West Berkshire
Water Cycle Study – Phase 2

Final Report

September 2021

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JBA Project Manager

Anna Beasley
Pipe House
Lupton Road
Wallingford
Oxfordshire OX10 9BS

Revision History

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S3-P02 / 16-07-21	2nd Draft	Eleanor Obourne (Natural England)
A1-C03 / 21-09-21	Final Report	Laila Bassett (West Berks Council)

Contract

This report describes work commissioned by West Berkshire Council. Louise Morgan, James Fitton and Richard Pardoe of JBA Consulting carried out this work.

Prepared by .... Louise Morgan BSc

Assistant Analyst

.... James Fitton BSc

Assistant Analyst

.... Richard Pardoe MSc MEng MCIWEM C.WEM

Senior Analyst

Reviewed by .... Paul Eccleston BA CertWEM CEnv MCIWEM C.WEM

Technical Director

Purpose

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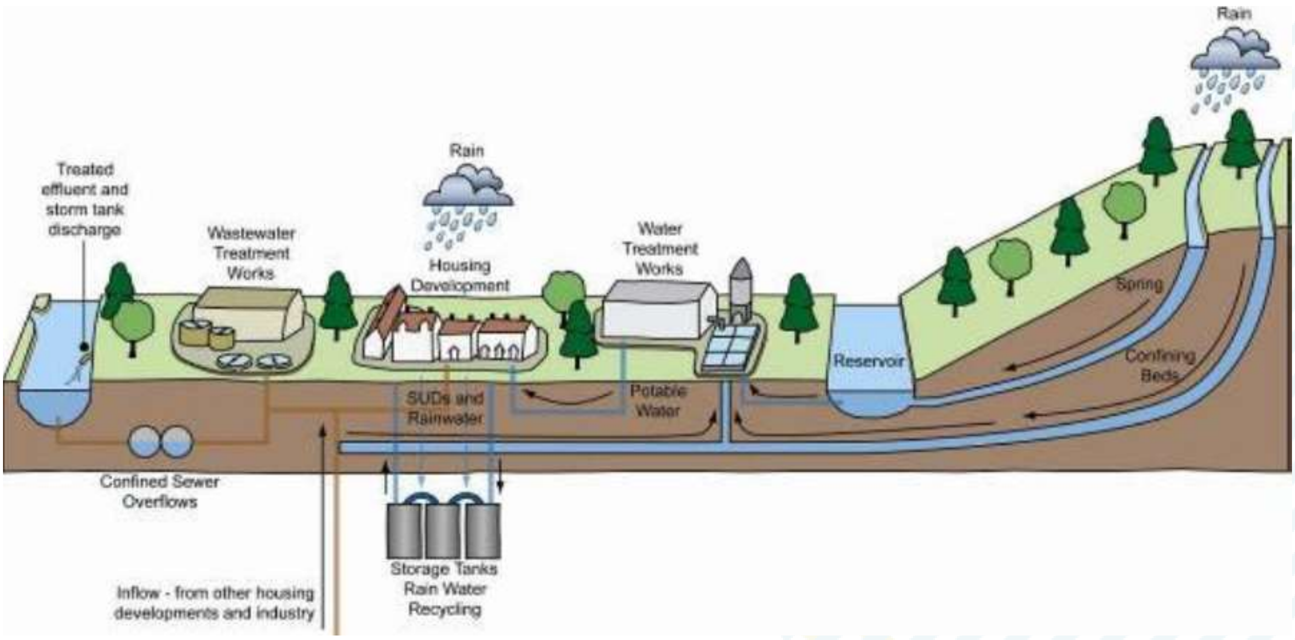
Executive Summary

In March 2020, JBA Consulting was commissioned by West Berkshire Council to undertake a Water Cycle Study (WCS) to inform the West Berkshire Local Plan Review to 2036. This study assesses the potential issues relating to future development across West Berkshire and the impacts on water supply, wastewater collection and treatment, and water quality. The Water Cycle Study is required to assess the constraints and requirements that will arise from potential growth on the water infrastructure.

New homes require the provision of clean water, safe disposal of wastewater and protection from flooding. The allocation of large numbers of new homes in certain locations may result in the capacity of existing available infrastructure being exceeded, a situation that could potentially cause service failures to water and wastewater customers, adverse impacts to the environment, or high costs for the upgrade of water and wastewater assets being passed on to the bill payers. In some cases, the environmental permits required to ensure current water quality is maintained after growth may be beyond technically achievable limits leading to a deterioration in water quality.

