Swindon Water Cycle Study

Prepared for
Swindon Borough Council

January 2014

CH2MHILL®
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SECTION 1

Contents

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Introduction and context

1.1 Swindon Water Cycle Study history

1.1.1 This phase 2 of the Swindon water cycle study builds upon work carried out by CH2MHILL (formerly Halcrow Group Limited) on The Swindon water cycle study (2007). It updates the original study where appropriate and brings it up to date with respect to new development forecasts and new statute and policy requirements.

1.1.2 Swindon has been a rapidly expanding for several decades, and is a significant employment centre for the region.

1.1.3 Swindon sits at the boundary of the River Thames river basin catchment to the north, and the South Downs chalk aquifer to the South. Two primary watercourses, the River Ray and River Cole drain Swindon, running north into the River Thames.

1.1.4 The development pressures at Swindon continue to be significant. Under the Localism Act 2012, local authorities must derive housing targets to meet the evidenced need. The housing targets for Swindon Borough to 2026 are set in the Swindon Borough Local Plan as submitted.

1.1.5 There is a finite capacity within the environment, and it cannot simply provide more and more water to serve new development. Equally, there is a limit to the amount of waste water that can be safely returned to our rivers and the sea without having a detrimental impact on the environment. Furthermore, we know that extreme rainfall can overwhelm drains and overtop flood defences. Climate change is bringing fresh challenges as patterns of rainfall are predicted to change, with more intense rainfall events. We must also make sure that water infrastructure contributes to the shift to a low carbon economy that is essential if greenhouse gas emissions are to be reduced. Planning for water has to take into account these natural constraints, and factors such as the timing and location imposed by the development itself.

1.1.6 This water cycle study has been undertaken to ensure that proposed growth does not adversely impact on the existing water cycle environment and that new water services infrastructure can be planned for and provided alongside new development in a sustainable and cost effective manner. Due to the scale of development proposed for Swindon, it is considered that a water cycle study is required to ensure that the proposed growth targets can be met without adversely impacting on the water environment and that required infrastructure can be planned for and brought online alongside new development, in a timely and phased manner.

1.2 The purpose of this document

1.2.1 Since the 2007 water cycle study was published, there has been significant change in both town and country planning policy and in environmental legislation. In particular the National Planning Policy Framework and the Floods and Water Management Act 2010 have significantly altered the responsibilities and duties of Swindon Borough Council. This document updates the water cycle study to ensure consistency with current legislation and policy.

1.2.2 The phase 1 study concluded:

- There is sufficient strategic water cycle capacity in Swindon to accommodate all of the development scenarios considered, however, this is subject to the ongoing work and recommendations outlined below.
- Development in Swindon can be accommodated without causing a failure of statutory environmental water quality objectives, subject to infrastructure being funded and delivered in the right place and at the right time.
- Development in Swindon up to 2025/26 need not be constrained by the uncertainties over the Upper Thames Reservoir, although the timely delivery of the reservoir will alleviate some water supply constraints
- There is sufficient area within the study boundary that can be developed (with or without mitigation) without increasing flood risk, subject to confirmation by a strategic flood risk assessment (SFRA).
- The use of greater demand management techniques may be used to offset the requirement for some water cycle infrastructure, or delay the time by which it is needed. However, this may require a change in legislation, or require strong enabling mechanisms.
- The exact location and phasing of development will need to be determined as part of the Swindon Borough local development framework (LDF) process to ensure that infrastructure is provided in the right place and at the right time.

1.2.3 It was accepted that some areas required further work to confirm the conclusion to the satisfaction of all project partners. These are discussed in section 1.2.1.

1.2.4 In addition, the NPPF puts new duties on planning authorities with respect to the water environment. These duties are:

- Paragraph 17. Planning should (inter alia) contribute to conserving and enhancing the natural environment and reducing pollution. Allocations of land for development should prefer land of lesser environmental value, where consistent with other policies in this Framework;

- Paragraph 94. Local planning authorities should adopt proactive strategies to mitigate and adapt to climate change, taking full account of flood risk, coastal change and water supply and demand considerations.
- Paragraph 99. Local Plans should take account of climate change over the longer term, including factors such as flood risk, coastal change, water supply and changes to biodiversity and landscape. New development should be planned to avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure. Subsequent paragraphs give more detail on flood risk policy
- Paragraph 109. The planning system should contribute to and enhance the natural and local environment by:
    - protecting and enhancing valued landscapes, geological conservation interests and soils;
    - recognising the wider benefits of ecosystem services;
    - minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures;
    - preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability; and
    - remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.
- Paragraph 165. Planning policies and decisions should be based on up-to-date information about the natural environment and other characteristics of the area including drawing, for example, from River Basin Management Plans.

1.2.5 This water cycle study is one of the means by which Swindon Borough Council are demonstrating delivery of these requirements.

1.3 Who has been involved in this study

1.3.1 Swindon Borough Council contracted CH2M HILL to prepare this document. Thames Water and the Environment Agency are our project partners, and have agreed the methodology and outputs of this report.

1.4 What this document does not cover:

Flood risk management and sustainable drainage

1.4.1 The phase 1 water cycle study included a section on flood risk management and sustainable drainage. Swindon Borough Council is now a Lead Local Flood Authority as defined by the Floods and Water Management Act 2010. AS part of this duty, the Council must develop, maintain, and keep up to date a Local Flood Risk Management Strategy. This Strategy is currently out for consultation (December 2013, www.Swindon.gov.uk/floodrisk), and includes:

- Aims and objectives
- An assessment of risk
- Policies, measures and actions to manage risk

1.4.2 Of note to this study, the Strategy includes a measure to develop local SuDS standards where appropriate for new development. This will be a key duty of the SuDS Approval Body when commenced in April 2014.

1.4.3 In addition, the addendum to the Strategic Flood Risk Assessment (2012) undertook a sequential test of the Core Strategy proposed development locations, and the Local Plan has selected strategic development location based on the outputs of this sequential testing.

1.4.4 It was agreed with the Environment Agency that these documents are the appropriate place to consider the impact of development on flood risk, not this water cycle study.

1.5 What this document covers

1.5.1 This document specifically answers the following questions, which were agreed with our partners as the outstanding technical constraints to development with respect to the water environment.

Environmental capacity – Water resources

1.5.2 The phase 1 water cycle study was completed before Thames Water had published their Water Resources Management Plan in June 2012. Therefore there was uncertainty surrounding the ability of the environment to support the proposed scale of development in the Swindon and Oxford Water Resource Zone. The WRMP has now been published after significant regulatory and

public scrutiny, and this plan forms the basis against which environmental capacity for water resources should be assessed.

