Central Bedfordshire Council
www.centralbedfordshire.gov.uk

Water Cycle Study Appendix A Water Quality Assessment

July 2017

A Appendix: Water Quality Assessment

A Appendix - Water Quality Assessment

A.1 Introduction

The increased discharge of effluent due to a growth in population served by a Wastewater Treatment Works (WwTW)[1] may impact the quality of the receiving water. The Water Framework Directive (WFD) does not allow a watercourse to deteriorate from its current class (either water body or element class).

It is Environment Agency (EA) policy to model the impact of increasing effluent volumes on the receiving watercourse. Where the scale of development is such that a deterioration is predicted, a new Environmental Permit (EP) may be required for the WwTW to improve the quality of the final effluent, so that the extra pollution load will not result in a deterioration in the water quality of the watercourse. This is known as a "no deterioration" or "load standstill".

It is the objective of the WFD that all waterbodies should meet Good Ecological Status (GES), or where they have been highly modified meet Good Ecological Potential (GEP). It is therefore also necessary to assess whether the proposed increase in effluent could prevent a watercourse from meeting GES or GEP.

If a watercourse fails the GES target, further investigations are needed to define the 'reasons for fail' and which actions could be implemented to reach such status.

As Central Bedfordshire Council has not provided growth numbers or locations at this stage, each WwTW was investigated to determine how many houses can be built with the current treatment technology without causing a deterioration of 10% or more, or a class deterioration. This analysis identified 18 Wastewater Treatment Works (WwTWs) to assess the current capacity of the systems, however two of these (Caddington and Studham) discharge to groundwater and were consequently not assessed (see section A.2.9). The EA has reviewed the list of WwTWs and recommended analysis of the following 16 treatment works:

- Anglian Water
  - Barton Le Clay
  - Biggleswade
  - Chalton
  - Clifton
  - Clophill
  - Dunstable
  - Flitwick
  - Leighton Linslade
  - Marston Moretaine (Level 2 only)
  - Poppy Hill
  - Potton
  - Sandy
  - Shillington
  - Stanbridgeford
  - Tempsford
- Thames Water
  - Markyate

This report assesses the current potential growth in the WwTWs without reaching deterioration.

A.1.1 Study Objectives

This report assesses the potential water quality impacts on the receiving watercourses due to the future growth in effluent flows. The aim of this assessment was to identify how many potential houses could be developed within each WwTW catchment, without causing deterioration and

1 Note that Anglian Water now uses the terminology water Recycling Centres (WRCs) to underline the role of treatment works in recycling water to the natural environment. The term wastewater and wastewater treatment is used generically in this report and applies both to Thames Water and Anglian Water assets.

without upgrading the WwTW. Note that available headroom capacity has been assessed for three measures:

- flow capacity against the Dry Weather Flow consent (presented in the main report),
- environmental capacity in the receiving watercourse (presented in detail in this appendix and summarised in the main report), and
- impact on additional effluent flows on flood risk in the receiving watercourse (presented in the main report).

A.2 Methodology

A.2.2 Growth Scenarios

In order to undertake this assessment, future effluent flows needed to be estimated to determine the number of additional houses that could be developed without causing deterioration. This was carried out through an iterative process, whereby the effluent flow (mean and standard deviation) were increased in increments, and the resulting water quality compared to the present day quality. Where this did not result in a deterioration, the effluent flow was repeated until deterioration was predicted. This test was repeated for the three determinands (BOD, NH_4 and P). Note that a cap of three times the present day effluent flow was applied. It is reasonable to assume that very few treatment works would be able to accommodate a three times increase in effluent without requiring an upgrade.

The final future effluent statistics were then used to estimate the number of houses using the following parameters:

- Anglian Water: an occupancy rate of 2.4 persons/dwelling, a water consumption of 133 l/p/d and 95% of water consumed being returned to sewer.
- Thames Water: an occupancy rate of 2.4 persons/dwelling, a water consumption of 125l/p/d and 95% of water consumed being returned to sewer.

A.2.3 Assessment of Deterioration

The Water Cycle Study is intended to, where possible, direct growth where there is infrastructure and environmental capacity to accommodate it, and to ensure that growth does not degrade the environment. Any increase in a pollutant load being discharged from a WwTW could cause a deterioration in the water quality of the receiving water body, and a review of the Environmental Permit may be triggered and an upgrade to the treatment work may be necessary. The EA set the following criteria to define significant deterioration:

- A class deterioration: For example, if an increased load of ammonia from a WwTW led to a water body currently defined as "Fair" ecological status dropping down to "Poor" status.
- A deterioration of more than 10%. For example, if the present-day 95 percentile BOD downstream of a WwTW is 2.0mg/l, but as a result of an increased WwTW discharge this rose to 2.3mg/l, this would be a deterioration of 15%.
- Any deterioration of a water body classed as "Bad". Where the water body is currently of "Bad" ecological status (the lowest WFD status), then no further deterioration is permitted.

A.2.4 Improving water quality to enable Good status to be met

Where a water body is currently not meeting good status, activities which impact upon that water body should be assessed to ensure that they will not prevent the water body from meeting Good status in the future. When assessing WwTW discharges, this means testing whether the water body could meet good status, if the upstream water quality were good and the treatment works were to be upgraded to current Best Available Technology (BAT). If it could, but the planned growth in the catchment would prevent Good status being met, it is considered that environmental capacity could be a limitation on growth.

This assessment has not been carried out at this early stage in the Central Bedfordshire assessment, due to:

- no information being available on the likely scale and locations of development
- the focus of this assessment being to identify the scale of development which could be accommodated in each catchment without causing deterioration and without requiring a treatment works upgrade.

This assessment will be included at stage 2.

A.2.5 River Quality Planning Tool

The Environment Agency RQP tool was the selected approach for this assessment in conjunction with the recommended guidance document; "Water Quality Planning: no deterioration and the Water Framework Directive"[2]. The tool uses a Monte Carlo Mass Balance approach which allows the user to both test the impact of a change in discharge volume or quality and to calculate Environmental Permit conditions needed to achieve a downstream water quality target.

RQP models were set up and run for each WwTW to determine the current impact of the treatment works.

The data required to run the RQP software were:

Upstream river data (received from the EA):

- Mean flow
- 95% exceedance flow
- Mean for each contaminants
- Standard deviation for each contaminant

Discharge data (received from the EA):

- Mean flow
- Standard deviation for the flow
- Mean for each contaminant

River Quality target data (received from the EA):

- 'No deterioration target'
- 'Good status' target

The above data inputs should be based on observations where available. In the absence of observed data, the EA require that the following values are used:

- Flow mean: 1.25*DWF
- Flow SD: 1/3*mean
- Quality data: permit values or assumed values
- If observed river flows were not available these were obtained from an existing model or low-flows estimation software.
- If observed water quality data were not available these were obtained from an existing model or a neighbouring catchment with similar characteristics, or the mid-point of the WFD class.
- Dry Weather Flow (DWF) permits and the measured Q90 flows were also provided by the EA.

Note that, for the 14 treatment works within the Environment Agency's Anglian Region, spreadsheets summarising the recommended model input values and standards were provided by the EA. These are reproduced in Annex I. For the Markyate treatment works in the Thames region, the EA provided tabulated flow and water quality observed data. These were analysed to produce input statistics for the RQP model.

A.2.6 Determinants

The determinants assessed at each WwTW were Biological Oxygen Demand (BOD), Ammonia (NH_4) and Phosphorus (P). It has been assumed that, as effluent volumes increase due to growth, each treatment works would continue to discharge at its present-day effluent quality (in other words that there would be no decline in the level of treatment as the works treats more wastewater).

A.2.7 Good Ecological Status

The WFD standards for Biological Oxygen Demand (BOD), Ammonia (NH_4) and Phosphorus (P) set by the EA for lowland and high alkalinity water bodies are shown in Table 1 below.

2 Environment Agency (2012) Water Quality Planning: no deterioration and the Water Framework Directive Accessed online at: http://www.fwr.org/WQreg/Appendices/No_deterioration_and_the_WFD_50_12.pdf 02/11/2016

Table 1: WFD Standards for Lowland and high Alkalinity water bodies

Determinand	Statistic (unit)	Standard (by class)			
		High	Good	Moderate	Poor
BOD	90 percentile (mg/)	4.0	5.0	6.0	7.5
NH_4	90 percentile (mg/l)	0.3	0.6	1.1	2.5
P	Mean (mg/l)	0.05	0.12 (Reach specific values shown below)	0.25	1.00

The EA has provided 2015 WFD catchment/reach specific 'Good Status' targets for phosphorus. The following targets have been used in this assessment at each WwTW:

Table 2: Phosphorus targets for 'Good Status' by WwTW

WwTW	P mean mg/l	Receiving watercourse
Barton Le Clay	0.197	Barton Brook
Biggleswade	0.088	River Ivel
Chalton	0.075	River Flit
Clifton	0.089	Henlow Brook
Clophill	0.076	River Flit
Dunstable	0.075	Ouzel Brook
Flitwick	0.076	Steppingley Brook
Leighton Linslade	0.075	River Ouzel
Poppy Hill	0.09	River Ivel
Potton	0.07	Sutton Brook
Sandy	0.09	River Ivel
Shillington	0.086	Campton Brook
Stanbridgeford	0.076	Ouzel Brook
Tempsford	0.089	Stone Brook
Markyate	0.077	River Ver

A.2.8 Assessing Compliance

The status of the receiving watercourse is reported using the same traffic-colour used by the EA "Method Statement for the Classification of Surface Water Bodies v3"[3] as shown in

3 Environment Agency (2012) Method statement for the classification of surface water bodies v3 Accessed online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/485389/LIT_5769_ed4e2b.pdf 02/11/2016