In addition to increased housing demand, future climate change presents further challenges to the existing water infrastructure network, including increased intensive rainfall events and a higher frequency of drought events. Sustainable planning for water must now take this into account. The water cycle can be seen in the figure below and shows how the natural and man-made processes and systems interact to collect, store or transport water in the environment.

The Water Cycle



Source: Environment Agency – Water Cycle Study Guidance

A Phase 1 Scoping study was completed in December 2020 and provided initial assessments of water resources and supply, wastewater network and treatment capacity, water quality, flood risk and odour for the potential allocations provided by West Berkshire Council in summer 2020. Where possible a red/amber/green (RAG) assessment was provided for each potential allocation based on information from Thames Water and JBA's own assessments. Further work in a Phase 2 study was recommended for water quality and environmental impact.

Since then, West Berkshire Council have refined their growth forecast and provided an updated list of proposed allocations as well as the latest planning commitments and completions. This Phase 2 study builds on the work completed in Phase 1 and updates each assessment based on this updated growth forecast. Where new development sites have been identified, these have been assessed following the same methodology as Phase 1. Water quality modelling and an environmental impact assessment have been carried out to address the gaps in evidence identified in Phase 1.

Where no change was made to a Phase 1 assessment, the conclusions and recommendations are repeated in the Phase 2 report.

The Water Cycle Study has been carried out in co-operation with the water companies, the Environment Agency (EA) and Natural England (NE) whilst also using published information from the neighbouring Local Planning Authorities (LPAs).

Proposed development sites were provided by West Berkshire Council and wastewater treatment works (WwTW) likely to serve growth in the area were identified using the Environment Agency Consented Discharges to Controlled Waters database. Each development site was then allocated to a WwTW in order to understand the additional wastewater flow resulting from the planned growth.

The objective of the study was to provide evidence to guide development towards the most sustainable sites. Red / Amber /Green (RAG) assessments were prepared at the site scale, where possible, for the different aspects of the water cycle. It should be remembered that where a development is scored amber or red in a water supply or wastewater infrastructure assessment, it does not mean that development cannot or should not take place in that location, merely that significant infrastructure may be required to accommodate it. The decision on the suitability of sites is made up of a number of assessments outside the scope of this report.

Water Resources

Thames Water (TW) are responsible for supplying the study area with water. In common with most of the south east, West Berkshire is an area of serious water stress. The more stringent water efficiency target for new development of 110 l/p/d allowed under Building Regulations is justified, however West Berkshire Council may want to consider going further than the 110l/p/d target, particularly in larger strategic developments.

Policies to reduce water demand from new developments, or to go further and achieve water neutrality in certain areas, could be defined to reduce the potential environmental impact of additional water abstractions in West Berkshire, and also help to achieve reductions in carbon emissions.

Growth plans defined in Water Resource Management Plans (WRMPs) are broadly in line with the growth projections of West Berkshire Council. The WRMP does not predict a supply-demand deficit, except in peak week or drought conditions, and proposes actions over the WRMP planning period to improve resilience.

Water supply infrastructure

An increase in water demand due to growth can cause the hydraulic capacity of the existing supply infrastructure to be exceeded. This is likely to manifest itself as low water pressure at times of high demand.

Proposed allocations across the study area were reviewed by Thames Water and given a relative scoring based on the impact upon the water supply network. Thames Water identified a number of development sites where further modelling and/or upgrades to the network would be required in order to serve those sites. Should these sites be allocated, delivery must be aligned with provision of these upgrades and West Berkshire Council should engage with TW early to enable infrastructure upgrades to be constructed prior to occupation of new developments.

WBC should continue to provide updates on their growth forecast to TW to enable further modelling to be undertaken if necessary.

Wastewater collection infrastructure

Thames Water (TW) provides wastewater services to West Berkshire. Sewerage Undertakers have a duty under Section 94 of the Water Industry Act 1991 to provide sewerage and treat wastewater arising from new domestic development. Except where strategic upgrades are required to serve very large or multiple developments, infrastructure upgrades are usually only implemented following an application for a connection, adoption, or requisition from a developer.

Development in areas where there is limited wastewater network capacity will increase pressure on the network, raise the risk of a detrimental impact on existing customers, and increase the likelihood of sewer flooding. Early engagement with Thames Water is required, and further modelling of the network may be needed at the planning application stage.

If there are areas where the current network is a combined sewer system, further separation of foul and surface water may be required, as well as suitably designed Sustainable Drainage Systems (SuDS).

The results in section 5 show that, in order to serve the proposed growth in a number of settlements across West Berkshire, wastewater infrastructure and/or treatment upgrades would be required. Early engagement between developers, the Council and Thames Water is recommended to allow time to plan the strategic infrastructure required to serve these developments.