Environmental capacity – Water quality

1.5.3 The water cycle study takes account of the Water Framework Directive and its objectives. The study considers:

- What effluent quality is required at Swindon Wastewater Treatment Works (WwTW) to prevent deterioration in Water Framework Directive Classification for all affected waterbodies
- Whether development can occur at the forecast level without compromising the ability of the waterbodies to achieve the good status target required by the Directive

Infrastructure capacity – Wastewater drainage, wastewater treatment and water supply

1.5.4 Thames Water are in the process of submitting their business plan for 2015 – 2020 for regulatory approval1. As part of this business planning process Thames Water have assessed the need for new infrastructure to support new development within Swindon. This water cycle study reviews information provided by Thames Water to conclude if plans are in place to provide the necessary infrastructure alongside the development as proposed in the Local Plan.

[1] The Periodic Review 2014 (PR14) is the process by which OFWAT approves the water companies' business plans from 2015 – 2020. This business plan period is known as Asset Management Plan 6 (AMP6).

SECTION 2

Environmental capacity

2.1 Water quality and wastewater treatment standards

2.1.1 This section details the effluent quality standards that wastewater treatment works infrastructure must meet to prevent any deterioration in Waterbody classification, a key statutory requirement of the Water Framework Directive. This is a necessary step before the Wastewater Treatment Works Infrastructure can be planned. The approach followed has been agreed by the Environment Agency, and Appendix A is the detailed technical note that reports the full methodology and outputs.

Figure 1 shows the Swindon Borough boundary and the watercourses within the study area.

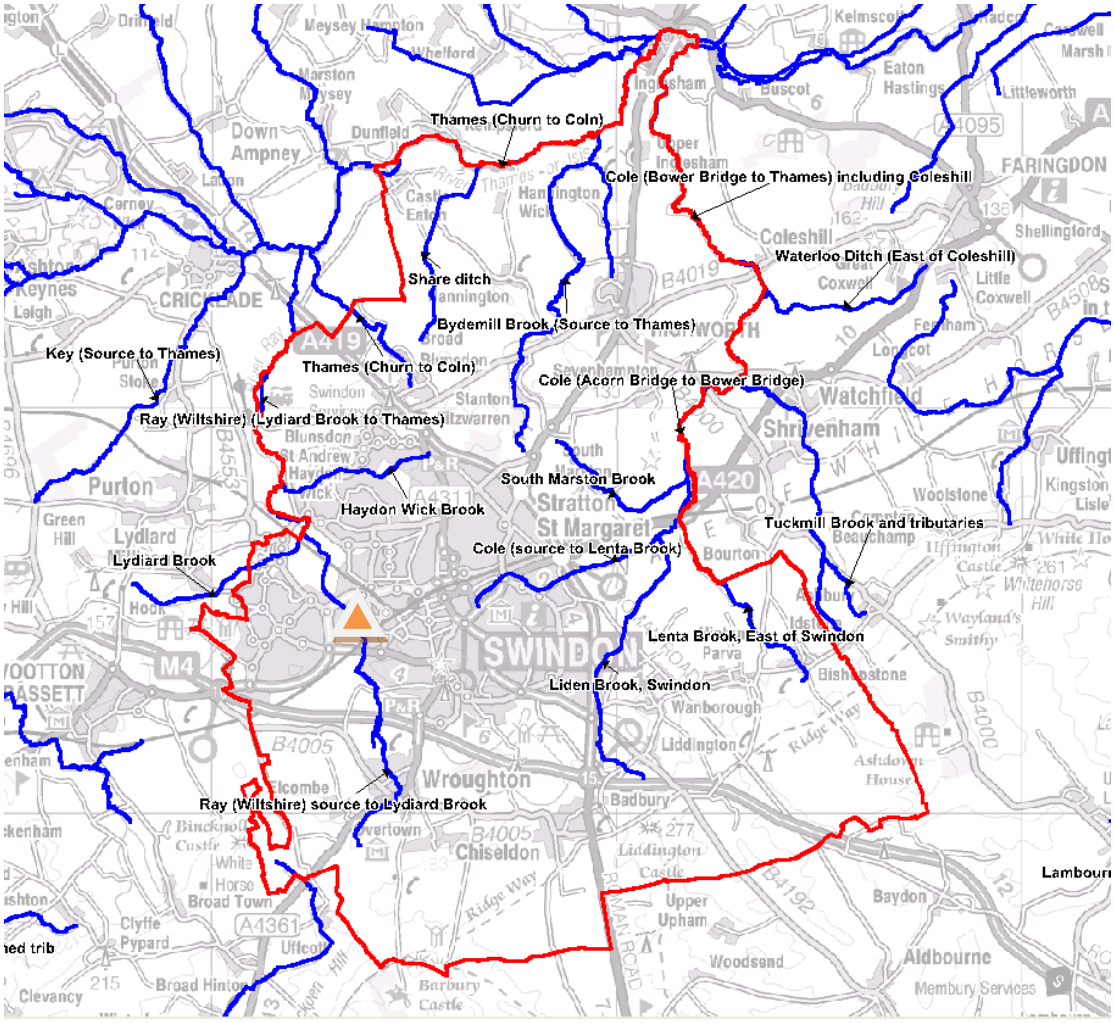

Figure 1 – Watercourses within Swindon water cycle study area

Key

- Swindon WwtW
- Waterbodies
- Swindon Borough Boundary

2.1.2 All of the strategic development locations being considered by the Local Plan within the Swindon urban area connect to the Swindon Wastewater Treatment Works. The location of this works is shown in Figure 1 – Watercourses within Swindon water cycle study area above. There are other public wastewater treatment works within Swindon Borough, but these are not subject to development at a scale that requires analysis within this study.

2.1.3 The phase 1 water cycle study considered two additional wastewater treatment works options; moving Swindon WwTW to land that Thames Water own at Seven Bridges near Cricklade, and a new wastewater treatment works serving the Eastern Development Area (now known as Eastern Villages). These options have not been taken forward for further consideration in this water cycle study for the following reasons:

- The 'no deterioration' requirement of the Water Framework Directive makes a new WwTW discharge to a waterbody that currently has no WwTW discharge unviable;
- The amended scale and profile of development make these options unviable.

2.1.4 Modelling has been undertaken to calculate the effluent quality standards to meet the Water Framework Directive requirements. This modelling concludes:

- the current effluent quality is sufficient to maintain Water Framework Directive high status and to prevent classification deterioration for Biochemical Oxygen Demand (BOD).
- the current effluent quality is sufficient to maintain Water Framework Directive high status for ammonia and to prevent classification deterioration.
- for phosphate, the results show that the effluent quality will need to be improved to meet Water Framework Directive moderate status (to 0.29 mg/l) and significantly improved to meet Water Framework Directive good status (to 0.11 mg/l). However, maintaining the current effluent quality prevents classification deterioration.

