer Council for Water, Association of Directors of Environment, Economy, Planning and Transport and Blueprint for Water
 - Guiding principles issued by Government; and,
 - The framework for development of Long-Term Delivery Strategies for PR24 issued by Ofwat

2 Option Development and Appraisal (ODA)

Progress



Purpose

- 2.1 Option development and appraisal (ODA) is one of the key stages within the DWMP Framework⁵. The previous stage, the baseline risk and vulnerability assessment (BRAVA), assessed how current drainage and wastewater systems perform, how risks will change in future under each time period being considered, and identified the principal drivers for changes in risk.
- 2.2 The objective of the ODA process is to identify and assess all possible options to address the risks identified through BRAVA and develop them. They can then be compared and evaluated by considering whether they offer ‘best value’⁶ to the communities we serve and the natural environment in our region. Once preferred options have been selected, these are further developed to a conceptual design level. This provides a consistent, high-level option definition for the comparable assessment of function, environmental and social performance, and cost.

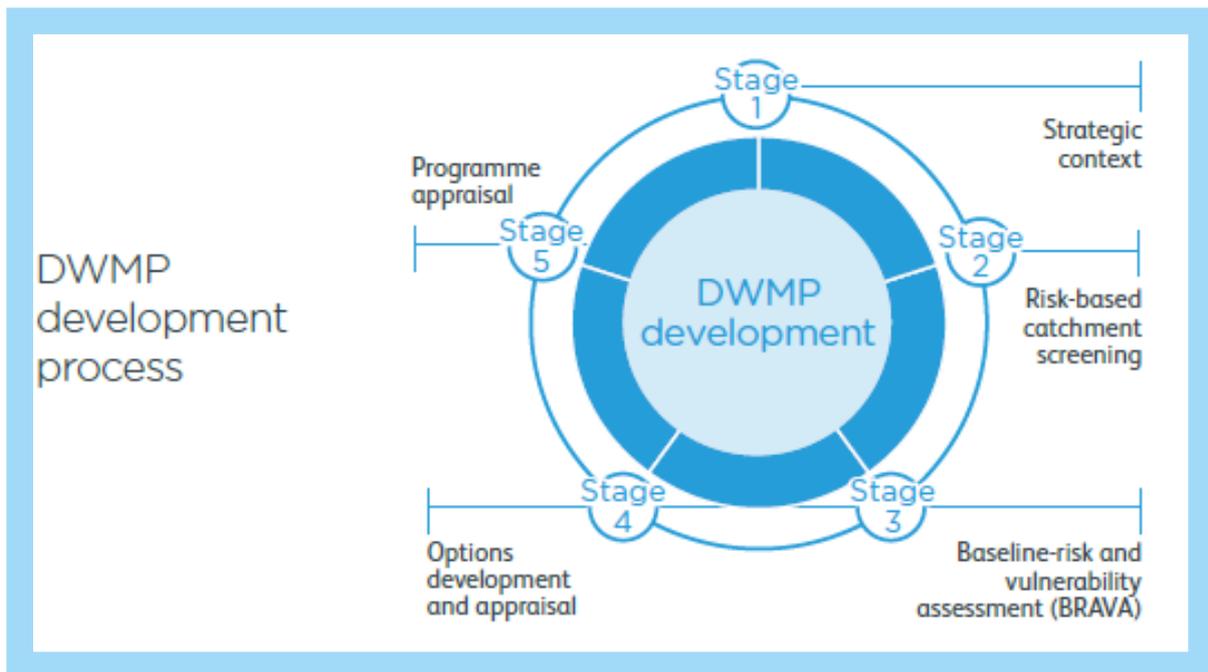


Figure 2-1 Position of the ODA stage within the DWMP development process

- 2.3 The [strategic context](#), [risk-based catchment screening \(RBCS\)](#) and [BRAVA](#) stages are the critical pre-optioneering steps which effectively define the nature and complexity of the issues (risks) to be addressed. These pre-optioneering steps are covered elsewhere in

⁵ https://www.water.org.uk/wp-content/uploads/2020/01/Water_UK_DWMP_Framework_Appendices_September-2019-D.pdf

⁶ <https://ukwir.org/eng/deriving-a-best-value-water-resources-management-plan>

separate Technical Appendices, together with the subsequent stage of [programme appraisal](#).