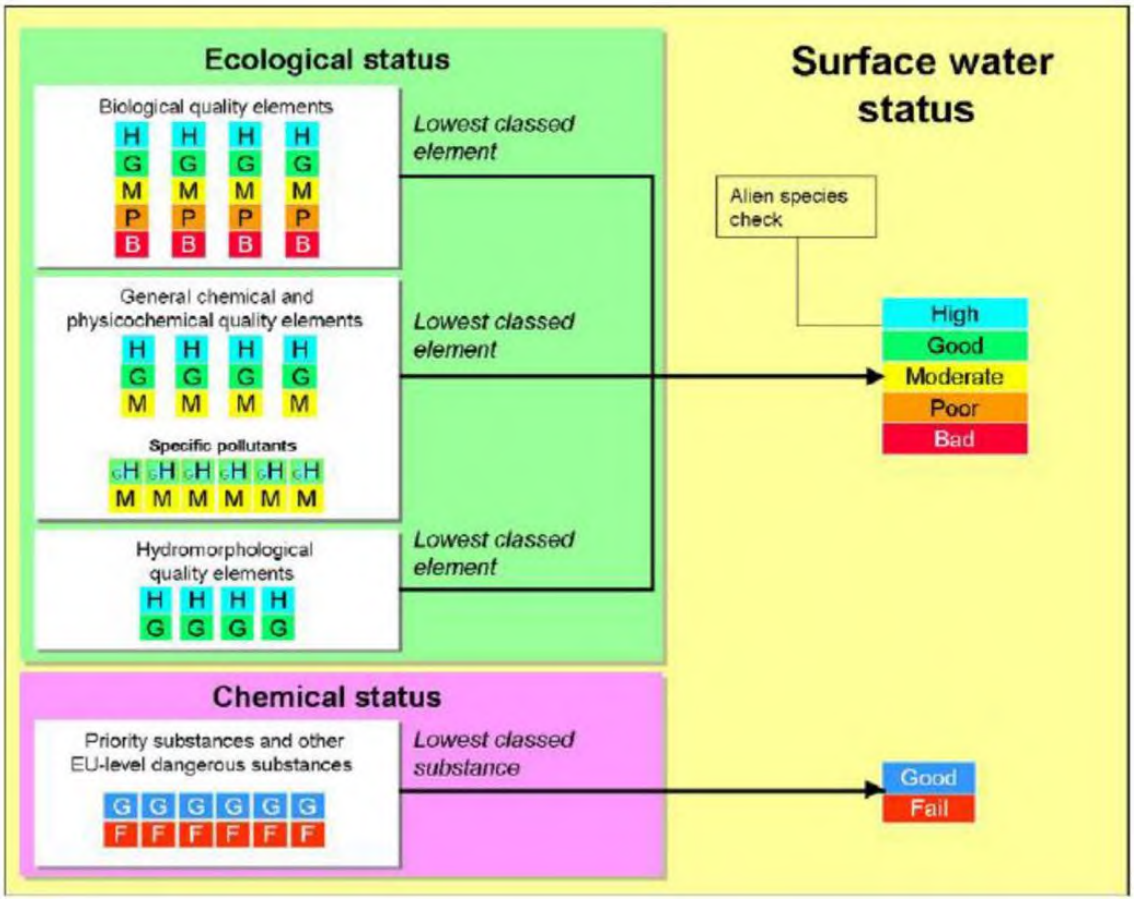
Figure 1. The WCS requires an assessment only based on the physico-chemical quality elements where each element is classified as bad, poor, moderate, good or high.

For each WwTW a summary table is provided (based on **Error! Reference source not found.**) for the receiving watercourse, reporting the 2015 WFD status for BOD, NH_4 and P, the overall status of the watercourse and future objectives.

Table 3: Summary table representing 2015 watercourse status and its objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Overall watercourse's status	Watercourse's status for BOD	Watercourse's status for NH_4	Watercourse's status for P
Objective	Overall watercourse's objective	Watercourse's objective for BOD	Watercourse's objective for NH_4	Watercourse's objective for P

Figure 1: Classification of Surface Water Status from "Method statement for the classification of surface water bodies v3"



A.2.9 Wastewater treatment works discharging to groundwater

Two wastewater treatment works at Caddington and Studham (both Thames Water) in Central Bedfordshire discharge to groundwater. If the proposed growth in either of these two catchments is anticipated to lead to an exceedance of the existing volumetric discharge permits, it would be necessary to undertake a groundwater risk assessment to demonstrate that the potential environmental impacts of the discharge are acceptable can be adequately mitigated. The Environment Agency provide guidance on how to undertake such an assessment[4].

Preparing such an assessment was beyond the scope of this stage 1 study. If significant development draining to either Studham or Caddington WwTW is proposed, it is recommended that the stage 2 study includes a groundwater impact assessment.

4 Environment Agency (2016) Groundwater risk assessment for your environmental permit. Accessed online at https://www.gov.uk/guidance/groundwater-risk-assessment-for-your-environmental-permit on 12/12/2016.

A.3 Results for Anglian Water WwTWs

A.3.10 Barton Le Clay

Barton Le Clay WwTW discharges into Barton Brook watercourse as shown in Figure 2.

Figure 2: Barton Le Clay WwTW discharge location

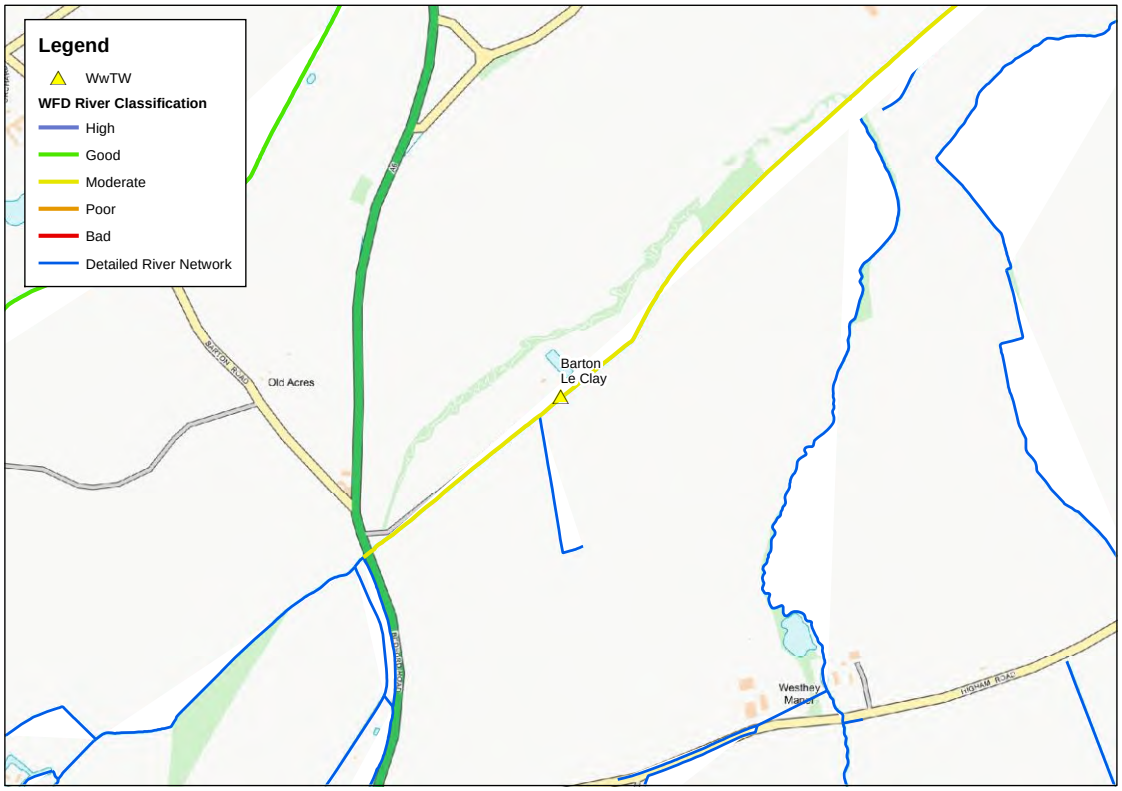


Table 4: Barton Brook status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	High	Poor
Objective	Not available	High	High	Good

Table 4 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Barton Le Clay has a moderate overall status, but BOD and NH_4 have a high status and P has a poor WFD status.

Table 5: Consent values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
1143	1094	15	6.09	5	3.43	Not available	n/a

Table 5 shows the consented values for Barton Le Clay WwTW. The works has permitted values for 2015 DWF, BOD and NH_4 and is currently working within these limits. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 6: Input data and RQP results for Barton Le Clay WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	2.748	Low Flow Software	1.43	Based on permitted DWF	N/A
	SD			0.48		
	5%ile	0.96				
BOD (mg/l)	Mean	1.15	Mid Class High	2.66	Observed Data (EA)	2.79
	SD	0.69		1.78		
	Target 90%ile	4.00	2015 WFD			
NH4 (mg/l)	Mean	0.09	Mid Class High	1.23	Observed Data (EA)	1.03
	SD	0.05		1.197		
	Target 90%ile	0.30	2015 WFD			
P (mg/l)	Mean	0.569	Mid Class Poor	5.21	Observed Data (EA)	2.32
	SD	0.569		1.20		
	Target Mean	1.058	2015 WFD			

Table 6 shows the input data and RQP results for Barton Le Clay. The model results indicate that BOD passes the target, whereas it fails the targets for both NH_4 and P.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 7 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. As deterioration of a water body classified as Bad is not permitted, no additional housing numbers can be allocated and therefore, no developments can be allocated to Barton Le Clay unless there is an upgrade to the treatment works to improve the water body status for Phosphorous.

Table 7: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	2.2	0.73	3.06	255
NH4	1.6	0.53	1.1	50
P	No Deterioration permitted			0

A.3.11 Biggleswade

Biggleswade WwTW discharges into the River Ivel as shown in Figure 3.

Figure 3: Biggleswade WwTW discharge location

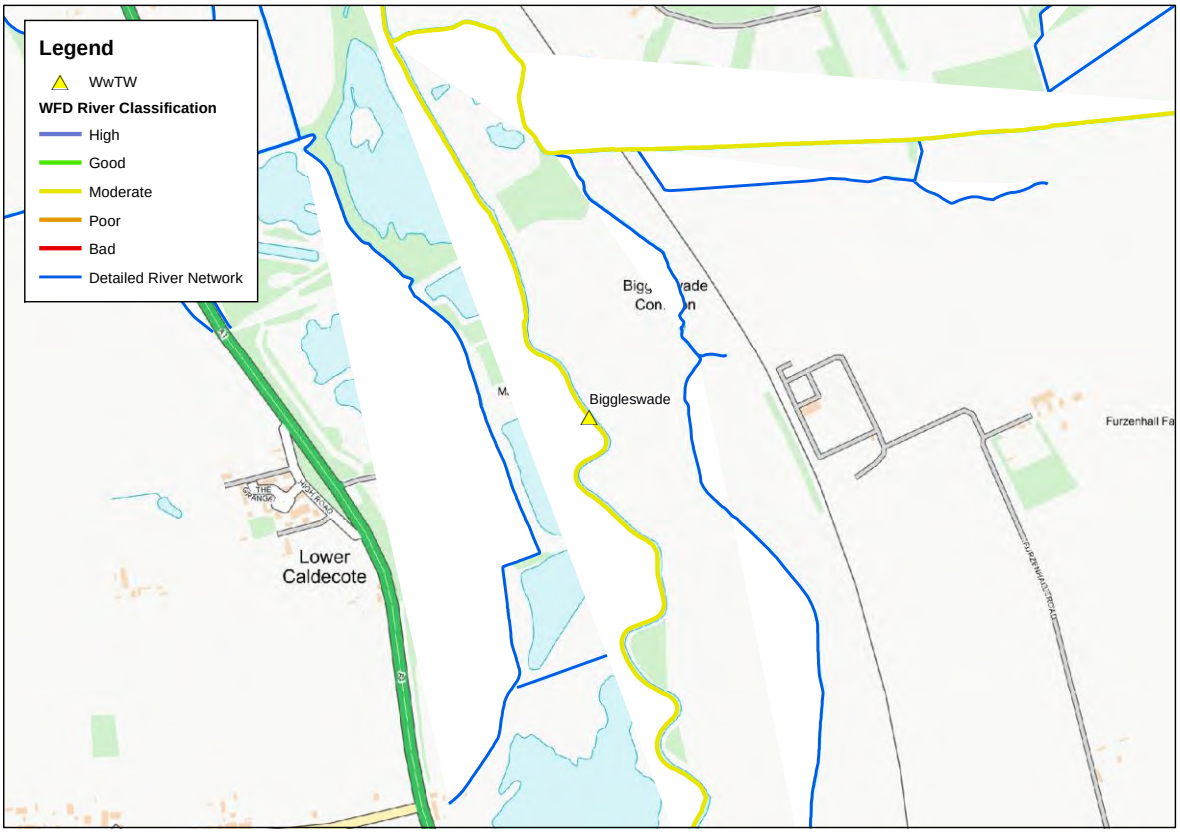


Table 8: The River Ivel status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	High	Moderate
Objective	Not available	High	High	Good

Table 8 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Barton Le Clay has a moderate overall status, but BOD and NH_4 have a high status and P has a moderate WFD status.

