Appendix 8.6.A – Claim WSX02 – Sewage treatment works capacity programme

Wessex Water

September 2018

Wessex Water
YTL GROUP

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Contents

1. Summary

This cost adjustment claim relates to the programme of work to increase capacity at our sewage treatment works (STWs). The table below provides a summary of the claim and the following sections provide more detail for each of the headings.

Heading	Summary
Brief description	Programme of work to increase treatment capacity at STWs to accommodate residential, trade effluent and flow related growth in the affected catchments, to be delivered in a timely fashion to avoid impeding development, and in order to maintain leading environmental performance.
Total value of claim for AMP7	£61.1 million (gross of any implicit allowance)
Total opex of claim for AMP7	£1.1 million (gross of any implicit allowance)
Total capex of claim for AMP7	£60.0 million (gross of any implicit allowance)
Price control	Wastewater network plus
Need for cost adjustment	The programme of work has been developed from a bottom-up assessment of the need to provide additional capacity at specific STWs in order to remain compliant with permit standards. The programme will provide greater treatment capacity in terms of population equivalent than predicted regional growth. The programme includes: • schemes to provide treatment capacity at over-loaded STWs • schemes to provide both treatment capacity and more advanced treatment for increased dry weather flows (DWF) and tighter permit limits and • a strategic scheme at Poole STW. We consider that the Ofwat model for STW growth does not adequately cover the factors driving the cost of this programme. This could be due to historical variability in data allocation definitions and different interpretations by other companies. We have concerns about the quality of the data used in the model development. We consider that the Ofwat model does not allow for cost variability attributed to: • capacity schemes requiring both capacity and more advanced treatment to meet tighter permit standards (i.e. DWF exceedance) and • weighted expenditure at small sites and associated diseconomies of scale. If Ofwat's implicit allowance does account for the investment needs outlined within our claim, the need for the cost adjustment will be avoided.
Management control	The underlying need for the investment of population growth, and the disproportionate distribution of this at our smaller sites are both factors that are outside of management control.

Heading	Summary
	DWF exceedance schemes requiring tighter permit limits in addition to capacity need supplementary investment which increases the cost over standard capacity schemes; the need for these schemes is outside of management control. We have minimised the costs to customers through a range of different options for meeting the need including: • taking advantage of synergies with other drivers • minimising the programme by deferring schemes, using operational interventions, and employing temporary treatment, where appropriate • mitigating increases in base flows (dry weather flow) by reducing flows at source through sewer infiltration sealing • investment in the lowest whole-life-cost additional treatment option.
Need for investment	The investment is required to maintain compliance and prevent a deterioration of the quality of the receiving waters. There is significant population growth in our region, and at some sites there is growth in trade effluent flows and loads and an increase in base dry weather flows. The need for the work is supported in principle by the Environment Agency. The need has also been assured by the Wessex Water Partnership.
Best option for customers	Customer research shows that protecting the environment is a priority for customers. A range of options has been evaluated including: • sweating the assets, pump away, catchment-wide permitting • mitigating increases in base flows (dry weather flow) by reducing flows at source • increased treatment capacity at STWs. Cost benefit analysis shows that the investment will deliver benefits greater than the costs, and that it is best value solution for customers.
Robust and efficient costs	We have benchmarked the cost estimates using independent external cost consultants and this shows that the cost estimates are robust and efficient.
Customer protection	Customers will be protected if the investment is cancelled, delayed or reduced in scope through the following performance commitment and its ODI: • Treatment works compliance – one of the common asset health performance commitments.
Affordability	The programme of work outlined in the Cost Adjustment Claim was included in our draft business plan that was tested with customers between January and June 2018. The acceptability testing was designed to test customers' acceptance of our overall package of service improvements and bill impacts. Testing has shown that acceptability and affordability is above 80% across all demographic subgroups, with 96% acceptability for informed households.
Board assurance	The proposals have been subject to our board assurance process, which is described in detail in section 12 of the main business plan narrative and supporting documents 12.1 to 12.8.

2. Background

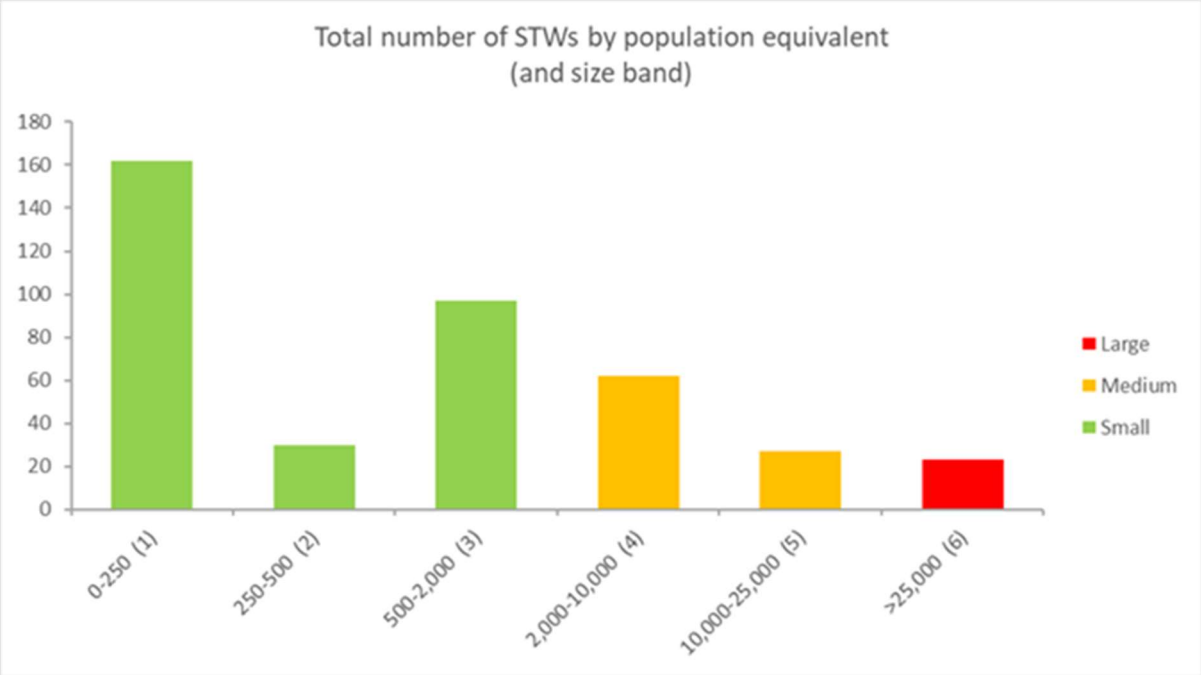
2.1 Overview

Wessex Water has 401 sewage treatment works (STWs) across Somerset, Wiltshire, Bristol, Gloucestershire and Dorset.

Our STWs are categorised into six groups, as specified by the following Ofwat definitions:-

Size band	Kg BOD/d	Population equivalent (p.e.)	Number of STWs (JAR 2018)
1	< 15	0 - 250	162
2	15 -30	250 - 500	30
3	30 - 120	500 – 2,000	97
4	120 - 600	2,000 – 10,000	62
5	600 - 1500	10,000 – 25,000	27
6 (Large Works)	> 1500	>25,000	23
			401

Figure 2-1: Total no. of Wessex Water STWs



Sewage treatment capacity requirements depend on existing and future loads, and Environment Agency (EA) requirements. EA requirements are outlined in environmental permits which impose limits on Dry Weather Flow, Flow to Full Treatment, storm discharges, and discharge quality as well as management systems and reporting obligations. Wessex Water monitor flows on principal sites and record the readings on the Sewage Waste Information Management Systems (SWIMS) database.

2.2 Historical Capacity enhancement

Our PR09 and PR14 approaches to assessing requirements for delivering proactive capacity investment in both sewerage networks and sewage treatment works followed the methodology defined in the UKWIR report 07/RG/08/2 '*Long Term/Least Cost Planning for Wastewater Supply-Demand*'.

At PR09 we identified ten named Defined STW projects (cost>£500k) and two smaller projects (cost <£500k) where it was clear that investment was almost certainly required. We also identified nine Defined Contingent STW projects. We delivered enhanced treatment capacity at our STWs of 78,930 p.e. (population equivalent) for £49m (17/18 price base, adjusted for CPIH).

In our Final Business Plan submission (FBP) at PR14, for capacity enhancement we named ten sites under the Defined STW projects and eight sites under the Contingent STW projects. These 18 projects projected an enhancement in p.e. capacity of 72,358 at a cost of £44m (17/18 price base, adjusted for CPIH); in the final determination Wessex Water was funded for £25m (17/18 FYE price base, adjusted for CPIH).
We are presently on track to deliver capacity enhancement at a total of 15 STWs by 2020, providing an additional 71,685 p.e. at a cost of £42m (17/18 prices).

Table 2-1: Historical Growth Programme Summary

	Capacity enhancement (p.e. provided)	Total programme capex (£m, 17/18 price base)	Unit cost (£/p.e. provided)
2010-15	78,930	£48.89	£619
2015-20	71,685	£42.39	£591

Wessex Water has consistently maintained good or industry leading under the Environmental Performance Assessment, which is interrelated to our historical capacity enhancement investment. Evidence of our performance is detailed in section 6.1.1. We have safeguarded this performance by undertaking capital investment schemes at the right time and at the STWs where growth within the respective catchments has removed treatment headroom.

The following table outlines the historical investment at STWs since 2010, with any schemes labelled SDB providing capacity enhancement.

Table 2-2: Historical Capacity Enhancement Plan

Site ID	Site name	Population equivalent 2017/18[1]	2010 to 2015 PR09	2015 to 2020 PR14
Large Works (Size Band 6)		**P.E. ≥ 25,000**		
13016	Bath (Saltford)	110,040		SDB
19156	Chard	30,274		NEP
13066	Christchurch	55,208	SDB	
13152	Holdenhurst	157,850		SDB
13267	Shepton Mallet	30,718	SDB/NEP	
13305	Taunton	83,832	DWF	NEP
13318	Trowbridge	64,030		SDB/NEP
19155	Weston super Mare	95,980	SDB/NEP	
13366	Yeovil Pen Mill	53,852	SDB/NEP	
Select other Works		**P.E. < 25,000**		
13004	All Cannings	1,189		Infilt Reduction/NEP
13007	Alveston	2,255		SDB
13008	Amesbury	9,402	SDB/NEP	
13032	Bradford on Tone	1,240	Infiltration Reduction	
19031	Buckland Newton	379		Infiltration Reduction
13048	Castle Cary	3,653	SDB/NEP	
13050	Cerne Abbas	889	Infiltration Reduction	
13057	Cheddar	9,301		NEP
10306	Chilthorne Domer	27	SDB	
13088	Crowcombe	245	SDB	
13094	Ditcheat	734	Infiltration Reduction	Infiltration Reduction
13132	Gillingham	14,305		SDB/NEP
13353	Great Wishford	2,042		Infiltration Reduction
13146	Hazelbury Bryan	824	SDB	
13158	Hurdcott	2,042		Infiltration Reduction
13163	Iwerne Minster	1,286	DWF	
13177	Lavington Woodbridge	3,922	Infiltration Reduction	
17968	Leyhill	1,261		SDB
13182	Longburton	412		Infiltration Reduction
13192	Maiden Newton	1,552		SDB/NEP
13202	Meare	1,261	DWF	
13204	Melksham	17,795	SDB/NEP	
10307	Melplash	9	SDB	
13211	Milborne Port	4,025		Infiltration Reduction
13223	North Petherton	3,531	Infiltration Reduction	
13231	Over Stratton	286	Infiltration Reduction	
13237	Pewsey	7,439	Infiltration Reduction	
13515	Porlock	2,346		SDB
13249	Puddletown	1,352	DWF	
13522	RAF Lyneham	5,176		NEP
13360	Royal Wootton Bassett	13,802	SDB/NEP	SDB/NEP
13268	Sherborne	11,747		SDB
13280	South Perrott	1,397	Infiltration Reduction	
13297	Sturminster Newton	6,469		SDB/NEP
13303	Sydling St Nicholas	354	Infiltration Reduction	
13304	Tarrant Crawford	17,918	SDB	
13308	Thingley	17,248		SDB/NEP
13309	Thornbury	13,807		SDB
13310	Thornford	4,501	Infiltration Reduction	SDB/NEP
13313	Tisbury	4,389	Infiltration Reduction	
13324	Wareham	11,420	SDB	
13330	Wellington	15,121		Infilt Reduction/NEP
13338	Westbury	23,882		SDB/NEP
13358	Wookey	1,109		Infiltration Reduction

1 - As per PR19 Table WWn2 methodology

Legend:

SDB	Completed Growth schemes
Infiltration Reduction	Completed sewer sealing schemes (to mitigate DWF schemes at STWs)
SDB/NEP	Completed mixed-purpose Growth & Quality schemes

3. Need for cost adjustment

In this section we provide evidence that the cost claim is not included in Ofwat's modelled baseline; and, that the allowances would, in the round, be insufficient to accommodate special factors without a claim.

Our claim is for a gross totex (less any implicit allowance) for our STW growth programme of £61.1m.

If Ofwat's allowance does account for the investment needs outlined within our claim, the need for the cost adjustment will be avoided.

3.1 Ofwat models

In March 2018 Ofwat published the consultation on econometric cost modelling[1] with the following information for enhancement models:

Enhancement activities	Relevant cost drivers
New development and growth; growth at sewage treatment works; reduce sewer flooding risk for properties	Scale: resident population; volume of wastewater treated; number of household and non-household properties billed for sewerage. Activity/system characteristics: total number of sewage treatment works; number of sewage treatment works in size band 5 and above; % of sewage treatment works in size band 5 and above; load per sewage treatment work; % of load treated in size bands 5 and above.

The model allows for a company's overall distribution of sites with respect to larger size sites, but not for diseconomies of scale with weighted expenditure at small sites.

Wessex Water consider that data used in these models from other Water and Sewage Companies (WaSCs) has inherent errors with respect to key driver allocation which skew the constants.

Providing additional capacity at sewage treatment works is often undertaken alongside capital maintenance and other quality enhancement at sites to ensure efficient delivery. This should lead to the allocation of costs between drivers and so is open to a degree of subjectivity.

In fact, Yorkshire Water explicitly state in relation to sludge growth that:

> "Growth expenditure is delivered alongside Quality (line 2) as the Primary Driver and so Growth is reported in line 2."[2]

[1] Ofwat (March 2018). Cost assessment for PR19: a consultation on econometric cost modelling. https://www.ofwat.gov.uk/wp-content/uploads/2018/03/Cost-assessment-for-PR19-A-consultation-on-econometric-cost-modelling.pdf

[2] Yorkshire Water (September 2017). Cost Assessment Data Table Submission.

If they have applied a similar set of principles to sewage treatment work growth, i.e. assigning costs on a primary-driver principle, then there is clearly an issue in applying econometric modelling to this area. This will greatly reduce the expenditure figure for STW growth and so the models will necessarily understate any forecast allowance.

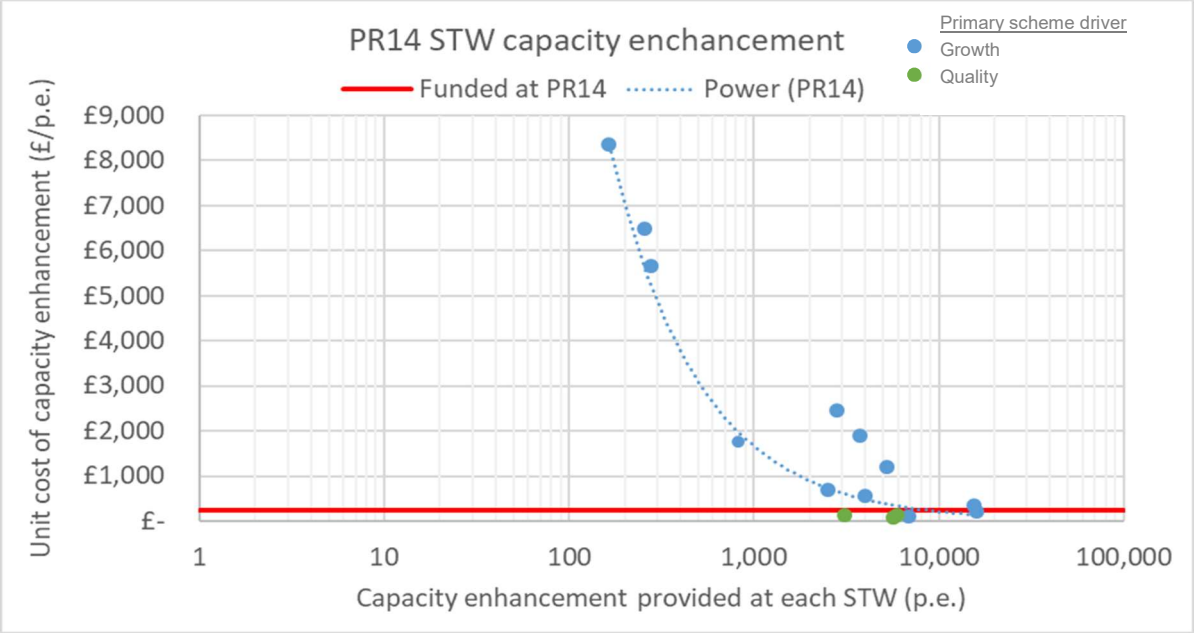
We also believe that due to the lack of break-down of data reported by WaSCs, the cost variability attributed to different types of capacity enhancement schemes are not represented adequately within the models; specifically, for schemes requiring both capacity enhancement and tighter permits (i.e. DWF exceedance) and for the relative spread of capacity enhancement expenditure across different sized sites.

3.2 PR14 models and capacity enhancement

At PR14 Ofwat used industry information to model baseline unit costs for these enhancement schemes, using connected population growth as the main variable in the models. The models were applied at an overall company level.

Due to diseconomies of scale, capacity provision at smaller sites has much higher unit costs than provision at larger sites. The graph below shows the unit costs of our schemes completed (or due to be completed) during 2015-20, plotted against the size of the enhancement capacity provided. The graph also shows the unit cost funded at PR14. These values are at 17/18 price base.

Figure 3-1: 2015-20 unit costs for capacity enhancement



As demonstrated in Figure 3-1, the smaller schemes have much higher unit costs, moving away from the Ofwat modelled allowance for schemes providing capacity enhancement of 6,000 p.e. or less.

Efficiencies were gained by undertaking schemes that combined capacity enhancement schemes with other needs at the site, as can be seen by the schemes where quality enhancement were the primary drivers (green data points in Figure 3-1).

3.3 Differences to previous Business Plans

Our programme for PR19 is materially different to previous business plans due to the high proportion of capex being attributed to:

- sites within a small size band
- schemes where there is both capacity enhancement and tighter permit standards required due to growth (DWF exceedance)
- our p.e. capacity provided for PR19 being greater than the regional growth due to quality drivers and strategic phasing needs.

This has skewed the overall quantum of our programme significantly, which we do not believe is represented within the Ofwat cost models. This is detailed further in the successive sections.

3.4 PR19 Capacity Enhancement schemes

As outlined further in Section 4.2: Forming the plan, for PR19 we have used a bottom-up approach to determine our capacity enhancement needs for 2020-25.

Our plan identifies 20 schemes at named STWs.

In addition we have included allowances for:

- sites where we are aware of significant local authority development plans
- sites where it is also likely we will fail the DWF permit during 2020-25 and require associated investment
- sites where we have deferred investment until 2025-30 but where development occurs sooner than we anticipated and thus require temporary treatment to maintain compliance.

Our projected total STW capacity enhancement capital expenditure (capex) is **£60.0m** of which 84% has capacity as the primary driver.

The following table shows the split of this Capex by STW size band, in comparison to previous Business Plans.

Table 3-1: Proportion of capacity enhancement capex by STW size band

	2010-15	2015-20	PR19
Sites <1,500 p.e.	13%	4%	18%
Sites 1,500-10,000	7%	26%	31%
Total sites ≤10,000 p.e.	20%	30%	49%
Sites >10,000 p.e.	80%	70%	51%

Our PR19 STW capacity enhancement programme is significantly different to previous business plans:

1. 49% of our PR19 capex (£29m) is attributed to sites of size 10,000 p.e. or less
    - The average investment at small sites in 2010-15 and 2015-20 was 25% of total capex
    - This represents a further skew in capex at small sites of 24% in PR19
    - As previously outlined, the PR14 Ofwat model did not allow for a programme where investment is skewed towards small sites in PR14, and we believe this is not accurately reflected in the proposed models for PR19.
2. 33% of total capex (£19.8m) is attributed to sites with DWF exceedance as the primary growth driver
    - These schemes require both capacity enhancement and tighter permit standards with no quality funding
    - During 2015-20 we have no schemes that required capacity and quality enhancement due to DWF exceedance.
    - During 2010-15 any such schemes were funded in the NEP.

If these DWF schemes did not require tighter permit standards, and their unit costs were comparable to the other capacity enhancement schemes, their total capex would be significantly less (refer to Section 4.1.3: Unit costs for capacity provision in PR19 for detail).

The proposed four DWF schemes have been investigated, and where possible, sealing works have been completed to reduce the infiltration flows. This has not reduced the DWF to these sites below the permit, and the recent growth has already caused the DWF to be exceeded. There is high certainty that these STWs will therefore not meet their DWF permit during 2020-25 without enhanced treatment, and thus face permit failures at 2025. The need for investment at these sites is evidenced further in section 5 and the annexes associated with these sites.

4. Management control

In this section we demonstrate that the cost is driven by factors beyond management control; and, that we have taken all reasonable steps to control the cost.

4.1 Factors beyond management control

4.1.1 Population growth distribution

The underlying need for investment in capacity enhancement is population and trade effluent growth in specific catchments. Whilst total growth is accounted for within Ofwat's models, the specific STW catchments in which this growth occurs is outside of management control.

As residential, commercial and industrial development occurs within a specific STW catchment, the flow and subsequent pollution load increases at the receiving works. Where this load exceeds the treatment capacity of the STW, risk of failure of the associated environmental permit increases. If the receiving STW does not have sufficient treatment headroom, investment in capacity enhancement is required to maintain compliance.

Unlike our water supply system, we cannot easily transfer sewage from one network to another. It is not possible to avoid capacity enhancement unless there is an adjacent catchment where the associated STW has sufficient headroom and it is more cost effective to divert flows from the new development to this adjacent catchment.

As previously discussed, if the growth occurs within catchments associated with small capacity sites, the unit cost for enhancement at these sites is significantly greater than large sites due to diseconomies of scale.

4.1.2 Capacity enhancement schemes due to DWF exceedance

If the growth within a catchment both exceeds the STW treatment capacity and leads to the STW's Dry Weather Flow (DWF) exceeding its permit, it is likely that investment is required not only for capacity but also for provision of advanced treatment to meet tighter permit standards.

For each permitted site, the Environment Agency (EA) sets numeric discharge permit limits for the daily DWF of treated sewage or other effluent that operators may discharge. The effluent quality limits are determined on the basis of the permitted DWF. In general, as the DWF increases, the quality limits become tighter.[3]

In a catchment where the measured DWF is exceeding the permit DWF value, we are required to investigate the reasons for the exceedance and provide a report to the EA.

[3] Environment Agency (October 2012). EPR 7.01 (v3) – Water Discharge and Groundwater Activity Permits. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/298081/LIT_7356_4132bc.pdf

Following investigation, as per the EPR 7.01[4], a higher DWF limit must be applied for if the cause of the exceedance is due to:

1. Growth of connected pop, or
2. Long-term increase in existing trade effluent discharges, or
3. New trade effluent discharge, or
4. Connection of other drainage systems.

To prevent deterioration of the receiving watercourse, a higher DWF permit limit will necessitate an associated tighter quality permit limit. If the tighter quality limit cannot be achieved at the respective STW, then in addition to capacity enhancement, a more advanced treatment process is also required.

Prior to PR14, quality enhancement due to a growth-related DWF exceedance was funded under the National Environment Programme (NEP) as a 'prevent deterioration' driver. As with PR14, under the Water Industry NEP (WINEP) for PR19, the EA no longer allows for prevent-deterioration funding for sites with a DWF exceedance (i.e. growth beyond the permit headroom).

The following statement outlines the funding principles for DWF schemes as follows:

> "*Investment required to 'prevent deterioration' to current permitted Dry Weather Flows (DWF) should be included in the WINEP under the prevent deterioration driver. Investment to accommodate growth beyond the permit headroom should not be included under prevent deterioration, but should be included in Water Company business plans, as a supply demand scheme.*"[5]

At PR14 we proposed the inclusions of some capacity enhancement schemes where DWF exceedance was a primary driver, however due to delayed growth within the associated catchments, these schemes were not progressed.

4.1.3 Unit costs for capacity provision in PR19

The key drivers behind the PR19 capacity enhancement are broadly as follows:

- **Growth** – where the increased load exceeds the treatment capacity and capability of the receiving works.
- **DWF exceedance due to growth** – as previously outlined.
- **Combined growth and quality** – as per growth, with the addition of a quality enhancement driver under the WINEP.
- **FFT driver** – under the WINEP the site requires a hydraulic capacity increase for a higher FFT. The additional capacity required up to the permit DWF or 2025 horizon is funded through quality, otherwise it is funded through growth.

[4] Environment Agency (October 2012) EPR 7.01 (v3) – Water Discharge and Groundwater Activity Permits.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/298081/LIT_7356_4132bc.pdf

[5] Environment Agency (March 2017). PR19 Driver Guidance – Prevent Deterioration (WQ) FINAL (003).

The following table summarises the capacity schemes identified for PR19, associated capex (proportion attributed to growth only – see Table 5-1 for full scheme costs), population served by each site and capacity to be provided with each PR19 scheme.

Table 4-1: PR19 Growth investment and population

Site ID	Site name	Scheme drivers	Capex growth (£m)	STW population served (p.e. 2018/19)[1]	Capacity enhancement (p.e. provided)
13008	AMESBURY STW	Growth	1.9	9,905	3,346
13013	AVONMOUTH STW	Increase FFT + growth	2.3	799,129	30,729
13027	BOURTON STW	Increase FFT + growth	0.1	1,921	204
13041	BURTON STW	DWF growth	4.0	266	69
13048	CASTLE CARY STW	Increase FFT + quality (BOD)	0.2	3,919	1,331
13075	COMPTON BASSETT STW	DWF growth + quality (FFT)	3.4	3,684	2,827
13077	CORFE CASTLE STW	Quality (UV) + growth	0.4	2,222	235
13353	GREAT WISHFORD STW	DWF growth	4.4	2,115	299
13140	HALSTOCK STW	Increase FFT + growth	0.1	314	39
13158	HURDCOTT STW	DWF growth	8.0	3,487	652
13165	KEYNSHAM STW	Quality (AmmN) + growth	0.7	18,864	2,544
13175	LANGPORT STW	Quality (phosphorus) + growth	2.6	10,281	1,039
13242	POOLE STW	Growth	11.4	168,397	35,479
13252	RADSTOCK STW	Quality (phosphorus & AmmN) + growth	1.4	24,802	3,025
13256	RODE STW	FFT + SCM + growth	0.4	1,080	195
13258	SALISBURY STW	Growth	5.9	60,168	9,008
13016	SALTFORD STW	Increase FFT + growth	1.1	118,271	19,937
13271	SHILLINGSTONE STW	Increase FFT + growth	0.03	2,870	268
13336	WEST HUNTSPILL STW	Quality (UV) + growth	1.4	61,219	5,599
13366	YEOVIL PEN MILL STW	Quality (BOD+ AmmN) + growth	1.3	58,959	7,346
	Temporary treatment	Growth	1.1	-	-
	DWF Exceedance	Growth	5.8	19,175*	6,337*
	Non-Specific Growth	Growth	2.1	-	8,206**
		Total	**60.0**	**1,351,048**	**138,714**

1 – These figures are representative of full load served by each works (i.e. 9/9 non-resident, consented trade loads plus addition for development in 2018).

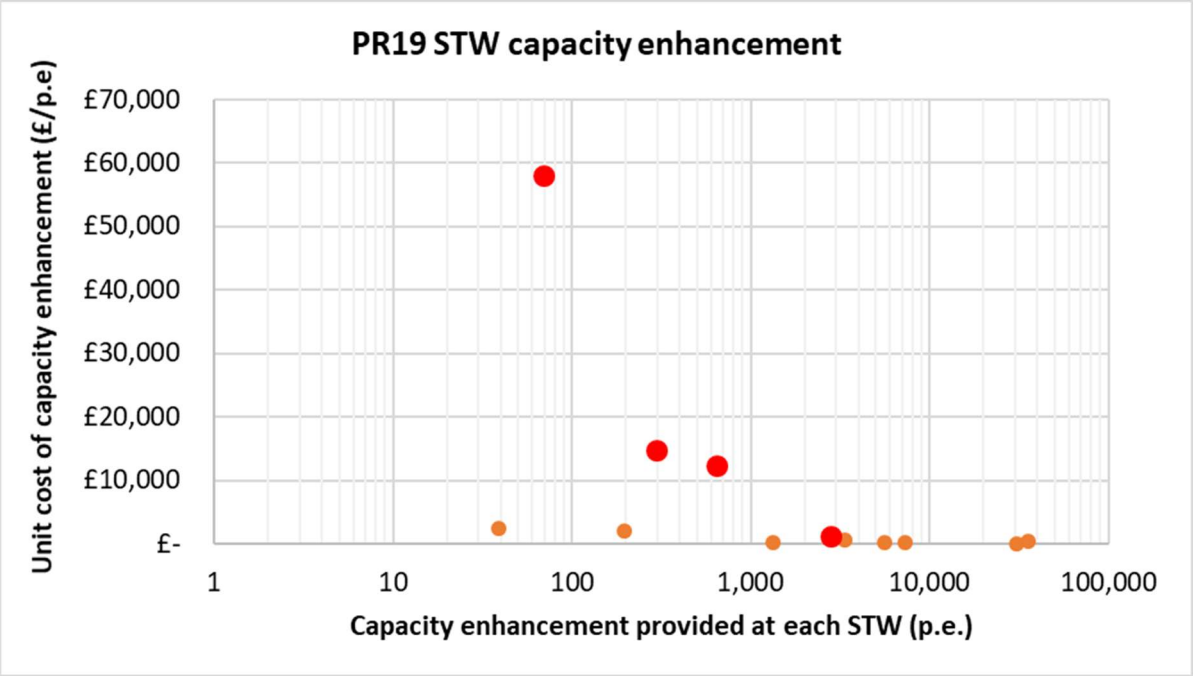
* These figures have been derived on the assumption the four highest risk DWF sites are those that receive investment during 2020-25

** This figure has been derived from the unit cost equation for the associated capex (Equation 1)

The size of the works and the key drivers are significant factors in the cost of a scheme and its associated unit cost of the capacity provided.

The following graph shows the unit costs (£/p.e. capacity provided) of our PR19 schemes for capacity enhancement at STWs.

Figure 4-1: PR19 STW capacity enhancement unit costs



The red data points in Figure 4-1 show the four schemes where DWF is a primary driver. With the exception of one scheme, which is a combined scheme with a quality driver, these DWF schemes are significantly outside of the unit cost curve of the other schemes.

DWF exceedance schemes have a higher unit cost than other capacity enhancement schemes of similar scale as they must provide both capacity enhancement and more advanced treatment. As previously explained, unlike other quality enhancement this is not funded under the WINEP.

Separating out the DWF schemes from the other capacity enhancement schemes produces two different unit cost models as illustrated in Figure 4-2 and Figure 4-3 below.

Figure 4-2: PR19 capacity enhancement unit cost model (DWF only)

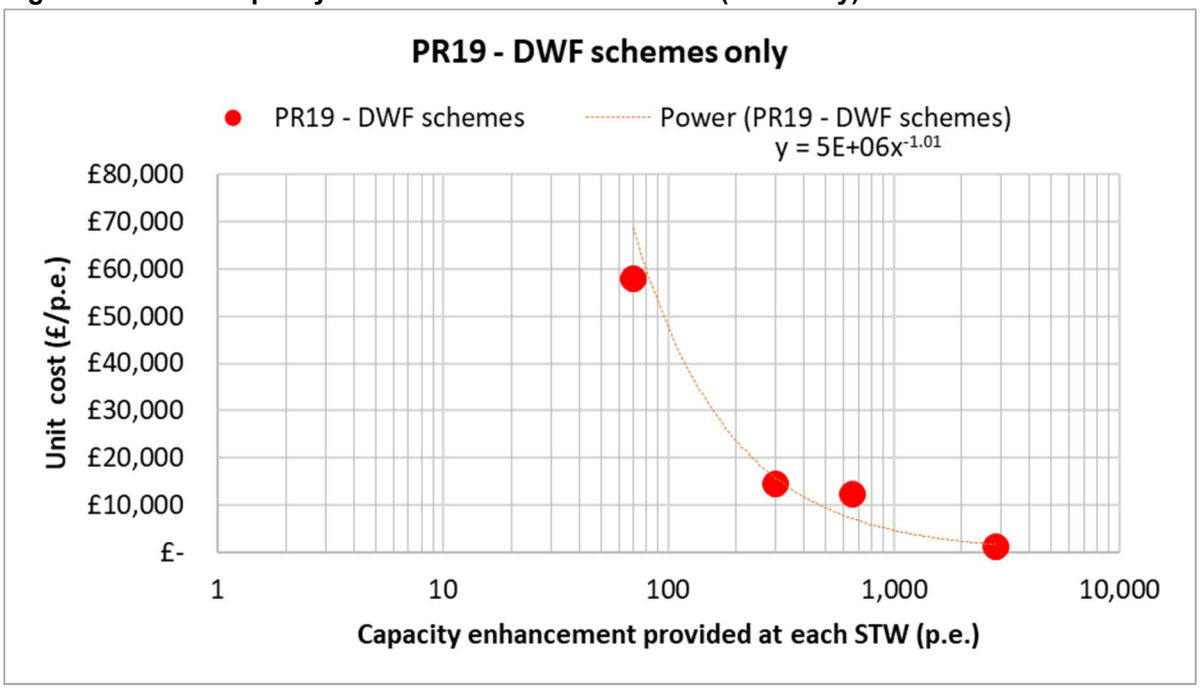
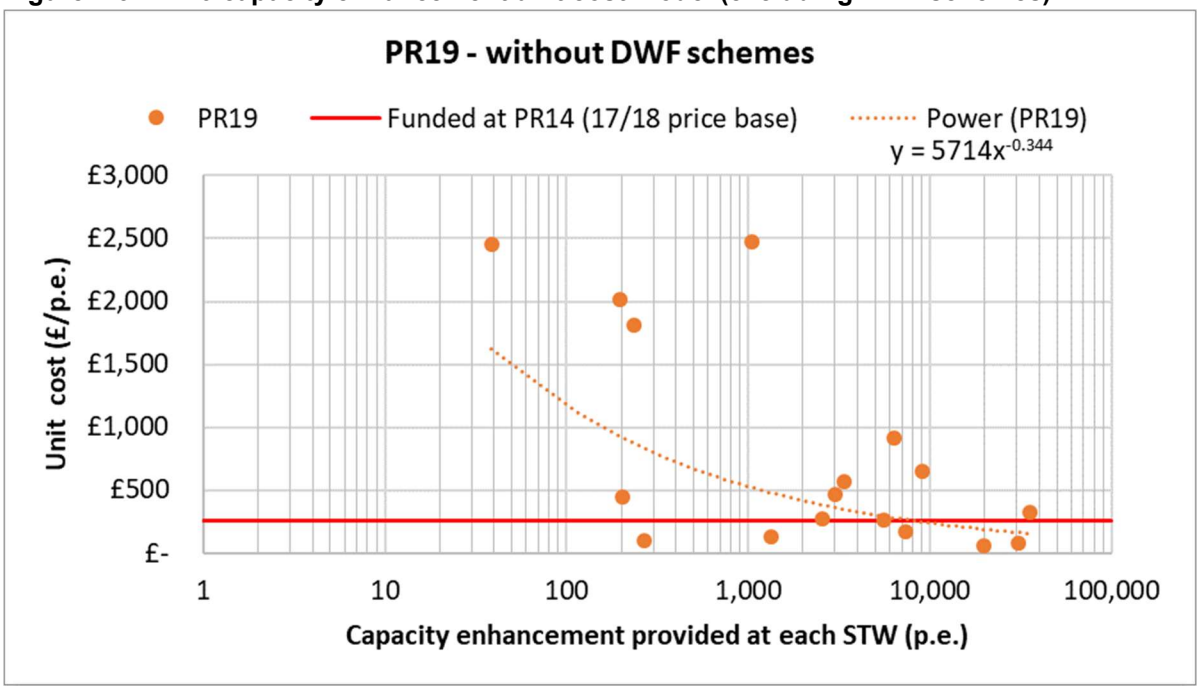


Figure 4-3: PR19 capacity enhancement unit cost model (excluding DWF schemes)



Removing the four DWF schemes provides us with a unit cost curve for STW capacity enhancement only.

Equation 1:

$$\boldsymbol{Unit\ cost}\left(\frac{\pounds}{\boldsymbol{p.e.}}\right) = \mathbf{5714} \times (\boldsymbol{capacity\ enhancement, p.e.})^{-\mathbf{0.344}}$$

If Equation 1 is applied to the four DWF exceedance schemes, this substantially reduces the overall capex of our growth programme. This is demonstrated in the following table.

Table 4-2: DWF exceedance sites - capex and unit costs

Site	STW capacity	PR19 Capex	Capacity enhancement	Unit cost	Adjusted unit cost (Equation 1)	Adjusted Capex
	(p.e. @2018)	(£m)	(p.e.)	(£/p.e.)	(£/p.e.)	(£m)
Burton STW	266	4.0	69	£57,981	£1,329	0.1
Compton Bassett STW*	3,684	3.4	2,827	£1,204	£371	1.1
Great Wishford STW	2,115	4.4	299	£14,587	£804	0.2
Hurdcott STW	3,487	8.0	652	£12,330	£615	0.4
Total		**19.8**				**1.8**

*scheme with combined quality driver (WINEP funded)
General note: the figures in this table have been rounded for simplicity.

- The difference between the actual capex of the DWF schemes (£19.8m) and the adjusted capex using Equation 1 (£1.8m) totals £18.0m.
- Hence the higher unit cost of the DWF schemes skews the overall programme for capacity enhancement by £18.0m.

In addition, for PR19 the capex of our schemes is weighted heavily to sites serving less than 10,000 p.e.

- These schemes account for 49% (£29.4m) of our total capex for STW capacity enhancement.
- In addition to accounting for almost half of our capacity enhancement programme, this weighting of schemes at small sites is 24% more significant than the previous two business plans (see section 3.4 for details).
- These small sites provide total capacity enhancement of 18,315 p.e. and thus have an overall unit cost of £620/p.e. compared to £245/p.e. for sites serving greater than 10,000 p.e.
- To avoid double counting, using the adjusted figures for the four DWF schemes (also small sites), the total capex of these small-site schemes is £11.4m.

4.2 Forming the plan to control costs

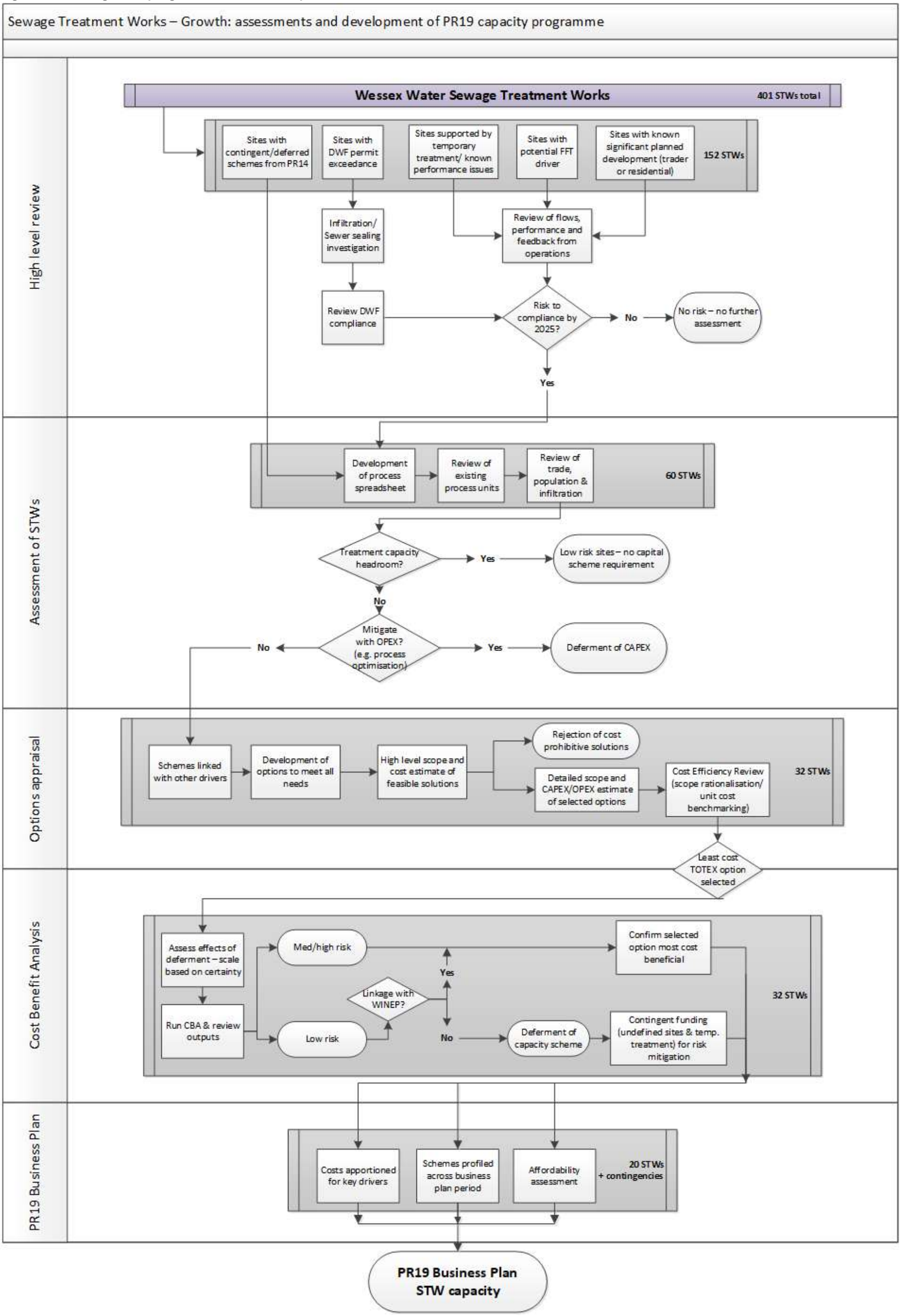
Wessex Water have used a systematic approach to assess and select STW sites requiring capacity enhancement investment in PR19. The process is summarised in Figure 4-4.

To minimise capital investment in capacity enhancement, the process was followed to discount any sites where the risk to compliance was not significant during 2020-25. Sites were also discounted where other measures could be employed whilst ensuring we meet our statutory obligations and customer expectations, such as:

- Operational optimisation (i.e. 'sweating the assets')
- Temporary treatment (where appropriate)
- Flow reduction at source (hydraulic)
- Abandonment of the site with flows pumped away to a nearby site/catchment
- Synergies with other drivers

The process followed is described in more detail in the successive subsections.

Figure 4-4: STW growth programme assessment process



4.2.1 High Level Review

The High Level Review phase was used as an initial screening to determine which sites may be at risk of compliance failure without investment. Sites were initially identified through several different methods including:

1. Sites with current or known future pressures on load and/or flow received at the works:
    a) Sites with catchments where housing or trader **development enquiries** have been made
    b) Sites with **temporary treatment** installed to support the process
    c) Sites identified by the EA as having a **low multiplier of FFT** (compared to DWF) and thus potentially requiring increase in overall hydraulic capacity. Whilst this is a quality driver, for efficiencies in investment, these sites were also assessed to determine if growth would lead to capacity enhancement investment within the next 10-15 years.
2. Sites listed as **contingent schemes** and/or deferred from PR14
3. Sites with **DWF permit exceedance** in current or previous 3-5 years

These reviews included:

- review of performance data and trends
- review of population forecasts and available headroom

If the sites passed this stage, i.e. were deemed there was a risk to compliance, they moved to the next stage of assessment.

Sites were discounted if they did not pose a risk to compliance, and thus did not undergo further assessment, as follows (corresponding to points above):

1. The sites with external pressures or likely flow increase (quality driver) underwent a more detailed assessment as a precursor to the second stage. These sites were only discounted where the site was deemed to have sufficient headroom for future demands or optimisation of operation had abated the previous issues.
2. **Contingent schemes** went straight to the second phase of assessment as the initial risk to compliance had previously been identified.
3. **DWF exceedance** sites first underwent an investigation to determine if the increase in DWF was due to increased infiltration in the sewer network. If this was the primary reason for flow increase, sewer sealing was either scheduled for completion during 2015-20 or included in the sewer maintenance programme for PR19.

4.2.2 Detailed Assessment of STWs

This stage involved a detailed assessment of each site using Wessex Water's standardised technical process spreadsheet, which uses JAR population data, measured catchment commercial and trade effluent flows and is calibrated with sampling and measurement data for each respective site. Population projections are also included using either ONS data (2014 base) or more detailed information from District Council local plans and development submissions where available.

This data is then used to assess the remaining capacity of each individual works, for each process unit, with respect to Wessex Water's design standards for load and flow.
Further detail for each of the sites included in the PR19 plan is available in the respective annexes of this document.

Sites were then discounted based on these assessments if the review found:

- there to be sufficient headroom within existing process units (i.e. likely requires operational optimisation to improve performance), or
- the projected overloading of the process unit(s) could be mitigated in the short-term with optimisation of existing processes, hence deferring capital investment until future Business Plan periods.

4.2.3 Options appraisal

Sites deemed to be at risk of failure by 2025 with current/future pressures on process units and compliance risk were then progressed to develop options for capacity enhancement to develop an understanding of costs.

Sites with multiple drivers (in addition to growth) had solutions developed to ensure all needs were met with a combined scheme, thus ensuring efficiency of delivery. Each site with growth as the primary driver has had two or more options developed, considering a mixture of alternative technologies and process configurations, whilst taking into account site restrictions and compatibility with existing process units.

Details of these options are presented in the respective site annexes.

The scheme options also underwent internal challenge reviews to ensure the scopes were efficient and were subjected to industry benchmarking reviews. The cost assurance process is detailed in section 7 of this document.

4.2.4 Cost Benefit Analysis

To ensure schemes were cost beneficial for investment during 2020-25, cost-benefit analyses (CBA) were undertaken.

To understand the impact of deferring the investments beyond 2025, sites were scaled by level of certainty (low, medium or high) with respect to permit failure at 2025. The level of certainty was assessed by a combination of the following:

- existing performance compared to permit (future expected permit limits for any quality enhancement sites),
- projected increase in growth until 2025,
- known site restrictions and
- sensitivity of receiving waters.

Sites were deemed as **Low**, if there was a high level of uncertainty over:

- the timing of the growth, and/or
- the impact of the increased load on treatment performance.

Sites were assessed as having a certainty of permit failure:

- **Medium** – if, with the existing treatment units, at least one numeric parameter is expected to fail by 2025 (other than SS; the EA have previously indicated that SS should not be a primary driver of capital investment).
- **High** - if, with the existing treatment units, more than one numeric parameter is expected to fail by 2025 and/or the permitted DWF exceeded.

Further detail of the CBA process are included in supporting document 3.3 of our Business Plan, with an overview available in section 6.2.2 of this document.

4.2.5 Synergies

Where possible, for sites where there are multiple needs and drivers (i.e. quality enhancement and capital maintenance) options have been developed for single projects which meet all the required outcomes. This provides efficiencies over meeting these needs with separate projects.

These schemes were then profiled to ensure any WINEP schemes can be met by their regulatory dates and incorporated into the overall company PR19 business plan to undergo affordability assessments.

5. Need for investment

In this section we set out the incremental improvement that the proposal will deliver; provide the evidence that the investment is required; and show how we have engaged with customers and our customer challenge group.

5.1 Investment Outcomes

In our business plan we are committing to deliver the best overall service amongst our peers on the things that matter most to customers:

- drinking water quality
- customer service
- supply resilience and interruptions
- internal sewer flooding
- environmental pollution
- leakage.

Our targets are all set at a level that will stretch us to improve our current performance and create a service that is better than the current best in the water industry.

The STW growth programme for PR19 will contribute to the following:

- **Outcome:** Environment
- **Performance commitment:** Treatment works compliance, with a committed performance level of 100% permit compliance.

Our plan is to achieve 100% permit compliance in every year of PR19, in line with Defra and the Environment Agency requirement in the Water Industry Strategic Environmental Requirements (WISER). This compliance target is a level which no company has ever consistently achieved before; sufficient expenditure to increase STW capacity in our region is integral to this commitment to deliver on the performance expectations set out in WISER.

More details of this performance commitment are outlined in section 8 of this document.

The investment in STW growth will provide additional treatment capacity of 138,714 p.e. It will enable development to proceed within our region unhindered by STW treatment capacity limitations.

It will also ensure we maintain permit compliance at our “at-risk” STWs on scheme completion and beyond 2025, contributing to our leading environmental performance and target for 100% permit compliance.

The investment programme allows for synergies and efficiencies with other drivers. The STW growth programme is outlined below in Table 5-1, with Figure 5-1 showing the spread of these sites across our region.

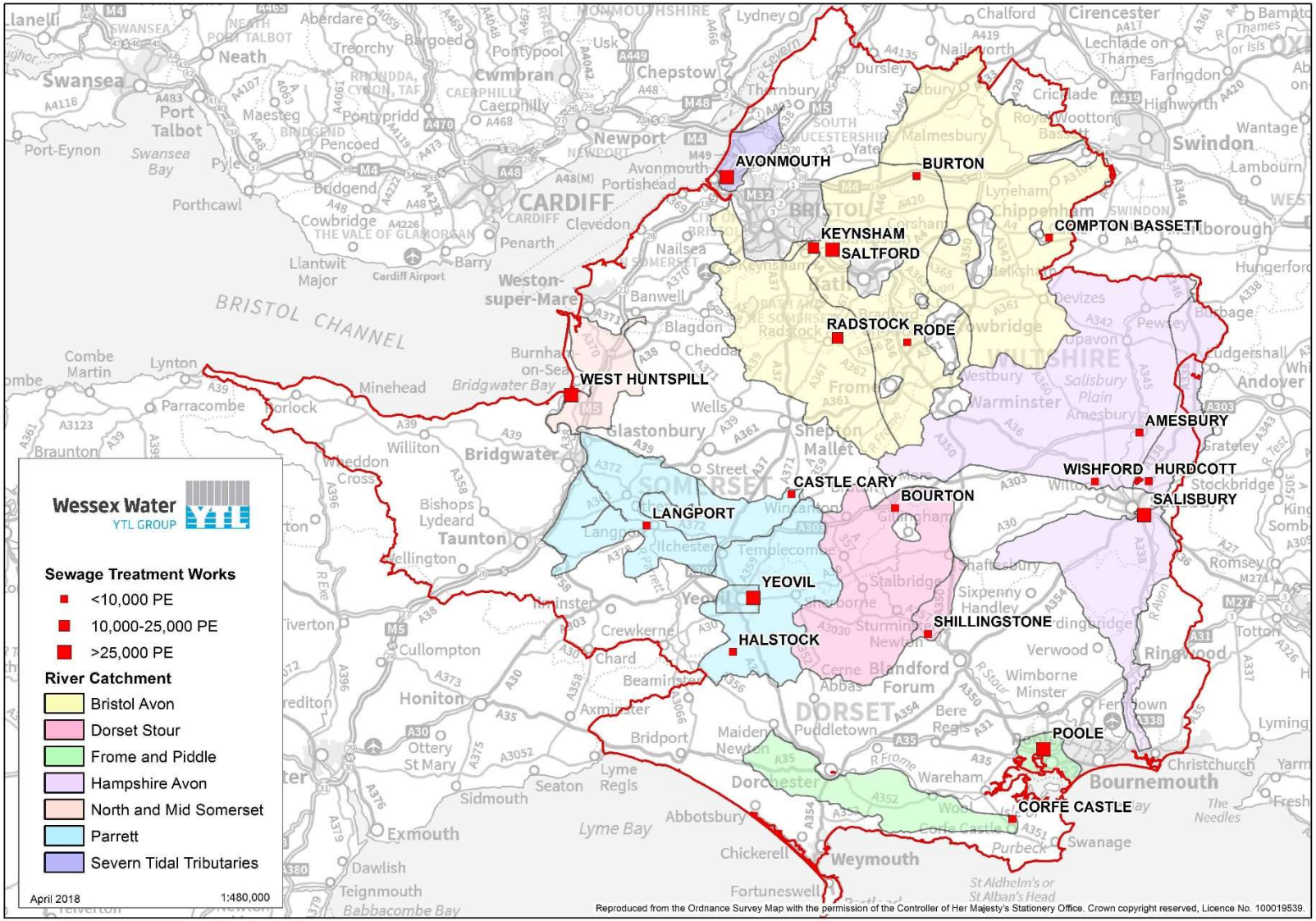
The Environment Agency have confirmed their support in principle for this programme of work (see Annex A).