2.4 Besides defining the pressures and drivers of change impacting upon the DWMP, the strategic context stage defined the objectives to be addressed by the plan. These planning objectives each have one or more planning metrics by which current and future performance have been measured or forecast against target values.

Planning objectives set at a strategic context stage

2.5 The 12 planning objectives shown in Figure 2-2 have been developed in consultation with stakeholders at the strategic context stage.

2.6 Four bespoke objectives, not currently amenable to long-term forecasting and modelling, were identified through consultation with our stakeholders. These are considered as ‘outcome measures’, being objectives that the DWMP must address. The performance of options against these objectives has also been determined during ODA stage.

Planning objective	DWMP assessment stage
Sewage treatment works quality compliance	BRAVA ODA Programme appraisal
Internal sewer flooding risk	
Risk of sewer flooding in a 1 in 50 storm	
Storm overflow performance	
Risk of pollution incidents	
Sewer collapses	
Sewage treatment works flow compliance	ODA Programme appraisal
External sewer flooding risk	
Wellbeing	
Reduce surface water runoff	
Reduce misconnections	
Carbon neutrality	

Key

- █ Common objectives reported nationally. [For more information please click on this link](#)
- █ Bespoke objectives amenable to long-term forecasting and modelling
- █ Bespoke objectives not currently amenable to long-term forecasting and modelling, and therefore considered as ‘outcome measures’

Figure 2-2 The 12 DWMP planning objectives set by stakeholders as part of the strategic context stage

2.7 During the ODA stage, options were developed and their benefit (expressed as how effective they were in reducing common and bespoke planning objective risks) was assessed.

Main principles of an optioneering framework

2.8 The ODA process outlined in the DWMP Framework⁷, and adopted for our DWMP, has followed the same method that has been developed and implemented successfully over many years for water resources management plans (WRMPs).

2.9 The benefits of the approach are that it:

- Is well established
- Involves movement through the various steps that follow a logical pathway
- Enables a level of effort proportionate both to the risk identified and assessment stage in the planning process
- Is relatively straightforward to present to non-technical stakeholders (or participants) as well as experts; and
- Provides a clearly consistent approach to both water and wastewater planning

2.10 The approach undertaken is a structured progression of development and appraisal of options as shown in Figure 2-3, commencing with the broadest possible range, culminating with a feasible set of options. In this first cycle of DWMP planning we have identified risks at a strategic scale. This means that our options are defined at a conceptual level where the spatial scale may be uncertain at this time.