Table 9: Consent Values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
4100	3241	25	10.69	10	3.11	2	1.06

Table 9 shows the consented values for Biggleswade WwTW. The works has permitted values for 2015 DWF, BOD, NH_4 and P and is currently working within these limits. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 10: Input data and RQP results for Biggleswade WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	194.31	Low Flow Software	5.13	Based on permitted DWF	
	SD			1.71		
	5%ile	67.22				
BOD (mg/l)	Mean	1.28	Observed Data	5.34	Observed Data (EA)	2.21
	SD	0.67		2.77		
	Target 90%ile	4.00	2015 WFD			
NH4 (mg/l)	Mean	0.110	Observed Data	1.29	Observed Data (EA)	0.25
	SD	0.080		0.95		
	Target 90%ile	0.30	2015 WFD			
P (mg/l)	Mean	0.210	Observed Data	1.04	Observed Data (EA)	0.24
	SD	0.060		0.38		
	Target Mean	0.210	2015 WFD			

Table 10 shows the input data and RQP results for Biggleswade. The model results indicate that for BOD and NH_4 passes the WFD target, whereas it fails the target for P.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 11 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. Ammonia is the limiting factor here, with an estimated environmental capacity of a maximum of 620 additional dwellings permissible, without improving the WwTW.

Table 11: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	15.6	5.2	2.44	3450
NH4	7	2.33	0.27	620
P	9	2	0.26	1280

A.3.12 Chalton

Chalton WwTW discharges into the River Flit as shown in Figure 4.

Figure 4: Chalton WwTW discharge location

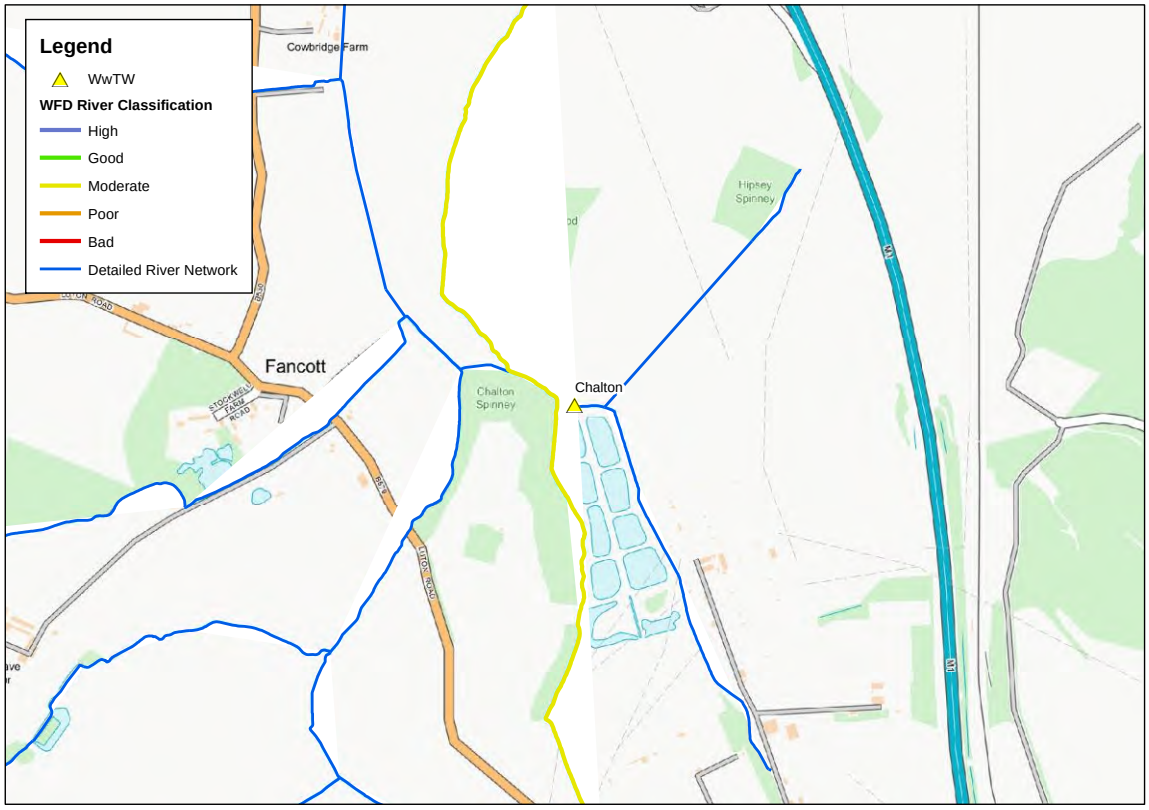


Table 12: River Flit status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	High	Poor
Objective	Not available	High	High	Good

Table 12 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Chalton has a moderate overall status, but BOD and NH_4 have a high status and P has a poor WFD status.

Table 13: Consent Values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
15,000	13,516	12	5.52	1	3.67	2	0.94

Table 13 shows the consented values for Chalton WwTW. The works has permitted values for 2015 DWF, BOD, and P and is currently working within these limits except for NH_4. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 14: Input data and RQP results for Chalton WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	1.037	Low Flow Software	18.75	Based on permitted DWF	
	SD			6.250		
	5%ile	0.432				
BOD (mg/l)	Mean	0.86	Observed Data	3.22	Observed Data (EA)	4.67
	SD	0.53		1.21		
	Target 90%ile	4.00	2015 WFD			
NH4 (mg/l)	Mean	0.040	Observed Data	1.78	Observed Data (EA)	2.94
	SD	0.040		0.98		
	Target 90%ile	0.30	2015 WFD			
P (mg/l)	Mean	0.607	Mid Class Poor	0.92	Observed Data (EA)	0.92
	SD	0.607		0.37		
	Target Mean	1.030	2015 WFD			

Table 14 shows the input data and RQP results for Chalton WwTW. The model results indicate that the present day effluent fails all of the pollutant targets.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 15Table 11 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. Note that at this works, modelling indicated that up to three times the current mean effluent flow (the maximum value tested in this study) would be permissible. This is because the watercourse has a very small upstream catchment and therefore its flow and quality downstream of the treatment works is dominated by the effluent discharge. Consequently, discharging large volumes of additional effluent does not significantly detriment the water quality. If very large-scale development is proposed at stage 2, SIMCAT modelling of the downstream reaches should be considered.

However, as deterioration of a water body classified as Bad is not permitted, no additional housing numbers can be allocated to Chalton unless there is an upgrade to the treatment works to improve the water body status for Phosphorous.

Table 15: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	56.25	18.75	4.81	12400
NH4	56.25	18.75	3.05	12400
P	No Deterioration permitted			0

A.3.13 Clifton

Clifton WwTW discharges into Henlow Brook as shown in Figure 5.

Figure 5: Clifton WwTW discharge location

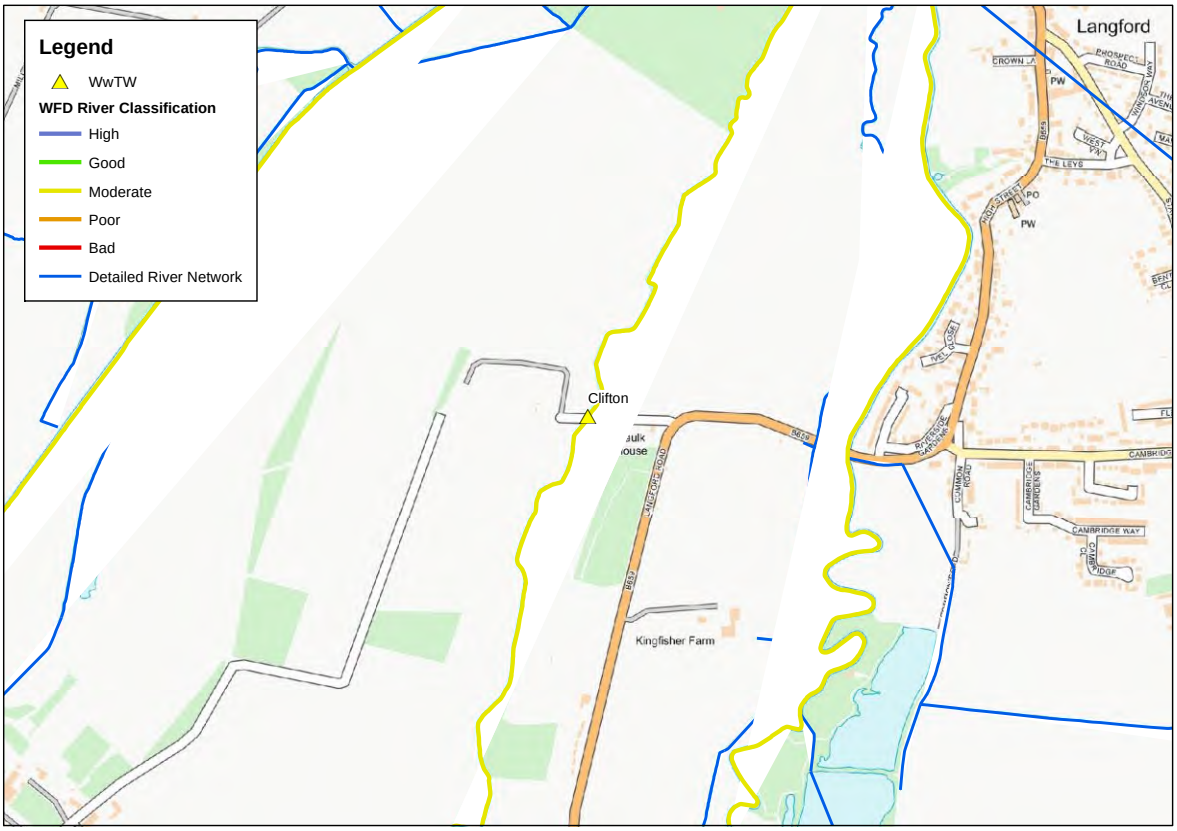


Table 16: Clifton status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	High	Poor
Objective	Not available	High	High	Good

Table 16 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Clifton has a moderate overall status, but BOD and NH_4 have a high status and P has a poor WFD status.

Table 17: Consent Values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
2931	2841	14	5.19	5	0.67	1	0.41

Table 17 shows the consented values for Clifton WwTW. The works has permitted values for 2015 DWF, BOD, NH_4 and P and is currently working within these limits. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 18: Input data and RQP results for Clifton WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	4.84	Flow Data	3.66	Based on permitted DWF	
	SD			1.22		
	5%ile	0.69				
BOD (mg/l)	Mean	1.14	Observed Data	1.84	Observed Data (EA)	2.91
	SD	1.09		1.83		
	Target 90%ile	4.00	2015 WFD			
NH4 (mg/l)	Mean	0.200	Observed Data	0.17	Observed Data (EA)	0.41
	SD	0.440		0.50		
	Target 90%ile	0.30	2015 WFD			
P (mg/l)	Mean	0.650	Mid Class Poor	0.40	Observed Data (EA)	0.53
	SD	0.650		0.43		
	Target Mean	1.091	2015 WFD			

Table 18 shows the input data and RQP results for Clifton WwTW. The model results indicate that BOD passes the current WFD target whereas NH_4 and P fail the targets.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 19 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. Modelling at this works indicated that up to three times the current mean effluent flow (the maximum value tested in this study) would be permissible for NH_4 and P. This is because the watercourse has a very small upstream catchment and therefore its flow and quality downstream of the treatment works is dominated by the effluent discharge. Consequently, discharging large volumes of additional effluent does not significantly detriment the water quality. However, if very large-scale development is proposed at Stage 2, SIMCAT modelling of the downstream reaches should be considered.