Wastewater treatment capacity

Headroom at Wastewater Treatment Works (WwTW) can be eroded by growth in population or per-capita consumption, requiring investment in additional treatment capacity or improvements in treatment processes. Thames Water operate all of the WwTWs serving growth across West Berkshire.

Two assessments of WwTW capacity were undertaken.

- JBA performed a headroom assessment comparing the current dry weather flow (DWF) at each WwTW against the permitted flow and adding the additional effluent from growth in the local plan period. Three WwTWs in West Berkshire are predicted to, or are already exceeding, their flow permit (Chieveley, Hungerford, Newbury). This assessment also took into account the frequency of operation of storm overflows at WwTWs. The number of operations in 2020 was found to be greater than 60 at ten of the WwTWs serving growth in West Berkshire. Further development in these catchments, without the appropriate measures by Thames Water, could lead to increased operation of these overflows and environmental damage.
- Thames Water carried out an assessment based on the relative suitability of development sites within each wastewater catchment. The least suitable sites (those where the WwTW would require investment in order to serve growth) were given a red or amber score, and those where minimal investment is required, or where investment is already planned, were given a green score. This assessment took into account capacity at the WwTW, as well as water quality, odour and infiltration within the catchment.

Many of the WwTWs in the study area would require upgrades in order to serve growth during the plan period. West Berkshire Council should consider the time taken to undertake these upgrades when phasing development and early engagement with TW is recommended to ensure required upgrades are in place prior to occupation. TW advised that "safeguarding" of land may be required in order to deliver these upgrades. Safeguarding in this context is ensuring that land required for water infrastructure in the future is not developed, preventing the upgrade. TW should advise WBC of their requirements for the safeguarding of land.

Odour

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 measures are retro fitted to existing WwTWs. National Planning Practice 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 nuisance.

Six sites were identified that were within 800m of a WwTW. At these sites it is recommended that an odour assessment it carried out as part of the planning process. The cost of this should be met by the developer.

Water quality

An increase in the discharge of effluent from Wastewater Treatment Works (WwTW) as a result of development and growth in the area 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 the overall watercourse classification or for individual elements assessed). Where appropriate, tighter environmental quality standards were applied, for example on the River Kennet and River Lambourn where much of the rivers is designated as a Special Area of Conservation (SAC) or Site of Special Scientific Interest (SSSI).

The Environment Agency's SIMCAT water quality modelling tool was used to provide an assessment of impact of growth on water quality. The models were calibrated by the EA with water quality data and assumptions from 2010-12, and updated by JBA with the latest effluent flows at WwTWs within the study area, and incorporating recent and planned improvements or permit changes at WwTWs provided by the EA. The modelling results can be used to identify areas at risk of deterioration but should not be used to set permit limits or definitively rule-out growth in particular catchments.

At two WwTWs (Compton and Greenham Common) growth within their catchments during the plan period could cause a significant deterioration (10% or greater) in water quality. However, improvements in treatment processes could prevent this deterioration.

A further test was undertaken to assess whether growth alone could prevent good ecological status being achieved in the future. This is based on the assumption that upstream water quality is improved to "good" status, and WwTW are upgraded to the technically achievable limit (TAL). If GES could be achieved now under those conditions but could not be achieved once growth occurs during the plan period, it can be said the environmental capacity is a constraint to growth. At no WwTW was this found to be the case.

Flood risk from additional foul flow

In catchments where a large growth in population is expected, and where the WwTW will discharge effluent to a small watercourse, the increase in discharged effluent might have a negative effect on the risk of flooding. An assessment was carried out to quantify such an effect.

The impact of increased effluent flows at WwTW from any of the proposed development is not predicted to have a significant impact upon flood risk in any of the receiving watercourses.

Environmental constraints

Development has the potential to cause an adverse impact on the environment through a number of routes, such as worsening of air quality, pollution to the aquatic environment, or disturbance to wildlife. In the context of a Water Cycle Study, the impact of development on the aquatic environment is under assessment.

A source-pathway-receptor approach can be taken to investigate the risk of an adverse impact on protected sites and identify where further assessment or action is required. The potential impacts of development on a number of protected sites such as Special Area of Conservation (SAC), Special Protection Areas (SPAs) SPAs, Sites of Special Scientific Interest (SSSIs) and Ramsar sites within, or downstream of the study area should be carefully considered in future plan making, as well as the large number of Priority Habitats and Priority Rivers.

The water quality modelling results were used to assess the impact on protected sites downstream of WwTWs. At many of the protected sites a significant deterioration in water quality would be predicted in the plan period if no mitigation was provided. However, deterioration can be prevented if improvements are made to upstream treatment processes.

