SODC Local Plan Water Cycle Study Update

Phase 2: Assessment of proposed strategic allocations

Draft for comment from the Environment Agency and Thames Water

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South Oxfordshire District Council

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Revision history

Revision Ref/Date	Amendments	Issued to
20/12/2018 v1.0	Early issue of draft report to client. Results from the Water Quality assessment are missing.	SODC
23/12/2018 v1.1	Water quality assessment added	SODC and Environment Agency
02/01/2019 v2	Addressed comments from James Gagg	SODC and Thames Water

Contract

This report describes work commissioned by James Gagg, on behalf of South Oxfordshire District Council, by an email dated 28 September 2018. South Oxfordshire's representative for the contract was James Gagg. Paul Eccleston and Jennifer Hill of JBA Consulting carried out this work.

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Purpose

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Executive summary

A Water Cycle Study (WCS) was published by South Oxfordshire District Council in October 2017. This study assessed the capacity and ability of the water supply and wastewater treatment system to deal with the additional development planned in the Regulation 19 consultation stage Local Plan. Subsequently the draft local plan has been revised, and as such, the evidence base required revision. Therefore, JBA Consulting was commissioned by SODC to update the existing WCS to inform the emerging Local Plan.

This document reports the second phase of update work. The first phase commented on all the alternative sites considered for the South Oxfordshire Local Plan 2034 Final Publication Version 2nd. This second phase only considers the proposed strategic allocations that will be put forward in the Local Plan Version 2nd. Both Water Cycle Studies updates will form an addendum to the existing WCS for South Oxfordshire. This report is a draft for comment from the Environment Agency and Thames Water.

This report documents the following assessments:

- Water resources assessment
- Water supply assessment
- Wastewater collection (sewerage) assessment
- Wastewater treatment works headroom assessment
- Water quality assessment
- Odour impact screening
- Flood risk impact assessment.

The WCS addendum concluded that the biggest issues for proposed strategic allocations in SODC, from a Water Cycle perspective, were regarding capacity constraints on existing wastewater collection and treatment infrastructure. This was because Thames Water have indicated that treatment work upgrades would be required to serve the proposed growth. However, no significant constraints to the provision of the infrastructure have been identified at Culham (which would serve allocations at Culham and Berinsfield). Major constraints were identified to providing the infrastructure at Chalgrove, Oxford and Wheatley. Therefore, it is recommended that SODC work with Thames Water and the Environment Agency to plan the infrastructure needed to serve the proposed growth in these catchments.

The flood risk impact assessment highlighted that the increased effluent from Culham WwTW could impact flood risk. This is because the WwTW discharges to the Clifton Hampden ditch, which is a minor watercourse. As such the WwTW effluent makes up a significant proportion of flow. Therefore, it is recommended that SODC work with Thames Water and the Environment Agency to plan how the impact of this can be mitigated.

Consideration of water resources, water supply, water quality and odour did not identify any issues which could not be resolved with the use of Best Available Technology.

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Abbreviations

AMP	Asset Management Plan
BAT	Best Available Technology
CSO	Combined Sewer Overflows
DWF	Dry Weather Flow
dWRMP	Draft Water Resource Management Plan
DYAA	Dry Year Annual Average
DYCP	Dry Year Critical Period
EA	Environment Agency
EP	Environmental Permits
FEH	Flood Estimation Handbook
JBA	Jeremy Benn Associates
LPA	Local Planning Authority
Ml/d	mega litre per day
OCC	Oxford City Council
SBP	Strategic Business Plan
SESRO	South East Strategic Reservoir Option
SODC	South Oxfordshire District Council
SuDS	Sustainable Drainage Systems
SWOX	Swindon and Oxfordshire
TWUL	Thames Water Utilities Limited
WCS	Water Cycle Study
WRMP	Water Resource Management Plan
WRZ	Water Resource Zone
WTW	Water Treatment Works
WwTW	Wastewater Treatment Works

1 Introduction

1.1 Terms of reference

A Water Cycle Study (WCS) was published by South Oxfordshire District Council (SODC) in October 2017. This study assessed the capacity and ability of the water supply and wastewater treatment system to deal with the additional development planned in the Regulation 19 consultation stage Local Plan. Subsequently the draft local plan has been reviewed and updated, and as such, an update to the evidence base was required. Therefore, JBA Consulting was commissioned by SODC to update the existing WCS to inform the new version of the emerging Local Plan.

This document reports the second phase of addendum work completed in 2018. The first phase commented on all the alternative sites considered for the South Oxfordshire Local Plan 2034 Final Publication Version 2nd. This second phase only considers the preferred scenario of growth which will be proposed by the Local Plan. Both Water Cycle Study updates will form an addendum to the existing WCS for South Oxfordshire. This report is a draft for comment from the Environment Agency and Thames Water.

1.2 The Water Cycle

National Planning Policy Framework Practice Guidance on Water Supply, Wastewater and Water Quality[1] describes a Water Cycle Study as:

"a voluntary study that helps organisations work together to plan for sustainable growth. It uses water and planning evidence and the expertise of partners to understand environmental and infrastructure capacity. It can identify joined up and cost-effective solutions, that are resilient to climate change for the lifetime of the development.

The study provides evidence for Local Plans and sustainability appraisals and is ideally done at an early stage of plan-making. Local authorities (or groups of local authorities) usually lead water cycle studies, as a chief aim is to provide evidence for sound Local Plans, but other partners often include the Environment Agency and water companies."

The Environment Agency's guidance on WCS[2] recommends a phased approach:

- Phase 1: Scoping study, focussing on formation of a steering group, identifying issues for consideration and the need for an outline study.
- Phase 2: Outline study, to identify environmental constraints, infrastructure constraints, a sustainability assessment and consideration of whether a detailed study is required.
- Phase 3: Detailed study, to identify possible infrastructure requirements, when they are required, how they will be funded and implemented and an overall assessment of the sustainability of proposed infrastructure. This does not negate the need for detailed site-specific planning of water and wastewater infrastructure. This should be undertaken through early engagement with Thames Water and is the responsibility of the developer.

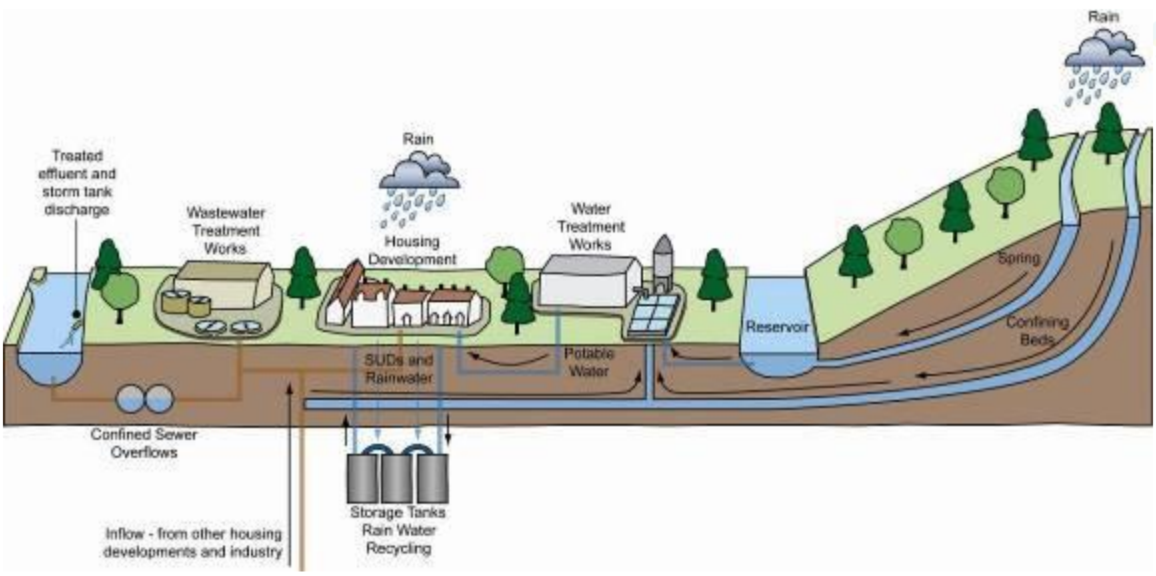
This WCS addendum could be classified as a Phase 2 WCS.

1 Planning Practice Guidance: Water supply, wastewater and water quality, Department for Communities and Local Government (2014). Accessed online at: http://planningguidance.planningportal.gov.uk/blog/guidance/ on: 09/03/2018

2 Water Cycle Study Guidance, Environment Agency (2009). Accessed online at: http://webarchive.nationalarchives.gov.uk/20140328084622/http://cdn.environment-agency.gov.uk/geho0109bpff-e-e.pdf on: 09/03/2018

Figure 1-1 shows the main elements that compromise the Water Cycle and shows how the natural and man-made processes and systems interact to collect, store or transport water in the environment.

Figure 1-1: The Water Cycle



1.3 Impact of development on the water cycle

New homes require the provision of clean water, safe disposal of wastewater and protection from flooding. It is possible that allocating large numbers of new homes at some locations may result in the capacity of the existing available infrastructure being exceeded. This situation could potentially lead to service failures to water and wastewater customers, have adverse impacts on the environment or cause the high cost of upgrading water and wastewater assets being passed on to bill payers. Climate change presents further challenges such as increased intensity and frequency of rainfall and a higher frequency of drought events that can be expected to put greater pressure on the existing infrastructure.

1.4 Objectives

Specific requirements for this Phase 1 assessment were; considering proposed and considered SODC sites:

- calculate the available headroom for water resources, supply and wastewater treatment

A follow-on stage will address the following requirements; considering the preferred growth scenario:

- calculate the available headroom for water resources, supply and wastewater treatment (including water quality), building on the work from Phase 1
- establish the evidence to input to an updated statement of common ground with Thames Water and the Environment Agency

1.5 Study area

The study area, shown in Figure 1-2, is the largely rural district of South Oxfordshire within the county of Oxfordshire in South East England. The district is around 655km^2 in size and has four main towns, Didcot, Henley-on-Thames, Wallingford and Thame. The north of the district contains part of the Oxford Green

Belt, and in the south, much of the district is designated as part of the North Wessex Downs or the Chilterns Areas of Outstanding Natural Beauty.

Significant watercourses within the study area include the River Thames, Thame and Cherwell. Some of the key transport routes passing through the district are the A40, A34, A44, A420, A412 and the M40.

Figure 1-2: South Oxfordshire District study area

1.6 Record of engagement

The preparation of this WCS addendum was supported by engagement with Thames Water, the Environment Agency and Oxford City Council. A summary of involvement of each party has been included below.

1.6.1 Thames Water

Representatives from SODC, Thames Water and JBA Consulting held a meeting in October 2018. During this meeting, the scope of works was discussed and the approach to the assessment was agreed. JBA requested a series of data from Thames Water, which was provided. The report and water quality modelling have been submitted to Thames Water for review.

1.6.2 Environment Agency

Representatives from the Environment Agency confirmed a meeting would not be required with SODC and JBA Consulting as the approach to the WCS update was consistent with the WCS from 2017. JBA requested a series of data from the Environment Agency, which was provided. The report and water quality modelling have been submitted to the Environment Agency for review.

1.6.3 Neighbouring authorities

Growth in Oxford City is of relevance to this study as the Oxford Wastewater Treatment Works (WwTW) could also serve new development in SODC. SODC requested the Oxford City Council Water Cycle Study which was provided once published.

Vale of White Horse and Reading Borough Council were not consulted during this process as there were no significant cross boundary issues to discuss.

2 Future growth

The purpose of this assessment is to conclude if the current water and wastewater infrastructure can cope with future demand. Therefore, an understanding of the cumulative development likely to impact the study area was required. In order to get a holistic understanding of growth, this assessment considered;

- Committed development in South Oxfordshire
- Proposed strategic development allocations in South Oxfordshire
- Planned proportional growth at existing towns and villages in South Oxfordshire
- Planned growth in neighbouring authorities

The focus on this update is assessment of the proposed strategic development allocations in South Oxfordshire, and their forecast impacts taking into account relevant neighbouring authority growth.

2.1 South Oxfordshire

The strategy for growth in South Oxfordshire is to focus new development at a few sites with significant capacity. This will be supported by proportional growth at existing towns and villages.

2.1.1 Existing allocation and committed development

In the South Oxfordshire District, some sites have already been allocated through the previous Local Planning and Neighbourhood Development (NDP) processes. In addition, successful planning applications have results in planning commitments. These have all be considered in the Water Cycle Study to enable the assessment to consider the cumulative impact of all the planned growth.

2.1.2 Allocated strategic development

This assessment has considered the preferred scenario for strategic growth. This proposes to allocate14,400 new homes over seven sites at; Northfield, Grenoble Road, Land north of Bayswater Brook, Chalgrove, Culham, Wheatley and Berinsfield. A list of site capacities and their proposed trajectory for construction has been included in Figure 2-1, noting that sites are projected to deliver beyond the current plan period of 2034

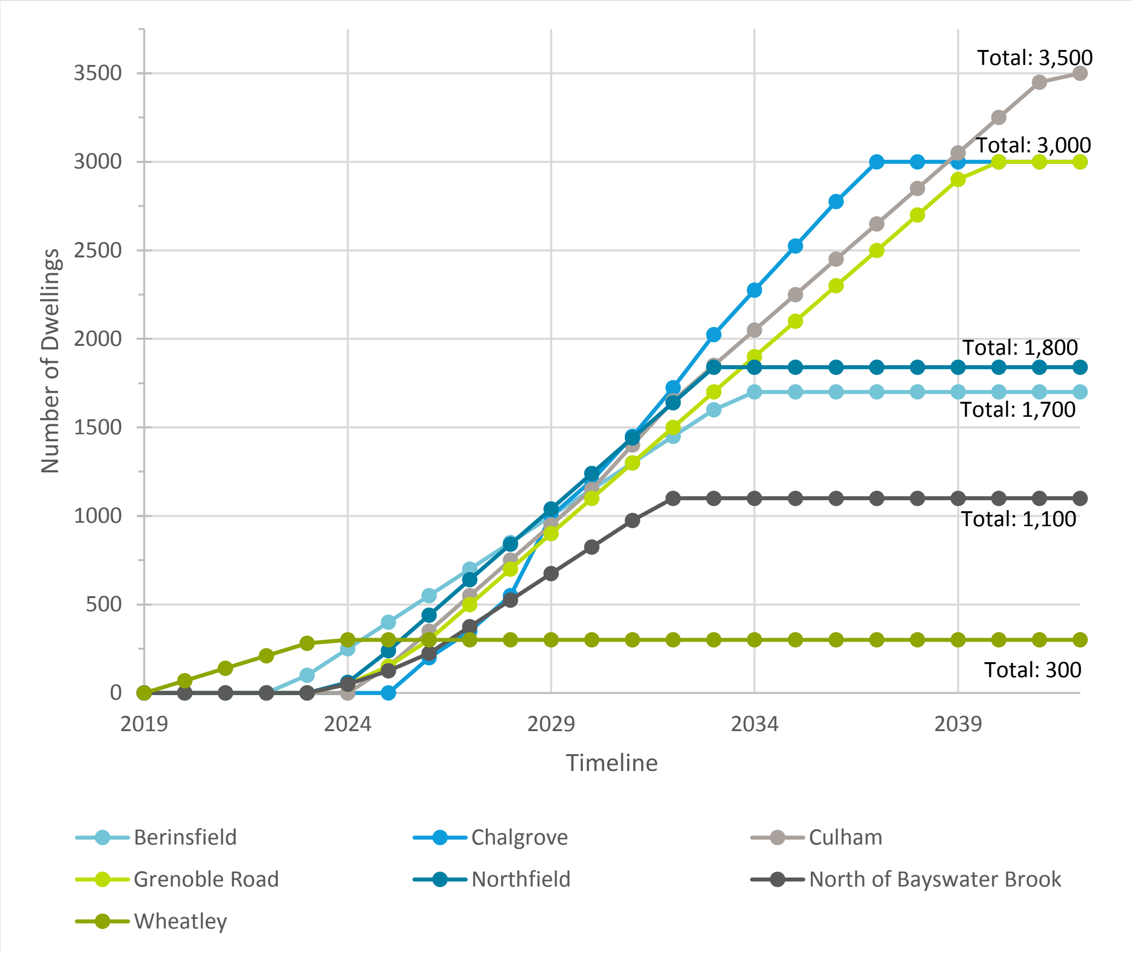


Figure 2-1: Growth trajectory for South Oxfordshire strategic allocations

2.2 Neighbouring authorities

Where growth within a neighbouring Local Planning Authority (LPA) area may be served by infrastructure within or shared with SODC, the LPA were contacted to provide information on any WCS for the area. In this instance, this includes Oxford City Council and Cherwell District Council.