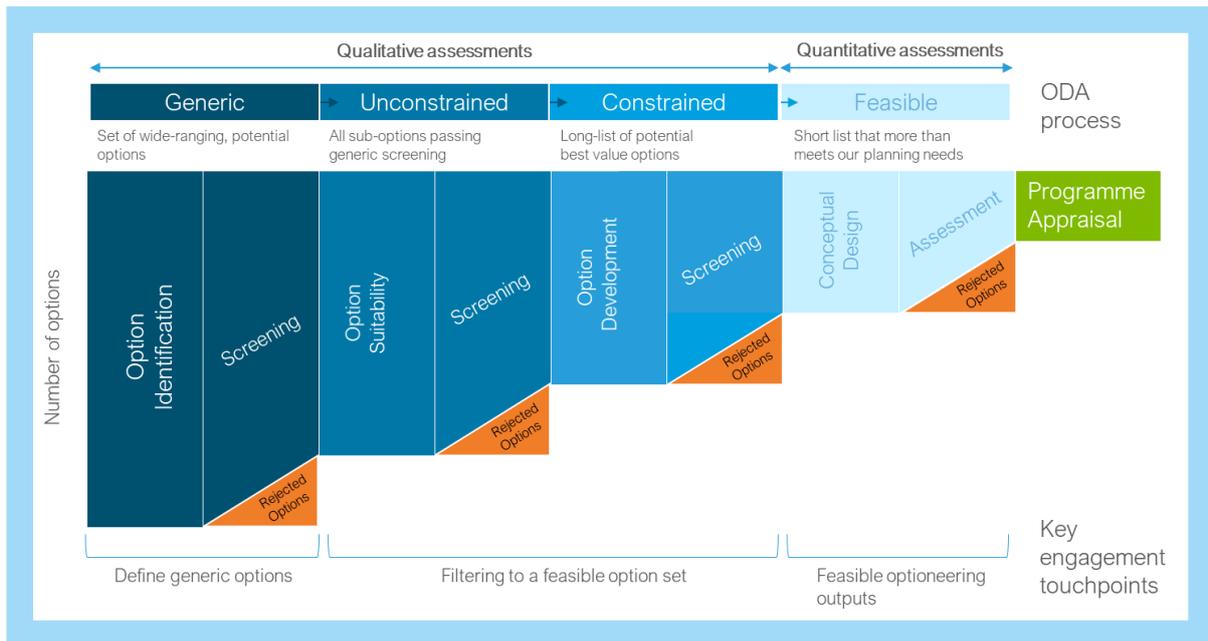


Figure 2-3 Overview of the ODA process

2.11 At each stage, the options are screened to remove those options that are not considered feasible for inclusion in the final basket of options to be assessed for the DWMP. The approach to screening options focused effort on defining feasible options, screening out at each stage those options assessed as disproportionately costly, technically infeasible or having significant and unacceptable environmental impacts.

⁷ https://www.water.org.uk/wp-content/uploads/2020/01/Water_UK_DWMP_Framework_Appendices_September-2019-D.pdf

2.12 Options are developed through increasing the level of assessment through each of the following stages:

- **Generic options:** all options at a generic level that could potentially address risks arising from the drainage and wastewater service (potential risks across all planning objectives). Generic options are appropriate for engagement with internal governance bodies and external stakeholders. These options were further disaggregated into sub-options for application by DWMP planners
- **Unconstrained options:** this is a high-level list of options screened from the generic sub-options appropriate for consideration at a specific location(s) where risks have been identified within the BRAVA / problem characterisation process
- **Constrained options:** options that have passed through from the unconstrained screening, filtering out options that are impracticable, have an assessed excessive cost against benefits, or have unacceptable environmental or economic impact
- **Feasible options:** this is a final screened list that has been tested on grounds of both monetised and non-monetised costs and benefits. Feasible option development also included environmental and social assessments, using criteria aligned to those required in a Strategic Environmental Assessment and relevant to Habitats Regulation Assessment and Water Framework Directive assessments

2.13 This structured approach:

- Ensures that all options that could be used to address identified risks are considered
- Promotes options that could be delivered through co-creation / partnership working
- Enables the development of adaptive pathways to address risk uncertainty driven by different futures
- Enables greater stakeholder engagement at each stage and provides a decision-making process that is transparent and auditable

2.14 Internal and external stakeholder reviews, and the detailed assessments undertaken at the feasible stage, all provide check and challenge points to mitigate potential risk of bias from the use of engineering judgement in the early stages of the process.

2.15 The process of screening options (to derive a portfolio for consideration during programme appraisal) was followed for all catchments with risks identified at the BRAVA stage. The option screening takes a proportionate approach considering the scale of catchment risk against an appropriate level of assessment. The level of option complexity was determined during the problem characterisation stage of [BRAVA](#), which identified catchments requiring complex, extended or standard approaches. This is in compliance with the DWMP Framework (appendix D, section D.3.1.3)⁸ For example, for our catchments outside London, a more streamlined approach was taken that moved from the unconstrained to feasible options list in a one-pass assessment (see section 9).

⁸ https://www.water.org.uk/wp-content/uploads/2020/01/Water_UK_DWMP_Framework_Appendices_September-2019-D.pdf

APPENDIX 4 TO STATEMENT OF EVIDENCE OF JOHN PATTON

CULHAM SEWAGE TREATMENT WORKS, TREATED EFFLUENT DISCHARGE PERMIT

Culham
30/05/2001

Consent: COPA/2374
CONDITION ADDED:- 28/01/2009
OSM1 - OSM13

ENVIRONMENT AGENCY

WATER RESOURCES ACT 1991 Section 88 - Schedule 10

NOTICE OF MODIFICATION OF CONSENT TO DISCHARGE

To: Thames Water Utilities Ltd.
FAO: The Secretary
Gainsborough House
Manor Farm Road
READING
Berkshire RG2 0JN

WHEREAS the Environment Agency (the "Agency") in pursuance of its powers under the Water Resources Act 1991 **GRANTED CONSENT** to the making of a discharge of sewage effluent on the 10th day of November 1985

FROM: Culham Sewage Treatment Works

NOTICE IS GIVEN that all the Conditions, Schedules and Annexes of the above consent are hereby deleted and replaced by the conditions set out on **Schedule 1** as attached.