Table 5-1: PR19 Growth Programme

Site details			Capex (£m)	Opex (£m/yr)	Purpose split		Capex (£m)		Opex (£m/yr)	
Site ID	Site name	Scheme drivers	Total	Total	Quality	Growth	Quality	Growth	Quality	Growth
13008	AMESBURY STW	Growth	1.9	0.1	-	100%	-	1.9	-	0.05
13013	AVONMOUTH STW	Increase FFT + growth	46.0	0.8	95%	5%	43.7	2.3	0.7	0.04
13027	BOURTON STW	Increase FFT + growth	1.8	0.03	95%	5%	1.7	0.1	0.03	0.002
13041	BURTON STW	DWF growth	4.0	0.04	-	100%	-	4.0	-	0.04
13048	CASTLE CARY STW	Increase FFT + quality (BOD)	1.7	0.02	90%	10%	1.6	0.2	0.02	0.002
13075	COMPTON BASSETT STW	DWF growth + quality (FFT)	6.8	0.1	50%	50%	3.4	3.4	0.05	0.05
13077	CORFE CASTLE STW	Quality (UV) + growth	4.3	0.2	90%	10%	3.8	0.4	0.1	0.02
13353	GREAT WISHFORD STW	DWF growth & FFT (no quality funding)	4.4	0.1	-	100%	-	4.4	-	0.1
13140	HALSTOCK STW	Increase FFT + growth	1.9	0.02	95%	5%	1.8	0.1	0.01	0.001
13158	HURDCOTT STW	DWF growth & FFT (no quality funding)	8.0	0.1	-	100%		8.0		0.1
13165	KEYNSHAM STW	Quality (AmmN) + growth	7.0	0.1	90%	10%	6.3	0.7	0.1	0.01
13175	LANGPORT STW	Quality (phosphorus) + growth	4.6	0.4	45%	55%	2.1	2.6	0.02	0.02
13242	POOLE STW	Growth	11.4	-0.1	-	100%	-	11.4	-	-0.1
13252	RADSTOCK STW	Quality (phosphorus & AmmN) + growth	7.1	0.2	80%	20%	5.7	1.4	0.2	0.04
13256	RODE STW	FFT + SCM + growth	2.6	0.02	30%	15%	0.8	0.4	0.005	0.002
13258	SALISBURY STW	Growth	5.9	0.4	-	100%	-	5.9	-	0.4
13016	SALTFORD STW	Increase FFT + growth	22.2	0.6	95%	5%	21.1	1.1	0.6	0.03
13271	SHILLINGSTONE STW	Increase FFT + growth	0.5	0.01	95%	5%	0.5	0.03	0.01	0.001
13336	WEST HUNTSPILL STW	Quality (UV) + growth	14.4	0.3	90%	10%	13.0	1.4	0.3	0.03
13366	YEOVIL PEN MILL STW	Quality (BOD+ AmmN) + growth	18.5	0.3	93%	7%	17.3	1.3	0.3	0.02
n/a	Temporary treatment	Growth	1.1	0.05	-	100%	-	1.1	-	0.05
n/a	DWF Exceedance	Growth	5.8	-	-	100%	-	5.8	-	
n/a	Non-Specific Growth	Growth	2.1	0.5	-	100%	-	2.1	-	0.1
							Total	**60.0**	**Annual**	**0.9***

*Annual opex is £0.9m/year. PR19 total opex = £1.1m

Figure 5-1: PR19 growth programme - STW locations

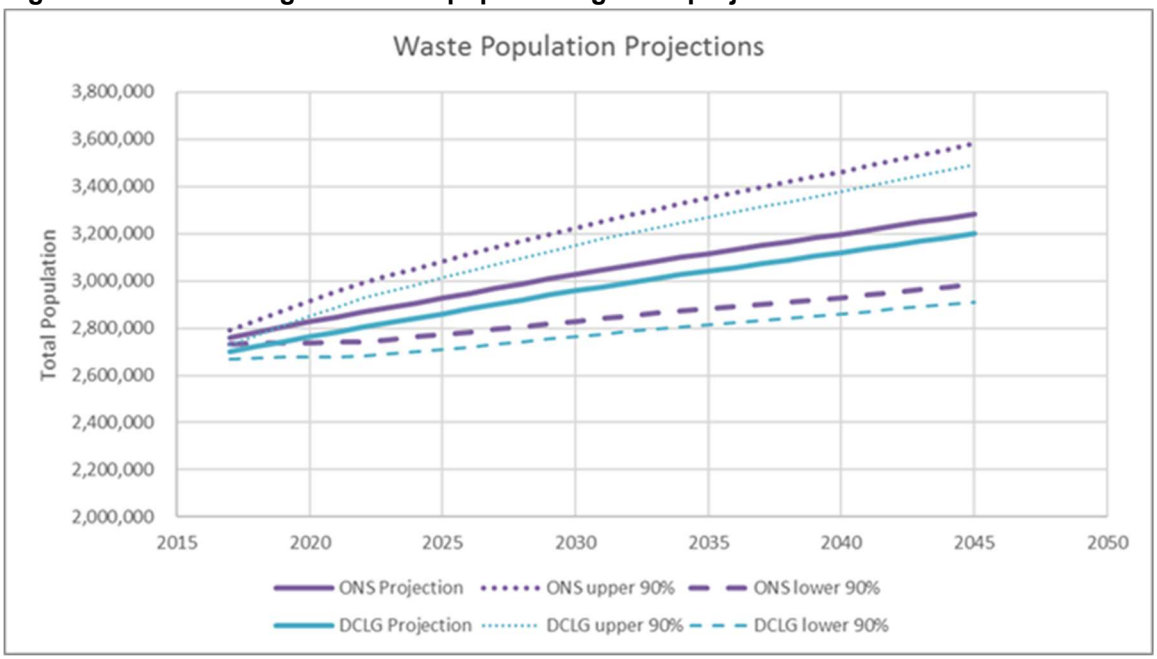


5.2 Providing capacity for our region

5.2.1 Regional population growth

Using data and uncertainties provided by the Office of National Statistics (ONS) the regional population growth within the Wessex Water region is forecast to be 101k ±67k for the period 2020-25, as shown in Figure 5-2. This graph also shows Department for Communities and Local Government (DCLG) projections; no variations for Brexit have been considered.

Figure 5-2: Wessex regional waste population growth projection



Our PR19 STW growth programme will provide greater capacity enhancement than our regional growth to ensure we provide the most efficient long-term solutions for our customers through synergies.

- Regional population growth (waste customers) = 100,914
- Capacity enhancement with PR19 programme = 138,714 p.e.

5.2.2 Synergies with FFT drivers

A large proportion of the additional capacity enhancement in our business plan is due to the synergies with schemes required under the U_IMP5 driver for the WINEP, 'Increasing Flow to Full Treatment (FFT) at WwTW with Low Permitted Dry Weather Flow (DWF) Ratios'.

The EA have stated, in relation to the U-IMP5 schemes that **"**Future risk due to growth should be picked up by the Water Companies under growth or maintenance in their Capital Programme, not WINEP.**"** and also that **"**U_IMP5 *(and U_IMP6*) drivers only apply to increases required to FFT *(and storm tank capacity)* over and above those required and funded under growth."[6]

[6] Environment Agency (November 2017). PR19 further guidance for completing WINEP3 for flow drivers U_MON3, U_MON4, U_IMP5 and U_IMP6 DRAFT v0.10.
Environment Agency (December 2017). PR19 Driver Guidance: Increasing Flow to Full Treatment (FFT)- FINAL v3.

This means that investment to meet the new FFT at year 2025 will be costed under the quality enhancement driver, while the provision of capacity to a reasonable design horizon (i.e. 2040) will be allocated to capacity enhancement.

A summary of these growth schemes where FFT is the primary driver is provided in the following table:

Table 5-2: Combined growth and FFT schemes

Site ID	Site Name	Catchment	Capex (£m) Quality	Capex (£m) Growth	Capacity enhancement (p.e. provided)
13013	Avonmouth STW	Lower Severn Vale	43.7	2.3	30,729
13027	Bourton STW	Dorset Stour	1.7	0.09	204
13048	Castle Cary STW	Parrett	1.6	0.2	1,331
13140	Halstock STW	Parrett	1.8	0.1	39
13016	Saltford STW	Bristol Avon	21.1	1.1	19,937
13271	Shillingstone STW	Dorset Stour	0.5	0.03	268
	Total		**70.4**	**3.8**	**52,507**

5.2.3 Future-proofing Poole STW

Poole STW is a works where we need to invest in capacity enhancement prior to the site reaching its full treatment capacity to enable future expansion.

The site presently suffers from hydraulic capacity issues and restrictions with available area for expansion within the existing site. In order to facilitate a phased plan of investment to meet future needs whilst ensuring the lowest whole-life cost, investment in capacity enhancement is required in PR19.

Further details of this scheme are provided in Annex N; in summary:

- The £11m investment in PR19 will provide an additional 35,479 p.e. treatment capacity (approx. 20% of existing site flow)
- This will facilitate demolition of Western Works during PR24, thus reducing the site treatment capacity
- Rebuilding of Western Works will be undertaken during PR24 and PR29 to meet future growth needs

5.3 Trade effluent growth

Across the country, there has been a general decline in trade effluent discharges. This masks, however, that trade effluent discharges are often located in our smaller rural catchments and is disproportionate to the size of the receiving STW.

Within the Wessex Water region we have been made aware of increases to several specific trade effluent discharges, either through new consents or increasing existing consents (both flow and loads) that would overload receiving works and hence require improvements to

prevent deterioration in consent compliance. These sites include Castle Cary, Langport and West Huntspill, with further details in their respective annexes of this document.

5.4 Increase in base flows (DWF)

We monitor STW flow compliance monthly to identify works that are approaching or exceeding their permitted DWF. The permit condition states that DWF compliance is measured by the total daily volume that is exceeded by 90% (Q90) of the recorded measured total daily volume values in any period of 12 months[7]. Permit compliance is reviewed over a number of years to allow for varying weather conditions, groundwater levels, flow changes due to growth within the sewerage catchments and sewerage improvement works. Where the calculated Q90 flow exceeds that permitted, investigations are progressed to determine the reason behind the exceedance. Plans are then developed to either remove this exceedance or apply for a revised permit.

Wessex Water has already undertaken steps under our control to remove sites from the growth programme where we believe investment can be avoided.

We have an additional seven sites where we deem there is a risk that measures to reduce the DWF will not be sufficient and thus capacity enhancement will be required during 2020-25. We have only allowed for four out of these seven sites most at risk within our investment programme under the “DWF undefined” funding line (£5.8m). This funding line has been developed based on costs of enhancement at these three sites. This is detailed in Annex V: Further DWF schemes.

5.5 Customer support

Detail of our customer research are explained in supporting document 1.1 of our Business Plan, with summary information provided in section 6.1.

We have routinely seen environmental issues high on our customers list of priorities and although we have no direct customer engagement on discharge compliance it is a key driver of our ongoing environmental performance.

Discharge permit compliance measures progress against the EA expectation to achieve 100 per cent compliance for all licences and permits, and reduced impact on the water environment. The detail behind the measure is given in Environment Agency Environmental Performance Assessment (EPA) Methodology[8].

Customers’ willingness to pay preferences are not linear over changing service levels. Loss aversion is a well-documented phenomenon.

[7]Environment Agency (October 2012) EPR 7.01 (v3) – Water Discharge and Groundwater Activity Permits. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/298081/LIT_7356_4132bc.pdf

[8] Environment Agency (November 2017). Water & Sewerage Company Environmental Performance Assessment (EPA) Methodology (version 3),. https://www.ofwat.gov.uk/wp-content/uploads/2017/12/WatCoPerfEPAmethodology_v3-Nov-2017-Final.pdf

We have seen this coming through our willingness to pay research; where customers on average would want to see a bill reduction of over six times what they would be willing to pay for an equivalent increase in services. Refer to supporting document 1.1 for further detail.

For improvements to river water quality customers are willing to pay £0.02 per household (hh) and £0.071 (Non-hh) per year per mile improved. The research suggests that they would then expect a reduction in bill of c£0.14 per hh per year per mile to see a deterioration in service.

We have assessed customers' acceptability of protection of the environment by length of river improved.

Customers Willingness to Accept (WTA) a reduction in river water quality was used to capture the value customers place on maintaining current river status, which is valued at £177,676 per mile of avoided deterioration. The WTA figure was fed into our CBA to ensure we adequately reflect the value our customers place on our investment in STW capacity enhancement.

6. Best option for customers

In this section we demonstrate how we have selected the best option for customers, including how the proposal delivers outcomes that reflect customers' priorities, identified through customer engagement; and the assurance from our customer challenge group. We also describe the optioneering process that we have followed including consideration of alternative options, risk and impact on the environment.

6.1 Customer priorities

In 2016 we reviewed and developed our 25 year Strategic Direction Statement. Through this process we engaged regularly with customers and other stakeholders via focus groups, surveys and expert panel discussions. In addition, the most significant areas of focus for the future at a national level were being identified by regulatory bodies. The combination of these reviews and consultation resulted in the change to our future priorities with the following change particularly relevant to sewage treatment:

- For over ten years we have led the industry in catchment wide solutions to improving our environment. To reflect that all of these actions interact we have combined the Protect rivers, lakes and estuaries, Reduce carbon footprint and Improve bathing waters into a single Environment focused outcome.

To develop the PR19 Business Plan we have engaged with more than 140,000 customers and stakeholders through numerous different engagement techniques. A sub-group of the Wessex Water Partnership (WWP), our customer challenge group, have provided independent assurance for our customer research. Refer to supporting document 1.1 of our Business Plan for further detail.

We've used customer views and engagement to develop many of our bespoke performance commitments. We have used the values they place on increments to performance and on willingness to avoid deterioration to assess whether investments are cost-beneficial (refer to section 5.5).

Customer research identified that our customers place a high priority and value on environmental improvements to watercourses in our region, and to river quality in particular. We have therefore developed additional commitments that would allow us to go the extra mile to deliver additional environmental benefit where this is cost-beneficial.

Our full Business Plan submission provides further detail on our customer engagement and section 8 provides information on the bespoke performance committment relating to sewage treatment.

6.1.1 Record of STW Compliance

Increases in flows to sewage works can result in tightened permit levels to prevent deterioration of the environment. STW compliance is therefore an important indicator as to whether investment levels have been sufficient to meet the pressures of new development and urban creep.

We have consistently performed as industry leading amongst the Water and Sewerage Companies (WaSCs), with respect to environmental performance. This is evidenced by our:

- Discharge permit compliance
- Prosecution record
- Environmental pollution record

The summary of historical EPA performance below shows that we have been one of only three WaSCs that have consistently maintained either "good" or "leading" status since 2011, and we have achieved the highest number of years with a "leading" EPA.

Table 6-1: Summary of historical WaSC EPA performance

WaSC	2011	2012	2013	2014	2015	2016	2017	Key (Star Rating)[9]
Anglian	Good	Good	Good	Good	Good	Good	Good	Leading
Dwr Cymru	Poor	Good	Good	Good	Good	Good	Requires improvement	Good
Northumbrian	Requires improvement	Good	Good	Good	Good	Requires improvement	Requires improvement	Requires improvement
Severn Trent	Good	Good	Leading	Good	Leading	Good	Leading	Poor
South West	Poor	Requires improvement	Poor	Requires improvement	Poor	Requires improvement	Requires improvement	
Southern	Requires improvement	Requires improvement	Poor	Requires improvement	Good	Good	Good	
Thames	Good	Good	Requires improvement	Good	Good	Requires improvement	Good	
UU	Good	Good	Leading	Good	Leading	Leading	Leading	
Wessex	Leading	Leading	Good	Good	Leading	Leading	Leading	
Yorkshire	Requires improvement	Requires improvement	Good	Leading	Good	Good	Good	

6.1.1.1 Discharge permit compliance

The following table illustrates permit compliance by WaSC between 2008 and 2016, with data sourced from the annual Environmental Performance Assessments (EPA), Environment Agency (https://www.gov.uk/government/publications/water-and-sewerage-companies-in-england-environmental-performance-report).

[9] Environment Agency (November 2017). Water & Sewerage Company Environmental Performance Assessment (EPA) methodology, v3. https://www.ofwat.gov.uk/wp-content/uploads/2017/12/WatCoPerfEPAmethodology_v3-Nov-2017-Final.pdf

Table 6-2: WaSC discharge permit compliance (%)

WaSC	2011	2012	2013	2014	2015	2016	2017
Anglian	97.1	98.1	97.5	98.6	99.0	99.1	98.6
Northumbrian	99.4	100.0	98.1	99.4	99.4	97.8	96.0
Severn Trent	97.5	99.1	99.3	99.9	99.0	99.6	99.6
Southern	96.0	96.8	96.0	99.0	99.3	98.7	97.1
South West	90.1	97.1	92.5	96.1	95.8	98.1	98.2
Thames	99.7	99.1	95.7	98.9	99.1	97.9	99.5
United Utilities	98.6	99.2	98.6	98.3	97.2	97.4	98.8
Welsh	95.6	98.6	97.9	99.1	98.6	99.0	96.7
Wessex	**99.7**	**99.7**	**99.0**	**99.7**	**99.7**	**99.4**	**99.0**
Yorkshire	97.3	93.2	98.0	99.3	99.3	97.2	98.6
Sector average*	***97.2***	***98.3***	***97.4***	***98.9***	***98.2***	***98.6***	***98.7***

*Excludes Welsh Water

- In six out of the past seven years, Wessex Water have been ranked 1st or 2nd for discharge permit % compliance.
- Our permit compliance is consistently above the sector average.

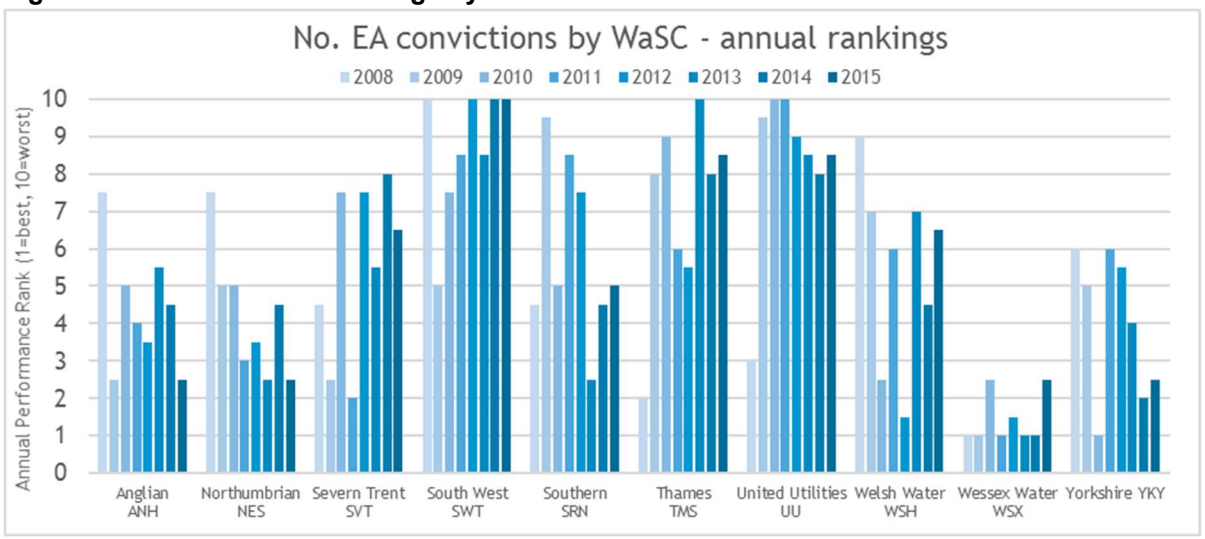
6.1.1.2 Environment Agency convictions

We have consistently performed better on environmental performance than the other WaSCs when comparing number of prosecutions per annum. Between 2008 and 2015, we had either none or only one recorded convictions from the Environment Agency (EA). This data has been sourced from via a Water UK legal network data share. Only four other WaSCs have had years with no EA convictions over this period. The full recorded convictions are outlined in the table below for all ten WaSCs (data only available to 2015) and summarised by performance ranking in the subsequent figure:

Table 6-3: EA convictions

WaSC	2008	2009	2010	2011	2012	2013	2014	2015
Anglian	6	1	3	3	1	3	2	**0**
Dwr Cymru	7	4	1	5	**0**	6	2	2
Northumbrian	6	2	3	2	1	1	2	**0**
Severn Trent	4	1	6	1	6	3	3	2
Southern	4	7	3	6	6	1	2	1
South West	9	2	6	6	42	10	13	8
Thames	2	5	9	5	5	18	3	3
United Utilities	3	7	16	25	13	10	3	3
Wessex	1	**0**	1	**0**	**0**	**0**	**0**	**0**
Yorkshire	5	2	**0**	5	5	2	1	**0**

Figure 6-1: Annual WaSC rankings by lowest EA convictions



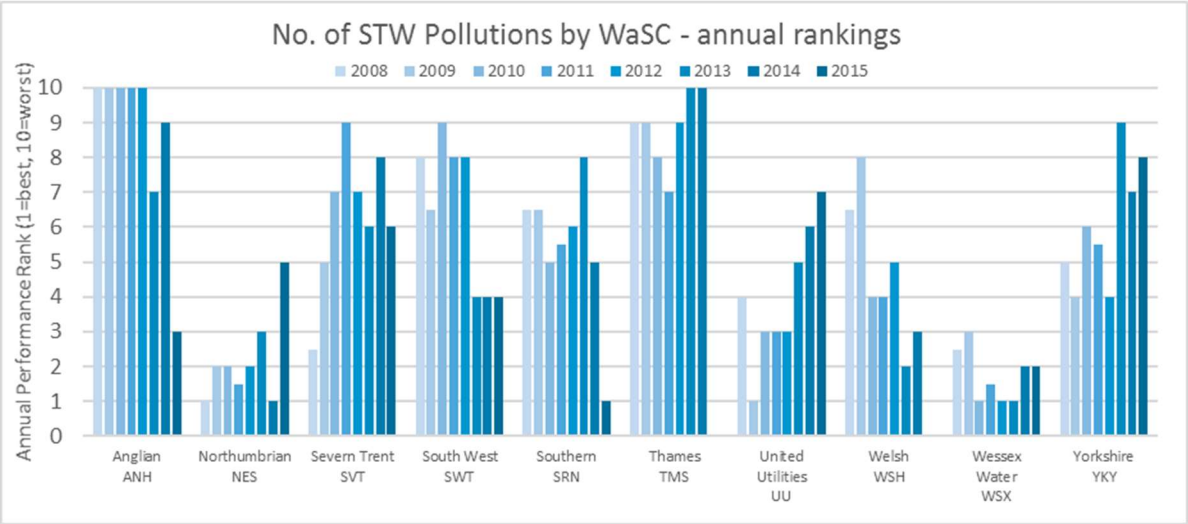
6.1.1.3 Pollutions from Sewage Treatment Works

We have historically maintained a low number of environmental pollutions from Sewage Treatment Works (STWs). This is summarised by the following table and illustrated by the following figure, which ranks WaSCs from 1 to 10 dependent on the number of STW category 1-3 pollutions by year. A ranking of 1 relates to the WaSC with the fewest pollutions and a ranking of 10 relates to the WaSC with the most. This information was gathered from the EA annual EPA reports with the exception of 2015, where data was sourced from the Water Industry Datashare (https://www.water.org.uk/publications/reports/industry-facts-and-figures-2016).

Table 6-4: WaSC category 1-3 pollutions

WaSC	2008	2009	2010	2011	2012	2013	2014	2015	2016
Anglian	108	144	178	220	222	106	132	38	108
Northumbrian	4	14	8	8	40	22	22	48	4
Severn Trent	14	34	114	168	84	94	90	50	14
Southern	42	48	70	72	82	118	58	28	42
South West	46	48	136	92	104	58	42	44	46
Thames	76	136	128	88	188	286	220	n/a	76
United Utilities	30	10	24	22	44	76	66	66	30
Welsh	42	54	68	58	50	20	32	n/a	42
Wessex	**14**	**18**	**4**	**8**	**14**	**18**	**24**	**30**	**14**
Yorkshire	32	24	90	72	46	126	86	144	32

Figure 6-2: Annual WaSC rankings by lowest pollutions



6.2 Approach to optioneering

6.2.1 Strategic planning, risk & the environment

The programme for STW growth has been developed from a risk management perspective. Once a need has been identified for a specific site, the process has been followed as per Section 4.2: Forming the plan to control costs. This process ensures the best solution for customers has been selected.

Timing, phasing and synergies with other drivers have all been considered throughout this process, with development of options to meet the needs of each site.

More detail for each of the individual sites and the respective options considered is provided in the annexes.

6.2.2 Cost-benefit analysis & risk

The risks associated with respect to compliance and impact on the environment have been considered in development of this plan. This has largely been undertaken using a detailed and complex cost-benefit-analysis (CBA) of all proposed schemes.

A detailed method statement and outputs is provided in supporting document 3.3. The CBA has assessed the internal costs (incurred costs) and benefits (avoided costs relative to the baseline) to Wessex Water alongside the wider external social and environmental changes resulting from the schemes.

Valuation data is a combination of internal costs assessments, customer research and benefit transfer. The CBA has been undertaken at a site and programme level.

6.2.2.1 Programme of investment

We plan to provide capacity to accommodate growth in a timely manner, without planning restrictions whilst ensuring we maintain service levels to meet our statuary obligations and to the level expected by our customers.

During the PR19 planning process a total of 32 STWs have been identified for possible intervention to provide capacity, each with varying levels of risk and certainty. As a result, a range of investment levels have been considered. Ensuring our STWs have the capacity and capability to treat sewage received to the permitted discharge levels is integral to our ability to achieve our performance commitment of 100% permit compliance. If we do not meet 100% permit compliance we are at risk of causing deterioration in the receiving environment, therefore the purpose of the assessments was to determine the most cost-effective programme of work, considering the various levels of risk to the environment.

Cost-benefit analysis (CBA) was undertaken for all schemes at risk of permit failure by 2025 and those where other drivers necessitated capacity enhancement for phasing and investment efficiencies. The levels of certainty of permit failure were outlined in in section 4.2.4.

Where treatment headroom is insufficient, sites without intervention and continued growth within the catchments will result in increased risk that the STWs will fail their environmental compliance and therefore result in a deterioration of the aquatic environment (reduction in biodiversity and potential fish kills) and recreational opportunities (fishing, aesthetics, odours/discolouration). These effects are listed in the Economic Valuation of Wastewater report published by the United Nations Environment Programme (UNEP, 2015). This would also result in regulatory compliance failures (i.e. fines) and failure of ODIs and Performance Commitments.

The 32 sites were subject to assessment at a site and programme level (5 scenarios in total). The key effect of the schemes is to provide capacity for growth which would therefore ensure continued environmental compliance and avoided deterioration of the environment. The sites assessed are a combination of:

- Category 1: There are 14 schemes where there is high certainty of growth within the catchment, which without intervention will affect STW compliance over PR19 and beyond. Within these sites a classification of Low, Medium and High has been applied to represent the expected risk of when compliance failures, and therefore the risk of environmental deterioration, will arise. This is based on current and expected performance.
- Category 2: There are 14 schemes linked to a PR19 WINEP quality scheme. At these sites an additional capital spend has been applied to the cost of the WINEP which provides the additional capacity for growth. Investing at the same time as the WINEP scheme provides significant cost savings. These sites are a combination of High, Medium and Low risk.
- Category 3: At present there are 19 sites subject to the PR14 sewer sealing programme which aims to reduce the Dry Weather Flow to avoid further capital investment. Current performance indicates that around four of these sites will not be successful and will therefore will require capital investment for the SDB.

Each site has been subject to CBA assessing how the costs and benefits vary between varying investment periods. The outcome indicates that some sites were identified as not

cost-beneficial. This is expected to result from difficulties in assessing the full social and environmental value of environmental protection. In addition, a number of the sites discharge into designated sites, such as SSSI and therefore the WTA data is likely to under value the full environmental significance of these site.

As maintaining environmental compliance is mandatory the key purpose of the CBA is to ensure the most cost-beneficial programme of work is undertaken in PR19. A total of five scenarios have been subject to CBA. These are presented below.

Scenario ID	Description
RLE_SDB_S1- Invest in all schemes in 2020-25	Invest in all 32 sites in PR19 which provides a high level of certainty that growth can be mitigated and avoided potential environmental effects on the environment.
RLE_SDB_S2- Invest in all High, Medium risk sites, phase low into 2025-30	Invest in High and Medium risk sites only as these sites are deemed most at risk of compliance failures. Low risk sites are phased into PR24.
RLE_SDB_S3- Invest in all High, Phase Medium and Low into 2025-30	Invest in High risk sites only. Medium or Low risk sites are phased into PR24.
RLE_SDB_S4- Delay all until 2025-30	Delay all sites until PR24.
RLE_SDB_S5- Mixed Approach	Scenario aims to capture the benefits of investing at the same time as the Quality Schemes in High, Medium and Low risk sites which will bring significant cost savings. The scenario then invests in other High or Medium risk sites, where low risk sites are deferred until PR24.

A number of the schemes have a very high benefit-to-cost ratio (BCR) which reflects the cost saving of investing at the same time as quality schemes and therefore the environment protection is achieved at a significantly lower cost. In summary, the CBA findings were as follows:

- S1 (invest all in PR19) provides a high level of certainty regarding environmental compliance, however there is a significant risk that the Low Risk sites are overinvested. The low risk sites are predominately small STWs, therefore due to the small size of the STW and the expected Low Risk the environmental compliance issues these sites could be mitigated via temporary treatment in the short term (S2). This would therefore allow these sites to be deferred to PR24.
- Deferring High and Medium sites (S3 and S4), is not deemed acceptable due the risk posed to the environment. Due to the size of these STWs and the number of sites, temporary treatment is not considered viable as a mechanism to ensure compliance. This risk is reflected in the BCR which is lower for S1 and S2. In addition deferring these sites into PR24 would result in affordability issues due to the number of sites where investment may be required in the next planning period.
- S5 (mixed approach) maximises the cost-efficiency of investing at the same time as quality schemes in High, Medium and Low risk sites. Investment in other High or Medium sites avoids a significant risk of environmental investment and as per S1 the

risk of low sites (not linked with a quality scheme) is considered mitigatable via temporary treatment. This scenario has the highest BCR and overall provides the best value for customers (maximising cost savings) and ensuring environmental compliance.

Our final STW growth programme has used the outcome of the CBA under S5 to ensure we will deliver the most beneficial programme which is the best value for customers, i.e. investing in capacity enhancement at high and medium risk sites during 2020-25 and also at sites with low risk but that have combined schemes with quality driver(s).

6.3 Plan for PR19 and beyond (best value)

Where an increase in load in the catchment (either due to household development or trade effluent loads) has resulted in an over-loading of the biological treatment capacity, putting at risk compliance with sanitary parameters such as BOD and Ammoniacal Nitrogen, additional biological process units are required to provide additional treatment capacity. Details of these schemes are outlined within the respective annexes of this document.

For schemes where we have deferred investment to 2025-30, and/or as part of the strategic plan for the site, phasing over 2020-30 (and beyond) is required, we have developed a strategic plan to cover this period.

This is shown in the following table, with the following colour-coding of the blocks:

SDB	Completed growth schemes
Infiltration Reduction	Completed sewer sealing schemes (to reduce infiltration and mitigate DWF schemes at STWs)
SDB/NEP	Completed mixed-purpose growth & quality schemes
SDB	PR19 growth schemes
SDB/WINEP	PR19 mixed-purpose growth & quality schemes
SDB	Potential PR19 growth schemes with very likely development but uncertain timing
Planned	Planned growth schemes

For completeness, the table also shows investment in previous periods. This shows DWF exceedance schemes where sewer sealing (comprising, investigations, sealing works and monitoring flows) has not been sufficiently effective at reducing DWF and thus improvements or a permit change at the STW themselves is now required.

Table 6-5: PR19 Capacity Enhancement Plan

Site ID	Site name	Population equivalent 2017/18[1]	PR19 growth driver	PR19 WINEP driver(s)	2010 to 2015 PR09	2015 to 2020 PR14	2020 to 2025 PR19	2025 to 2030 PR24	2030 to 2035 PR29
Large Works (Size Band 6)		**P.E. ≥ 25,000**							
13016	Bath (Saltford)	110,040	Development/Performance	FFT Increase		SDB/WINEP			
13013	Bristol (Avonmouth)	733,871	Development	FFT Increase			SDB/WINEP	Planned	
19156	Chard	30,274		P Removal		NEP			
13064	Chippenham	37,806							Planned
13066	Christchurch	55,208			SDB				
13096	Dorchester	30,379		P Removal					Planned
13131	Frome	31,716						Planned	
13152	Holdenhurst	157,850		P Removal		SDB			Planned
13171	Kingston Seymour	54,219							Planned
13172	Kinson	44,447		P Removal					Planned
13242	Poole	156,607	Development				SDB	Planned	
13243	Portbury Wharf	29,684							Planned
13258	Salisbury	57,510	Development/Performance				SDB		
13267	Shepton Mallet	30,718		P, AmmN & Zn Removal	SDB/NEP				
13305	Taunton	83,832		P Removal	DWF	NEP			
13318	Trowbridge	64,030		P Removal		SDB/NEP			
13336	West Huntspill	47,370	Development/Trade	Bathing Water			SDB/WINEP		
19155	Weston super Mare	95,980			SDB/NEP				
13342	Weymouth	79,232						Planned	
13366	Yeovil Pen Mill	53,852	Development	P, BOD & AmmN Removal	SDB/NEP		SDB/WINEP		

1 - As per PR19 Table WWn2 line 3

Site ID	Site name	Population equivalent 2018	PR19 growth driver	PR19 WINEP driver(s)	2010 to 2015 PR09	2015 to 2020 PR14	2020 to 2025 PR19	2025 to 2030 PR24
Select other Works		**P.E. < 25,000**						
13004	All Cannings	1,189	DWF Exceedance			Infilt Reduction/NEP	DWF	
13007	Alveston	2,255				SDB		
13008	Amesbury	9,402	MOD Development		SDB/NEP		SDB	
17143	Ashill	87	Development/Performance				SDB	
13017	Beckington	916						Planned
13022	Bishops Lydeard	2,051	Development/Performance				SDB	
13027	Bourton	1,626		FFT Increase			SDB/WINEP	
13032	Bradford on Tone	1,240			Infiltration Reduction			
19031	Buckland Newton	379	DWF Exceedance			Infiltration Reduction	DWF	
13041	Burton	254	Development				SDB	
13048	Castle Cary	3,653	Development/Trade		SDB/NEP		SDB/WINEP	
13050	Cerne Abbas	889			Infiltration Reduction			
13057	Cheddar	9,301		P Removal		NEP		
13058	Chew Stoke	7,367	Airport Growth				SDB	Planned
10306	Chilthorne Domer	27			SDB			
13075	Compton Bassett	2,906	Historical Growth & Development	FFT Increase			SDB/WINEP	
13077	Corfe Castle	1,621	Development	P Removal & UV Disinfection			SDB/WINEP	
13390	Corsley Heath	39	Development				SDB	
13088	Crowcombe	245			SDB			
13094	Ditcheat	734			Infiltration Reduction	Infiltration Reduction		
13128	Fordingbridge	9,341	Development & Holiday Camp Connection				SDB	Planned
13132	Gillingham	14,305		P & AmmN Removal		SDB/NEP		
13353	Great Wishford	2,042	DWF Exceedance			Infiltration Reduction	DWF	
13158	Halstock	302	Development	FFT Increase			SDB/WINEP	
13146	Hazelbury Bryan	824			SDB			
13157	Hullavington	1,104	Development				SDB	
13158	Hurdcott	2,042	DWF Exceedance			Infiltration Reduction	DWF	
13163	Iwerne Minster	1,286			DWF			
13165	Keynsham	18,466	Development	AmmN Removal			SDB/WINEP	
13175	Langport	9,507	Development/Trade	P Removal			SDB/WINEP	
13177	Lavington Woodbridge	3,922			Infiltration Reduction			
17968	Leyhill	1,261	Development			SDB	SDB	
13182	Longburton	412				Infiltration Reduction		
13187	Lydford	327						Planned
13192	Maiden Newton	1,552				SDB/NEP		
13202	Meare	1,261			DWF			
13204	Melksham	17,795			SDB/NEP			
10307	Melplash	9			SDB			

Site ID	Site name	Population equivalent 2018	PR19 growth driver	PR19 WINEP driver(s)	2010 to 2015 PR09	2015 to 2020 PR14	2020 to 2025 PR19	2025 to 2030 PR24
13215	Minehead	19,125						Planned
13211	Milborne Port	4,025				Infiltration Reduction		
13223	North Petherton	3,531			Infiltration Reduction			
13231	Over Stratton	286			Infiltration Reduction			
13237	Pewsey	7,439			Infiltration Reduction			
13515	Porlock	2,346				SDB		
13249	Puddletown	1,352			DWF			
13252	Radstock	24,323	Development	P & AmmN Removal			SDB/WINEP	
13522	RAF Lyneham	5,176				NEP		
13255	Ringwood	15,926	Development				SDB	Planned
13256	Rode	1,032	Development	FFT Increase			SDB/WINEP	
13360	Royal Wootton Bassett	13,802			SDB/NEP	SDB/NEP		
13266	Sharpness	4,437	Development/Trade/ Performance				SDB	
13268	Sherborne	11,747				SDB		
13271	Shillingstone	2,816	Development	FFT Increase			SDB/WINEP	
13280	South Perrott	1,397			Infiltration Reduction			
13297	Sturminster Newton	6,469				SDB/NEP		
13303	Sydling St Nicholas	354			Infiltration Reduction			
13304	Tarrant Crawford	17,918		P Removal	SDB			
13308	Thingley	17,248				SDB/NEP		
13309	Thornbury	13,807				SDB		
13310	Thornford	4,501			Infiltration Reduction	SDB/NEP		
13313	Tisbury	4,389			Infiltration Reduction			
13324	Wareham	11,420		N removal	SDB			
13330	Wellington	15,121	DWF Exceedance	P Removal		Infilt Reduction/NEP	DWF	
13338	Westbury	23,882				SDB/NEP		
13346	Wick St Lawrence	19,070						Planned
13358	Wookey	1,109	DWF Exceedance			Infiltration Reduction	DWF	

6.3.1 Unit costs in PR19

We have reviewed the average cost of increasing sewage treatment per population equivalent historically and compared this with the average cost per p.e. proposed for PR19. The information is presented in the following table:-

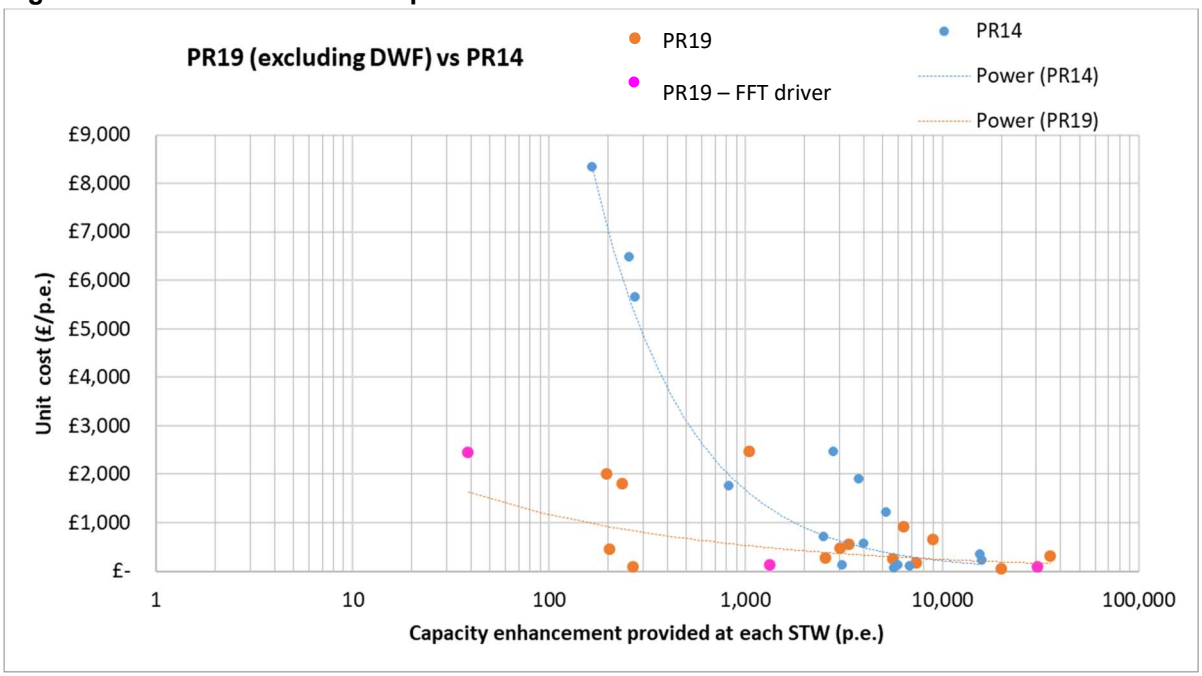
Table 6-6: Average cost of capacity schemes (at 2017/18 price base)

Aggregate cost per head (£/p.e)		PR14	PR19
All schemes		£591	£433
DWF exceedance (actual)		-	£5,153
Excluding DWF schemes	Schemes for sites <1,500 p.e.	£5,647	£2,083
	Schemes for sites 1,500 to 10,000 p.e.	£1,058	£484
	Schemes for sites >10,000 p.e.	£466	£245
All schemes (with DWF adjusted)		-	£302

Overall our growth programme for PR19 provides efficiencies over PR14. The efficiencies gained in PR19 are largely due to the synergies for schemes with a primary driver of increase in FFT, as shown by the pink markers in Figure 6-3.

When we adjust the PR19 unit cost of our DWF schemes, our overall unit cost of capacity enhancement normalises to £302/p.e. Adjusting for the skew towards smaller sites results in an even lower unit cost.

Figure 6-3: PR19 unit costs compared with PR14



7. Robust and efficient costs

In this section we provide the evidence to show that the cost estimates are robust and efficient; and, where appropriate, the third party assurance on the robustness of the cost estimates.

We describe our methodology for preparing costs estimates and the outcome of an external benchmarking exercise, which shows that the proposed costs are robust and efficient.

7.1 Methodology

Our overall approach to developing the investment programme is to identify the lowest whole life cost option for individual projects or programmes of work on a totex basis.

7.1.1 Capital cost estimates

Generally we categorise capital cost estimates into four types described in Table 7-1 below.

Table 7-1: Capital estimate types

Estimate type	Description
First principle	More detailed than cost curves, prepared by specialist estimators in our delivery team. Based on plant/labour/materials build up from proposed work items and quantities.
Cost curve	Based on cost equations derived from the costs of similar work from completed schemes, using known asset types and proposed work items and sizes. We use cost equations developed in-house and also from TR61 software.
Blocks	Based on past trends, capped amounts or where insufficient detail can be established for other methods. Often reactive or market driven work.
Unit rate	Based on a unit rate for specific discrete activities such as domestic meter installations that are combined with a forecast or known level of activity.

For the sewage treatment works capacity programme 77% of our capex estimates are first principle estimates, with the remainder estimated by cost curve for more standard items.

7.1.2 Operational cost estimates

Changes in operational cost arising from capital works are assessed as part of the estimating process. Experienced engineers assess changes in operational demands arising from proposed schemes such as energy use, chemical use and manpower. These values are then monetised. Minor changes arising from capital maintenance projects are excluded.

Other operational effects of investment such as impact on sludge transport or consent charges are also assessed where necessary. Business rates are not included at scheme level but considered within the overall totex plan.

7.1.3 Cost components

Cost estimates are typically divided into the components described in Table 7-2.

Table 7-2: Capital estimate cost components

Component	Description
Construction work items	Cost of plant, labour, materials and preliminaries such as site supervision and management. Plant and equipment is procured from framework agreements, which are tendered. Quotations are obtained from the market for specialist equipment.
Project management	Project management and main contractor overhead and profit. % additions based on the size and type of projects.
Design	Outline & detail design. % additions based on the size and type of projects.
Third party	Typically these cover land purchase, easements, compensation payments, specialist surveys and other utility costs.
Risk	Risk allowances are required to cover unforeseen events and scope development.

7.1.4 Estimating resources

Most of our programme, where adequate detail is available, uses first principle or unit rate estimates generated by our internal delivery team.

In all cases the estimating resources used for pricing the main construction works have extensive experience both with Wessex Water and as commercial estimators for contracting companies. In addition to their core estimating skills the team also have substantial technical and design skillsets which contribute to making sure that the scope of works is complete and buildable.

Additional estimating support was provided by our procurement team, who have day to day responsibility for procuring goods and services for us.

7.1.5 Project risk and uncertainty

Risk allowances are required to cover unforeseen scope development, ground conditions and other risks.

Typical risks to project costs, in addition to scope development, that may not be known during early development include changes in:

- Planning permission and conditions
- Environmental protection and improvement measures
- Land purchase costs, loss of business claims and other 3rd party compensation
- Extensive service / utility issues
- Major operational constraints
- Ground conditions.

The risk allowance required in the early stages of scope development is higher than when the project is implemented. We consider our scheme proposals are at around 5% design and that the risk allowances are appropriate and proportionate for business planning.

7.2 Independent benchmarking

We have employed independent specialist cost consultants to produce estimates for a representative sample of the investment proposals.

The cost consultants employed, as listed below, have extensive experience in the water sector and have worked with Welsh Water, Thames Water, South West Water and other water companies:

- ChandlerKBS
- AECOM
- Tuner & Townsend
- Mott MacDonald
- MACE.

We supplied the cost consultants with project briefs, appraisal reports, scopes of works, M&E schedules and civil quantities where available. In all cases the cost consultants were asked to provide independent estimates without sight of our cost values.

The project costs were estimated by the cost consultants using cost modelling, based on their extensive data bases of historic water industry cost models that include construction costs, design costs, project on-costs and risk. Cost models have been modified where appropriate to suit the level of design work completed.

Further detail of the benchmarking undertaken and comparisons are provided in supporting document 8.11 of our Business Plan.

8. Customer protection

In this section we set out how customers are protected if the investment is cancelled, delayed or reduced in scope; and how this is linked to outcomes and a suitable outcome delivery incentive in our business plan.

8.1 PC on STW Compliance

Following consultation with customers and stakeholders and development of our 25 year Strategic Plan, we are proposing eight outcomes across the five price controls for PR19.

These eight outcomes have 41 associated performance commitments (PCs). In addition we will continue to measure and report performance against other statutory and regulatory obligations such the EA's Environmental Performance Assessment (EPA). These will be included in management reporting and exceptions reported in our Annual Performance Report.

Customer valuations are also used in the setting of incentives. We have many types of research by which to assess a final customer valuation. Our criteria for assessing weightings of independent items of research includes:

- Quality of choice architecture / options provided
- Comparison to observed behaviour
- Completeness of results
- Statistical significance of results
- Cognitive validity of results.

We overlay qualitative research on the willingness to pay valuations and make transparent adjustments where evidence shows it is required – especially for informed stakeholders.

Providing STW capacity enhancement is essential to maintaining the high standards of our region's rivers. If this work is not undertaken then our industry leading STW numerical compliance will reduce; resulting in a deterioration of the region's rivers.

To protect customers against non-delivery we are proposing a performance commitment with financial incentives for failure.

This forms part of our **Protecting and enhancing the environment outcome**, with the associate **PC** of **Treatment Works Compliance**.

- **Detailed definition of performance measure:** Percentage of sewage treatments works and water treatment works that are compliant with their discharge permit as reported to the Environment Agency.
- **Proposed PC:** Discharge permit performance commitment = 100%.
- **Incentive type:** Underperformance payment only

We are proposing an underperformance dead band for this measure which will be set at the 'green' level currently used by the EA in the EPA assessment.

Discharge permit compliance measures progress against EA expectation to achieve 100 per cent compliance for all licences and permits, and reduced impact on the water environment. More detail of this PC is provided within supporting document 3.1.

Our historical performance for permit compliance is outlined in the table below, with the figures in green highlighting our best-ever performance:

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
% permit compliance	99.0	98.7	98.7	**99.7**	**99.7**	99.0	**99.7**	**99.7**	99.4	99.0

Our best ever performance is 99.7%; therefore our target of 100% permit compliance is stretching and our investment in STW capacity due to growth is critical to meeting treatment works compliance.

We have undertaken a risk based assessment of the likelihood that a site will fail if we do not invest. This analysis has informed our quantification of the benefits in the CBA case and are used to inform the incentive rate.

Each failing site reduces our numeric compliance by 0.33%. So, if we undertake no investment our performance would be expected to reduce by 4.5%. We have used this to inform the marginal cost on which to set the incentive rate refunding customers the full value over the price control if we do not deliver the investment.

As this PC has an associated underperformance payment only, failure to invest and thus failure to meet the PC will ensure our customers are protected.

9. Affordability

The programme of work described in this supporting document was included in our draft business plan that was tested with customers between January and June 2018.

The customer research is designed to test whether customers find the plan acceptable and affordable. The stimulus material covered our overall package of service improvements, statutory enhancements and bill impacts. We tested our plan with household customers, business customers, retailers, those in vulnerable circumstances and industry stakeholders. Results were triangulated across a variety of qualitative and quantitative methodologies to maximise the robustness of both the sample and conclusions.

Testing has shown that 96% of our customers find our business plan acceptable. Acceptability is above 80% across all demographic subgroups. Those in vulnerable circumstances were slightly less accepting of the plan than other groups, but still at a very high level.

A large majority of household customers (92%) consider our plans are affordable for them. Affordability amongst business customers was also very high at 96%. Vulnerable customers also found the plan acceptable and affordable, and were positive about the assistance that we provide to this group.

Full details of our acceptability testing can be found in supporting document 1.1 and details of how we address affordability and vulnerability are in included in supporting document 2.1.

10. Board assurance

The proposals have been subject to our board assurance process, which is described in detail in section 12 of the main business plan narrative and supporting documents 12.1 to 12.8.

Section 12 of the main business plan narrative includes the following statements that are relevant to this supporting document:

> The full Board confirms that, in our view, the proposals within the Business Plan are consistent with and should allow the company to deliver against its statutory obligations, now and up to 2025.
>
> We, the Board of Wessex Water, understand our accountability for this Business Plan. We are unequivocal in our assurance that the Plan is both high-quality and deliverable. We also confirm that it is consistent with our long-term vision for the company and our strategy.
>
> The Board assures that this plan is informed by customer engagement and the views of the Wessex Water Partnership (WWP), and that the performance commitments contained within it reflect customer priorities, are stretching and reporting is robust.
>
> The Board confirms that the expenditure projections contained within this Business Plan are robust and efficient, and that large investments are deliverable and best for customers.

Annex A. Environment Agency support

creating a better place
for people and wildlife

Environment Agency

Mr Julian Welbank
Head of Asset Strategy
Wessex Water Services Ltd
Claverton Down Road
Claverton Down
Bath
BA2 7WW
(Delivered by email)

Our ref: Wessex Water
Your ref:
Date: 23 April 2018

Dear Julian

Re: Cost Adjustment Claims - North Bristol Sewerage strategy and Wastewater treatment works capacity programme

As promised via email, here is our official line on the two cost adjustment claims you are proposing to submit to Ofwat, as named above.

Our primary focus in these situations is to ensure that the environment is not put at risk. If a cost-adjustment mechanism is the best way to manage this risk, in a way that also protects customers, then we can give in-principle support for proposals by water companies on a case by case basis. In these two situations, we can support (in principle) these cost adjust claims, with the caveat that both would need to meet Ofwat's materiality thresholds and evidence requirements. Our support does not provide any indication that the proposals would meet these criteria. When any company asks us for in-principle support for cost adjustment claims, we require them to provide assurance that the cost-adjustment is not a substitute for poor planning by the company and is a genuine area of uncertainty/difference. We have received this assurance from you separately.

Yours sincerely

Jeremy Bailey

Jeremy Bailey
Account Manager - River Basin Management Services (RBMS)
National Operations, Environment Agency

customer service line 03708 506 506
gov.uk/environment-agency

Annex B. Amesbury STW

1. Summary

Name	Amesbury STW
STW population served (2018/19 p.e)	9,905
Treatment capacity provided - PR19 enhancement (p.e)	3,346
Main driver	Growth
Subsidiary driver	-
Total Capex (£m)	1.888
Growth Capex (£m)	1.888

2. Need

The site was extended during 2010-15, however, because of uncertainty with respect to the visitor centre at Stonehenge a short design horizon was adopted (2020) as part of a strategic plan to develop the site in a phased manner. The extension of the visitor centre has taken place but has not resulted in significant additional flow to the STW, however, we have now been made aware of major development of Boscombe Down MOD site.

Boscombe Down already discharges to Amesbury with a current p.e. of around 1000 (circa 10% of the total p.e. served by the STW). The planned development will include for an increase in employment of around 10,000 employees, housing for 750 families of service personnel and a 120-bed hotel. If completed to the full extent the site would equate to around increase of 6,500 p.e.

Recent Ammonia trends show the STW is at the limit of the treatment capacity provided, as would be expected with the design horizon adopted for the last growth scheme.

3. Background

Site Details	
The site serves:	The STW serves the town of Amesbury and Boscombe Down Airbase. See plan in Appendix.
Treatment Process	
The STW works is a conventional biological filter works (primary settlement, secondary filters, humus settlement).	

4. Evidence

Growth and Investment (Historical)

Date	Project	Driver	Scheme
1998	D7526	Capital maintenance	New secondary filter to replace 3 older filters
2004	D1318	Quality	Phosphorus removal to <2mg/L
2009	D9234	Quality	Additional Phosphorus removal to < 1mg/L

Date	Project	Driver	Scheme
2013	D9546	Growth and Capital maintenance	New inlet works, 2 new primary tanks, two additional secondary filters.

The size of population in the catchment has developed as shown below:-

	2002	2006	2010	2015	2017
Resident p.e.	7089	8279	8423	9038	9144
Total p.e.	7739	9001	9138	9762	9820

Over the last 10 years residential population has risen by around 1% per annum.

Growth (Future)

The Local Plan[10] for Amesbury STW catchment area includes plans for future housing development as shown below. The associated increase in households is expected as follows:-

	2018-2020	2021-2025
New dwellings (Nº)	370	650
New residents (p.e.)	832	1,462

We have been provided with provisional figures for the Boscombe Down development as follows:-

Future Boscombe Phase	Approx. Dates	Employment Numbers (Total)	Residential (Total)
Existing situation	Current time	2,000	0
Phase 1	2021-2027	10,000	750 Service Family Accommodation (SFA) units; 500 Single Living Accommodation (SLA) units; 120 bed hotel
Phase 2	2025+	13,000	As Phase 1
Phase 3	2030+	15,000	As Phase 1

Phase 1 approximates to a p.e. increase of 6,500 p.e. (or around two thirds the current population served by the STW).

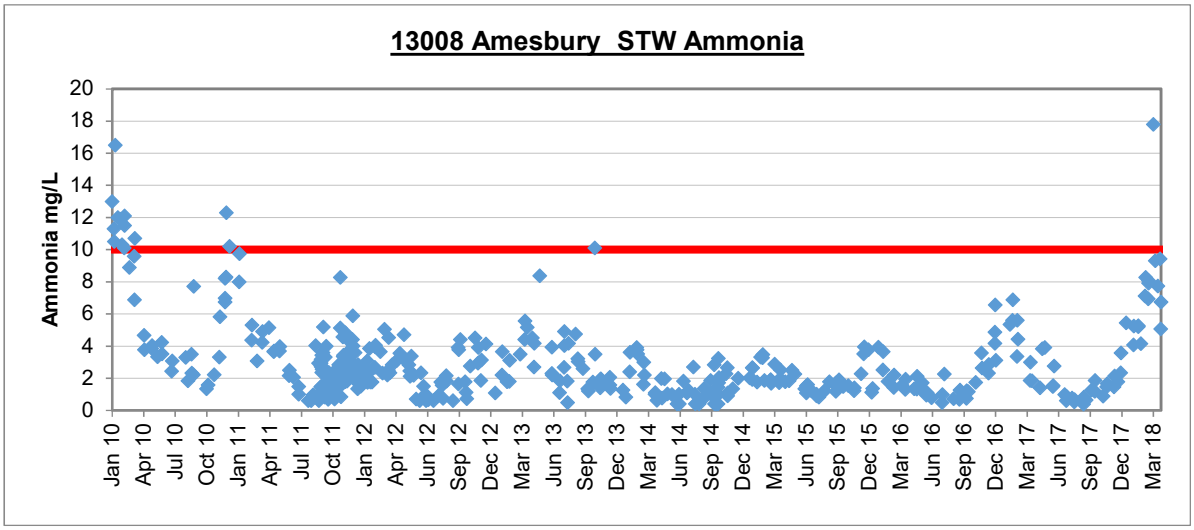
[10] Wiltshire Council (March 2018). Housing Land Supply Statement. http://www.wiltshire.gov.uk/spp-housing-land-supply-statement-2017-published-2018-march.pdf

The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035
Future p.e.	9,905	10,871	14,217	21,432	22,911

Performance

Performance of the STW since 2010 is demonstrated by the following graph:-



Scheme D9546 was delivered over the period 2011 to 2013, with new filters installed early in the programme. Performance has improved but has started to deteriorate as the design horizon of 2020 approaches.