Runoff from development sites is a potential source of diffuse pollution and could be managed through implementation of SuDS with a focus on treating the water quality of surface runoff from roads and development sites. Opportunities exist for these SuDS schemes to offer multiple benefits of flood risk reduction, amenity value and biodiversity. In the wider area, opportunities exist to implement natural flood management techniques to achieve multiple benefits of flood risk management, water quality improvement and habitat creation.

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Abbreviations / Glossary

ALS	Abstraction Licensing Strategy
AMP	Asset Management Plan
AONB	Area of Outstanding Natural Beauty
AP	Assessment Point
ASNW	Ancient Semi-Natural Woodland
BIDS	Business, Industrial, distribution and Storage
BOD	Biochemical Oxygen Demand
BREEAM	Building Research Establishment Environmental Assessment Methodology
CAMS	Catchment Abstraction Management Strategies
CAPEX	Capital Expenditure
CFMP	Catchment Flood Management Plan
CSO	Combined Sewer Overflow
DCLG	Department of Communities and Local Government (Replaced by MHCLG)
DWF	Dry Weather Flow
DWI	Drinking Water Inspectorate
DWMP	Drainage and Wastewater Management Plan
EA	Environment Agency
EFI	Ecological Flow Indicator
EP	Environmental Permit
EU	European Union
FEH	Flood Estimation Handbook
FWMA	Flood and Water Management Act
FZ	Flood Zone
GIS	Geographic Information Systems
HOF	Hands-Off Flow
HOL	Hands-off Level
JBA	Jeremy Benn Associates
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
l/p/d	Litres per person per day
Ml/d	Mega (Million) litres per day
MHCLG	Ministry of Housing Communities and Local Government
NH4	Ammonia
NMP	Nutrient Management Plan
NPPF	National Planning Policy Framework
OAN	Objectively Assessed Need
OfWAT	Water Service Regulation Authority
OS	Ordnance Survey
P	Phosphorous
RAG	Red / Amber / Green assessment
RBD	River Basin District
RBMP	River Basin Management Plan
ReFH	Revitalised Flood Hydrograph
RoFSW	Risk of Flooding from Surface Water (replaced uFMfSW)

RQP	River Quality Planning tool
SA	Sustainability Appraisals
SAC	Special Area of Conservation
SBP	Strategic Business Plan
SEA	Strategic Environmental Assessment
SfA	Sewers for Adoption
SFRA	Strategic Flood Risk Assessment
SHELAA	Strategic Housing and Economic Land Availability Assessment
SHMA	Strategic Housing Market Assessment
SPA	Special Protection Area
SPD	Supplementary Planning Document
SPS	Sewage Pumping Station
SPZ	Source Protection Zone
SS	Suspended Solids
SSSI	Site of Special Scientific Interest
SU	Sewerage Undertaker
SuDS	Sustainable Drainage Systems
SWOX	Swindon and Oxfordshire (WRZ)
SWMP	Surface Water Management Plan
TW	Thames Water
UWWTD	Urban Waste Water Treatment Directive
WaSC	Water and Sewerage Company
WBC	West Berkshire Council
WCS	Water Cycle Study
WFD	Water Framework Directive
WINEP	Water Industry National Environment Programme
WRMP	Water Resource Management Plan
WRZ	Water Resource Zone
WTW	Water Treatment Works
WwTW	Wastewater Treatment Works

1 Introduction

1.1 Terms of Reference

JBA Consulting was commissioned by West Berkshire Council (WBC) to undertake a Water Cycle Study (WCS) to inform the council's emerging Local Plan Review. This study assesses the potential issues relating to future development across West Berkshire and the impacts on water supply, wastewater collection and treatment and water quality.

Unmitigated future development and climate change can adversely affect the environment and water infrastructure capability. A WCS will provide the required evidence, together with an agreed strategy to ensure that planned growth occurs within environmental constraints, with the appropriate infrastructure in place in a timely manner so that planned allocations are deliverable.

This report builds on the Phase 1 Scoping Study delivered in 2020, assessing additional sites not included in Phase 1, and updating each assessment where appropriate. Phase 2 also addresses water quality and environmental impact.

1.2 Impacts 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.

1.3 Water Cycle Study Guidance

New guidance on Water Cycle Studies[1] has been published by the Environment Agency in between Phase 1 and 2, changing the three-phase structure to a two-phase structure. The principle of the assessments, and content remains largely unchanged and so there is no change to scope of the West Berkshire WCS as a result of the new guidance.