NOTICE IS GIVEN that for the purposes of implementing the requirements of the Urban Waste Water Treatment Regulations 1994, the conditions specified in **Schedule U** as attached are hereby appended to the consent as Schedule U.

Subject to the provisions of Schedule 10 of the Water Resources Act 1991, no notice shall be served by the Agency, which alters the modifications made by this notice, without the agreement in writing of the consent holder, during a period of 48 months from the date this notice is served.

Dated: 30 MAR 2001 **Signed:**

E.V. Bray

Team Leader, Water Quality Consenting
West Area of Thames Region

NOTE: Consent COPA/2374 is updated accordingly.

CONDITIONS OF CONSENT TO DISCHARGE

TREATED SEWAGE EFFLUENT ("the Discharge")

FROM: CULHAM SEWAGE TREATMENT WORKS

1.
 - 1) The works shall be operated and effluent shall be treated in a manner which, so far as reasonably practicable, minimises the polluting effects of the discharge made from the works on controlled waters.
 - 2) This condition does not require:
 - a) any higher standard to be achieved in relation to any characteristic of the discharge which is specifically regulated by conditions 6, 7 and 8 than is required by those conditions;
 - b) any alteration of the works or a change in the type of treatment used.
2. The discharge shall be made in the manner and at the place as specified as:
 - a) discharging by means of pipe outlet
 - b) discharging to the Clifton Hampton Ditch
 - c) at National Grid Reference SU 539 955.
3. An appropriately labelled sample point shall be provided and maintained at National Grid Reference SU 539 955, so that a representative sample of the Discharge may be obtained. The consent holder shall ensure that all constituents of the Discharge pass through the said sampling point at all times and in any legal proceedings it shall, for the purposes of Section 10 of the Rivers (Prevention of Pollution) Act 1961, be presumed, until the contrary is shown that any sample of the Discharge taken at the said sampling point is a sample of what was discharging into controlled waters.
4. The volume of the Discharge shall not exceed 2868 cubic metres per day.
5. From the 1st April 2004
 - a) A continuous flow recorder, to a specification provided by the Agency, with on-site visual display from which readings can be readily obtained, shall be provided and operated to record the daily volume and instantaneous flow of sewage through the treatment works.

- b) As soon as practicable after completion of the flow recorder installation the Consent Holder shall employ an independent expert to certify that the installation complies with the Agency's specification. The Consent Holder shall satisfy himself as to the professional competence of the expert. A copy of the certifier's report shall be provided to the Agency when it is available.
 - c) Records of the flow readings shall be maintained by the Consent Holder and shall be provided to the Agency when requested, in a format specified by the Agency.
 - d) The Consent Holder shall produce and maintain a quality control manual, to the satisfaction of the Agency, specifying procedures for the calibration, operation and maintenance of the flow recorder. The flow recorder shall be calibrated, operated and maintained by the Consent Holder in accordance with the provisions of the manual. The Consent Holder shall keep a record of these procedures available for inspection by the Agency and provide a copy to the Agency on request.
 - e) The Consent Holder shall record all failures of the continuous flow recorder and any other breaks in the flow record. The reasons for these failures and breaks shall be recorded and all steps taken to prevent a re-occurrence. The Consent Holder shall ensure that as far as possible the recorder remains fully operational at all times. Any failures shall be remedied as soon as possible.
 - f) Flows of sewage through the treatment works shall be measured at the inlet or such other point(s) as are agreed by the Agency.
6. a) For the period up to and including the 31st March 2004 subject to paragraph (c) below the Discharge shall not contain more than;
- i) 45 milligrammes per litre of suspended solids (measured after drying at 105° C)
 - ii) 30 milligrammes per litre of biochemical oxygen demand (measured after 5 days at 20° C with nitrification suppressed by the addition of allyl-thiourea)
- b) For the period from the 1st April 2004 subject to paragraph (c) below the Discharge shall not contain more than;
- i) 35 milligrammes per litre of suspended solids (measured after drying at 105° C)
 - ii) 15 milligrammes per litre of biochemical oxygen demand (measured after 5 days at 20° C with nitrification suppressed by the addition of allyl-thiourea)
 - iii) 6 milligrammes per litre of ammoniacal nitrogen (expressed as N);