2.2.1 Oxford City Council

All growth in Oxford city would have to be treated at Oxford WwTW. Therefore, growth in Oxford is important to the growth plan for SODC.

Oxford City Council completed a Water Cycle Study in 2018 which considered two growth scenarios:

- Scenario 1; The realistic scenario - 8,000 homes by 2036;
- Scenario 2; The higher growth scenario – 12,000 homes by 2036

The study concluded that:

- The water resource developments proposed by Thames Water in their latest WRMP should meet the expected increases in demand for both scenarios.
- The Oxford WwTW recently underwent a significant upgrade to increase treatment capacity four-fold, which should mean that there is sufficient treatment beyond 2036.

- Population growth will likely lead to an increase in discharges from the WwTW, therefore liaison will likely be required with the Environment Agency to amend existing permits whilst ensuring that water quality and flood risk are not compromised.
- Provided the correct measures are followed by the key stakeholders and the WwTW are upgraded where necessary the environmental capacity should be sufficient to ensure that the water environment remains healthy.

2.2.2 Cherwell District Council

A Partial Review of the Cherwell Local Plan 2011-2031 is being prepared to help meet the unmet housing needs of Oxford. Whereas the Adopted Local Plan for Cherwell focussed growth in Bicester and Banbury, the Partial Review includes site allocations around Kidlington. Half of Kidlington drains towards Oxford Wastewater Treatment works and as such new allocations in this area could impact the growth plan for SODC. Based on the location of the sites put forward in the Partial Review, it was concluded that 4,400 additional homes could drain to Oxford WwTW from Kidlington.

Cherwell District Council competed a Water Cycle Study in 2017. The purpose of the WCS was to assess the potential impact of increased development, to accommodate Cherwell's apportionment of Oxford's unmet housing need, upon the water environment across the district.

The study concluded that:

- There would be adequate water resources to cater for growth over the plan period
- Oxford WwTW has no flow capacity available for planned growth, therefore growth upgrades and careful development phasing will be required immediately. Treatment process upgrades using conventional treatment technology can ensure compliance with legislative water quality targets as well as meet more stringent, non-statutory river quality targets.

3 Water resources assessment

When new houses are planned it is important to ensure that there are enough water resources in the area to cover the increase in demand without the risk of shortage in the future or in periods of high demand. Thames Water is responsible for supplying water for the whole district and all the potential site allocations are located within the supply zones of Thames Water.

The aim of this assessment is to flag up if the emerging housing growth projections proposed by SODC exceeds what TWUL has considered in planning the future demands for water, so that actions can be implemented, and resources planned to overcome future shortages.

3.1 Methodology

Thames Water's draft Water Resource Management Plan[3] (dWRMP) published in February 2018 was reviewed. Attention was focussed upon:

- The available water resources and future pressures which may impact the supply element of the supply/demand balance.
- The allowance within those plans for housing and population growth and its impact upon the demand side of the supply/demand balance.

In addition, Thames Water were provided with the list of settlements including the number of houses planned for each scenario and were invited to comment upon these.

The results were assessed against the following three positions:

- The dWRMP has planned for the increase in demand.
- Insufficient evidence in the dWRMP to confirm that the planned increase in demand can be met.
- The dWRMP does not take into consideration the planned increase in demand. Additional water resources may be required.

3.2 Results

The dWRMP sets out how Thames Water plan to provide a secure and sustainable supply of water for customers from 2020 to 2100. As part of the planning process, Thames Water has divided their supply area into six Water Resource Zones (WRZs). The Swindon and Oxfordshire (SWOX) zone covers the majority of the South Oxfordshire District, except the south west of the district, which is in the small Henley WRZ.

3.2.1 Swindon and Oxford (SWOX)

The SWOX zone was forecasted to increase consumption from 141Ml/d in 2016/17 to 170Ml/d in 2044/45. The increases in household consumption are driven by increases to population. The assessment concluded that SWOX has a supply/demand deficit in dry year critical period (DYCP) starting from 2022/23 and growing throughout the planning period.

As part of the dWRMP, Thames Water have developed a preferred plan to balance the water demand with available resources in the short, medium and long term. The plan is based on the strategy that the demand per customer is reduced and a large-scale reservoir is built to provide a long-term water supply.

[3] https://corporate.thameswater.co.uk/About-us/our-strategies-and-plans/water-resources

In the short term (between 2020 and 2025) Thames Water will increase metering to 95% of customers and promote water efficient. The aim is that 8.8Ml/d of benefits will be delivered through the water efficiency campaign.

In the medium term (between 2020 and 2025) Thames Water will introduce an incentive based financial tariff, commencing in 2035. Thames Water have proposed the development of South East Strategic Reservoir Option (SESRO), which will be available from 2037. This would provide water resource to the SWOX and London water resource zones and enable reduced extraction from Farmoor Reservoir.

In the long term (between 2040 and 2099) Thames Water will manage an inter zonal water transfer from SWOX to the Slough, Wycombe and Aylesbury WRZ, via the River Thames. This will be used to address the deficit in SWA but will result in reduced available water resources in SWOX by up to 24Ml/d.

3.2.2 Henley

The Henley zone was forecasted to increase consumption from 7Ml/d in 2016/17 to 8Ml/d in 2044/45. The increases in household consumption are driven by increases to population. The assessment concluded that the Henley zone had no forecast supply-demand deficit over the planning period for either dry year annual average (DYAA) or DYCP. The resource zone was classified as low risk.

The water resource plan for the Henley zone is simple due to the surplus of supply throughout the plan period. Steps include reducing leakage by 0.36Ml/d and total demand by 1.47Ml/d. As part of reducing demand, household meter penetration of 96% should be achieved by 2039-40.

3.3 Thames Water Assessment

Thames Water were provided with a complete list of potential site allocations and the potential / equivalent housing numbers for each. Using this information, they were asked to comment on the impact of the proposed growth on water resources in the SODC area. A risk assessment was then applied using the following definitions to score each site:

Adopted WRMP has planned for the increase in demand, or sufficient time to address supply demand issues in the next WRMP.	Insufficient evidence in adopted WRMP to confirm that the planned increase in demand can be met.	Adopted WRMP does not take into consideration the planned increase in demand. Additional water resources may be required.

Table 3-1 summarises the scoring given to each site by Thames Water.

Table 3-1: Summary of Thames Water water resource comments and risk score

Proposed strategic allocations	Water Resource Assessment	Water Resource Comment
Berinsfield, Chalgrove, Culham, Grenoble Road, Northfield, North of Bayswater Brook, Wheatley	Adopted WRMP has planned for the increase in demand, or sufficient time to address supply demand issues in the next WRMP.	The water treatment capacity in this area is unlikely to be able to support the demand anticipated from this development. Significant infrastructure upgrades are likely to be required to ensure sufficient treatment capacity is available to serve this development.

4 Water supply infrastructure

An increase in water demand adds pressure to the existing supply infrastructure. This is likely to manifest itself as low pressure at times of high demand. An assessment is required to identify whether the existing infrastructure is adequate or whether upgrades will be required. The time required to plan, obtain funding and construct major pipeline works can be considerable and therefore water companies and planners need to work closely together to ensure that the infrastructure is able to meet growing demand.

Water supply companies make a distinction between supply infrastructure, the major pipelines, reservoirs and pumps that transfer water around a WRZ, and distribution systems, smaller scale assets which convey water around settlements to customers. This outline study is focused on the supply infrastructure. It is expected that developers should fund water company impact assessments and modelling of the distribution systems to determine requirements for local capacity upgrades to the distribution systems.

4.1 Methodology

Thames Water were provided with a complete list of potential site allocations and the potential / equivalent housing numbers for each. Using this information, they were asked to comment on the impact of the proposed growth on water supply infrastructure in the SODC area. A risk assessment was then applied using the following definitions to score each site:

Capacity available to serve the proposed growth	Infrastructure and/or treatment work upgrades are required to serve proposed growth, but no significant constraints to the provision of this infrastructure have been identified	Infrastructure and/or treatment upgrades will be required to serve proposed growth. Major constraints have been identified.

Table 4-1 summarises the scoring given to each potential site allocation by Thames Water.

Table 4-1: Summary of Thames Water water supply comments and risk score

Proposed strategic allocations	Water Supply Assessment	Water Supply Comment
Berinsfield, Chalgrove, Culham, Grenoble Road, Northfield, North of Bayswater Brook	Infrastructure and/or treatment work upgrades are required to serve proposed growth, but no significant constraints to the provision of this infrastructure have been identified	The water treatment capacity in this area is unlikely to be able to support the demand anticipated from this development. Significant infrastructure upgrades are likely to be required to ensure sufficient treatment capacity is available to serve this development.
Wheatley	Capacity available to serve the proposed growth	

4.2 Conclusions

Due to the scale of the development proposed at most of the potential site allocations, Thames Water have concluded that significant network reinforcement would be required to serve these communities. However, no significant constraints to providing additional water supply infrastructure have been identified for any of these potential site allocations. In addition, as the proposed growth at Wheatley is relatively small, it was not expected by Thames Water to cause an issue for the existing water supply infrastructure.

5 Wastewater disposal

Thames Water is the Sewerage Undertaker across the whole district as shown in Figure 5-1. The role of the sewerage undertaker includes collection and treatment of wastewater from domestic and commercial premises, and in some areas drainage of surface water from building cartilages to combined or surface water sewers. It excludes, unless adopted by TWUL, systems that do not connect directly to the wastewater network, e.g. highway drainage.

Increased wastewater flows into collection systems due to growth in population or per-capita consumption can lead to overload of infrastructure, increasing the risk of sewer flooding and, where present, increase the frequency of discharges from Combined Sewer Overflows (CSOs).

Likewise, headroom at wastewater treatment works can be eroded by growth in population or per-capita consumption, requiring investment in additional treatment capacity. As the volume of treated effluent rises, even if the effluent quality is maintained, the pollutant load discharged to the receiving watercourse will increase. In such circumstances the Environment Agency, as the environmental regulator, may tighten the permitted effluent permits in order to achieve a "load standstill" i.e. ensuring that as effluent volumes increase the pollutant load discharged does not increase. Again, this would require investment by the water company to improve the quality of the treated effluent.

In combined sewerage systems, or foul systems with surface water misconnections, there is potential to create headroom in the system, thus enabling additional growth, by removal of surface water connections. This can mostly readily be achieved on redevelopment of brownfield sites with combined sewerage, where there is potential to discharge water via sustainable drainage systems (SuDS) to groundwater, watercourses or surface water sewers.

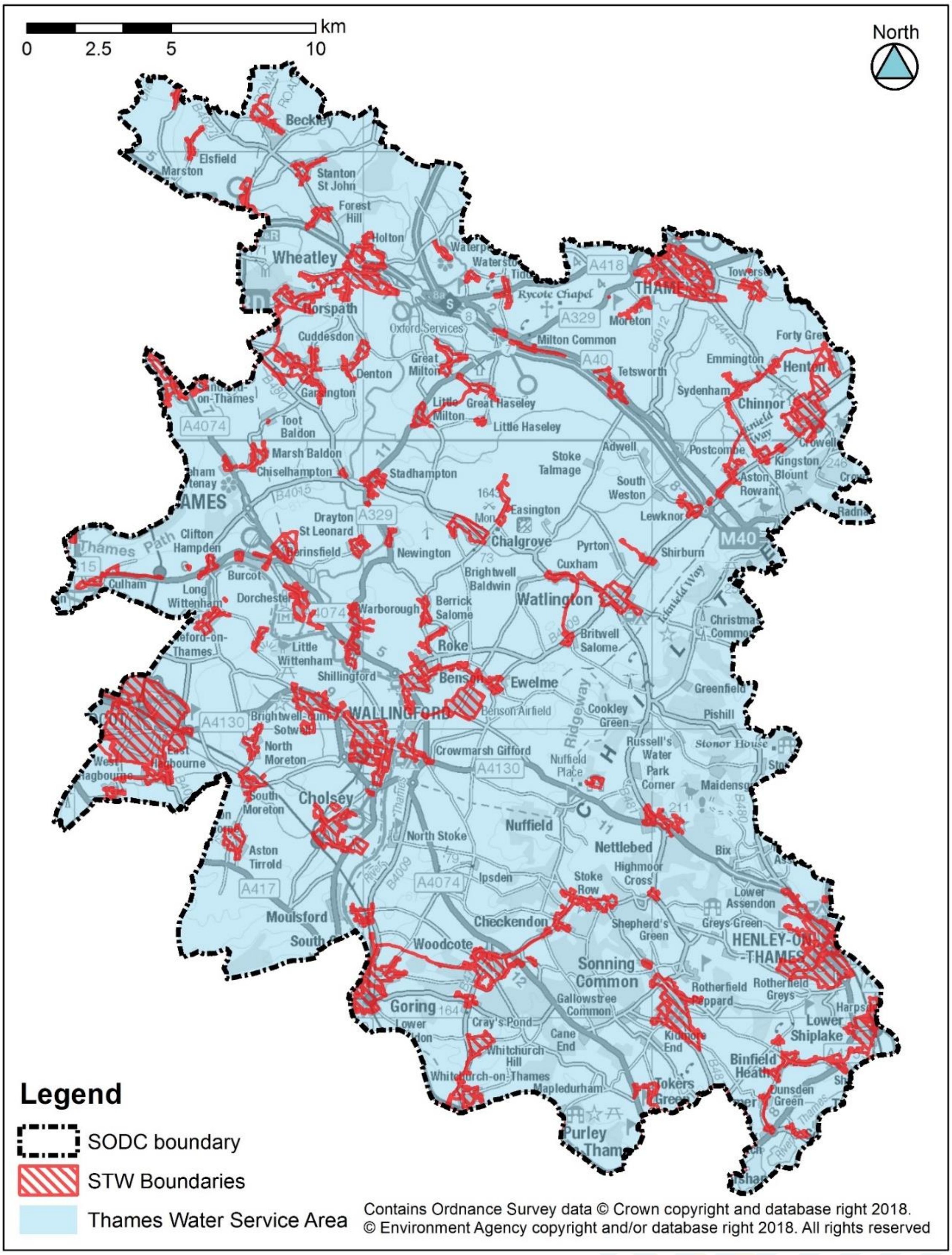


Figure 5-1: Existing Thames Water wastewater network catchments within South Oxfordshire

5.1 Foul sewerage network capacity assessment

New houses add pressure to the existing sewerage system. An assessment is required to identify the available capacity within the existing systems and the potential to upgrade overloaded systems to accommodate growth. The scale and cost of upgrading works may vary very significantly depending upon the location of development in relation to the network and the receiving WwTW.

It may be possible that an existing sewerage system is already working at its full capacity and further investigations have to be carried out to define which solution is necessary to implement to increase its capacity. New infrastructure may be required if for example a site is not served by an existing system.