1.4 Study Area

West Berkshire covers an area of approximately 704km^2 and has a population of 158,450 reported in the 2011 census. The main urban areas are Newbury, Thatcham, Hungerford, Pangbourne and Lambourn.

West Berkshire is located within the Thames river basin with the majority of the population living within the Kennet Valley. The study area contains the Rivers Thames, Lambourn, Kennet, Pang, Bourne and the Kennet and Avon Canal.

Thames Water (TW) supply water to the whole of the area, as well as providing wastewater services.

1 Water Cycle Study Guidance, Environment Agency (2021). Accessed online at: https://www.gov.uk/guidance/water-cycle-studies on: 21/05/2021

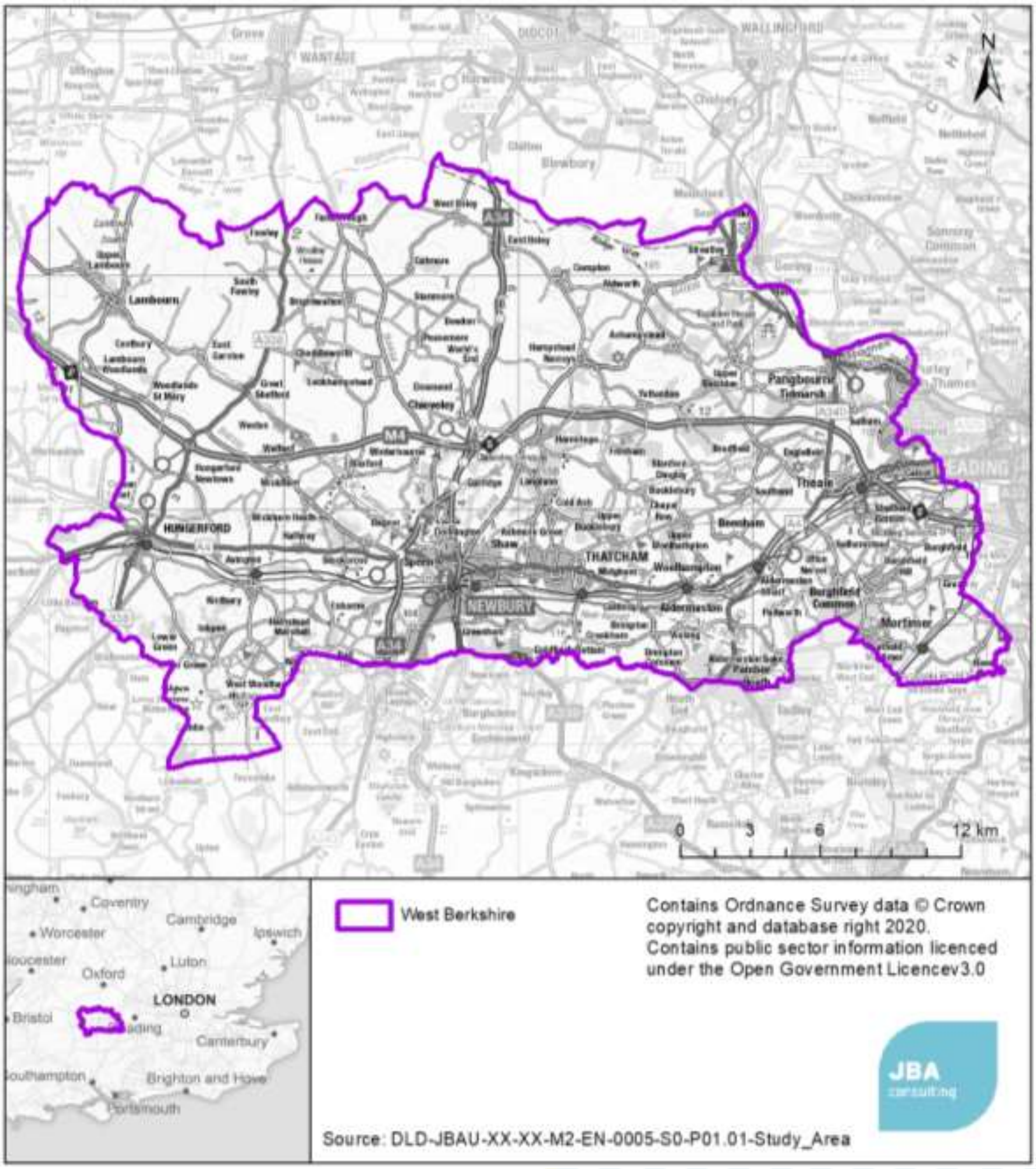

Figure 1.1 West Berkshire WCS study area

1.5 Record of Engagement

1.5.1 Introduction

Preparation of a WCS requires significant engagement with stakeholders, within the Local Planning Authority area, with water and wastewater utilities, with the Environment Agency, and where there may be cross-boundary issues, with neighbouring local authorities. This section forms a record of engagement for the WCS.