Without the Boscombe Down development the AmmN loading rate on the filters would exceed design standard loading around 2020, BOD loadings on the filters would not be exceeded until around 2025. Also, given the current rate of development, DWF would be exceeded around 2025 which in turn would drive a consent tightening. Any tightening of the discharge consent would require either an additional process stream, probably an activated sludge plant, potentially with a tertiary stage for the existing filter streams.

The DWF exceedance will be advanced, depending on the rate of development of the Boscombe Down site.

5. Options

As described above a strategic development of the site was proposed when scheme D9546 progressed. The plan provided in Appendix 2 shows the proposed site layout to accommodate two new filters.

Proposals for further expansion in PR19 depend on the Boscombe Down development. Options are considered to be as follows:-

- Provide one new filter,
- Provide two new filters,
- Install a new activated sludge plant process stream,

The latter option will only be required as and when a consent tightening arising from DWF exceedance occurs. Since there is a level of uncertainty regarding the timing of the Boscombe Down development it would be premature to progress this option at this stage.

Land availability within the existing site boundary is limited. The provision of a filter in the NW corner of the site limits the land that would be available for a new ASP in the future. Installing a filter in the NE corner does not have this disadvantage. A single filter will provide capacity for growth from the town and the initial flow from Phase 1 of the Boscombe Down development.

We therefore plan to progress the next stage of the strategic plan for this site i.e. a single filter. Thereafter in PR24 our plans will need to accommodate this new development requirement and the strategy will most likely change to provision of a new ASP process stream rather than further secondary filters.

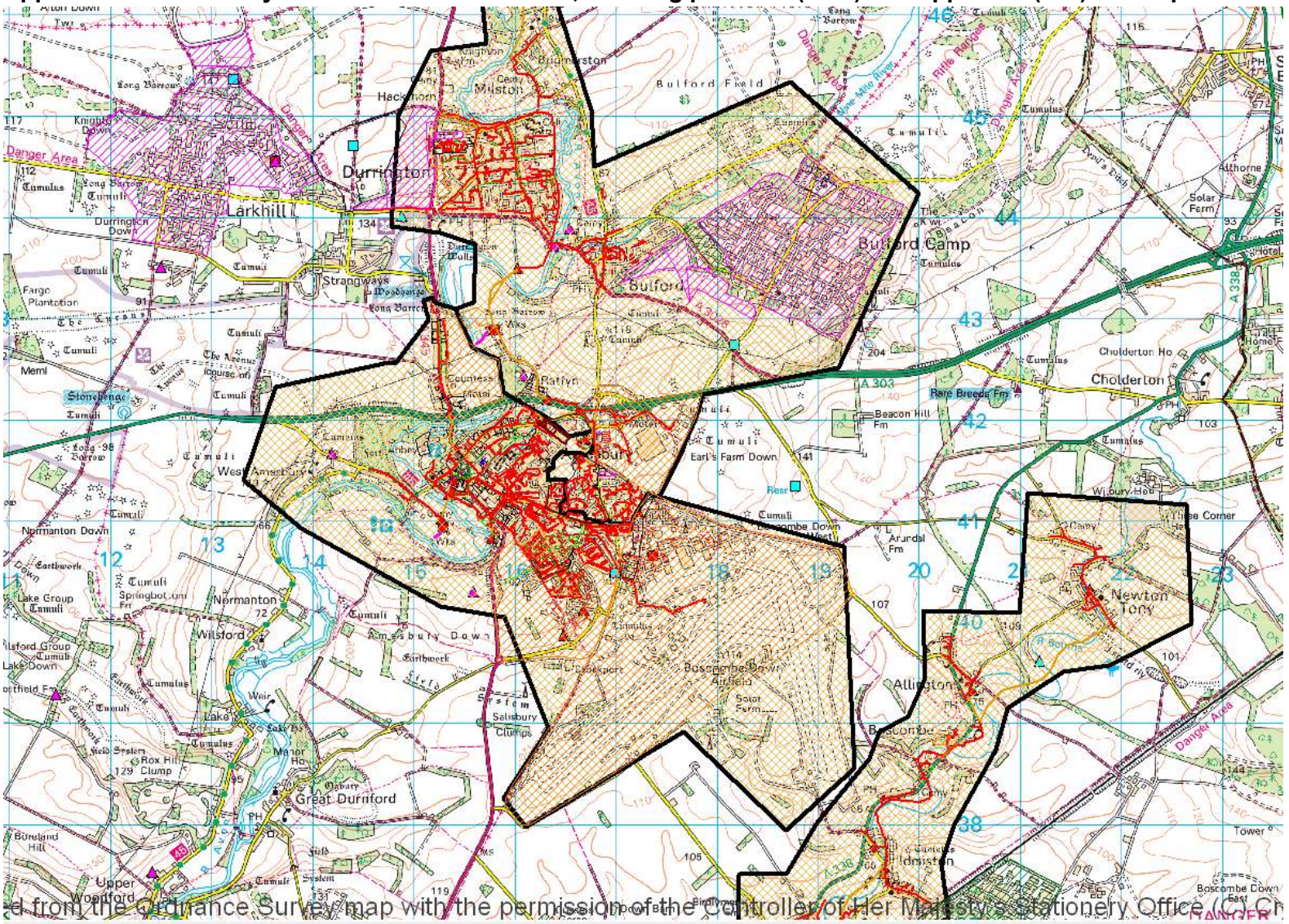
6. Proposed Solution

Install a 25m diameter secondary filter – Capex £1.888M.

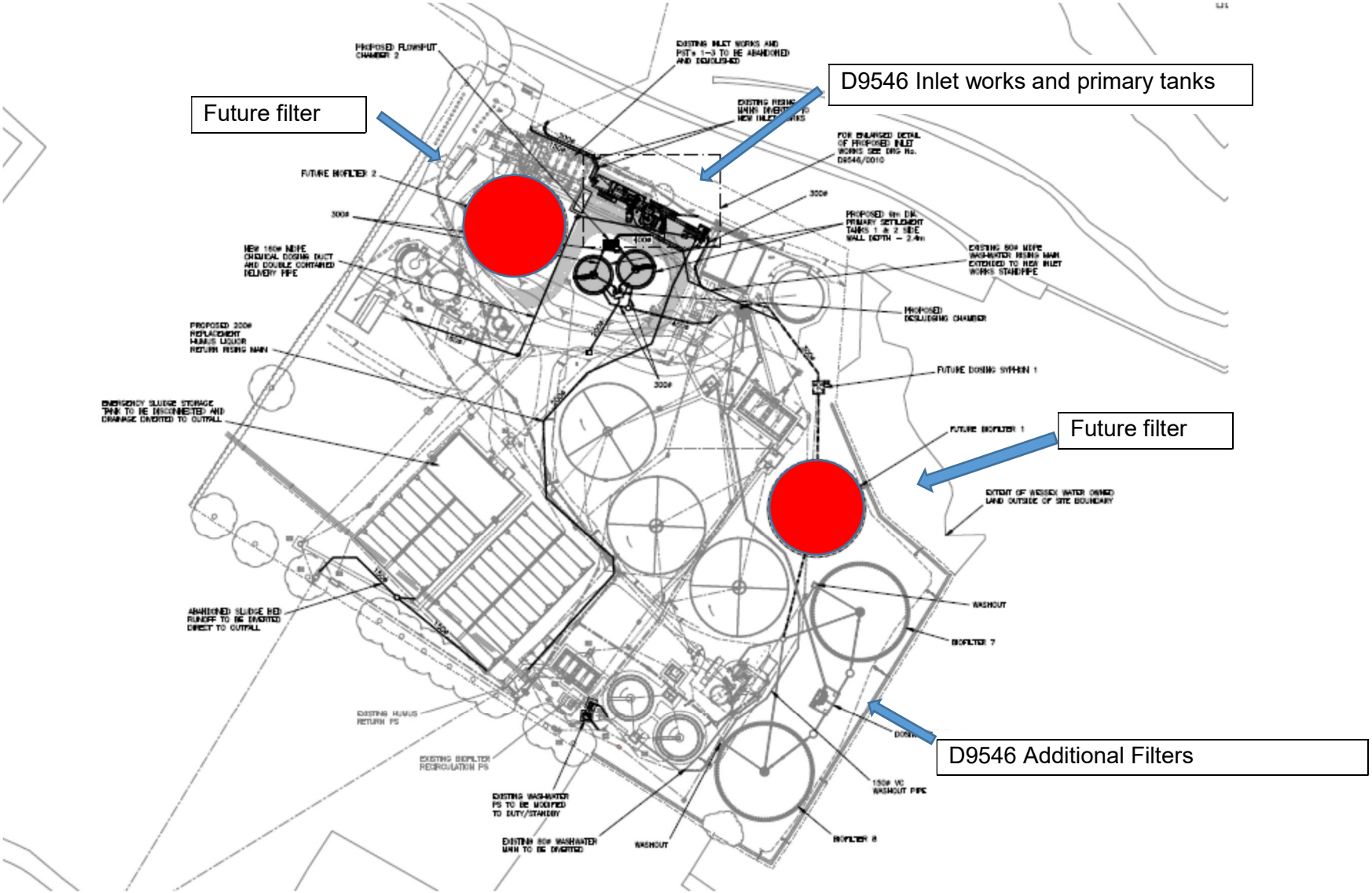
The costs have been apportioned between drivers as below :-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	100%	1.888	0.054
	Total	1.888	0.054

Appendix 1 – Amesbury STW – Plan of Catchment, showing potential (▨) and approved (▨) development areas



Appendix 2 – Plan showing proposed expansion of the STW



Annex C. Avonmouth STW

1. Executive Summary

Name	Avonmouth STW
STW population served (2018/19 p.e)	799,129
Treatment capacity provided - PR19 enhancement (p.e)	30,729
Main driver	FFT
Subsidiary driver	Growth
Total Capex (£m)	46.022
Growth Capex (£m)	2.301

Most of the sewage at Avonmouth STW, approximately 91%, is treated through 11 Sequencing Batch Reactor (SBR) basins. On a monthly average, the SBR plant is approaching its design loading, however during peak loads and due to the batched process, the receiving basins become heavily overloaded and performance deteriorates significantly. These peak loads generally occur when the daily diurnal peaks coincide with discharges from trucked organic waste to the site. In addition, the composition of organic waste received has changed during the current and previous price review periods, reducing settleability, and thus a higher COD load is being passed forward to the secondary SBR process.

Due to the existing consented low FFT:DWF multiplier, there is a WINEP driver to increase the FFT through the works in PR19.

2. Background

Site Details	
The site serves following:	Avonmouth STW serves the majority of the Bristol city area, receives a high trade load and also receives additional loads from the onsite Organic Waste facility and the Food Waste facility. The site also receives sludge imports from other STWs to treat in the APD and MAD facility, producing additional liquor loads in addition to the liquors from the indigenous sludge.
Site	
Avonmouth STW has a common inlet works and PSTs (6) which split the flow into two secondary treatment streams; one stream is conventional activated sludge with final settlement tanks, and the second stream is activated sludge in Sequencing Batch Reactors (SBRs, 11) which take 91% of the flow. The site is co-located with a Bioresources Treatment Centre.	

3. Need

To ensure that the site continues to maintain environmental permit compliance, additional hydraulic and treatment capacity will be required to accommodate both increased Flow to Full Treatment (FFT) and growth.

The WINEP(3) requires an increase in FFT passed through the treatment process, which will

result in a new permit at Avonmouth STW, as below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?	Old Permit (l/s)	New Permit (l/s)
7WW200045	U_IMP5	Increased FFT	31/03/2025	Green	3,472	4,700

Historical and future planned growth in both residential and trade flows and loads requires additional treatment capacity to ensure that the site continues to maintain environmental permit compliance, additional treatment capacity will be required to comply with the permit at the works. This increase in biological treatment capacity will not be required until the period 2025-29, however the increase in FFT capacity provided during 2020-2024 will simultaneously provide the required process capacity.

4. Evidence

Growth & Investment (historical)

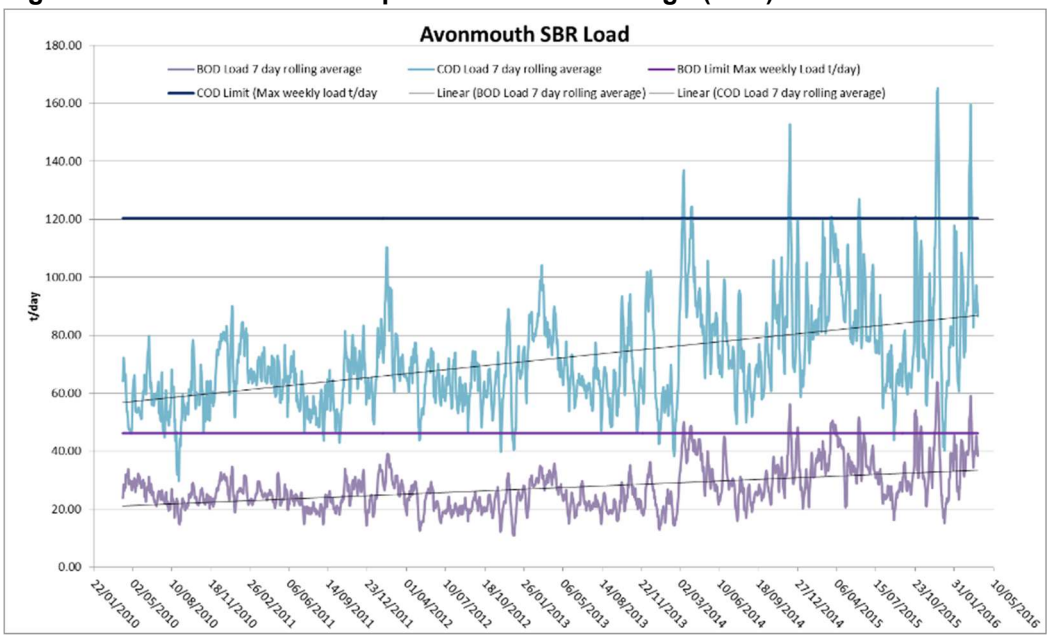
The size of population in the Avonmouth STW catchment has developed as shown below:-

	2002	2008	2010	2015	2017
Resident p.e.	573,360	602,901	601,734	612,048	665,166
Total p.e.	763,011	762,803	749,449	701,449	750,462

Residential population has risen on average by 1.1% per annum. Variabilities in the total p.e. are associated with seasonal variations in trade effluent loads. The last investment in capacity at Avonmouth STW occurred in 2003, with the addition of three SBR basins.

The baseline DWF for Avonmouth STW has been steadily increasing in the past 5 years. The pollution load (BOD/COD) on the SBR secondary process, which treats 91% of the flow, has concurrently been steadily increasing. This is demonstrated in Figure 10-1 below.

Figure 10-1: Avonmouth SBR pollution load vs. design (limit)



Growth (future)

There is significant development planned within the Avonmouth catchment, as shown in Appendix 1.

The Local Plans[11] for the Avonmouth STW catchment area includes plans for future housing development as shown below. The associated increase in households is expected as follows:-

Year	2018-2020	2021-2025
New dwellings (Nº)	11,242	10,895
New residents (p.e.)	25,294	24,513

In addition to domestic growth, commercial and trade growth will place additional load on the works.

The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	799,129	818,529	849,258	874,771	899,452	924,888

Due to the existing permit requirements being UWWTD for % removal and absolutes for COD and BOD, it is unlikely that these will be tightened further under an increase in DWF consent.

The existing permit FFT is a low multiplier of DWF (<3), and Wessex Water is therefore required to provide additional treatment capacity for a new FFT permit of 4,700 L/s as per the WINEP (for FFT to 2025).

The DWF will likely be exceeded during PR24, triggering a further increase in FFT and requiring further investment in hydraulic treatment capacity.

Table 10-1: DWF Projections

m^3/d	2016	2020	2025	2030	2040
Predicted DWF	164,347	170,614	178,786	187,353	205,744
Consented DWF	179,867	-	-	-	-

Performance

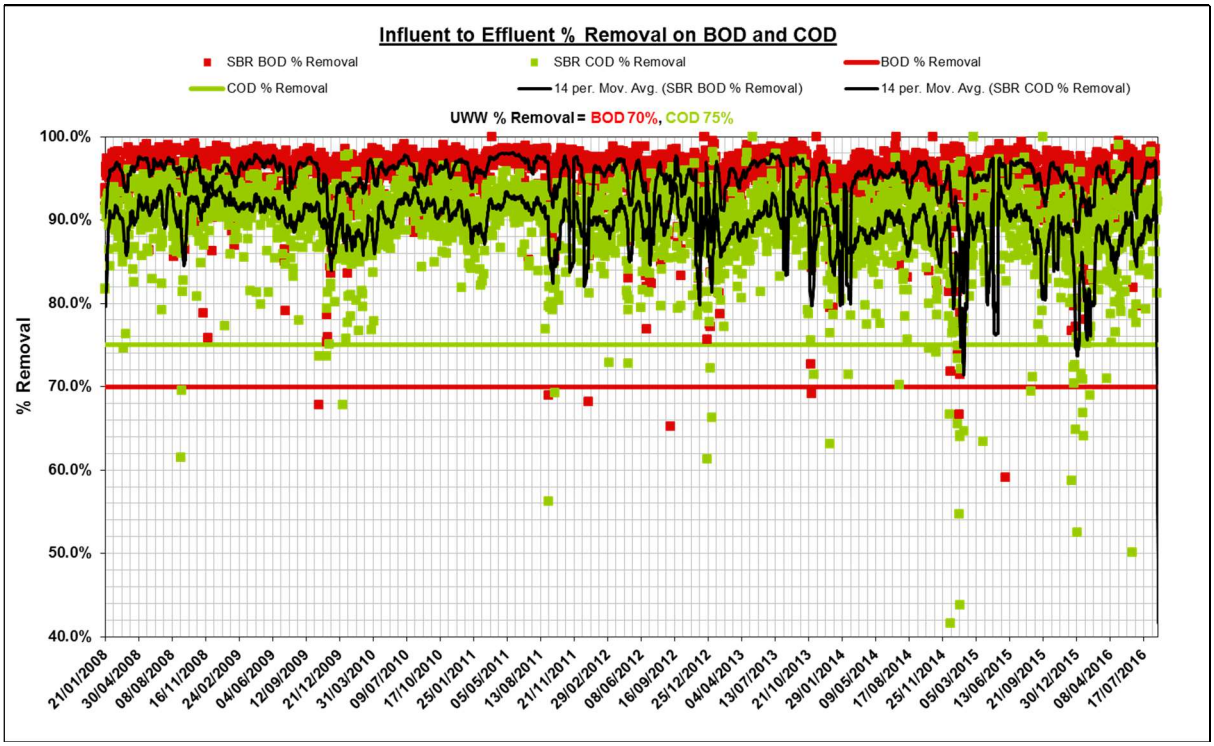
An analysis of the incoming loads to Avonmouth STW has shown that:

- the average design loadings for the SBR basins are frequently exceeded, with peaking factors or shock loading on individual basins impacting performance.
- a change in settlability of COD has further increased the load to the SBR basins, primarily due to trade waste discharges.

[11] Bristol City Council (March 2017) Bristol Local Plan - Bristol Monitoring Report,. South Gloucestershire Council (March 2017) Authority's Monitoring Report 2017. North Somerset Council (March 2017) Annual Monitoring Report 2017.

EA permit compliance is measured by COD and BOD performance (% removal and absolute); COD performance has noticeably deteriorated over the same period as the trends in increased loading, placing compliance at risk. This is illustrated in the SBR performance chart below.

Figure 10-2: Avonmouth STW - SBR basin BOD/COD removal



5. Long-term plan

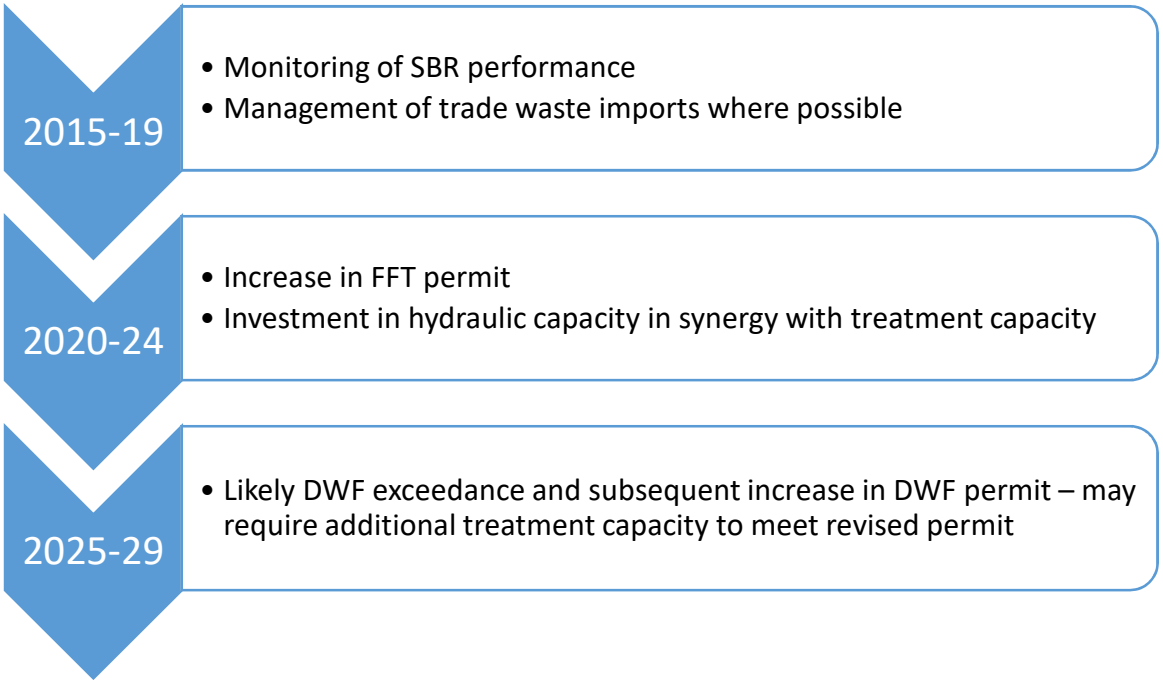
Whilst peak loadings are regularly exceeding design loadings for the SBR, the total daily incoming loads do not exceed design and are not expected to do so until 2040.

A solution is required to ensure performance does not deteriorate in the short term. Without improvements to treatment capability, the continued deterioration in performance means it is likely the works will fail its environmental permit conditions prior to 2025.

Due to the requirement under the WINEP, a significant increase in hydraulic capacity is required to pass 3PG+Imax+3E through the treatment process at the works. The hydraulic capacity enhancement will additionally provide treatment capacity enhancement up until 2025. Following this it is expected the permitted DWF will be exceeded before 2030, triggering a permit change.

We are anticipating the need for further investment in treatment capacity enhancement in PR24.

The following flow-chart summarises the long-term plan for Avonmouth STW.



6. Options

For the PR19 works, four options were considered, two for treatment capacity only and two solutions that provide both treatment and hydraulic capacity enhancement. In brief, these four options included the following:

- **Option 1** – Trade discharge balancing tank
  - New bunded storage tank, utilising existing discharge PS to receive waste
  - New return PS (to discharge waste similar to existing location in STW)
- **Option 2** – Single additional SBR
  - One new SBR basin and associated ancillaries, as per the design of the existing basins (to total two banks of 6 basins)
- **Option 3** – 4 additional SBRs
  - Four new PSTs, four new SBR basins and associated ancillaries, as per design of existing, located on Wessex Water land to the south of existing site boundary
- **Option 4** – Additional ASP stream
  - Four new PSTs, aeration lanes and FSTs located on Wessex Water land to the south of existing site boundary

Option	Treatment Capacity only		Treatment + Hydraulic Capacity	
	1	2	3	4
Provides treatment capacity to 2025	✓	✓	✓	✓
Provides hydraulic capacity to meet new FFT	X	X	✓	✓
Requires additional pumping	X	X	✓	✓

Option	Treatment Capacity only		Treatment + Hydraulic Capacity	
	1	2	3	4
Requires additional aeration power	X	✓	✓	✓
Best use of existing assets	✓	✓	✓	✓
Scheme Capex (£m)	3.223	10.483	46.022	80.839
Opex (£k/yr)	65	191	778	2,297
Lowest whole-life cost	✓	X	✓	X
Growth Capex (£m)	3.223	10.483	2.301	4.042

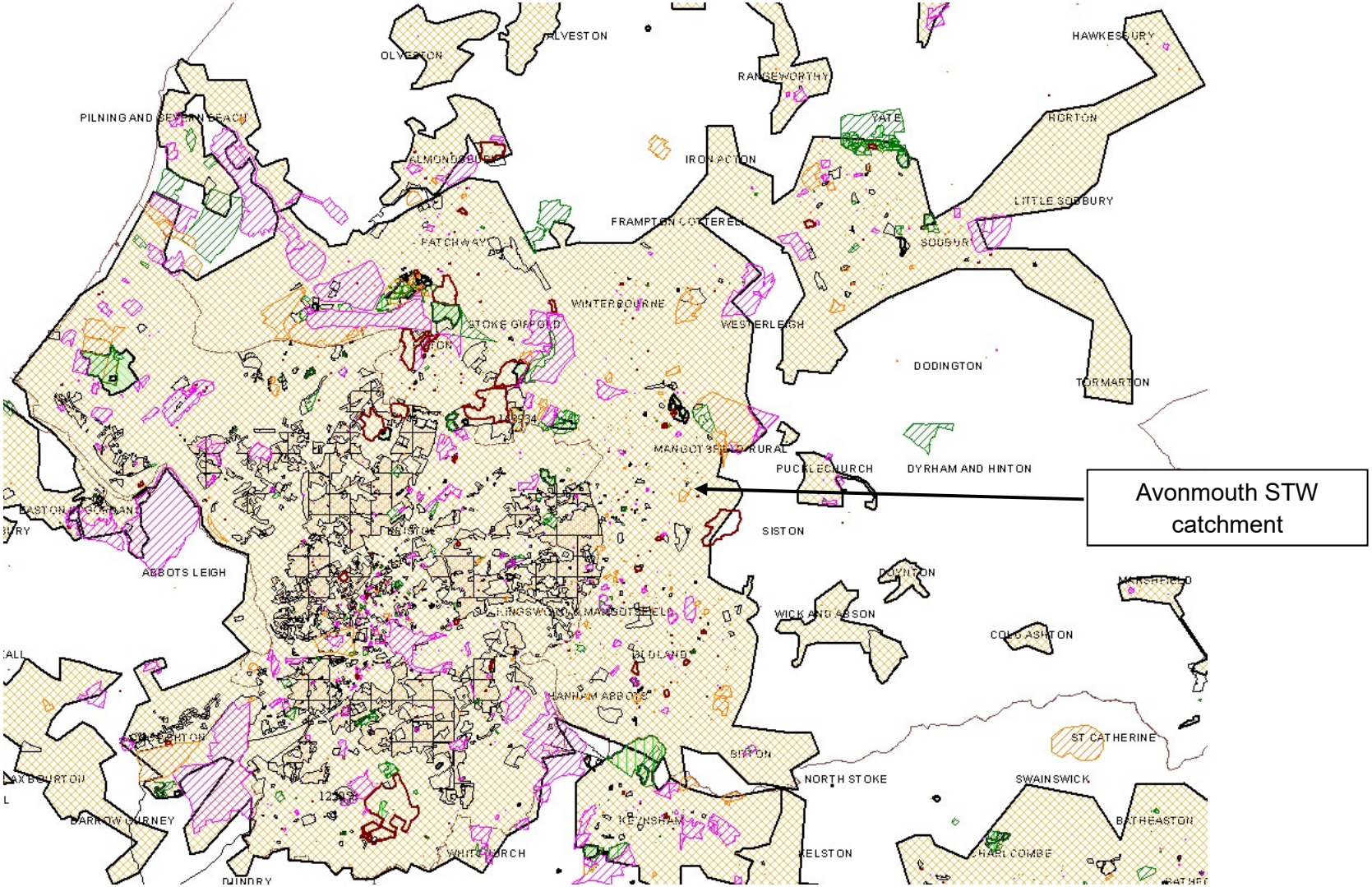
7. Proposed Solution

Option 3 is the preferred solution as:

- This option addresses the following:
  - the immediate risk to treatment performance,
  - the FFT driver as per the WINEP and
  - also allows for future treatment capacity.
- This provides synergies with the FFT driver and has the lowest whole life cost for the two options which address both drivers (3 & 4).

Appendix 1: Avonmouth STW catchment development

Plan of Catchment, showing potential ( ) and approved ( ) development areas
(Also showing adjacent STW catchments)



Annex D. Bourton STW

1. Summary

Name	Bourton STW
STW population served (2018/19 p.e)	1,921
Treatment capacity provided - PR19 enhancement (p.e)	204
Main driver	Quality (UWWTD)
Subsidiary driver	Growth
Total Capex (£m)	1.821
Growth Capex (£m)	0.091

2. Need

In December 2017 we were advised that the WINEP for PR19 would require an increase in flow to full treatment (FFT) at Bourton STW by about 66% (from 6.8 L/s to 11.3 L/s). This was confirmed in the WINEP(3) in March 2018, which included the increase in FFT described below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?	Old Permit (m^3/d)	New Permit (m^3/d)
7WW200096	U_IMP5	FFT	31/03/2023	Green	588	976

The 11.3 L/s figure represents the "3DWF" existing permit limit for 2025.

The EA have stated, in relation to the U-IMP5 projects that "Future risk due to growth should be picked up by the Water Companies under growth or maintenance in their Capital Programme, not WINEP" and also that "U_IMP5 (and U_IMP6) drivers only apply to increases required to FFT (and storm tank capacity) over and above those required and funded under growth." [12]
This means that investment to meet the new FFT at year 2025 will be costed under the quality enhancement driver, while the provision of capacity to a reasonable design horizon (i.e. 2040) will be allocated to Growth enhancement.

For this relatively small STW there is very little difference in the nature, scale and cost of works required to provide hydraulic capacity to a design horizon of 2040 rather than 2025.(i.e. 12.0 L/s rather than 11.3 L/s) Designing for the longer horizon is a longer term and more cost efficient investment strategy.

A project has been developed, taking account of these two drivers and synergies, to provide an efficient solution for the hydraulic capacity enhancement.

[12] Environment Agency (November 2017). PR19 further guidance for completing WINEP3 for flow drivers U_MON3, U_MON4, U_IMP5 and U_IMP6 DRAFT v0.10.
Environment Agency (December 2017). PR19 Driver Guidance: Increasing Flow to Full Treatment (FFT)- FINAL v3.

3. Background

Site Details	
The site serves following :	The village of Bourton and surrounding villages of Penselwood, Zeals and Stourton.
Treatment Process	
The STW is a conventional biological filter works with primary tanks, secondary filters (2) and humus settlement tanks. See plan in Appendix 2.	

4. Options

Hydraulic Capacity

The existing biological filters work well and provide an efficient, low energy and sustainable treatment process. They have some hydraulic design capacity headroom, but not sufficient to accommodate the flow increase required in the WINEP.

The primary tanks and humus tanks do have capacity to accept the proposed increase in flow.

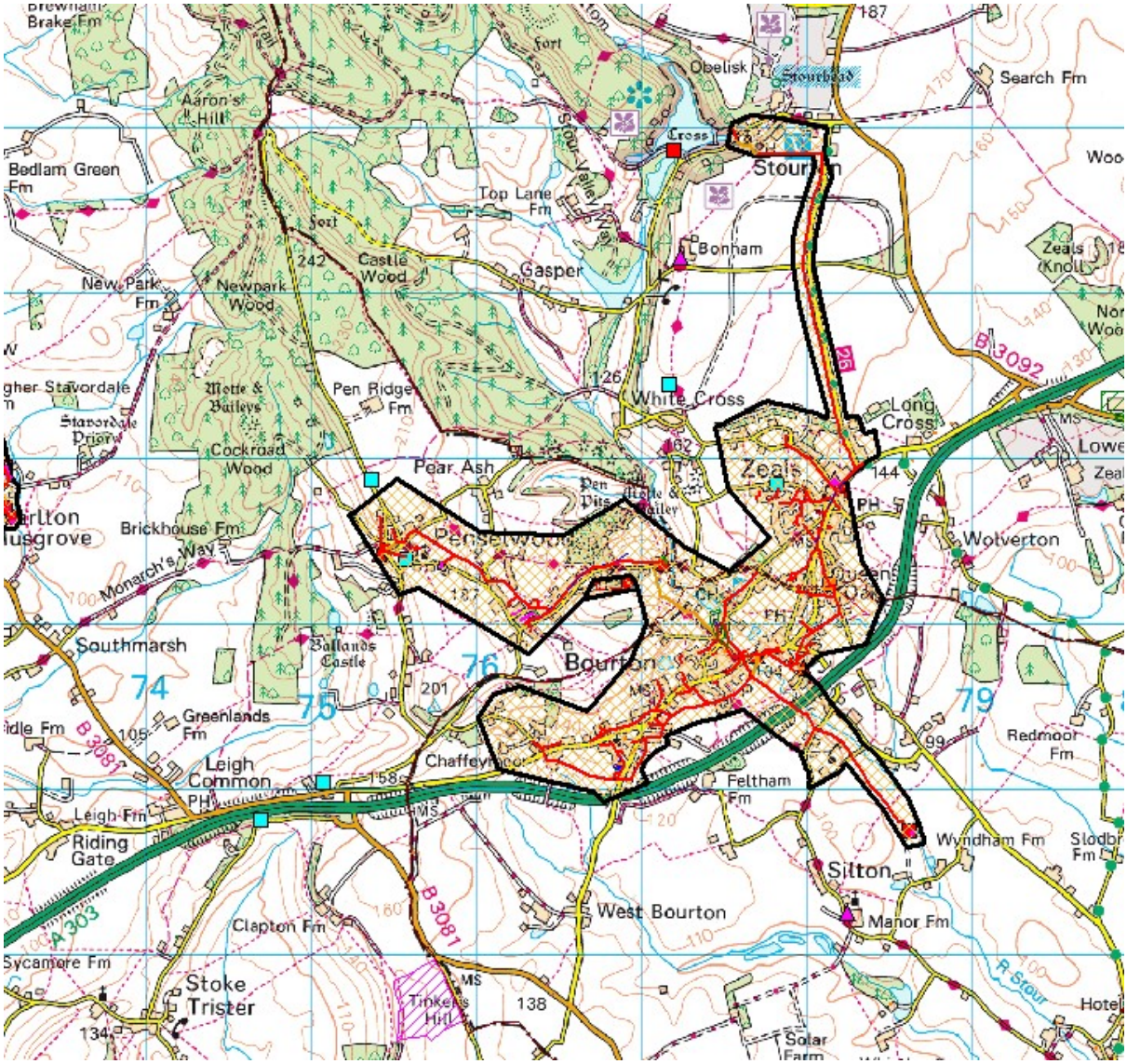
A single option proposal has therefore been made to provide increased capacity through the provision of one additional biological filter, together with a new feed pumping station. This continues to make beneficial use of the existing treatment plant assets.

5. Proposed Solution

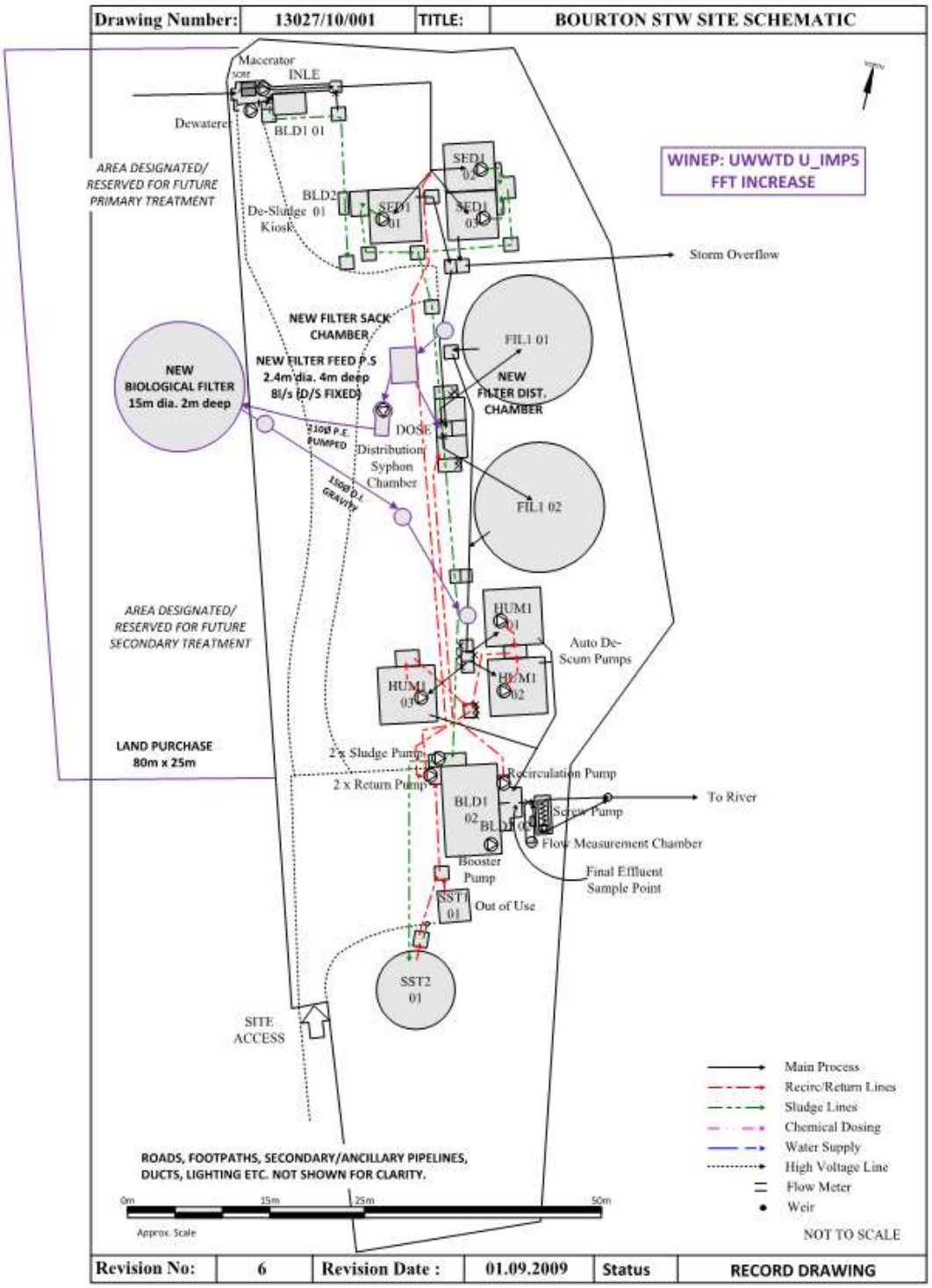
One additional biological filter and feed pumping station is proposed.

	Capex (£m)	Opex (£m/yr)
Total scheme	1.821	0.030
STW Growth (capacity)	0.091	0.002

Appendix 1 – Plan of Bourton STW catchment



Appendix 2 – Sketch of proposed solution at Bourton STW



Annex E. Burton STW

1. Summary

Name	Burton STW
STW population served (2018/19 p.e)	266
Treatment capacity provided - PR19 enhancement (p.e)	69
Main driver	Growth (DWF)
Subsidiary driver	N/A
Total Capex (£m)	4.024
Growth Capex (£m)	4.024

2. Need

Burton STW has marginally exceeded its DWF permit in each of the last three years. The associated sewerage catchment was investigated in 2017 to determine if this was due to infiltration. Infiltration was not shown to be a cause of the increased flow and thus no sewer sealing was conducted.

To ensure the works maintains environmental compliance, a new DWF permit will be required with associated pro-rata tightening of AmmN, BOD and SS parameters to ensure the existing load discharged to the receiving water does not increase (prevent-deterioration).

3. Background

Site Details	
The site serves the following :	The treatment works receives flows from the village of Burton, which is located to the north of Bath. All flows are pumped into the treatment works. The catchment lies entirely within the Cotswolds Area of Outstanding Natural Beauty (AONB).
Treatment Process	
The STW uses septic tanks followed by Rotating Biological Contactor (RBC) units. A single humus tank takes all flows prior to discharge to the adjacent stream. The site has also been supported by a temporary SAF unit since 1999, due to incoming load exceeding the capacity of the RBC units	

4. Evidence

Growth & Investment (Historical)

The size of population in the Burton STW catchment has developed as shown below:-

	2002	2008	2010	2015	2017
Resident p.e.	147	190	208	207	236
Total p.e.	147	200	218	226	256

Relative to the catchment size, the residential population in Burton has grown significantly in the last 15 years, increasing by 4% per annum (average) from 2002 to 2010. From 2015 to

2017 the residential population increased by 7% per annum.

The site has been supported with additional treatment capacity by the installation of a temporary SAF unit in 1999. The site is extremely limited with respect to available space and the SAF unit causes significant issues with maintenance access.
The RBC units were installed in 1989 and cannot accommodate additional media to treat the incoming load.

Growth (Future)
Burton STW is already exceeding its permitted DWF, with sewer investigations completed in 2017, concluding that infiltration within the catchment was minimal.

The future increase in households is expected as follows:-

	2018-2020	2021-2025
New dwellings (Nº)	3	5
New residents (p.e.)	7	11

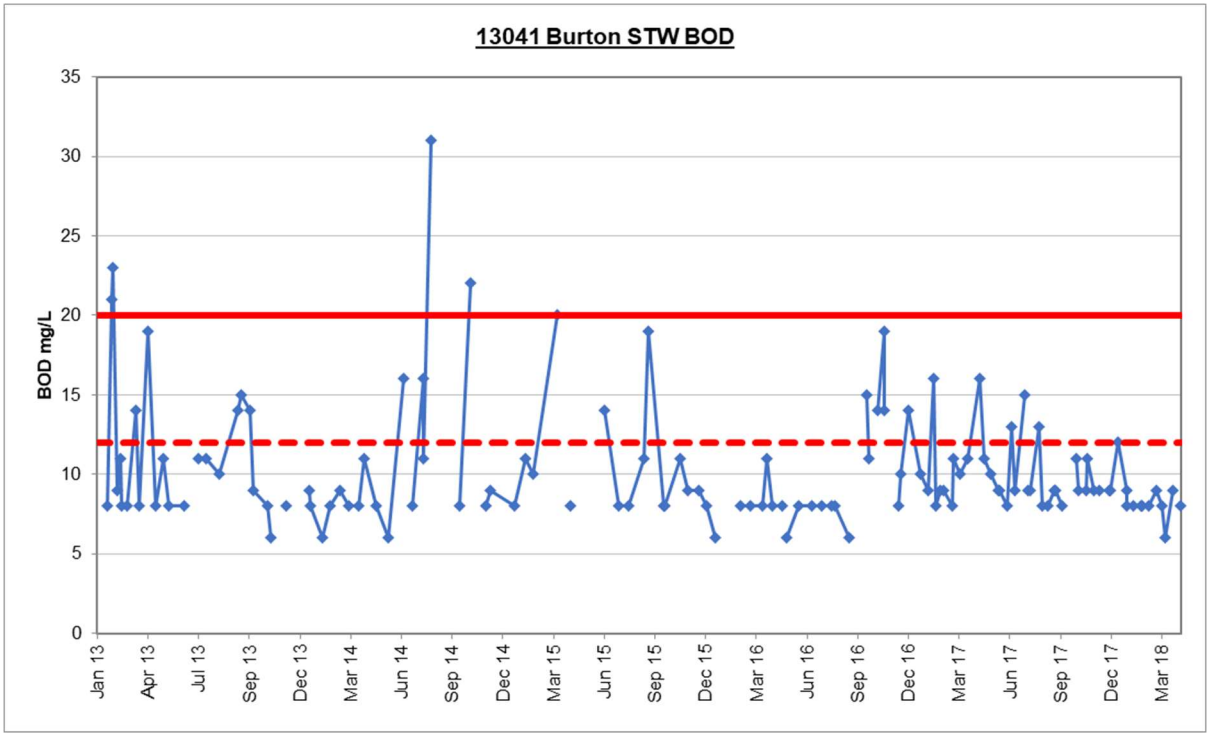
In addition to domestic growth, commercial and trade growth will place additional load on the works.

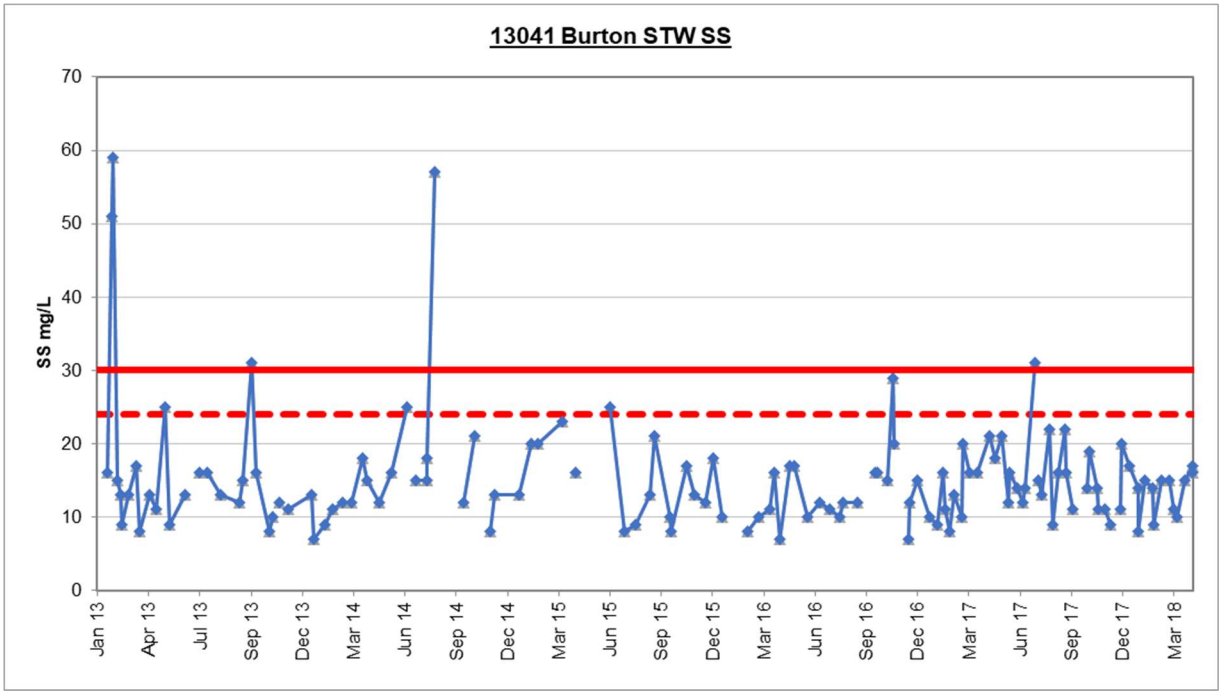
The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	266	271	282	291	298	305

Performance
The original RBC treatment plant has become overloaded and the works has been supported long-term by a temporary SAF unit. The SAF installation has safety issues with access and the associated temporary pipework and the unit restricts access to the RBCs for maintenance. The SAF aids in ammonia performance but the BOD and SS performance of the site is also poor. The existing humus tank has sufficient capacity for the current and proposed future FFT.

The following graphs show the historical performance of the site against its permit, with current and future (assumed pro-rata) consents shown by the red lines. The dashed lines represent the future expected consents.





Operationally, the site has the following issues with regards access and amenity:

- Access to the site passes closely to nearby residents, with existing complaints about tanker movements
- Only small tankers can access the site with the existing access road
- The site has received noise complaints from nearby residents due to the blowers for the temporary SAF unit.

5. Long-term plan

The treatment needs for the STW have exceeded the available space on the site. Additional land is required to facilitate the required treatment units to enable capacity and quality enhancement.

The existing and proposed site is part of the Cotswolds AONB and the proposed new site location is a County Wildlife Site.

In addition to site restrictions with available space and access, the adjacent available land has a very steep embankment.

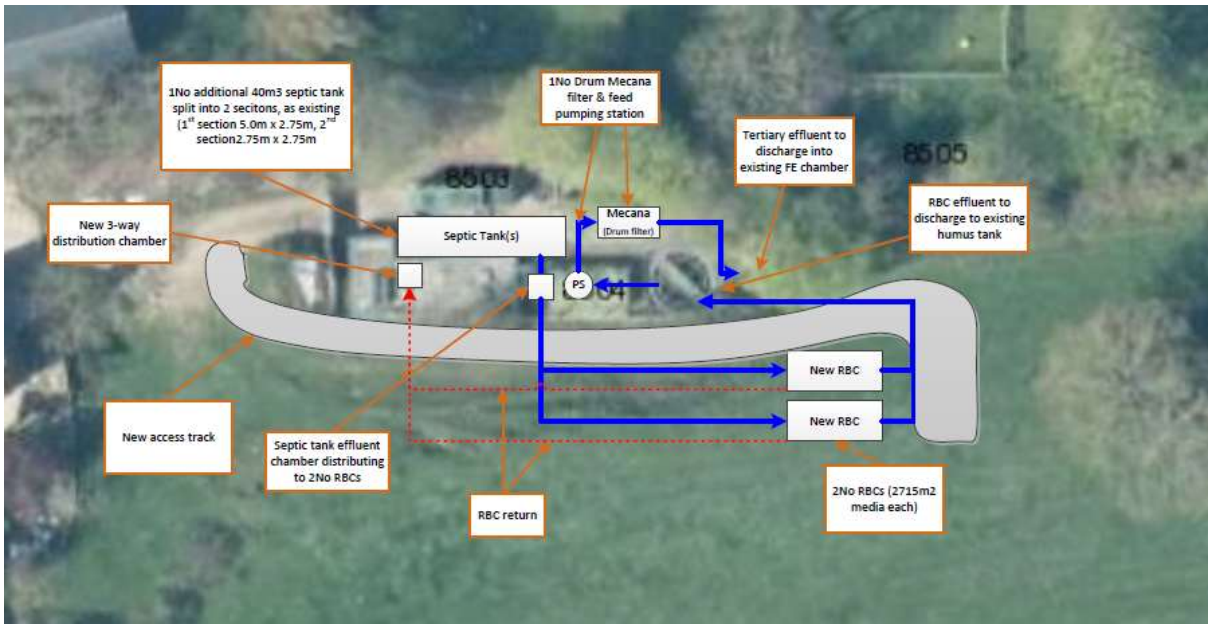
6. Options

Pump-away
The option to abandon the works entirely and pump away the sewage to the closest alternative catchment has been considered. The receiving works, Great Badminton STW, would require significant improvement and expansion works to take the additional loading. The capex of transfer alone has been estimated in excess of £1.4m before allowing for the costs of upgrading and expanding Great Badminton STW.
Great Badminton is also a small works, serving 618 p.e. at present, thus a transfer of Burton STW would require a c.50% increase in capacity of this site.

Two options were considered for increasing capacity at and adjacent to the existing site.

- **Option 1** – New sewage treatment works adjacent to existing site
    - 2No Rotating Biological Contactors
    - New elevated inlet works
    - New Humus Settlement Tank
    - Tertiary filter feed pumping station
    - Tertiary Solids Removal
    - MCC Kiosk
    - Abandon existing works and remove SAF unit
    - Land purchase for new site, adjacent to existing works
    - New site access and site roads

- **Option 2** – Extension of existing septic tanks with new RBCs adjacent to existing site
  - 2No Rotating Biological Contactors
  - New 3-way inlet distribution chamber with 1 no. additional septic tank
  - Tertiary filter feed pumping station
  - Tertiary Solids Removal
  - MCC Kiosk
  - Remove SAF unit
  - Land purchase for new RBCs and access, adjacent to existing works
  - New site access and site roads



	Capex (£m)	Opex (£m/yr)
Option 1: New Sewage Works	4.254	0.044
Option 2: New RBCs & Septic tank	4.024	0.040

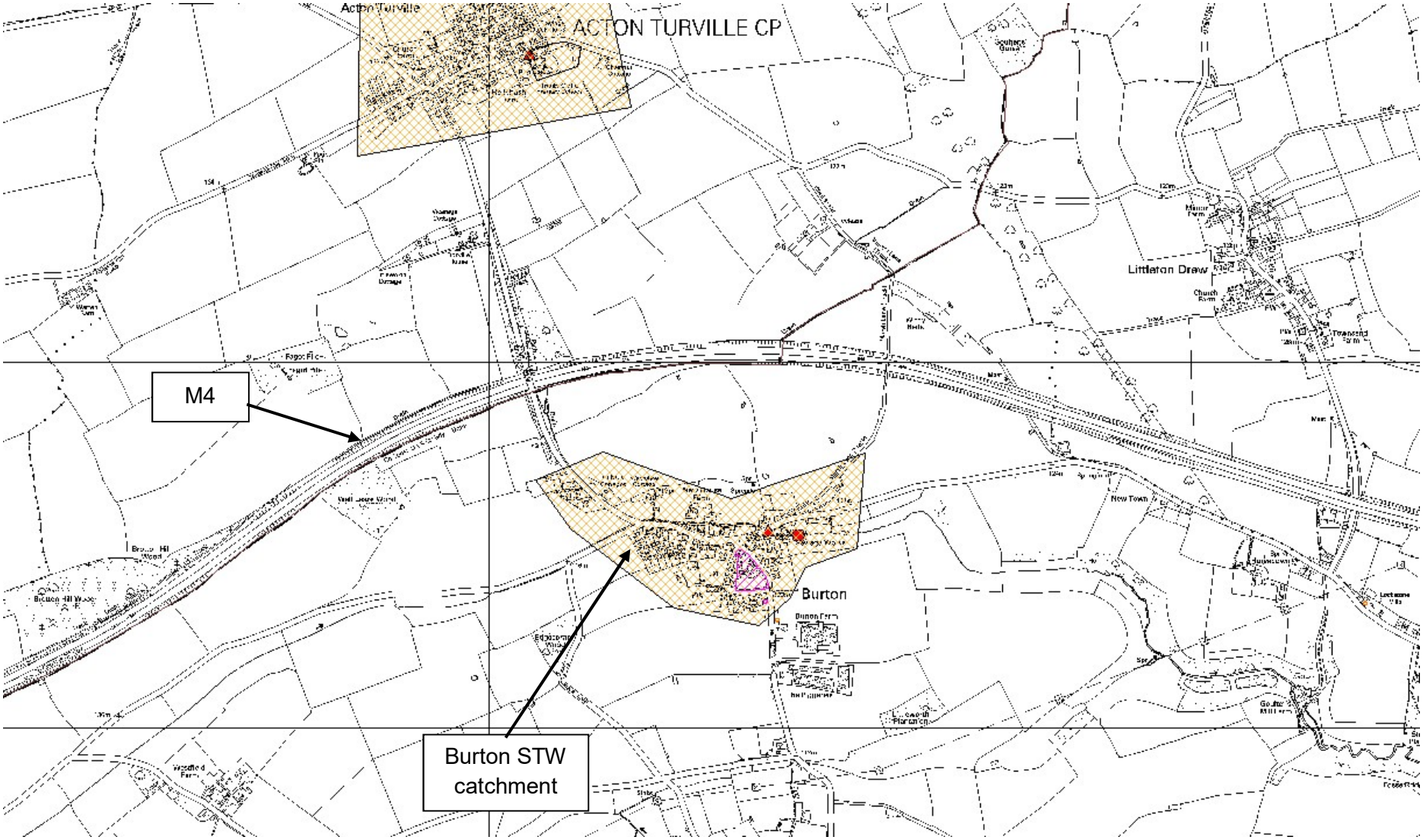
7. Proposed Solution

All options considered would meet the future capacity and permit compliance needs for Burton STW.