Sewerage undertakers must consider growth in demand for wastewater services when preparing their five-yearly Strategic Business Plans (SBPs) which set out investment for the next Asset Management Plan (AMP) period. Typically, investment is committed to provide new or upgraded sewerage capacity to support allocated growth with a high certainty of being delivered. Additional sewerage capacity to serve windfall sites, smaller infill development or to connect a site to the sewerage network across third party land is normally funded via developer contributions.

5.1.1 Method for the Thames Water assessment of foul sewerage network capacity

Thames Water was provided with the list of potential site allocations and the potential / equivalent housing numbers for each and were invited to comment upon the impact of development on sewerage infrastructure within South Oxfordshire.

The results were assessed against the following three positions:

Capacity available to serve the proposed growth	Infrastructure and/or treatment work upgrades are required to serve proposed growth, but no significant constraints to the provision of this infrastructure have been identified	Infrastructure and/or treatment upgrades will be required to serve proposed growth. Major constraints have been identified.

5.1.2 Results for the Thames Water assessment of foul sewerage network capacity

Thames Water's assessment of the sewerage system capacity is summarised in Table 5-1.

Table 5-1: Sewerage System Capacity Assessments

Proposed strategic allocations	Wastewater Treatment Works	Sewerage Infrastructure Assessment	Sewerage Infrastructure Assessment Comments
Berinsfield	Culham	Infrastructure and/or treatment work upgrades are required to serve proposed growth, but no significant constraints to the provision of this infrastructure have been identified.	No specific comments
Chalgrove	Chalgrove	Infrastructure and/or treatment upgrades will be required to serve proposed growth. Major constraints have been identified.	No specific comments
Culham	Culham	Infrastructure and/or treatment upgrades will be required to serve proposed growth. Major constraints have been identified.	No specific comments
Grenoble Road	Oxford	Capacity available to serve the proposed growth	On the information, available to date we do not envisage infrastructure concerns

Proposed strategic allocations	Wastewater Treatment Works	Sewerage Infrastructure Assessment	Sewerage Infrastructure Assessment Comments
			regarding wastewater infrastructure capability in relation to this site.
Northfield	Oxford	Infrastructure and/or treatment work upgrades are required to serve proposed growth, but no significant constraints to the provision of this infrastructure have been identified.	The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development.
North of Bayswater Brook	Oxford	Infrastructure and/or treatment work upgrades are required to serve proposed growth, but no significant constraints to the provision of this infrastructure have been identified.	The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development.
Wheatley	Wheatley	Infrastructure and/or treatment upgrades will be required to serve proposed growth. Major constraints have been identified.	No specific comments

5.2 Wastewater treatment works flow

Two assessments of wastewater capacity have been made. This first was completed by Thames Water. The second was an independent assessment by JBA Consulting.

5.2.1 Method for the Thames Water assessment of WwTW flow capacity

Thames Water was provided with the list of potential site allocations including the and the potential / equivalent housing numbers for each and were invited to comment upon the impact of development on sewerage infrastructure within South Oxfordshire.

The results were assessed against the following three positions:

Capacity available to serve the proposed growth	Treatment work upgrades are required to serve proposed growth, but no significant constraints to the provision of this infrastructure have been identified	Treatment upgrades will be required to serve proposed growth. Major constraints have been identified.

5.2.2 Results for the Thames Water assessment of WwTW flow capacity

Thames Water's assessment of the WwTW capacity is summarised in Table 5-2.

Table 5-2: WwTW Flow Capacity Assessments

Proposed strategic allocations	Wastewater Treatment Works	Sewerage Infrastructure Assessment	Sewerage Infrastructure Assessment Comments
Berinsfield, Culham	Culham	Treatment work upgrades are required to serve proposed growth, but no significant constraints to the provision of this infrastructure have been identified.	No specific comments
Chalgrove	Chalgrove	Infrastructure and/or treatment upgrades will be required to serve proposed growth. Major constraints have been identified.	No specific comments
Grenoble Road, Northfield, North of Bayswater Brook	Oxford	Infrastructure and/or treatment upgrades will be required to serve proposed growth. Major constraints have been identified.	Infrastructure at the wastewater treatment works in this area is unlikely to be able to support the demand anticipated from all this development. Significant infrastructure upgrades are likely to be required to ensure sufficient treatment capacity is available to serve this development.
Wheatley	Wheatley	Infrastructure and/or treatment upgrades will be required to serve proposed growth. Major constraints have been identified.	No specific comments

5.2.3 Method for the JBA assessment of WwTW flow capacity

The Environment Agency is responsible for regulating sewage discharge releases via a system of Environmental Permits (EPs). Monitoring for compliance with these permits is the responsibility of both the EA and the plant operators. Increased domestic population and/or employment activity can lead to increased wastewater flows arriving at a WwTW. Where there is insufficient headroom at the works to treat these flows, this could lead to failures to meet flow consents. JBA have used the consented discharge data and the flow monitoring data to complete an independent assessment of capacity available at the WwTWs likely to receive flows from new development in South Oxfordshire.

The process was as follows:

- Calculate the current measured Dry Weather Flow (DWF). This was calculated as the 80-percentile exceedance flow for the period January 2013 to December 2017.
- The flow data was cleaned to remove zero values and low outlier values which would bring the measured DWF down.
- Potential development sites and existing commitments were assigned to a WwTW using the sewerage drainage area boundaries.

For each site, the future DWF was calculated using the occupancy rates and per-capita consumption values obtained from the Water Resource Management Plans and the assumption that 95% of water used is returned to sewer. Permitted headroom was used as a substitute for actual designed hydraulic capacity for each WwTW being assessed.

5.2.4 Results for the JBA assessment of WwTW flow capacity

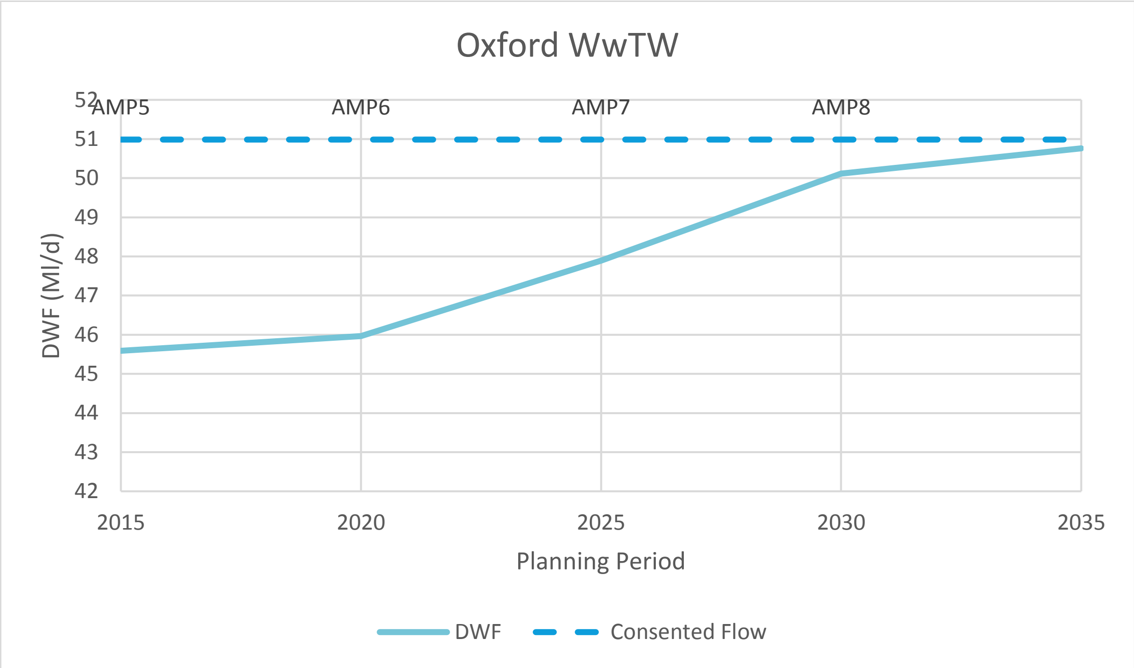
Oxford WwTW

Oxford WwTW is located to the south of Oxford City, within the SODC authority area. The effluent is discharged to the Northfield Brook.

In the first phase of the SODC WCS there were no potential site allocations around Oxford and therefore the headroom at Oxford WwTW was not considered. However, there are now four proposed strategic allocation in SODC which could drain to Oxford WwTW. These have been considered with the development allocated (or proposed for allocation) for Oxford and Kidlington, which would also drain to Oxford WwTW.

Flow data was provided from Thames Water covering the period from January 2016 to November 2018. This showed that the treatment works is currently well within its consented discharge. However, as there is significant proposed growth planned for the fringes of Oxford over the plan period we estimate that the permit would be reached AMP 9 if no improvements were made to capacity, as illustrated by Figure 5-2.

Figure 5-2: Flow permit assessment for Oxford WwTW



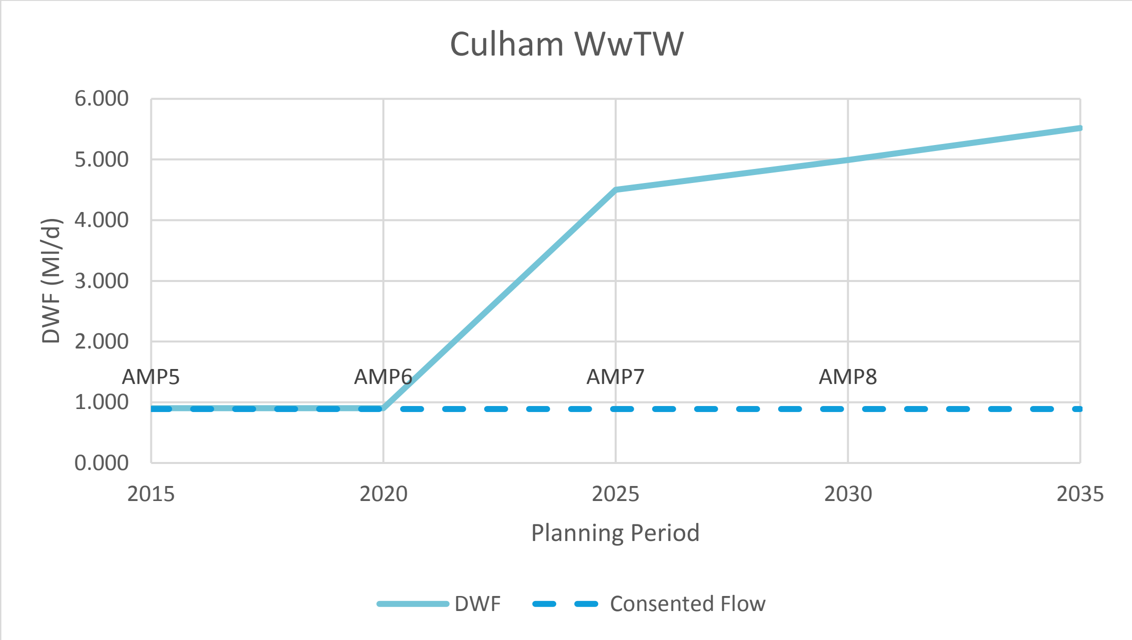
Culham WwTW

Culham WWTW is located east of the science park, near the village of Clifton Hampden. It receives flow from the Culham, Clifton Hampden, Burcot and Berinsfield.

It is likely that the strategic housing allocations at Berinsfield and Culham and the strategic employment allocation at Culham would all drain to Culham WwTW.

The DWF is currently operating at the limit of the consented flow. The planned growth for the drainage area would increase the DWF and therefore push the discharged flows above the permitted value as illustrated by Figure 5-3.

Figure 5-3: Flow permit assessment for Culham WwTW



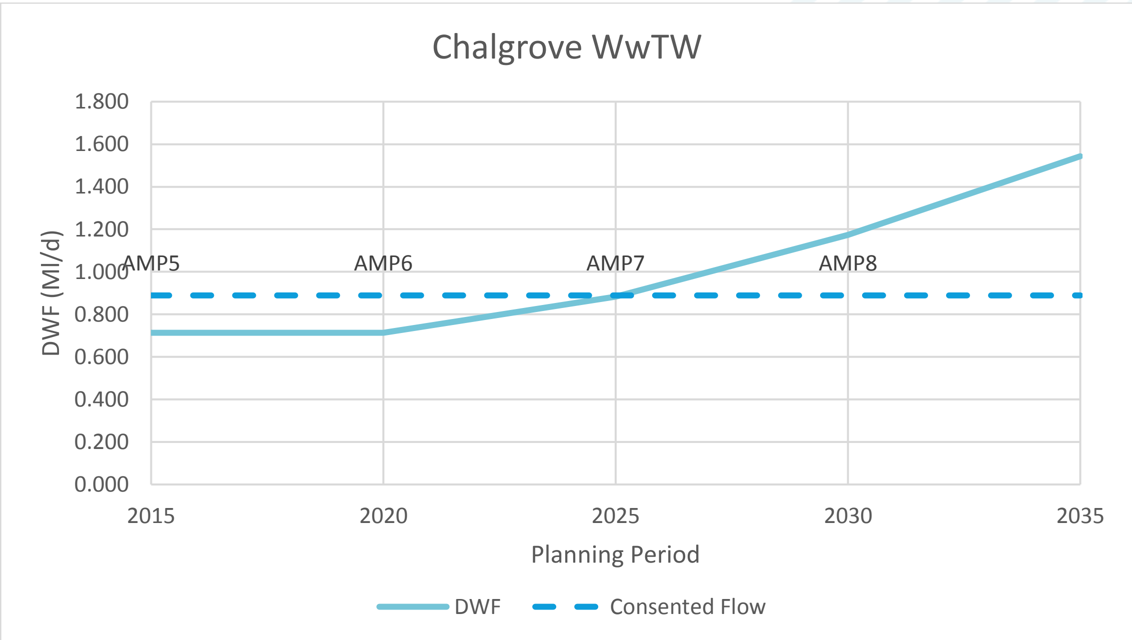
Chalgrove WwTW

Chalgrove WwTW is locates near the village of Warpsgrove, north of Chalgrove. The effluent discharges to a tributary of the Haseley Brook. It receives flow from Chalgrove and Warpsgrove.

It is likely that the strategic housing allocation at Chalgrove Airfield would all drain to Chalgrove WwTW.

The treatment works is currently within its consented discharge. However, due to the planned growth in the drainage area, it is predicted that this consent will be reached by the end of AMP6 and exceeded during AMP7 and AMP 8, as illustrated by Figure 5-4.

Figure 5-4: Flow permit assessment for Chalgrove WwTW



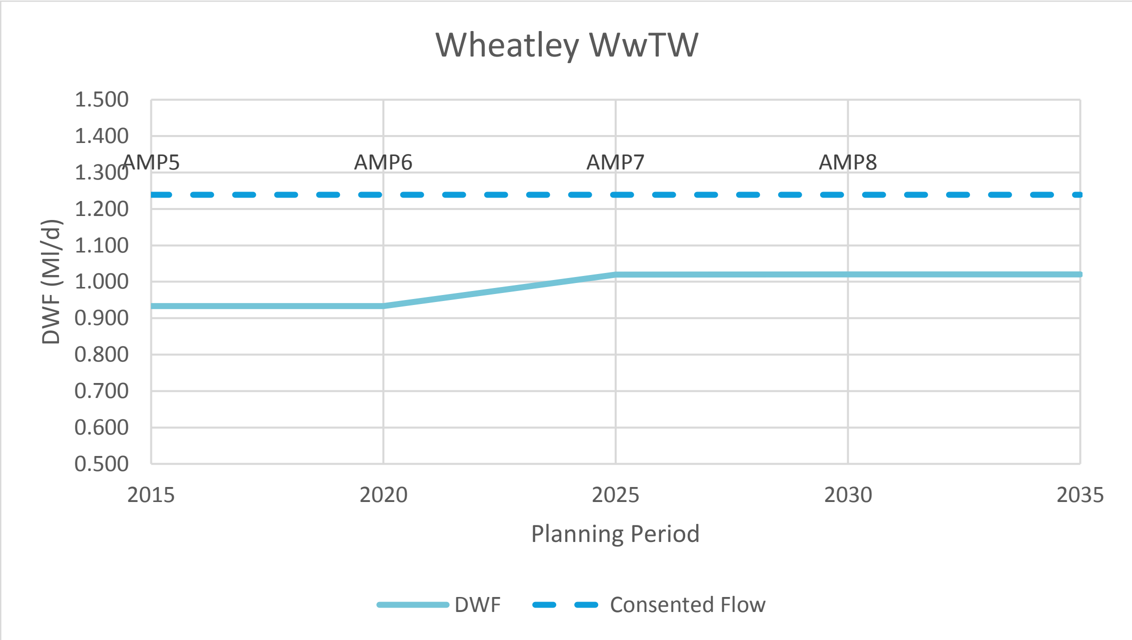
Wheatley WwTW

Wheatley WwTW is located to the south-east of Wheatley. The effluent is discharged to a tributary of the Cuddesdon Brook.