2.1.5 The 0.11mg/l standard for phosphate is within the band currently agreed by the Environment Agency and Water Companies as being achievable with current wastewater treatment works technology2. However, upgrades to WwTW and

[2] Review of best practice in treatment and reuse/recycling of phosphorus at wastewater treatment works, Environment Agency 2012

catchment improvement schemes to achieve good status cannot be determined through a single site water cycle study. It is estimated that there are over 2000 WwTW that contribute to a phosphate EQS failure in England, of which Swindon WwTW is one. Swindon is also one of more than 500 which contribute to a water quality standard failure even with a discharge permit standard of 1mg/l.

2.1.6 There are therefore hundreds, possibly thousands of WwTW across England that will need new effluent standards to meet the new standards for Phosphate in the Water Framework Directive, and many of the improvements will only be effective if catchment wide programmes have been put in place. Therefore, in order for Water Companies to obtain approval to invest in their assets to meet these new standards, the Environment Agency and Water Companies will need to develop and agree a company-wide prioritisation of investment in WwTW. The upgrade process required will come 'at a cost in terms of significant investment and in terms of additional energy use (with commensurate carbon dioxide emissions)'.

2.1.7 This process will need to:

- prioritise waterbodies most risk at risk of deterioration;
- protect bill payers from significant increases in bills;
- ensure that the process is consistent with the carbon budget enacted through the Climate Change Act 2008;
- be aligned with the water company Asset Management Plan; and
- agree a threshold beyond which the infrastructure upgrade involves disproportionate cost.

2.1.8 This process will need to be complete by 2027 to comply with the Water Framework Directive. With respect to Swindon Borough Council and Swindon WwTW, assuming that infrastructure can be provided to maintain the current effluent quality (discussed in section 4), then development can proceed without causing any deterioration to Water Framework Directive classification status whilst this process is underway.

2.2 Water resources

2.2.1 The existing potable water supply network is operated and maintained by Thames Water Utilities Ltd (TWUL). Swindon is located within the Swindon and Oxfordshire (SWOX) water resource zone.

2.2.2 The majority of Swindon's drinking water is supplied by Farmoor Reservoir located five miles to the west of Oxford. This reservoir takes water from the adjacent River Thames. This source is locally supplemented by groundwater abstractions, such as those at Moulsford, South Stoke and Latton. To the south of Swindon there is also an abstraction at Axford from the chalk aquifer.

Water resources management plan

2.2.3 As the appointed water company, Thames Water has a responsibility to provide sufficient quantity and quality of water to meet the needs of its customers, whilst also minimising their impacts on the environment. This responsibility applies to new customers as well, and population growth as well as changing demands within the existing customer base must therefore be comprehensively planned for.

2.2.4 All water companies have a duty to produce water resources plans covering the next 25 years. These plans set out how companies intend to provide sufficient water to meet their customers' needs. Although not previously compulsory, companies have prepared 25 year water resource management plans on a voluntary basis, and shared these with the Government and regulators, since 1999. On 1 April 2007 these plans became compulsory under changes to the Water Industry Act 1991, and are now also subject to public consultation before they are finalised.

2.2.5 Information regarding the strategic water resources for Swindon was initially obtained from TWUL draft Water Resources Management Plan (WRMP) 2008. This underwent a public consultation exercise during the summer of 2008 and a revised draft WRMP was published in 2009. In the summer 2010, a Public Inquiry was held to examine the dWRMP. In May 2011, Defra issued instructions to amend the rdWRMP, following the publication of the Planning Inspector's recommendations and consultation with the Environment Agency and stakeholders. TWUL then published a draft Work Plan, setting out how they intended to amend the rdWRMP in accordance with Defra's instructions. This was subject to stakeholder consultation before the publication of a Final Work Plan, which was used to prepare the final WRMP document. Further public consultation was carried out between December 2011 and January 2012, with the changes identified being incorporated in the fWRMP before submission to the Secretary of State. In June 2012 the Secretary of State approved the TWUL Water Resources Management Plan covering the period 2010-2035. The fWRMP covering the period of 2010-2035 is now published in the TWUL website. TWUL are currently developing a plan which covers the period 2015 to

2040. This is referred to by the abbreviation WRMP14, recognising that it needs to be finalised in 2014.

2.2.6 Whilst strategic plans for meeting future demand over a 25 year period are set out in the WRMP, detailed design of schemes is not undertaken until works have been granted funding by Ofwat.

2.2.7 Any improvements to the water services infrastructure needs to be programmed into a water company's capital programme, which runs in five year Asset Management Plan (AMP) cycles.

Future Water Resource Strategy

2.2.8 TWUL adopts a twin track approach for water resource management via both demand management and water resource development. This means that, in order to increase water supply, demand management programmes of leakage reduction, metering and water efficiency are considered alongside water resource scheme options, such as reservoir and groundwater development, and effluent re-use or desalination.

2.2.9 Demand reduction has been prioritised over resource development. It is noted that many aspects of demand management relies on customer behaviour, and whilst TWUL can influence these habits, it is ultimately outside of their control to enforce them. It is therefore essential to the success of demand reduction measures that other bodies also promote the importance of being water smart. This includes Local Authorities (through both planning policy and public education), the Environment Agency, and local press. When this does occur achievements can be made in reducing water demand.

Demand Management

2.2.10 Demand management measures are traditionally viewed in isolation from each other. In reality, all the options are inherently linked and Thames Water have proposed an integrated approach to Demand Management, called the IDM approach. This approach draws on the synergies and overlaps between the separate elements of the demand management strategy to maximise demand savings whilst minimising duplication of activity and therefore cost.

2.2.11 Although leakage levels are considered low for SWOX, leakage reduction of 4Ml/d is planned during the AMP5 period, in response to the supply-demand deficit for this period. This is to be delivered through a combination of increased find and fix activity and supply pipe leakage savings from metering. The performance of mains replacement is currently subject to an independent review, which will inform leakage proposal for the next WRMP. The demand management programme for SWOX also includes a 10-year targeted progressive metering programme and an enhanced water efficiency programme.