The option included within our business plan for Burton STW, Option 2, is the lowest whole-life cost option.

Appendix 1 - (Burton STW): Plan of Catchment, showing potential (▨) development area

(Also showing part of Great Badminton STW catchment)



Annex F. Castle Cary STW

1. Summary

Name	Castle Cary STW
STW population served (2018/19 p.e)	3,919
Treatment capacity provided - PR19 enhancement (p.e)	1,331
Main driver	Quality (U-IMP5 and WFD)
Subsidiary driver	Growth
Total Capex (£m)	1.746
Growth Capex (£m)	0.175

2. Need

The STW is reaching the limit of its treatment capacity, in particular the performance of the plant to achieve its permit for BOD and Ammonia is becoming erratic. Significant growth is expected in the Castle Cary catchment to the end of 2025. This growth means that the design ammonia loading will be reached by the end of PR19 or year one of PR24. The predicted FFT will also exceed the consent by mid PR19.
This future planned growth in both residential and trade flows and loads means that additional treatment capacity needs to be provided in order to maintain permit compliance.

Additionally the WINEP(3) requires an increase in FFT and a tightening of the Phosphorus and Biochemical Oxygen Demand (BOD) permits at Castle Cary STW, as below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?	Old Permit	New Permit
7WW200168	U_IMP5	FFT	31/03/2023	Green	2,203 m^3/d	2,687 m^3/d
7WW201060	HD_IMP	Phosphorus	22/12/2024	Green	-	0.50 mg/L
7WW200174	WFD_ND	BOD	31/03/2025	Green	15 mg/L	6.5 mg/L

The 2,687m^3/d figure represents the "3PG+I_{max}+ 3E" at year 2025.

The EA have stated, in relation to the U-IMP5 projects that "Future risk due to growth should be picked up by the Water Companies under growth or maintenance in their Capital Programme, not WINEP" and also that "U_IMP5 (and U_IMP6) drivers only apply to increases required to FFT (and storm tank capacity) over and above those required and funded under growth." [13]
This means that investment to meet the new FFT at year 2025 will be costed under the quality enhancement driver, while the provision of capacity to a reasonable design horizon (i.e. 2040) will be allocated to capacity enhancement.

[13] Environment Agency (November 2017). PR19 further guidance for completing WINEP3 for flow drivers U_MON3, U_MON4, U_IMP5 and U_IMP6 DRAFT v0.10.
Environment Agency (December 2017). PR19 Driver Guidance: Increasing Flow to Full Treatment (FFT)- FINAL v3.

To ensure that the site continues to maintain permit compliance, additional treatment capacity will be required to treat the increased loading on the RBCs and to accommodate growth within the Castle Cary catchment.

3. Background

Site Details	
The site serves :	The market town of Castle Cary and the villages of Ansford and Clanville. See plan in Appendix.
Treatment Process	
The STW is a works with primary tanks, Rotating Biological Contactors (RBCs) providing secondary treatment, humus settlement tanks and tertiary grass plots. There are 5 RBCs in total.	

4. Evidence

Growth and Investment (Historical)

Additional treatment capacity at Castle Cary STW was last provided some 8 years ago, between 2009/10. Three old RBCs were replaced by five modern units. Other than routine capital maintenance there has been no significant investment at the STW since then.

The size of population in the catchment has developed as shown below:-

	2008	2010	2015	2017
Resident p.e.	3,236	3,205	3,173	3,491
Total p.e.	3,531	3,643	3,436	3,697

Growth (Future)

The local plans[14] for Castle Cary STW catchment area include plans for future housing development expected as follows:-

	2018-2020	2021-2025
New dwellings (Nº)	102	170
New residents (p.e.)	229	382

In addition we are aware of two further trade developments:

i) The local major trader, Crown Pet Foods, has approached us to discuss the capacity of our Castle Cary STW to accept increased flows and loads from a proposed expansion at their manufacturing works.

ii) A developer is planning the conversion of Hadspen estate into a hotel and day spa, including an onsite laundry and cider production. This would also represent a significant increase in loading onto the STW.

[14] South Somerset District Council (September 2017). South Somerset Authority Monitoring Report. https://www.southsomerset.gov.uk/media/898612/annual_monitoring_report_2017_issue.pdf

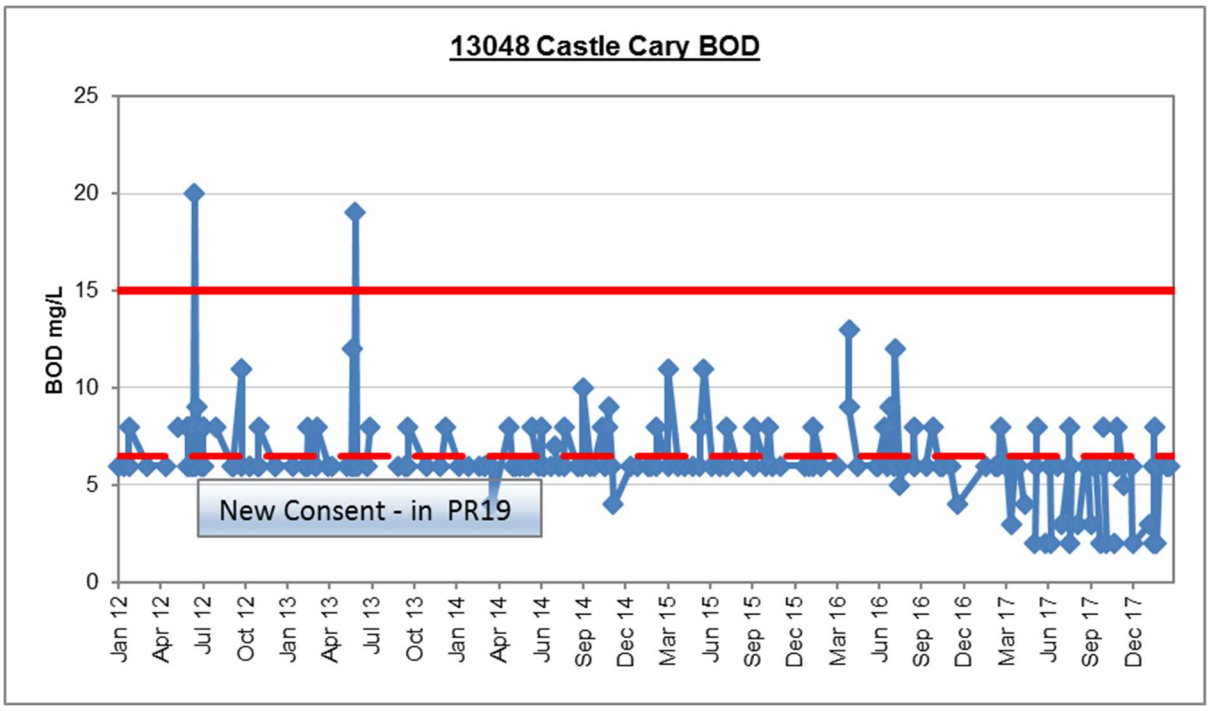
Both of these developments would increase flows and loads over and above those shown in the table above.

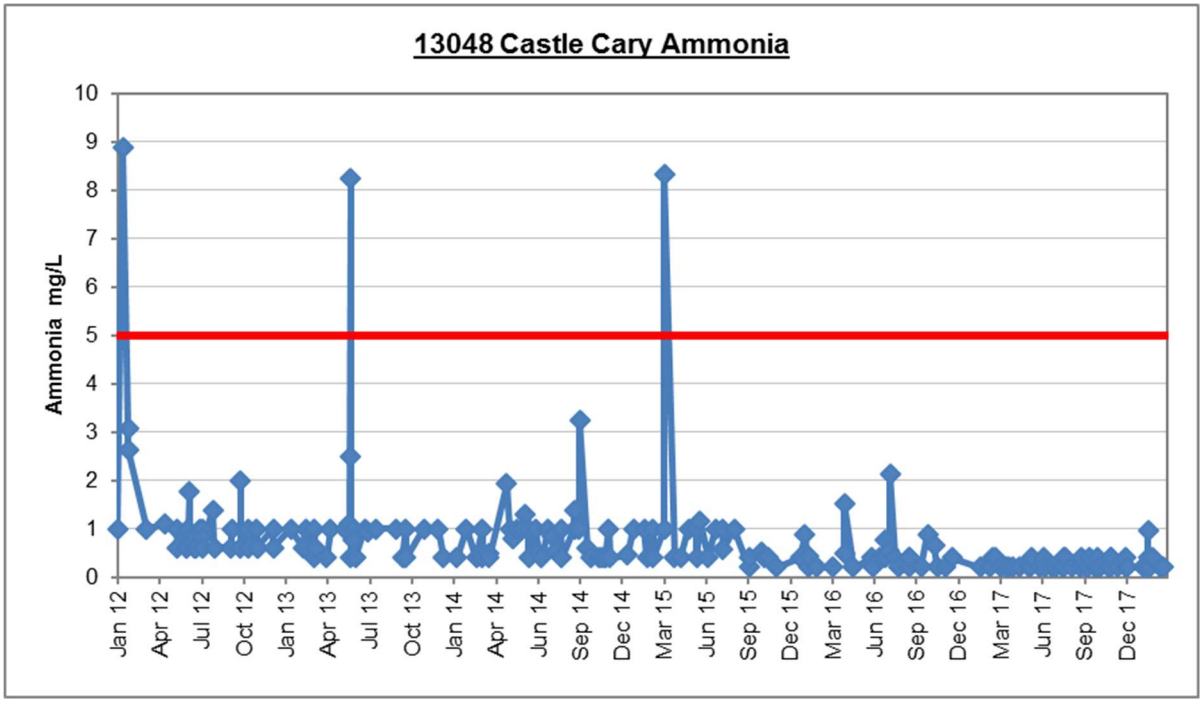
The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	3,919	4,177	5,118	5,283	5,394	5,509

Performance

Evidence from our sampling data for BOD and Ammonia over the last 5 years shows that compliance with existing permit conditions is good, with only a few exceptions, as shown below:-





The WINEP3 requires a tightening of the BOD permit from 15.0mg/L to 6.5 mg/L, which drives the need for investment in additional treatment processes at the STW.

5. Options

A combined scheme is proposed to provide additional hydraulic capacity, and to achieve the proposed more stringent BOD permit of **6.5 mg/**L and the**.** This includes:-

- Additional secondary treatment to provide hydraulic capacity, improved BOD and Ammonia removal

A separate scheme fully funded under our quality programme will provide front end and secondary point chemical dosing with new tertiary treatment capacity to meet the tighter BOD and new Phosphorus permit standards.

From inspection, since the existing STW utilises the RBC process, and has been set out with five RBCs and arrangements for a 6th RBC to be installed, then the additional secondary treatment will be provided by an additional RBC treatment unit.

6. Proposed Solution

A high-level comparison of the treatment options is summarised below:-

Option	Additional Secondary treatment - RBC	Additional Secondary treatment – SAF	Additional Secondary treatment – biological filter
Provides treatment capacity	✓	✓	✓
Meets new P and BOD permits	✓	✓	✓

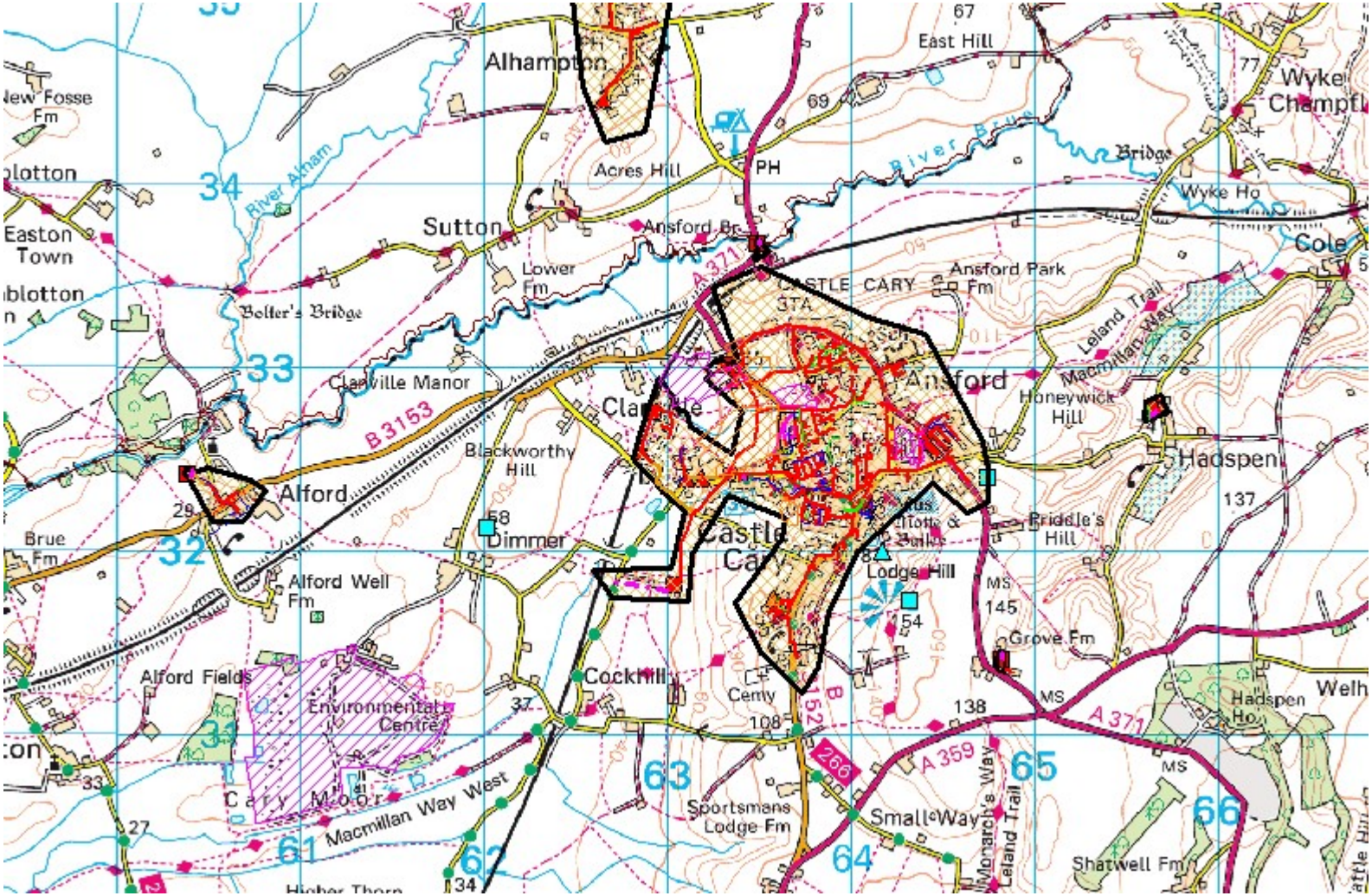
Option	Additional Secondary treatment - RBC	Additional Secondary treatment – SAF	Additional Secondary treatment – biological filter
Requires additional pumping	X	✓	✓
Requires additional aeration power	X	✓	X
Best use of existing assets	✓	X	X
Capex (£m)	£1.75	>£1.75 *	>£1.75*
Lowest whole-life cost	✓	X	X

*Note : Based on a high-level assessment, and due to the additional capital and operating costs of pumping and aeration plant for these options.

The costs have been apportioned between drivers as below :-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	10%	£0.175	0.002
Quality enhancement – FFT & BOD	90%	£1.485	0.022
	Total	£1.746	0.024

Appendix 1 – Castle Cary STW: Plan of Catchment, showing potential (▨) and approved (▨) development areas



Annex G. Compton Bassett STW

1. Summary

Name	Compton Bassett STW
STW population served (2018/19 p.e)	3,684
Treatment capacity provided - PR19 enhancement (p.e)	2,827
Main driver	Growth/Quality
Subsidiary driver	Growth/Quality
Total Capex (£m)	6.808
Growth Capex (£m)	3.404

2. Need

Compton Bassett STW has reached the limit of its treatment and hydraulic capacity due to historical growth. Ongoing development and significant population growth is forecast within the STW catchment, representing a doubling of the domestic flow and load contributions to the STW before 2025.

As a result of catchment growth, Compton Bassett STW exceeded its DWF permit in 2017 and this trend is expected to continue. To ensure the works maintains environmental compliance, a new DWF permit will be required with associated pro-rata tightening of AmmN, BOD and SS parameters to ensure the load discharged to the receiving water does not increase with the additional flow being treated.

Additional treatment capacity is required to ensure that the site continues to maintain environmental permit compliance.

Additionally the WINEP(3) requires an increase in FFT passed through the treatment process, which will result in a new permit at Compton Bassett STW, as below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?	Old Permit (l/s)	New Permit (l/s)
7WW200238	U_IMP5	Increased FFT	31/03/2023	Green	17.5	tbc

A combined project has been developed, taking account of these multiple drivers and synergies, to provide an efficient solution for these capacity and quality enhancements.

3. Background

Site Details	
The site serves :	Originally built to serve the villages of Compton Bassett, Yatesbury, Cherhill and Calstone, the site now also serves the eastern side of the town of Calne and also receives some pumped flows from the village of Heddington and the surrounding area.

	There is also a large trade component to the works from the adjacent landfill site. See plan in Appendix.
Treatment Process	
The STW is a conventional biological filter works with primary tanks, secondary filters and humus settlement tanks.	

4. Evidence

Growth and Investment (Historical)

The significant development in the catchment is on the eastern edge of Calne. Previously, the sewerage system had flowed westwards across the town to Calne STW. This system had sufficient capacity for the early stages of the development (which commenced in 2011); the full development, however, would overload the system and require significant network enhancements and upgrades at Calne STW. As such, a new sewage pumping station was built (Abberds Lane) to transfer flows to Compton Bassett STW.

A trial Dissolved Air Flotation (DAF) unit was brought to the site near the end of 2016 to assist with treating the highly COD-loaded leachate from a nearby landfill site. This was subsequently replaced with a larger and more semi-permanent DAF in early 2018. Otherwise, there has been no additional treatment capacity added to the site since the current setup was built in 1944.

Investment at this STW has focussed on capital maintenance and quality enhancement, the most significant of which have included:-

Date	Project	Driver	Scheme
2005	D9097	Quality enhancement	Improvements to achieve UWWTD compliance for COD and BOD removal (as p.e.>2,000)
2014	D9613	Growth	Hydraulic upgrades to inlet works following sewer requisition
2017	DK143	Capital maintenance	Installation of DAF unit to alleviate COD issues
2018	DK149	Capital maintenance	Replacement of sludge tank

The size of population in the catchment has developed as shown below:-

	2001	2005	2010	2015	2017
Resident p.e.	1,731	1,624	1,449	1,925	2,719
Total p.e.	1,819	2,334	1,933	2,799	3,711

Growth (Future)

The Local Plan[15] for the Compton Bassett STW catchment area includes plans for future housing development as follows:-

[15] Wiltshire Council (March 2018). Housing Land Supply Statement. http://www.wiltshire.gov.uk/spp-housing-land-supply-statement-2017-published-2018-march.pdf

	2018-2020	2021-2025
New dwellings (Nº)	350	200
New residents (p.e.)	787	450

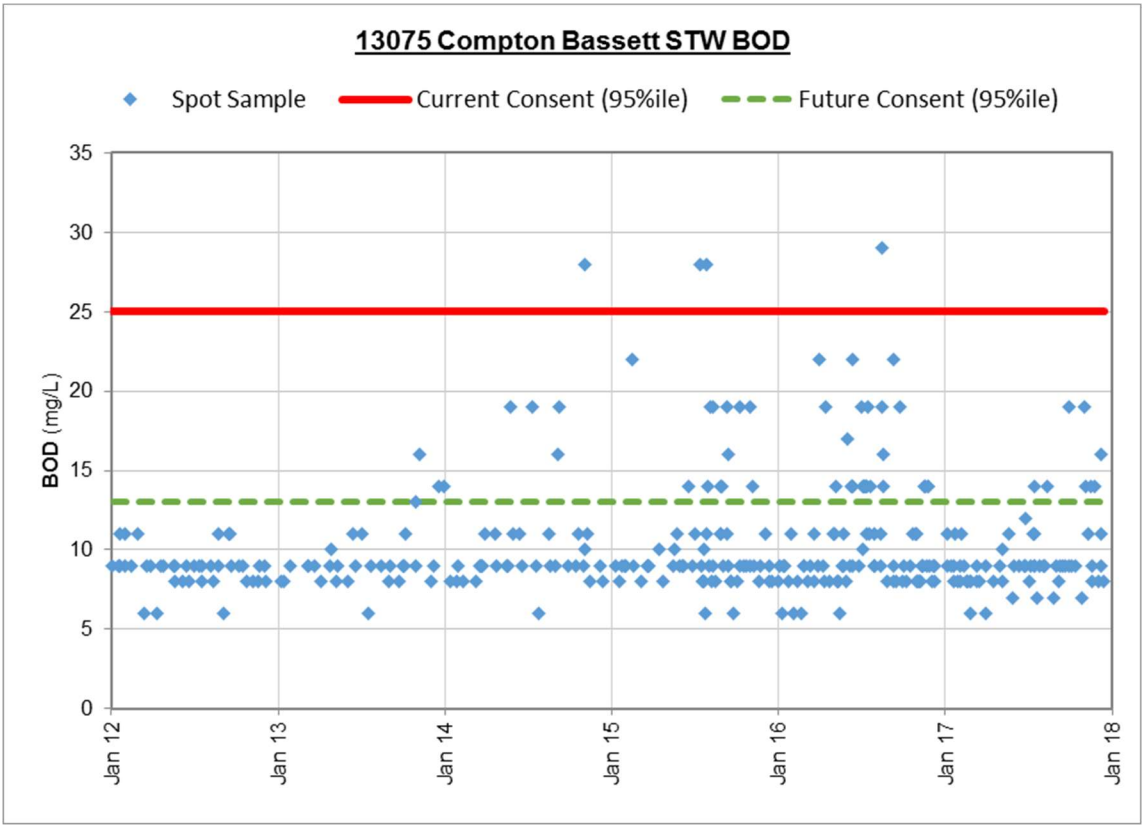
In addition to domestic growth, commercial and trade growth will place additional load on the works.

The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	3,684	4,220	4,744	4,856	4,980	5,107

Performance

Evidence from our sampling data (24 hr composite samples) over the last 6 years shows an increasing (deteriorating) trend in the levels of BOD in the final effluent, which has seen marked worsening following recent development. The below chart also shows what the pro-rata consent tightening would be as a result of the DWF increase:-



5. Options

Capacity

When compared to the Wessex Water engineering standards, the maximum loading (BOD, SS and Ammonia) on the existing treatment units is acceptable; however, this is not reflected by their performance in recent years. This deterioration could be attributed to flows from a significant new housing development being sent to Compton Bassett from September 2013 (higher strength due to less infiltration).

With further development ongoing and proposed in the same area, additional treatment capacity is needed within the next 5 years to accommodate the additional flow and loads. The feasible options for providing this additional capacity include either:-

- Option 1 – Divert flows to Calne STW and improve Calne STW as appropriate
  A high level was undertaken to review the possibility of reconnecting flows to Calne STW. However this was discounted as this will require improvements at Calne STW itself (comparable to those being proposed at Compton Bassett STW) as well as extensive sewerage upgrades to accommodate the additional flows and mitigate any flood risk.

- Option 2 – New primary and tertiary treatment, with additional secondary treatment
  2a) New inlet works, new 2no. primary settlement tanks, 1no. biological filter and 2no. tertiary cloth filters.
  2b) New inlet works, new 2no. primary settlement tanks, 2no. moving bed biological reactors (MBBRs) and 2no. tertiary cloth filters.
  Modular MBBRs were considered to see whether they offered any financial benefit over the traditional stone media filter

- Option 3 – New (and enhanced) primary and tertiary treatment
  3) New inlet works, new 2no. primary settlement tanks and 2no. tertiary cloth filters. By enhancing primary treatment over Options 2a or 2b would reduce the solids (BOD) loading on the biological filters, allowing them to be more effective at nitrification rather than carbonaceous treatment, thus reducing the requirement for additional secondary treatment. Enhanced tertiary treatment would mitigate deficiencies of reduced secondary treatment, though would not offer improved hydraulic capacity through the secondary processes if flows were to increase beyond those forecast.

A high-level comparison of the treatment options is summarised below:-

Option No.	1	2a	2b	3
Option Description	Divert flows to Calne STW	Additional biological filter	New MBBRs	Reduced scope
New/Additional Treatment Processes				
Inlet Works		✓	✓	✓
Primary		PST	PST	PST
Secondary		Biological Filter	MBBRs	-
Tertiary		Cloth filters	Cloth filters	Cloth filters
Capex (£m)	>10.0	7.725	8.558	6.808
Opex (£k/yr)	>100	120	142	106
Lowest whole-life cost	X	X	X	✓

6. Proposed Solution

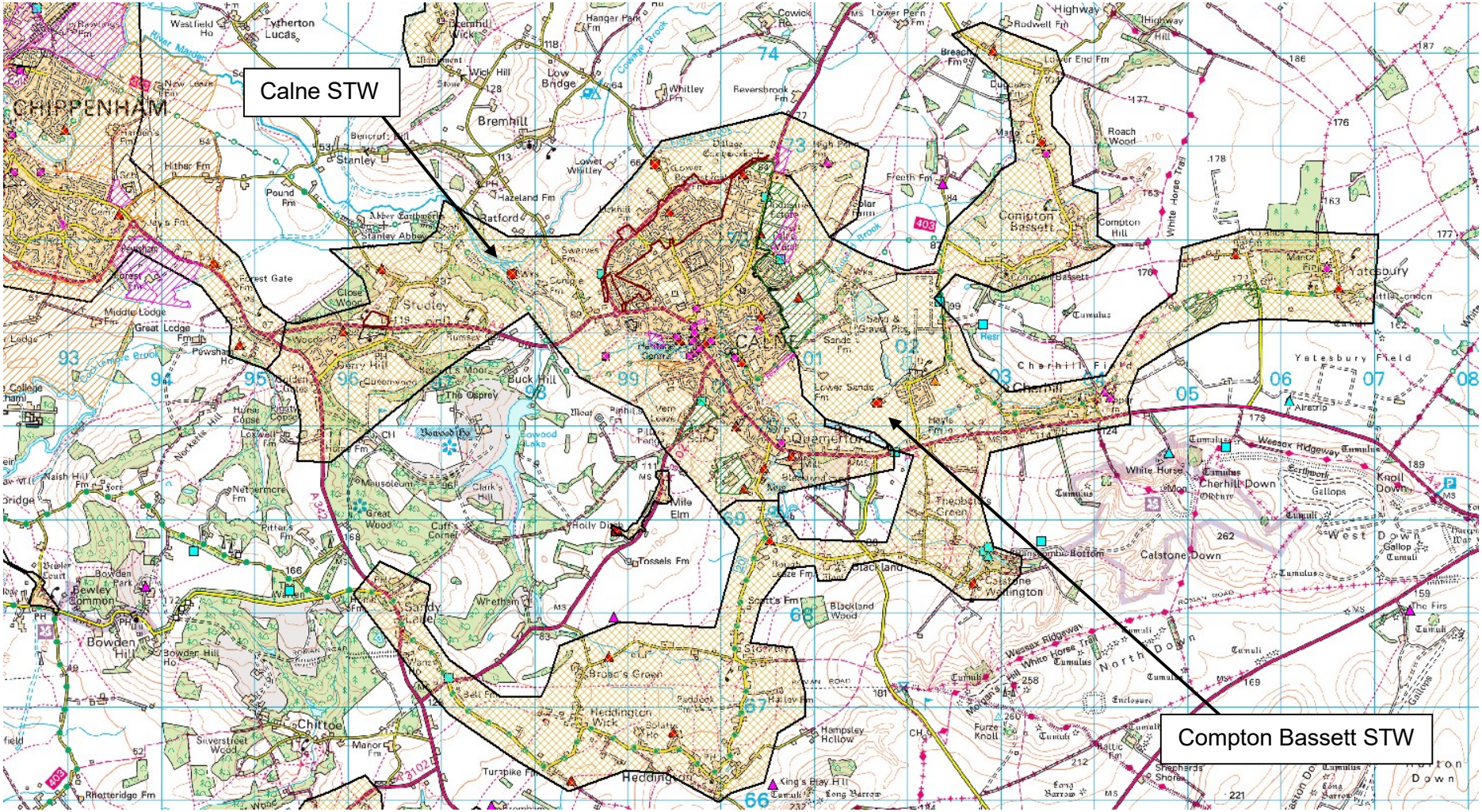
The proposed solution is therefore option 3, to provide (enhanced) primary and tertiary treatment at Compton Bassett STW for:-

- increased treatment capacity (to 2035)
- revised DWF and FFT consents
- more stringent sanitary permits (13 mg/L BOD, 20mg/l SS, 15mg/l AmmN)

The costs for the proposed option have been apportioned between drivers as below :-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	50%	3.404	0.053
Quality enhancement – FFT increase	50%	3.404	0.053
	Total	6.808	0.106

Appendix 1 Compton Bassett STW – Plan of Catchment, showing potential ( ), and approved ( ) development areas
(Also showing Calne STW catchment)



Annex H. Corfe Castle STW

1. Summary

Name	Corfe Castle STW
STW population served (2018/19 p.e)	2,222
Treatment capacity provided - PR19 enhancement (p.e)	235
Main driver	Quality
Subsidiary driver	Growth
Total Capex (£m)	4.263
Growth Capex (£m)	0.426

2. Need

Ongoing development and population growth is forecast within the Corfe Castle STW catchment, particularly with regards to day visitors and holiday makers. Additional treatment capacity is required to ensure that the site continues to maintain environmental permit compliance.

Additionally, the WINEP(3) requires Corfe Castle STW to receive tertiary treatment to achieve E.coli reductions between influent and Shell Fish Water boundary and a tightening to remove Phosphorus, as below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?	Old Permit	New Permit
7WW200245	SW_ND SW_IMP		30/06/2021	Green	n/a	UV Disinfection
7WW100074	WFD_IMPg	Phosphorus	22/12/2021	Green	n/a	1.3mg/l

A combined project has been developed, taking account of these multiple drivers and synergies, to provide an efficient solution for these capacity and quality enhancements.

3. Background

Site Details	
The site serves:	See catchment plan in Appendix.
Treatment Process	
The STW is a conventional biological filter works with primary tanks, secondary filters and humus settlement tanks.	

4. Evidence

Growth and Investment (Historical)
Corfe Castle has a significant non-resident population, particularly during holiday periods and bank holiday weekends (equivalent to 35% of the total population equivalent).

Corfe Castle has been supported by a temporary submerged aerated filter (SAF) since 2014. The EA agreed to reduce the DWF permit in 2015, which allowed the pro-rata relaxation of sanitary parameters (BOD/AmmN/SS).

Additional (permanent) treatment capacity at Corfe Castle STW was last provided 20 years ago, with the site developing as follows:

- 1960s – Primary settlement tanks, biological filters, humus settlement tanks
- 1989 – Humus settlement tank (to replace tanks built in 1960s)
- 1998 – High rate filter (tertiary)

Since then, investment at this STW in recent years has focussed on capital maintenance, the most significant of which have included:-

Date	Project	Driver	Scheme
2016	DH228	Capital maintenance	Lagoon refurbishment
2017	D9798	Capital maintenance	Inlet Screen replacement
2017	DJ135	Capital maintenance	Sludge tank replacement

The size of population in the catchment has developed as shown below:-

	2001	2005	2010	2015	2017
Resident p.e.	1,328	1,398	1,288	1,293	1,341
Total p.e.	1,727	3,374	3,200	2,133	2,119

Population figures are reflective of the variability in tourist numbers in the Corfe Castle catchment.

Growth (Future)

The Local Plan[16] for the Corfe Castle STW catchment area includes plans for future housing development. In addition to domestic growth, commercial and trade growth will place additional load on the works.

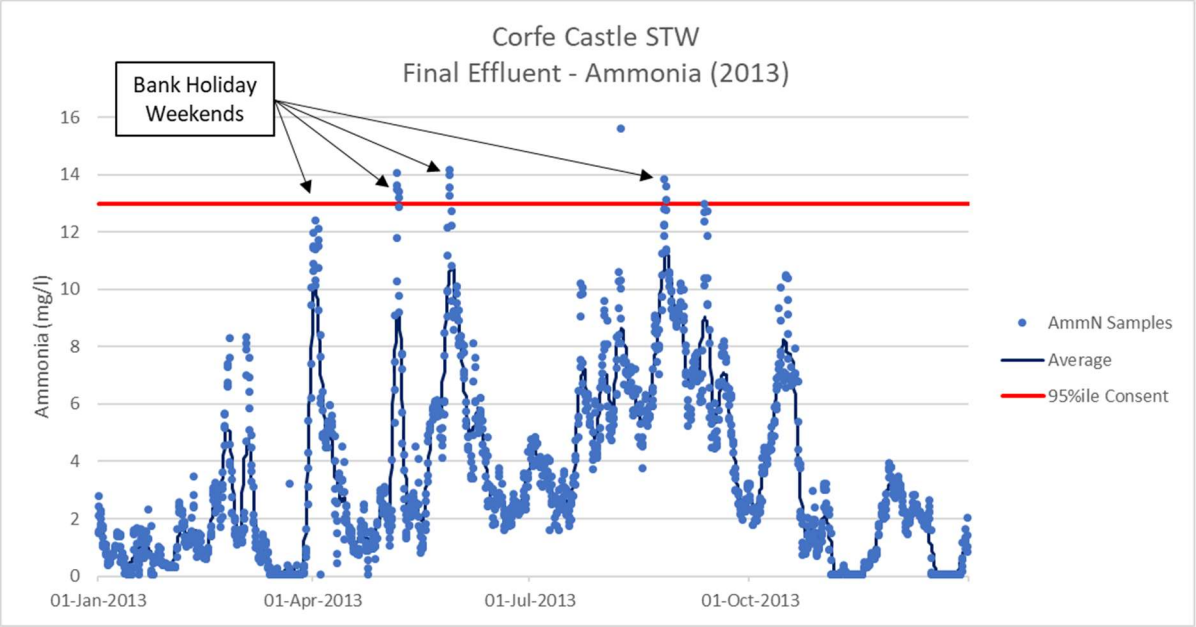
The projected load to be served by the works (p.e.) is summarised below:

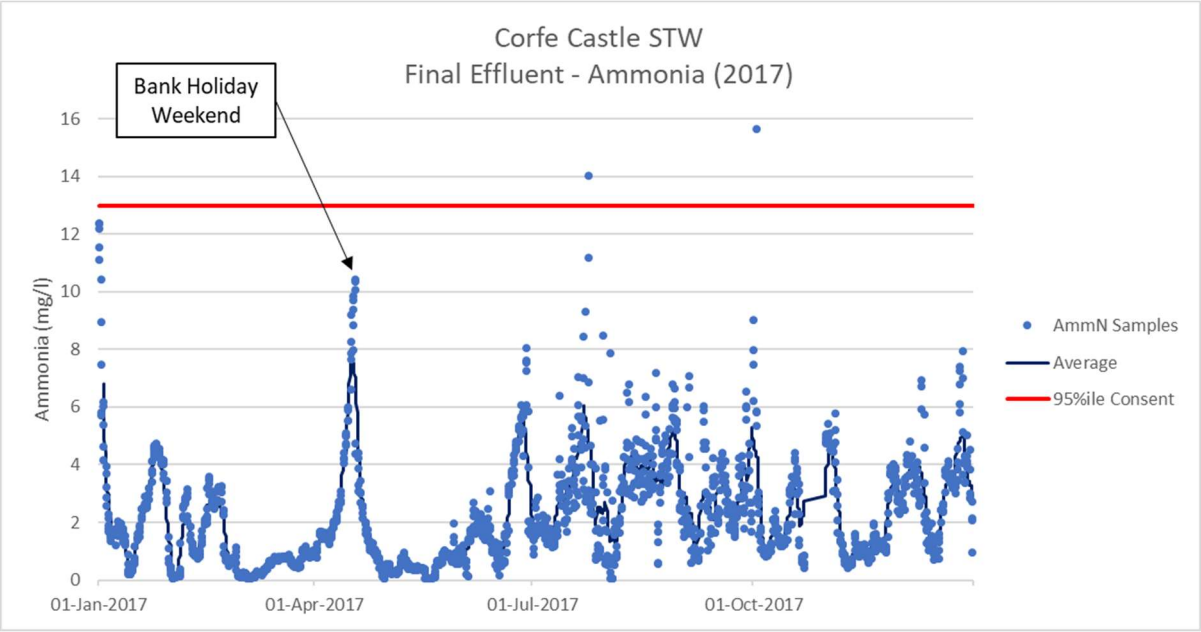
	2018	2020	2025	2030	2035	2040
Future p.e.	2,222	2,245	2,301	2,360	2,419	2,480

Performance

The following charts show the impact of the increased load during holiday periods. A temporary SAF was installed in 2014 and the subsequent improvement in performance can be seen by comparing the graphs.

[16] , Purbeck District Council (August 2017). Purbeck Local Plan Part 1 Monitoring Report – Housing Completions and Commitments. https://www.dorsetforyou.gov.uk/media/223224/Housing-Completions-and-Commitments-2017/pdf/Housing-Completions-and-Commitments-Report-2017.pdf





5. Options
Quality Enhancements

Our standard design solution for achieving a **1.3mg/L P** permit standard (annual average) is:-

- Single point (front-end) ferric dosing
- with any required improvements to inlet screens and primary settlement

Given its scope, the Phosphorus removal has been designed and priced separately, with no purpose split assigned to Growth

To achieve the WINEP(3) requirements for E.Coli reduction requires the installation of a tertiary UV plant, in accordance with EPR 7.01 Water Discharge and Groundwater Activity Permits (published by the EA), and on the basis of suitable secondary treatment.

Capacity

When compared to the Wessex Water engineering standards, the maximum loading (BOD, SS and Ammonia) on the existing treatment units is acceptable; however, this does not fully consider the seasonal/weekend variation from the non-resident population (e.g. day visitors or holiday makers). This variable population puts pressure on the existing treatment process units at the STW, especially as they respond to the increase load.

The requirement for E.Coli reduction requires effective secondary treatment, and so the quality and capacity elements cannot be considered in isolation. The feasible options for providing this additional capacity include either:-

i) 1 No. additional biological filter and 1No. additional humus settlement tank
ii) 1 No. new moving bed biological reactor (MBBR) and 1No. additional humus settlement tank

A high-level comparison of the treatment options is summarised below:-

Option No.	1	2
Option Description	New UV plant With improved secondary treatment: - additional biological filter - additional humus tank	New UV plant With improved secondary treatment: - new MBBR - additional humus tank
Provides treatment capacity	✓	✓
Capex (£m)	4.263	4.883
Opex (£k/yr)	155	177
Lowest whole-life cost	✓	X

6. Proposed Solution

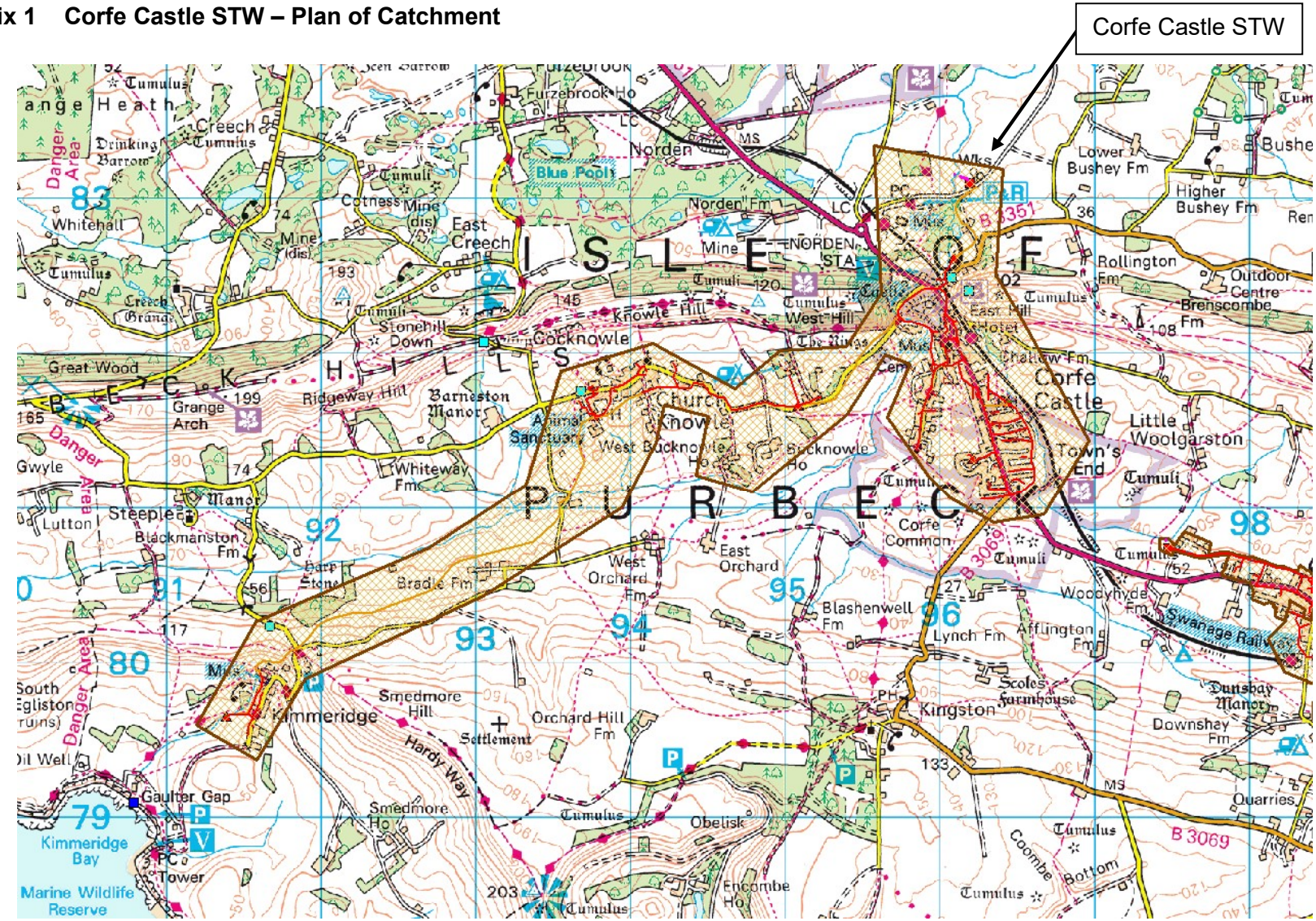
The proposed solution is therefore to provide improved secondary treatment at Corfe Castle STW for:-

- increased treatment capacity (to 2035)
- new UV disinfection permit

The costs for the proposed solution have been apportioned between drivers as below:-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	10%	0.426	0.016
Quality enhancement – UV disinfection	90%	3.837	0.140
	Total	4.263	0.155

Appendix 1 Corfe Castle STW – Plan of Catchment



Annex I. Great Wishford STW

1. Summary

Name	Great Wishford STW
STW population served (2018/19 p.e)	2,115
Treatment capacity provided - PR19 enhancement (p.e)	299
Flow capacity being provided	9.3 L/s (increase of 53%)
Main driver	Growth (DWF)
Subsidiary driver	-
Total Capex (£m)	4.356
Growth Capex (£m)	4.356

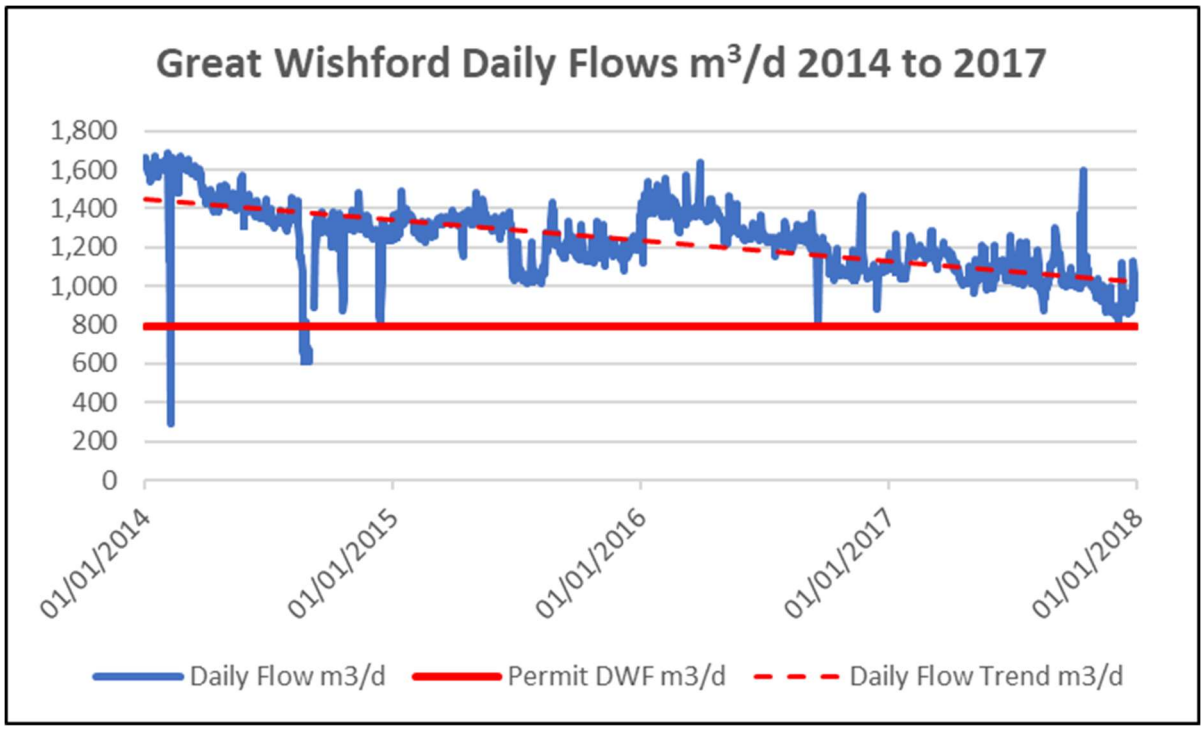
2. Need

Great Wishford STW is breaching its Dry Weather Flow (DWF) permit by 17%.

Historical growth has caused an increase in base flows to the STW and contributed to the DWF permit exceedance. Future development will exacerbate this further.

The EA have stated that breaches in DWF compliance will be reported in their annual Environmental Performance Assessment (EPA) from January 2026. This will be based on the previous 5 years, with flow compliance assessed for the period 2021 to 2025.

In PR14 Wessex included a project to seal the sewerage system to remove infiltration with the aim of enabling this treatment works to comply with its permit DWF. During 2015-20 Wessex carried out sealing works to the upstream sewerage catchment with some reduction in flows. However, the measured DWF continues to exceed its permit and it is now necessary for the treatment works DWF permit level to be increased.



The revised DWF permit will require a tightening of numeric permit limits, and an increase in the FFT through the STW.

There is also planned domestic growth, this will increase loads and require additional treatment capacity to achieve the pro rata tighter permit limits.

The EA WINEP(3) has not identified any quality driver for a scheme at Great Wishford in PR19.

3. Background

Site Details	
The site serves the following:	The villages of Great Wishford, Little Wishford, Stapleford, Hanging Langford, Little Langford, Steeple Langford, Stoford, South Newton and Wylye. See plan in Appendix.
Treatment Process	
This STW is a conventional biological filter works with primary tanks, secondary filters and humus settlement tanks. There is also chemical dosing for P removal.	

4. Evidence

Growth and Investment (Historical)

Additional treatment capacity at Great Wishford STW was last provided some 27 years ago, in 1991 with the construction of a humus settlement tank and storm tank. Phosphorus removal was installed under a quality driver in 2009, no additional biological treatment capacity was provided.

Since the last provision of capacity in 1991 the resident population has increased from 1,748 to 2,062 in 2017, this represents an increase of 18%.

The connected population within this works catchment has increased as indicated below:-

	2001	2005	2010	2015	2017
Resident p.e.	1,748	1,980	1,809	1,910	1,978
Total p.e.	1,748	2,098	1,997	2,109	2,093

Growth (Future)

The Local Plan[17] for the Great Wishford STW catchment area includes plans for housing development. In addition to domestic growth, commercial and trade growth will place additional load on the works.

The projected load to be served by the works (p.e.) is summarised below:

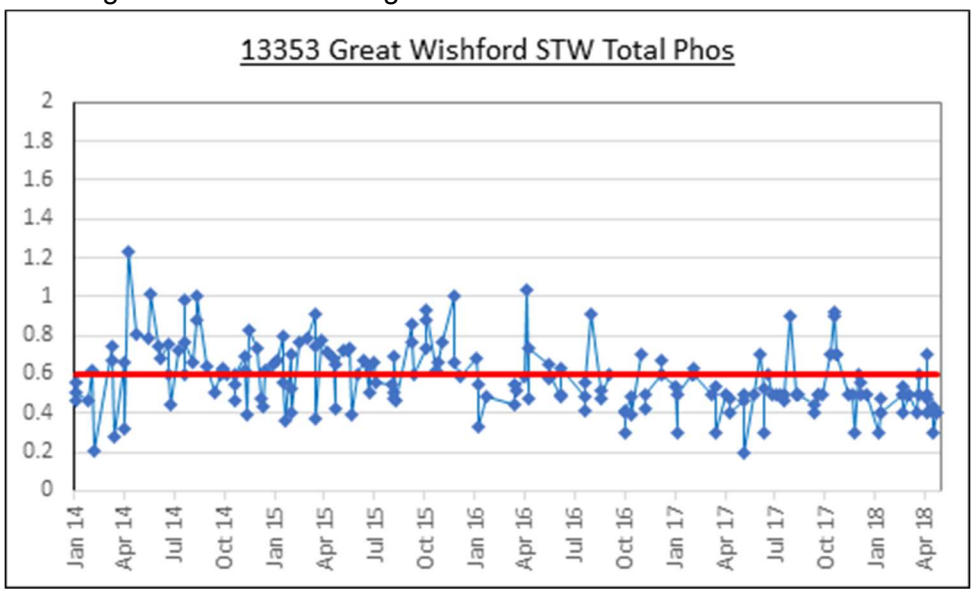
	2018	2020	2025	2030	2035	2040
Future p.e.	2,115	2,137	2,190	2,246	2,302	2,361

Performance

Great Wishford STW continues to exceed its permit DWF (791m^3/d) even after extensive sewer sealing works. An increase in the permit DWF from 791 to 1,350m^3/d is needed. This will result in the following changes to the permit at the STW:-

- Permit limits tightened from 20:30:10 to 12:24:6mg/L (BOD:SS:AmmN),
- Phosphorus limit tightened from 1mg/L to 0.6mg/L
- Increase in permit FFT from 17.7L/s to 27L/s (53% increase)

The following figure shows the current effluent performance for total phosphorus against the future tightened limit of 0.6 mg/L.



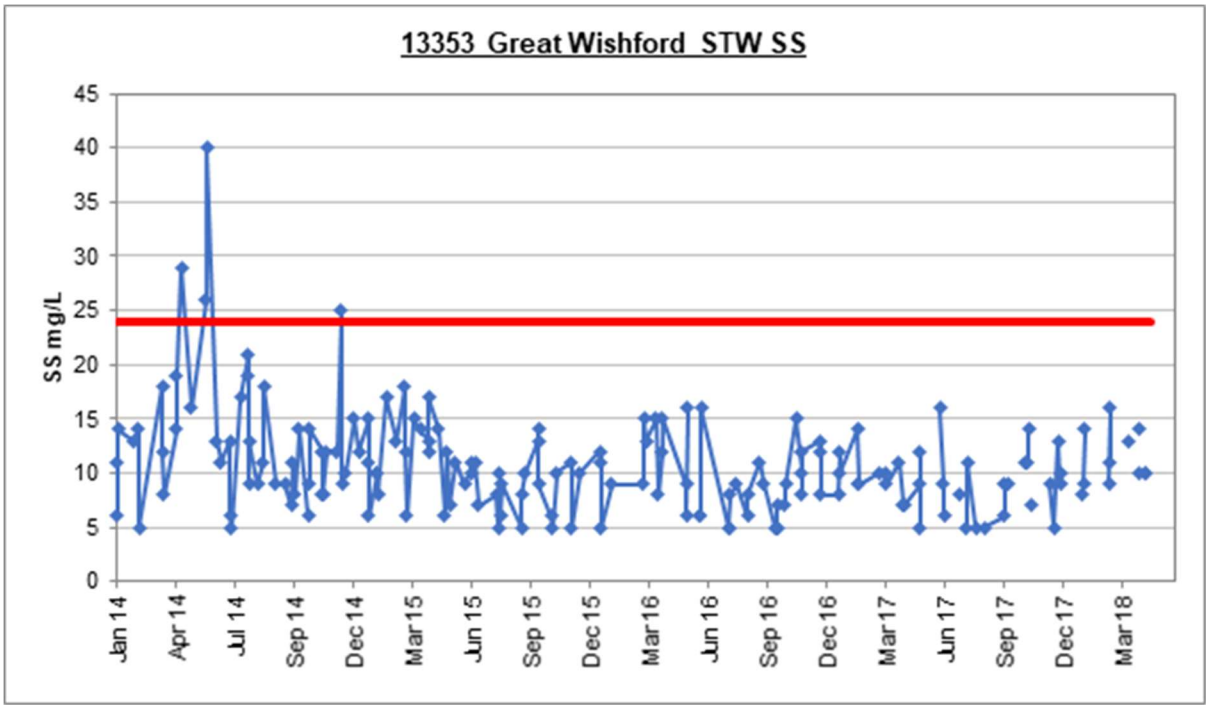
[17] Wiltshire Council (March 2018). Housing Land Supply Statement. http://www.wiltshire.gov.uk/spp-housing-land-supply-statement-2017-published-2018-march.pdf

The tightening of the phosphorus limit will require the installation of a secondary dosing installation, and a tertiary treatment plant for solids removal.
The increase in permit FFT will require an additional humus tank as the existing humus tanks are overloaded. New flow control chambers and pipelines will also be needed to pass the increased flow.

The existing biological filters will exceed our standard design loading rates for the new permit, with the biological filters being overloaded by 22% (BOD) and 25% (AmmN) at the planning horizon of 2040. However, we are not proposing to invest in additional filters in PR19 as the existing works out-perform our standard (see table below for historical performance summary against the future permits. This is a risk that we will be taking to minimise investment at this treatment works.