It is likely that the strategic housing allocation at Wheatley would all drain to Wheatley WwTW.

The treatment works is currently well within its consented discharge. The considered future growth which would drain to Wheatley is relatively small (totalling 409 dwellings). As a result, the increased discharge is not predicted to cause the discharged from WwTW to exceed its consent, as illustrated by Figure 5-5

Figure 5-5: Flow permit assessment for Wheatley WwTW



5.2.5 Conclusions

Flow permit assessments were carried out at all of the WwTWs that are expected to serve the strategic allocations made by the Local Plan. This assessment has considered the cumulative impact of forecasted residential and employment sites and existing commitments. Wheatley WwTW has sufficient cumulative capacity to serve the site allocations identified. The analysis suggests that consents at Oxford, Chalgrove and Culham can be expected to be exceeded in the future. The phased trajectory of growth means that these consents are predicted to exceed in varying timescales. The consent at Culham WwTW is likely to be the first to be exceeded (from 2022) as it is already operating at the limit. Thames Water comments have not indicated any barriers against providing the necessary upgrades. The consents at Chalgrove and Oxford WwTW are not predicted to be exceeded until later, 2025 and 2035 respectively. Therefore, there is more time available to make the strategic upgrades required to service the new development.

5.2.6 Recommendations

Thames Water have stated that they would welcome the opportunity to work closely with the Local Planning Authority and the developer to better understand and effectively plan for the sewage treatment infrastructure needs required to serve a specific development. They have highlighted that it is important not to under estimate the time required to deliver necessary infrastructure. For example: Wastewater Treatment Works upgrades can take 18 months to 3 years to design and build.

5.3 Water quality impact assessment

An increase in the discharge of effluent from Wastewater Treatment Works (WwTW) as a result of development and growth in the area in which they serve can lead to a negative impact on the quality of the receiving watercourse. Under the Water Framework Directive (WFD), a watercourse is not allowed to deteriorate from its current WFD classification (either as an overall watercourse or for individual elements assessed).

It is Environment Agency (EA) policy to model the impact of increasing effluent volumes on the receiving watercourses. Where the scale of development is such that a deterioration is predicted, a variation to the Environmental Permit (EP) may be required for the WwTW to improve the quality of the final effluent, so that the increased pollution load will not result in a deterioration in the water quality of the watercourse. This is known as "no deterioration" or "load standstill". The need to meet river quality targets is also taken into consideration when setting or varying a permit.

5.3.1 Objectives

The Environment Agency operational instructions on water quality planning and no-deterioration are currently being reviewed. Previous operational instructions[4] (now withdrawn) set out a hierarchy for how the no-deterioration requirements of the WFD should be implemented on inland waters. The potential impact of development should be assessed in relation to the following objectives:

- Could the development cause a greater than 10% deterioration in water quality?
  This objective is to ensure that all the environmental capacity is not taken up by one stage of development and there is sufficient capacity for future growth.
- Could the development cause a deterioration in WFD class of any element assessed?
  This is a requirement of the Water Framework Directive to prevent a deterioration in class of individual contaminants. The "Weser Ruling"[5] by the European Court of Justice in 2015 specified that individual projects should not be permitted where they may cause a deterioration of the status of a water body. If a water body is already at the lowest status ("bad"), any impairment of a quality element was considered to be a deterioration. Emerging practice is that a 3% limit of deterioration is applied in such cases.
- Could the development alone prevent the receiving watercourse from reaching Good Ecological Status or Potential?

Is GES possible with current technology or is GES technically possible after development with any potential WwTW upgrades. Here, it is standard practice to assume that the upstream water quality is reaching good class, i.e. that point and diffuse sources of pollutants have been reduced upstream.

4 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 on 08/08/2017

5 European Court of Justice (2015) PRESS RELEASE No 74/15 Accessed online at https://curia.europa.eu/jcms/upload/docs/application/pdf/2015-07/cp150074en.pdf on 08/08/2017

Many of the WwTWs in the district outfall to headwaters, in other words they discharge to relatively short rivers with small upstream catchments and relatively low flows. This means that the potential dilution of pollutant loads from wastewater effluents may be limited, particularly during periods of low river flows.

The full water quality assessment is included in Appendix B. This section provides a summary of the methodology, results and conclusions.

5.3.2 Methodology

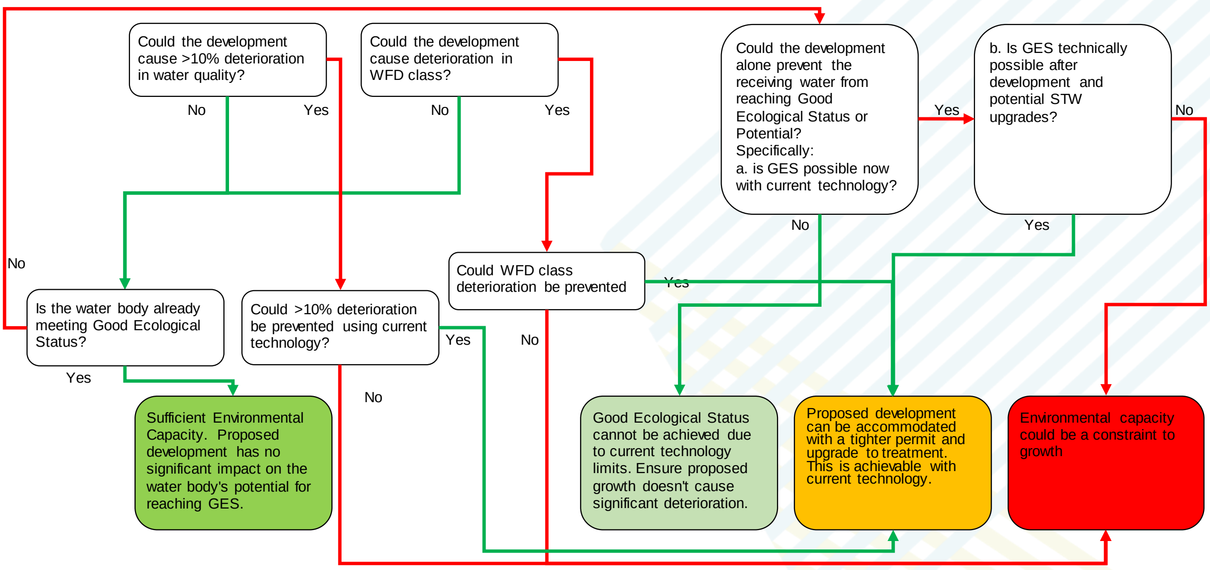
Early iterations of this Water Cycle Study modelled the impact of increased discharges of effluent on a single reach basis, using the Environment Agency's River Quality Planning (RQP) toolkit. Following latest guidance from the EA's Thames area office, this assessment has been revised to use a catchment modelling approach, using the EA's SIMCAT software. This approach has the advantage of assessing the cumulative impacts of increased effluent from all WwTWs discharging to a river or its tributaries.

The approach was applied in the 2017 WCS to the following WwTW in the South Oxfordshire District; Benson, Chalgrove, Chinnor, Cholsey, Culham, Didcot, Henley, Lewknor, Stadhampton, Tetsworth, Thame, Tiddington, Watlington and Wheatley, as well as six WwTWs within the Aylesbury Vale; Aylesbury, Haddenham, Long Crendon, Stone, Waddesdon and Worminghall.

During this 2018 WCS update, further water quality modelling was completed for Oxford WwTW. The assessment considered the following contaminates: Biochemical Oxygen Demand (BOD), Ammonia (NH4) and Phosphorus (P). The model was updated to a baseline using observed river flow, river quality, effluent flow and effluent quality statistics for the period 2015-2018. Therefore, any recent growth was captured in the baseline models.

The methodology followed is summarised in Figure 5-6.

Figure 5-6: Water quality impact assessment following EA Thames West guidance



5.3.3 Results

Table 5-3 summarises the modelling results for the following tests:

- percentage deterioration;
- class deterioration.
- could the water body be prevented from meeting Good status.

The following risk-based screening assessment was applied:

No infrastructure upgrade required to achieve	Infrastructure upgrade likely to be required, but achievable using BAT	Cannot be achieved using BAT. Environmental capacity could be a constraint on growth.

Table 5-3: Summary of water quality assessment results

Watercourse (WwTW)	Could the development cause a greater than 10% deterioration in WQ?	Could the development cause a deterioration in WFD class of any element?	Could the development prevent the water body from reaching GES?
Northfield Brook (Oxford)	Predicted deterioration is <10%.	No class deterioration is predicted.	Good Ecological Status can be achieved for BOD and is probably achievable for NH_4. GES cannot be achieved for P due to current technology limits. Planned growth would not compromise the ability to meet Good in the future.

- The impacts of increased effluent discharges from Oxford WwTW as a result of growth within South Oxfordshire, Oxford City (higher growth scenario) and Cherwell were assessed using the Environment Agency's SIMCAT model for the Thames river basin.
- There is no predicted deterioration of class for any of the modelled determinands, ammonia, BOD and phosphate.
- The percentage deterioration as a result of growth is predicted to be between 1% and 2% for all determinands at points downstream of the WwTW. Consequently, no deterioration is predicted as a result of the proposed growth within the Oxford catchment.
- The models were used to test whether WFD "Good" class could be achieved with the application of treatment to technically achievable limits (TAL). Results indicate that it would be possible to achieve "Good" class downstream of Oxford STW for BOD. For ammonia, the required discharge quality, 0.95mg/l, is slightly below TAL (1mg/l), but within a range that is probably still achievable. Good is not achievable for phosphate, as this would require treatment significantly beyond the limits of current treatment technology.
- Finally, the model was used to test, for BOD and Ammonia, whether the planned growth could compromise the ability to achieve Good class in the Northfield Brook. Results indicate that the ability to meet Good would not be compromised.

6 Odour assessment

Where new developments encroach upon an existing Wastewater Treatment Works (WwTW), odour from that site may become a cause for nuisance and complaints from residents. Managing odour at WwTWs can add considerable capital and operational costs, particularly when retro-fit to existing WwTWs. National Planning Policy Guidance recommends that plan-makers consider whether new development is appropriate near to sites used (or proposed) for water and wastewater infrastructure, due to the risk of odour impacting on residents and requiring additional investment to address.

6.1 Method

Sewerage undertakers recommend that an odour assessment may be required if the site of a proposed development is close to a WwTW and is encroaching closer to the WwTW than existing urban areas.

A GIS assessment was carried out to identify sites that are the sewerage undertaker considers may be at risk from odour nuisance due to encroachment on an existing WwTW. For Thames Water, this is development sites less than 800m from the WwTW and encroaching closer to the WwTW than existing urbanised areas.

If there are no existing houses close to a WwTW it is more likely that an odour assessment is needed. Another important aspect is the location of the site in respect to the WwTW. Historic wind direction records for sites in SODC indicate that the prevailing winds is from a west-south-west direction (Brize Norton) to a Southerly direction (Benson)[6].

The following risk-based screening assessment was applied:

Site is unlikely to be impacted by odour from WwTW	Site location is such that an odour impact assessment is recommended	Site is in an area with confirmed WwTW odour issues

6.2 Data Collection

The datasets used to assess the impact of odour from a WwTW were:

- Site location in GIS format (provided by SODC)
- WwTW locations (provided by TW)
- Site tracker spreadsheet

6.3 Results

Four of the seven proposed strategic allocations are within 800m of a WwTW, however this does not take into account the size of the WwTW. The sites at risk are shown in Table 6-1. At these sites, it is recommended that an odour assessment is undertaken by the site developer.

6 RenSMART website http://www.rensmart.com/Weather/WindArchive#monthlyLayer accessed on 11/04/2017

Table 6-1: List of potential sites at risk of nuisance odour from WwTWs

Proposed strategic allocations	Distance to WwTW (m)	Cardinal Direction to WwTW
Grenoble Road	176	South east
Chalgrove	648	South west
Wheatley	732	North-north west
Culham	747	West

Due to its proximity to Oxford WwTW, Grenoble Road is highest risk site. It is understood that there is an ongoing site-specific odour assessment for this site. However, these have not been provided for review in this study.

Most of the sites within the 800m are located south of the WwTW. As the prevailing wind is likely to be from a west-south-west direction or southerly direction, it is unlikely that these sites would be subject to nuisance odours. However, the Wheatley site is north-north west of the Wheatley WwTW and therefore is the second highest risk site.

As this is only a high-level assessment, it is recommended that all the sites highlighted in Table 6-1 are subject to further nuisance odour screening during the planning process.

7 Flood risk impact

In catchments with a large planned growth in population and which discharge effluent to a small watercourse, the increase in the discharged effluent might have a negative effect on the risk of flooding. An assessment has been carried out to quantify such an effect.

7.1 Methodology

The following process has been used to assess the potential increased risk of flooding due to extra flow reaching a specific WwTW:

- Calculate the increase in DWF attributable to planned growth;
- Identify the point of discharge of these WwTWs;
- At each outfall point, use the FEH CD-ROM v3.0 to extract the catchment descriptors;
- Use FEH Statistical method to calculate peak 1 in 30 and 1 in 100-year fluvial flows;
- Calculate the additional foul flow as a percentage of the 1 in 30 and 1 in 100-year flow

A risk score was applied to score the associated risk as follows:

Additional flow ≤5% of Q30. Low risk that increased discharges will increase fluvial flood risk	Additional flow ≥5% of Q30. Moderate risk that increased discharges will increase fluvial flood risk	Additional flow ≥5% of Q100. High risk that increased discharges will increase fluvial flood risk

The following datasets were used to assess the risk of flooding:

- Current and predicted future DWF for each WwTW
- Location of WwTW outfalls
- Catchment descriptors from FEH CD-ROM v3.0[7]

The hydrological assessment of river flows was applied using a simplified approach, appropriate to this type of screening assessment. The Q30 and Q100 flows quoted should not be used for other purposes, e.g. flood modelling or flood risk assessments.

7.2 Results

Table 7-1 reports the additional flow from each WwTW as a percentage of the Q30 and Q100 peak flow. This shows that additional flows from the WwTW post potential development would have a negligible effect on the predicted peak flow events at Oxford, Chalgrove and Wheatley. However, the increased effluent from the Culham treatment works which could service the proposed strategic allocations at Culham and Berinsfield would impact flood risk. The increase in flows predicted is likely to have a high impact on flood flows on the receiving watercourse.