2.2.12 Thames Water has developed a water efficiency programme which includes wider communication, promotions of cistern displacement devices and water butts, an education programme targeting schools and higher education institutions, and partnership activities to continue to effectively promote the water efficiency message. In addition to the baseline programme, an enhanced water efficiency programme has been developed. This programme includes the dovetailing of domestic audits with a compulsory metering programme, to offer customers the opportunity to save water when metering provides a financial incentive for doing so. Commercial properties will also be targeted through a commercial audit programme and subsidised activity. A web based tool has also been developed (Waterwisely) which helps customers to calculate their water usage and provides information on how to save water. TWUL estimates that around 6 million litres of water a day were saved during 2011/12 as a result of their water efficiency programme.

Save Water Swindon

2.2.13 Swindon is classified by the Environment Agency as a 'seriously water stressed area', with the typical Swindon resident using an average 164 l/d, which is more than the national average (148l/p/d), and well above the government target of 130l/p/d. Save Water Swindon is an initiative launched by Thames Water, Waterwise and WWF in June 2010 to reduce water usage in Swindon by 1 million litres per day by 2014. The aim is to ensure that there is sufficient water for the local people, while reducing the pressure on the rivers and on the natural environment.

2.2.14 Phase I of the campaign, which run from June 2010 to June 2011, included offering free home makeovers (carried out by professional installers) and free self-install water saving kits to local people. The Phase I Evaluation report was published in September 2012, and it is estimated that the campaign helped to reduce the water use in Swindon by 130,000 litres a day in its first year. Thames Water is currently providing free home makeovers and self-install packs of water saving gadgets for residential properties, as well as water efficiency training and guidance to schools and businesses.

Supply-side Water Resource Development

2.2.15 In order to secure supplies for the predicted future demand TWUL has identified several resource development schemes. These are detailed in the fWRMP. The schemes will supply flow to more than one planning zone, and may be further extended by the enhancement of trunk mains and local water distribution which will facilitate the supply to new and existing customers.

2.2.16 The Upper Thames Major Resource Development (UTMRD) Reservoir proposed for Abingdon was previously identified as the preferred option by Thames Water to maintain security of supply in both London and SWOX WRZs

which would be available from AMP7 onwards. Due to the exclusion of long-term risk associated with sustainability reductions in the London WRZ in accordance with Defra's instructions, there is no requirement for a strategic resource and the UTR is not selected within the rdWRMP09.

2.2.17 The preferred programme for SWOX comprises the same resource development schemes in AMP5 (2010–15), as per Defra's inctructions. The raw water transfer from Culham to Farmoor WTW was selected to address the supply-demand deficit beyond 2024/25. The final plan includes a sustainability reduction of Axford abstraction, which will affect the Deployable Output for SWOX WRZ from 2014/15 onwards.

Infrastructure capacity

3.1 Water supply

3.1.1 Thames Water have confirmed that with respect to resource and transmission, the resource is available based on the published Water Resources Management Plan, and any shortfall is already planned for (through a win-track approach to demand management and new resource). There is sufficient treatment capacity, especially with the planned upgrade to a key water treatment works (Gatehampton WTW).

3.1.2 Water supply infrastructure delivery will follow an established process. **Small scale infrastructure upgrades** to support specific sites will be funded by the Developer through the Requisition Process[3]. This process typically takes about 12 – 18 months to deliver the infrastructure required.

3.1.3 **Significant offsite infrastructure reinforcements** have not been identified as being necessary to support the Local Plan to 2020. However, it is possible that detailed water supply modelling, which can only be undertaken when there is greater certainty about the phasing and specifics of each development, may identify larger scale infrastructure requirements. Where this is the case, Thames Water can try to secure customer investment to deliver this infrastructure through the Periodic Review Process. There are no such upgrades identified as necessary in PR14 for AMP6, therefore if such infrastructure was modelled as being necessary, the earliest it could be delivered through this process is 2020. Should significant offsite infrastructure be required in advance of this date, developers would need to fund the infrastructure directly through the requisition process.

3.2 Wastewater treatment works

3.2.1 Thames Water completed a growth study on Swindon WwTW in November 2013.

3.2.2 This growth study concluded that a number of infrastructure improvements were necessary to provide the hydraulic and wastewater treatment process capacity for development up to 2021. Providing that the following scope items are delivered, Swindon WwTW will have adequate process and hydraulic capacity to deal with the growth to 2021:

- Improvements to chemical dosing system

[3] Requisition charges are paid by the developer to the water company and enable the recovery of the costs incurred in providing assets to serve the new development, where the costs exceed income received from bills over 12 years. These requisition charges are calculated on a site specific basis and can only be calculated when there is reasonable certainty about the strategic site layout. The requisition charge can include the cost of network reinforcement where work is required to provide offsite infrastructure. See http://secure.thameswater.co.uk/dynamic/cps/rde/xchg/corp/hs.xsl/11195.htm for further information.

- Improvements to sludge processing capacity
- Provide an additional sludge blending tank.
- Improvements to Combined Heat Power plant capacity (used to recover energy from the sludge treatment process).

3.2.3 These improvements are included within Thames Water 2015 – 2020 business plan (PR14, AMP6), but this plan is currently subject to Ofwat approval, and the final determination of the business plans will not be complete until December 2014.

3.2.4 Additional sludge treatment capacity will be needed post 2021, and Thames Water will consider this scheme as part of the next periodic review and business planning process (PR19, AMP7).

3.2.5 The improvements have been designed to meet the same permit standards as the existing infrastructure. The WwTW currently outperforms its permitted quality, and although it is expected that the planned improvements will maintain the current discharge quality, theoretically the effluent quality could deteriorate to the permitted effluent quality and Thames Water would remain compliant with their permit. If the effluent quality is maintained, there will be no deterioration of the Water Framework Directive classification standards.

3.3 Wastewater networks

3.3.1 Thames Water are currently delivering substantial strategic improvements to the main trunk sewer that takes sewage into the Swindon WwTW, which will complete in May 2014. These upgrades have been planned to ensure that strategic system into Swindon WwTW has capacity for the development planned in the Local Plan up to 2026. Sewer incapacity in this area has been the cause of localised sewer flooding in the Rodbourne and Cheney Manor areas, and the scheme will address these issues.

3.3.2 Other sewerage network infrastructure delivery will follow an established process. **Small scale infrastructure upgrades** to support specific sites will be funded by the Developer through the Requisition Process4. This process typically takes about 12 – 18 months to deliver the infrastructure required.

3.3.3 **Significant offsite infrastructure reinforcements** identified as being necessary to support the Local Plan allocations to 2015 are currently being planned and delivered as part of AMP5. It should be noted that Thames Water

[4] Requisition charges are paid by the developer to the water company and enable the recovery of the costs incurred in providing assets to serve the new development, where the costs exceed income received from bills over 12 years. These requisition charges are calculated on a site specific basis and can only be calculated when there is reasonable certainty about the strategic site layout. The requisition charge can include the cost of network reinforcement where work is required to provide offsite infrastructure.

planned in in their 2009 business plan to deliver network improvements by 2015 to cope with the forecast development up until 2020. However, the final determination by OFWAT only allowed funding for infrastructure needed to support forecast development to 2015. The rationale for this decision was:

- Significant uncertainty regarding market demand for and delivery of housing over the period 2010 to 2015
- A desire to see the costs of infrastructure to serve new developments to be funded by the developments themselves, not by all bill payers.