Table 19: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	8.2	2.73	3.19	1500
NH4	10.98	3.66	0.41	2410
P	10.98	3.66	0.47	2410

A.3.14 Clophill

Clophill WwTW discharges into the River Flit as shown in Figure 6.

Figure 6: Clophill WwTW discharge location

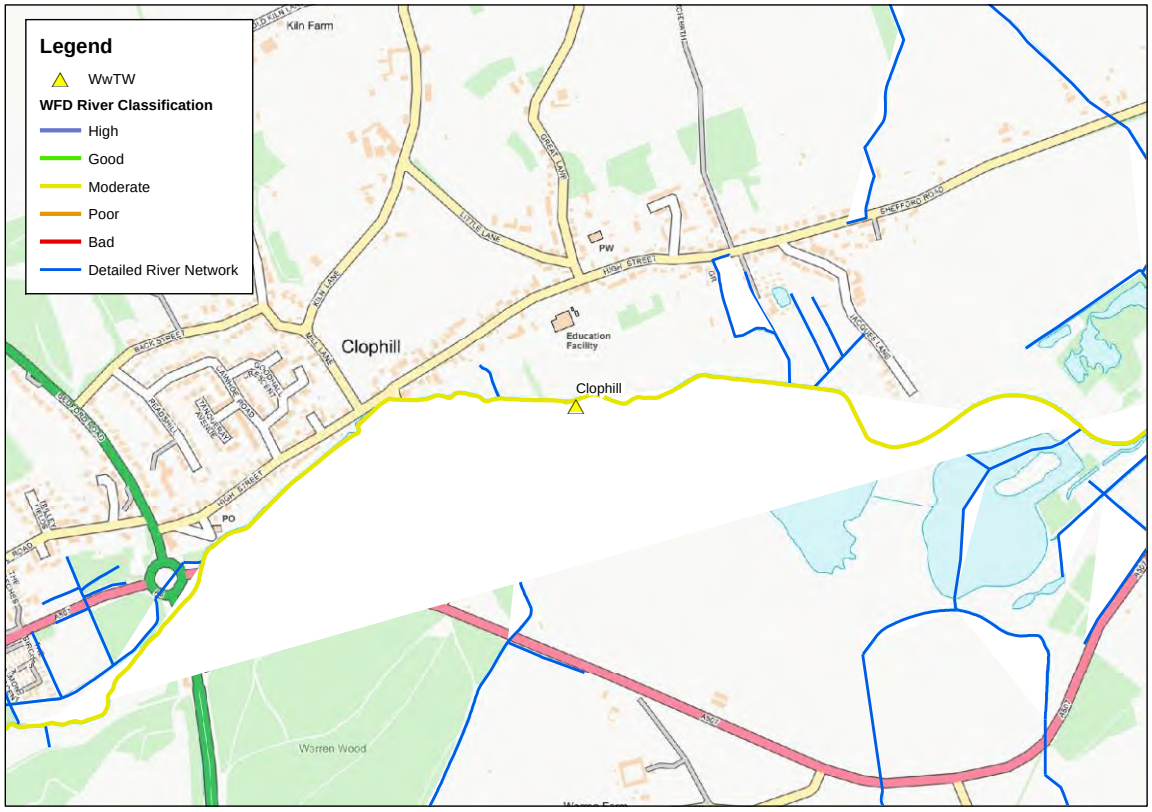


Table 20: River Flit status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	Good	Poor
Objective	Not available	High	Good	Good

Table 22 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Clophill has a moderate overall status, BOD has a high status whilst NH_4 has a good status.

Table 21: Consent values for DWF, BOD, NH_4

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
1800	1159	45	22.56	15	11.8	Not available	

Table 21 shows the consented values for Clophill WwTW. The works has permitted values for 2015 DWF, BOD and NH_4 and is currently working within these limits. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 22: Input data and RQP results for Clophill WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	46.20		2.25	Based on permitted DWF	
	SD			0.75		
	5%ile	19.20				
BOD (mg/l)	Mean	1.15	Mid Class High	15.63	Observed Data (EA)	2.83
	SD	0.69		7.73		
	Target 90%ile	4.00	2015 WFD			
NH4 (mg/l)	Mean	0.260	Mid Class Good	4.66	Observed Data (EA)	0.82
	SD	0.150		3.76		
	Target 90%ile	0.60	2015 WFD			
P (mg/l)	Mean	0.612	Mid Class Poor	7.06	Observed Data (EA)	0.96
	SD	0.612		1.09		
	Target Mean	1.036	2015 WFD			

Table 22 shows the input data and RQP results for Clophill WwTW. The model results indicate that BOD passes the current target whereas NH_4 and P fail the targets.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 23 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. Ammonia is the limiting factor here, with an estimated environmental capacity of a maximum of 150 additional dwellings permissible, without improving the WwTW.

Table 23: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	2.85	0.95	3.09	200
NH4	2.7	0.9	0.9	150
P	3	1	1.06	250

A.3.15 Dunstable

Dunstable WwTW discharges into Ouzel Brook watercourse as shown in Figure 7.

Figure 7: Dunstable WwTW discharge location

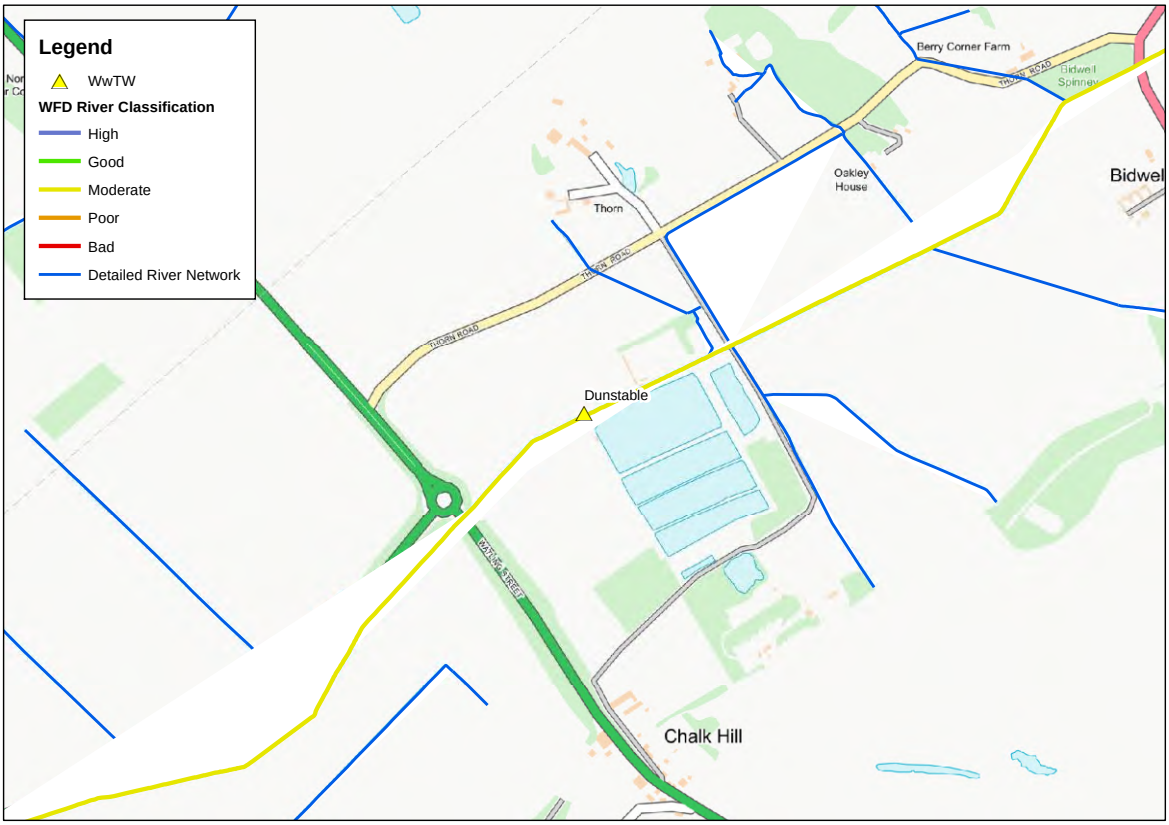


Table 24: Dunstable status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	High	Poor
Objective	Not available	High	High	Good

Table 24 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Dunstable has a moderate overall status, but BOD and NH_4 have a high status and P has a poor WFD status.

Table 25: Consent Values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
17,000	11,701	12	5.43	3	1.92	2	1.73

Table 25 shows the consent values for Dunstable WwTW. The works has permitted values for 2015 DWF, Bod, NH_4 and P and is currently working within these limits. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 26: Input data and RQP results for Dunstable WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	2.77	Low Flow Software	21.25	Based on permitted DWF	
	SD			7.08		
	5%ile	0.95				
BOD (mg/l)	Mean	2.20	Observed Data	2.59	Observed Data (EA)	4.32
	SD	2.66		1.47		
	Target 90%ile	4.00	2015 WFD			
NH4 (mg/l)	Mean	0.19	Observed Data	0.62	Observed Data (EA)	1.26
	SD	0.21		0.75		
	Target 90%ile	0.30	2015 WFD			
P (mg/l)	Mean	0.608	Observed Data	1.70	Observed Data (EA)	1.61
	SD	0.608		0.78		
	Target Mean	1.031	2015 WFD			

Table 26 shows the input data and RQP results for Dunstable. The model results indicate that none of the pollutants pass the current targets.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 27 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. Modelling at this works indicated that up to three times the current mean effluent flow (the maximum value tested in this study) would be permissible. This is because the watercourse has a very small upstream catchment and therefore its flow and quality downstream of the treatment works is dominated by the effluent discharge. Consequently, discharging large volumes of additional effluent does not significantly detriment the water quality. If very large-scale development is proposed at Stage 2, SIMCAT modelling of the downstream reaches should be considered.

However, as deterioration of a water body classified as Bad is not permitted, no additional housing numbers can be allocated to Dunstable unless there is an upgrade to the treatment works to improve the water body status for Phosphorous.

Table 27: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	63.75	21.25	4.4	14050
NH4	63.75	21.25	1.35	14050
P	No Deterioration permitted			0

A.3.16 Flitwick

Flitwick WwTW discharges into the Steppingley Brook watercourse as shown in Figure 8.