7 FEH CD-ROM v3.0 © NERC (CEH). © Crown copyright. © AA. 2009. All rights reserved.

Table 7-1: Summary of DWF increase as a percentage of 1 in 30 and 1 in 100-year peak flow

WwTW	FEH Stat Q30 (m^3/s)	FEH Stat Q100 (m^3/s)	Additional Average DWF (Ml/d)	Additional Flow (m^3/s)	Flow increase % Q30	Flow increase % Q100
Culham	0.2	0.3	4.2	0.048	23.1 %	17.9 %
Chalgrove	2.1	2.7	0.6	0.007	0.3 %	0.3 %
Oxford	4.8	6.3	5.1	0.059	1.2 %	0.9 %
Wheatley	1.1	1.4	0.1	0.001	0.1 %	0.1 %

7.3 Conclusions

A detailed assessment of flood risk can be found within the SODC Strategic Flood Risk Assessment. The impact of increased effluent flood is predicted to have a significant impact upon flood risk at Culham, which is likely to be the treatment options of flow from the proposed strategic allocations at Culham and Berinsfield.

7.4 Recommendations

Proposals to increase discharges to a watercourse may also require a flood risk activities environmental permit from the Environment Agency (in the case of discharges to Main River), or a land drainage consent from the Lead Local Flood Authority (in the case of discharges to an Ordinary Watercourse).

During the planning process, decisions regarding treatment of wastewater flows from Culham WwTW should consider how the increased effluent will impact flood risk.

8 Summary and overall conclusion

The WCS addendum was carried out with cooperation from Thames Water. This section summarises the conclusions of the individual assessments.

Water resources

- All SODC is served by Thames Water. The authority is largely covered by the SWOX resource zone, with a small area covered by the Henley resource zone.
- SWOX has a supply/demand deficit from 2022/23. Thames Water have developed a strategy to balance the water demand with available resources. This focuses on reducing per customer demand and planning for construction of a large-scale reservoir in the longer-term.
- The Henley resource zone has no forecast supply-demand deficit. Thames Water plan to reduce leakage and reduce per customer demand.
- Thames Water have commented that their WRMP has planned for the increase in demand, or there is sufficient time to address supply demand issues for all the proposed strategic allocations.

Water supply

- Thames Water have commented on the capacity of the existing water supply network to serve the potential development allocations. This concluded that although infrastructure upgrades would be required to serve this scale of development, no significant constraints to the provision of this infrastructure have been identified.

Wastewater collection

- All SODC is served by Thames Water. Thames Water have commented on the capacity of the existing sewerage network to serve the proposed strategic allocations.
- Major constraints have been identified to provide the infrastructure upgrades required to serve the proposed strategic allocations at Chalgrove, Culham and Wheatley.
- No significant constraints have been identified to provide the infrastructure upgrades required to serve the proposed strategic allocations at Berinsfield, Northfield and North of Bayswater Brook.
- Capacity is available to serve the proposed strategic allocations at Grenoble Road.

Wastewater treatment

- All SODC is served by Thames Water. Thames Water have commented on the capacity of the existing WwTW to serve the proposed strategic allocations.
- Major constraints have been identified to provide the infrastructure upgrades required to serve the proposed strategic allocations at Chalgrove, Oxford and Wheatley.
- No significant constraints have been identified to provide the infrastructure upgrades required to serve the proposed strategic allocations at Berinsfield and Culham.
- JBA have completed a high-level assessment of headroom, which accounts for the cumulative impact of the proposed strategic allocations and committed development.

- The assessment found that the consented discharge from Wheatley would not be exceeded due to the potential development. However, permits at Culham, Chalgrove and Oxford WwTW were all expected to be exceeded by 2035 due to the new development.
- The JBA capacity assessment of the wastewater infrastructure has raised potential issues at Culham, Chalgrove and Oxford. Thames Water have concluded that this can be addressed by adopting best available technology at Culham. However, major constraints have been indicated to providing additional capacity at Chalgrove and Oxford, and therefore upgrades will need to be planned associated with proposed growth.
- The Thames Water capacity assessment of the wastewater infrastructure has raised an additional potential issue at Wheatley and they concluded that major constraints have been identified to deliver the upgrades required. However, the JBA assessment concluded that the proposed growth should not cause the Wheatley WwTW to exceed its permit. Therefore, it is proposed that further discussion is held with Thames Water regarding the Wheatley treatment works, including review of the latest evidence work undertaken.

Odour assessment

- JBA have completed a high-level assessment of potential nuisance odour at the potential site allocations.
- Four of the proposed strategic allocations are within 800m of a WwTW and therefore could be at risk. Grenoble Road is at highest risk and it is understood that a detailed assessment is ongoing. Wheatley is the second highest risk.

Flood Risk Impact

- JBA have completed a high-level assessment of the impact of increased effluent discharge on flood risk to the receiving watercourses.
- The assessment found that the increased discharge to minor watercourses from the proposed strategic allocation at Culham could impact flood risk. The flood risk impact is expected to be negligible at all other receiving watercourses.

Statement of Common Ground

It is recommended that SODC, Thames Water and the Environment Agency consider the full outcomes of the Water Cycle Study work in any Statement of Common Ground on water matters between these parties.

Appendices

A Thames Water comments

Water Resources RAG descriptions
Adopted WRMP has planned for the increase in demand, or sufficient
Insufficient evidence in adopted WRMP to confirm that the planned
Adopted WRMP does not take into consideration the planned increase in

Water Supply RAG descriptions
Capacity available to serve the proposed growth
Infrastructure and/or treatment work upgrades are required to serve proposed
Infrastructure and/or treatment upgrades will be required to serve proposed

WwTW Flow Capacity RAG descriptions
Capacity available to serve the proposed growth
Infrastructure and/or treatment work upgrades are required to serve proposed
Infrastructure and/or treatment upgrades will be required to serve proposed

Foul Sewerage RAG descriptions
Capacity available to serve the proposed growth
Infrastructure and/or treatment work upgrades are required to serve
Infrastructure and/or treatment upgrades will be required to serve

Surface Water Network RAG descriptions
Capacity available to serve the proposed growth
Infrastructure and/or treatment work upgrades are required to
Infrastructure and/or treatment upgrades will be required to serve

Odour Screening RAG descriptions
Site is unlikely to be impacted by odour from WwTW
Site location is such that an odour impact assessment is
Site is in an area with confirmed WwTW odour issues.

Effluent flood risk RAG descriptions
Additional flow ≤5% of Q30. Low risk that increased
Additional flow ≥5% of Q30. Moderate risk that
Additional flow ≥5% of Q100. High risk that increased

Water Quality RAG descriptions
Sufficient Environmental Capacity. Proposed development has
Proposed development can be accommodated with a tighter
Good Ecological Status cannot be achieved due to current
environmental capacity could be a constraint to growth.

								Water Supply						Wastewater															Flood risk		Water Quality	
Local Planning Authority	In study area?	Parish / Settlement	Location	Type	Size	Proposed Use	Potential housing number (2011-31)	Water Company	Water Resource Zone	Water Resources RAG	Water Resources Comments	Water Supply Networks RAG	Water Supply Networks Comments	Company Treating Wastewater	WwTW	WwTW Flow Capacity RAG	WwTW Flow Capacity Comments	Sewerage Undertaker	Sewerage catchment	Foul Sewerage Network Capacity RAG	Foul Sewerage Network Capacity Comments	Surface Water Network capacity	Surface Water Network Capacity Comments	Site boundary distance from WwTW (m)	Site encroaches closer than existing urban area?	Location of site relative to WwTW	Odour Screening RAG	Odour screening comments	Effluent discharge flood risk RAG	Effluent discharge flood risk Comments	Water Quality RAG	Water Quality Comments
SODC	Yes	New settlement	Harrington	Residential	6500	Housing	6500	TWUL	SWOX	Green	No comment provided	Amber	The water network capacity in this area is unlikely to be able to support the demand anticipated from this development. Strategic water supply infrastructure upgrades are likely to be required to ensure sufficient capacity is brought forward ahead of the development. The developer is encouraged to work Thames Water early on in the planning process to understand what water infrastructure is required, where, when and how it will be delivered.	TWUL	No existing public sewerage	Red	Infrastructure at the wastewater treatment works in this area is unlikely to be able to support the demand anticipated from this development. Significant infrastructure upgrades are likely to be required to ensure sufficient treatment capacity is available to serve this development. Thames Water would welcome the opportunity to work closely with the Local Planning Authority and the developer to better understand and effectively plan for the sewage treatment infrastructure needs required to serve this development. It is important not to under estimate the time required to deliver necessary infrastructure. For example: Sewage Treatment Works upgrades can take 18 months to 3 years to design and build. Implementing new technologies and the construction of a major treatment works extension or new treatment works could take up to ten years	TWUL	No existing public sewerage	red	The wastewater network capacity in this area is unlikely to be able to support the demand anticipated from this development. Strategic drainage infrastructure is likely to be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a wastewater network capacity constraint the developer should liaise with Thames Water and provide a detailed drainage strategy with the planning application, informing what infrastructure is required, where, when and how it will be delivered		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete
SODC	Yes	Oxford	Lower Elsfield / Land at Bayswater	Residential	1500	Housing	1500	TWUL	SWOX	Green	No comment provided	Amber	The water network capacity in this area is unlikely to be able to support the demand anticipated from this development. Strategic water supply infrastructure upgrades are likely to be required to ensure sufficient capacity is brought forward ahead of the development. The developer is encouraged to work Thames Water early on in the planning process to understand what water infrastructure is required, where, when and how it will be delivered.	TWUL	Oxford	Amber	Infrastructure at the wastewater treatment works in this area may be unable to support the demand anticipated from this development. Minor infrastructure upgrades maybe required to ensure sufficient treatment capacity is available to serve this development. Thames Water would welcome the opportunity to work closely with the Local Planning Authority and the developer to better understand and effectively plan for the sewage treatment infrastructure needs required to serve this development. It is important not to under estimate the time required to deliver necessary infrastructure. For example: Sewage Treatment Works upgrades can take 18 months to 3 years to design and build	TWUL	Oxford	Amber	The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with Thames Water to determine whether a detailed drainage strategy informing what infrastructure is required, where, when and how it will be delivered is required. The detailed drainage strategy should be submitted with the planning application		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete
SODC	Yes	Oxford	Land at Wick Farm	Residential	1750	Housing	1750	TWUL	SWOX	Green	No comment provided	Amber	The water network capacity in this area is unlikely to be able to support the demand anticipated from this development. Strategic water supply infrastructure upgrades are likely to be required to ensure sufficient capacity is brought forward ahead of the development. The developer is encouraged to work Thames Water early on in the planning process to understand what water infrastructure is required, where, when and how it will be delivered	TWUL	Oxford	Amber	Infrastructure at the wastewater treatment works in this area may be unable to support the demand anticipated from this development. Minor infrastructure upgrades maybe required to ensure sufficient treatment capacity is available to serve this development. Thames Water would welcome the opportunity to work closely with the Local Planning Authority and the developer to better understand and effectively plan for the sewage treatment infrastructure needs required to serve this development. It is important not to under estimate the time required to deliver necessary infrastructure. For example: Sewage Treatment Works upgrades can take 18 months to 3 years to design and build	TWUL	Oxford	Amber	The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with Thames Water to determine whether a detailed drainage strategy informing what infrastructure is required, where, when and how it will be delivered is required. The detailed drainage strategy should be submitted with the planning application		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete
SODC	Yes	Oxford	Land adjacent to Thornhill Park and Ride	Residential	650	Housing	650	TWUL	SWOX	Green	No comment provided	Amber	The water network capacity in this area is unlikely to be able to support the demand anticipated from this development. Strategic water supply infrastructure upgrades are likely to be required to ensure sufficient capacity is brought forward ahead of the development. The developer is encouraged to work Thames Water early on in the planning process to understand what water infrastructure is required, where, when and how it will be delivered.	TWUL	Oxford	Green		TWUL	Oxford	Amber	The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with Thames Water to determine whether a detailed drainage strategy informing what infrastructure is required, where, when and how it will be delivered is required. The detailed drainage strategy should be submitted with the planning application		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete
SODC	Yes	Oxford	Grenoble Road	Residential	3000	Housing	3000	TWUL	SWOX	Green	No comment provided	Amber	The water network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing water network infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. The developer is encouraged to work Thames Water early on in the planning process to understand what infrastructure is required, where, when and how it will be delivered	TWUL	Oxford	Red	Infrastructure at the wastewater treatment works in this area is unlikely to be able to support the demand anticipated from this development. Significant infrastructure upgrades are likely to be required to ensure sufficient treatment capacity is available to serve this development. Thames Water would welcome the opportunity to work closely with the Local Planning Authority and the developer to better understand and effectively plan for the sewage treatment infrastructure needs required to serve this development. It is important not to under estimate the time required to deliver necessary infrastructure. For example: Sewage Treatment Works upgrades can take 18 months to 3 years to design and build. Implementing new technologies and the construction of a major treatment works extension or new treatment works could take up to ten years	TWUL	Oxford	Amber	On the information available to date we do not envisage infrastructure concerns regarding wastewater infrastructure capability in relation to this site.		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete
SODC	Yes	Oxford	Northfield	Residential	2000	Housing	2000	TWUL	SWOX	Green	No comment provided	Amber	The water network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing water network infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. The developer is encouraged to work Thames Water early on in the planning process to understand what infrastructure is required, where, when and how it will be delivered	TWUL	Oxford	Amber	Infrastructure at the wastewater treatment works in this area may be unable to support the demand anticipated from this development. Minor infrastructure upgrades maybe required to ensure sufficient treatment capacity is available to serve this development. Thames Water would welcome the opportunity to work closely with the Local Planning Authority and the developer to better understand and effectively plan for the sewage treatment infrastructure needs required to serve this development. It is important not to under estimate the time required to deliver necessary infrastructure. For example: Sewage Treatment Works upgrades can take 18 months to 3 years to design and build	TWUL	Oxford	Amber	The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with Thames Water to determine whether a detailed drainage strategy informing what infrastructure is required, where, when and how it will be delivered is required. The detailed drainage strategy should be submitted with the planning application		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete
SODC	Yes	Reading	Playhatch	Residential	1000	Housing	1000	TWUL	Kennet Valley	Red	Due to a unprecedented recent increase in demand in this area Playhatch WTW is operating at very close to our licence to abstract water and the 2018 summer supply demand deficit is highlighted as leaving the area at very low headroom. The predicted additional demand of this development of 15.63 l/s/1.35 Mld takes the works over the peak treatment and abstraction license. I have definite concerns that this demand combined with the 'Reading Golf Club (450 net capacity)' and Palmers Riding Stables, Emmer Green, Reading (500 houses) will result in loss of customer supply.	Amber	The water treatment capacity in this area is unlikely to be able to support the demand anticipated from this development. Significant infrastructure upgrades are likely to be required to ensure sufficient treatment capacity is available to serve this development. Thames Water would welcome the opportunity to work closely with the Local Planning Authority and the developer to better understand and effectively plan for the water treatment infrastructure needs required to serve this development. It is important not to under estimate the time required to deliver necessary infrastructure. For example: Water Treatment Works upgrades can take 18 months to 3 years to design and build. Implementing new technologies and the construction of a major treatment works extension or new treatment works could take up to ten years	TWUL	Reading	Amber	It is a significant development which requires careful planning. We would welcome information on phasing of this development. Based on available information, at this time, no major upgrades are required to accommodate this development.	TWUL	Reading	Amber	The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with Thames Water to determine whether a detailed drainage strategy informing what infrastructure is required, where, when and how it will be delivered is required. The detailed drainage strategy should be submitted with the planning application		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete
SODC	Yes	Reading	Reading Golf Club	Residential	450	Housing	450	TWUL	SWOX	Red	Due to a unprecedented recent increase in demand in this area Playhatch WTW is operating at very close to our licence to abstract water and the 2018 summer supply demand deficit is highlighted as leaving the area at very low headroom. The predicted additional demand of this development of 7.03/ 0.61 Mld takes the works to its peak treatment and abstraction license. I have concerns that this demand combined with the 'Playhatch (Land East of Caversham Park Rd, Reading) (1000 net capacity)' will result in loss of customer supply.	Amber	The water treatment capacity in this area is unlikely to be able to support the demand anticipated from this development. Significant infrastructure upgrades are likely to be required to ensure sufficient treatment capacity is available to serve this development. Thames Water would welcome the opportunity to work closely with the Local Planning Authority and the developer to better understand and effectively plan for the water treatment infrastructure needs required to serve this development. It is important not to under estimate the time required to deliver necessary infrastructure. For example: Water Treatment Works upgrades can take 18 months to 3 years to design and build. Implementing new technologies and the construction of a major treatment works extension or new treatment works could take up to ten years	TWUL	Reading	Amber	It is a significant development which requires careful planning. We would welcome information on phasing of this development. Based on available information, at this time, no major upgrades are required to accommodate this development.	TWUL	Reading	Amber	The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with Thames Water to determine whether a detailed drainage strategy informing what infrastructure is required, where, when and how it will be delivered is required. The detailed drainage strategy should be submitted with the planning application		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete
SODC	Yes	Didcot	Land at Great Western Park	Residential	1000	Housing	1000	TWUL	SWOX	Green	No comment provided	Amber	The water network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing water network infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. The developer is encouraged to work Thames Water early on in the planning process to understand what infrastructure is required, where, when and how it will be delivered	TWUL	Didcot	Amber	Infrastructure at the wastewater treatment works in this area may be unable to support the demand anticipated from this development. Minor infrastructure upgrades maybe required to ensure sufficient treatment capacity is available to serve this development. Thames Water would welcome the opportunity to work closely with the Local Planning Authority and the developer to better understand and effectively plan for the sewage treatment infrastructure needs required to serve this development. It is important not to under estimate the time required to deliver necessary infrastructure. For example: Sewage Treatment Works upgrades can take 18 months to 3 years to design and build	TWUL	Didcot	Amber	The wastewater network capacity in this area is unlikely to be able to support the demand anticipated from this development. Strategic drainage infrastructure is likely to be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a wastewater network capacity constraint the developer should liaise with Thames Water and provide a detailed drainage strategy with the planning application, informing what infrastructure is required, where, when and how it will be delivered		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete
SODC	Yes	Reading	Palmers Riding Stables, Emmer Green, Reading	Residential	510	Housing	510	TWUL	SWOX	Red	Due to a unprecedented recent increase in demand in this area Playhatch WTW is operating at very close to our licence to abstract water and the 2018 summer supply demand deficit is highlighted as leaving the area at very low headroom. The predicted additional demand of this development of 7.03/ 0.61 Mld takes the works to its peak treatment and abstraction license. I have concerns that this demand combined with the 'Playhatch (Land East of Caversham Park Rd, Reading) (1000 net capacity)' and Reading Golf Club (450 net capacity) will result in loss of customer supply.	Amber	The water treatment capacity in this area is unlikely to be able to support the demand anticipated from this development. Significant infrastructure upgrades are likely to be required to ensure sufficient treatment capacity is available to serve this development. Thames Water would welcome the opportunity to work closely with the Local Planning Authority and the developer to better understand and effectively plan for the water treatment infrastructure needs required to serve this development. It is important not to under estimate the time required to deliver necessary infrastructure. For example: Water Treatment Works upgrades can take 18 months to 3 years to design and build. Implementing new technologies and the construction of a major treatment works extension or new treatment works could take up to ten years	TWUL	Reading	Amber	It is a significant development which requires careful planning. We would welcome information on phasing of this development. Based on available information, at this time, no major upgrades are required to accommodate this development.	TWUL	Reading	Amber	The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with Thames Water to determine whether a detailed drainage strategy informing what infrastructure is required, where, when and how it will be delivered is required. The detailed drainage strategy should be submitted with the planning application		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete
SODC	Yes	New settlement	Land off Thame Road, North Weston	Residential	1203	Housing	1203	TWUL	SWOX	Green	No comment provided	Amber	The water network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing water network infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. The developer is encouraged to work Thames Water early on in the planning process to understand what infrastructure is required, where, when and how it will be delivered	TWUL	No existing public sewerage	Amber	Infrastructure at the wastewater treatment works in this area is unlikely to be able to support the demand anticipated from this development. Significant infrastructure upgrades are likely to be required to ensure sufficient treatment capacity is available to serve this development. Thames Water would welcome the opportunity to work closely with the Local Planning Authority and the developer to better understand and effectively plan for the sewage treatment infrastructure needs required to serve this development. It is important not to under estimate the time required to deliver necessary infrastructure. For example: Sewage Treatment Works upgrades can take 18 months to 3 years to design and build. Implementing new technologies and the construction of a major treatment works extension or new treatment works could take up to ten years	TWUL	No existing public sewerage	Amber	The wastewater network capacity in this area may be unable to support the demand anticipated from this development. Local upgrades to the existing drainage infrastructure may be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a potential wastewater network capacity constraint, the developer should liaise with Thames Water to determine whether a detailed drainage strategy informing what infrastructure is required, where, when and how it will be delivered is required. The detailed drainage strategy should be submitted with the planning application		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete
OCC	No	Oxford	Various	Residential	8620	Housing	8620	TWUL	SWOX	Green	No comment provided	Not assessed	Comment not yet provided	TWUL	Oxford	Red	Major project to upgrade the network and Sewage Treatment Works required. AMP8 earliest	TWUL	Oxford	Red	Due to the complexities of wastewater networks the level of information contained in this document does not allow Thames Water to make a detailed assessment of the impact the proposed housing provision will have on the wastewater infrastructure. To enable us to provide more specific comments on the site proposals we require details of the Local Authority's aspiration for each site. For example, an indication of the location, type and scale of development together with the anticipated timing of development. Thames Water would welcome the opportunity to meet with the Local Planning Authority to discuss the wastewater infrastructure needs relating to the Local Plan.		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete
CDC	No	Kidlington	Land north of Kidlington	Residential	4400	Housing	4400	TWUL	SWOX	Green	No comment provided	Not assessed	Comment not yet provided	TWUL	Oxford	Red	Infrastructure at the wastewater treatment works in this area is unlikely to be able to support the demand anticipated from this development. Significant infrastructure upgrades are likely to be required to ensure sufficient treatment capacity is available to serve this development. Thames Water would welcome the opportunity to work closely with the Local Planning Authority and the developer to better understand and effectively plan for the sewage treatment infrastructure needs required to serve this development. It is important not to under estimate the time required to deliver necessary infrastructure. For example: Sewage Treatment Works upgrades can take 18 months to 3 years to design and build. Implementing new technologies and the construction of a major treatment works extension or new treatment works could take up to ten years	TWUL	Oxford	Red	The wastewater network capacity in this area is unlikely to be able to support the demand anticipated from this development. Strategic drainage infrastructure is likely to be required to ensure sufficient capacity is brought forward ahead of the development. Where there is a wastewater network capacity constraint the developer should liaise with Thames Water and provide a detailed drainage strategy with the planning application, informing what infrastructure is required, where, when and how it will be delivered		Assessment not yet complete					Assessment not yet complete		Assessment not yet complete		Assessment not yet complete