- c) The limit for any of the relevant parameters set out in paragraphs (a) and (b) above may be exceeded where, in any series of samples of the Discharge taken at regular but randomised intervals in any period of twelve consecutive months as listed in Column 1 of the table at Annexe 1 to this consent, not more than the relevant number of samples, as listed in Column 2 of said table, exceed the applicable limit for that relevant parameter.
7. For the period from the 1st April 2004 the Discharge shall not contain more than;
- i) 50 milligrammes per litre of biochemical oxygen demand (measured after 5 days at 20° C with nitrification suppressed by the addition of allyl-thiourea)
 - ii) 23 milligrammes per litre of ammoniacal nitrogen (expressed as N).
8. As far as is reasonably practicable, the works shall be operated so as to prevent the Discharge from containing any significant trace of visible oil or grease.
9. a) No sample of the discharge, taken at a time when unusual weather conditions are adversely affecting the operation of the sewage treatment works, shall be taken into account in deciding whether or not the conditions contained in paragraphs 1, 6 and 7 of this consent have been complied with.
- b) For the purpose of this condition 'unusual weather conditions' shall include: -
- i) low ambient temperatures as evidenced by effluent temperatures of 5°C or less, or by the freezing of mechanical equipment in the works;
 - ii) significant snow deposits;
 - iii) tidal or fluvial flooding;
 - iv) weather conditions causing unforeseen loss of power supply to the sewage treatment which could not be ameliorated by the reasonable provision and operation of standby generation facilities.
- c) On any occasion where unusual weather conditions adversely affect the operation of the sewage treatment works, the consent holder shall use its best endeavours to mitigate that adverse affect.
- d) For a sample of the discharge to be considered for the purposes of (a) above, the consent holder shall notify the Agency by telefax or telephone as soon as unusual weather conditions are known to have adversely affected operations and shall confirm the circumstance in writing as soon as possible thereafter (and in any event within 14 days of the occurrence of such conditions). That notification shall include a full description of the unusual weather conditions and their impact on the operation of the works.

10. The Consent Holder shall notify the Agency in writing if any known planned introduction or material change, in respect of discharges from trade premises to the sewerage system, occurs that may increase or introduce into the effluent any 'dangerous substance' (set out in Annexe 2 to this notice as updated from time to time and notified to the Consent Holder in writing), and any other substance considered by the Consent Holder as having or likely to have a significant effect on the receiving waters.
11. 1) A discharge shall not be made from the works if it would cause a significant increase in the polluting effects of the discharge on controlled waters as a result of a new or altered discharge of trade effluent into the works.
- 2) A discharge of trade effluent into the works is new if:
- a) it is made by the sewerage undertaker and is of a kind not made into the works by the undertaker immediately before the date of this modification of the consent; or
 - b) it is made by a third party and the discharge is authorised on or after that date.
- 3) A discharge of trade effluent into the works is altered if:
- a) it is made by the sewerage undertaker and its composition or quantity changes significantly on or after the date of this modification of the consent; or
 - b) it is made by a third party and the alteration of the discharge is authorised on or after that date.
- 4) An increase in the polluting effects of the discharge on controlled waters is not significant for the purposes of this condition if it relates to any characteristic of the discharge which is specifically regulated by conditions 6, 7 and 8 of this consent but it may be significant if it is caused by a change in some other characteristic of the discharge.
- 5) For the purposes of this condition 'trade effluent' means:
- a) any discharge by a sewerage undertaker other than
 - i) domestic sewage from premises connected directly or indirectly to the works; or
 - ii) surface water run-off;
 - b) any discharge by a third party which is authorised under Chapter III of Part IV of the Water Industry Act 1991 or which is only accepted as a result of a contract with the sewerage undertaker.

12. 1) A discharge made from the works shall not contain any poisonous, noxious or polluting matter or solid waste matter which is attributable to any unauthorised discharge into the works.
- 2) A discharge into the works is unauthorised if it is made by a third party and either there is no obligation to receive it or conditions subject to which there is an obligation to receive it are not observed.
- 3) Nothing in this, or any other, condition of this consent prevents anyone from relying on any defence available to them under section 87 of the Water Resources Act 1991.

ANNEXE 1

The limit for any of the relevant parameters set out in paragraph 6 of Schedule 1 of the attached consent may be exceeded where, in any series of samples of the discharge taken at regular but randomised intervals in any period of twelve consecutive months, as listed in Column 1 of the table below, no more than the relevant number of samples, as listed in Column 2 of the said table, exceed the applicable limit for that relevant parameter.