3.3.4 No significant offsite or strategic infrastructure upgrades are currently planned for 2015 – 2020 and Thames Water consider that infrastructure to support the forecast development to 2020 can be delivered through the requisition process, with local connections and key upgrades to the existing sewerage network. These upgrades typically take 12 – 18 months to plan and deliver.

3.3.5 It is likely that more major strategic sewerage upgrades will be needed in the period 2020 to 2026, but until there is certainty about the phasing and completion of sites, in particular the phasing of sites within the Eastern Villages, it is not possible to develop a strategic sewerage plan.

3.3.6 Thames Water will develop a detailed sewerage strategy to support development to 2026 in AMP6 (2015 – 2020) and include this strategy in their business plan in 2019 (PR19, AMP7). Therefore if such strategic infrastructure was modelled as being necessary, the earliest it could be delivered through this process is 2020. Should significant offsite infrastructure be required in advance of this date, developers would need to fund the infrastructure directly through the requisition process.

3.3.7 Thames Water consider that this approach is the only approach that would secure regulatory approval by their regulator OFWAT.

4. Conclusions

4.1.1 The two primary concerns raised in the outline water study were uncertainty over water resources environmental capacity and uncertainty over the capacity of the river systems to accept an increase in treated effluent without causing water quality failures.

Water quality

4.1.2 Detailed modelling undertaken by this study has identified that the Local Plan growth will not lead to a deterioration of Water Framework Directive classification for BOD, Ammonia or Phosphate.

4.1.3 In the longer term, Swindon WwTW will be one of many WwTW in England that will need to have expensive and energy consuming upgrades applied to meet the good status standards for Phosphate in the River Ray. For phosphate, the results show that the effluent quality will need to be improved to meet Water Framework Directive moderate status (to 0.29 mg/l) and significantly improved to meet Water Framework Directive good status (to 0.11 mg/l). The 0.11mg/l standard for phosphate is within the band currently agreed by the Environment Agency and Water Companies as being achievable with current wastewater treatment works technology. However, upgrades to WwTW and catchment improvement schemes to achieve good status cannot be determined through a single site water cycle study. In order for Water Companies to obtain approval to invest in their assets to meet these new standards, the Environment Agency and Water Companies will need to develop and agree a company-wide prioritisation of investment in WwTW. In order to be compliant with the Water Framework Directive this process will need to be completed and delivered by 2027. Whilst this process is underway, the improvements to the wastewater treatment infrastructure at Swindon WwTW will prevent any deterioration in water quality.

Water availability

4.1.4 Whilst there are still uncertainties about the availability of water for Swindon within the SWOX zone, these are not material considerations for the Local Plan; Thames Water and the Environment Agency consider that the demand for water within the SWOX zone to 2026 can be met with a combination of demand management measures and planned water resource infrastructure schemes.

Water services infrastructure

4.1.5 Thames Water have an on-going programme of upgrades to water services infrastructure, which will ensure that infrastructure is delivered alongside development. This programme needs to remain flexible because of

uncertainties in the market demands for new housing, and Thames Water investment in modelling the upgrades required must be proportionate to the level of certainty associated with each development. Specifically:

- The wastewater treatment works infrastructure scheme planned for AMP6 will provide capacity to 2021, but this is subject to approval by Ofwat in December 2014.

- Additional wastewater treatment improvements will be needed to provide capacity to 2026, and these will be included in Thames Water's PR19 for delivery in the period 2020 – 2026

- A major wastewater network upgrade scheme is being delivered to provide strategic capacity in the main trunk sewer at the inlet to the treatment works. This scheme will provide capacity for all development planned to 2026 and will resolve local sewer flooding issues in the Cheney Manor and Rodbourne areas.

- Ofwat only allowed Thames Water to invest customer's money in other wastewater network improvements to provide capacity to 2015. These schemes are currently being delivered.

- Thames Water consider that wastewater network upgrade schemes to provide capacity to 2021 can be provided with targeted improvements to the existing sewerage system delivered through the requisition process. More significant strategic upgrades are likely to be required after 2021, in particular to serve the Eastern Villages. These cannot be planned until there is greater certainty about the exact phasing of the villages, and Thames Water will work with Swindon Borough Council and the Environment Agency to deliver a Drainage Strategy following the drainage strategy framework principles (http://www.ofwat.gov.uk/future/sustainable/drainage/rpt_com201305drainagestrategy.pdf) for Swindon by 2017. This Drainage Strategy will inform the Thames Water PR19 business plan, and provide a credible investment basis for strategic upgrades.

Appendix A: Technical note

Project	Swindon Water Cycle Study	**Date**	09 September 2013
Subject	Water Quality Modelling	**Ref**	

Introduction

An addendum to the Level 2 WCS is needed to identify foul water infrastructure requirements according to the revised level of growth, taking account of the WFD in order to identify sustainable options that can be delivered when required to enable growth without the risk of pollution. This technical note describes the water quality modelling that has been undertaken.

Figure 1 shows the Swindon borough boundary and the watercourses within the study area.