1.5.2 Scoping Study Engagement

The preparation of the Phase 2 WCS was supported by the following engagement:

Inception Meeting

Engaged Parties	West Berkshire Council Environment Agency Thames Water
Details	Discussion of project scope and methodology

Collaboration with Water and Wastewater Companies

Engaged Parties	Thames Water
Details	Water company assessments of water and wastewater infrastructure and capacity constraints.

2 Future Growth in West Berkshire

2.1 Growth in West Berkshire

The following section summarises how West Berkshire is expected to grow during the plan period and allows a forecast to be created that can used to estimate the volume of water and wastewater required in the future and assess the impact of the resulting pressure on water infrastructure.

This forecast consists of:

- Allocations - sites allocated in the existing Local Plan, or which are to be considered further for allocation in the Local Plan Review
- Committed sites – unallocated sites which have grant of planning permission
- Recent completions – sites completed in the last year that may not yet appear in flow data provided by the water companies
- Windfall – sites that have not been specifically identified in the Local Plan. They normally comprise previously developed sites that have unexpectedly become available
- Neighbouring authority growth – growth served by infrastructure within or shared with the study area

West Berkshire Council provided information on expected growth during the plan period which was collated into a forecast for housing and employment. This is summarised in Appendix A and the locations of sites identified in the study are shown in Figure 2.1.