TABLE

<u>Column 1</u>	<u>Column 2</u>
Series of samples taken in any period of twelve months	Maximum number of samples for a given determinand permitted to exceed limit
4 - 7	1
8 - 16	2
17 - 28	3
29 - 40	4
41 - 53	5
54 - 67	6
68 - 81	7
82 - 95	8
96 - 110	9
111 - 125	10
126 - 140	11
141 - 155	12
156 - 171	13
172 - 187	14
188 - 203	15
204 - 219	16
220 - 235	17
236 - 251	18
252 - 268	19
269 - 284	20
285 - 300	21
301 - 317	22
318 - 334	23
335 - 350	24
351 - 365	25

ANNEX 2

- | | |
|--|------------------------------|
| 1. Mercury and its compounds | 2. Cadmium and its compounds |
| 3. Hexachlorocyclohexane
(lindane and related compounds) | 4. Carbon tetrachloride |
| 5. DDT (the isomers of 1,1,1-trichloro-2,2 bis{p-chlorophenyl} ethane) | |
| 6. Pentachlorophenol (PCP) | 7. Aldrin |
| 8. Dieldrin | 9. Endrin |
| 10. Isodrin | 11. Hexachlorobenzene (HCB) |
| 12. Hexachlorobutadiene (HCBD) | 13. Chloroform |
| 14. Polychlorinated biphenyls | 15. Dichlorvos |
| 16. 1,2-Dichloroethane | 17. Trichlorobenzene |
| 18. Atrazine | 19. Simazine |
| 20. Tributyltin compounds | 21. Triphenyltin compounds |
| 22. Trifluralin | 23. Fenitrothion |
| 24. Azinphos-methyl | 25. Malathion |
| 26. Endosulfan | 27. Lead |
| 28. Chromium | 29. Zinc |
| 30. Copper | 31. Nickel |
| 32. Arsenic | 33. *Iron |
| 34. *pH outside range 5.5 to 9.0 | 35. *Boron |
| 36. Vanadium | 37. PCSD'S |
| 38. Cyfluthrin | 39. Sulcofuron |
| 40. Flucifuron | 41. Permethrin |
| 42. 4-Chloro-3-methyl-phenol | 43. 2-Chlorophenol |
| 44. 2,4-Dichlorophenol | 45. 2,4-D (ester) |
| 46. 2,4-D (non ester) | 47. 1,1,1-Trichloroethane |
| 48. 1,1,2-Trichloroethane | 49. Bentazone |
| 50. Benzene | 51. Biphenyl |
| 52. Chloronitrotoluenes | 53. Demeton |
| 54. Dimethoate | 55. Linuron |
| 56. MCPA | 57. Mecoprop |
| 58. Mevinphos | 59. Napthalene |
| 60. Omethoate | 61. Toluene |
| 62. Triazophos | 63. Xylene |
| 64. Cyanide | 65. Azinphos-ethyl |
| 66. Fenthion | 67. Parathion |
| 68. Parathion-methyl | 69. Trichloroethylene |
| 70. Tetrachloroethylene | 71. Dioxins |
| 72. PAHs | 73. Nonyl phenol |
| 74. Nonyl phenyl ethoxylate | 75. Di-ethylhexyl phthalate |
| 76. Bisphenol-A | 77. Diazinon |
| 78. Chlorfenvinphos | 79. Chlorotoluron |
| 80. Isoproturon | 81. Diuron |
| 82. Propetamphos | 83. Flumethrin |
| 84. Amitraz | 85. High-Cis Cypermethrin |
| 86. Cyromazine | 87. Deltamethrin |
| 88. Cypermethrin | |

This list is applicable as at 1 December 1998 and will be updated as and when changes to the relevant legislative requirements occur.

*Notification to the Agency by the Consent holder is only required in respect of changes to trade effluents likely to cause significant changes to the pH value, and/or iron or boron concentrations, of the crude sewage.