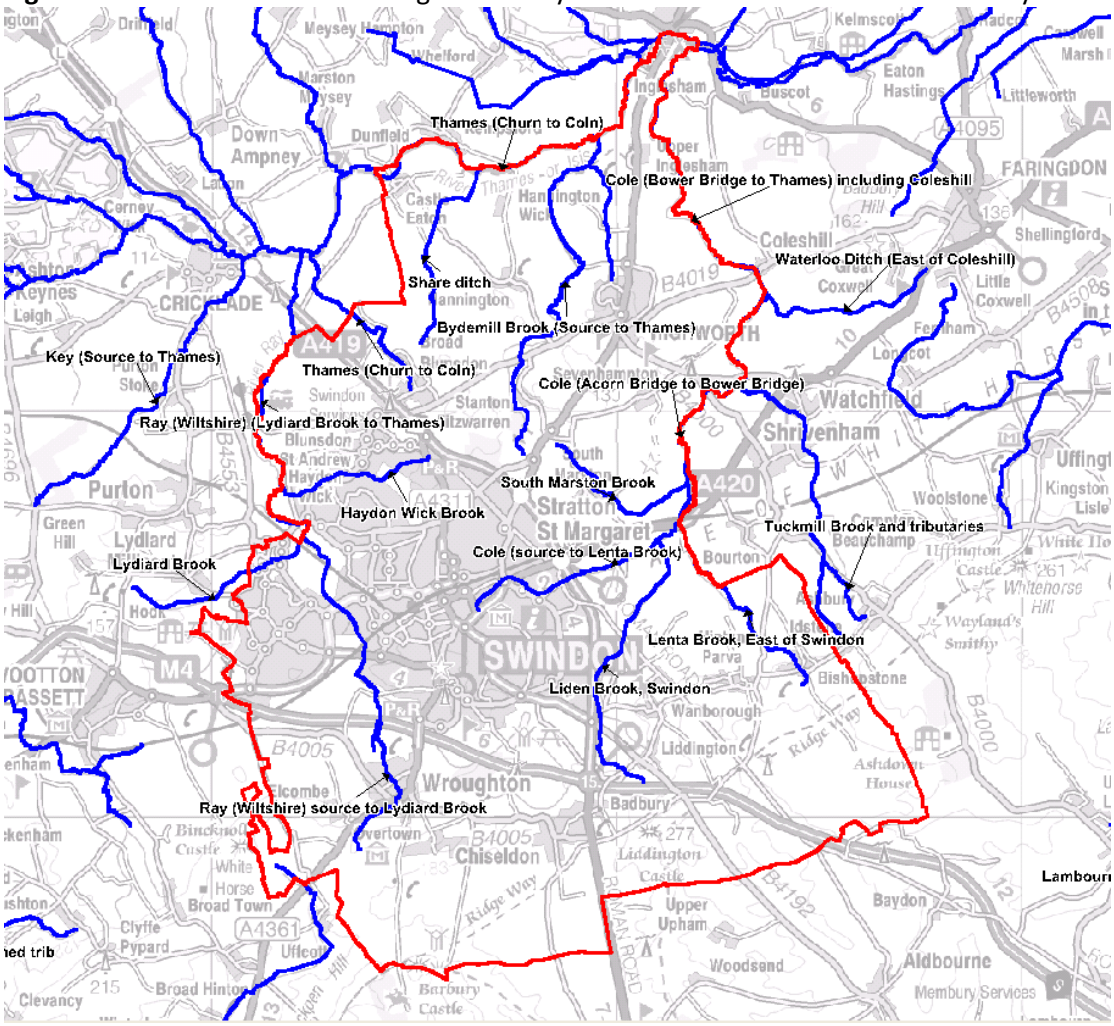

Figure 2 – Watercourses within Swindon WCS area

Data Sources

The following data sources were used to check the calibration of the SIMCAT model:

- Environment Agency's "What's in your backyard?" interactive maps
- River Basin Management Plan for the Thames Region, December 2009
- UK Environmental Standard and Conditions (Phase I), WFD UK TAG, April 2008

The following data sources were used for the water quality modelling scenarios for future growth:

- Swindon Borough Local Plan 2026, Pre-Submission Document, December 2012

Simcat model

8.1 Calibration report

In 2009 work was undertaken by WRc to update the 2006 model of the Thames and Medway catchments with observed data from April 2005 to March 2008, to add additional features and to calibrate the model.

Once additional features had been added, the Thames and Medway SIMCAT models were then calibrated manually to achieve a good match where possible within the specified ± 1 standard deviation calibration criteria for mean and 95th percentile values for flow and quality. Following the manual calibration, auto-calibration was used for all determinands to add or remove load to accurately match the observed data where suitable.

The models are now considered to be 'fit for purpose' and are suitable to be used for the Current Actual scenario and for further what–if scenario model runs.

The calibration report contains no specific detail regarding the calibration of the rivers in the Swindon WCS area.

8.2 Flow calibration

Only two flow gauges were located in the Swindon WCS area to review the flow calibration. These were on a reach of the River Cole (Bower Bridge to Thames) and the River Ray (Wiltshire).

Table 1 summarises the results.

There is a good calibration between the modelled and observed river flows.

Table 1 – Flow calibration

	River Cole		River Ray	
	Mean	**95-percentile**	**Mean**	**95-percentile**
Observed flow	130.5 Ml/d	12.8 Ml/d	143.9 Ml/d	47.4 Ml/d
Modelled flow	131.1 Ml/d	13.9 Ml/d	145.2 Ml/d	45.2 Ml/d

8.3 Water quality calibration

The water quality calibration of the SIMCAT model was reviewed using water body data from the Environment Agency's "What's in your backyard?" interactive maps. These included data for ammonia and phosphate; however, no data was available for BOD and therefore the BOD calibration has not been checked.

Table 2 and **Table 3** show the comparison between the SIMCAT model results and the current status for ammonia and phosphate respectively, for each river reach within Swindon Borough. Those highlighted in red text are where the model results differ from the EA data.

Table 2 shows that the model predicts ammonia classification well.

The phosphate classification estimated by the model (**Table 3**) is generally one class worse than the classification by the Environment Agency.

For the purposes of the water cycle study, the key reach that may be impacted by changed effluent discharge at Rodbourne Swindon WwTW is the River Ray – Lydiard Brook to River Thames. The modelled ammonia classification in this reach is high rather than the observed of good. The modelled phosphate classification is the same as the observed; poor.

Table 2 – Model calibration - Ammonia

					Ammonia - SIMCAT model results			
		Ammonia		SIMCAT model	head of reach		end of reach	
Water body ID	**Name**	**Type**[1]	**mg/l (90-%ile)** [2]	**Reach No**	**90-%ile**		**90-%ile**	
GB106039022860	Liden Brook, Swindon	Good	0.6	155	0.291	High	0.415	Good
GB106039022870	Lenta Brook, East of Swindon	High	0.3	153	0.029	High	0.026	High
GB106039022880	Cole (Liden Brook to Lenta Brook)	High	0.3	156	0.199	High	0.191	High
GB106039022890	Cole and Dorcan Brook (Source to Liden Brook confluence)	High	0.3	154	0.029	High	0.023	High
GB106039022900	Cole (Acorn Bridge to South Marston Brook)	High	0.3	157	0.141	High	0.135	High
GB106039022910	South Marston Brook to Swindon	High	0.3	158	0.085	High	0.071	High
GB106039022930	Cole and tributaries at Sevenhampton	High	0.3	159	0.124	High	0.112	High
GB106039022990	Thames (Churn to Coln)	High	0.3	141	0.112	High	0.104	High
	Thames (Churn to Coln)	High	0.3	142	0.104	High	0.091	High
GB106039023171	Upper Kennet to Marlborough	High	0.3	361	0.104	High	0.102	High
GB106039023310	Lydiard and Shaw Brooks at Swindon	High	0.3	116	0.050	High	0.231	High
GB106039023320	Ray (Wiltshire) source to Lydiard Brook	High	0.3	115	0.096	High	0.171	High
GB106039023330	Ray (Wiltshire): Lydiard Brook to Thames	Good	0.6	117	0.172	High	0.160	High
GB106039023680	Share Ditch	High	0.3	143	0.083	High	0.079	High
GB106039023710	Bydemill Brook (Source to Thames)	Moderate	1.1	111	0.662	Moderate	0.619	Moderate
GB106039023730	Cole (Bower Bridge to Thames) including Coleshill	High	0.3	161	0.111	High	0.075	High