Appendices

B Water Quality Modelling Report

A Water Quality Assessment

A.1 Introduction

The increased discharge of effluent due to a growth in population served by a Waste Water Treatment Works (WwTWs) may impact on the quality of the receiving waterbody. The Water Framework Directive (WFD) does not allow a watercourse to deteriorate from its current class (either overall waterbody class 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 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 either meet Good Ecological Status (GES) or if they have been highly modified to meet Good Ecological Potential (GEP). Therefore, it is necessary to assess whether proposed growth will prevent a watercourse from meeting GES or GEP. The WCS should, where possible, guide development to locations where it will not lead to environmental deterioration or require investment with a low cost-benefit being required to prevent deterioration.

A.2 Future growth in effluent discharges

This addendum Water Cycle Study considers the impacts of growth in the following WwTW catchments:

- Didcot WwTW
- Oxford WwTW
- New settlement at Harrington, with the potential to drain to Great Milton, Little Milton, Tetsworth of Thames WwTWs, or to a new WwTW.
- Reading WwTW

Future increases in volumes of effluent discharged were estimated based on the number of future housing units and/or employment space to be constructed (see section 5.2 of the addendum report for details of the assessment of headroom). The impact on wastewater treatment headroom is also summarised in Table A-1 below. Note that the growth scenarios for Little Milton, Great Milton, Tetsworth and Thame all consider taking the full 6,500 homes of a new settlement at Harrington, simply to illustrate that none of these treatment works has capacity at present to serve Harrington.

Table A-1: WwTW headroom

WwTW	Housing growth (SODC and neighbouring LPAs)	Employment growth (m2) (SODC and neighbouring LPAs)	Headroom Assessment				
			Present day		End of AMP9 (2035)		
			Observed 80%ile DWF (Ml/d)	Headroom % of Permitted	Additional DWF (Ml/d)	Total DWF (Ml/d)	Headroom % of Permitted
Didcot	11808	159200	10.621	7%	21.960	32.581	-184%
Great Milton	6500	0	0.116	52%	1.880	1.996	-722%
Little Milton	6500	0	0.262	15%	1.880	2.142	-593%

WwTW	Housing growth (SODC and neighbouring LPAs)	Employment growth (m2) (SODC and neighbouring LPAs)	Headroom Assessment				
			Present day		End of AMP9 (2035)		
			Observed 80%ile DWF (Ml/d)	Headroom % of Permitted	Additional DWF (Ml/d)	Total DWF (Ml/d)	Headroom % of Permitted
Oxford	18936	Not identified	45.589	11%	5.172	50.761	0%
Reading	17393	Not identified	54.643	69%	0.570	55.213	69%
Tetsworth	6500	0	0.215	34%	1.880	2.095	-547%
Thame	7929	62000	2.813	-1%	17.400	20.213	-624%

It was concluded that water quality impact modelling was required for Oxford WwTW, because the scale of growth is significant and could require a change to the flow permit.

The new settlement at Harrington could have a significant water quality impact because, at whichever of the four existing WwTWs it may discharge to, a change to the site's flow consent would be required. However, South Oxfordshire District Council advised during preparation of the water quality analysis that the Harrington site is not included within their Preferred Scenario for the Local Plan. It was, therefore, excluded from further assessment.

Additional water quality impact modelling was not required for Didcot, because the addition of 1,000 homes at Land at Great Western Park represents a relatively small increase on the 23,320 homes and 95,400m^2 of employment space previously assessed, and therefore the results of the WCS v4.3 are considered to remain valid, that Didcot WwTW has capacity to accommodate the planned growth in its catchment without causing a deterioration to water quality in the Moor Ditch.

Water quality modelling was also not taken forward for Reading WwTW, as the volume of potential growth within SODC draining to this works is very minor. The vast majority of growth discharging to Reading WwTW will be within Reading Borough and Wokingham Borough, and it is, therefore, appropriate that water quality impacts should be assessed by their respective Local Planning Authorities.

For the assessment of water quality impacts from growth in other catchments, please refer to Appendix A of the Water Cycle Study version 4.3 dated 15/01/2018.

A.3 Assessing deterioration

The study was required to assess the impact of the increased effluent discharges on the receiving watercourses. Increase in a pollutant load being discharged from a WwTW could cause a deterioration and the EA set the following criteria to define significant deterioration, at which point a review of the Environmental Permit may be triggered:

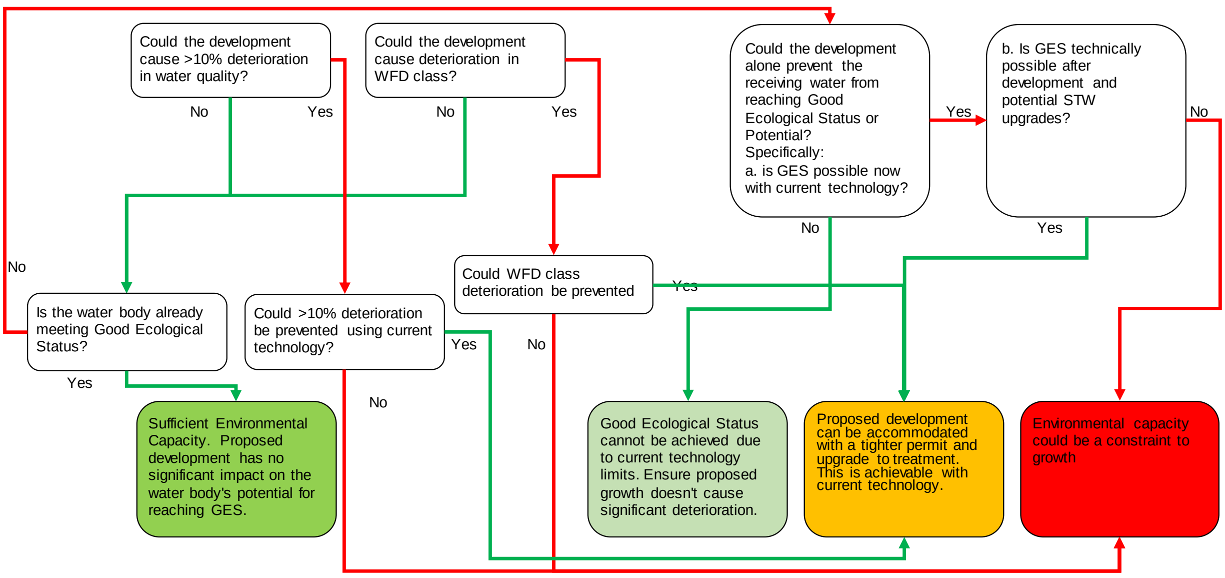
- A class deterioration. For example, if an increased load of ammonia from a WwTW led to a water body currently defined as "Fair" ecological status dropping down to "Poor" status.
- A deterioration of more than 10%. For example, if the present-day 90 percentile BOD downstream of a WwTW is 2.0mg/l, but 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. In practice, the Environment Agency advises that deterioration should be limited in such cases to less than 3%.

Where a WwTW is predicted to lead to a deterioration, it is necessary to determine a possible future permit value which would prevent this from occurring.

A.4 Assessing potential to meet Good Ecological Status

Where a watercourse is not currently meeting a Good class for any single determinand, it cannot be deemed to meet GES or GEP. For a WCS, it is essential to determine whether Good class could be reached in the present day. If this is possible, within the limitations of existing treatment technologies, a further test is made to determine whether the watercourse could be prevented from achieving a Good class solely as a result of growth in the catchment. If the latter is the case, environmental capacity within the watercourse may be a constraint to growth, and alternative solutions, such as relocating growth, relocating points of discharge or addressing sources of diffuse pollution may be necessary. This assessment process has recently been set out in a guidance document by the Environment Agency's West Thames Area[1]. This guidance is summarised in the flow chart below:

Figure A-1: Water quality assessment flow chart



A.5 Technically Achievable Limits

Where deterioration is predicted, or the watercourse is not meeting Good class for one or more determinands, modelling can be used to test whether improved treatment to Technically Achievable Limits (TAL) (previously known as Best Available Technology (BAT)) could prevent deterioration and enable the receiving watercourse to meet the physico-chemical requirements to achieve Good Ecological Status or Potential.

The EA advised that the following permit values are achievable using TAL, and that these values should be used for modelling all WwTW potential capacity irrespective of the existing treatment technology and size of the works:

- Ammonia (95%-ile) 1mg/l
- BOD (95%-ile) 5mg/l
- Phosphorous (mean) 0.25mg/l

Note that phosphorus removal has been the subject of long-term national trials investigating novel techniques and optimisation of existing methods. This major study, which involved all UK water companies, completed in late 2017, and concluded that a TAL for phosphorous should be set at 0.25mg/l as an annual average[2]. This report was not available to JBA Consulting at the time the water quality assessment was

1 Environment Agency West Thames Area (2015) Water Cycle Study Guidance and Requirements - West Thames Area.
2 Environment Agency (2017) PR19: New approaches for permitting phosphorus. Unpublished note.

undertaken for the main WCS (version 4.3), which used the previously agreed TAL of 0.5mg/l.