95%ile (mg/L)	BOD atu	COD	SS	AmmN
2014	10.8	45.2	25.8	3.1
2015	8.0	27.0	16.7	1.5
2016	8.0	26.5	15.2	2.1
2017	8.0	30.0	14.0	1.8
2018	8.0	33.0	15.4	1.1
Proposed permit	**12**		**24**	**6**

The following figure shows the current effluent performance for SS against the future tightened limit of 24 mg/L.



With increased permit FFT (17.7 to 27L/s) the solids performance will deteriorate putting the numeric compliance at risk.

5. Options

Capacity and associated permit tightening
As a result of the pro rata tighter permit limits and the increase in permit FFT, additional treatment process units will be required to ensure continued compliance. The planning horizon for the above is 2040.

The following options have been considered.

	No improvements – Use existing units	Tertiary plant (TSF or Mecana)	Secondary dosing point	Increase hydraulic capacity	Pump away to Salisbury STW
Phosphorus limit 0.6mg/L	Overloaded against design standards and recognised industry requirements.	Required to ensure compliance with proposed phosphorus permit limit.	Required to ensure permit compliance on an average basis. Recognised treatment process	No improvement to permit phosphorus compliance.	Salisbury STW has headroom in its permit to accept this flow with no change to its P permit.
Permit FFT 27L/s	Insufficient hydraulic capacity, will result in flooding and pollution.	Will be sized to pass proposed flow but will not improve hydraulic capacity of existing process.	No improvement to hydraulic capacity.	Required to pass proposed permit FFT.	Additional treatment capacity would be required at Salisbury STW.

Additional treatment capacity is needed within the next 5 years so that the STW can comply with the new DWF permit.

Numeric Permit Tightening
To achieve the tighter phosphorus permit limit of **0.6mg/L**:

- Secondary chemical dosing installation.
- Tertiary treatment either sand filter or cloth filter.

Increased permit FFT

- Hydraulic improvements including flow control chambers and larger pipelines.
- One additional humus settlement tank.

The option to transfer flows to Salisbury STW and abandon Great Wishford STW has been appraised. This option has an estimated cost of £4.9m for the transfer only. In addition, treatment capacity improvements at Salisbury STW would also be required. This option has therefore been ruled out on the basis of its higher cost.

6. Proposed Solution

A high-level comparison of the treatment options is summarised below:-

Option	Secondary Chemical dosing	Hydraulic improvements	Existing Treatment units	Pump away to Salisbury STW

	and Tertiary treatment			
Meets new P permit limit	✓	×	×	✓
Provides increased hydraulic capacity	Part of works	✓	×	✓
Utilises existing assets	✓	✓	✓	×
Capex (£m)	4.356		-	4.857
Opex (£k/yr)	80		-	138
Lowest whole-life cost	✓		n/a	×

An additional secondary chemical dosing installation will be provided together with a tertiary stage to achieve the tighter phosphorus discharge permit limit. Chemical dosing at the works inlet will continue. The decision on the type of tertiary stage will be determined through detailed design and through our procurement system.

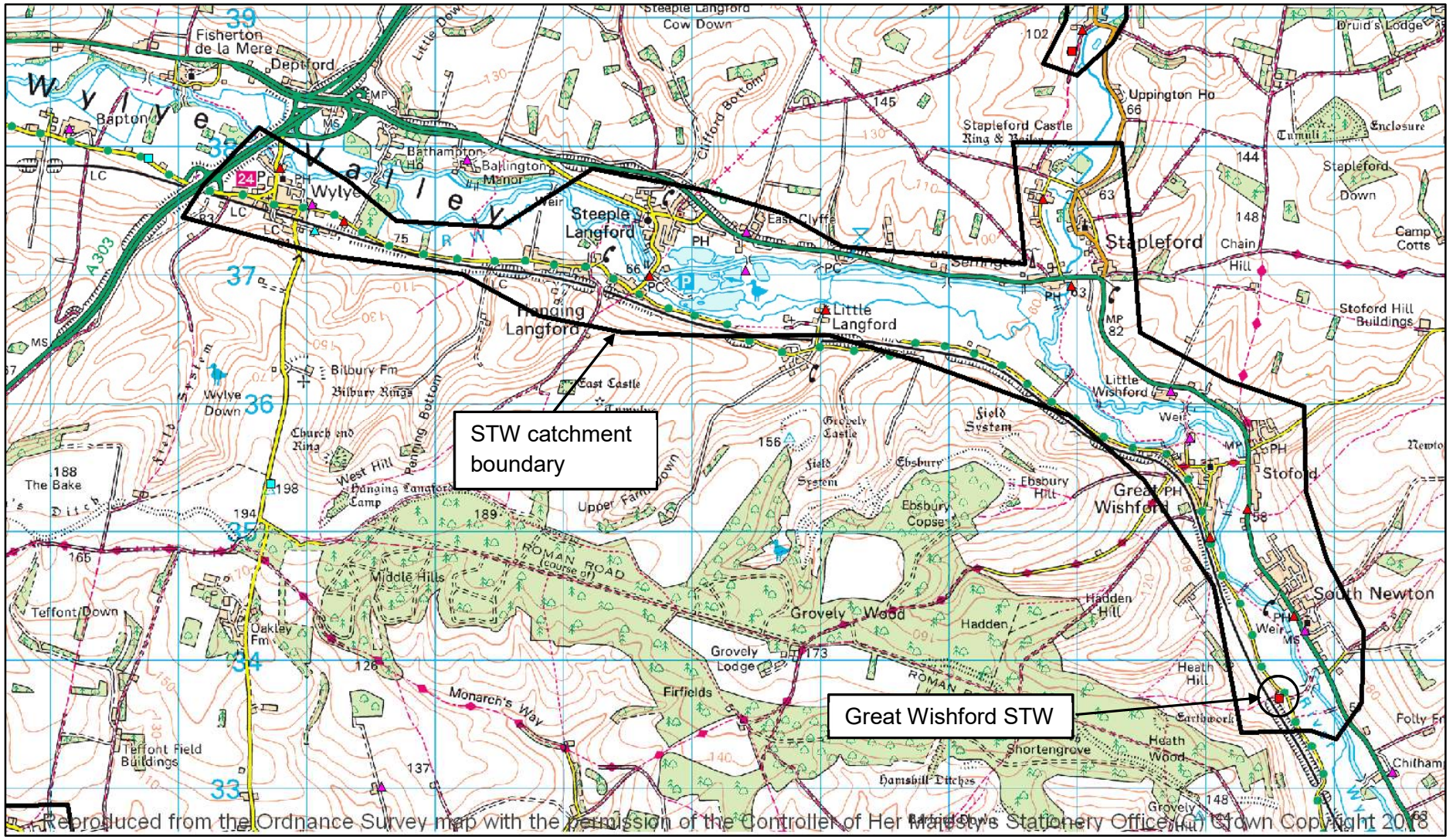
Hydraulic improvements will be provided to ensure that this treatment works can pass the increased permit FFT through the main treatment process. An additional humus settlement tank is needed as the existing units will be overloaded when the permit FFT increases.

The costs for the above improvements have been estimated at:-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	100%	4.356	0.080
	Total	4.356	0.080

The Environment Agency has confirmed that the above improvements do not qualify for any quality funding as the permit change is driven by the need for an increased permit DWF.

Appendix 1 - Great Wishford STW – Plan of Catchment



Annex J. Halstock STW

1. Summary

Name	Halstock STW
STW population served (2018/19 p.e)	314
Treatment capacity provided - PR19 enhancement (p.e)	39
Main driver	Quality (UWWTD)
Subsidiary driver	Growth
Total Capex (£m)	1.891
Growth Capex (£m)	0.095

2. Need

In December 2017 we were advised that the WINEP for PR19 would require an increase in flow to full treatment (FFT) at Halstock STW by about 30% (from 2.3 L/s to 3.0 L/s). This was confirmed in the WINEP(3) in March 2018, which included the increase in FFT described below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?	Old Permit (m^3/d)	New Permit (m^3/d)
7WW20041	U_IMP5	FFT	31/03/2024	Green	199	259

The 3.0 L/s figure represents the MDPF, this is will increase over time due to growth to 3.3L/s in year 2040.

The EA have stated, in relation to the U-IMP5 projects that "Future risk due to growth should be picked up by the Water Companies under growth or maintenance in their Capital Programme, not WINEP" and also that "U_IMP5 (and U_IMP6) drivers only apply to increases required to FFT (and storm tank capacity) over and above those required and funded under growth." [18]
This means that investment to meet the new FFT at year 2025 will be costed under the quality enhancement driver, while the provision of capacity to a reasonable design horizon (i.e. 2040) will be allocated to Growth enhancement.

For this very small STW there is very little difference in the nature, scale and cost of works required to provide hydraulic capacity to a design horizon of 2040 rather than 2025. Designing for the longer horizon is a longer term and more cost efficient investment strategy.

A project has been developed, taking account of these two drivers and synergies, to provide an efficient solution for the hydraulic capacity enhancement.

[18] Environment Agency (November 2017). PR19 further guidance for completing WINEP3 for flow drivers U_MON3, U_MON4, U_IMP5 and U_IMP6 DRAFT v0.10.
Environment Agency (December 2017). PR19 Driver Guidance: Increasing Flow to Full Treatment (FFT)- FINAL v3.

3. Background

Site Details	
The site serves following :	The village of Halstock.
Treatment Process	
The STW is a slightly unusual hybrid RBC/ biological filter works with septic tank, RBC, secondary filters and a humus settlement tank. See plan in Appendix 2.	

4. Options

Hydraulic Capacity

The existing biological RBC and filter work well and provide an efficient, low energy and sustainable treatment process. They have hydraulic design capacity headroom, to accommodate the flow increase required in the WINEP.
The humus tank also has capacity to accept the proposed increase in flow.

The septic tank is already significantly over-loaded hydraulically when compared with our standard design parameters, and the proposed increase in flow will cause a further deterioration in performance.

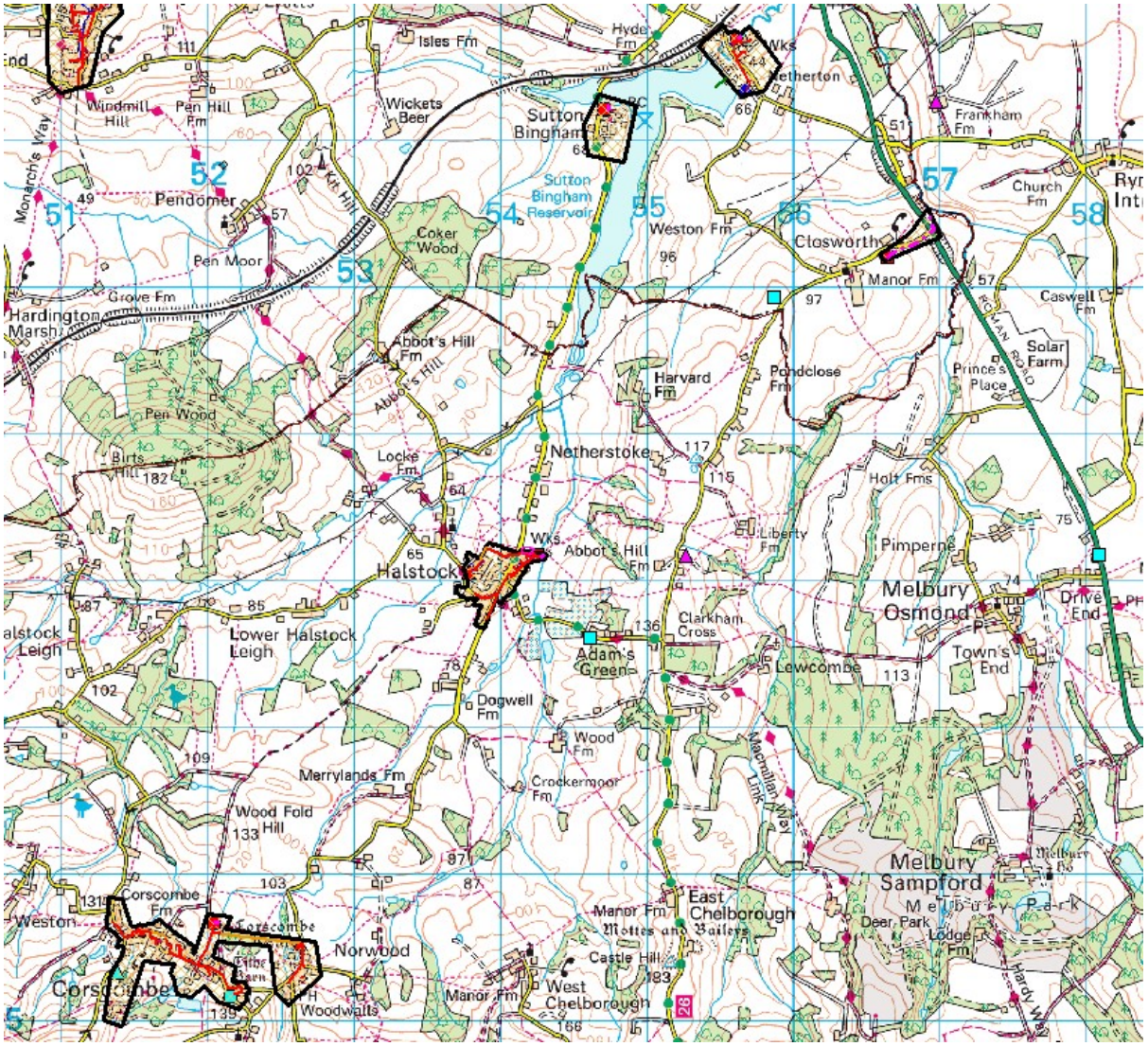
A single option proposal has therefore been made to provide increased capacity through the provision of one new primary settlement tank, together with a new sludge storage tank. This continues to make beneficial use of the existing treatment plant assets.

5. Proposed Solution

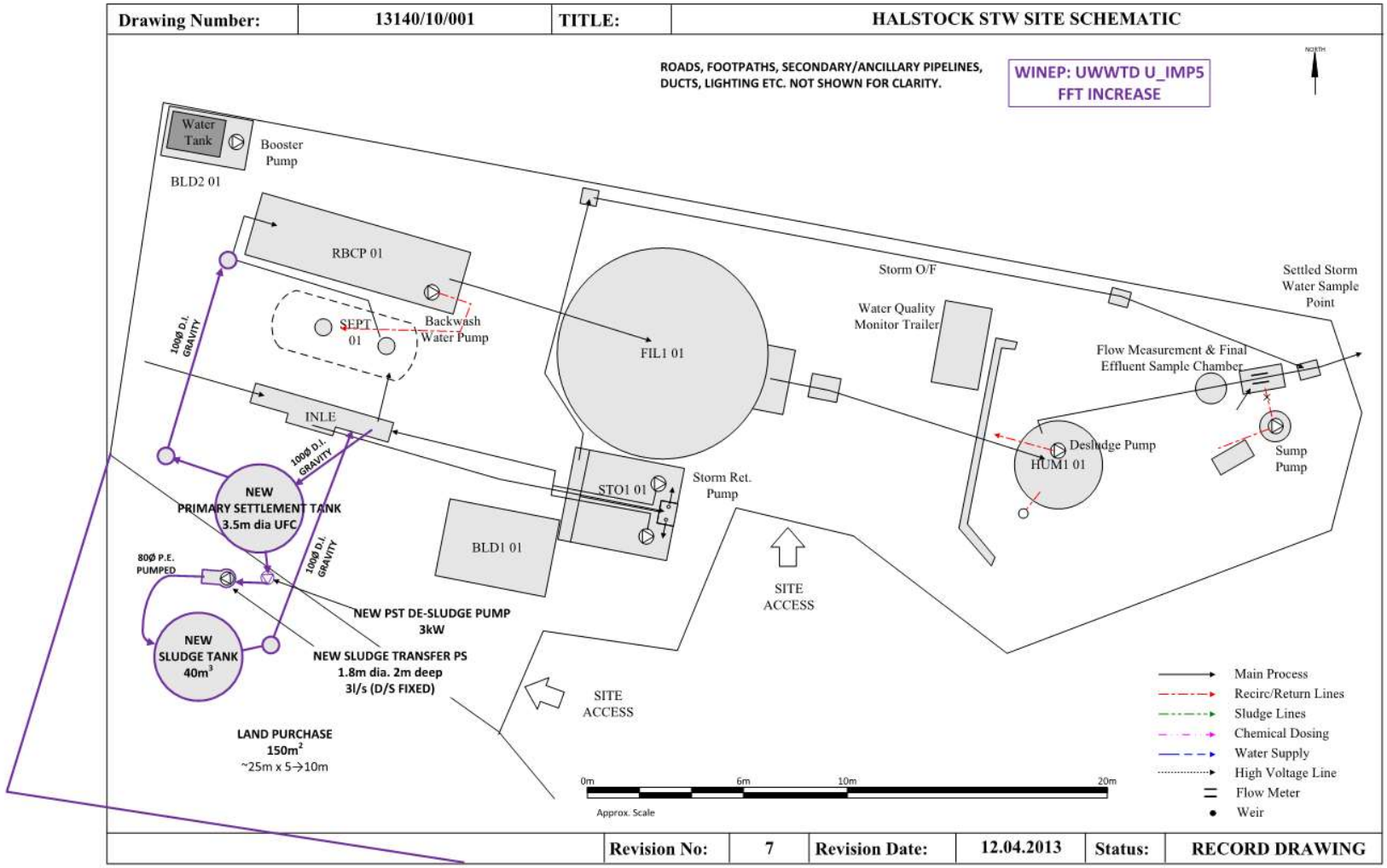
One new primary settlement tank and new sludge storage tank is proposed.

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	5%	0.095	0.014
Quality enhancement – increase FFT	95%	1.796	0.001
	Total	1.891	0.015

Appendix 1 – Plan of Halstock and nearby catchments



Appendix 2 – Sketch of Proposed solution



Annex K. Hurdcott STW

1. Summary

Name	Hurdcott STW
STW population served (2018/19 p.e)	3,487
Treatment capacity provided - PR19 enhancement (p.e)	652
Flow capacity being provided	65 L/s (increase of 69%)
Main driver	Growth (DWF)
Subsidiary driver	-
Total Capex (£m)	8.04
Growth Capex (£m)	8.04

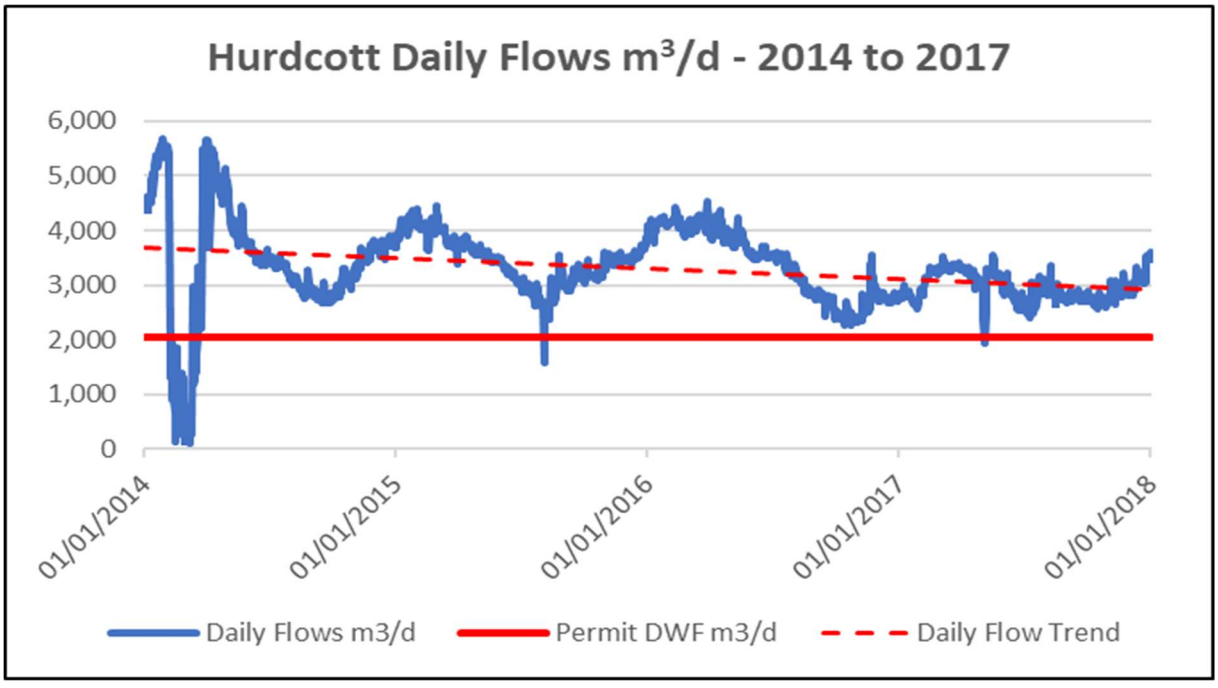
2. Need

Hurdcott STW is breaching its Dry Weather Flow (DWF) permit by 31%.

Historical growth has caused an increase in base flows to the STW and contributed to the DWF permit exceedance. Future development will exacerbate this further.

The EA have stated that breaches in DWF compliance will be reported in their annual Environmental Performance Assessment (EPA) from January 2026. This will be based on the previous 5 years, with flow compliance assessed for the period 2021 to 2025.

During 2015-20 Wessex carried out sealing works to the upstream sewerage catchment with some reduction in flows. However, the measured DWF continues to exceed its permit and it is now necessary for the treatment works DWF permit level to be increased.



The revised DWF permit will require a tightening of numeric permit limits, and an increase in the FFT through the STW.

There is also planned domestic growth, this will increase loads and require additional treatment capacity to achieve the pro rata tighter permit limits.

The EA WINEP(3) has not identified any quality driver for a scheme at Hurdcott STW in PR19.

3. Background

Site Details	
The site serves following :	The villages of Hurdcott, Winterborne Gunner, Winterborne Dauntsey, Winterborne Earls, Gomeldon, Porton, Idmiston, Boscombe, Allington, and Newton Tony. See plan in Appendix 1.
Treatment Process	
This STW has a conventional biological filter works with primary tanks, secondary filters, humus settlement tanks with the addition of tertiary sand filters. There is also chemical dosing for P removal.	

4. Evidence

Growth and Investment (Historical)

Additional treatment capacity at Hurdcott STW was last provided some 9 years ago, in 2009, with the construction of tertiary sand filters, phosphorus removal and storm storage.

Date	Project	Driver	Scheme
	D9221	Quality Enhancement	Phosphorus removal to achieve 1mg/L P and storm storage
2007	D9221	Quality Enh.	Phase 1 – single point dosing, sludge storage
2009	D9221	Quality Enh.	Phase 2 – secondary dosing, tertiary sand filters, storm storage.

The connected population within this works catchment has increased as indicated below:-

	2008	2010	2015	2017
Resident p.e.	3,046	3,047	3,299	3,395
Total p.e.	3,141	3,094	3,354	3,427

Growth (Future)

The Local Plan[19] for the Hurdcott STW catchment area includes plans for housing development. In addition to domestic growth, commercial and trade growth will place additional load on the works.

The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	3,487	3,567	3,768	3,863	3,960	4,060

[19] Wiltshire Council (March 2018). Housing Land Supply Statement. http://www.wiltshire.gov.uk/spp-housing-land-supply-statement-2017-published-2018-march.pdf

Performance

Hurdcott STW continues to exceed its permit DWF (2,034m^3/d) even after extensive sewer sealing works. This is probably due to the sewers being close to the river with ground water levels remaining high for prolonged periods of time. An increase in the permit DWF from 2034 to 2,994m^3/d is needed to enable this treatment works to comply with its permit. This will result in the following changes to the permit at the STW:-

- permit limits tightened from 20:30:10 to 14:28:3mg/L (BOD:SS:AmmN).
- Phosphorus permit limit tightened from 1mg/L to 0.7mg/L.
- Increase in permit FFT from 38.9 to 65L/s (69% increase).

The tightening of the phosphorus limit will require the installation of a secondary dosing point and flocculation.

The proposed increase in permit FFT from 38.9 to 65L/s (69% increase) will have a major impact on this works' treatment requirements. This increase will require the installation of a primary settlement tank, 2nr biological filters, humus settlement tank and 2nr tertiary sand filters to accommodate this increase in peak flow rate. Hydraulic improvements including flow control, pumping station, flow distribution and larger pipelines.

The installation of the tertiary sand filters during 2005-10 and their good performance means that the existing treatment works should not require any additional biological treatment capacity to achieve the tighter pro rata permit limits for BOD:SS:AmmN.

13158 Hurdcott STW

95%ile

	BOD atu	COD	Susp Solids	Ammonia as N
2014	8.0	24.8	6.3	1.0
2015	8.0	15.0	12.0	1.0
2016	8.0	18.9	7.0	0.4
2017	8.0	39.2	6.3	0.6
2018	8.0	22.6	9.5	0.4
Consent	**14**		**28**	**3**

5. Options

Capacity enhancements

As a result of the tightening of the phosphorus limit and the increase the permit FFT, additional treatment process units will be required together with an increase in hydraulic capacity. The planning horizon for the above is 2040.

The following options have been considered.

	Additional Sand Filters	Secondary dosing point	Increased hydraulic capacity
Phosphorus limit 0.7mg/L	Required to ensure compliance with proposed phosphorus permit limit.	Required to ensure permit compliance.	No improvement to phosphorus compliance.
Permit FFT 65L/s	Required to pass proposed flow but will not improve hydraulic capacity of existing process units.	No improvement to hydraulic capacity.	Required to pass increase in permit FFT.

Additional treatment capacity is needed within the next 5 years so that that the STW can comply with the new DWF permit.

The option to abandon Hurdcott STW and transfer flows to Salisbury STW has been considered, it is estimated that this would cost £12.8m for the transfer of flow and the required increase in FFT capacity at Salisbury.

Substantial amounts of sewer sealing works have been completed, this STW continues to exceed its permit DWF, it is now considered that a permit revision is needed to comply with the permit DWF.

Enhancements

To achieve the tighter phosphorus permit limit of **0.7mg/L**:

- Secondary chemical dosing point.
- Additional sand filters.

Increased permit FFT

- Additional primary tank, 2nr biological filters, humus tank, 2nr tertiary sand filters.
- Hydraulic improvements including flow control chambers, pumping station, flow distribution and larger pipelines.

6. Proposed Solution

A high-level comparison of the treatment options is summarised below:-

Option	Secondary Chemical dosing point	Hydraulic improvements	Existing Treatment units	Pump away to adjacent catchment
Meets new P permit limit	✓	×	×	n/a
Provides increased hydraulic capacity	×	✓	×	n/a
Utilises existing assets	✓	✓	✓	
Capex (£m)	8.043		n/a	12.771
Opex (£k/yr)	60		n/a	396
Lowest whole life cost	✓		n/a	×

An additional secondary chemical dosing point will be provided, chemical dosing at the works inlet will continue.

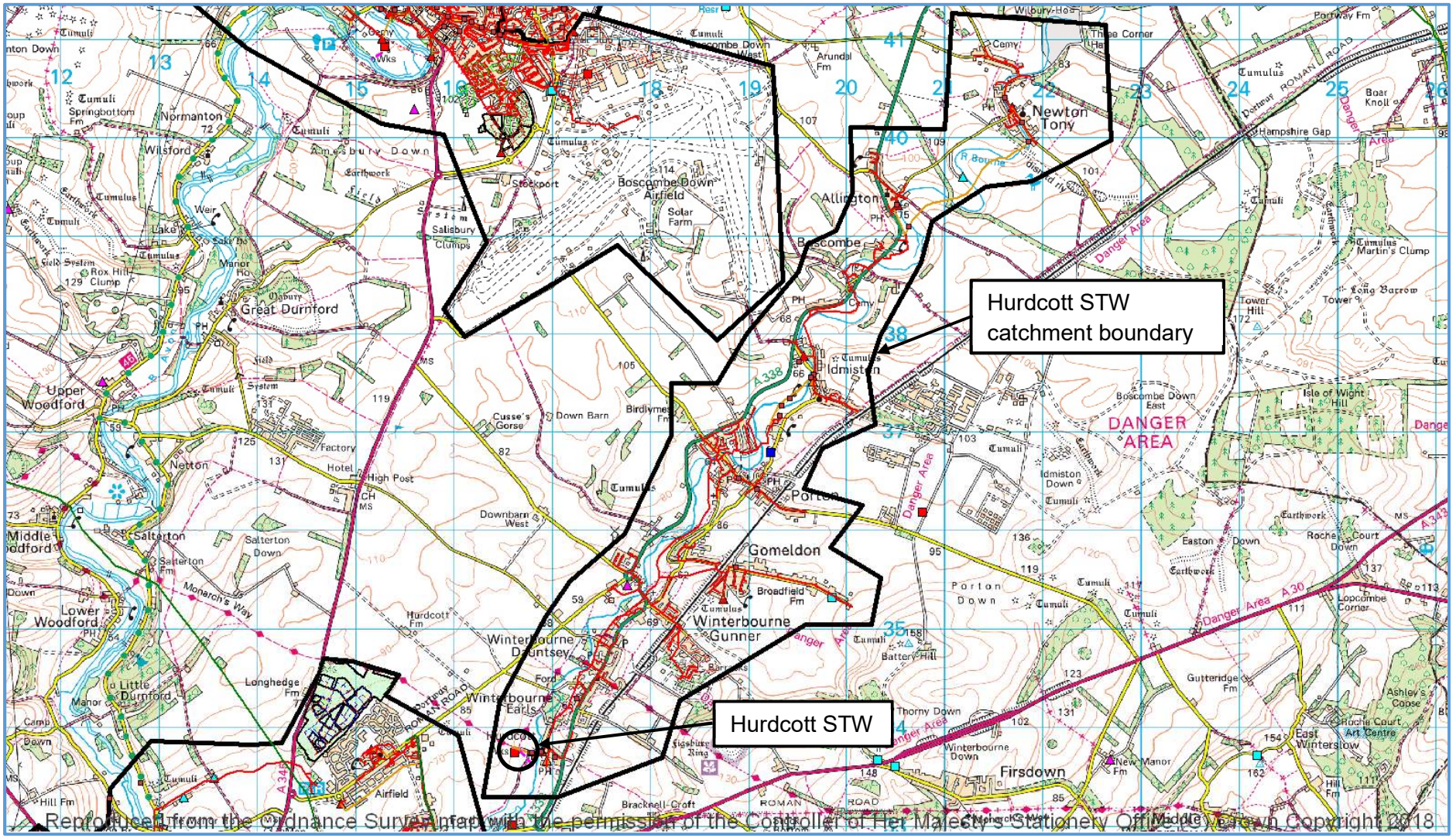
Hydraulic improvements will be provided to ensure that this treatment works can pass the increased permit FFT through the main treatment process, additional primary settlement tank, biological filter, humus settlement tank and 2nr sand filters are needed as the existing units will be overloaded when the permit FFT increases.

The costs for the above improvements have all been identified as STW growth:-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	100%	8.043	0.060
	Total	8.043	0.060

The Environment Agency has confirmed that the above improvements do not qualify for any quality funding as the permit change is driven by the need for an increased permit DWF.

Appendix 1 - Hurdcott STW – Plan of Catchment



Annex L. Keynsham STW

1. Summary

Name	Keynsham STW
STW population served (2018/19 p.e)	18,864
Treatment capacity provided - PR19 enhancement (p.e)	2,544
Main driver	Quality (WFD- ND)
Subsidiary driver	Growth
Total Capex (£m)	6.969
Growth Capex (£m)	0.697

2. Need

The STW is approaching the limit of its treatment capacity, in particular the capacity of the biological filters to remove ammonia is becoming over-loaded. Historical and future planned growth in both residential and trade flows and loads requires additional treatment capacity to be provided in order to maintain permit compliance.

Additionally the WINEP(3) requires a tightening of the AmmN permit at Keynsham STW, as below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?	Old Permit (mg/L)	New Permit (mg/L)
7WW300202	WFD_ND	Ammonia	31/03/25	Green	12.0	10.0

A combined project has been developed, taking account of these two drivers and synergies, to provide an efficient solution for the capacity and quality enhancements.

3. Background

Site Details	
The site serves :	The town of Keynsham and part of the village of Saltford. It borders the south-east boundary of the Bristol sewerage catchment area. A significant development planned at Hicks Gate between Bristol and Keynsham is likely to drain to the Keynsham STW. See plan in Appendix.
Treatment Process	
The STW is a conventional biological filter works with primary tanks, secondary filters and humus settlement tanks. There is also chemical dosing for P removal.	

4. Evidence

Growth and Investment (Historical)

Additional treatment capacity at Keynsham STW was last provided some 29 years ago, in 1989. Two additional filters were installed to add to the six original filters built in 1960.

Since then investment at this STW has focussed on capital maintenance, with filter media being replaced on several filters, and quality enhancement; the most significant of which have included:-

Date	Project	Driver	Scheme
2007	D9367	Capital maintenance	Filter media replacement
2009	D9531	Capital maintenance	Filter media replacement
2004	D1278	Quality enhancement	Phosphorus removal to achieve 2.0mg/L P

The size of population in the catchment has developed as shown below:-

	2012	2014	2015	2017
Resident p.e.	19,038	17,157	17,593	18,070
Total p.e.	19,761	17,638	18,274	18,509

The large decrease in resident population between 2012 and 2014 was due to the diversion of a pump station, which meant that a large proportion of the Keynsham catchment within the town of Saltford (approx. 800 households) was transferred to the Bath (Saltford) STW catchment.

Growth (Future)

The Local Plan[20] for Keynsham STW catchment area includes plans for future housing development as shown below:

	2018-2020	2021-2025
New dwellings (Nº)	345	575
New residents (p.e.)	776	1,293

In addition to domestic growth, commercial and trade growth will place additional load on the works.

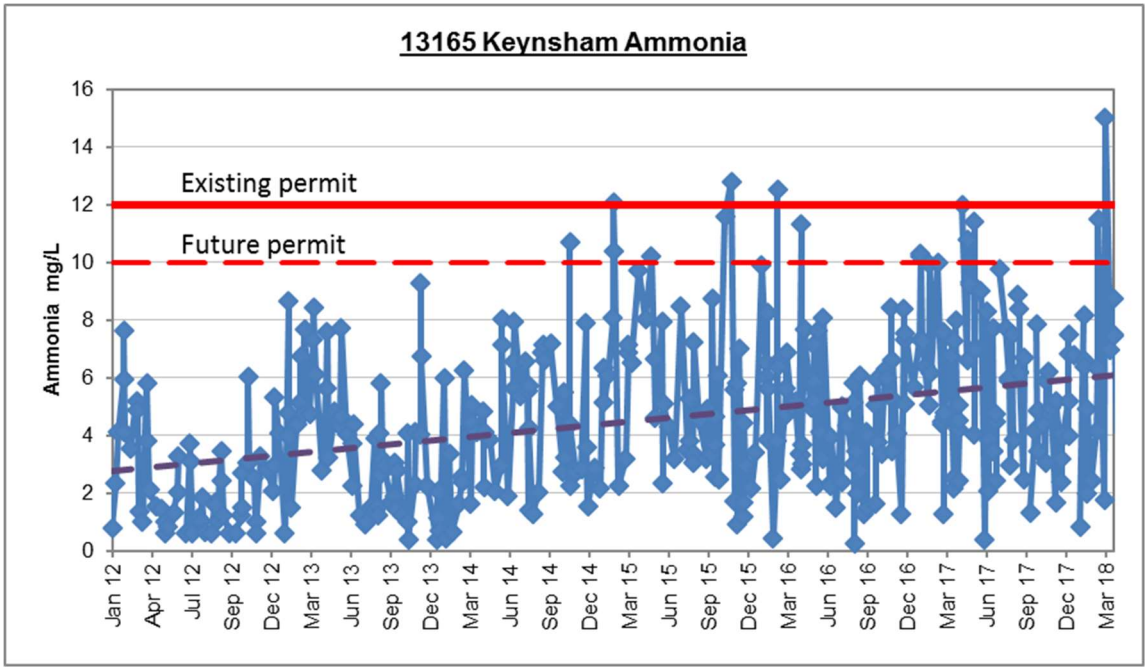
The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	18,864	19,392	20,708	21,394	21,936	22,491

Performance

Evidence from our sampling data over the last 6 years shows an increasing (deteriorating) trend in the levels of AmmN in the final effluent:-

[20] B&NES Council (March 2017). Bath & North East Somerset Council Monitoring Report. http://www.bathnes.gov.uk/sites/default/files/sitedocuments/Planning-and-Building-Control/Planning-Policy/AMR/amr_housing_dashboard_2011-17.pdf



In addition, due to the planned growth in the catchment and the associated increase in base flows, the EA have advised that the AmmN permit will tighten from 12.0 to 10.0mg/L in PR19. This is to prevent deterioration of the receiving watercourse.

5. Options

Capacity

At 2020 the biological filters will be loaded at between 20-30% over their design capacity for AmmN removal (to new permit level). By 2035 our assessment shows that they will be about 40% over-loaded.
They are within capacity for BOD removal, with considerable headroom available.
The STW is well within its dry weather flow (permit) figure, with significant headroom available to accept growth in the base flow. (DWF)

Additional treatment capacity is needed within the next 5 years. The existing treatment process uses conventional biological filtration which is a low energy, sustainable and effective process capable of achieving the proposed new permit standard. The feasible solution for providing this additional capacity therefore includes:-

i) Provision of additional secondary treatment : 3no. additional biological filters + additional humus tank – pumped feed

Replacement of the filter works with a smaller footprint activated sludge plant has been considered, however this has been estimated in excess of £10m.

Quality Enhancements

Our standard design solutions for achieving a **10.0mg/L AmmN** permit standard (95%ile) include:-

- Secondary treatment – biological filters (stone media or plastic media)

- Secondary treatment - activated sludge process

The existing STW at Keynsham is set out as a conventional secondary treatment process with stone media conventional filters. It is clear, from inspection that additional treatment using a similar fixed film (filter) treatment process will be the most efficient, sustainable and lowest whole-life-cost solution to meet the tighter AmmN standard.

6. Proposed Solution

A high-level comparison of the treatment options is summarised below:-

Option	Additional Secondary biological filters - pumped	New Activated Sludge Process
Provides treatment capacity	✓	✓
Meets new AmmN permit	✓	✓
Utilises existing assets	✓	X
Capex (£m)	6.969	>£10.0
Opex (£k/yr)	132	>500
Lowest whole-life cost	✓	X

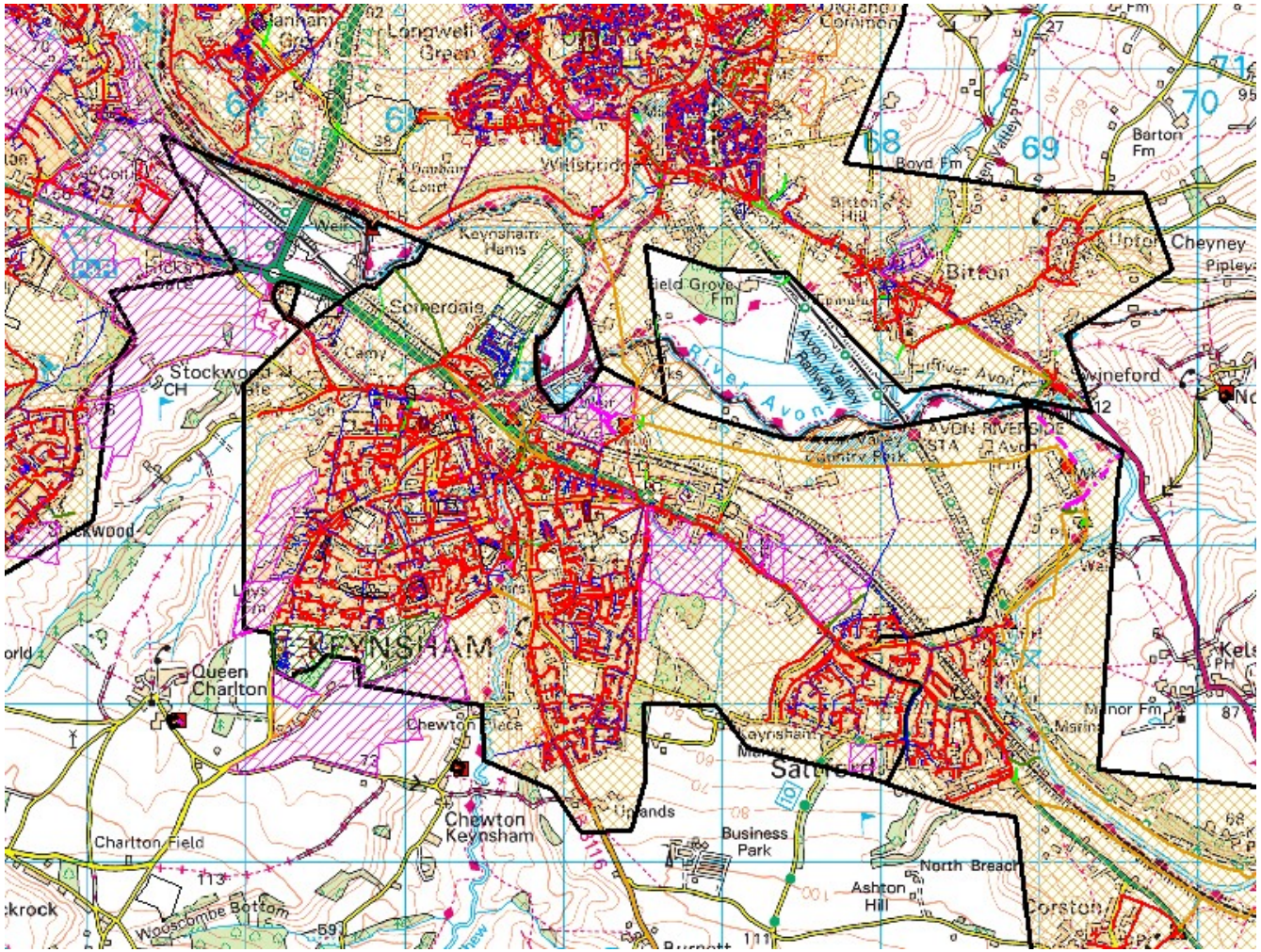
The proposed solution is therefore to use the lower energy and more sustainable solution of gravity fed biological filters to achieve:-

- increased treatment capacity (to 2035)
- a more stringent AmmN permit (10.0 mg/L AmmN)

The costs have been apportioned between drivers as below :-

	Percentage	Capex (£m)	Opex (£m/yr)
Quality enhancement - AmmN	90%	6.272	0.119
STW Growth (capacity)	10%	0.697	0.013
	Total	6.969	0.132

Appendix 1 - Keynsham STW – Plan of Catchment, showing potential ( ) and approved ( ) development areas



Annex M. Langport STW

1. Summary

Name	Langport STW
STW population served (2018/19 p.e)	10,281
Treatment capacity provided - PR19 enhancement (p.e)	1,039
Main driver	Quality (WFD)
Subsidiary driver	Growth
Total Capex (£m)	4.626
Growth Capex (£m)	2.570

2. Need

The STW is operating near the limit of its treatment capacity. There has been historical growth in residential flows and further residential development within the catchment is planned. Trade flow comprises the discharge from an abattoir/meat processing and recent changes to on-site treatment at the traders premises have resulted in increased Ammonia load arriving at the site.

To maintain compliance temporary treatment has been installed.

Additionally the WINEP(3) requires a tightening to remove Phosphorus from the discharge at Langport STW, as below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?	Old Permit (mg/L)	New Permit (mg/L)
7WW200516	WFD_IMPg	Phosphorus	22/12/24	Amber	n/a	3.8[21]
7WW200516	HD_IMP	Phosphorus	-	Red		0.5

A combined project has been developed, taking account of these multiple drivers and synergies, to provide an efficient solution for these capacity and quality enhancements.

3. Background

Site Details	
The site serves :	The STW serves Langport and the surrounding villages of Aller, High Ham, Ham, Pitney, Long Sutton, Drayton and Curry Rivel. See plan in Appendix.
Treatment Process	
The STW works is a conventional biological filter works (primary settlement secondary filters, humus settlement) with tertiary grass plots	

[21] Our “Alternative approaches to the delivery of the WINEP” proposes a new permit of 1.0mg/L

4. Evidence

Growth and Investment (Historical)

The original works was constructed in the 1960s, a major extension was undertaken in the mid 1970's when new primary tanks, additional secondary filters and new humus tanks were provided. This was the last investment for growth (>40years ago).

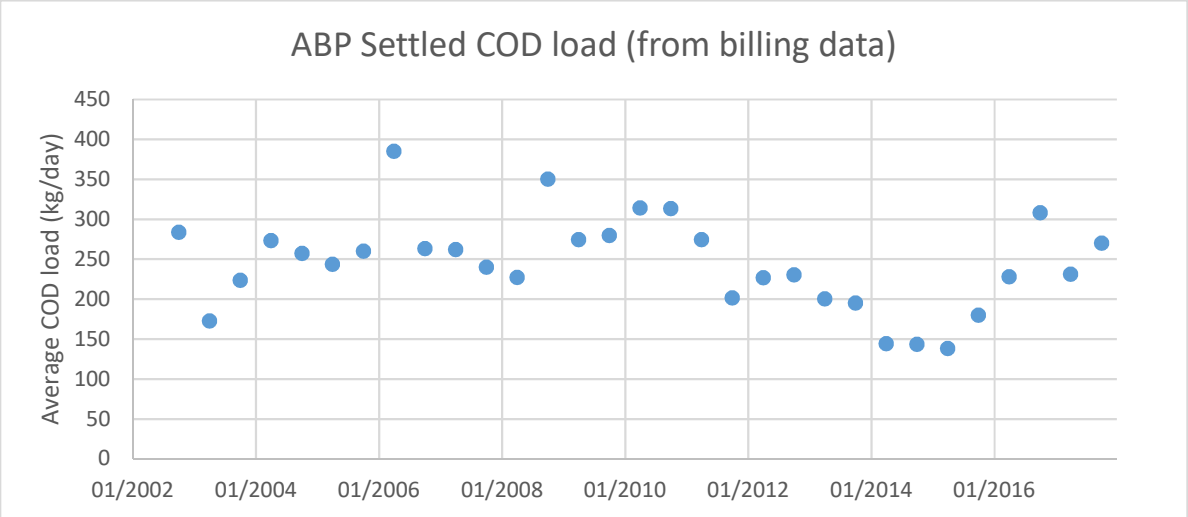
Date	Project	Driver	Scheme
2015	D9386	Capital maintenance	New inlet screen and screenings handling plant
2017	DK267	Capital maintenance	3 Temp SAF plants installed

The size of population in the catchment has developed as shown below:-

	2001	2005	2010	2015	2017
Resident p.e.	6634	6930	6588	7062	7288
Total p.e.	9098	9471	9161	9032	8970

Residential population has risen consistently by 0.6% per annum. Variabilities in the total p.e. are associated with seasonal variations in trade effluent loads.

The total p.e. includes a trade element and the above figures would suggest that the increase in domestic load has been offset by reduced trade load. However, trade load is variable and the above table simplifies the figures. The following graph of actual trade over the same period better represents this impact of trade flows on the STW.



Growth (Future)

The Local Plan[22] for the Langport STW catchment area includes plans for future housing development as shown below:

[22] South Somerset District Council (September 2017). South Somerset Authority Monitoring Report. https://www.southsomerset.gov.uk/media/898612/annual_monitoring_report_2017_issue.pdf

	2018-2020	2021-2025
New dwellings (Nº)	51	85
New residents (p.e.)	114	191

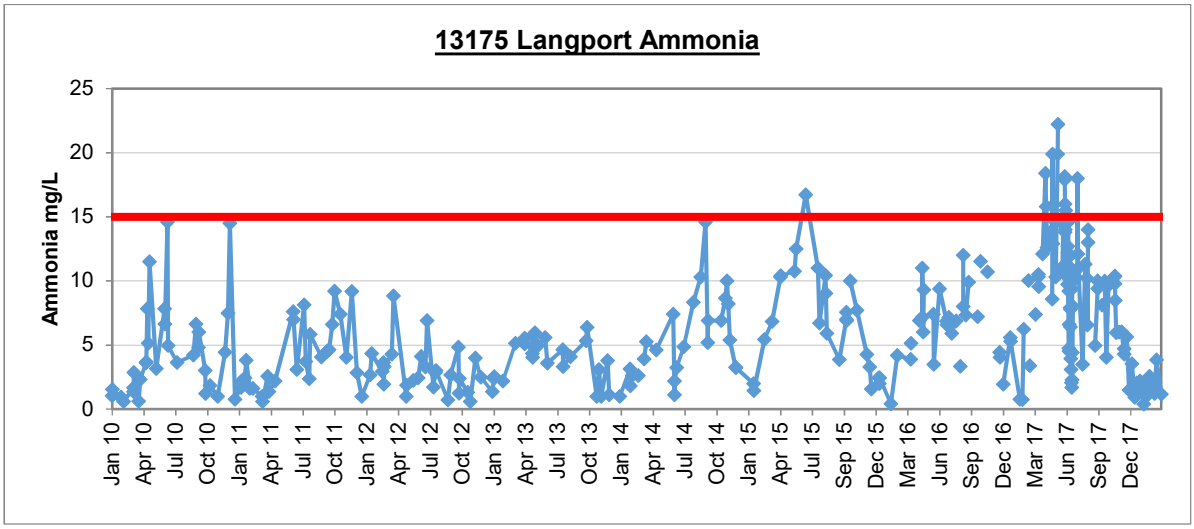
In addition to domestic growth, commercial and trade growth will place additional load on the works.

The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	10,281	10,465	10,801	11,147	11,505	11,876

Performance

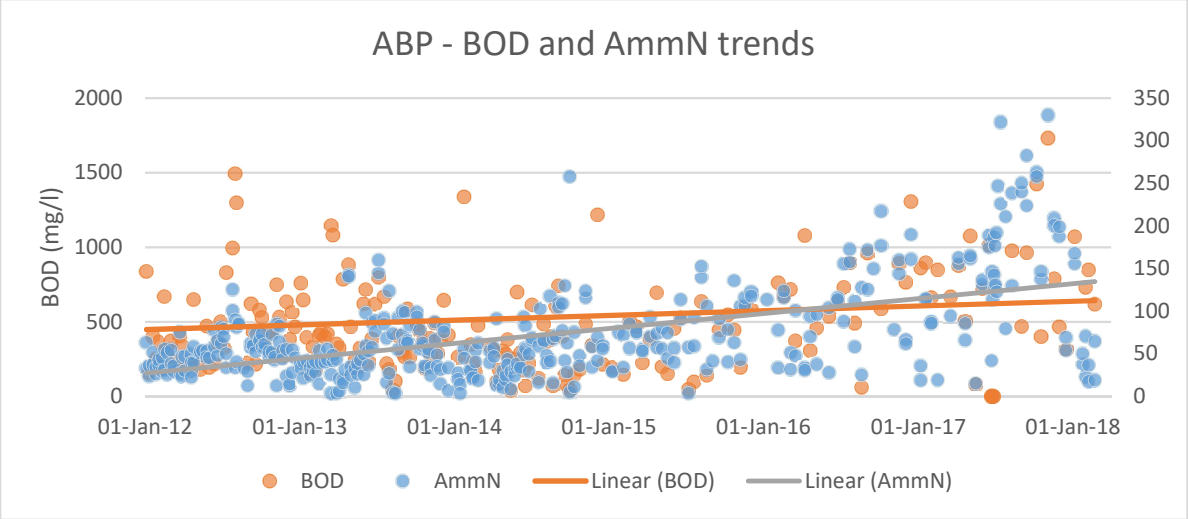
Performance of the STW since 2010 is demonstrated by the following graph:-



There is a gradual decline in performance from 2014 onwards. The site had two 'look-up' failures in 2017 for ammonia, making the site 'one away'.

The improvement in late 2017 reflects the installation of the short-term measure of providing 3 No. temporary submerged aerated filters.

The rising Ammonia load is predominantly due to the influence of the trader. The following graph shows that whilst the BOD concentration to the STW from the trader (from which the p.e. figures are derived) has remained consistent over the last 5 years the Ammonia concentration has increased significantly by a factor of at least 3.



5. Options

A combined scheme to provide additional AmmN treatment capacity and achieve the proposed Phosphorus consent of **1.0 mg/L**[23] include:-

- Aerated tertiary sand filters with single point chemical dosing, or
- Single point front end chemical dosing with additional secondary treatment capacity

6. Proposed Solution

A high-level comparison of the treatment options is summarised below:-

Option	Aerated Sand Filters	Chemical dosing + secondary treatment
Capability to meet tighter P consent	✓	✓
Capex (£m)	4.297	4.626
Opex (£k/annum)	102	37
Lowest whole-life cost	X	✓

The costs have been apportioned between drivers as below :-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	55%	2.570	0.016
Quality enhancement - Phosphorus	45%	2.057	0.021
	Total	4.626	0.037

[23] Our "Alternative approaches to the delivery of the WINEP" proposes a new permit of 1.0mg/L

Appendix 1 – Plan of Catchment, showing potential ( ), and approved ( ) development areas
(Also showing Somerton STW catchment)

Annex N. Poole STW

1. Summary

Name	Poole STW
STW population served (2018/19 p.e)	168,397
Treatment capacity provided - PR19 enhancement (p.e)	35,479
Main driver	Growth (Strategic)
Subsidiary driver	-
Total Capex (£m)	11.431
Growth Capex (£m)	11.431

The Poole STW catchment has seen significant growth recently and due to the historical evolution of the site, the works now has three treatment streams; both the Eastern and Western works are now overloaded compared to design capacity. The third stream, the BAFF plant, which takes approx. 65% of the flow, performs well and produces the highest quality effluent. During storm flows, the hydraulic restrictions caused by the fine media at the BAFF plant causes more flow and load to be transferred to the Eastern and Western works, exacerbating the overloading issues on these streams and thus performance deteriorates. The site also struggles to reliably pass permit FFT due to these hydraulic restrictions.

The site itself is very constrained for available space and due to continuous development in the surrounding area, there is no scope for expansion within the immediate vicinity of the site, nor is there land available within a feasible distance for relocation.

Poole STW effluent discharges into Holes Bay and is a highly sensitive area. Holes Bay flows into Poole Harbour, which is a large natural harbour situated between Bournemouth and Swanage on the south coast of England. It is designated as a Site of Special Scientific Interest (SSSI), a Special Protection Area (SPA) under the Habitats Regulations 1994, and as a Ramsar site. It is also designated as a Sensitive Area under the Urban Waste Water Treatment Directive. See Appendix 2 for a map of the environmental designations.