Consent: COPA/2374

Schedule: U

Date Issued: 7.11.2003

CONDITIONS OF CONSENT TO DISCHARGE

TREATED URBAN WASTE WATER ("the Discharge")

FROM: CULHAM SEWAGE TREATMENT WORKS

- U0 a) The Consent Holder shall comply with the Urban Waste Water Treatment (England and Wales) Regulations 1994 ("the Regulations").
- b) For the purpose of conditions U1 and U2 below, interpretations and references to a numbered regulation or Schedule shall have the meaning as in the Regulations, unless otherwise indicated.
- U1 a) The Discharge derives from an agglomeration with a population equivalent of between 2,000 and 10,000 discharging to fresh waters in a Sensitive Area (Eutrophic) as identified under Part I (a) of Schedule 1.
- b) The Consent Holder shall inform the Agency in writing of any change, or proposed change, to the population equivalent such as would make a material change to the application of the Regulations and shall, on request, inform the Agency in writing of the actual population equivalent.
- c) The Discharge shall be subject to Regulation 5(1) and shall satisfy the relevant requirements of Part I of Schedule 3.
- U2 a) The Consent Holder shall provide apparatus for the purpose of:
- i) measuring or recording the volume, rate of flow, nature, composition or temperature, and
- ii) collecting samples of any waste water, as is necessary to ensure compliance with paragraph (b) below.
- b) The Consent Holder shall monitor the Discharge to verify compliance with the requirements of condition U1(c) above in accordance with the control procedures as set out in Part II of Schedule 3.
- c) The Consent Holder shall provide to the Agency any information collected in complying with paragraph (b) above in a manner agreed with the Agency.
- U3 a) Condition U2 above shall apply for the purpose of verifying compliance with the Directive from the date as specified in the relevant paragraph of Regulation 5 as incorporated into this consent under U1(c) above.



CONSENT NO.
List 1

Mod Notice 28th January
2009



ENVIRONMENT
AGENCY

28/01/2009

Culham OSM

WATER RESOURCES ACT 1991

SECTION 88 - SCHEDULE 10
(AS AMENDED BY THE ENVIRONMENT ACT 1995)

NOTICE OF MODIFICATION OF CONSENT TO DISCHARGE

TO: Thames Water Utilities Limited ("the Consent Holder")
Clearwater Court
Vastern Road
Reading
Berkshire
RG1 8DB

Following a review of the conditions of its consent, the ENVIRONMENT AGENCY ("the Agency") exercising its powers under paragraph 7(2)(b) of Schedule 10 to the Water Resources Act 1991, HEREBY MODIFIES ITS CONSENTS for making discharges

OF: Treated Sewage Effluent

with respect to the attached list of consents, (List 1)

FROM the date upon which this modification takes effect, each of the consents in the attached List 1 is modified as follows:

Addition of the following new conditions OSM 1 – OSM 13 and Annexes OSM1 and LUT1 as specified in this notice of modification

NOTE. This modification notice wholly replaces previous modification notices for Consent No. List 1, which were issued on 14th October 2008, 12th January 2009 and 26th January 2009.

All other conditions of the consents in List 1 remain unaltered and in force. This notice of modification should be read in conjunction with, and attached to each consent as specified in the attached list of consents or schedules to consents.

Where a discharge is regulated by a schedule to a consent, then the wording in these conditions shall be taken as referring to that schedule in place of the term 'consent'.

Under the provisions of Paragraphs 7 and 8 of Schedule 10 to the Water Resources Act 1991, no notice shall be served by the Agency, which alters the effect of modifications made by this notice, without the agreement in writing of the Consent Holder, during a period of 4 years from the date this notice is served.

This modification is served on 28th day of January 2009

This modification takes effect on 1st April 2009 or a later date agreed in writing by the Agency but no later than 1st January 2010.

Signed 

Mark Hutchinson
Permitting Team Leader

New conditions added: Operator Self Monitoring (OSM) conditions

OSM Monitoring programme

- OSM 1 The Consent Holder shall, unless otherwise agreed in writing by the Agency, undertake a monitoring programme for the parameters specified by this consent which control the effluent quality by numeric limits, at not less than the frequencies specified in Annex OSM 1 to this permit.
This does not include List 1 substances included within a consent in the General Standards Table.
- OSM 2 The monitoring programme referred to in condition OSM1 shall:
- (a) cover a calendar year, and
 - (b) be recorded and referred to in a Quality Management System before the commencement of a calendar year sample period.