[1]Current ecological status from Environment Agency "What's in my backyard?"
[2]Classification values from: UK Environmental Standards and Conditions Phase 1, April 2008

Table 3 – Model calibration - Phosphate

					Phosphate - SIMCAT model results			
		Phosphate		SIMCAT model	head of reach		end of reach	
Water body ID	Name	Classification[1]	mg/l mean [2]	Reach No	Mean	Classification	Mean	Classification
GB106039022860	Liden Brook, Swindon	Poor	1	155	0.443	Poor	0.796	Poor
GB106039022870	Lenta Brook, East of Swindon	Good	0.12	153	0.049	High	0.049	High
GB106039022880	Cole (Liden Brook to Lenta Brook)	Moderate	0.25	156	0.402	Poor	0.399	Poor
GB106039022890	Cole and Dorcan Brook (Source to Liden Brook confluence)	Good	0.12	154	0.089	Good	0.087	Good
GB106039022900	Cole (Acorn Bridge to South Marston Brook)	Moderate	0.25	157	0.300	Poor	0.295	Poor
GB106039022910	South Marston Brook to Swindon	Good	0.12	158	0.133	Moderate	0.132	Moderate
GB106039022930	Cole and tributaries at Sevenhampton	Moderate	0.25	159	0.280	Poor	0.273	Poor
GB106039022990	Thames (Churn to Coln)	Moderate	0.25	141	0.279	Poor	0.275	Poor
	Thames (Churn to Coln)	Moderate	0.25	142	0.267	Poor	0.259	Poor
GB106039023171	Upper Kennet to Marlborough	Good	0.12	361	0.122	Moderate	0.063	Good
GB106039023310	Lydiard and Shaw Brooks at Swindon	Good	0.12	116	0.089	Good	0.088	Good
GB106039023320	Ray (Wiltshire) source to Lydiard Brook	Good	0.12	115	0.089	Good	0.351	Poor
GB106039023330	Ray (Wiltshire): Lydiard Brook to Thames	Poor	1	117	0.329	Poor	0.331	Poor
GB106039023680	Share Ditch	Bad	>1	143	0.797	Poor	1.262	Bad
GB106039023710	Bydemill Brook (Source to Thames)	Bad	>1	111	1.724	Bad	1.711	Bad
GB106039023730	Cole (Bower Bridge to Thames) including Coleshill	Moderate	0.25	161	0.347	Poor	0.327	Poor

[1]Current ecological status from Environment Agency "What's in my backyard?"
[2]Classification values from: UK Environmental Standards and Conditions Phase 1, April 2008

Growth data

Swindon Borough is currently home to approximately 209,000 people. The planned growth for Swindon includes the construction of 22,000 new homes between 2011 and 2026, to be phased as follows:

- 1,150 average per annum between 2011 and 2016; and
- 1,625 average per annum between 2016 and 2026.

Table 4 shows how the new dwelling numbers will be distributed. It is considered that the growth in Highworth and Other Villages will not be sent to Rodbourne WwTW and therefore these have not been included in the future flows calculations.

The Local Plan proposes either expanding Rodbourne WwTW or building "an additional WwTW to the east of Swindon to serve the New Eastern Village developments, if proven to be the most sustainable option, particularly to ensure delivery of the housing trajectory."

For the purposes of this study all growth has been modelled as draining to Rodbourne WwTW.

Table 4 – New development in Swindon

Location	Planned number of dwellings
Swindon's Central Area	About 1,000
Remainder Swindon's existing urban area	About 3,500
Northern Development Area	589
Wichelstowe	4,064
Commonhead	890
Tadpole Farm	1,695
New Eastern Villages	About 6,000
Rowborough	About 1,500
South Marston: Greenfield	500
South Marston: Brownfield	About 140
Kingsdown	About 1,650
Highworth	At least 200
Wroughton	At least 150
Other Villages	At least 100

Source: Swindon Borough Local Plan 2026, December 2012

Current Building Regulations require that all new residential properties have fittings with a good standard water efficiency to achieve a standard of 125 l/p/d. The number of people per dwelling has been estimated as 2.5 and an assumption of 25% infiltration has been used for calculating future flows. For the number of planned dwellings shown in Table 4 (excluding Highworth and Other Villages), a total additional flow of approximately 8.5 Ml/d will be sent to Rodbourne WwTW.

The current dry weather flow is 44.2 Ml/d. It is estimated that a total dry weather flow of 52.7 Ml/d will require treatment at the sewage treatment works by 2026. This is above the currently permitted 48.3 Ml/d.

Model scenarios and results

In order to comply with the Environment Agency's No Deterioration policy and the Water Framework Directive (WFD) objectives, the following scenarios are required to be investigated:

1. Effluent quality needed to achieve WFD Class limit at downstream monitoring point
2. Effluent quality needed to achieve WFD Class limit immediately downstream of the discharge (if different to the above)
3. Effluent quality needed to achieve current modelled downstream quality (i.e. 0% numeric deterioration)
4. Effluent quality needed to achieve current modelled downstream water quality + 10% numeric deterioration
5. Effluent quality needed to achieve good status at the point of mixing.

Scenario 1
A discharge with the dry weather flow predicted in 2026, but maintaining the existing discharge quality, will not lead to a deterioration in the modelled classification status at any downstream sample point. Table 6 shows the modelled classification status at all of the sample points in the model. No sample point deteriorates from its current status.

Scenario 2
A discharge with the dry weather flow predicted in 2026, but maintaining the existing discharge quality, will not lead to a deterioration in the modelled classification status at the point of mixing. This is shown in Table 5.