Figure 8: Flitwick WwTW discharge location

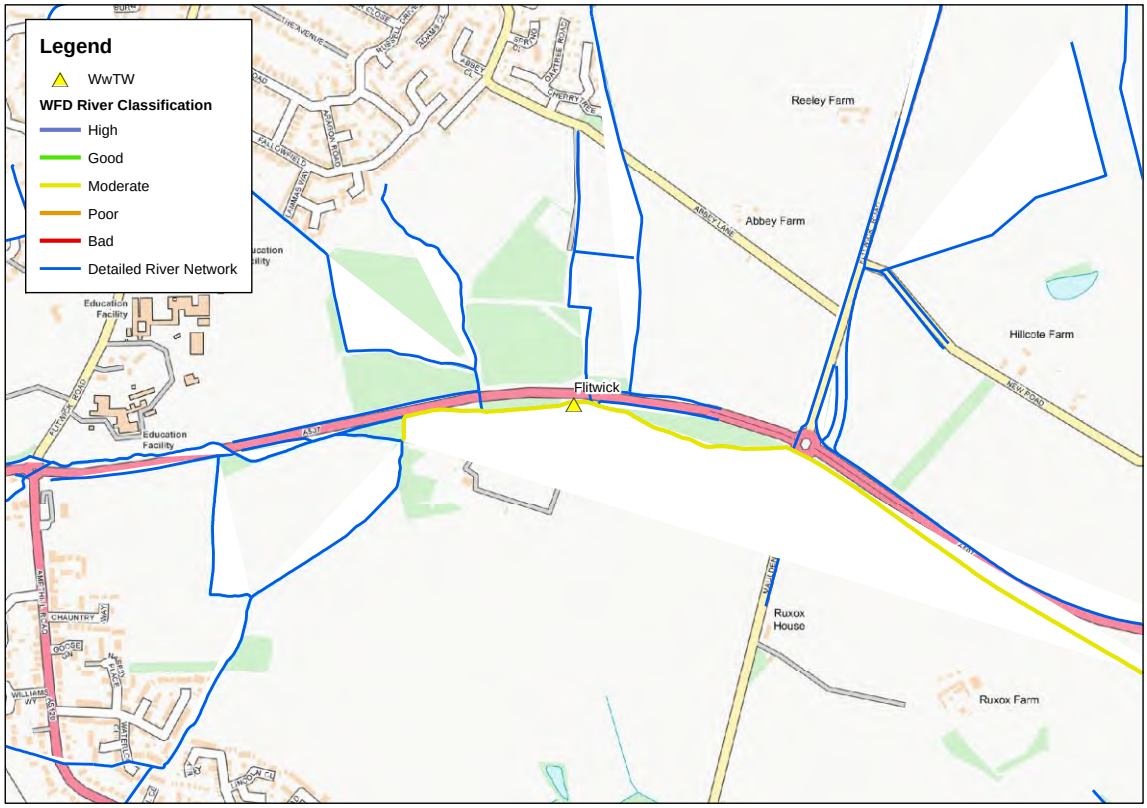


Table 28: Steppingley Brook status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	High	Poor
Objective	Not available	High	High	Good

Table 28 shows the current status of the receiving watercourse including the overall status as well as individual statuses for BOD, NH_4 and P. Flitwick has a moderate overall status, but BOD and NH_4 have a high status and P has a poor WFD status.

Table 29: Consent Values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
8300	3971	15	4.47	5	1.89	2	1.11

Table 29 shows the consented values for Flitwick WwTW. The works has permitted values for 2015 DWF, BOD, NH_4 and P and is currently working within these limits. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 30: Input data and RQP results for Flitwick WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	8.64	Low Flow Softw are	10.38	Based on permitted DWF	
	SD			3.46		
	5%ile	2.16				
BOD (mg/l)	Mean	1.30	Mid Class High	2.23	Observed Data (EA)	3.01
	SD	1.20		1.16		
	Target 90%ile	4.00	2015 WFD			
NH4 (mg/l)	Mean	0.06	Mid Class High	0.69	Observed Data (EA)	0.88
	SD	0.062		0.65		
	Target 90%ile	0.30	2015 WFD			
P (mg/l)	Mean	0.612	Mid Class Poor	1.08	Observed Data (EA)	0.91
	SD	0.612		0.76		
	Target Mean	1.037	2015 WFD			

Table 30 shows the input data and RQP results for Flitwick. The model results indicate that only BOD passes the current WFD target, whereas NH_4 and P fail the targets.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 31 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. Modelling at this works indicated that up to three times the current mean effluent flow (the maximum value tested in this study) would be permissible for BOD and NH_4. This is because the watercourse has a very small upstream catchment and therefore its flow and quality downstream of the treatment works is dominated by the effluent discharge. Consequently, discharging large volumes of additional effluent does not significantly detriment the water quality. However, if very large-scale development is proposed at Stage 2, SIMCAT modelling of the downstream reaches should be considered. Phosphorous is the limiting factor here, with an estimated environmental capacity of a maximum of 1,200 additional dwellings permissible, without improving the WwTW.

Table 31: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	27	9	3.29	5480
NH4	14	4.66	0.97	1200
P	27	9	1	5480

A.3.17 Leighton Linslade

Leighton Linslade WwTW discharges into the River Ouzel as shown in Figure 9.

Figure 9: Leighton Linslade WwTW discharge location

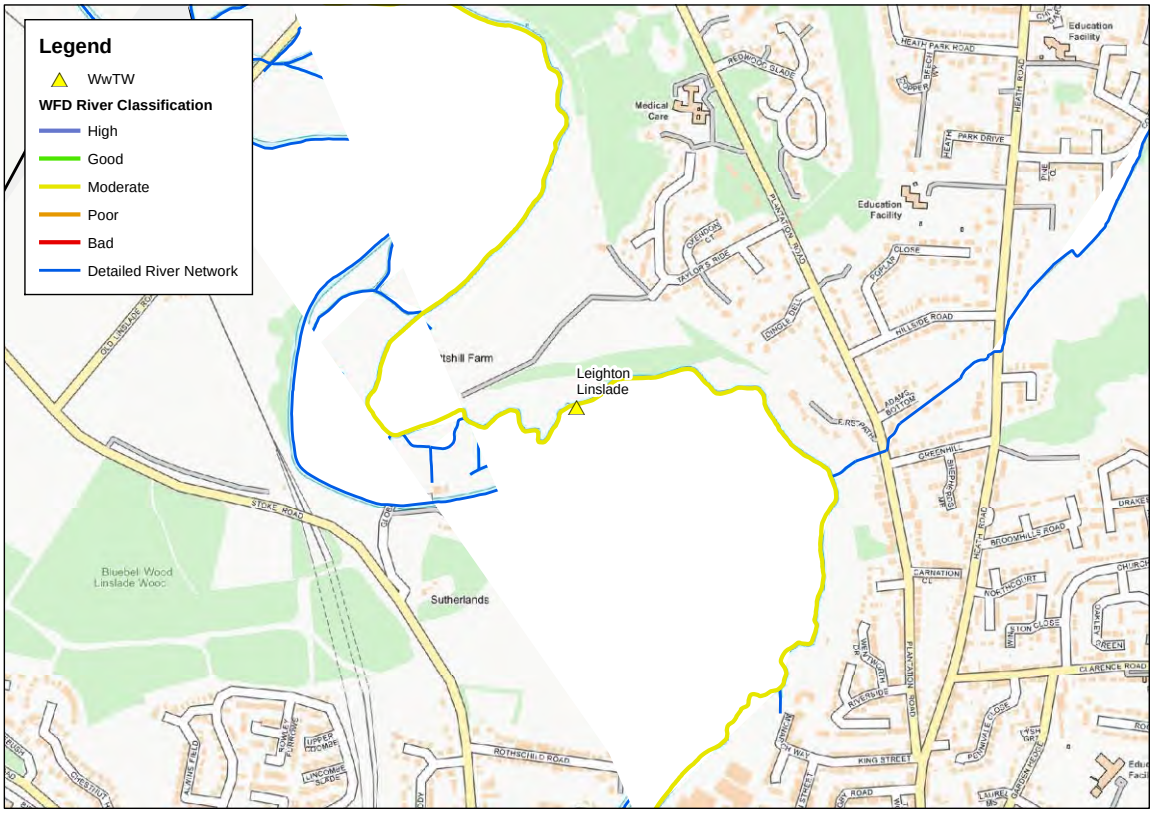


Table 32: River Ouzel status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	Good	Poor
Objective	Not available	High	Good	Good

Table 32 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Leighton Linslade has a moderate overall status, BOD has a high status and NH_4 has a good status. P is the only determinant with a poor WFD status.

Table 33: Consent Values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
7600	5059	60	15.02	30	5.2	2	1.31

Table 33 shows the consented values for Leighton Linslade WwTW. The works has permitted values for 2015 DWF, BOD, NH_4 and P and is currently working within these limits. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 34: Input data and RQP results for Leighton Linslade WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	83.03	Low Flow Software	9.50	Based on permitted DWF	
	SD			3.16		
	5%ile	5.12				
BOD (mg/l)	Mean	2.03	Observed Data	7.57	Observed Data (EA)	5.71
	SD	1.28		3.86		
	Target 90%ile	4.00	2015 WFD			
NH4 (mg/l)	Mean	0.10	Observed Data	2.51	Observed Data (EA)	1.44
	SD	0.120		1.30		
	Target 90%ile	0.60	2015 WFD			
P (mg/l)	Mean	0.24	Observed Data	1.28	Observed Data (EA)	0.49
	SD	0.15		0.66		
	Target Mean	1.029	2015 WFD			

Table 34 shows the input data and RQP results for Leighton Linslade. The model results indicate that none of the pollutants pass the current targets.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 35 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. Ammonia is the limiting factor here, with an estimated environmental capacity of a maximum of 760 additional dwellings permissible, without improving the WwTW.

Table 35: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	13.5	4.5	6.26	1320
NH4	11.8	3.93	1.58	760
P	12.8	4.26	0.54	1100

A.3.18 Poppy Hill

Poppy Hill WwTW discharges into the River Ivel watercourse shown in Figure 10.

Figure 10: Poppy Hill WwTW discharge location

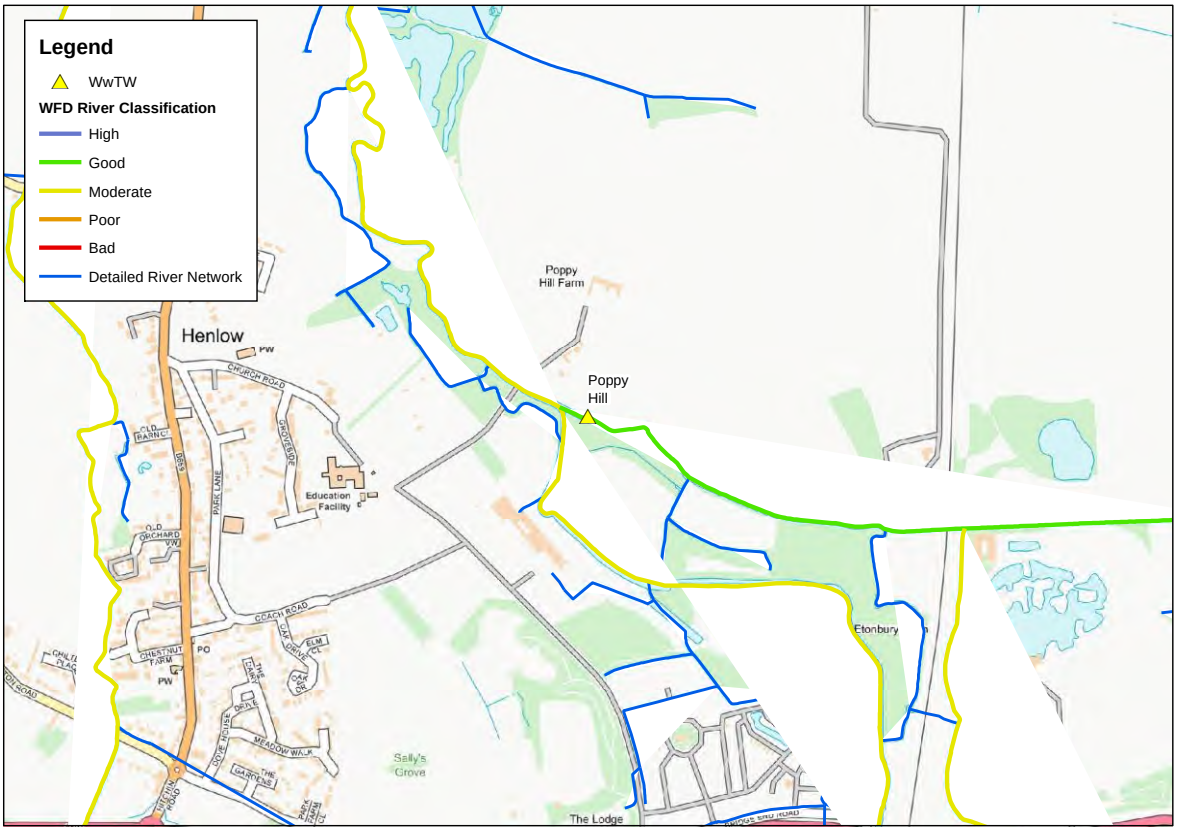


Table 36: River Ivel status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	High	Moderate
Objective	Not available	High	High	Good

Table 36 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Poppy Hill has a moderate overall status, but BOD and NH_4 have a high status and P has a poor WFD status.