This study did not take into consideration if it is feasible to upgrade each existing WwTW to such technology due to constraints of costs, timing, space, carbon costs, etc.

A.6 Water Industry National Environment Programme

The Water Industry National Environment Programme (WINEP) is a five-year plan which sets out all of the actions required of the water industry to meet their environmental obligations. The next plan, which runs from 2020 to 2025, has been published by the EA as a spreadsheet of schemes and investigations to be carried out over this period[3]. The table in Annex A summarise the scheduled WINEP schemes and investigations up to 2025, within the operational catchments which cover or flow into South Oxfordshire (Thame, Chilterns South and Ock). The table has been filtered to show only those schemes and investigations relating to continuous discharges. Notably, the majority of schemes are related to removal of Phosphorous. Of specific relevance to this study, Oxford STW has a driver to improve the Ammonia permit from 3mg/l to 1mg/l (95 %ile) by March 2025. There is also a Phosphorous driver at Oxford STW, but this has a "red" level of certainty, meaning that it will not be delivered during the coming WINEP period.

A.7 Modelling method selection

The main Water Cycle Study (version 4.3) used, at the advice of the Environment Agency, their Thames basin SIMCAT model to assess the impacts of growth on water quality. It was therefore decided to apply the same approach to this study for the Northfield Brook to model impacts of growth at Oxford STW.

SIMCAT is a 1D stochastic, steady state, deterministic model which represents inputs from point-score effluent discharges and the behaviour of solutes in the river.[4] SIMCAT can simulate inputs of discharge and water quality data and statistically distribute them from multiple effluent sources along the river reach. It uses the Monte Carlo method for distribution that randomly models up to 2,500 boundary conditions. The simulation calculates the resultant water quality as the calculations cascade further downstream. Once the distribution results have been produced, an assessment can be undertaken on the predicted mean and ninety percentile concentrations or loads.

Existing SIMCAT models developed by the Environment Agency for the Thames catchment were supplied for the 2017 WCS, one modelling Ammonia and BOD, the other modelling Phosphorous. There were understood to have been largely based on observed flow and quality data for the period 2005 to 2008. The main WCS (v4.3) had updated these models using river quality, flow and effluent monitoring observations during the period of 2014 to 2016. For the purpose of this study, the models were updated based on data for the period 2014-2017, but only for those discharges and water bodies under consideration. Details are provided in the following sections.

A.8 Northfield Brook

A.8.1 Current status

The Northfield Brook is classified as a WFD waterbody from its source to the confluence with the River Thames, although the official waterbody mapping shows it commencing to the rear of the Kassam Stadium complex. It's overall classification for 2016 was Poor[5]. Within the physico-chemical elements, it is classed as Bad for Ammonia and Poor for Phosphate.

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[3] Environment Agency (2018) Water Industry National Environment Programme. Accessed online at https://data.gov.uk/dataset/a1b25bcb-9d42-4227-9b3a-34782763f0c0/water-industry-national-environment-programme on 10/12/2018

[4] Cox BA (2003) A review of currently available in-stream water-quality models and their applicability for simulating dissolved oxygen in lowland rivers. Sci Total Environ. 2003 Oct 1;314-316:335-77.

5 Environment Agency Catchment Data Explorer, Accessed online at https://environment.data.gov.uk/catchment-planning/WaterBody/GB106039030180 on 18/12/2018

Table A-2: Northfield Brook Overview

Id	GB106039030180
Type	River
Hydromorphological designation	not designated artificial or heavily modified
NGR	SP5371702133
Catchment area	1792.6 ha
Length	1.766 km
Surveillance Water Body	No
Catchment area	17.926 km2

Table A-3: Northfield Brook Cycle 2 Classifications

Classification Item	2013	2014	2015	2016
Overall Water Body	Moderate	Bad	Bad	Poor
Ecological	Moderate	Bad	Bad	Poor
Biological quality elements	-	Bad	Bad	Poor
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good	Supports Good
Physico-chemical quality elements	-	-	Moderate	Moderate
Ammonia (Phys-Chem)	-	-	Bad	Bad
Dissolved oxygen	-	-	Poor	Poor
pH	-	-	High	High
Phosphate	-	-	Poor	Poor
Temperature	-	-	High	High
Specific pollutants	Moderate	Moderate	High	High
Chemical	Fail	Fail	Good	Good

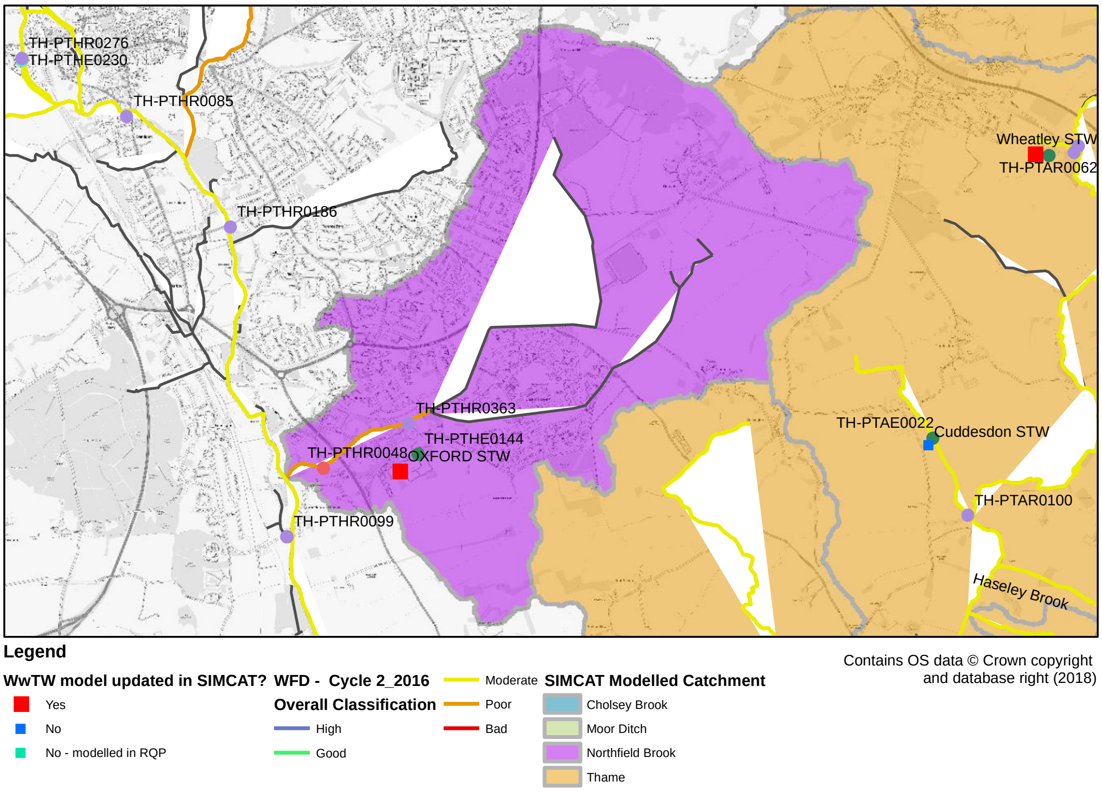
The "Reasons for Not Achieving Good" (RNAGs) include ammonia, phosphate, dissolved oxygen, invertebrate, macrophyte and phytobenthos elements related primarily to sewage discharges from the Oxford STW.

A.8.2 Model preparation

Model schematisation

1.8km of the Northfield Brook is defined as a Reach in the SIMCAT model from Kassam Stadium to the confluence with the River Thames. The model schematisation was not changed from the supplied Thames basin model.

Figure A-2: Northfield Brook overview



River flow

There are no flow gauges located on the Northfield Brook. River flow values remain, therefore, as modelled in the original Thames basin SIMCAT model.

River quality

There are river quality sampling points on the Pottery Stream below Oxford STW (PTHR0363) and on the Northfield Brook at Henley Road (PTHR0363), however neither of these have any samples for sanitary determinands or nutrients during the period 2014-2017.

WwTW flow

WwTW flow records were requested from Thames Water for the period 2014 to 2017, however only 2016, 2017 and part of 2018 were supplied. The model was updated with mean (53.233Ml/d) and standard deviation of flow (9.642Ml/d) for the period 2016-17.

A future growth model was prepared, to represent the potential future water quality impacts following planned growth to 2036. Only WwTW flows were modified. The 2036 future mean effluent flows were calculated as:

- Future mean flow = present day (2014-17) mean flow + estimated additional effluent (see headroom assessment in main report).

The future standard deviation of flow was calculated using the same coefficient of variance as between the present-day mean and standard deviation:

- Future standard deviation of flow = (present-day SD / present-day mean) * future mean

WwTW quality

WwTW quality values were updated using 2014-17 observed data at Oxford (Sandford) STW, as supplied by an Environment Agency data request:

Table A-4: Final effluent quality for Oxford STW, 2014-17

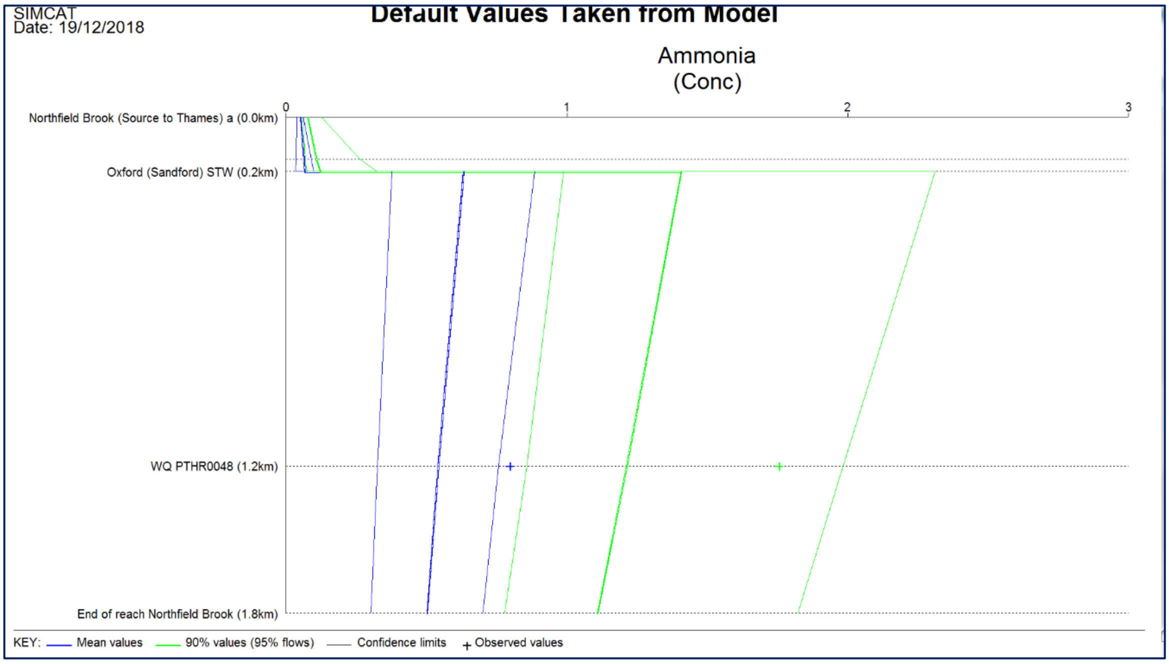
Sample point	Ammonia (mg/l)			Biochemical Oxygen Demand (mg/l)			Phosphorous (mg/l)		
	No. of samples	Mean	Standard Deviation	No. of samples	Mean	Standard Deviation	No. of samples	Mean	Standard Deviation
Oxford (Sandford (STW)	32	0.688	0.886	137	4.084	1.694	96	0.558	0.238

A.8.3 Model calibration

Ammonia

There are no observed Ammonia samples in the period of water quality data analysed (2014-2017). The baseline SIMCAT model includes sampled values for Ammonia at PTHR0048, and these are shown in the graph below. The model is predicting mean and 90%ile values for Ammonia below the observed records, and in the case of mean values the prediction is outside the confidence limits. The model was not, however, changed to improve this calibration, as they are understood to relate to the period 2005 to 2008 and may therefore not be representative of present-day quality.

Figure A-3: Northfield Brook baseline ammonia



Biochemical Oxygen Demand

There are no observed BOD values at PTHR0048.

Phosphate

There are no observed Phosphorous values at PTHR0048.

A.8.4 Test for deterioration due to growth

The present-day baseline and future growth (2035) models were both run using model mode zero where there is no gap filling or auto-calibration between diffuse inputs. Results were compared to identify where deterioration is predicted to occur (see section A.3 for definitions of deterioration). Results for Northfield Brook were as follows:

- For Ammonia, the baseline model results predicted a "poor" water quality class, better than those reported "bad" class for the watercourse in the WFD Cycle 2 (2016) results. For the purposes of this assessment this is acceptable, as deterioration is being compared against a higher class than the watercourse is currently reported at.

- For phosphate, the reported class and the modelled class were both "Poor".
- Results comparing the baseline and future results are shown below in Table A-5, Figure A-4 and Figure A-5. There is no predicted deterioration of class for any of the modelled determinands, ammonia, BOD and phosphate.
- The percentage deterioration as a result of growth is predicted to be between 1% and 2% for all determinands at points downstream of the WwTW. Consequently, no deterioration is predicted as a result of the proposed growth within the Oxford catchment.

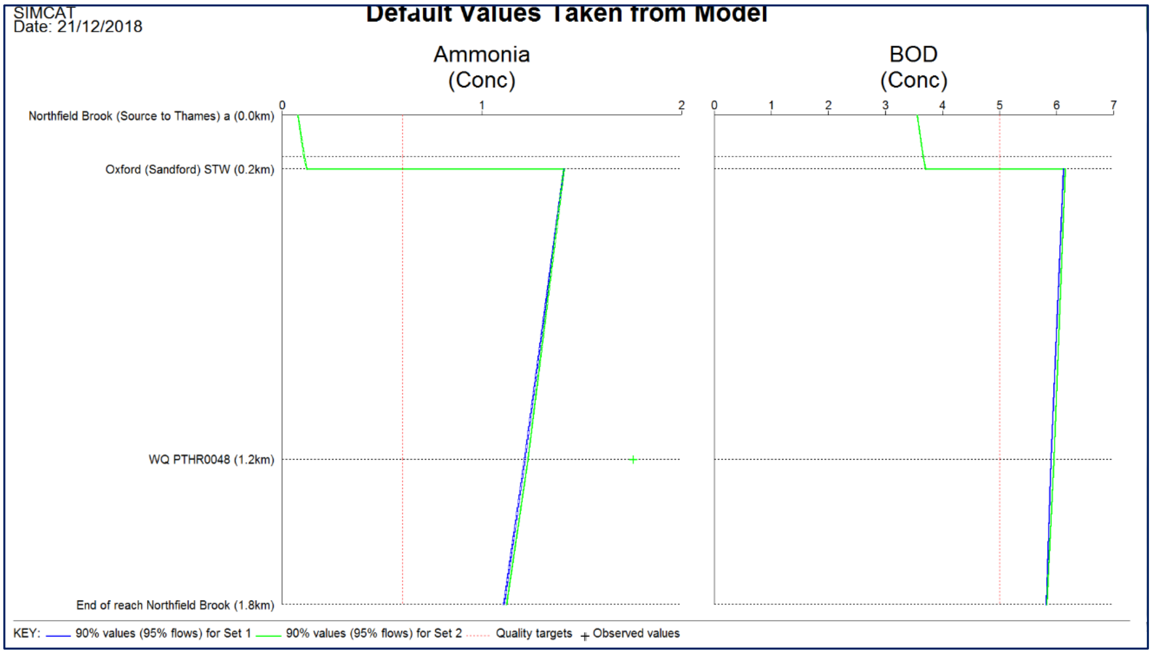
Table A-5: Results of the test for deterioration due to growth, Northfield Brook