Table 5 - River quality for current and future flows at mixing point

	Model Current Status		Model Future Growth	
Name	**mg/l**	**Classification**	**mg/l**	**Classification**
BOD (90%ile)	3.061	High	2.988	High
Ammonia (90%ile)	0.217	High	0.226	High
Phosphate (mean)	0.405	Poor	0.411	Poor

Table 6 – River quality for current and future flows at end of reach

	PHOSPHATE	Current Status (mean)		Model Current Status (mean)		Model Future Growth (mean)	
		EA	Standard	end of reach		end of reach	
Water body ID	Name	Type	mg/l	mg/l	Type	mg/l	Type
GB106039023320	Ray (Wiltshire) source to Lydiard Brook	Good	0.12	0.351	Poor	0.362	Poor
GB106039023330	Ray (Wiltshire): Lydiard Brook to Thames	Poor	1	0.331	Poor	0.342	Poor
GB106039022990	Thames (Churn to Coln)	Moderate	0.25	0.275	Poor	0.280	Poor
		Moderate	0.25	0.259	Poor	0.264	Poor
	BOD	Current Status (90-percentile)		Model Current Status (90-percentile)		Model Future Growth (90-percentile)	
		EA	Standard	end of reach		end of reach	
Water body ID	Name	Type	mg/l	mg/l	Type	mg/l	Type
GB106039023320	Ray (Wiltshire) source to Lydiard Brook	n/a	-	3.472	High	3.396	High
GB106039023330	Ray (Wiltshire): Lydiard Brook to Thames	n/a	-	3.113	High	3.070	High
GB106039022990	Thames (Churn to Coln)	n/a	-	1.685	High	1.685	High
		n/a	-	1.648	High	1.642	High
	AMMONIA	Current Status (90-percentile)		Model Current Status (90-percentile)		Model Future Growth (90-percentile)	
		EA	Standard	end of reach		end of reach	
Water body ID	Name	Type	mg/l (90-percentile)	mg/l	Type	mg/l	Type
GB106039023320	Ray (Wiltshire) source to Lydiard Brook	High	0.3	0.171	High	0.177	High
GB106039023330	Ray (Wiltshire): Lydiard Brook to Thames	Good	0.6	0.160	High	0.165	High

GB106039022990	Thames (Churn to Coln)	High	0.3	0.104	High	0.106	High
		High	0.3	0.091	High	0.091	High

Scenario 3

Scenario 3 assesses the future effluent quality required to ensure that the current downstream quality is maintained, i.e. there is no numeric deterioration. The targets for the river quality (phosphate, BOD and ammonia) are the same as the current status obtained from the calibrated SIMCAT model. **Table 7** shows the targets set and the effluent quality required at the WwTW to achieve no deterioration.

Scenario 4

Scenario 4 assesses the future effluent quality required to ensure the downstream water quality is deteriorated by no more than 10%. The targets for the river quality (phosphate, BOD and ammonia) are the current status values obtained from the calibrated SIMCAT model plus an additional 10%. **Table 7** shows the targets set and the effluent quality required at the WwTW to achieve no deterioration.

Scenario 5

Scenario 5 assesses the future effluent quality required at Rodbourne WwTW for the downstream waterbody to achieve moderate and good status for phosphate and high status for BOD and ammonia. Based on the phosphate results an additional simulation assesses the current effluent quality required at Rodbourne WwTW for the downstream waterbody to achieve moderate and good status for phosphate.

Scenario 6

Scenario 6 includes the new Good Ecological standards for phosphates of 70-100µg/L as determined by the Environment Agency.

Table 7 shows the targets set and the effluent quality required at the WwTW to achieve various WFD statuses.

Table 7 – Scenario 3-5 results – new effluent quality required

	Target river quality			Required discharge quality		
	P (mg/l)	**BOD (mg/l)**	**Amm (mg/l)**	**P (mg/l)**	**BOD (mg/l)**	**Amm (mg/l)**
Scenario	**mean**	**90-pctile**	**90-pctile**	**mean**	**95-pctile**	**95-pctile**
Current effluent quality				0.46	3.16	0.41
Current effluent consent				1	11	1
Scenario 3	0.40	3.06	0.22	0.45	3.23	0.41
Scenario 4	0.45	3.37	0.24	0.50	3.65	0.44
Scenario 5 – high status	-	4.00	0.30	-	4.56	0.52
Scenario 5 – good status	0.12	-	-	0.16	-	-
Scenario 5 – moderate status	0.25	-	-	0.29	-	-
Scenario 5 – good status – current flows	0.12	-	-	0.16	-	-
Scenario 5 – moderate status – current flows	0.25	-	-	0.29	-	-
Scenario 6 – new good standard for phosphates	0.07			0.102		

Note: Upstream water quality is good for phosphate, high for ammonia and poor for BOD.

Table 7 shows that the current effluent quality is sufficient to maintain WFD high status and to prevent numeric deterioration for BOD. Note that in the SIMCAT model the upstream river quality is poor for BOD. The effluent quality is better than the upstream river quality and therefore the downstream river quality actually improves with the additional future flows at Rodbourne WwTW.
The current effluent quality is also sufficient to maintain WFD high status for ammonia. However, to prevent numeric deterioration, a very small improvement will be necessary.
For phosphate, the results show that the effluent quality will need to be improved to meet WFD moderate status (to 0.29 mg/l) and significantly improved to meet WFD good status (to 0.16 mg/l). For no numeric deterioration, a very minor improvement is required. 10% numeric deterioration is achieved with no change in the current effluent quality.

Based on the WFD results for phosphate, an additional simulation was undertaken to assess the current effluent quality required at Rodbourne WwTW for the downstream waterbody to achieve moderate and good status for phosphate. These results show that the current flows require the same effluent quality as the future flows to meet WFD moderate and good status and therefore the increase in population does not hinder the ability to meet good status. A combination of improvements to both the upstream river quality and effluent quality will be required in order to meet WFD good status.

Conclusion

This analysis has shown that with the increased dry weather flow of 52.7 Ml/d by 2026, the current consent of 48.3 Ml/d will be exceeded.

Current effluent quality from BOD, Ammonia, and phosphate is significantly better than the consent. If Thames Water were to discharge at the consented limit, there would be a significant deterioration in water quality in the River Ray.

If the current effluent quality can be maintained for the additional effluent flow predicted up to and including 2026, there will be no deterioration for BOD or Ammonia in the River Ray or the River Thames. Rodbourne STW discharge improves the BOD quality of the River Ray, therefore any additional flow will improve the oxygen status of the river.

For phosphate, maintaining the current modelled effluent quality will prevent deterioration of the waterbody with the predicted future flows. However, to meet WFD good or moderate status with existing flows and future flows, both the upstream water quality and the effluent quality will require improvements.

The effluent quality improvements needed to achieve good or moderate status are not affected by growth. E.g. achieving good status will require a very tight P effluent quality of 0.16mg/l (as an annual average) both for current flows, and for predicted future flows in 2026.