QMS and MCERTS

- OSM 3 The Consent Holder shall have an appropriate Quality Management System covering Operator Self Monitoring.
- OSM 4 The Consent Holder shall ensure that appropriate actions and activities carried out to fulfil the requirements of condition OSM1 are recorded.
- OSM 5 Any sampling or analysis carried out to fulfil the requirements of condition OSM 1 shall be managed and operated by the Consent Holder or its appointed organisation or organisations in accordance with ISO 17025 for the MCERTS Performance Standard for Organisations Undertaking Sampling and Chemical Testing of Water (Part1) to the reasonable satisfaction of the Agency.
- OSM 6
- (a) **For the period up to 1 July 2010**, any organisation undertaking sampling and analysis to fulfil the requirements of condition OSM1 shall have applied for accreditation to ISO 17025 for the MCERTS Performance Standard for Organisations Undertaking Sampling and Chemical Testing of Water (Part1), unless otherwise agreed in writing by the Agency, and
 - (b) **From 1 July 2010**, any organisation undertaking sampling and analysis to fulfil the requirements of condition OSM1 shall have gained accreditation to ISO 17025 for the MCERTS Performance Standard for Organisations Undertaking Sampling and Chemical Testing of Water (Part1), unless otherwise agreed in writing by the Agency.
- OSM7 The Consent Holder shall ensure that all required records of compliance and accreditation with ISO 17025 for the MCERTS Performance Standard for Organisations Undertaking Sampling and Chemical Testing of Water (Part 1) are maintained.

Records

- OSM 8 All records required to be made by this consent shall:
- (a) be legible, and
 - (b) be made as soon as reasonably practicable, and
 - (c) if amended, be amended in such a way that the original and any subsequent amendments remain legible, or are capable of retrieval and
 - (d) be retained, unless otherwise agreed in writing by the Agency, for at least 6 years from the date when the records were made, and
 - (e) where the records have been requested in writing by the Agency, copies shall be supplied to the Agency within 14 days, unless otherwise agreed in writing by the Agency,

Reporting routine analysis

- OSM 9 The analytical results from the monitoring programme required by condition OSM 1 must be supplied to the Agency in an electronic format defined by the Agency, as soon as is reasonably practical for each result, and at least on a quarterly basis.

Reporting exceedances

- OSM 10 When the Consent Holder becomes aware that a sample result has exceeded a numeric water quality limit specified within this Consent, (including those covered by the Look-up Table) the Consent Holder shall, unless prior agreement has been given in writing by the Agency, notify the Agency as soon as is reasonably practicable by a reporting system and format specified by the Agency.
- OSM 11 When the Consent Holder becomes aware that the Discharge is not compliant with the Look-up Table (as set out in Annex LUT1) for a numeric water quality limit specified within this Consent, the Consent Holder shall, unless prior agreement has been given in writing by the Agency, notify the Agency as soon as is reasonably practicable by a reporting system and format specified by the Agency.

Reporting sample missed or lost

- OSM 12 After becoming aware, or following notification that, a sample has not been taken on the Monitoring Programme pre-scheduled date, or is lost, or a result for that sample can not be reported, the Consent Holder shall record the details and reschedule the sample.

Annual monitoring summary compliance report

- OSM 13 A summary report :
- (a) of compliance with the monitoring programme referred to in condition OSM1 shall be made for each calendar year, and
 - (b) shall be submitted to the Agency within two months following the end of the year and shall have the data summarised and shall be in the format required by the Agency.

Annex OSM1 – Opra Tier 3 Sampling Frequency

Determinand	'Normal frequency' of samples per year	Reduced Sampling frequency after 12 consecutive months of numeric consent compliance, samples per year or pro rata over the remainder of a year	On consent failure return to Normal frequency as soon as reasonably practicable, samples per 12 months	Out of hours samples
Sanitary	24	12	24	For 24 samples 2 out of hours samples per annum
Non sanitary	12	12	12	For 12 samples 1 out of hours sample per annum

Annex OSM1 relates to spot samples which must be collected at approximately equal intervals during the year, but should include samples from different days of the week and different times. Approximately 10% of samples should be outside of the normal sampling window which is 9am - 3pm, Monday to Friday.

Annex LUT 1

Series of samples taken in any period of 12 consecutive months	Maximum number of samples for a given determinand permitted to exceed limit
4-7	1
8-16	2
17-28	3
29-40	4
41-53	5
54-67	6
68-81	7
82-95	8
96-110	9
111-125	10
126-140	11
141-155	12
156-171	13
172-187	14
188-203	15
204-219	16
220-235	17
236-251	18
252-268	19
269-284	20
285-300	21
301-317	22
318-334	23
335-350	24
351-365	25