	Baseline (2017)			Future (2036)		
Feature	Ammonia (conc) 90%ile	BOD (conc) 90%ile	Phosphate (conc) mean	Ammonia (conc) 90%ile	BOD (conc) 90%ile	Phosphate (conc) mean
Northfield Brook (Source to Thames) a	0.08	3.55	0.00	0.08	3.55	0.00
WQ PTHR0047	0.11	3.66	0.03	0.11	3.66	0.03
Oxford (Sandford) STW	1.41	6.11	0.52	1.41	6.14	0.52
WQ PTHR0048	1.21	5.89	0.50	1.23	5.94	0.51
GB106039030180 Boundary	1.11	5.81	0.50	1.12	5.82	0.50
End of reach Northfield Brook	1.11	5.81	0.50	1.12	5.82	0.50

Key

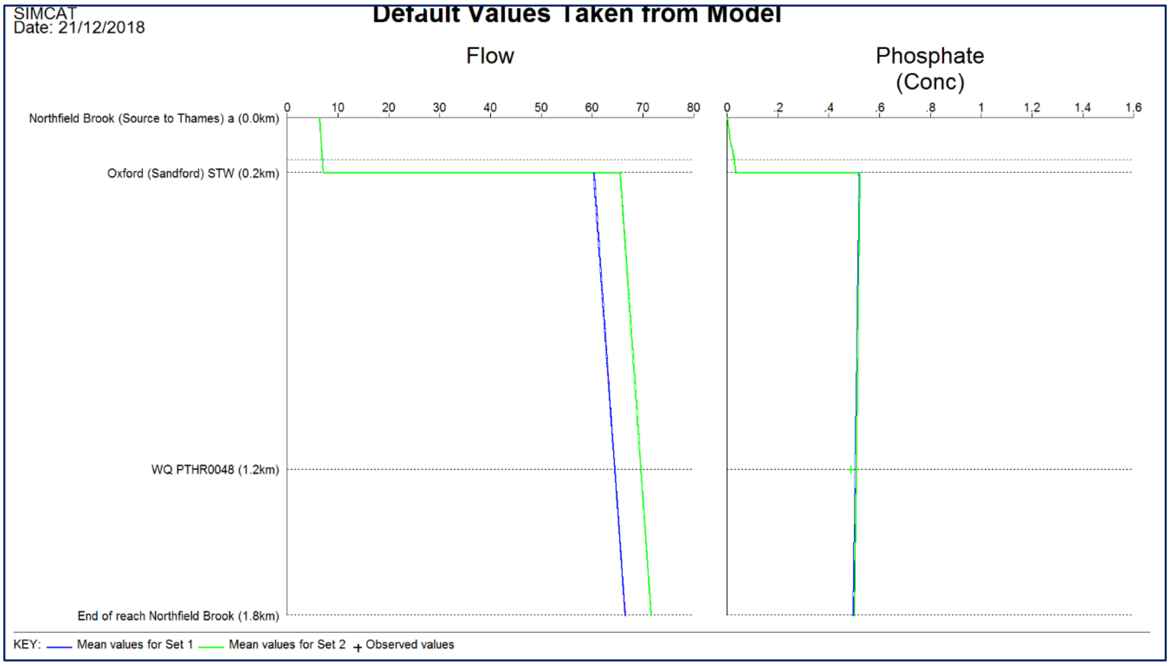
Determinand	Statistic	High	Good	Moderate	Poor	Bad
Ammonia	90%ile	< 0.3	0.301 - 0.6	0.601 - 1.1	1.101 - 2.5	>2.501
BOD	90%ile	< 4	4.01 - 5	5.01 – 6	6.01 - 7.5	>7.501
Phosphate	Mean	< 0.05	0.0501 - 0.12	0.1201 - 0.25	0.2501 - 1	>1.01

Figure A-4: Plot of deterioration, ammonia and BOD



Green = baseline, Blue = Future (2036)

Figure A-5: Plot of deterioration, flow and phosphate



Green = baseline, Blue = Future (2036)

Full results are shown in Annex A.

A.8.5 Test whether deterioration can be prevented

As no deterioration was predicted, no assessment of whether deterioration can be prevented was required.

A.8.6 Test whether Good class is currently achievable

Where no deterioration is predicted, or deterioration can be prevented, but the watercourse is not currently Good or High for any determinand, modelling then moved on to test whether Good class is currently achievable. This was carried out using

SIMCAT run type 8, which tests what treatment standard would be required to meet river quality targets. Note that run-type 9 (which also assumes that the upstream water quality is Good) was not required, as the water quality upstream of Oxford WwTW is "High" for ammonia, BOD and phosphate.

Before running SIMCAT in run type 8, the river quality targets were set at the mid-point of the Good class, assuming lowland rivers (<80m elevation), high alkalinity and cyprinid fishery:

Table A-6: River quality targets set in SIMCAT

Determinand	Statistic	High	Good	Mid-point of Good
BOD	90 %ile	4.0	5.0	4.5
Ammonia	90 %ile	0.3	0.6	0.45
Phosphorous	Annual mean	0.050	0.120	0.085

Results indicate that it would be possible to achieve "Good" class downstream of Oxford STW for BOD. For ammonia, the required discharge quality, 0.95mg/l, is slightly below TAL (1mg/l), but within a range that is probably still achievable. Good is not achievable for phosphate, as this would require treatment significantly beyond the limits of current treatment technology.

Table A-7: Discharge quality required to meet Good in Northfield Brook

Determinand	Permit type	Technically achievable limit	Discharge quality required to meet Good
Ammonia	95%ile	1mg/l (96 percentile)	0.95mg/l
BOD	95%ile	5mg/l	6.2 mg/l
Phosphate	Mean	0.25mg/l	0.13 mg/l

A.8.7 Test whether planned growth would prevent Good class from being achieved in the future

Where the application of TAL in the present day could improve water quality to meet Good class, it is important to understand whether this could be compromised as a result of future growth within the catchment. This was modelled by applying the same method described above in section A.8.6 to the future growth 2036 model. The same river quality targets and best available discharge quality values were set, and SIMCAT run type 8 was used.

Results indicate that "Good" class for BOD could be retained in the future, with a 95 percentile permit value of 6.2mg/l. For Ammonia, as with the present-day case, treatment would need to be slightly better than TAL, at 0.95mg/l, to meet Good with future growth.

The test was not run for Phosphate, as it has been demonstrated that this is not achievable in the present day due to the limitations of treatment technologies.

A.9 Summary and conclusions

Table A-8 summarises the modelling results for passing or failing the following tests:

- percentage deterioration;
- class deterioration.
- could the water body be prevented from meeting Good status.

Table A-8: Summary of water quality assessment results

Watercourse (WwTW)	Could the development cause a greater than 10% deterioration in WQ?	Could the development cause a deterioration in WFD class of any element?	Could the development prevent the water body from reaching GES?
Key	No infrastructure upgrade required to achieve		No infrastructure upgrade required to achieve
	Infrastructure upgrade likely to be required, but achievable using BAT		Infrastructure upgrade likely to be required, but achievable using BAT, or not achievable due to current technology limits.
	Cannot be achieved using BAT. Environmental capacity could be a constraint on growth.		Cannot be achieved using BAT. Environmental capacity could be a constraint on growth.
Northfield Brook (Oxford)	Predicted deterioration is <10%.	No class deterioration is predicted.	Good Ecological Status can be achieved for BOD and is probably achievable for NH_4. GES cannot be achieved for P due to current technology limits. Planned growth would not compromise the ability to meet Good in the future.

- This assessment complements the water quality modelling carried out for the SODC WCS v4.3 in 2017, and considers the potential water quality impacts of growth within South Oxfordshire being treated at Oxford, Didcot and Reading WwTWs. In addition, a potential new settlement at Harrington, which could potentially discharge to Little Milton, Great Milton, Tetsworth or Thame WwTW was considered.
- No water quality modelling has been carried out for Reading, as the potential growth within South Oxfordshire draining to Reading WwTW is very minor. The vast majority of growth discharging to Reading WwTW will be within Reading Borough and Wokingham Borough, and it is, therefore, appropriate that water quality impacts should be assessed by their respective Local Planning Authorities.
- Additional water quality impact modelling was not required for Didcot, because the addition of 1,000 homes at Land at Great Western Park represents a relatively small increase on the 23,320 homes and 95,400m^2 of employment space previously assessed, and therefore the results of the WCS v4.3 are considered to remain valid, that Didcot WwTW has capacity to accommodate the planned growth in its catchment without causing a deterioration to water quality in the Moor Ditch.
- A new settlement at Harrington, could have a significant water quality impact because, at whichever of the four existing WwTWs it may discharge to, a change to the site's flow consent would be required. However, South Oxfordshire District Council advised during preparation of the water quality analysis that the Harrington site is not included within their Preferred Scenario for the Local Plan. It was, therefore, excluded from further assessment.
- The impacts of increased effluent discharges from Oxford WwTW as a result of growth within South Oxfordshire, Oxford City (higher growth scenario) and Cherwell were assessed using the Environment Agency's SIMCAT model for the Thames river basin.
- There is no predicted deterioration of class for any of the modelled determinands, ammonia, BOD and phosphate.
- The percentage deterioration as a result of growth is predicted to be between 1% and 2% for all determinands at points downstream of the WwTW. Consequently,

no deterioration is predicted as a result of the proposed growth within the Oxford catchment.

- The models were used to test whether WFD "Good" class could be achieved with the application of treatment to technically achievable limits (TAL). Results indicate that it would be possible to achieve "Good" class downstream of Oxford STW for BOD. For ammonia, the required discharge quality, 0.95mg/l, is slightly below TAL (1mg/l), but within a range that is probably still achievable. Good is not achievable for phosphate, as this would require treatment significantly beyond the limits of current treatment technology.
- Finally, the model was used to test, for BOD and Ammonia, whether the planned growth could compromise the ability to achieve Good class in the Northfield Brook. Results indicate that the ability to meet Good would not be compromised.

Annex 1: WINEP continuous discharge schemes / investigations

WINEPID	Scheme / Investigation /Site /License	Waterbody	Obligation	Issue	Current Permit Limit (mg/l)	Propose d Permit Limit (mg/l)
THM00079	COMPTON SEWAGE TREATMENT WORKS	Pang	Urban Wastewater Treatment Regulations	Phosphorus	N/A	
THM00473	CHAPEL ROW SEWAGE TREATMENT WORKS	Pang	Urban Wastewater Treatment Regulations	Flow measurement		
THM00475	DORTON STW	Dorton, Chearsley and Waddesdon Brooks	Urban Wastewater Treatment Regulations	Flow measurement		
THM00478	NUNEHAM COURTNEY STW	Thames (Evenlode to Thame)	Urban Wastewater Treatment Regulations	Flow measurement		
THM00480	SHELLINGFOR D STW	Ock (to Cherbury Brook)	Urban Wastewater Treatment Regulations	Flow measurement		
THM00488	APPLETON STW, ABINGDON, OXON	Frilford and Marcham Brook	Water Framework Directive	Phosphorus	5	0.3
THM00506	Charney Bassett STW	Ock (to Cherbury Brook)	Water Framework Directive	Phosphorus		1.5
THM00518	Cuddesden STW	Thame (Scotsgrove Brook to Thames)	Water Framework Directive	Phosphorus		0.25
THM00520	DORTON STW	Dorton, Chearsley and Waddesdon Brooks	Water Framework Directive	Phosphorus		0.5
THM00536	KINGSTON BAGPUIZE STW	Ock and tributaries (Land Brook confluence to Thames)	Water Framework Directive	Ammonia	7	3

WINEPID	Scheme / Investigation /Site /License	Waterbody	Obligation	Issue	Current Permit Limit (mg/l)	Proposed Permit Limit (mg/l)
THM00537	KINGSTON BAGPUIZE STW	Ock and tributaries (Land Brook confluence to Thames)	Water Framework Directive	Phosphorus		0.25
THM00538	Lewknor STW	Lewknor Brook	Water Framework Directive	Phosphorus		1
THM00559	STANFORD IN THE VALE STW	Ock (to Cherbury Brook)	Water Framework Directive	Phosphorus		0.4
THM00562	TETSWORTH STW	Latchford Brook at Tetsworth	Water Framework Directive	Phosphorus		0.4
THM00563	UFFINGTON STW	Ock (to Cherbury Brook)	Water Framework Directive	Phosphorus		
THM00564	WADDESDON STW	Fleet Marston Brook, Denham Brook, Pitchcott Brook west	Water Framework Directive	Phosphorus		0.5
THM00567	WATLINGTON STW	Chalgrove Brook	Water Framework Directive	Phosphorus		0.6
THM00570	WINGRAVE STW	Thame upstream of Aylesbury	Water Framework Directive	Phosphorus		0.7
THM00573	WORMINGHALL STW	Worminghall Brook and tributaries	Water Framework Directive	Phosphorus		0.5
THM00579	AYLESBURY STW	Thame (Aylesbury to Scotsgrove Brook)	Water Framework Directive	Phosphorus	1	
THM00589	CHALGROVE STW	Haseley Brook	Water Framework Directive	Phosphorus		
THM00591	Chilton STW	Peppershill and Shabbington Brooks	Water Framework Directive	Phosphorus		

WINEPID	Scheme / Investigation /Site /License	Waterbody	Obligation	Issue	Current Permit Limit (mg/l)	Proposed Permit Limit (mg/l)
THM00592	CHINNOR STW	Kingsey Cuttle Brook and tributaries at Thame	Water Framework Directive	Phosphorus		
THM00595	CUDDINGTON STW	Thame (Aylesbury to Scotsgrove Brook)	Water Framework Directive	Phosphorus		
THM00596	DIDCOT STW	Moor Ditch and Ladygrove Ditch	Water Framework Directive	Phosphorus	2	
THM00600	Great Milton STW	Thame (Scotsgrove Brook to Thames)	Water Framework Directive	Phosphorus		
THM00601	HADDENHAM STW	Scotsgrove Brook (upstream Kingsey Cuttle Brook)	Water Framework Directive	Phosphorus		
THM00606	LITTLE MILTON STW	Thame (Scotsgrove Brook to Thames)	Water Framework Directive	Phosphorus		
THM00609	OXFORD (SANDFORD) STW	Northfield Brook (Source to Thames) at Sandford	Water Framework Directive	Phosphorus		
THM00610	PRINCES RISBOROUGH STW	Kingsey Cuttle Brook and tributaries at Thame	Water Framework Directive	Phosphorus	2	
THM00617	THAME STW	Scotsgrove Brook (upstream Kingsey Cuttle Brook)	Water Framework Directive	Phosphorus	2	
THM00618	Tiddington STW	Thame (Scotsgrove Brook to Thames)	Water Framework Directive	Phosphorus		

WINEPID	Scheme / Investigation /Site /License	Waterbody	Obligation	Issue	Current Permit Limit (mg/l)	Proposed Permit Limit (mg/l)
THM00619	Towersey STW	Kingsey Cuttle Brook and tributaries at Thame	Water Framework Directive	Phosphorus		
THM00668	Hurley STW	Thames (Reading to Cookham)	Water Framework Directive	Ammonia		8
THM00722	OXFORD (SANDFORD) STW	Northfield Brook (Source to Thames) at Sandford	Water Framework Directive	Ammonia	3	1
THM00703	Chilton STW (CIP2 T1)	Peppershill and Shabbington Brooks	Water Framework Directive	Copper (dissolved)		22 ug/l (mean)
THM00717	Chinnor STW (CIP2 T1)	Kingsey Cuttle Brook and tributaries at Thame	Water Framework Directive	Triclosan		0.4 ug/l (95%) 1.1 ug/l (UT)
THM00718	Chinnor STW (CIP2 T1)	Kingsey Cuttle Brook and tributaries at Thame	Water Framework Directive	Triclosan		
THM00486	Forest Hill STW (CIP1)	Holton Brook and tributaries	Water Framework Directive	Aluminium (total)		

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