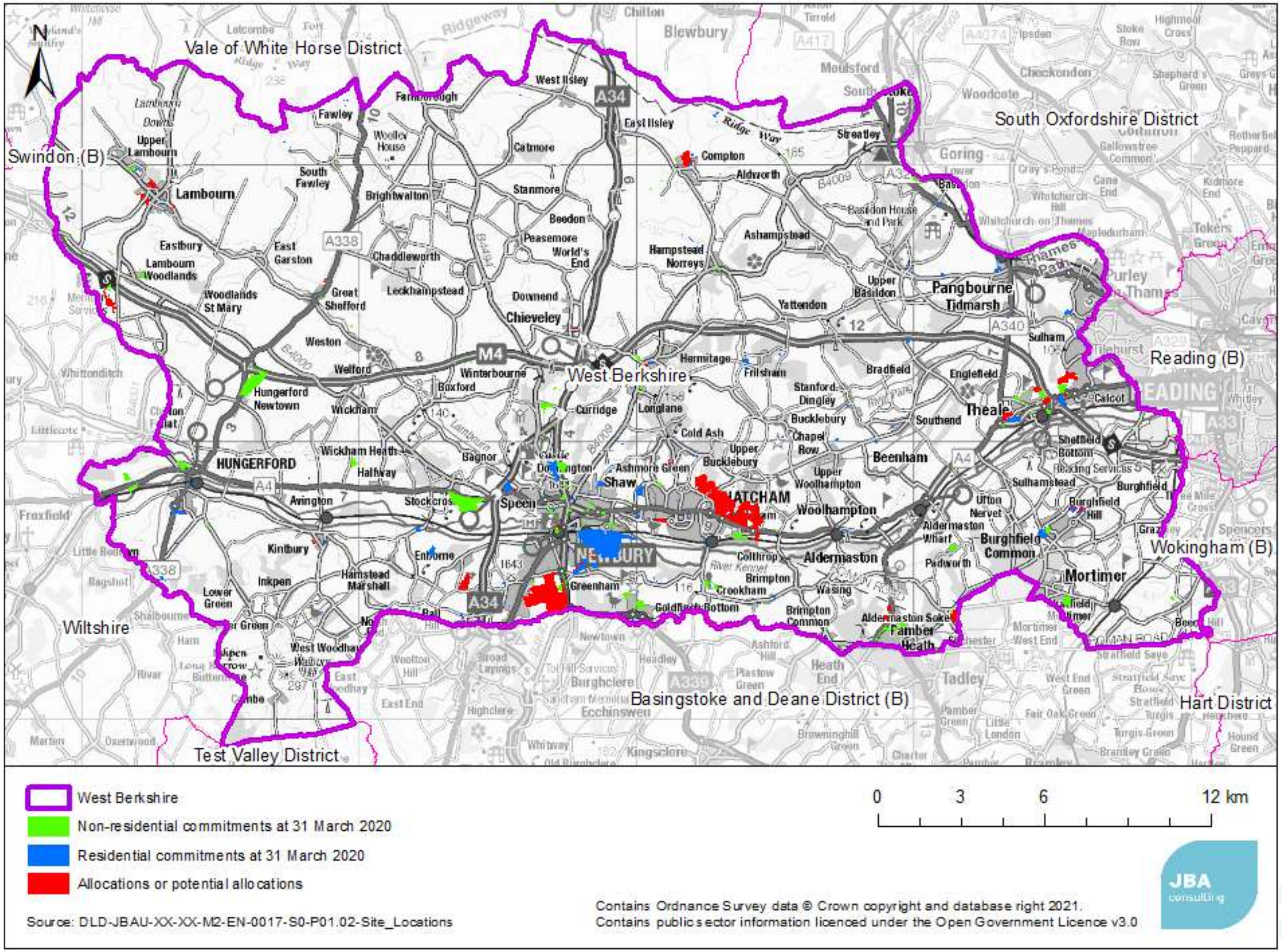

Figure 2.1 Potential development sites in West Berkshire

The NPPF expects local authorities to follow the standard approach for assessing local housing need, unless exceptional circumstances justify an alternative approach. In West Berkshire this results in a housing need of 520 dwellings per annum (pa). This figure is reviewed annually to take into account newly published household projections and affordability ratios.

Because this figure will change annually, WBC have identified its requirement as a range rather than a single figure. The range defined for the Local Plan Review consultation in December 2020 was 520 to 575 dwellings pa (8,840 to 9,775 homes between 2020-37).

The growth forecast provided by WBC in Phase 1 was updated with proposed Local Plan Review (LPR) allocations, commitments (at March 31st 2020) and extensions to Designated Employment Areas (DEAs). This is summarised in Table 2.1 below. Windfall and neighbouring authority growth was unchanged from the Phase 1 study.

Table 2.1 Summary of Growth in West Berkshire (2020 – 2037)

Type of Growth	Number of Homes	Employment Floorspace – all types (m^2)
Proposed Allocations	6,344	95,700
Commitments (Unallocated sites with planning permission)	6,576	268,300
Small site windfall allowance*	2,020	N/A
TOTAL	**14,940**	364,000
Housing need 2019-2037	8,840 – 9,775	N/A

** Though the contribution from large and medium unallocated sites is significant, WBC consider that these should not be included within the windfall allowance. Development of large, and to a lesser extent, medium sites varies significantly from year to year.*

2.2 Growth Outside of West Berkshire

The sewer catchments provided by Thames Water were used to identify neighbouring Local Planning Authority (LPA) areas that may be served by infrastructure within or shared with West Berkshire. Reading, Wokingham and Basingstoke and Deane all share infrastructure with West Berkshire. Published information from each LPA was then used to inform an estimate of growth. This was added to the growth forecast collated from information within the study area. Where there was no trajectory specified by the neighbouring councils, committed development was spread evenly over the next five years (2019/20 to 2023/24) and Local Plan development was spread evenly from 2019/20 to the end of the Local Plan period.

Table 2.2 Summary of Neighbouring LPA growth

LPA	WwTW	Proposed number of dwellings during plan period	Employment floorspace (m^2)	Time Period
Reading Borough Council	Reading	15,960	201,215	2013 - 2036
Wokingham Borough Council	Reading	12,310	18,500	Assumed 2020-2036
Basingstoke and Deane Borough Council	Silchester	30 (commitments)	0	Assumed 2020-2025

The following authorities border West Berkshire but do not share significant water infrastructure:

- South Oxfordshire
- Vale of White Horse
- Wiltshire
- Test Valley

3 Water Resources and Water Supply

3.1 Introduction

The aim of the water resources assessment is to ensure that sufficient water is available in the region to serve the proposed level of growth, and that it can be abstracted without a detrimental impact on the environment, both during the plan period and into the future.

The Phase 1 Report characterised the study area, identifying the key surface water and groundwater bodies, and local geology and summarises the potential of water resource and supply across West Berkshire. As there is no change in the overall housing demand in Phase 2, no further assessment has been undertaken in this report. The Phase 1 conclusions and recommendations are re-stated below.

3.2 Phase 1 Conclusions

West Berkshire contains two water resource zones, which are classified by the Environment Agency as being under serious water stress, justifying as a minimum the more stringent target of 110l/p/d under building regulations. This is supported by the River Basin Management Plans and aligns with the National Water Resources Framework national target.