Table 37: Consent Values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
4700	4339	20	11.71	8	4.19	2	1.44

Table 37 shows the consented values for Poppy Hill WwTW. The works has permitted values for 2015 DWF, Bod, NH_4 and P and is currently working within these limits. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 38: Input data and RQP results for Poppy Hill WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	99.53	Low Flow Softw are	5.88	Based on permitted DWF	
	SD			1.96		
	5%ile	38.88				
BOD (mg/l)	Mean	1.15	Mid Class High	6.50	Observed Data (EA)	2.36
	SD	0.69		2.72		
	Target 90%ile	4.00				
NH4 (mg/l)	Mean	0.09	Mid Class High	2.13	Observed Data (EA)	0.35
	SD	0.050		1.07		
	Target 90%ile	0.30				
P (mg/l)	Mean	0.15	Mid Class Moderate	1.42	Observed Data (EA)	0.23
	SD	0.15		0.42		
	Target Mean	0.212				

Table 38 shows the input data and RQP results for Poppy Hill. The model results indicate that BOD is the only pollutant that passes the current WFD target, whereas NH_4 and P fail the target.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 39 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. Ammonia is the limiting factor here, with an estimated environmental capacity of a maximum of 240 additional dwellings permissible, without improving the WwTW.

Table 39: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	9.4	3.13	2.59	1160
NH4	6.6	2.2	0.38	240
P	6.7	2.23	0.25	270

A.3.19 Potton

Potton WwTW discharges into the Sutton Brook watercourse shown in Figure 11.

Figure 11: Potton WwTW discharge location

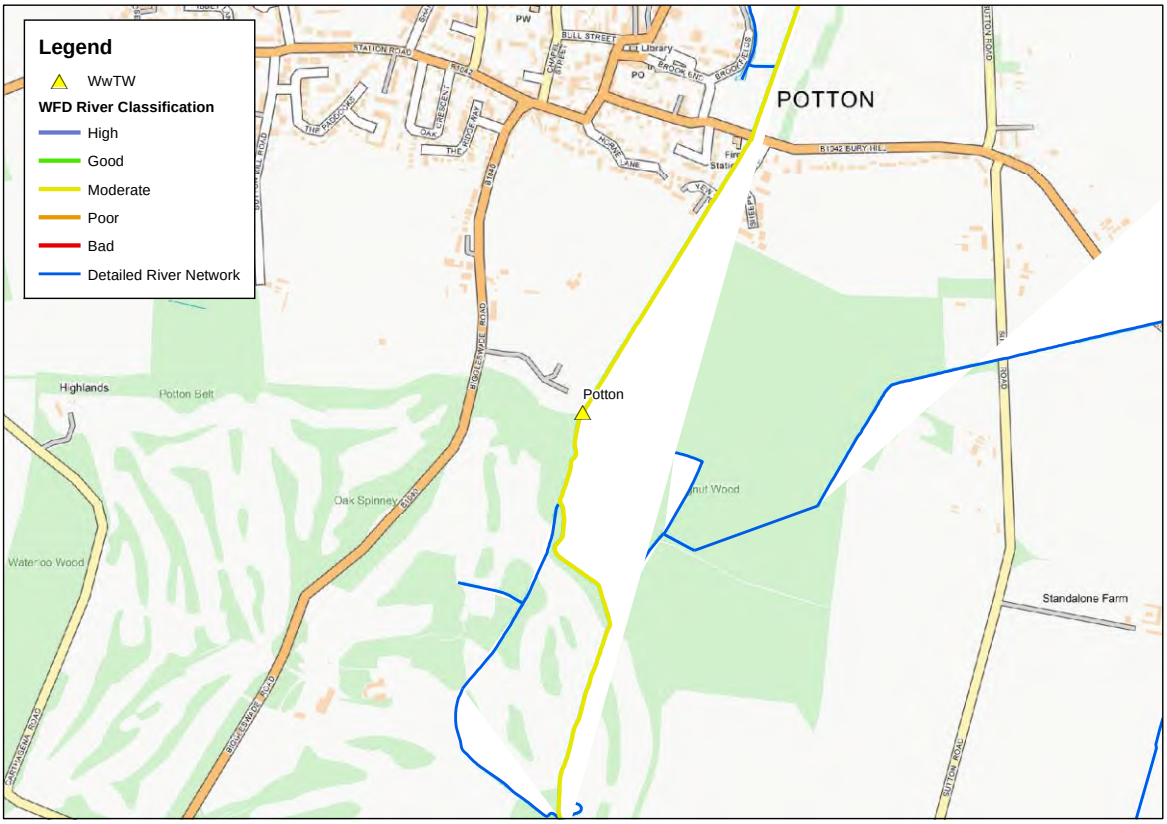


Table 40: Sutton Brook status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	Good	Moderate
Objective	Not available	High	Good	Good

Table 40 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Potton has a moderate overall status, BOD has a high status and NH_4 has a good status.

Table 41: Consent Values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
1200	678	15	4.85	8	6.03	1	0.53

Table 41 shows the consented values for Potton WwTW. The works has permitted values for 2015 DWF, BOD, NH_4 and P and is currently working within these limits. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 42: Input data and RQP results for Potton WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	9.42	Low Flow Software	1.50	Based on permitted DWF	
	SD			0.50		
	5%ile	2.22				
BOD (mg/l)	Mean	1.89	Observed Data	2.71	Observed Data (EA)	3.25
	SD	1.16		1.12		
	Target 90%ile	4.00				
NH4 (mg/l)	Mean	0.21	Observed Data	2.25	Observed Data (EA)	1.13
	SD	0.220		2.02		
	Target 90%ile	0.60				
P (mg/l)	Mean	0.07	Observed Data	0.52	Observed Data (EA)	0.15
	SD	0.04		0.28		
	Target Mean	0.176				

Table 42 shows the input data and RQP results for Potton WwTW. The model results indicate that BOD is the only pollutant that passes the current target, whereas NH_4 and P do not pass the target.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 43 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. Ammonia and Phosphorous are the limiting factors here, with an estimated environmental capacity of a maximum of 80 additional dwellings permissible, without improving the WwTW.

Table 43: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	4.5	1.5	3.33	1000
NH4	1.75	0.583	1.24	80
P	1.75	0.583	0.16	80

A.3.20 Sandy

Sandy WwTW discharges into the River Ivel watercourse as shown in Figure 12.

Figure 12: Sandy WwTW discharge location

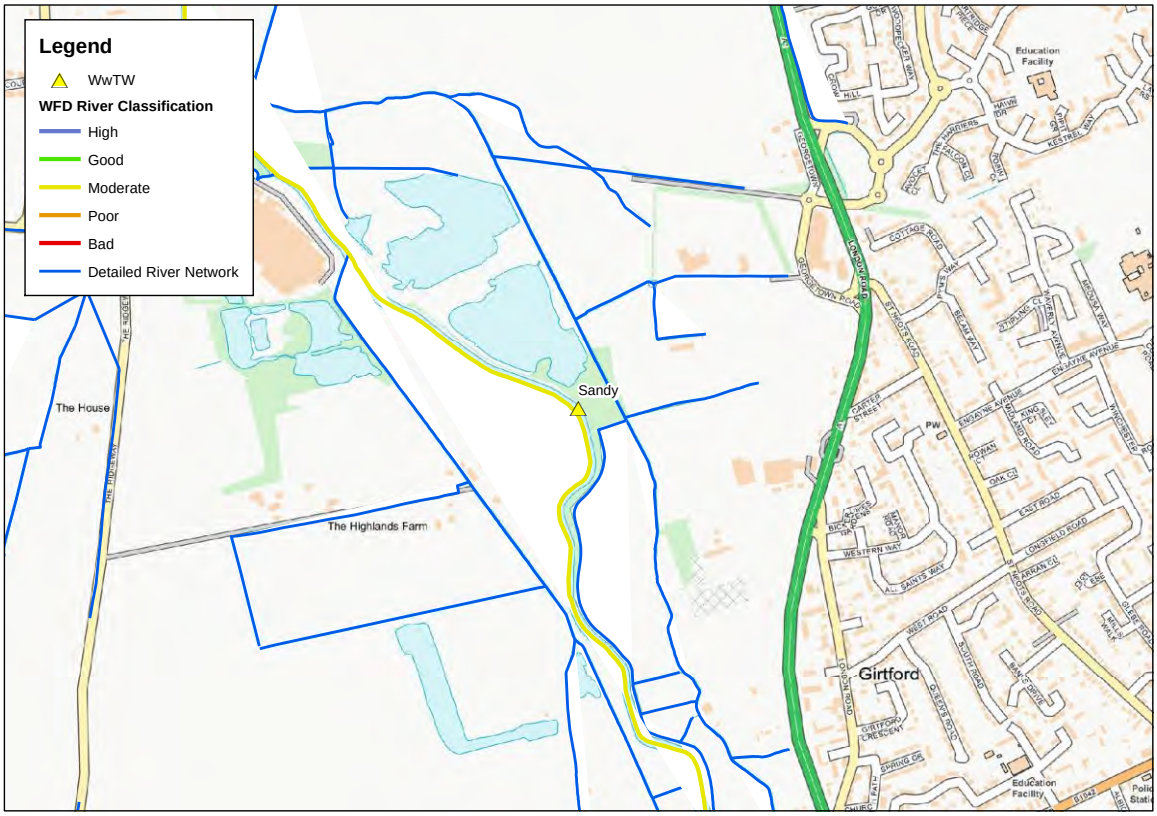


Table 44: River Ivel status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	High	Moderate
Objective	Not available	High	High	Good

Table 44 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Sandy has a moderate overall status, but BOD and NH_4 have a high status and P has a moderate WFD status.