“Tourism makes a major contribution to the economy of Poole, with visitors contributing over £200m annually, supported by over 5,000 jobs in local businesses. Poole Harbour has stunning natural scenery and provides a superb arena for water based activities. Poole’s beaches are held in high regard due to their quality and cleanliness”. [24]

A judicial review into the government’s and EA’s approach to dealing with polluting discharges into Poole Harbour reported in 2018. As a result of the judicial review a legally binding Consent Order (CO) has been agreed between the parties involved. This requires the EA, working with Natural England (NE), to evaluate whether the existing measures and mechanisms to tackle pollution will lead to the improvements in water quality necessary to meet the conservation objectives for the Poole Harbour Natura 2000 (N2K) site. The EA, with support from NE, have subsequently produced a draft technical document

[24] Borough of Poole (July 2017). Poole Local Plan: Pre submission draft.

"Recommendations to deliver Favourable Status across Poole Harbour Catchment " which sets out options for further environmental improvements that will be required across the catchment to meet the environmental objectives. It includes recommendations for further Nitrogen and Phosphorus load reductions from fluvial and point source discharges into the harbour.
An investigation into the impact of discharges from our STWs on Poole Harbour is included in PR19 WINEP, following which the permitted total Nitrogen from Poole STW is expected to tighten and a phosphorus consent placed on the works in PR24. This would require enhancement of the existing nitrogen removal process and a new phosphorus removal process located within the existing STW site.

Investment in capacity is required in PR19 due to phasing requirements as a result of the site spatial limitations; deferment would lead to further deterioration in the available treatment headroom and significantly limit the ability to expand the capacity at the existing site in an efficient manner.

2. Need

The STW has reached the limit of its treatment capacity and the one stream has reached its hydraulic capacity (BAFF plant). Historical and future planned growth in both residential and trade flows and loads requires additional treatment capacity to ensure that the site continues to maintain environmental permit compliance, additional treatment capacity will be required to comply with the existing FFT permit at the works.

Site spatial restrictions require future rebuild of one of the treatment streams (Western Works) with a more efficient, smaller footprint treatment process. Additional capacity must be provided during 2020-25 to facilitate these works during 2025-35.

The regional medium-term plan allows for flows from Lytchett Minster STW to be transferred to Poole STW early in PR24. This will place an additional increase in load on the works. Poole STW must have treatment headroom ahead of this transfer to accommodate this additional load whilst maintaining environmental permit compliance.

Additionally the WINEP(3) requires an investigation for both Total Nitrogen and Phosphorus discharged into Poole Harbour, which will inform new permits at Poole STW, as below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?
7WW300207	HD_INV	Nitrate	31/03/2022	Green
7WW300207	HD_INV	Phosphorus	31/03/2022	Green

Any additional tightening of nutrient permits will require construction of additional treatment processes in future within the existing spatially constrained site.

3. Background

Site Details	
The site serves the following:	Poole Sewage Treatment Works (STW) treats incoming sewage from the Poole area and discharges final effluent into Poole Harbour. The Poole STW site is located within an urban and semi-industrial area and the land surrounding the site is fully developed. There is a site-specific odour management plan in place. Poole STW is the only sewage works within the Wessex Water region with a total nitrogen consent due to the environmental significance of the receiving environment. The site also receives many trade effluent discharges including a number of metal plating companies.

Treatment process:	The incoming FFT to the site is split between three treatment streams, being:
	• Eastern Works – 21% FFT
	• BAFF plant – 65% FFT
	• Western Works
	  ○ ASP1 – 6% FFT
	  ○ ASP2 – 8% FFT

4. Evidence

Growth and capacity (historical)

The Poole region has grown steadily over time with past investments made to enhance the treatment capacity as required.

The size of population in the catchment has developed as shown below:-

	2002	2006	2010	2015	2017
Resident p.e.	124,450	137,428	130,088	136,245	144,516
Total p.e.	173,230	178,401	175,258	161,333	172,541

Resident populations have been steadily increasing, on average rising by 1.6% per annum since 2010. Variabilities in the total p.e. are associated with seasonal variations in trade effluent loads.

Figure 10-3 shows the upwards trend in flow received at the Poole works since 2012, with Figure 10-4 providing a summary of historical enhancement expenditure and changing environmental drivers.

Figure 10-3: Poole STW historical flow

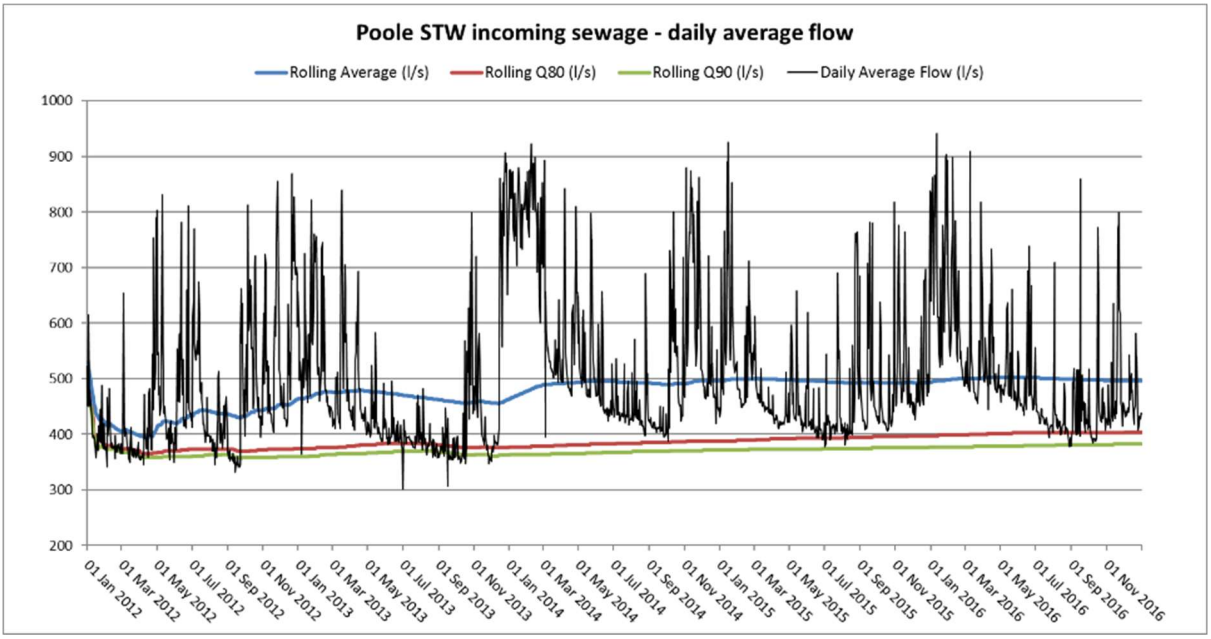
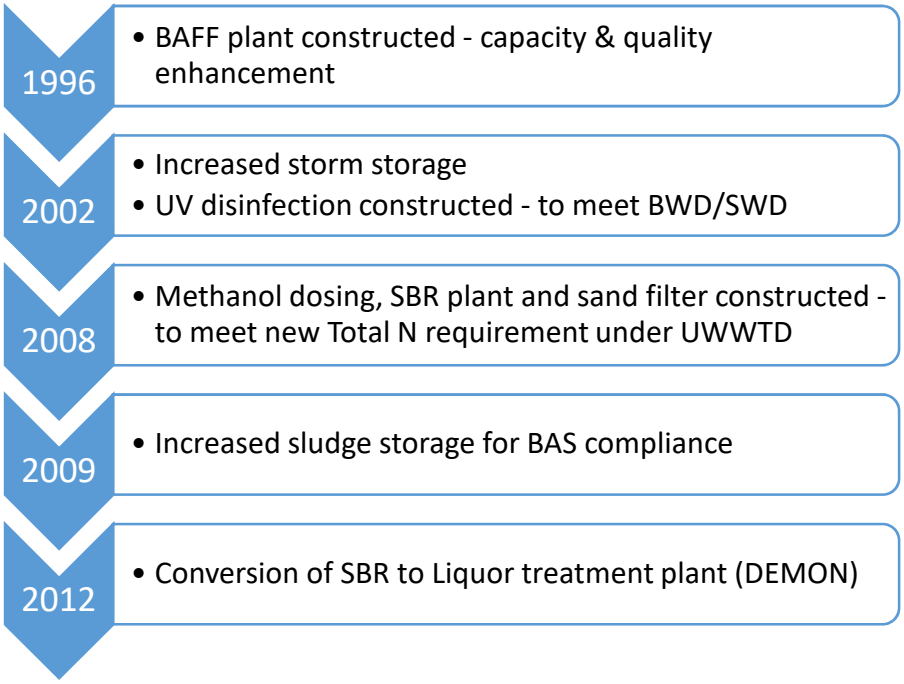


Figure 10-4: Poole STW historical enhancement



Growth (future)

There is significant growth within the Poole STW catchment, with an established development plan for the region. Poole has been assessed as requiring a minimum of 14,200 new homes from 2013 to 2033 (710 homes per year)[25]. This is a step change in housing growth requirement of 10,000 for the period 2006 to 2026 (500 homes per year). [26]
See Appendix 3 for areas of proposed development within the existing Poole STW catchment. Projected housing development is summarised below:

[25] Borough of Poole (July 2017). Poole Local Plan: Pre submission draft.
[26] Borough of Poole (July 2017). Poole Local Plan: Pre submission draft.

	2018-2020	2021-2025
New dwellings (Nº)	1,548	2,580
New residents (p.e.)	3,483	5,805

In addition to domestic growth, commercial and trade growth will place additional load on the works.

The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	168,397	171,037	177,396	181,678	186,266	190,969

Lytchett Minster STW (located to the west of the Poole catchment) is expected to exceed 10,000 p.e. load on the works soon after 2025. This triggers the requirement for Nitrogen removal under the Urban Wastewater Treatment Directive (UWWTD).
As part of the regional plan, options to meet this requirement have been assessed by Wessex Water and the most efficient solution is to transfer flows to Poole STW rather than upgrade the works to remove total nitrogen. In addition to a further increase load received by the Poole STW, this will trigger a tighter total nitrogen consent to prevent deterioration of the receiving water body.

Performance
The BAFF plant installed in the 1990s was selected as an innovative and efficient process for the available site footprint. The subsequent development in the catchment, and installation of MCERTS flowmeters since the commissioning of the BAFF plant have caused the plant to reach its treatment capacity and have stretched the hydraulic capability of the process.

Poole STW struggles to reliably pass its permitted flow to full treatment (FFT) and operational improvements and modest capital investment have been made to optimise hydraulic performance on the three existing treatment streams. This has included:

- additional cross-site pipeline to maximise flows to Eastern works,
- introduction of additional screening stage to improve the BAFF plant performance (reduction of solids passed through, which can cause blockages)
- increased operational resources

These operational improvements represent short-term measures that will not provide FFT compliance in the longer term. More significant interventions will be required to ensure FFT compliance becomes more resilient at Poole STW in the long term.

A process review has identified that the Western Works is currently overloaded with respect to sludge age and the Eastern Works with respect to sludge loading rate. Both streams have insufficient aeration capacity and subsequently perform poorly during peak loads.
The BAFF plant produces the highest quality effluent of each of the three treatment streams; during a storm event, the FFT split to the BAFF plant decreases due to blinding etc. and thus more flow is pushed to the other treatment streams. As these other streams already have

insufficient aeration capacity, increased flow during a storm event causes ammonia performance to deteriorate.

The combined final effluent performance (including the BAFF plant) currently meets permit compliance, however, due to the hydraulic constraints no additional flow can be passed through the BAFF plant (existing flow split to the BAFF plant of 21% FFT).

See Figure 10-5 and Figure 10-6 for ammonia performance graphs for the Western and Eastern works (respectively) during times of high flows into the works.

Figure 10-5: Western Works - Effluent Ammonia Performance during storm event

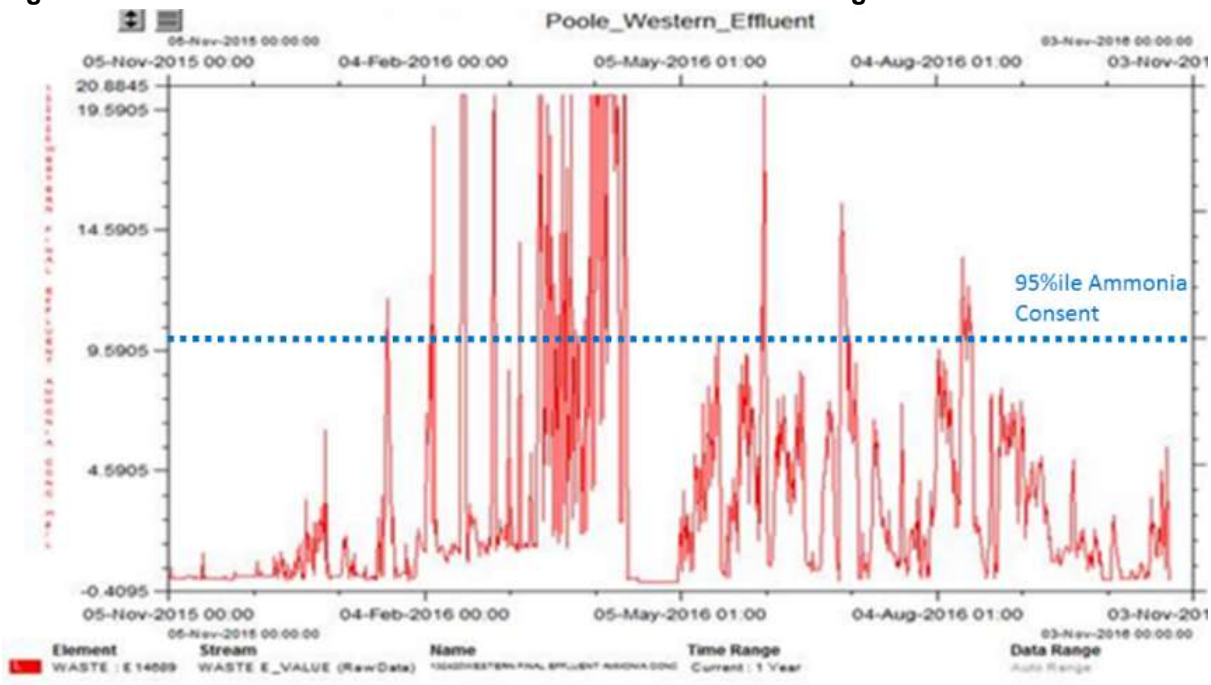
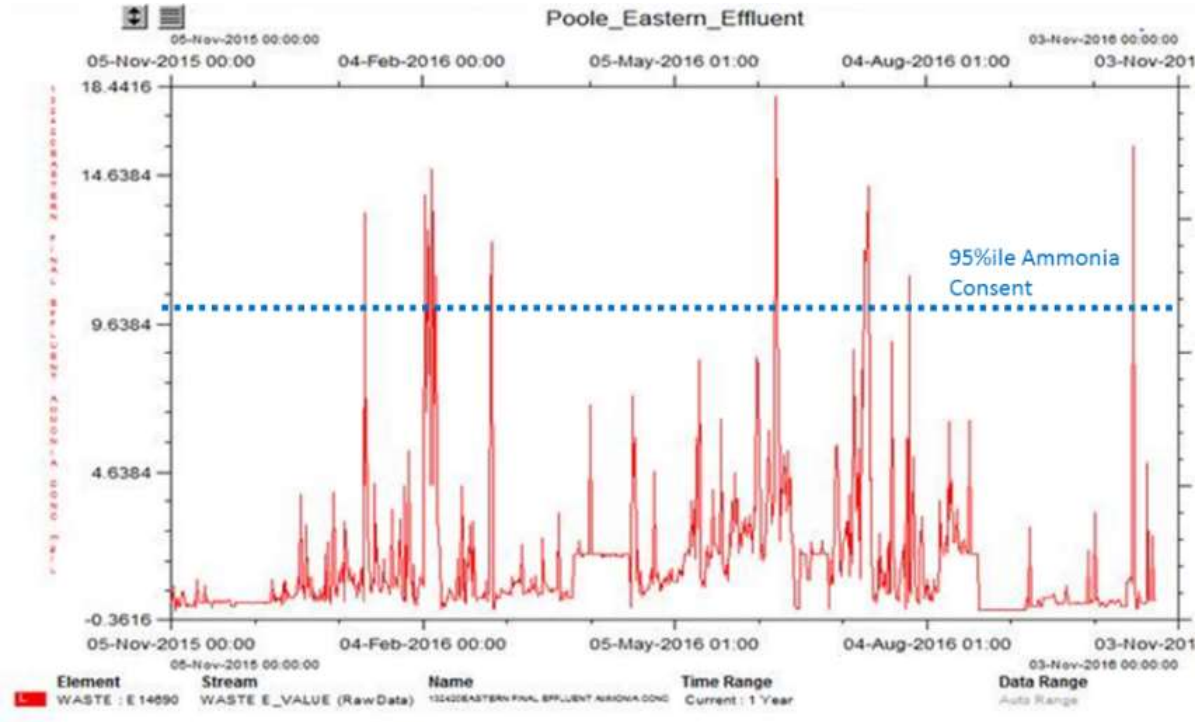


Figure 10-6: Eastern Works - Effluent Ammonia Performance during storm event



The reduced performance of the Western and Eastern works will only be exacerbated as incoming load to the site increases with catchment population growth. This deteriorating performance and associated reduction in FFT to the BAFF plant will lead to an increase the risk of process failure and thus poor environmental performance in future.

In order to delay investment, in the short term the poor performance of the Western and Eastern process streams has been managed by the performance of the newer BAFF plant, however in the medium to long-term, significant capital investment is required.

5. Long-term plan

The long-term plan for the STW will be significantly influenced by the final confirmed recommendations of the Judicial Review Consent Order. The current draft document suggests a future need for significant improvement in treatment to remove Nitrogen and Phosphorus to very low levels. There is minimal space available within the existing works to build more treatment units, without demolishing existing structures.
The site boundaries have been encroached upon by industrial and commercial developments, removing any opportunities to purchase further land adjacent to the site.

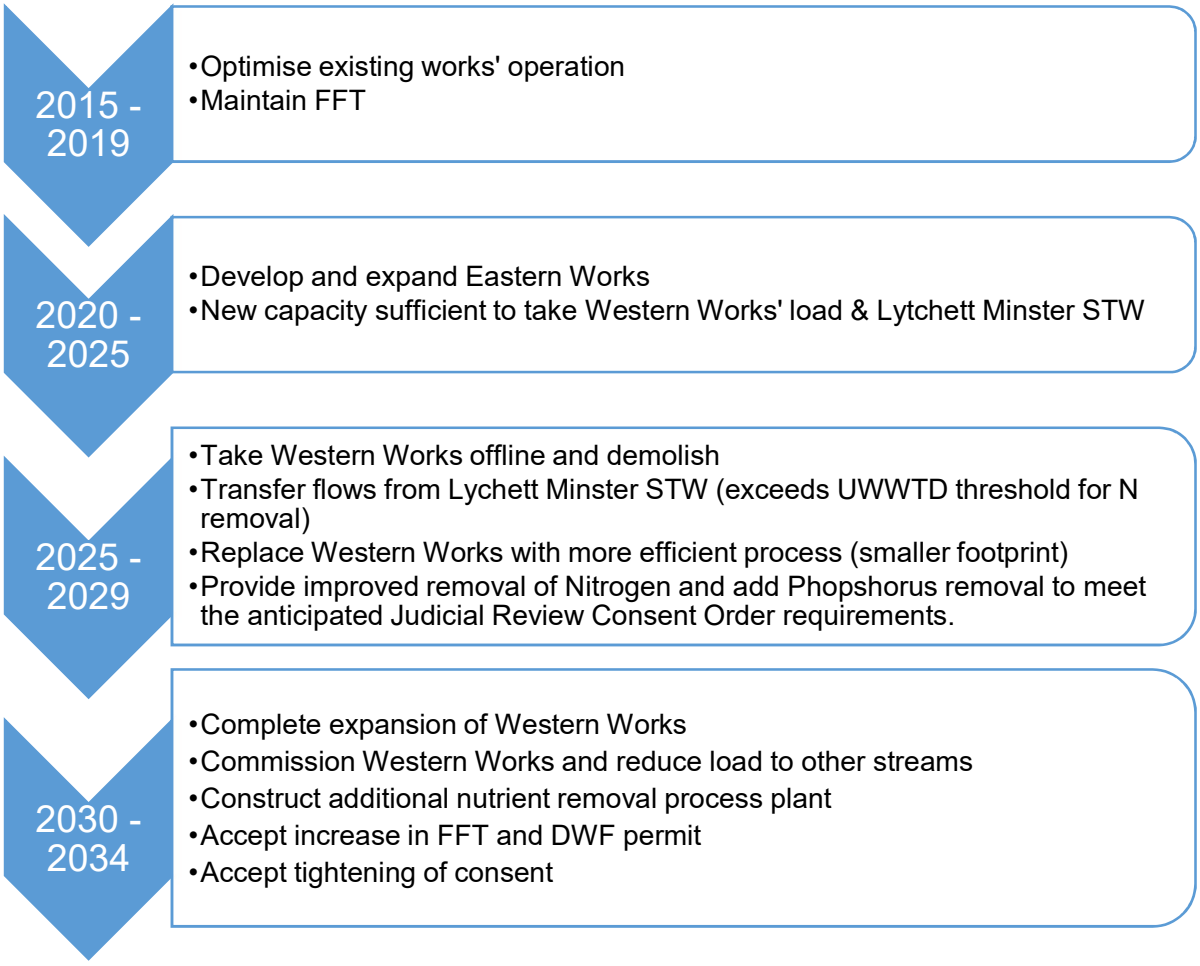
Opportunities of relocating some of the STW to a nearby site have been investigated as part of the longer-term strategy for the works. The majority of vacant land within the Poole catchment has environmental designations (i.e. SSSI, Scheduled National Monument and AONB) and the remaining vacant land has been earmarked by the Poole council for domestic/commercial development (schools etc.)

If the site were to relocate, the value of the land for the existing site (retaining the existing inlet works and effluent discharge arrangements) of approx. 7 ha. is estimated at £4.5m.

This figure, however, can only be treated as a mere indication of potential land value and will be dependent upon site condition, legal restrictions, planning and market strength.

A phased approach is required with an initial investment in a 'small footprint' treatment process to provide additional capacity and headroom capacity. This will then allow an older less space efficient treatment process to be replaced with a more efficient 'smaller footprint' treatment process in the future. The high-level long-term plan for Poole STW is summarised in Figure 10-7.

Figure 10-7: Poole STW long-term plan



The works required to facilitate future growth and quality enhancement at Poole STW have been estimated as part of our long-term planning. The following table summarises the costs of each phase (at 17/18 price base):

Phase	Scope	Capex (£m)	Business Plan
1	• New capacity (20% of existing p.e.)	11.4	PR19
2	• Hydraulic modifications for increased flows (Lytchett Minster) • Demolition of Western Works	5.2	PR24
3	• New Western Works	27.3	PR24+PR29
4	• New methanol dosing	9.7	PR29

6. Options (PR19)

For the works required during 2020-2025, 5 options were considered as follows:

No.	Title	Detail	Capex £m	Opex £k
1	Additional Activated Sludge treatment stream using existing DEMON liquor treatment plant	• Refurbish the existing DEMON SBR to create an additional aeration lane and provide additional secondary treatment on Eastern works • Use existing final settlement tank capacity on Eastern works.	12.766	376
2	Additional Activated Sludge treatment stream using existing DEMON liquor treatment plant	• Refurbish the existing DEMON SBR to create an additional aeration lane and provide additional secondary treatment on Eastern works • Modify existing abandoned primary settlement tanks to provide final settlement for the new aeration lane.	12.213	341
3	New Nereda treatment stream using existing DEMON liquor treatment plant	• Refurbish the existing DEMON SBR to create a Nereda treatment plant. This will provide additional secondary treatment and will not require tertiary nitrate removal.	13.116	130
4	Build a new Nereda treatment plant	• This will provide additional secondary treatment and will not require tertiary nitrate removal.	11.431	-126
5	Install 10 x Hybacs SMART units upstream of the existing aeration lanes on Eastern works.	• This will involve the demolition of the existing abandoned primary settlement tanks.	12.358	249

The following table summarises the benefits and drawbacks of each solution:

Option	Capacity increase	Tertiary Denitrification Required	New DEMON Required	Use of abandoned PST	Eastern Aeration Upgrade Required
1	10 %	✓	✓	✗	✓
2	15 %	✓	✓	✓	✓
3	11 %	✗	✓	✗	✓
4	20 %	✗	✗	✗	✓
5	15 %	✓	✗	✓	✓

7. Proposed Solution

The solution selection for PR19 is Option 4 as:

- This option does not require flows to be passed through the tertiary denitrification stage
- It meets the required improvement in performance and treatment capacity for the short-term, and is in alignment with the capabilities of existing assets (i.e. UV

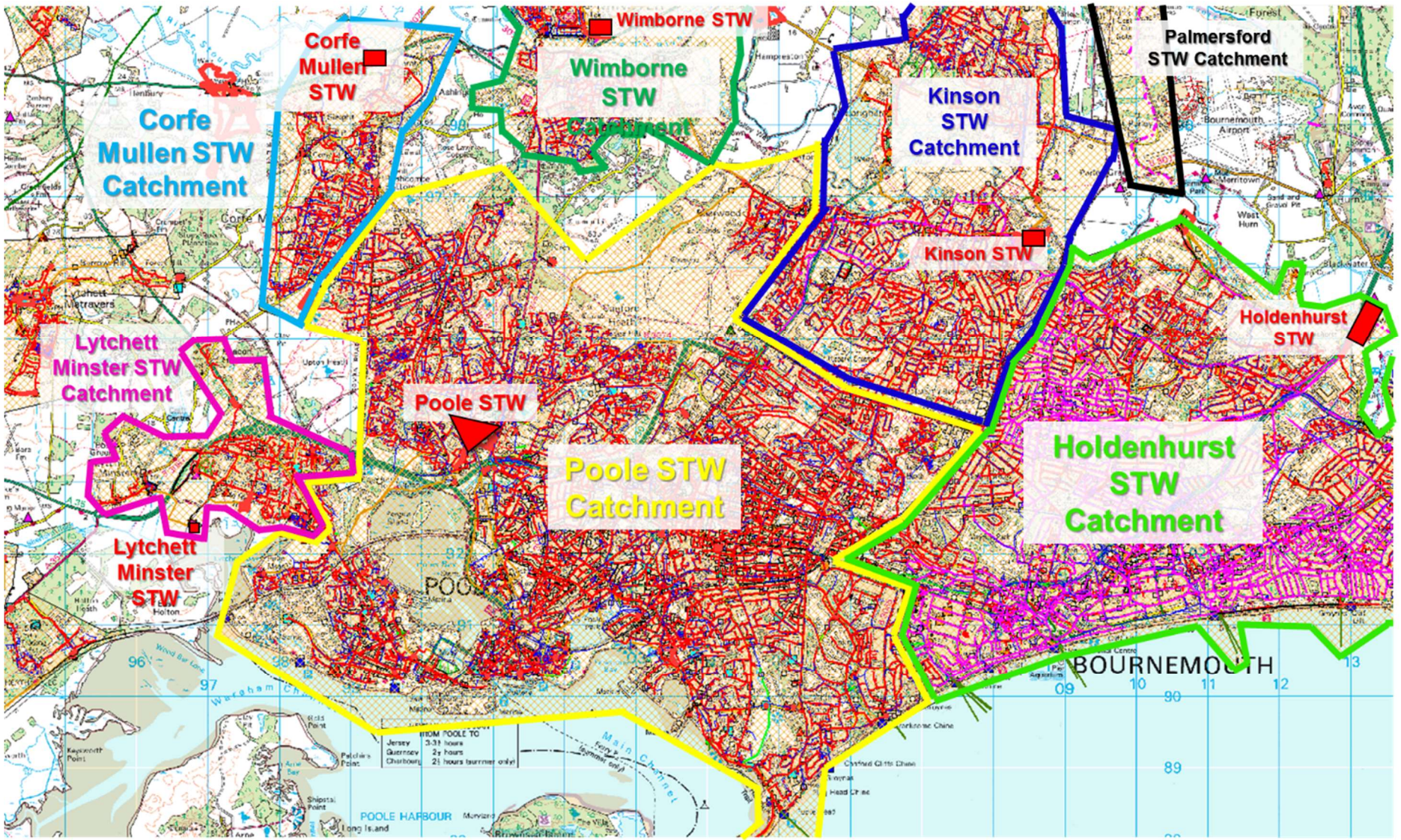
disinfection), and

- In the longer-term, it meets requirements to take an increase in flow and load when decommissioning off the Western Works, enabling the construction of a new works in the same location, with increased capacity for future development
- It has the lowest whole-life cost

The costs for the above improvements have all been identified as STW growth:-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	100%	11.431	-0.126
	Total	11.431	-0.126

Appendix 1 - Poole STW & adjacent STW catchments



Appendix 2 – Poole Harbour environmental designations

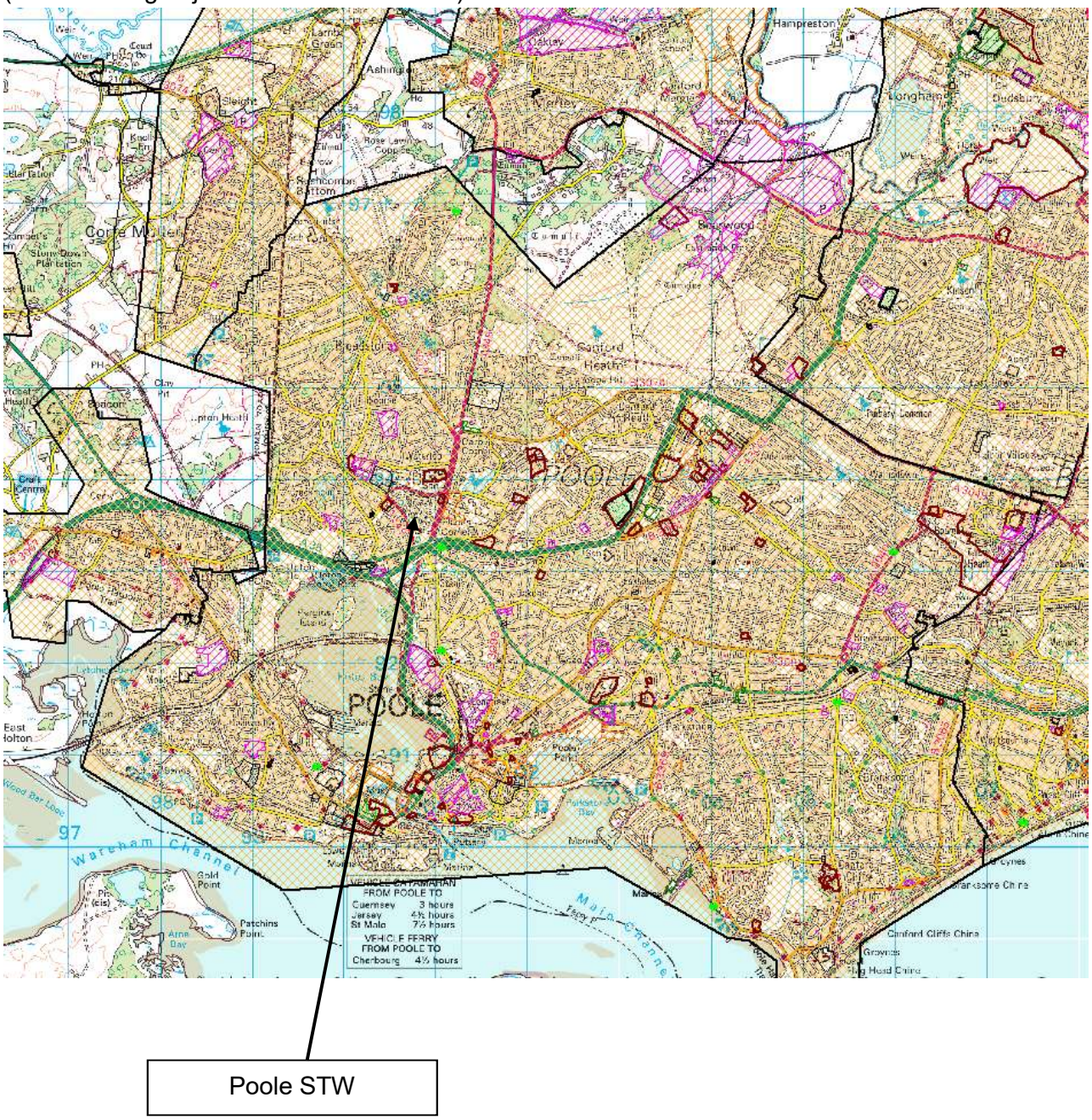
Designation:

- AONB
- SSSI


Poole STW
Holes Bay (STW effluent discharge location)
POOLE
POOLE HARBOUR

Appendix 3 - Poole STW catchment development

Plan of Catchment, showing potential ( ) and approved ( ) development areas
(Also showing adjacent STW catchments)



Annex O. Radstock STW

1. Summary

Name	Radstock STW
STW population served (2018/19 p.e)	24,802
Treatment capacity provided - PR19 enhancement (p.e)	3,025
Main driver	Quality (WFD)
Subsidiary driver	Growth
Total Capex (£m)	7.059
Growth Capex (£m)	1.412

2. Need

The STW has reached the limit of its treatment capacity, in particular the ability of the plant to remove ammonia is becoming critical. Historical and future planned growth in both residential and trade flows and loads requires additional treatment capacity to be provided in order to maintain permit compliance.

Additionally the WINEP(3) requires a tightening of both the Phosphorus and AmmN permits at Radstock STW, as below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?	Old Permit (mg/L)	New Permit (mg/L)
7WW200720	WFD_IMPg	Phosphorus	22/12/21	Green	1.0	0.70
7WW200723	WFD_ND	Ammonia	31/03/25	Green	6.0	4.0

A combined project has been developed, taking account of these multiple drivers and synergies, to provide an efficient solution for these capacity and quality enhancements.

3. Background

Site Details	
The site serves :	The towns of Radstock and Midsommer Norton; The surrounding villages of Chewton Mendip, Litton, Ston Easton, Kilmersdon, and Clandown. See plan in Appendix.
Treatment Process	
The STW is a conventional biological filter works with primary tanks, secondary filters and humus settlement tanks. There is also chemical dosing for P removal.	

4. Evidence

Growth and Investment (Historical)

Additional treatment capacity at Radstock STW was last provided some 29 years ago, in 1989. A completely new treatment works comprising new primary settlement tanks, new

secondary biological filters (8 N°.) and new humus settlement tanks was constructed. Since then investment at this STW has focussed on capital maintenance and quality enhancement, the most significant of which have included:-

Date	Project	Driver	Scheme
1998	D4771	Capital maintenance	Improvements to sludge storage, and odour control
2006	D9158	Capital maintenance	Replacement Inlet Screens and macerator
2004	D1399	Quality enhancement	Phosphorus removal to achieve 2.0mg/L P

The size of population in the catchment has developed as shown below:-

	2001	2005	2010	2015	2017
Resident p.e.	20,098	20,862	20,973	21,199	22,195
Total p.e.	22,115	22,622	22,121	22,341	22,987

Growth (Future)

The Local Plan[27] for Radstock STW catchment area includes plans for future housing development as shown below:

	2018-2020	2021-2025
New dwellings (N°)	390	650
New residents (p.e.)	877	1,462

In addition to domestic growth, commercial and trade growth will place additional load on the works.

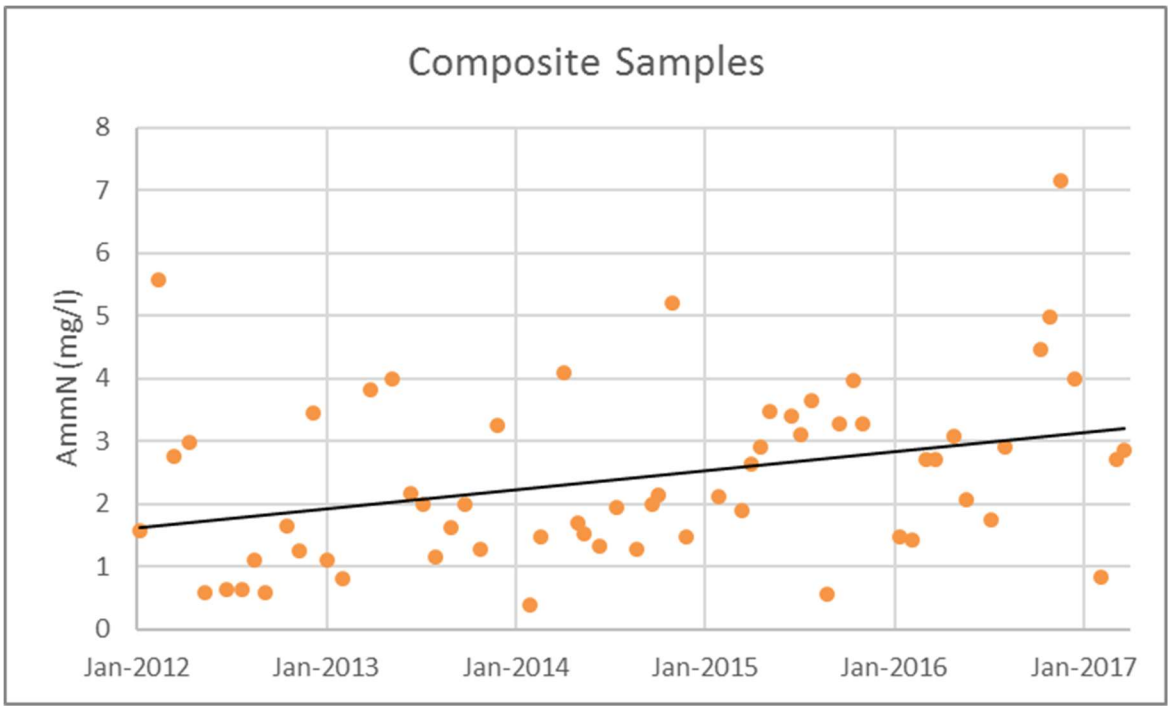
The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	24,802	25,395	26,874	27,719	28,420	29,139

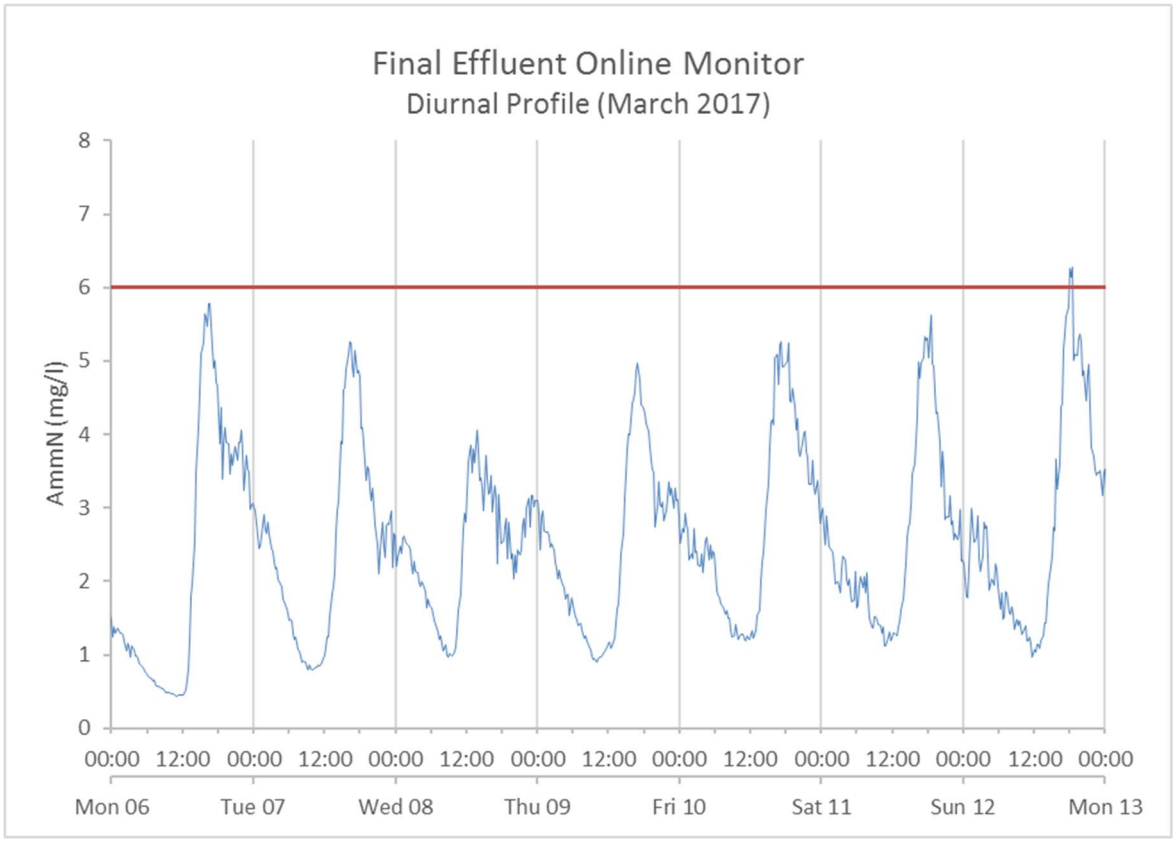
Performance

Evidence from our sampling data (24 hr composite samples) over the last 5 years shows an increasing (deteriorating) trend in the levels of AmmN in the final effluent:-

[27] B&NES Council (March 2017). Bath & North East Somerset Council Monitoring Report. http://www.bathnes.gov.uk/sites/default/files/sitedocuments/Planning-and-Building-Control/Planning-Policy/AMR/amr_housing_dashboard_2011-17.pdf



In addition, our on-line AmmN monitor at the STW has shown that at certain times of day (afternoon) the final effluent regularly reaches or breaches the permit level.



5. Options

Capacity

At 2020 the biological filters will be at, or marginally over their design capacity for AmmN removal (to existing permit level). By 2035 our assessment shows that they will be about 12% over-loaded.
They are within capacity for BOD removal, with considerable headroom available.
The STW is well within its dry weather flow (permit) figure, with significant headroom available to accept growth in the base flow. (DWF)

Additional treatment capacity is needed within the next 5 years. The feasible options for providing this additional capacity include either:-

i) Provision of additional secondary treatment: 1 No. additional biological filter
ii) Provision of additional tertiary aerated sand filters (6-8 No.)

Quality Enhancements

Our standard design solutions for achieving a **4.0mg/L AmmN** permit standard (95%ile) include:-

- Tertiary treatment
- 'extended aeration' activated sludge secondary treatment

At an existing STW with efficient and relatively modern biological filter secondary treatment in place, it is clear, from inspection and from similar previous assessments, that the addition of a tertiary treatment stage will be the lower whole-life-cost solution to meet a tighter AmmN standard.

Bristol Avon Catchment wide permitting approach

The PR14 NEP included a scheme (6Wx006821) for the addition of a 0.50mg/L P consent at our Shoscombe STW for delivery by 22/12/21. Shoscombe is a small rural STW, adjacent to and about 2 km downstream from Radstock catchment, serving a population of 1,830. It has difficult access and was identified as a relatively expensive STW to develop.

To optimise investment we have reviewed more efficient solutions and by carrying out our own river quality modelling (SAGIS) we were able to show that an improvement in the P permit at Radstock STW to 0.70 mg/L would provide the equivalent improvement in the River Avon phosphorus concentrations and benefit an overall longer length of river.

We were therefore able to agree an exchange with the EA, with the quality enhancement for phosphorus at Radstock STW acting as an acceptable substitute for the originally proposed scheme at Shoscombe STW, which has subsequently been removed from the WINEP(3).

Our standard design solutions for a **0.70 mg/L Phosphorus** permit standard (annual average) include:-

- Tertiary treatment (filtration)
- activated sludge secondary treatment with 2-point chemical dosing

As with the tightening of ammonia standards, at an existing STW with efficient and relatively modern biological filter secondary treatment in place, it is clear, from inspection and from similar previous assessments and for PR19, that the addition of a tertiary treatment stage will also be the lower whole-life-cost solution for improved P removal.

6. Proposed Solution

A high-level comparison of the treatment options is summarised below:-

Option	Tertiary Aerated Sand-filters	Additional Secondary biological filters	New Activated Sludge Process
Provides treatment capacity	✓	✓	✓
Meets new AmmN permit	✓	X	✓
Meets new P permit	✓	X	✓
Utilises existing assets	✓	✓	X
Capex (£m)	£7.059	n/a	>£10.0
Lowest whole-life cost	✓	X	X

The proposed solution is therefore to take advantage of the synergies provided by a tertiary aerated filter stage to provide treatment for:-

- increased treatment capacity (to 2035)
- a more stringent AmmN permit (4.0 mg/L AmmN)
- a more stringent Phosphorus permit (0.70mg/L P)

The costs have been apportioned between drivers as below:-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	20%	1.412	0.039
Quality enhancement - Phosphorus	60%	4.24	0.116
Quality enhancement - AmmN	20%	1.42	0.039
	Total	7.059	0.194

Appendix 1 - (Radstock STW) – Plan of Catchment, showing potential (▨) and approved (▨) development areas

Annex P. Rode STW

1. Summary

Name	Rode STW
STW population served (2018/19 p.e)	1,080
Treatment capacity provided - PR19 enhancement (p.e)	195
Main driver	Quality (U-IMP5) & Capital Maintenance
Subsidiary driver	Growth
Total Capex (£m)	2.620
Growth Capex (£m)	0.393

2. Need

Ongoing development and population growth is forecast within the Rode STW catchment. Additional treatment capacity is required to ensure that the site continues to maintain environmental permit compliance.

Additionally, the WINEP(3) requires Rode STW to remove Phosphorus to a standard of 2mg/L by 22 Dec 2021 and for the permit FFT to be increased from 6.1 to 8.0L/s to prevent flows going to storm on dry days.

A combined project has been developed, taking account of these multiple drivers and synergies, to provide an efficient solution for these capacity and quality enhancements.

3. Background

Site Details	
The site serves:	See catchment plan in Appendix.
Treatment Process	
The STW is a conventional biological filter works with primary tanks, secondary filters and humus settlement tanks.	

4. Evidence

Growth and Investment (Historical)
Development within the Rode STW catchment has increased by 22% since 2001, compliance has been maintained by the installation of two a temporary submerged aerated filter plants (SAF). These units were installed after this treatment works became “one away” from failing its permit.

Treatment works improvements over time at Rode STW have included:

- Primary and Humus settlement tanks constructed circa 1974
- Sludge tank constructed circa 1995
- Storm storage quality scheme 2000-2005
- Original biological filters - major refurbishment in 2011
- Tertiary SAF plant installed circa 2016

The size of population in the catchment has developed as shown below:-

	2001	2005	2010	2015	2017
Resident p.e.	841	981	972	970	1,035
Total p.e.	841	1,037	1,011	1,009	1,063

A review of the process units has identified that the biological filters are overloaded for both BOD and ammonia and rely on the temporary treatment plants to achieve compliance. The increase in load from future growth will require additional treatment capacity.

Growth (Future)

Development plans within the Rode STW catchment area includes plans for future housing development as shown below. The associated increase in population is shown below:

	2018-2020	2021-2025
New dwellings (Nº)	35	5
New residents (p.e.)	78	11

In addition to the above, we anticipate an additional 70 homes being constructed by 2025, however these have not yet factored into our projections.

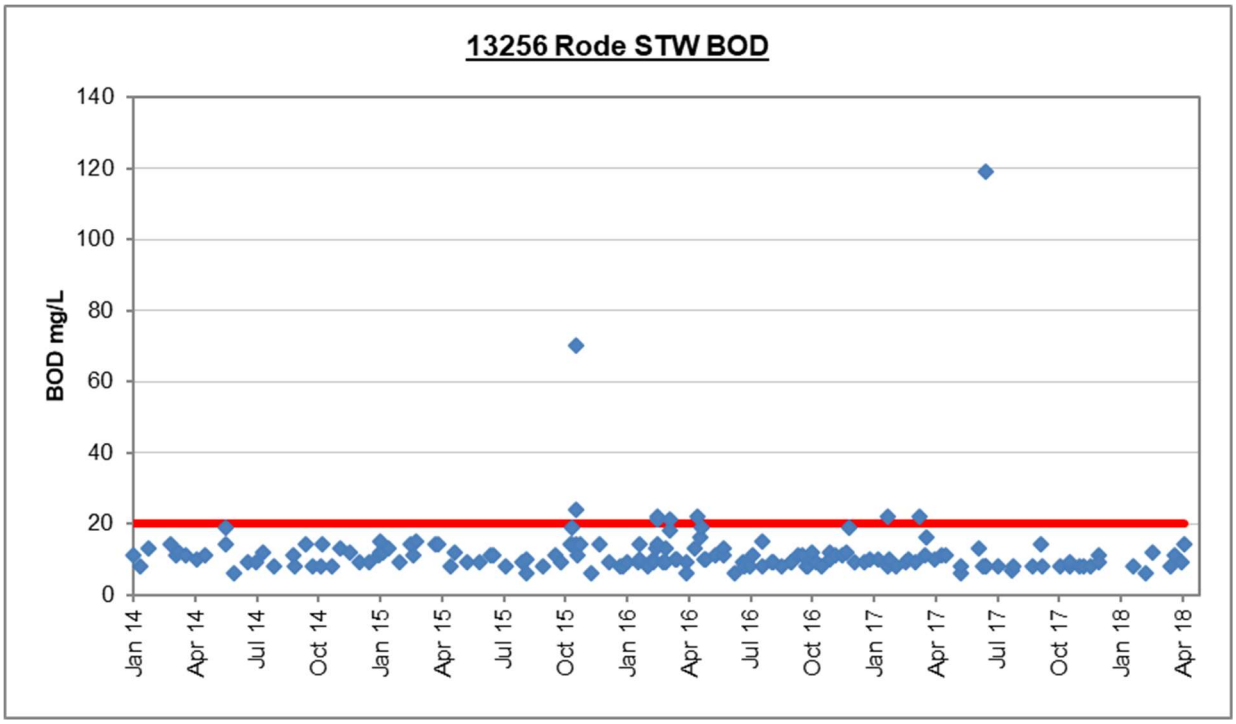
In addition to domestic growth, commercial and trade growth will place additional load on the works.

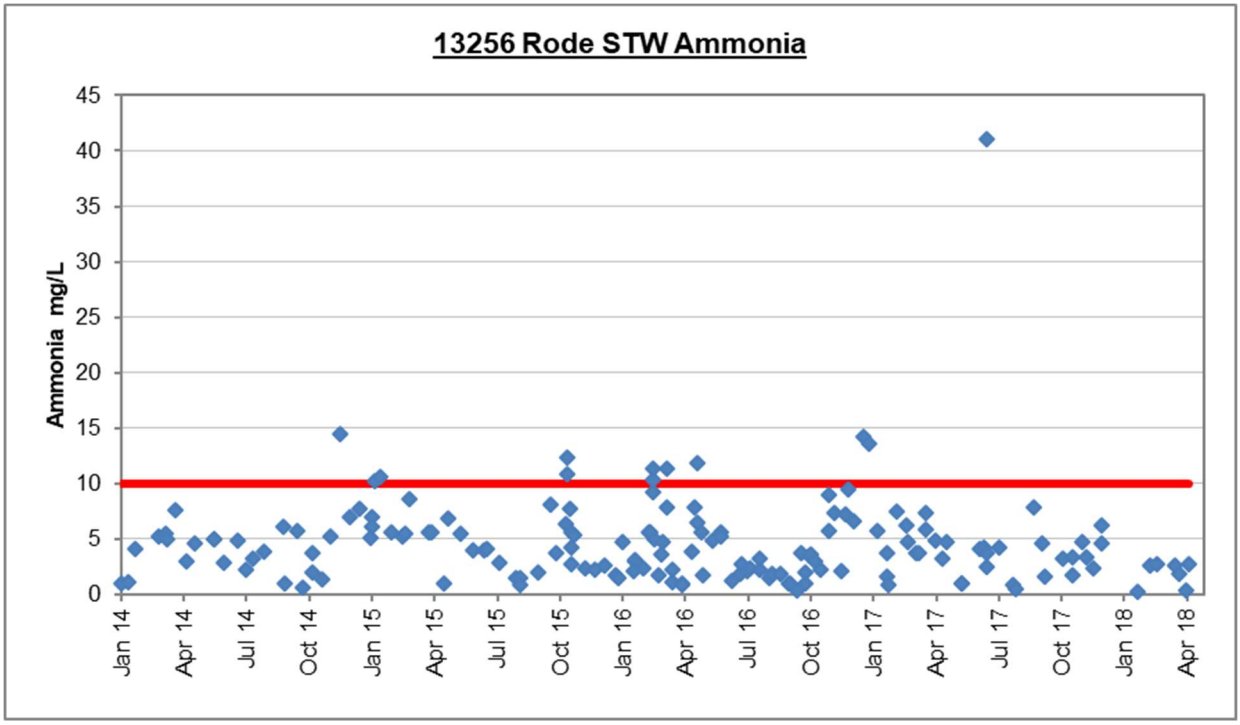
The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	1,080	1,133	1,145	1,171	1,200	1,230

Performance

The following charts indicate the performance of Rode STW with the temporary treatment plants operating. The proposed increase in dwellings will increase the biological load arriving at this treatment works by 25%, this will put compliance at increased risk as the existing filters are already overloaded by 30%. The existing filters are very shallow at only 1.3m depth and struggle to nitrify.





5. Options

Quality Enhancements

Our standard design solution for achieving a **2.0mg/L P** permit standard (annual average) is:-

- Single point (front-end) ferric dosing
- with any required improvements to inlet screens and primary settlement

Given its well-defined scope and purpose, the Phosphorus removal has been designed and priced separately at a project cost of £1.333m, with no purpose split assigned to Growth. The WINEP3 has a regulatory delivery date of 22 Dec 2021.

Capacity

When compared to the Wessex Water engineering standards, the maximum loading (BOD, SS and Ammonia) on the existing treatment units exceed the allowable design limits for the numeric permit limits, this is shown by the performance of the treatment works. Compliance is at risk even with the installed temporary treatment. Two options have been considered to maintain permit compliance:

iii) Conventional biological filters with feed pumping station and sludge tank

iv) Submerged aerated filters with feed pumping station and sludge tank

The existing filters are to be demolished as they are very shallow and so do not nitrify sufficiently to comply with the permit limits. A more permanent and robust solution is required to provide capacity for the existing short fall in treatment capacity and for the future developments proposed. The required increase in permit FFT to avoid spills to storm on dry days also requires additional capacity.