Table 45: Consent Values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
2200	1961	14	24.92	13	8.63	2	1.38

Table 45 shows the consented values for Sandy WwTW. The works has permitted values for 2015 WFD, BOD, NH_4 and P and is currently working within these limits, except for BOD. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 46: Input data and RQP results for Sandy WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	228.10	Low Flow Software	2.75	Based on permitted DWF	
	SD			0.91		
	5%ile	79.66				
BOD (mg/l)	Mean	1.29	Observed Data	12.11	Observed Data (EA)	2.36
	SD	0.75		6.63		
	Target 90%ile	4.00				
NH4 (mg/l)	Mean	0.11	Observed Data	3.41	Observed Data (EA)	0.29
	SD	0.11		2.75		
	Target 90%ile	0.30				
P (mg/l)	Mean	0.19	Observed Data	1.35	Observed Data (EA)	0.21
	SD	0.06		0.59		
	Target Mean	0.212				

Table 46 shows the input data and RQP results for Sandy. The model results indicate that BOD and NH_4 pass the current targets, whereas P fails the WFD target.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 47 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. Ammonia is the limiting factor here, with an estimated environmental capacity of a maximum of 340 additional dwellings permissible, without improving the WwTW.

Table 47: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	5.8	1.93	2.59	1000
NH4	3.8	1.26	0.32	340
P	4.8	1.6	0.23	670

A.3.21 Shillington

Shillington WwTW discharges into the Campton Brook watercourse as shown in Figure 13.

Figure 13: Shillington WwTW discharge location

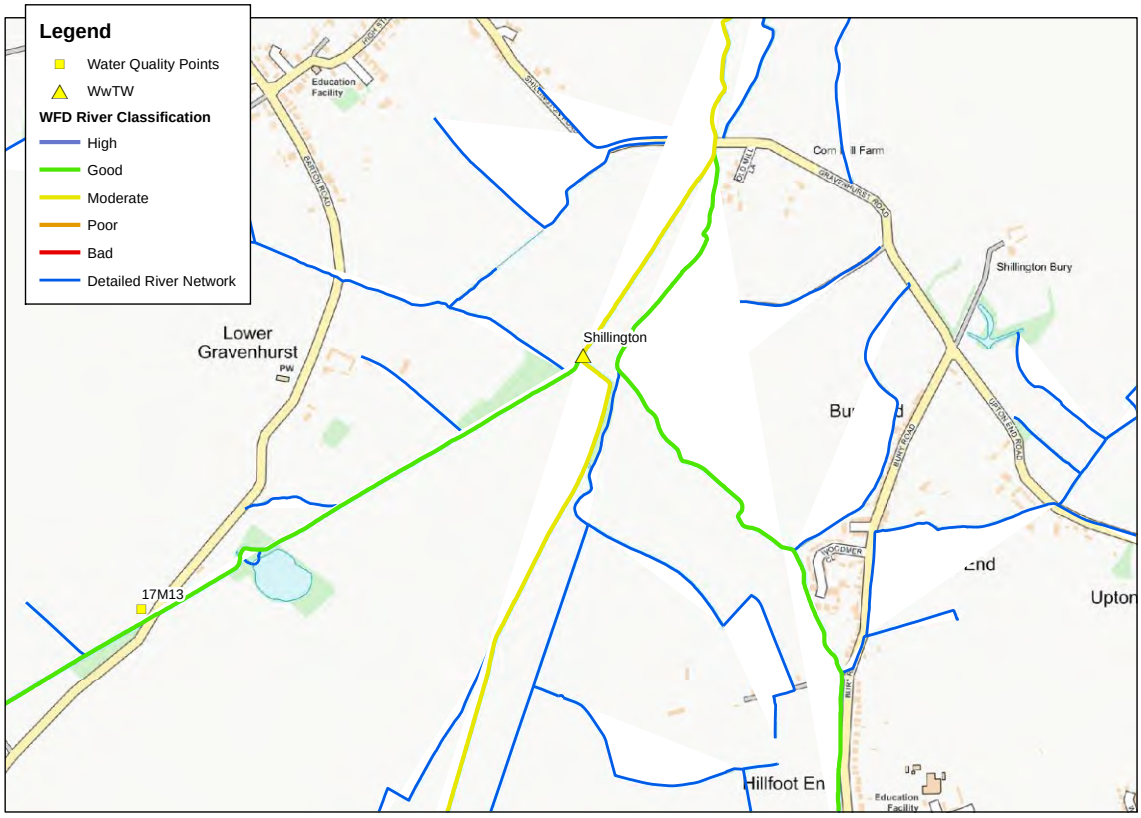


Table 48: Campton Brook status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	High	Moderate
Objective	Not available	High	High	Good

Table 48 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Shillington has a moderate overall status, but BOD and NH_4 have a high status and P has a moderate WFD status.

Table 49: Consent Values for DWF, BOD and NH_4

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
1204	681	40	29.03	15	11.28	Not available	n/a

Table 49 shows the consented values for Shillington WwTW. The works has permitted values for 2015 DWF, BOD and NH_4 and is currently working within these limits. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 50: Input data and RQP results for Shillington WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	8.81	Low Flow Softw are	1.51	Based on permitted DWF	
	SD			0.50		
	5%ile	0.50				
BOD (mg/l)	Mean	1.15	Mid Class High	16.95	Observed Data (EA)	11.75
	SD	0.69		6.35		
	Target 90%ile	4.00				
NH4 (mg/l)	Mean	0.09	Mid Class High	4.69	Observed Data (EA)	3.48
	SD	0.050		3.44		
	Target 90%ile	0.30				
P (mg/l)	Mean	0.640	Mid Class Poor	4.45	Observed Data (EA)	1.85
	SD	0.640		1.87		
	Target Mean	1.077				

Table 50 shows the input data and RQP results for Shillington. The model results indicate that none of the pollutants pass the WFD targets.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 51 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. However, as deterioration of a water body classified as Bad is not permitted, no additional housing can be allocated to Shillington unless there is an upgrade to the treatment works to improve the water body status for BOD, NH_4 and Phosphorous.

Table 51: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	No Deterioration permitted			0
NH4	No Deterioration permitted			0
P	No Deterioration permitted			0

A.3.22 Stanbridgeford

Stanbridgeford WwTW discharges into the Ouzel Brook watercourse shown in Figure 14.

Figure 14: Stanbridgeford WwTW discharge location

Table 52: Ouzel Brook status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	High	High	Poor
Objective	Not available	High	High	Good

Table 52 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Stanbridgeford has a moderate overall status, but BOD and NH_4 have a high status and P has a poor WFD status.

Table 53: Consent Values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
2482	2871	20	4.35	12	1.06	2	0.65

Table 53 shows the consented values for Stanbridgeford WwTW. The works has permitted values for BOD, NH_4 and P and is currently working within these limits. The measured flow is currently above the permitted DWF. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 54: Input data and RQP results for Stanbridgeford WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	9.50	Low Flow Software	3.102	Based on permitted DWF	
	SD			1.034		
	5%ile	0.95				
BOD (mg/l)	Mean	1.47	Observed Data	2.19	Observed Data (EA)	2.70
	SD	0.87		1.12		
	Target 90%ile	4.00				
NH4 (mg/l)	Mean	0.10	Observed Data	0.33	Observed Data (EA)	0.40
	SD	0.13		0.43		
	Target 90%ile	0.30				
P (mg/l)	Mean	0.43	Observed Data	0.63	Observed Data (EA)	0.52
	SD	0.35		0.59		
	Target Mean	1.036				

Table 54 shows the input and RQP results for Stanbridgeford. The model results indicate that BOD is the only pollutant that passes the WFD target.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 55 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. Ammonia is the limiting factor here, with an estimated environmental capacity of a maximum of 430 additional dwellings permissible, without improving the WwTW.

Table 55: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	8.05	2.68	2.97	1640
NH4	4.4	1.46	0.44	430
P	8.05	2.68	0.56	1640

A.3.23 Tempsford

Tempsford WwTW discharges into the Stone Brook watercourse as shown in Figure 15.

Figure 15: Tempsford WwTW discharge location

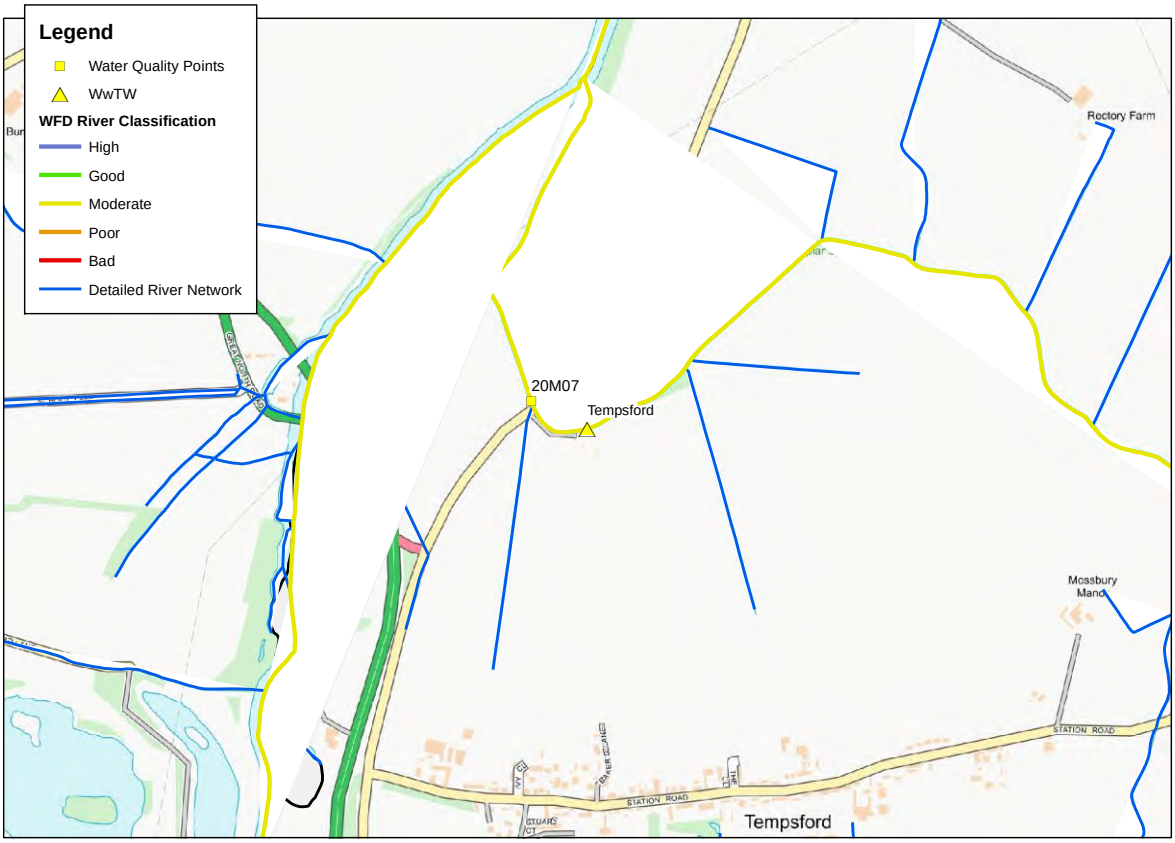


Table 56: Stone Brook status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	Moderate	Good	Moderate
Objective	Not available	Good	Good	Good

Table 56 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for Bod, NH_4 and P. Tempsford has a moderate overall status and BOD and P also have a moderate status. NH_4 is the only pollutant with a good WFD target status.