The high-level comparison of the treatment options is summarised below:-

Option No.	1	2
Option Description	Conventional biological filters Filter feed pumping station Standby generation Sludge storage	Permanent SAF units SAF feed pumping station Standby generation Sludge Storage
Provides treatment capacity	✓	✓
Capex (£m)	2.515	2.620
Opex (£k/yr)	14.60	35.60
Lowest whole-life cost	✓	X

6. Proposed Solution

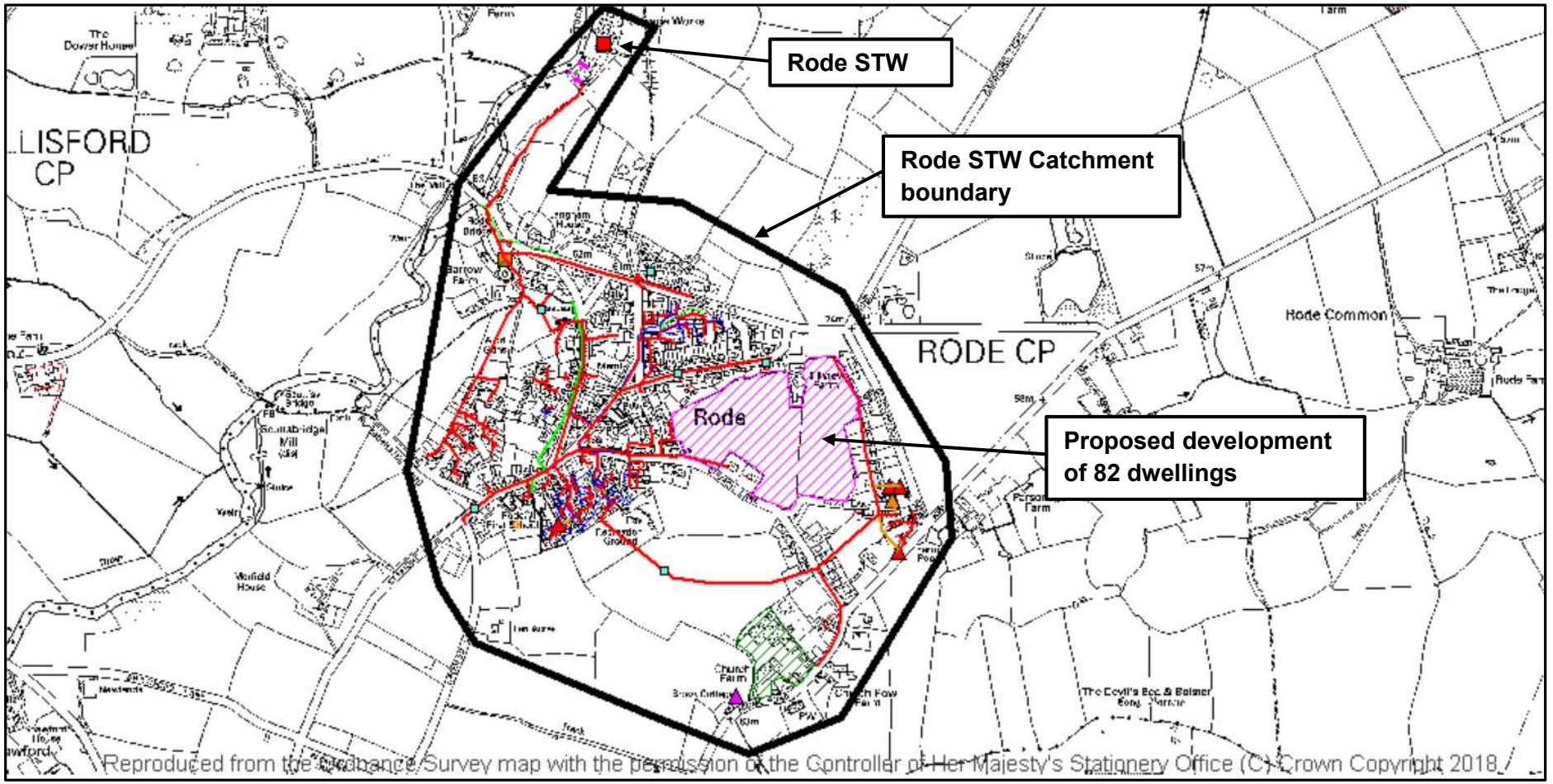
The proposed solution is option 1 to provide improved secondary treatment at Rode STW based on conventional biological filters, this is the lowest whole life cost option:-

- increased treatment capacity (to 2040)

The costs for the proposed solution have been apportioned between drivers as below:-

	Percentage	Capex (£m)	Opex (£k/yr)
STW Growth (capacity)	15%	0.393	2
STW FFT increase	30%	0.786	5
STW capital maintenance	55%	1.441	8
Totals split purpose scheme	100%	2.620	15

Appendix 1 - Rode STW Catchment



Annex Q. Salisbury STW

1. Summary

Name	Salisbury STW
STW population served (2018/19 p.e)	60,168
Treatment capacity provided - PR19 enhancement (p.e)	9,008
Main driver	Growth
Subsidiary driver	-
Total Capex (£m)	5.881
Growth Capex (£m)	5.881

2. Need

The STW has reached the limit of its treatment capacity, in particular the performance of the plant to achieve its 5.0mg/L permit for ammonia is becoming erratic. Historical and future planned growth in both residential and trade flows and loads requires additional treatment capacity to be provided in order to maintain permit compliance.

In addition to development recently completed, it is anticipated that an additional 3,400 houses will be constructed within the Salisbury STW catchment by 2026. The loading (BOD and Ammonia) on all existing filters already exceeds the Wessex Water design standards. The current plant performance is generally meeting permit conditions but further increases in loadings will result in compliance failures.

To ensure that the site continues to maintain permit compliance, additional treatment capacity will be required to treat the increased loading on the filters and to accommodate growth within the Salisbury catchment.

3. Background

Site Details	
The site serves :	The city of Salisbury and surrounding towns and villages including Wilton, Laverstock, West and East Harnham and Alderbury. See plan in Appendix.
Treatment Process	
The STW is a conventional biological filter works with primary tanks, secondary filters and humus settlement tanks. There are 8 conventional filters with stone media and 2 newer filters with plastic media. There is also chemical dosing for P removal.	

4. Evidence

Growth and Investment (Historical)

Additional treatment capacity at Salisbury STW was last provided some 28 years ago, between 1987- 1990. Two new secondary biological filters and two additional humus settlement tanks were constructed. Since then investment at this STW has focussed on capital maintenance and quality enhancement, the most significant of which have included:-

Date	Project	Driver	Scheme
2012/3	D9587	Capital maintenance	Closure and demolition of digestion plant
2017	D9162	Capital maintenance	Salisbury STW Inlet Screen Replacement
2001	D1220	Quality enhancement	Salisbury STW Phosphorus removal
2010	D9096	Quality enhancement	Salisbury STW Additional P removal and Effluent Pipeline

The size of population in the catchment has developed as shown below:-

	2001	2005	2010	2015	2017
Resident p.e.	48,284	52,444	49,052	51,372	53,504
Total p.e.	59,925	59,758	57,384	59,646	60,043

Growth (Future)

The Local Plan[28] for Salisbury STW catchment area includes plans for future housing development. The associated increase in population is also shown:-

	2018-2020	2021-2025
New dwellings (Nº)	945	2,075
New residents (p.e.)	2,126	4,669

In addition to domestic growth, commercial and trade growth will place additional load on the works.

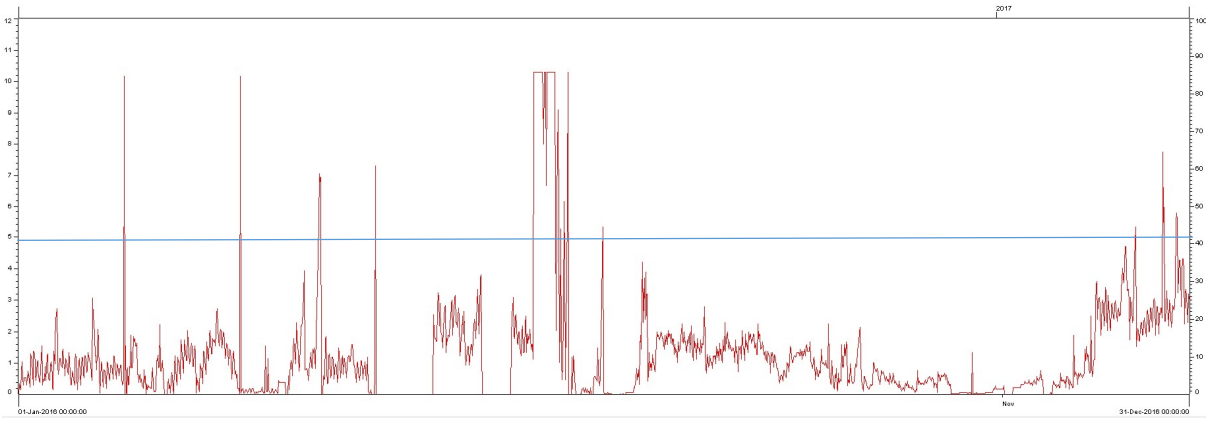
The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	60,168	61,690	66,544	68,911	70,698	72,532

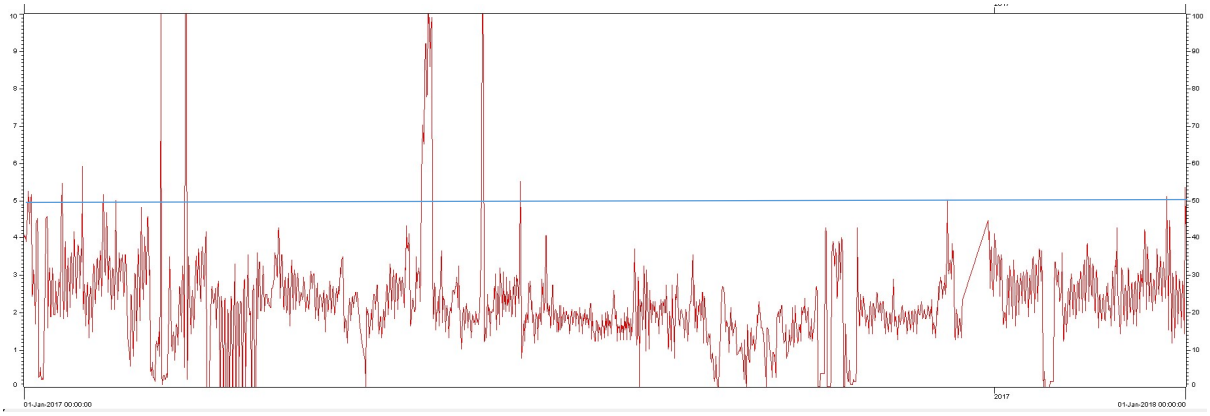
Performance

Evidence from our monitoring data (final effluent AmmN monitor) over the last 3 years shows an increasing (deteriorating) trend in the levels of AmmN in the final effluent, as shown below:-

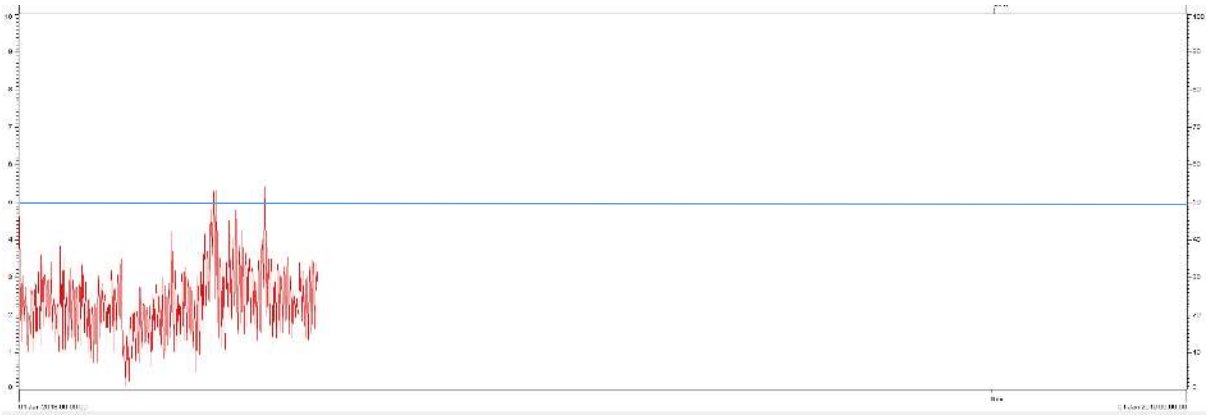
[28] Wiltshire Council (March 2018). Housing Land Supply Statement. http://www.wiltshire.gov.uk/spp-housing-land-supply-statement-2017-published-2018-march.pdf



Effluent AmmN : 2016



Effluent AmmN : 2017



Effluent AmmN : 2018 (part)

We are also aware that the loadings on the biological filter plant significantly exceed our current design standards; the process assessment shows that they are currently between 10-30% over-loaded for BOD and/or AmmN. We consider this explains the erratic treatment performance which occurs at times.

5. Options

Capacity

At 2020 the biological filters will be over their design capacity for AmmN removal (to existing permit level). By 2030 our assessment shows that they will be about 25% over-loaded.

The STW is well within its dry weather flow (permit) figure, with significant headroom available to accept growth in the base flow. (DWF)

Additional treatment capacity is needed within the next 5 years. The feasible options for providing this additional capacity include either:-

i) Provision of additional secondary treatment : 1-2 No. additional biological filter (Plastic media)
ii) Provision of additional tertiary aerated sand filters (24 No.)

We have previously purchased an area of land adjacent to and to the west of the existing STW site, which is available for the construction of additional treatment units.

6. Proposed Solution

A high-level comparison of the treatment options is summarised below:-

Option	Additional Secondary biological filters	Tertiary Aerated Sand-filters
Provides treatment capacity	✓	✓
Meets existing AmmN permit	✓	✓
Opportunity to “stretch” P permit	X	✓
Utilises existing assets	✓	✓
Capex (£m)	5.881	8.996
Opex (£k/yr)	375	644
Lowest whole-life cost	✓	X

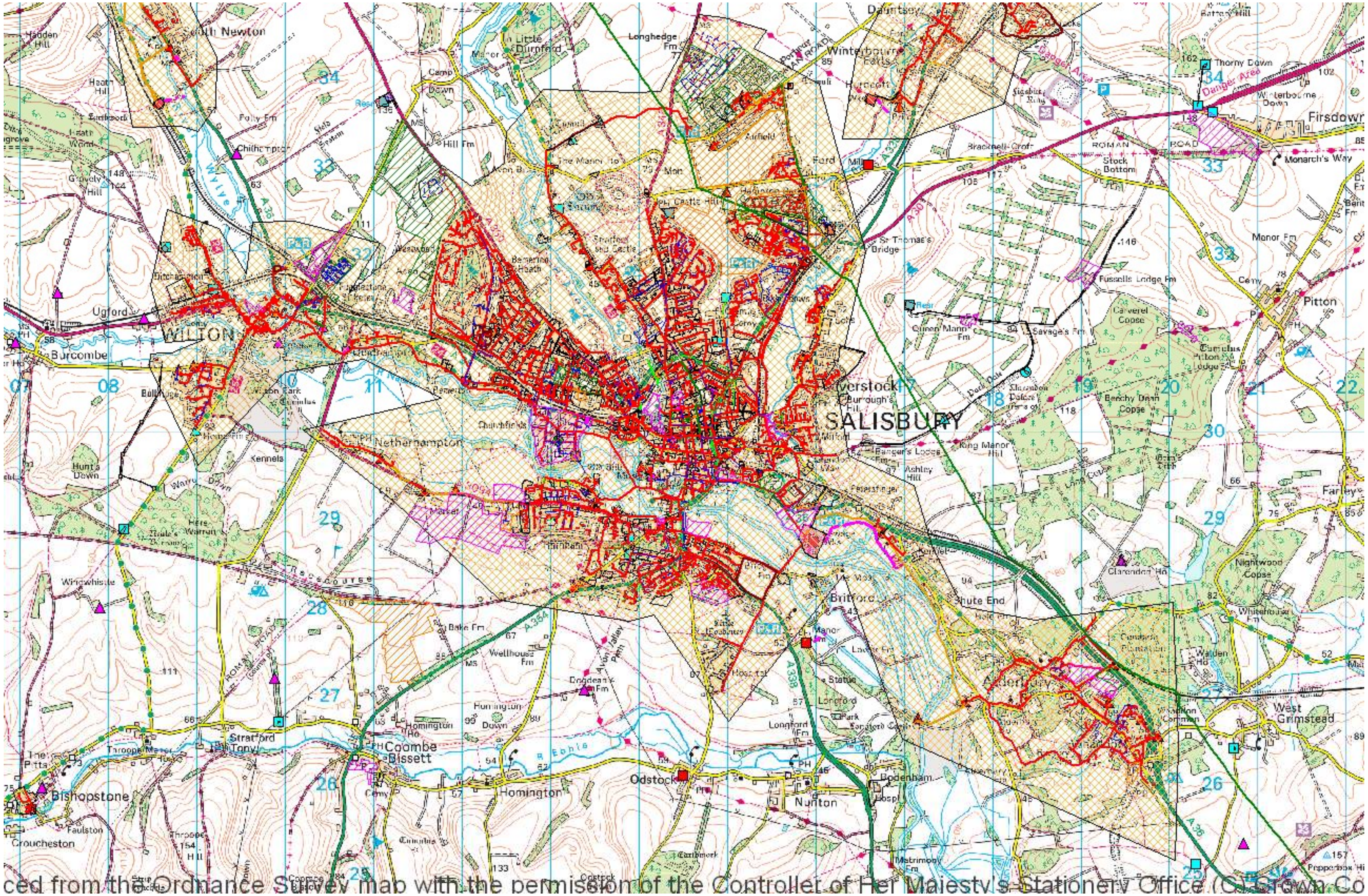
The proposed solution is therefore to extend the existing treatment process, providing additional secondary filtration for:-

- increased treatment capacity (to 2035)
- compliance with existing AmmN permit (5.0 mg/L AmmN)

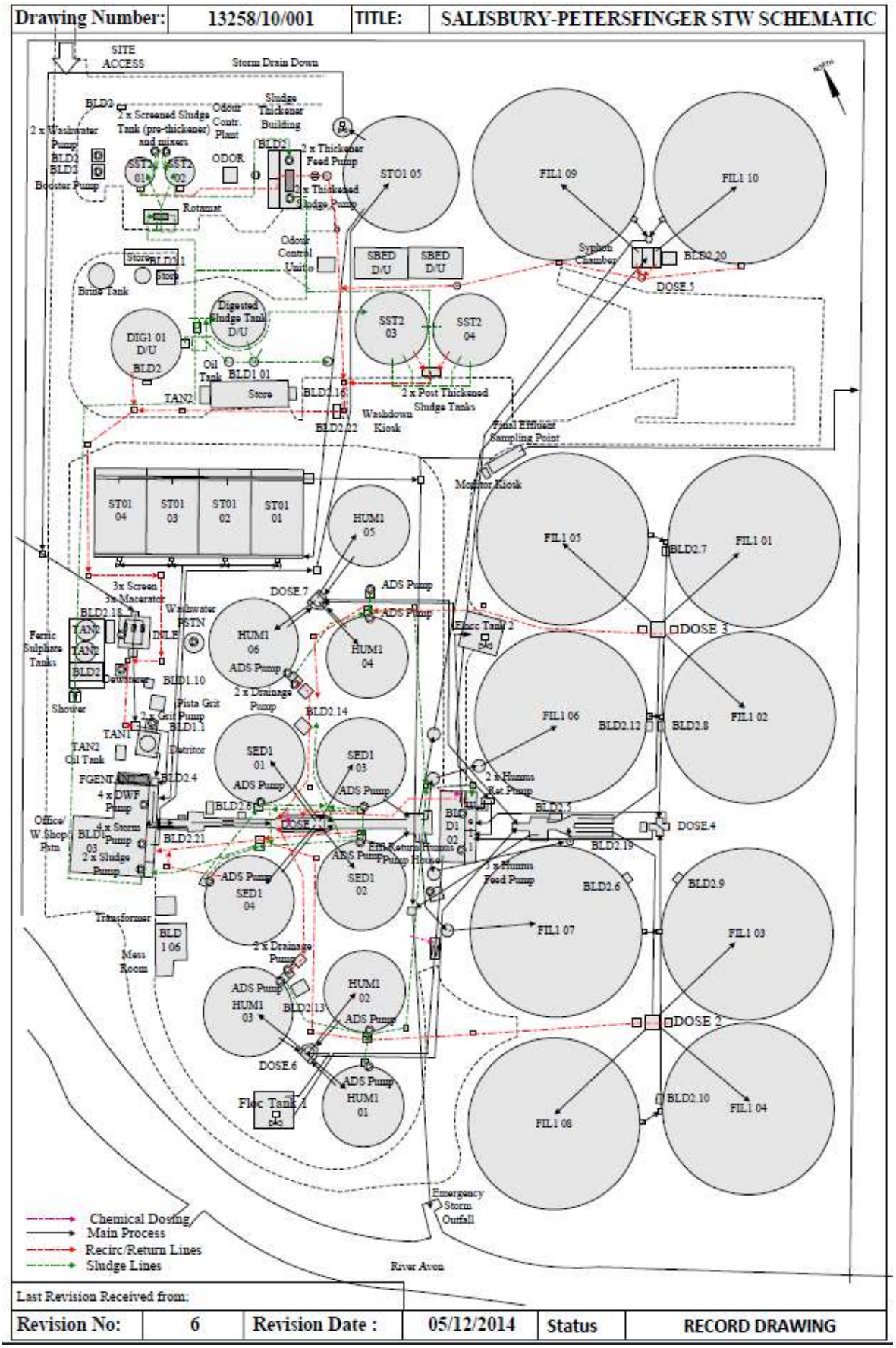
The costs have been apportioned between drivers as below :-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	100%	5.881	0.375
	Total	5.881	0.375

Appendix 1 - Salisbury STW – Plan of Catchment, showing potential ( ) and approved ( ) development areas



Appendix 2 - Schematic Site Layout



Annex R. Saltford STW

1. Summary

Name	Saltford STW
STW population served (2018/19 p.e)	118,271
Treatment capacity provided - PR19 enhancement (p.e)	19,937
Main driver	Quality (UWWTD)
Subsidiary driver	Growth
Total Capex (£m)	22.199
Growth Capex (£m)	1.110

2. Need

The STW has reached the limit of its treatment capacity. Historical and future planned growth in both residential and trade flows and loads requires additional treatment capacity to be provided in order to maintain permit compliance.

Additionally, in December 2017 we were advised that the WINEP for PR19 would require an increase in flow to full treatment (FFT) at Saltford STW by about 27% (from 580 L/s to 734 L/s). This was confirmed in the WINEP(3) in March 2018, which included the increase in FFT described below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?	Old Permit (m^3/d)	New Permit (m^3/d)
7WW200053	U_IMP5	FFT	31/03/2025	Green	50,112	63,936

The 734L/s figure represents the "3PG+I_{max}+ 3E" at year 2025.

The EA have stated, in relation to the U-IMP5 projects that "Future risk due to growth should be picked up by the Water Companies under growth or maintenance in their Capital Programme, not WINEP" and also that **"**U_IMP5 *(and U_IMP6*) drivers only apply to increases required to FFT *(and storm tank capacity)* over and above those required and funded under growth." [29]

This means that investment to meet the new FFT at year 2025 will be costed under the quality enhancement driver, while the provision of capacity to a reasonable design horizon (i.e. 2040) will be allocated to capacity enhancement.

Access to the STW is very poor, via a narrow road through Saltford village. A design horizon to 2040 has therefore been selected for this scheme to avoid returning in the near future.

[29] Environment Agency (November 2017). PR19 further guidance for completing WINEP3 for flow drivers U_MON3, U_MON4, U_IMP5 and U_IMP6 DRAFT v0.10.
Environment Agency (December 2017). PR19 Driver Guidance: Increasing Flow to Full Treatment (FFT)- FINAL v3.

The equivalent "3PG+I_{max}+ 3E" figure at year 2040 is 795 L/s, which represents an increase in FFT over the existing of 37%.

A combined project has been developed, taking account of these multiple drivers and synergies, to provide an efficient solution for the capacity and quality enhancements.

3. Background

Site Details	
The site serves following :	The towns of Bath and Saltford (part); The surrounding villages of Batheaston, Bathford, Corston, Monkton Farleigh and South Stoke. See plan in Appendix.
Treatment Process	
The STW is a conventional biological filter works with primary tanks, secondary filters (20) and humus settlement tanks. There is also chemical dosing for P removal.	

4. Evidence

Growth and Investment (Historical)
Additional (permanent) treatment capacity at Saltford STW was last provided approximately 35 years ago, in 1983. Since then investment at this STW has focussed on capital maintenance and quality enhancements, the most significant of which have included:-

Date	Project	Driver	Scheme
various	various	Capital maintenance	Replacement filter media in 6 (out of 20) trickling filters
2016	D9778	Capital maintenance	New Inlet and Storm Screens
2004	D1276	Quality enhancement	Phosphorus removal to achieve 1.0mg/L P
2005	C1258	Quality enhancement	Bath CSO scheme – new storm tanks at Saltford STW
2018-20	D9650	Growth	A scheme is in progress to provide temporary treatment capacity pending completion of the PR19 proposed combined quality and capacity enhancement scheme.

Historical population growth in the catchment is as shown below. This includes a growth a residential, student and tourism (visitor) numbers.

	2005	2010	2015	2017
Resident p.e.	89,747	92,150	93,747	104,493
Total p.e.	105,866	110,447	109,543	115,943

Growth (Future)

The Local Plan[30] for Saltford (Bath) STW catchment area includes plans for future housing development. The associated increase in population is also shown:-

	2018-2020	2021-2025
New dwellings (Nº)	2,422	3,610
New residents (p.e.)	5,449	8,122

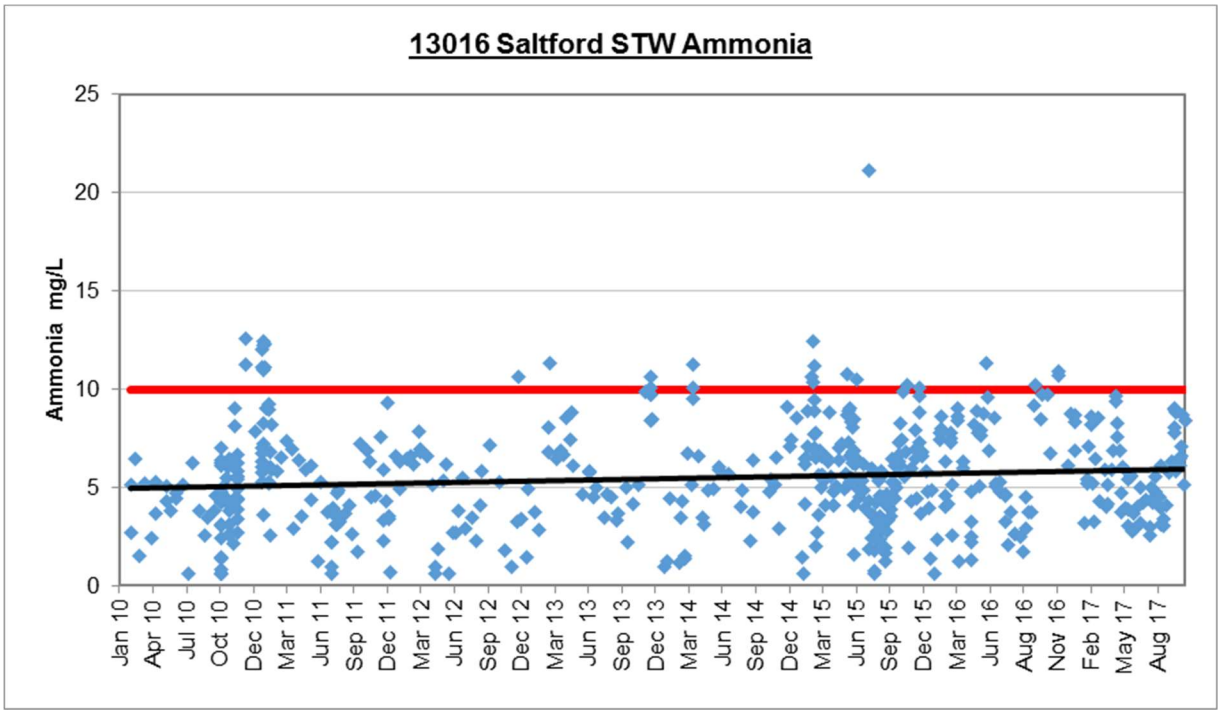
In addition to domestic growth, commercial and trade growth will place additional load on the works.

The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	118,271	122,016	130,533	134,943	138,403	141,953

Performance

The increase in load at the STW over the years has resulted in a deterioration in treatment performance, particularly in respect of AmmN. The 95%ile Ammonia has reached or breached the permit level on several occasions as shown on the graph below :-



[30] B&NES Council (March 2017). Bath & North East Somerset Council Monitoring Report. http://www.bathnes.gov.uk/sites/default/files/sitedocuments/Planning-and-Building-Control/Planning-Policy/AMR/amr_housing_dashboard_2011-17.pdf

5. Options

Capacity

The existing biological filters are already receiving loads in excess of their design capacity. By 2020 we estimate that in terms of the 10mg/L AmmN permit standard they will be 9% over-loaded with respect to BOD loads, and approximately 35% over-loaded with respect to AmmN loads.

The STW is well within its dry weather flow (permit) figure, with significant headroom available to accept growth in the base flow. (DWF)

Additional treatment capacity is needed. The feasible options for providing this additional capacity include either:-

i) Provision of additional secondary treatment : a new activated sludge treatment stream
ii) Provision of additional secondary treatment : a new MBBR treatment stream
iii) Provision of additional secondary treatment : a new biological filter treatment stream
iv) Provision of a tertiary nitrifying MMBR treatment stage.

The option of providing additional treatment by extending the existing conventional biological filter treatment process (option (iii)) is discounted due to the limited land area available at the STW site.

PR14 - Tertiary Nitrifying Moving Bed BioReactor (MMBR) Capacity option

A plan to provide additional treatment capacity at Saltford STW was included in our PR14 business plan and was being progressed during 2015-20 for delivery by 2020. An options appraisal had identified the lowest whole life cost solution as a tertiary treatment stage using a tertiary nitrifying MMBR treatment process. An £8million scheme with this solution was being designed when, in December 2017, we were advised by the EA that the WINEP for PR19 would require an increase in flow to full treatment (FFT) at Saltford STW by about 27%. The planned PR14 solution was not compatible with this proposed increase in flow, and so was put on hold pending a review of alternative options.

The review compared:

- Continuation of the £8m PR14 capacity scheme to provide tertiary treatment, followed by an PR19 scheme to increase FFT by 27%,

  with

- Construction of a single scheme to provide both additional treatment capacity and an increase in FFT, by provision of a new treatment stream in parallel with the existing.

The second option, construction of a combined synergy scheme, was shown to be the more cost efficient and lowest whole-life cost solution.

A consideration in this review was the need to maintain compliance at the STW during the extended period into PR19 prior to completion of the combined scheme. This is a significant challenge, and is being managed by:-

- Arranging a temporary relaxation in the AmmN permit with the EA (linked to a short term reduction in permit DWF)
- Installation of additional temporary treatment at Saltford STW.

Quality Enhancement

All options for increasing the hydraulic throughput through Saltford STW by 27% require the provision of an additional new treatment stream, in parallel with the existing, to pass the increased flow. This is because the existing filter treatment works is at the limit of its hydraulic capacity. Our standard treatment solutions for this size of STW with conventional secondary treatment standards (25:40:10 mg/L BOD:SS:AmmN (95%ile) and <1.0mg/L P (annual average)) include:-

i) Provision of additional primary and secondary treatment: a new activated sludge treatment stream
ii) Provision of additional primary and secondary treatment: a new MBBR treatment stream
iii) Provision of additional primary and secondary treatment: a new biological filter treatment stream

The option of providing additional treatment by extending the existing conventional biological filter treatment process was discounted due to the limited land area available at the STW site.

6. Proposed Solution

A high-level comparison of the treatment options is summarised below:-

Option	New Activated Sludge treatment stream	New Secondary MBBR treatment stream	New Secondary biological filters treatment stream	New nitrifying MMBR tertiary treatment stage.
Provides treatment capacity	✓	✓	✓	✓
Meets new FFT permit	✓	✓	✓	X
Fits on existing site	✓	✓	X	✓
Utilises existing assets	✓	✓	✓	✓
Capex (£m)	22.199	23.508	Not feasible	Fails to provide hydraulic capacity
Opex (£k/yr)	600	668		
Lowest whole-life cost	✓	X	X	X

Access

Access to the STW is poor and via a narrow road through the village of Saltford. An access appraisal by our Engineering and Construction team has concluded that a new access will be needed for the construction of the proposed works, which will also involve a new access bridge over the River Avon.

The medium to long-term plan for Bath and improvements to its CSOs potentially requires investment in additional storm storage capacity at Saltford STW in PR24 or PR29. This would also involve a significant construction project. We are therefore planning to provide a new access to the STW which can be used for construction traffic in PR19, and then as a new permanent access to the STW serving day-to-day operational needs as well as all future major engineering schemes.

We are currently in discussion with Bath & NE Somerset council (BANES) over the need and preferred location for this new access road and river crossing.

Solution

The proposed solution is therefore to take advantage of the synergies provided a combined scheme, providing additional primary treatment and a new activated sludge secondary treatment stream to provide treatment for:-

- increased treatment capacity for historical and future population growth
- a 37% increase in flow to treatment (to 795L/s)

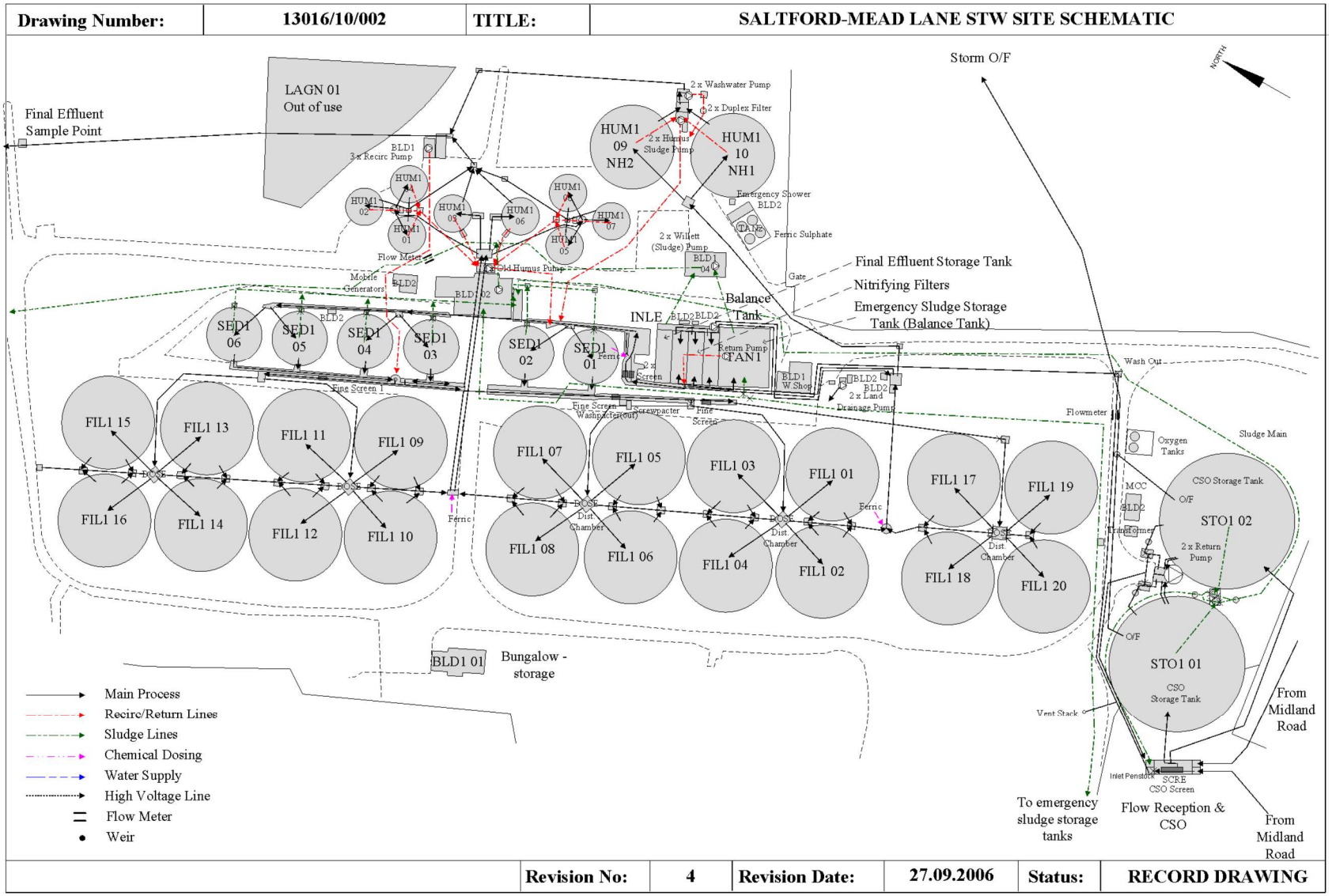
A new site access road and bridge over the River Avon is also proposed.

The marginal cost of providing a 10% increase in FFT over and above the 2025 figure stated in the WINEP are relatively small. Costs have therefore been apportioned between drivers as below :-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	5%	1.110	0.570
Quality enhancement – increase FFT	95%	21.089	0.030
	Total	22.199	0.600

Appendix 1 – Plan of Saltford (Bath) STW catchment area, showing potential ( ) and approved ( ) development areas

Appendix 2 - Schematic plan of Saltford STW site



Annex S. Shillingstone STW

1. Summary

Name	Shillingstone STW
STW population served (2018/19 p.e)	2,870
Treatment capacity provided - PR19 enhancement (p.e)	268
Main driver	Quality (UWWTD)
Subsidiary driver	Growth
Total Capex (£m)	0.528
Growth Capex (£m)	0.026

2. Need

In December 2017 we were advised that the WINEP for PR19 would require an increase in flow to full treatment (FFT) at Shillingstone (from 19.5 to 22.5 L/s). This was confirmed in the WINEP(3) in March 2018, which included the increase in FFT described below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?	Old Permit (m^3/d)	New Permit (m^3/d)
7WW200792	U_IMP5	FFT	31/03/2025	Green	1,685	1,944

The 22.5 L/s figure represents the maximum daily peak flow (MDPF).

The EA have stated, in relation to the U-IMP5 projects that "Future risk due to growth should be picked up by the Water Companies under growth or maintenance in their Capital Programme, not WINEP." and also that **"**U_IMP5 *(and U_IMP6*) drivers only apply to increases required to FFT *(and storm tank capacity)* over and above those required and funded under growth." [31]

This means that investment to meet the new FFT at year 2025 will be costed under the quality enhancement driver, while the provision of capacity to a reasonable design horizon (i.e. 2035) will be allocated to Growth enhancement.

For this relatively small STW there is very little difference in the nature, scale and cost of works required to provide hydraulic capacity to a design horizon of 2035 rather than 2025. Designing for the longer horizon is a longer term and more cost-efficient investment strategy.

A project has been developed, taking account of these two drivers and synergies, to provide an efficient solution for the hydraulic capacity enhancement.

[31] Environment Agency (November 2017). PR19 further guidance for completing WINEP3 for flow drivers U_MON3, U_MON4, U_IMP5 and U_IMP6 DRAFT v0.10.
Environment Agency (December 2017). PR19 Driver Guidance: Increasing Flow to Full Treatment (FFT)- FINAL v3.

3. Background

Site Details	
The site serves following :	The village of Shillingstone and surrounding villages of Child Okeford and Okeford Fitzpaine.
Treatment Process	
The STW is a conventional biological filter works with primary tanks, secondary filters and humus settlement tanks. The site also has three lagoons in series for tertiary treatment.	

4. Options

Hydraulic Capacity

The existing biological filters work well and provide an efficient, low energy and sustainable treatment process. They have sufficient hydraulic design capacity headroom to accommodate the flow increase required in the WINEP.

The humus tanks do have capacity to accept the proposed increase in flow.

A single option proposal has therefore been made to provide increased capacity through the provision of one additional humus tank. This continues to make beneficial use of the existing treatment plant assets.

5. Proposed Solution

One additional humus tank is proposed.

	Capex (£m)	Opex (£k/yr)
Total scheme	0.528	13
STW Growth (capacity)	0.026	1

Annex T. West Huntspill STW

1. Summary

Name	West Huntspill STW
STW population served (2018/19 p.e)	61,219
Treatment capacity provided - PR19 enhancement (p.e)	5,599
Main driver	Quality
Subsidiary driver	Growth
Total Capex (£m)	14.441
Growth Capex (£m)	1.444

2. Need

The catchment served by West Huntspill STW has experienced substantial development in recent years, and the provision of additional capacity at the site was included in our business plan at PR14 as a "defined contingent" Growth project. Recent performance has deteriorated due to the increased loads onto the works, and the works is supported by temporary treatment measures to ensure consent compliance.

Historical and future planned growth in both residential and trade flows and loads requires additional treatment capacity to be provided to maintain environmental permit compliance.

The Bathing Water Directive and Regulations provide the framework for the management of the bathing waters in England. New tighter standards were introduced in 2015, with bathing waters being classified as: Excellent, Good, Sufficient, Poor. Under the directive, all bathing waters are required to meet at least Sufficient classification. Burnham Jetty North has a planning class of Poor (in 2016 and 2017), and is impacted by the discharges from West Huntspill STW.

Accordingly, West Huntspill STW has been identified in WINEP3 as needing process improvements to comply with the Bathing Water Directive:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?
7WW200965	BW_IMP1	Other	31/03/21	Green

Proposed Permit Limit:

> *West Huntspill STW to receive improved treatment to achieve 25,000-fold (4.4 log) reduction in enteroviruses and a 250,000-fold (5.4 log) reduction in E. coli between the crude influent to the treatment works and Burnham Jetty North EC designated bathing water monitoring point, based on standard influent concentrations.*

A combined project has been developed to achieve both of these quality and capacity enhancements.

3. Background

Site Details	
The site serves following villages:	Burnham on Sea and Highbridge, Berrow, Brent Knoll, East Brent, Lympsham, Burnham Without, Mark, Blackford (part of the parish of Wedmore), East Huntspill, West Huntspill, Pawlett, Puriton, Woolavington, Cossington, Chilton Polden, Edington, Catcott and Shapwick. Flow to West Huntspill is pumped from Sloway Lane P/S and also gravity fed from Highbridge to an inlet chamber.
Treatment Process	
The STW is an activated sludge plant with primary tanks, two aeration lanes and humus settlement tanks. There is also existing UV disinfection of final effluent. The site also has a co-located Bioresources Treatment Centre.	

4. Evidence

Growth & Investment (historical)

The size of population in the catchment has developed as shown below:-

	2002	2006	2010	2015	2017
Resident p.e.	30,207	35,209	34,015	35,420	36,887
Total p.e.	45,951	52,614	48,985	52,792	54,760

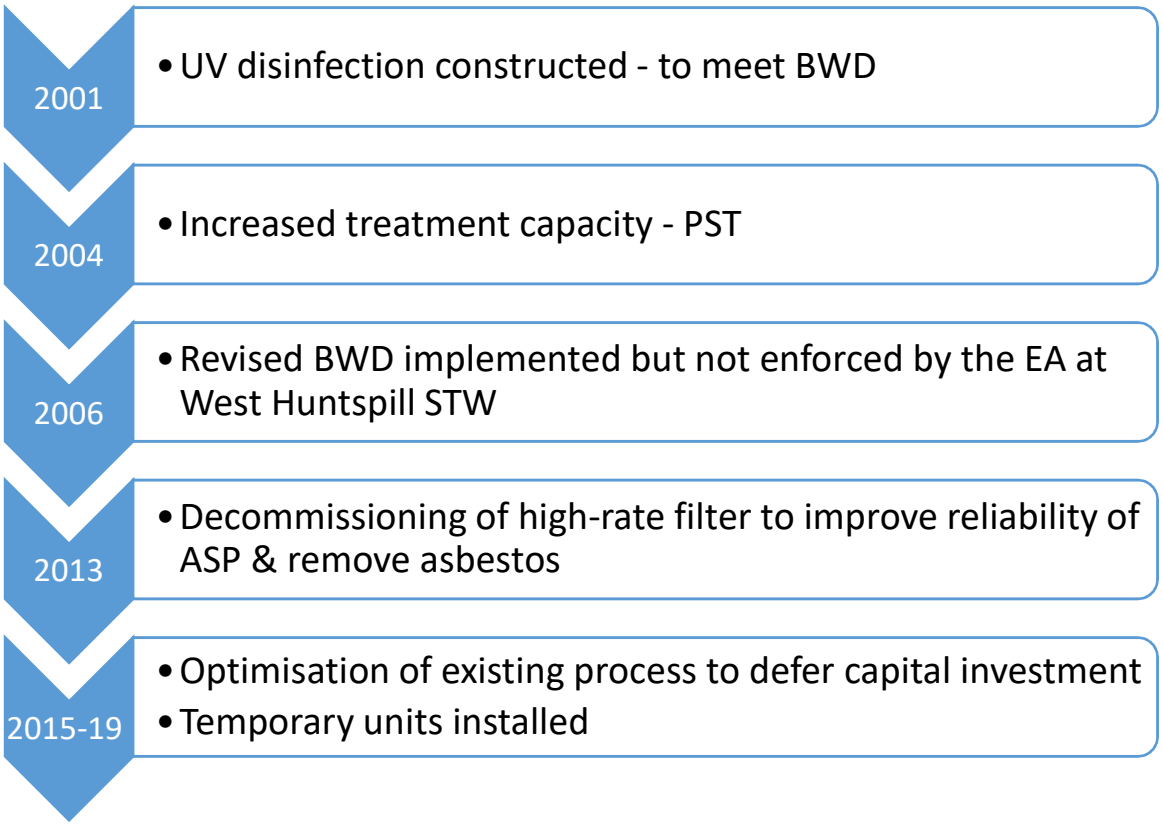
The works has been adapted as growth continues within the catchment to include staged temporary treatment units and process optimisation to ensure compliance with the existing environmental permit.

UV disinfection was installed at West Huntspill STW in 2001 to meet the requirements under the Bathing Water Directive (as per the updated conditions, 1991). The UV system was installed prior to the implementation of the revised Bathing Water Directive (rBWD, 2006) and thus a reduction in log-removal across the secondary treatment process was not considered in the consent by the EA.

Significant investment has been deferred in the past with the existing process optimised as far as is reasonable, with temporary treatment installed. The last significant investment with respect to growth was during 2000-2005, where an additional PST was constructed. A scheme was proposed for PR14 to increase treatment capacity as a contingent Growth scheme but was deferred by making operational adjustments (e.g. dosing to improve PST performance) and installation of temporary treatment to manage to increased loads received at the works in the short term.

This is summarised below in Figure 10-8.

Figure 10-8: West Huntspill STW historical enhancement



Growth (future)

There is significant growth within the West Huntspill catchment, with an established development plan for the region.

The Local Plan[32] for West Huntspill STW catchment area includes plans for future housing development. The associated increase in population is also shown:-

	2018-2020	2021-2025
New dwellings (Nº)	155	495
New residents (p.e.)	349	1,114

In addition to domestic growth, commercial and trade growth will place additional load on the works.

The projected load to be served by the works (p.e.) is summarised below:

	2018	2020	2025	2030	2035	2040
Future p.e.	61,219	81,222	83,703	85,348	86,821	88,328

There are several trade effluent discharges in the catchment comprising 23% of the biological load at present (measured not consented), of which 97% is contributed by two

[32] Sedgemoor District Council (January 2017). Local Plan Consultation: Proposed Submission Local Plan. https://www.sedgemoor.gov.uk/media/713/Proposed-Submission-Local-Plan/pdf/Proposed_Submission_Local_Plan

traders. Both of these dominant traders have applied for an increase in their consented discharge limits, and a new trader has requested a connection to the sewerage network. Taken these trade flow increases/additions into consideration would bring the total trade proportion of flows to the works to nearer 35%.

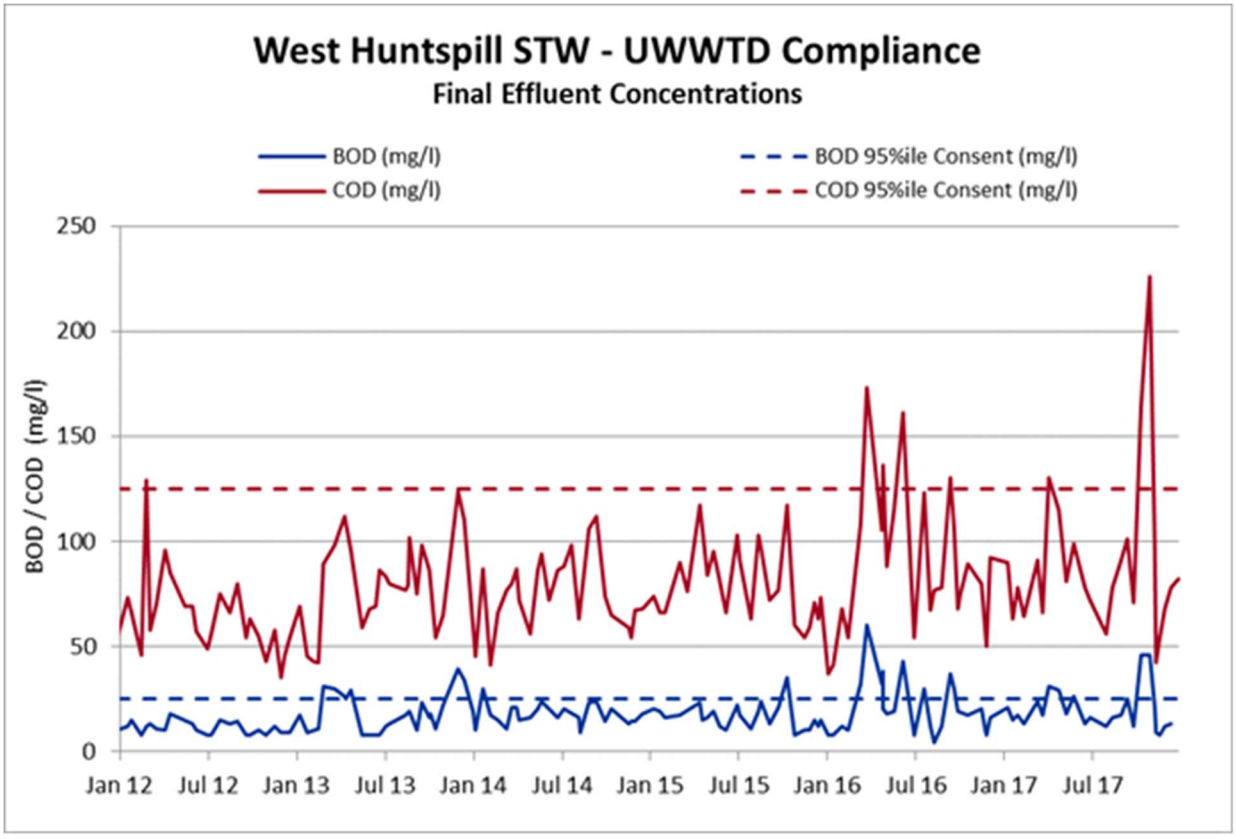
Performance

The site has experienced a continued deterioration in site performance with a noticeable increase in samples exceeding the suspended solids consent limit, regular UWWTD sample failures (COD & BOD) and a gradual decline in UV efficacy. The existing process units are overloaded when compared to Design Standards. Previous site investigations have highlighted several causes for inadequate treatment including, loading restrictions on the ASP, non-compliant trade discharges and poor centrate quality.

For several years, the site has regularly failed to meet the percentage removal target for BOD and COD and samples have on occasions exceeded the 95%ile BOD limit.

With increased load, current performance at the site is poor, with adverse trends experienced against all consent parameters, as demonstrated in the following performance graph.

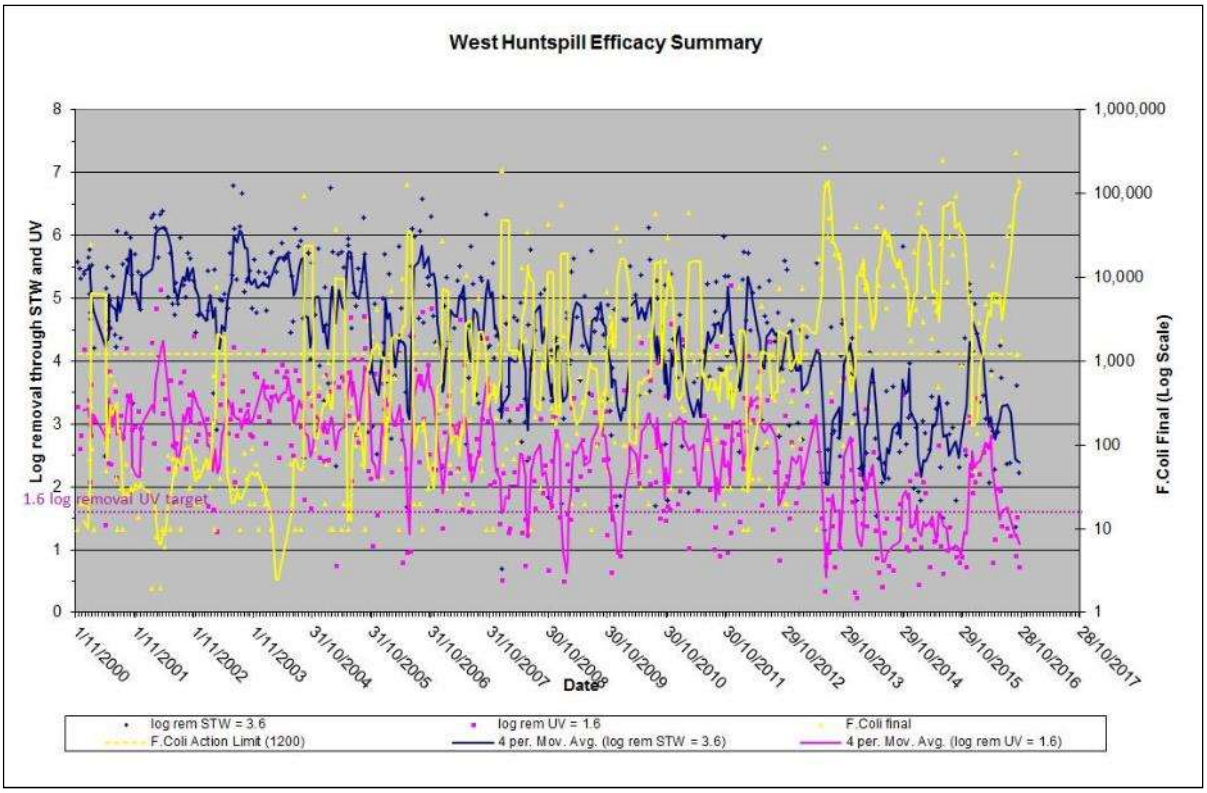
Figure 10-9: UWWTD - BOD performance



West Huntspill remains compliant according to existing requirements previously set by the Environment Agency (BWD, 1991). However, as shown below, UV treatment efficacy has deteriorated gradually since the summer of 2013 despite the received UV dose being greater

than 100. Current faecal coliform log kill performance is considered inadequate and requires improvement.

Figure 10-10: UV disinfection performance



A review of the UV plant was conducted in October 2016 by Blackwell Water Consultancy. They concluded that poor transmissivity was directly related to a high concentration of suspended solids in the final effluent, due to upstream processes performing inadequately. Operational staff have also indicated that occasional drops in transmissivity might be the result of specific trade discharge events.

5. Long-term plan

The decision to invest in a significant upgrade to treatment capacity at West Huntspill STW secures the long-term compliance and reliability of the works. The site has previously undergone process optimisation and utilisation of temporary treatment to defer such investment in the past, but without investment in PR19, the environmental performance of the site would be at significant risk of failure.

6. Options

For the PR19 works, 2 options were considered as follows:

No.	Title	Detail	Capex £m	Opex £k/yr
1	New Pumped-fed ASP	• A new (fourth) Primary Settlement Tank (PST) similar to existing PSTs. • A new conventional activated	14.441	304

No.	Title	Detail	Capex £m	Opex £k/yr
		sludge plant, run in parallel with the existing ASP plant, equipped with a Fine Bubble Diffused Aeration system. • ASP feed pumping station. • MCC for new process • New ASP effluent pipework to connect to the existing ASP outlet pipework to final settlement.		
2	HYBACS units upstream of the existing ASP	• A new (fourth) Primary Settlement Tank (PST) similar to existing PSTs. • Installation of 12 HYBACS units • HYBACS feed pumping station. • MCC for new process.	10.202	304

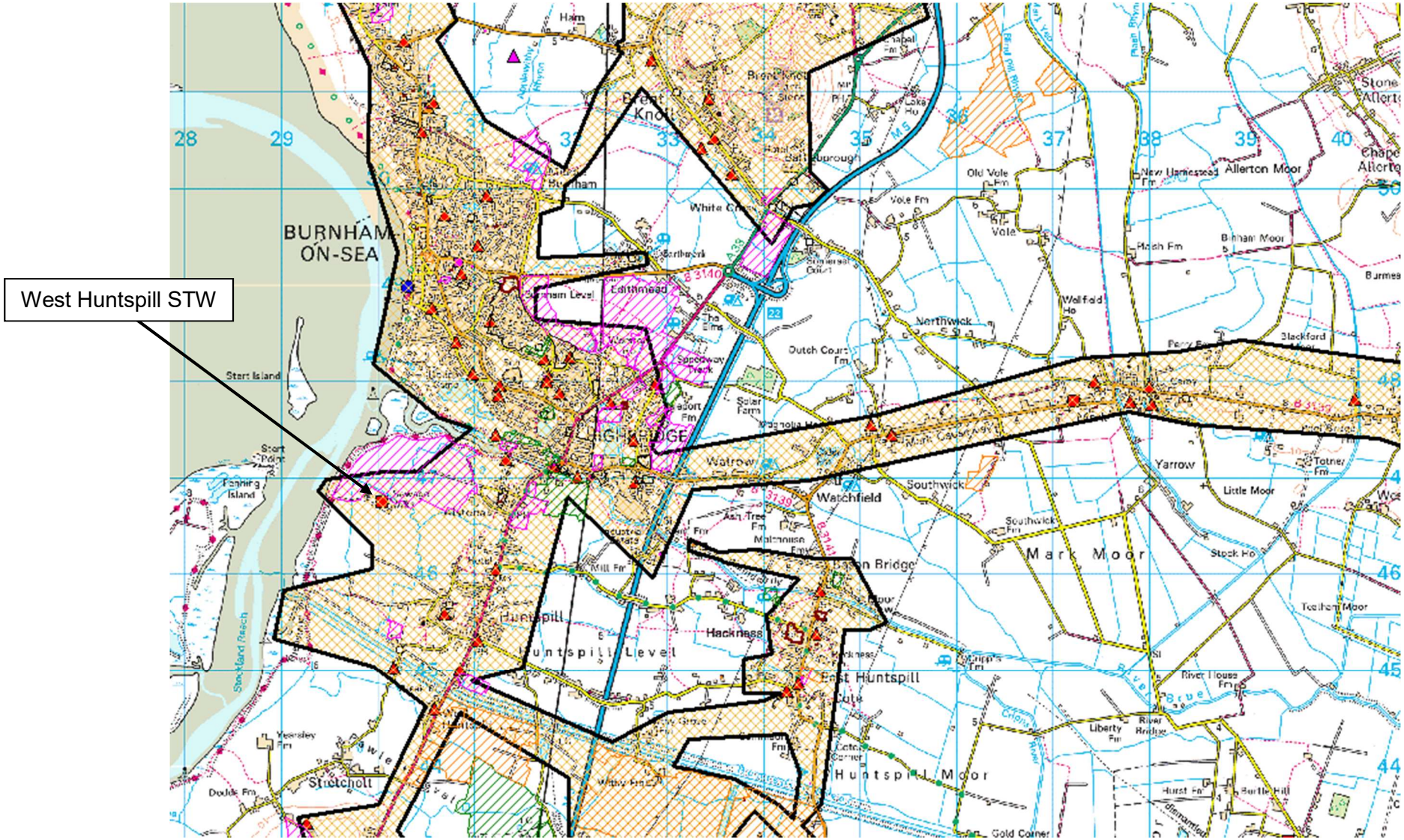
The proposed option is Option 1 as:

- This option provides adequate carbonaceous treatment capacity to meet the current load on the works and to cater for the significant increase in load by 2025 from new developments within the catchment.
- Installing a new ASP plant will provide the sufficient log removal and effluent quality for UV disinfection, and thus provide the required performance to meet the rBWD.
- The HYBACS units are not guaranteed to offer the WINEP required log removal, there is a significant risk that if this option were pursued then there would not be enough time to rectify any potential deficiencies ahead of meeting the tight WINEP delivery deadline.

The costs of the proposed option have been apportioned between drivers as below:-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	10%	1.444	0.032
Quality enhancement – UV disinfection	90%	12.997	0.289
	Total	14.441	0.321

Appendix 1 - West Huntspill STW – Plan of Catchment, showing potential ( ), and approved ( ) development areas



Annex U. Yeovil STW

1. Summary

Name	Yeovil STW
STW population served (2018/19 p.e)	58,959
Treatment capacity provided - PR19 enhancement (p.e)	7,346
Main driver	Quality (WFD)
Subsidiary driver	Growth
Total Capex (£m)	18.510
Growth Capex (£m)	1.260

2. Need

The STW has reached the limit of its treatment capacity, in particular the ability of the plant to remove ammonia is becoming critical. Historical and future planned growth in both residential and trade flows and loads requires additional treatment capacity to be provided in order to maintain permit compliance.

Additionally the WINEP(3) requires a tightening of the Phosphorus, AmmN and Biochemical Oxygen demand permits at Yeovil STW, as below:-

WINEP ID	Driver Code	Driver code Information	Completion Date	Level of certainty?	Old Permit (mg/L)	New Permit (mg/L)
7WW201047	WFD_ND	Ammonia	31/03/25	Green	15	12
7WW201048	WFD_ND	Biochemical Oxygen Demand / Dissolved Oxygen	31/03/25	Green	30	12
7WW201044	HD_IMP WFD_IMP SSSI_IMP	Phosphorus	22/12/24	Green	2	0.65
7WW201045	WFD_IMPg	Ammonia	22/12/24	Amber	15	4
7WW201046	WFD_IMPg	Biochemical Oxygen Demand / Dissolved Oxygen	22/12/24	Amber	30	14

A combined project has been developed, taking account of these multiple drivers and synergies, to provide an efficient solution for these capacity and quality enhancements.

The WINEP also requires us to provide increased storm storage at this STW. As this is a specific requirement for improved assets not related to the treatment enhancement for growth or the above quality drivers we have considered this separately.

3. Background

Site Details	
The site serves :	The STW receives gravity flows from Yeovil, including the nearby villages of Odcombe, Bradford Abbas and Stoford. Sludge is pumped to the Vale Road site for treatment and liquors from Vale Road are returned to the works drainage pumping station. See plan in Appendix.
Treatment Process	
The STW is a two-stage biological filter works with first stage primary tanks, a high rate filter process with associated settlement followed by secondary filters and humus settlement tanks. There is also chemical dosing for P removal.	

4. Growth and Investment (Historical)

The original works was constructed in the 1950s, with additional secondary filters provided in the mid 1960's. Between 1976 and 1980 further secondary filters were installed and the high rate filter stage introduced for part of the flow. In the early 2000's it was recognised that expansion was required as loads to the site exceeded the treatment capacity provided and measures were planned, however, the requirement for these was obviated by the closure of a major trader. The headroom released by this has now been lost. Limited additional capacity was provided when a second high-rate filter was installed along with chemical dosing for P removal, although this provides limited capacity for Ammonia removal.

Date	Project	Driver	Scheme
2002	D7613	Growth (Study)	Appraisal report concluded additional biological filter capacity and humus settlement capacity required
2006	D9115	Growth (Deferred)	Planned expansion of STW deferred due to closure of a major trader
2007	D9201	Capital maintenance	Inlet screens and associated plant
2013	D9513	Quality enhancement	Phosphorus removal to achieve 2.0mg/L P Scope included provision of an additional HRF and settlement tank
2014	D9515	Capital maintenance	Replacement screenings handling, refurbish grit plant, new filter columns for secondary filters and new MCCs

The size of population in the catchment has developed as shown below:-

	2001	2005	2010	2015	2017
Resident p.e.	43,167	44,510	45,092	45,985	47,414
Total p.e.	64,039	73,911	50,850	55,049	54,740

Sludge processed

	2002	2005	2010	2015	2017
Tonnes Dry Solids	3,400	3,460	4,760	4160	4,260

The total p.e. figures reflect the closure of major trader in 2006, with a significant reduction between 2005 and 2010. The trade load will not have contained a high Ammonia content therefore the headroom released will have been significantly lower than that demonstrated by the total p.e. figures as p.e. is based on BOD loadings. The BOD load from the trader will have been much more significant than the Ammonia load.

Yeovil STW receives sludge liquors from Vale Road sludge treatment centre. Sludge liquors have a high Ammonia content. The closure of the trader enabled the Vale Road to discharge more liquors, reflected by the increase in sludge treated shortly after the closure. The ability of the STW to process liquors has, however, reduced as shown by the reduction in sludge processed more recently.

5. Growth (Future)

The local plan[33] for Yeovil STW catchment area include plans for future housing development expected as follows:-

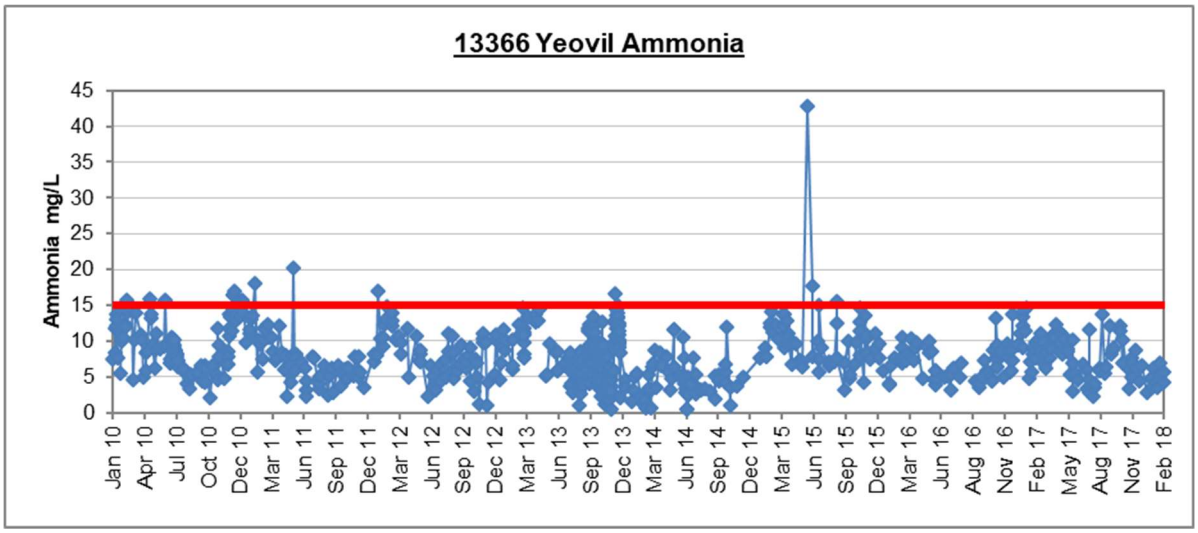
	2018-2020	2021-2025
New dwellings (Nº)	735	980
New residents (p.e.)	1,654	2,205

Taking account of anticipated increases in trade loads and commercial loads, we estimate an overall increase in population load as shown below:-

	2018	2020	2025	2030	2035	2040
Future p.e.	58,959	60,437	63,707	65,859	67,783	69,769

6. Performance

Performance of the STW since 2010 is demonstrated by the following graph:-



[33] South Somerset District Council (September 2017). South Somerset Authority Monitoring Report. https://www.southsomerset.gov.uk/media/898612/annual_monitoring_report_2017_issue.pdf

The STW regularly approaches its limit for Ammonia discharge, compliance with the discharge permit has, on occasions, been met by tankering sludge liquors from Vale Road STC, requiring significant Opex.

The Ammonia loading on the second stage filters (where most of the Ammonia removal occurs) is already 20% greater than design standards and by 2025 will be 30% greater.

7. Options

Capacity
For PR14 we reviewed options to provide for additional treatment capacity at the site. The following options were considered:-

- Additional stone media filters
- Additional plastic media filters
- Tertiary treatment (Nitrifying filters)

These options were considered again for PR19, and each option has a similar order of cost.

Quality Enhancements
Yeovil STW has multiple drivers for quality enhancement.

Water Framework Directive (No deterioration) driver requires a consent tightening for **AmmN from 15mg/L to 12mg/L** and for **BOD from 30mg/L to 12mg/L.** This requirement is definite.

Our standard design solutions for achieving these consent levels (permit standard 95%ile) would be similar to the options for capacity enhancement outlined above i.e. additional secondary treatment or provision of a tertiary Nitrifying filters.

The Water Framework Directive improvement driver for good ecological status is indicative awaiting Ministerial approval. A consent tightening to **4.0mg/L AmmN** would be required .

The achieve this consent the following options could be considered:-

- An additional activated sludge process stream, or
- Additional secondary treatment and tertiary aerated sand filters

A further combined Habitats Directive, Water Framework Directive and SSSI driver requires a tightening of our permit standard for **Phosphorus** to **0.65mg/L** (annual average).

Phosphorus tightening will require:-

- Tertiary treatment (filtration) with 2-point chemical dosing, or
- Activated sludge secondary treatment with 2-point chemical dosing

8. Proposed Solution

Land availability around this STW is limited. We have only a small parcel of land that can be used for additional treatment units. This restricts the options we can adopt for this site. Whereas the requirements for growth and the more limited quality enhancements can be

achieved by utilising additional secondary units with chemical dosing the requirement to achieve a 4mg/L AmmN consent would not be feasible with this strategy. We have therefore concluded that the option for a new activated sludge process stream should be adopted.

A high-level comparison of the treatment options is summarised below:-

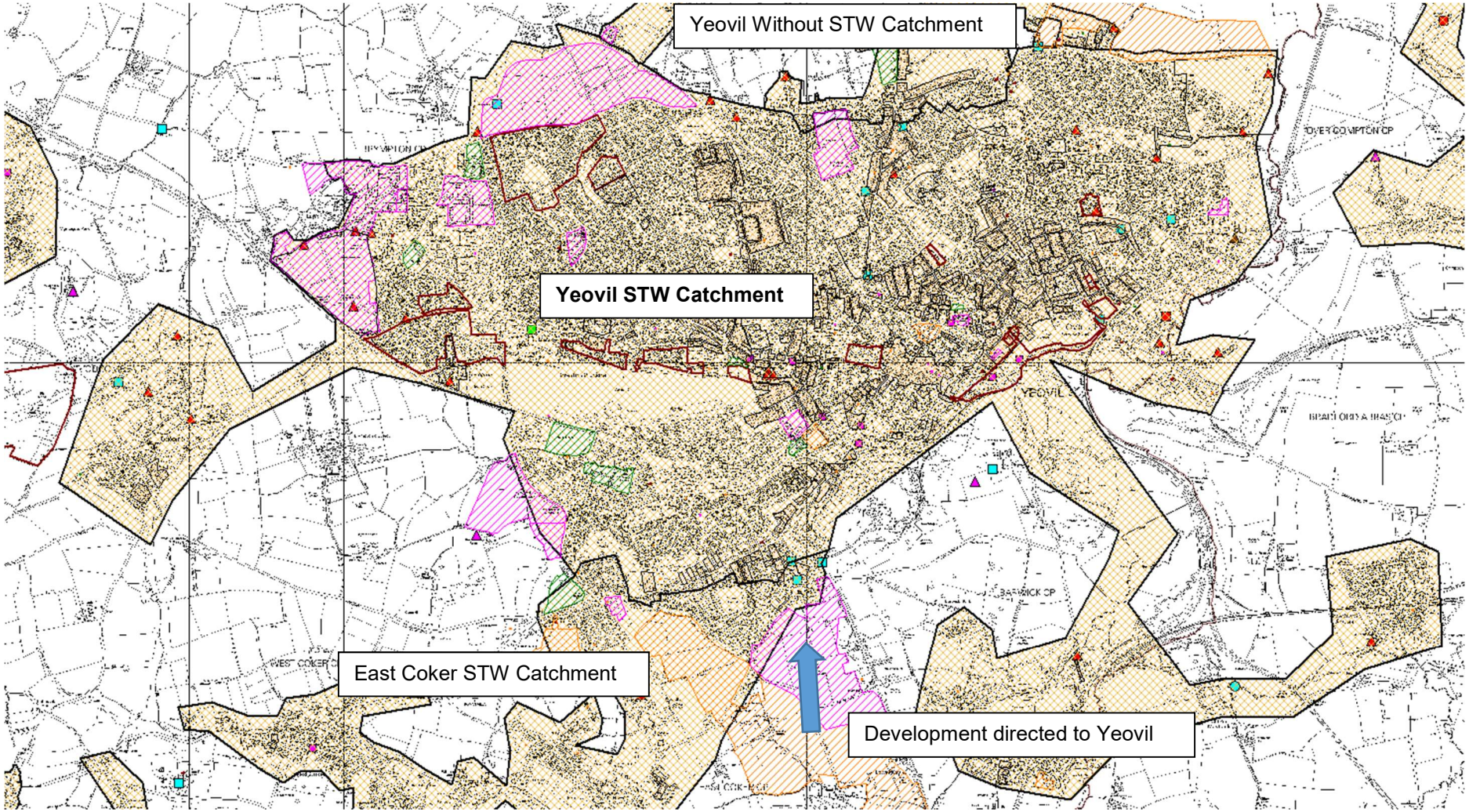
Option	Stone media filters with dedicated P-removal stage	Plastic media filters with dedicated P-removal stage	Tertiary Nitrifying filters with dedicated P-removal stage	ASP
Treatment Provision:				
Growth Capacity	✓	✓	✓	✓
AmmN (to 12mg/L)	✓	✓	✓	✓
P (0.65mg/L)	✓	✓	✓	✓
AmmN (4mg/L)	✗	✗	✗	✓
Capex (£m):				
AmmN (12mg/L) and Growth	4.759	3.992	3.348	
P (0.65mg/L)	4.261	4.261	4.261	18.510
AmmN (4mg/L)	5.280	5.280	5.280	
Total to achieve all drivers:	14.300	13.533	12.889	18.510
Restricts future expansion on site	✓	✓	✓	✗
Meets long term strategy for STW development	✗	✗	✗	✓
Lowest whole-life cost	✗	✗	✗	✓*

*Due to land purchase, pump away and treatment costs associated with providing additional capacity beyond the 2035 design horizon at a new location – refer to site plan in Appendix.

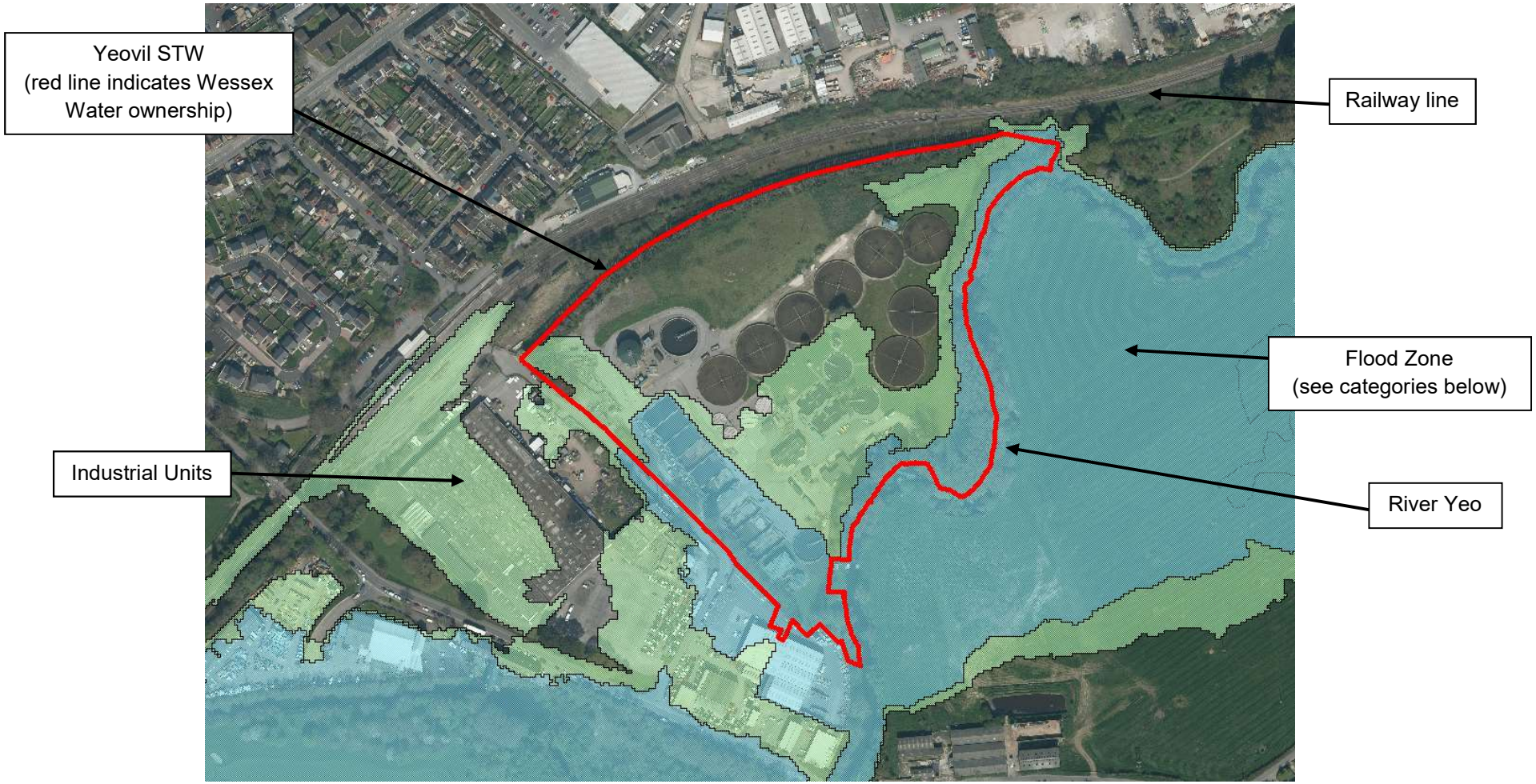
The costs have been apportioned between drivers as below :-

	Percentage	Capex (£m)	Opex (£m/yr)
STW Growth (capacity)	7%	1.260	0.021
Quality enhancement	93%	17.249	0.293
	Total	18.510	0.315

Appendix 1 – Yeovil STW – Plan of Catchment, showing potential ( ) and approved ( ) development areas



Appendix 2 – Yeovil STW – Site Plan (showing constraints to future expansion)



Environment Agency Flood Zones:

Flood Zone 3 – High Probability – Land having a 1 in 100 or greater annual probability of flooding

Flood Zone 2 – Medium Probability – Land having between a 1 in 100 and 1 in 1,000 annual probability of flooding

Annex V. Further DWF schemes

1. Need

The EA have stated that DWF compliance will be reported from January 2026 with flow compliance based on the previous five years of flow data, i.e. years 2021 to 2025. If the measured DWF flow exceeds the STW permit DWF in the latest year (i.e. 2025) and also exceeds the permit DWF in three or more years in the five year period, the EA will report this as a failing STW. This is a regulatory change and will affect EPA performance.

STWs that exceed their permit DWF and cannot be brought back into compliance through infiltration reduction will need a permit change. This will result in pro rata tightening of the existing numeric permit limits and an increase in the permit flow to full treatment. These two requirements may result in the need for additional treatment units. In addition, we will continue to invest in sewer sealing works to remove sources of infiltration, where economical to do so, in order to minimise the amount of investment required at the STWs.

Growth in these STW catchments will also need to be included within the assessment of the future permit DWF, numeric limits and FFT.

Seven STWs have been identified as needing a permit change if sewer sealing works are not successful during the current Business Plan period (by 2020), with another four STWs at risk, see table below. Four STWs, Burton, Compton Bassett, Great Wishford and Hurdcott (total enhancement of 3,848 p.e.) have been reported in previous sections of this document.

2. Background

Site Details	
STW population served (2018/19 p.e)	22,851 – STWs permit change required 29,558 – STWs permit at risk
The STWs have been identified:	Seven with a high likelihood of needing a permit change: All Cannings, Buckland Newton, Longburton, Milborne Port, Over Stratton, Wellington Tone and Wookey. Four at risk: Blackheath, Marnhull Common, Puncknowle and Ringwood.

3. Evidence
Growth and Investment (Historical)

The table below identifies the measured DWF compared against each STW permit DWF over the last five years. The level of exceedance depends on the weather conditions in the year. Red numbers identify a year in which the DWF permit has been exceeded.

STW Permit Change	Permit DWF m^3/d	Measured DWF m^3/d				
		2013	2014	2015	2016	2017
All Cannings STW	**240**	252	279	259	288*	259*
Buckland Newton STW	**83**	84	101	80	165	122*
Longburton STW	**75**	72	84	81*	149*	102*
Milborne Port STW	**900**	784	931	914	887*	950*
Over Stratton STW	**71**	87	131	92	69	90
Wellington Tone STW	**3,000**	2,922	3,158	2,981	3,018	3,042
Wookey STW	**315**	408	434	439	427	507*
STW Permit at Risk						
Blackheath STW	**1,200**	1,059	1,139	1,142	1,128	1,237
Marnhull Common STW	**1,163**	1,094	1,159	1,068	1,119	1,238
Puncknowle STW	**435**	220	228	351	380	481
Ringwood STW	**4,564**	4,009	5,277	3,868	3,791	4,681

* denotes measured flows post sewer sealing works.

Additional sealing works are currently programmed for completion by 2020 at All Cannings, Longburton, Milborne Port, Wellington Tone, Wookey and Over Stratton.

The four “at risk” STWs that exceeded their DWF permit in 2017 have been identified for sewer investigations in 2018/19, this will determine the level of infiltration and whether it can be reduced to enable DWF compliance.

Sewer sealing works has successfully reduced dry weather flows at Bradford on Tone, Cerne Abbas, Ditcheat, Lavington Woodbridge, North Petherton, South Perrott and Tisbury; these STWs are now compliant with their permit DWF.

STW Permit Change	Permit DWF m^3/d	Measured DWF m^3/d				
		2013	2014	2015	2016	2017
Bradford on Tone STW	**280**	293	330	454	266*	252*
Cerne Abbas STW	**159**	162	175	122*	125*	105*
Ditcheat STW	**144**	150	136	152	129*	139*
Lavington Woodbridge STW	**1,212**	1,167	1,393	1,241	1,157	1,132*
North Petherton STW	**780**	650	803	804	727	667*
South Perrott STW	**160**	155	171	172	151*	153*
Tisbury STW	**925**	995	1,037	980	792*	838*

Performance

The seven STWs identified have all complied with their existing numeric permit limits. The table below compares the performance of each STW against the expected pro rata permit limits, based on 2017 sample data.

STW Name with Permit Change	Permit DWF m^3/d	Revised Permit DWF m^3/d	Pro rata tightening (mg/L)				95%ile performance (mg/L)			Annual Average (mg/L)	Treatment Required
			BOD	SS	AmmN	P	BOD	SS	AmmN	P	
All Cannings STW	240	**300**	12	24	4	0.8	93.5	118.7	16.8	N/A	Tertiary
Buckland Newton STW	83	**150**	30	45	15	-	9.0	13.5	1.2	-	
Longburton STW	75	**120**	16	32	6	-	11.0	19.0	2.2	-	
Milborne Port STW	900	**1,100**	16	38	10	-	8.8	17.0	1.4	-	
Over Stratton STW	71	**115**	40	60	20	-	22.0	21.6	7.1	-	
Wellington Tone STW	3,000	**3,600**	30	45	10	1.7	21.0	35.0	17.1	N/A	Filters
Wookey STW	315	**530**	12	24	6	-	8.0	6.9	3.4	-	

An increase in permit DWF will also result in an increase in permit FFT and so additional hydraulic improvements will also be required at two of these STWs.

STW Name	Permit FFT L/s	Proposed FFT L/s	Treatment requirements
All Cannings STW	N/A	N/A	All flows go to full treatment, no improvements required.
Buckland Newton STW	5.5	5.5	Storm storage proposed instead of increase in permit FFT.
Longburton STW	N/A	N/A	All flows go to full treatment, no improvements required.
Milborne Port STW	41.0	41.0	No change
Over Stratton STW	N/A	N/A	All flows go to full treatment, no improvements required.
Wellington Tone STW	153.0	153.0	No change
Wookey STW	15.0	16.2	Additional Anoxic selector and FST required for increase in peak flow.

The above review identifies that All Cannings and Wellington Tone will require additional treatment units to comply with the tighter permit limits; these are required to ensure that there is no deterioration in the receiving water body as required by EA policy. With the increase in permit FFT at Wookey, additional hydraulic units will be required to pass the increase in flow and ensure compliance with numeric limits. Buckland Newton will require the installation of a storm tank. We have estimated the costs of the additional treatment and capacity enhancements at these four treatment works at **£5.8m.**

4. Options and Solutions

Capacity and associated permit tightening

Sewer investigations and sewer sealing works have been completed at each of the above STWs catchments to remove infiltration sources. Where STWs continue to exceed their permit DWFs, the remaining option is for the permit DWFs to be increased, resulting in pro rata tightening of the existing permit limits. Our assessment of the seven treatment works above is that three of them should be able to accept the increase in flow and associated permit tightening with no capital investment during PR19. At four of the STWs improvement works will be required as described below:

All Cannings STW

Tertiary treatment consisting of either sand filters or cloth media filter to achieve the tighter BOD, SS and AmmN permit limits.

	Nr Samples	Permitted Failures	BOD (12mg/L)	SS (24mg/L)	AmmN (4mg/L)
2017	52	5	7	7	6
2018	4	1	0	1	0

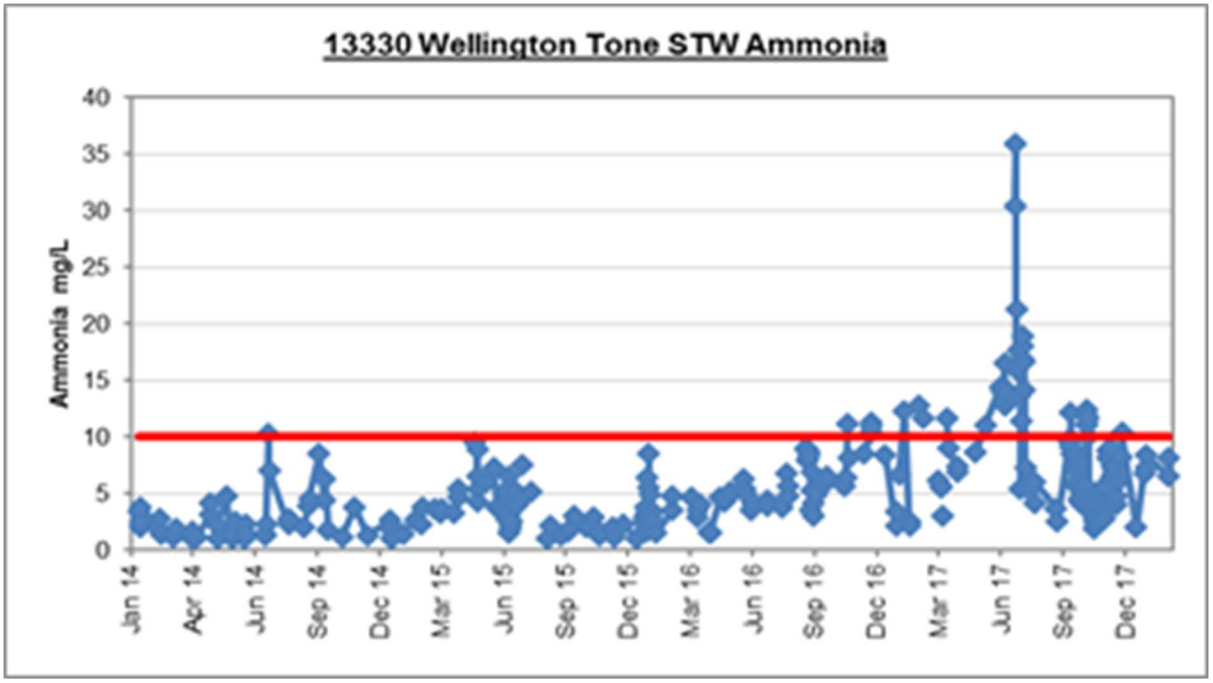
Buckland Newton STW

At Buckland Newton, instead of increasing the permit FFT, we proposes to install a storm storage tank at £0.6m. This will avoid the need to provide increased hydraulic capacity through the main treatment process including construction of an additional RBC and humus settlement stage at an estimated cost of £1.3m.

Wellington Tone STW

To ensure compliance with tighter ammonia limit an additional conventional filter treating only part of the flow, is required. The alternative would be the provision of tertiary aerated sand filters, but these would cost substantially more as they would need to be sized to take the full flow to treatment.

	Nr Samples	Permitted Failures	BOD (12mg/L)	SS (24mg/L)	AmmN (4mg/L)
2017	115	10	0	0	33
2018	13	2	0	0	0



Wookey STW

The increase in permit FFT will result in the final settlement tank being overloaded putting the works BOD and SS permit at risk. The proposal is to install an additional final settlement tank and an anoxic selector to improve solids settlement and removal.

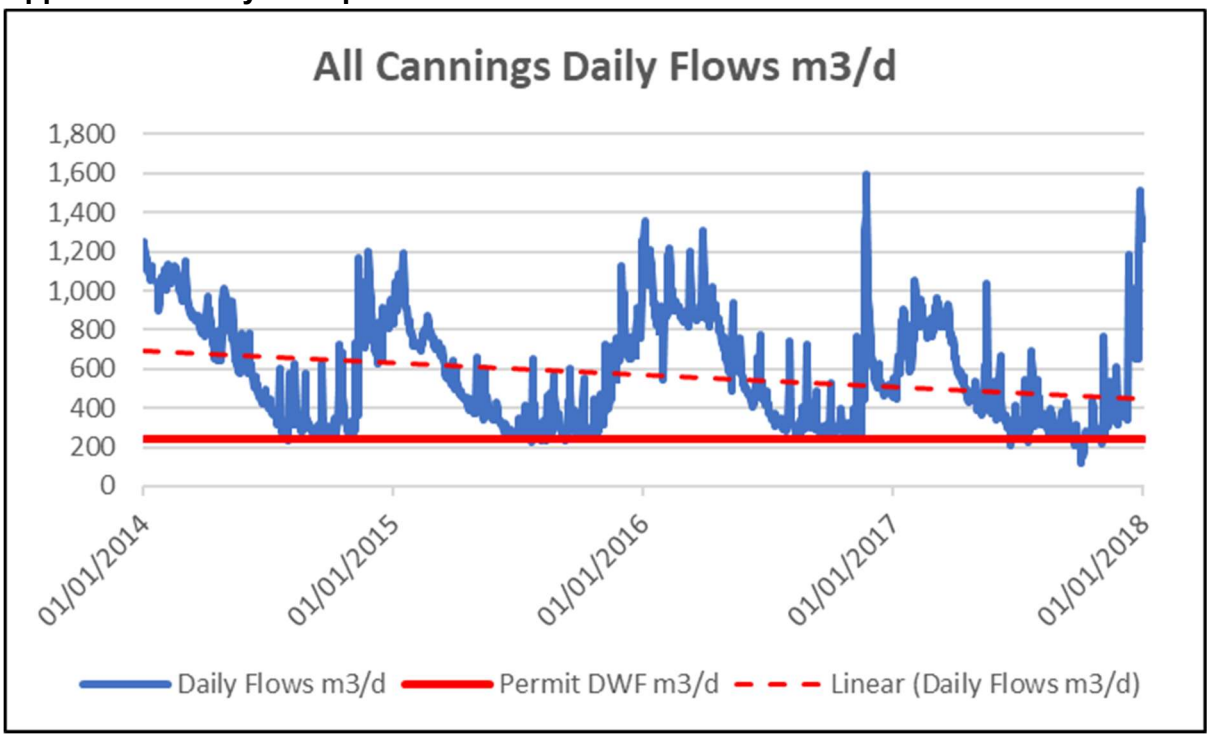
5. Proposed Solutions

The improvements required are identified as being STW growth and are estimated at:-

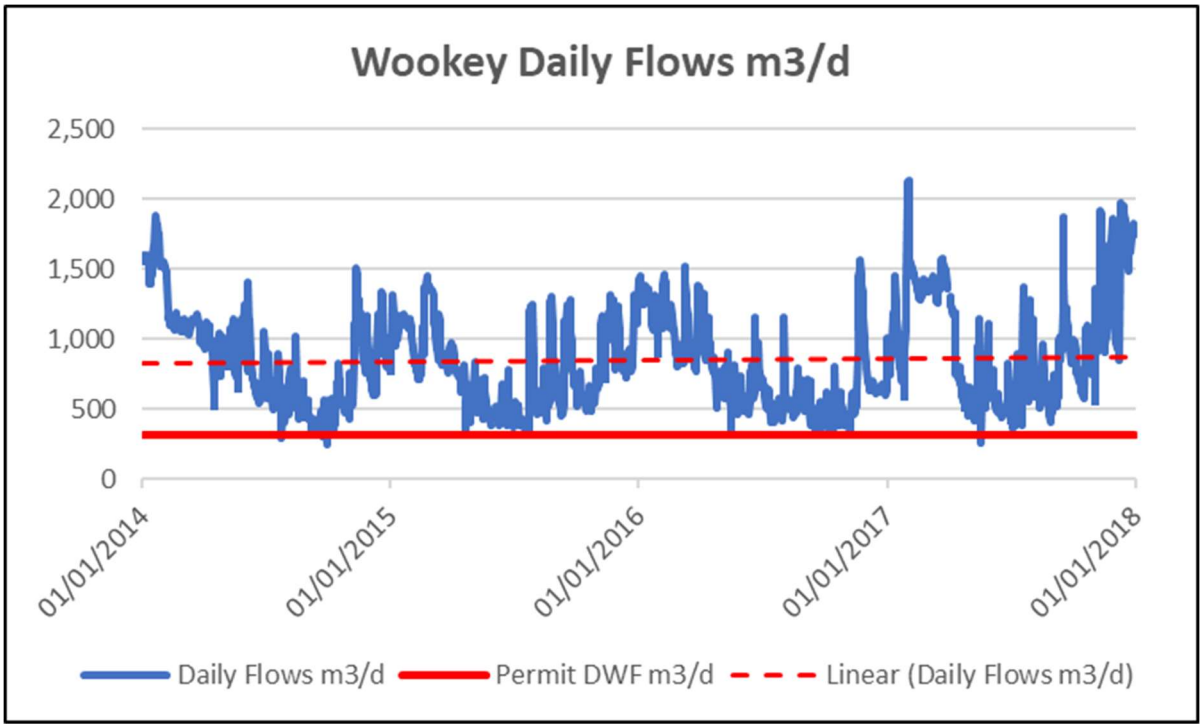
	Capex (£m)	Opex (£m/yr)
All Cannings STW	1.6	0.04
Buckland Newton STW	0.6	0.02
Wellington Tone STW	2.5	0.06
Wookey STW	1.1	0.03
Total	**5.8**	**0.15**

The Environment Agency has confirmed that these improvements do not qualify for quality funding as the permit change is driven by the need for an increased permit DWF due to growth.

Appendix 1 - Daily Flow plots



Trend analysis indicates a reduction in flows through sewer sealing works, but the works continues to exceed its permit DWF limit. It is proposed to increase the permit DWF from 240 to 300m^3/d.



Trend analysis indicates a small increase in flows even though sewer sealing works have been completed, further sealing works are planned for 2018. The works continues to exceed its permit DWF limit and so it is proposed to increase the permit DWF from 315 to 530m^3/d.

Annex W. Undefined Growth and Temporary Treatment

1. Need

In addition to the 20 STWs listed in the Annexes above, which have well defined and certain capacity enhancement needs, there are several STW catchments where development is very likely, but where the timing of the development is uncertain. This includes residential, commercial, trade and non-resident (tourist) developments planned in our region.

Our strategy for this dealing with this is two-fold:-

i) To design the capacity enhancements required at these STWs, and to allow funding for a proportion of the schemes to be implemented during PR19. The proportion is based on our assessment of the probability of each development occurring during PR19.

ii) To use temporary treatment plant to help maintain compliance in the short to medium term. This is more appropriate for our smaller STWs, and also for those where a quick response is needed, to avoid delaying a development or a trade load increase.

The STWs affected include:-

Name	Likelihood (%)	Planned additional capacity	Basis for investment decision
Ashill STW	30	SAF/temporary treatment	Development rate and performance of existing SAF plant.
Bishops Lydeard STW	50	Secondary filter/SAF plant	Development rate and performance of existing filters
Chew Stoke STW	20	Primary tank, Secondary plastic filter and humus tank.	Bristol Airport development rate
Corsley Heath STW	20	Pump Away/temporary treatment	Timing of new development
Fordingbridge STW	30	Secondary filter	Rate of residential development, and holiday camp connection.
Hullavington STW	50	Secondary filter/SAF/temporary treatment	Rate of residential and commercial development.
Leyhill STW	30	Secondary filter	Rate of residential development.
Ringwood STW	30	Secondary filter	Rate of residential development.
Sharpness STW	50	Final settlement tank	Rate of residential, commercial and trade development and performance of existing plant.

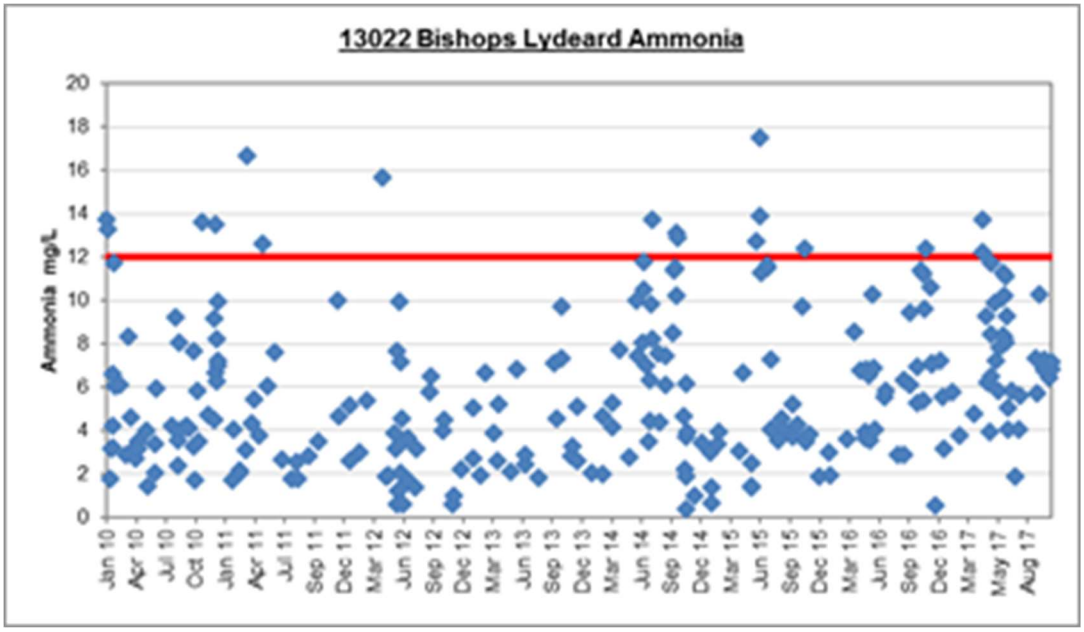
Name	Capex range (£m)		Likelihood (%)	PR19 proposals (£m)	
	Low	High		Capex allowance	Opex allowance
Ashill STW	0	0.20	30	0.06	
Bishops Lydeard STW	0	0.60	50	0.30	
Chew Stoke STW	0	4.0	20	0.80	
Birchwood Close STW (Corsley Heath)	0	0.20	30	0.06	
Fordingbridge STW	0	1.527	30	0.30	
Hullavington STW	0	0.70	50	0.35	
Leyhill STW	0	0.60	30	0.20	
Ringwood STW	0	2.525	30	0.75	
Sharpness STW	0	0.80	50	0.40	
TOTAL	**0**	**11.15**		**3.2**	**0.13**

High level reviews have been carried out on these STWs with results as summarised below:

2. Bishops Lydeard STW

Development plans include 173 homes off Taunton Road identified in the TDBC Site Allocation and Development Management Plan (adopted December 2016). Resident population is set to increase from 2.115 in 2017 to 2,566 in 2025. The West Somerset Railway is also increasing the number of tourists visiting the town.

The STW is at the limit of its capacity for Ammonia removal, as shown below. We have concluded that an additional secondary filter will be required to provide additional capacity.



3. Chew Stoke STW

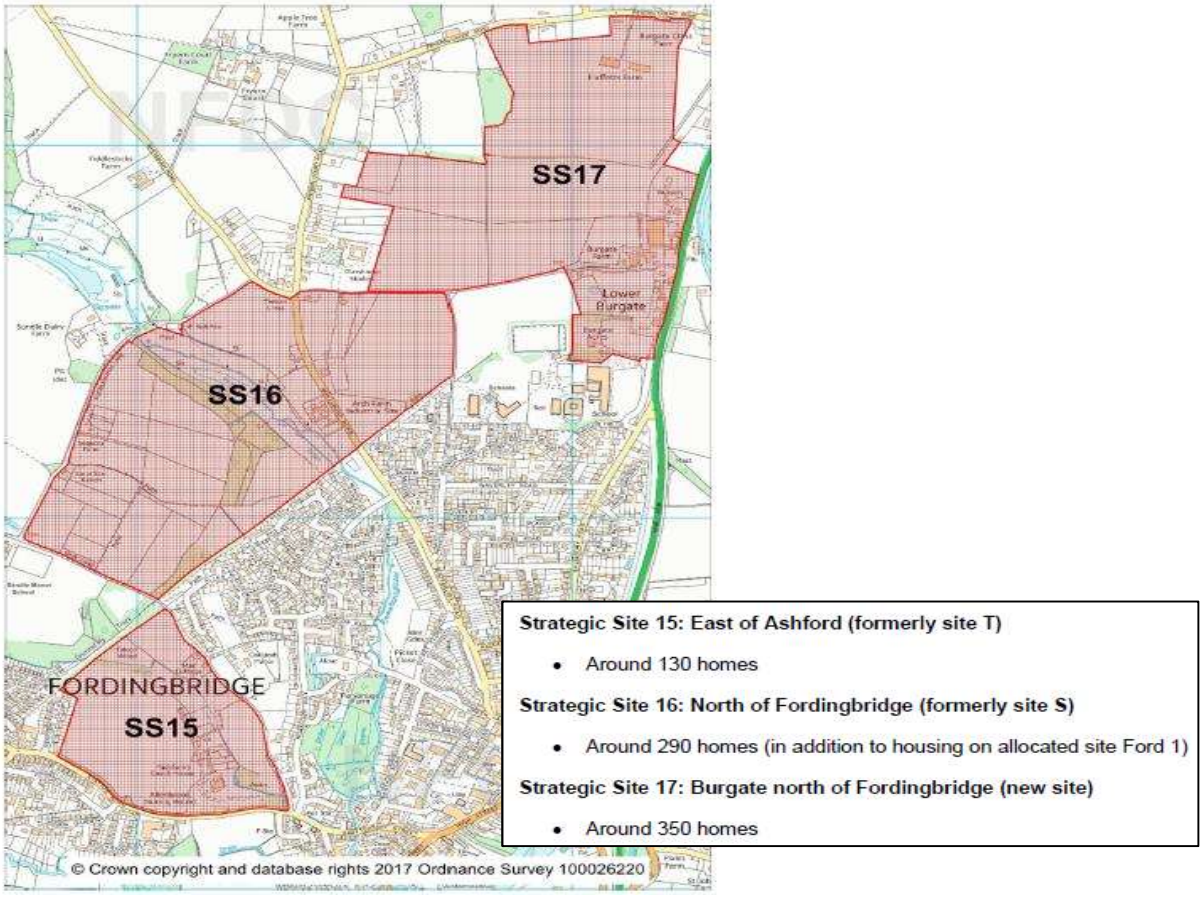
A large proportion of the biological load (approx. 60%) arriving at Chew Stoke STW arrives from Bristol International Airport. The proposed increase in flight numbers will result in additional flows and loads being discharged to this treatment works.

The requirement for a capacity increase at Chew Stoke STW is dependent on the rate of growth at Bristol Airport. The biological load from 2017 is identified as subject to a 33% increase up to 2025. This would require a primary settlement tank and plastic media filter. The load increase up to 2040 is identified to increase by 53% requiring a permit tightening of discharge limits and the requirement for additional tertiary treatment. Development rates have been identified for some time at Bristol Airport but these have not yet materialised. The potential increase for the 2025 horizon has therefore been identified with a likelihood factor of 20%.

4. Fordingbridge STW

In Fordingbridge the development area adopted in the 2009 Local Plan (Ford1 Whitsbury Road 17/10150) has achieved full planning permission subject to legal agreement. The developer intends to commence construction of 145 dwellings in 2018. The STW is performing well and can accommodate this development. However, a further possible 1,045 dwellings are being planned and a local holiday park (Sandy Balls holiday park) has enquired about transferring its sewage from circa 2,000 holiday-makers, to the STW.

Figure 10-11: Development Sites in Fordingbridge



The existing secondary filters perform very well, but the above development will cause them to be over-loaded with respect to AmmoniaN. We have assessed that one additional secondary filter will therefore be required.

5. Hullavington STW

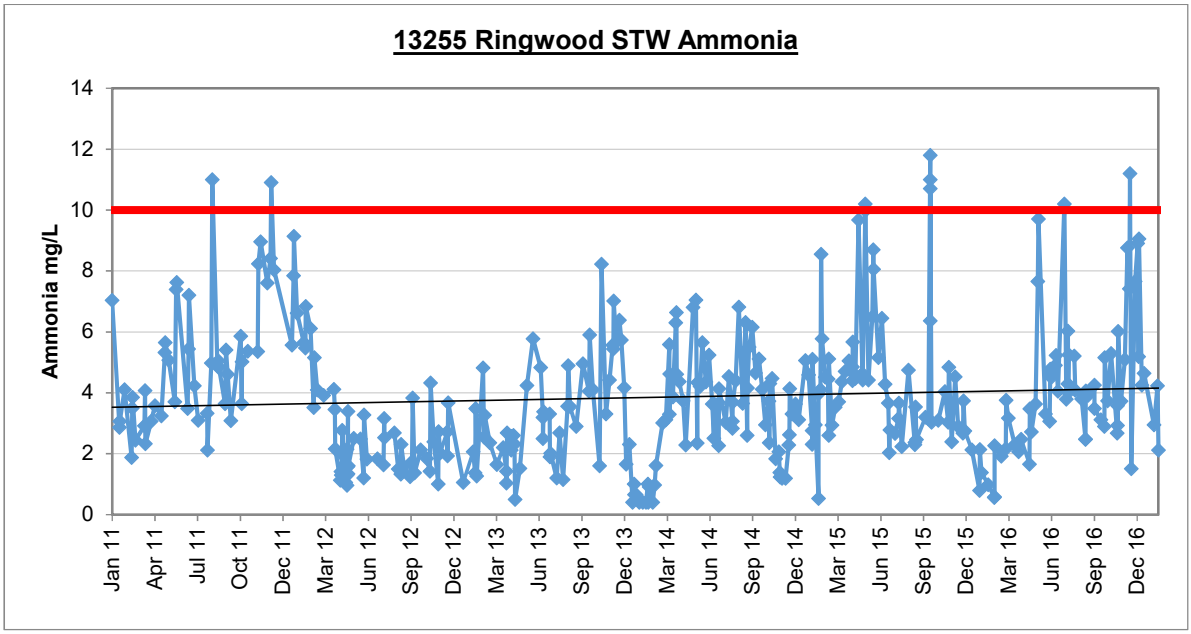
This is a relatively small rural STW serving the villages of Hullavington and Grittleton, with a resident population of just over 1,000 p.e. Development is planned in the village which will increase the population by 175p.e. In addition, the Hullavington former barracks and airfield are due for development (by Dyson) leading to a further increase in flows and loads on the STW. Additional secondary treatment will be required, either in the form of biological filters (as existing) or a SAF plant. Temporary treatment (SAF plant) may be utilised initially while land and planning issues are resolved.

6. Leyhill STW

Leyhill STW is a former Ministry of Justice STW which we adopted in 2015. It serves the prisons at Leyhill and Eastwood Park, and the village of Falfield, serving an overall existing population of 1,260 p.e. Planning consent has recently been granted for 85 dwellings at Heneage Farm, Falfield, South Gloucestershire, and enquiries have also been received from the Tortworth Court Hotel which is located only 300 metres from the STW. The impact of these developments would be to increase the DWF to the STW over its current permit limit, leading to a tightening of the quality parameters. The STW's performance currently is very good, and a single additional secondary filter is proposed to meet the more stringent permit limit.

7. Ringwood STW

Residential development is forecast to grow by 9.4% by 2025, from 14,826 (2017) to 16,215 (2027). The existing filters are at or approaching their design loading rate for AmmoniaN and their performance with respect to AmmoniaN removal is deteriorating. We have assessed that an additional secondary filter will be required.



8. Sharpness STW

Development plans include redevelopment of the Berkley Centre, and other residential development in Sharpness. The local trader (Purton Carbons)) has also recently increased its trade discharge. The increase in loads will require an increase in the MLSS in the Oxidation Ditch, which in turn increases the solids loading on the single final settlement tank. We have assessed that an additional final settlement tank will be required.

9. Temporary Treatment Plant

As part of the £3.2m funding for these contingent growth schemes, we have included a sum of £1.0m for the purchase of modular temporary treatment plant. This is based on our estimate for procuring and installing:-

2 No. containerised Moving Bed BioReactors (MBBRs)
2 No. Dissolved Air Flotation (DAF) plants
2 No. Submerged Aerated Filter (SAF) plants

These will be sized to match the STW in which catchment growth has occurred. For estimating purposes the capacity of the proposed units has been taken as:-

2 No. MBBRs -	2,000 p.e. each
2 No. DAFs -	1,500 p.e. each
2 No. SAFs -	350 p.e. each