Table 57: Consent Values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
700	468	20	14.8	3.5	5.08	1	0.45

Table 57 shows the consented values for Tempsford WwTW. The works has permitted values for 2015 DWF, BOD and P and is currently working within these limits. NH_4 is the only pollutant which exceeds its consent value. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 58: Input data and RQP results for Tempsford WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	8.04	Low Flow Softw are	0.875	Based on permitted DWF	
	SD			0.290		
	5%ile	1.09				
BOD (mg/l)	Mean	5.75	Mid Class Moderate	5.66	Observed Data (EA)	11.06
	SD	5.75		4.85		
	Target 90%ile	6.50				
NH4 (mg/l)	Mean	1.80	Mid Class Poor	1.95	Observed Data (EA)	3.53
	SD	1.80		1.66		
	Target 90%ile	2.50				
P (mg/l)	Mean	0.15	Mid Class Moderate	0.44	Observed Data (EA)	0.2
	SD	0.15		0.19		
	Target Mean	0.211				

Table 58 shows the inputs and RQP results for Tempsford. The model results indicate that none of the pollutants can pass the current targets.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 59 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. However, as deterioration of a water body classified as Bad is not permitted, no additional housing can be allocated to Tempsford unless there is an upgrade to the treatment works to improve the water body status for Phosphorous.

Table 59: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	No Deterioration permitted			0
NH4	2.625	0.875	3.4	580
P	1.5	0.2	0.22	200

A.4 Results for Thames Water WwTWs

A.4.1 Markyate

Markyate WwTW discharges into the River Ver watercourse as shown in Figure 16.

Figure 16: Markyate WwTW discharge location

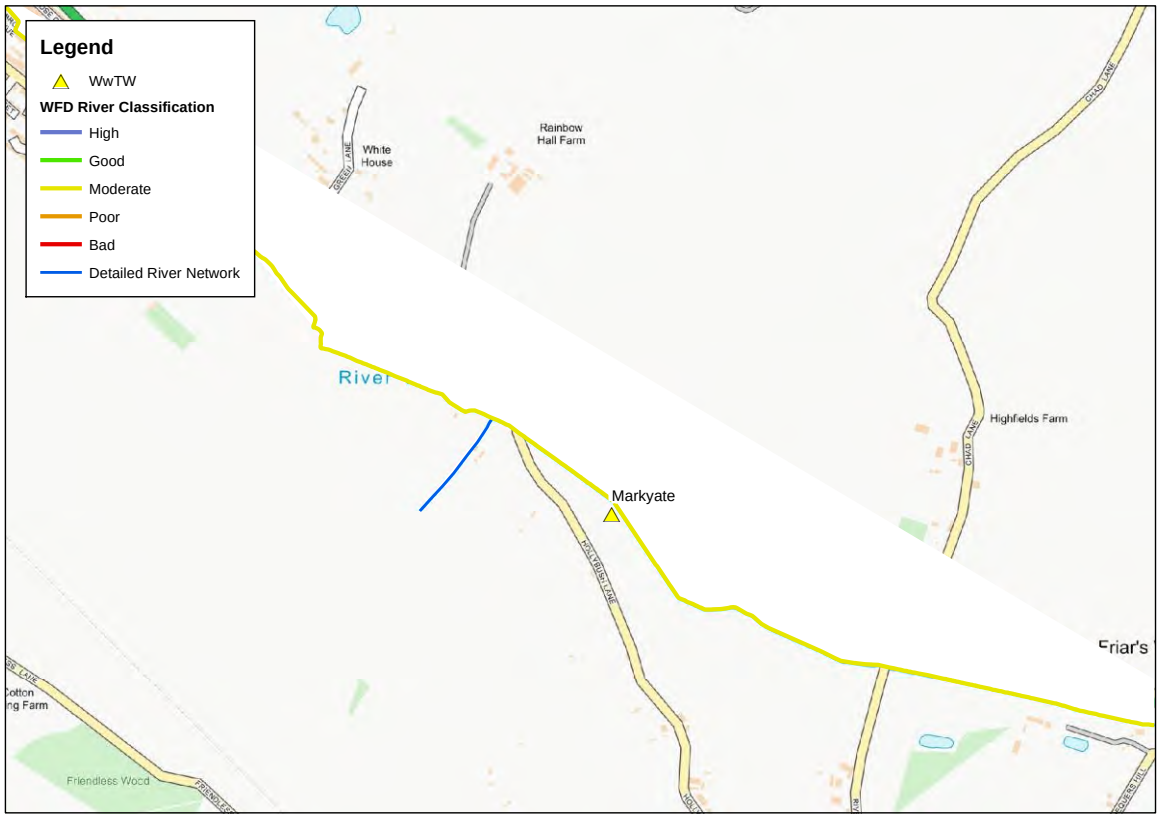


Table 60: River Ver status and objectives

	Overall	BOD	Ammonia	Phosphorus
2015 status	Moderate	Good	Good	Good
Objective	Good by 2027	High by 2027	High by 2027	High by 2027

Table 60 shows the current status of the receiving watercourse including the overall status as well as the individual statuses for BOD, NH_4 and P. Markyate has a moderate overall status and all the pollutants have a good WFD status.

Table 61: Consent values for DWF, BOD, NH_4 and P

DWF (m3/d)		BOD (mg/l)		NH4 (mg/l)		P (mg/l)	
Permitted DWF	Measured Q90	95%ile consent value	Modelled 95%ile	95%ile consent value	Modelled 95%ile	Mean consent value	Modelled mean
N/A	Not available to calculate	20	7.1	Not available	N/A	Not available	N/A

Table 61 shows the consented values for Markyate. The works has permitted values for BOD only as data for the other pollutants was not available. BOD is currently working within its consented value. It has been assumed that, as effluent volumes increase due to growth, the treatment works would continue to discharge at its present-day effluent quality.

Table 62: Input data and RQP results for Markyate WwTW

Parameter	Statistic	River	Source	Present Day		
				WRC	Source	RQP Result
Flow (Ml/d)	Mean	0.17	Low Flow Software	1.030	Observed Data	
	SD			0.257		
	5%ile	0.04				
BOD (mg/l)	Mean	4.50	Mid Class Good	3.950	Observed Data (EA)	6.20
	SD	4.50		1.646		
	Target 90%ile	5.00	2015 WFD			
NH4 (mg/l)	Mean	0.450	Mid Class Good	0.527	Observed Data (EA)	1.14
	SD	0.450		1.034		
	Target 90%ile	0.60	2015 WFD			
P (mg/l)	Mean	0.05	Observed Data	3.168	Observed Data (EA)	2.82
	SD	0.05		1.389		
	Target Mean	0.077	2015 WFD			

Table 62 shows the inputs and RQP results for Markyate. The model results indicate that none of the pollutants can pass the current targets.

Future flows have been estimated for each pollutant to determine the maximum number of houses that the WwTW can accommodate without class deterioration or more than 10% deterioration. Table 63 shows the future maximum additional effluent flows, and equivalent number of new dwellings which could be accommodated without causing deterioration or requiring a treatment works upgrade. Note that at this works, modelling indicated that up to three times the current mean effluent flow (the maximum value tested in this study) would be permissible. This is because the watercourse has a very small upstream catchment and therefore its flow and quality downstream of the treatment works is dominated by the effluent discharge. Consequently, discharging large volumes of additional effluent does not significantly detriment the water quality. If very large-scale development is proposed at stage 2, SIMCAT modelling of the downstream reaches should be considered.

However, as deterioration of a water body classified as Bad is not permitted, no additional housing can be allocated to Markyate unless there is an upgrade to the treatment works to improve the water body status for Phosphorous.

Table 63: Number of houses permitted and future flow statistics

Pollutant	Future Flow Mean	Future Flow SD	RQP Result	No of Houses
BOD	3.09	1.03	4.18	720
NH4	3.09	1.03	1.24	720
P	No Deterioration permitted			0

A.5 Summary and Conclusion

A.5.2 Method

The increased discharge of effluent due to a growth in population served by a Wastewater Treatment Works (WwTW) may impact the quality of the receiving water. The Water Framework Directive (WFD) does not allow a watercourse to deteriorate from its current class (either water body or element class).

It is Environment Agency (EA) policy to model the impact of increasing effluent volumes on the receiving watercourse. Where the scale of development is such that a deterioration is predicted, a new Environmental Permit (EP) may be required for the WRC to improve the quality of the final effluent, so that the extra pollution load will not result in a deterioration in the water quality of the watercourse. This is known as a "no deterioration" or "load standstill".

As Central Bedfordshire Council has not provided growth numbers or locations at this stage, each WwTW was investigated to determine how many houses can be built with the current technology without more than 10% deterioration or class deterioration. There were 17 Wastewater Treatment Works (WwTWs) that were identified, however two of these discharge to groundwater and were not assessed. The EA has reviewed the list of WwTWs and has suggested that a water quality assessment should be undertaken on fifteen of these.

A.5.3 Results

Table 64 summarises the modelling results of the maximum potential dwellings that could be placed in each sewer treatment catchment.

Table 64: Potential Housing Summary and future WwTW flow statistics

WRC	Future Flow Mean	Future Flow SD	No of Houses
Barton Le Clay	Upgrade Treatment Works		0
Biggleswade	7	2.33	620
Chalton	Upgrade Treatment Works		0
Clifton	8.2	2.73	1500
Clophill	2.7	0.9	150
Dunstable	Upgrade Treatment Works		0
Flitwick	14	4.66	1200
Leighton Linslade	11.8	3.93	760
Poppy Hill	6.6	2.2	240
Potton	1.75	0.583	80
Sandy	3.8	1.26	340
Shillington	Upgrade Treatment Works		0
Stanbridgeford	4.4	1.46	430
Tempsford	Upgrade Treatment Works		0
Markyate	Upgrade Treatment Works		0

A.5.4 Conclusions

The following conclusions are drawn from this stage 1 water quality impact assessment:

- Barton Le Clay, Chalton, Dunstable, Markyate, Shillington, and Tempsford WwTWs need to be upgraded to accommodate housing growth without causing deterioration of the "Bad" WFD class. It is therefore anticipated that all growth in these catchments would need to be phased to enable time for upgrades to be implemented.
- All of the remaining WwTWs have some capacity within their existing quality permits to accommodate future development without causing a class deterioration or more than 10% deterioration.
- In some settlements the available capacity is quite small, reflecting the limited dilution potential available in the receiving watercourse.
- In other settlements the WwTW allows for a large future effluent discharge which does not affect the water quality downstream due to large volumes of discharge. However, if large scale developments are proposed at these locations additional SIMCAT modelling should be considered to test for deterioration downstream as a result of growth at several treatment works discharging to the same river system.
- Where development in excess of the equivalent number of dwellings indicated is allocated, it is probable that a WwTW upgrade would be required in order to meet a tighter permit condition set to ensure that load-standstill is met.
- This stage 1 assessment has not considered the potential for growth to prevent watercourses from meeting WFD Good Ecological Status.
- The assessment is provided to indicate what environmental headroom for growth is available without the need to upgrade treatment works or make other interventions. It is not intended as an absolute constraint to growth.

Further analysis will be undertaken in the stage 2 assessment when development numbers are provided from Central Bedfordshire Council.