WBC may want to consider going further than the 110l/p/d water efficiency target particularly in larger strategic developments. Elsewhere in the south east, Southern Water have committed to achieving a water demand of 100l/p/d day across their supply region by 2040 and have advised councils in their area to adopt this as policy for new developments in their local plan, and to achieve 80l/p/d in strategic developments. This approach was supported in that area by South East Water, SES Water, the Environment Agency and Natural England.

Policies to reduce water demand from new developments, or to go further and achieve water neutrality in certain areas, could be defined to reduce the potential environmental impact of additional water abstractions in West Berkshire, and also help to achieve reductions in carbon emissions.

A comparison was carried out between the level of growth anticipated in each water company's water resource management plan, and West Berkshire's housing need. The WRMP was found to be broadly in line with growth projections of WBC.

West Berkshire's growth forecasts were shared with Thames Water who were asked to comment on the availability of water resources to serve the expected level of growth. Whilst they provided a detailed water supply infrastructure assessment, they referred to their WRMP for comments on water resources.

3.3 Recommendations

The recommendations for water resources are provided in Table 3.1 below.

Table 3.1 Recommendations for water resources

Action	Responsibility	Timescale
Continue to regularly review forecast and actual household growth across the supply region through WRMP Annual Update reports, and where significant change is predicted, engage with Local Planning Authorities.	TW	Ongoing
Provide yearly profiles of projected housing growth to water companies to inform the WRMP update.	WBC	Ongoing
The concept of water neutrality has the potential to provide a benefit in	WBC, EA, TW	In Local Plan Review and

Action	Responsibility	Timescale
improving resilience to climate change and enabling all waterbodies to be brought up to Good status. Explore further with the water companies and the Environment Agency how the Council's planning and climate change policies can encourage this approach.		Climate Change Action Plan
Strategic residential developments, and commercial developments should consider incorporating greywater recycling and/or rainwater harvesting into development at the master planning stage in order to reduce water demand.	WBC, TW	In Local Plan Review

4 Water Supply Infrastructure

4.1 Introduction

An increase in water demand due to growth can exceed the hydraulic capacity of 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. A site-by-site assessment of the potential allocations was undertaken by Thames Water and presented in Phase 1. This has been updated in Phase 2 to remove sites no longer being considered, and to add sites not assessed in Phase 1.

4.2 Methodology

Thames Water were provided with all of the allocations and potential allocations in a GIS format, alongside a spreadsheet containing all of the relevant site details (number of dwellings, employment floorspace etc). They were asked to provide a Red/Amber/Green (RAG) assessment alongside site specific comments for each site.

A relative ranking - red to green was provided based on a consideration of water treatment capacity, storage and bulk transfer capacity, and water main capacity. Sites with a "green" assessment Thames Water consider to be most suitable, "amber" next suitable, and "red" least suitable from a water supply perspective. It can be thought of an indication that further modelling and/or provision of infrastructure would be required in order to serve that development. It does not mean that development could or should not take place in that location.

In addition to this, Thames Water also provided an assessment of the impact on the local distribution network based on the size of the development site.

4.3 Results

Table 4.1 summarises the RAG assessments made by Thames Water. Where significant issues were identified, they are described in more detail in Table 4.2.

Table 4.1 Summary of Thames Water RAG assessment for water supply

RAG Score	Number of sites	Number of homes	Employment land (m^2)
Green	33	3,371	70,332
Amber	12	1,273	28,400
Red	2	1,700	0

Table 4.2 Sites with specific water supply issues

Affected site	TW Comment	Explanation / Recommendation
SP16, Sandleford Park, Newbury	*"This development has its own strategic modelling report. Investment options review complete. It is above the capacity of wash common tower to supply. Likely to require phasing with new main from Enborne Grange WTW but within the resource capability and mains reinforcement. Planned investment under AMP7 business plan."*	Whilst this has been given a Red score and requires investment by TW to deliver the required additional capacity, this has been the subject of a modelling report already and a solution exists to resolve this issue.

Table 4.3 summarises the local distribution network assessment provided by Thames Water. No network modelling has been undertaken to form this assessment which is based purely on the size of development sites. In general sites with less than 20 dwellings can be accommodated with minimal impact on the network and have therefore been given a "green score". Sites containing between 20 and 50 dwellings have been given an "amber" score and may require some reinforcement of the network depending on location and the capacity of the existing network. Sites larger than 50 dwellings are likely to have an impact on the existing network and require network reinforcement in order to avoid any detrimental effect on existing customers.

Table 4.3 Summary of Thames Water assessments of the local distribution network

RAG Score	Number of sites	Number of homes	Employment land (m^2)
Green	14	2,615	3,032
Amber	12	395	39,200
Red	21	3,334	56,500

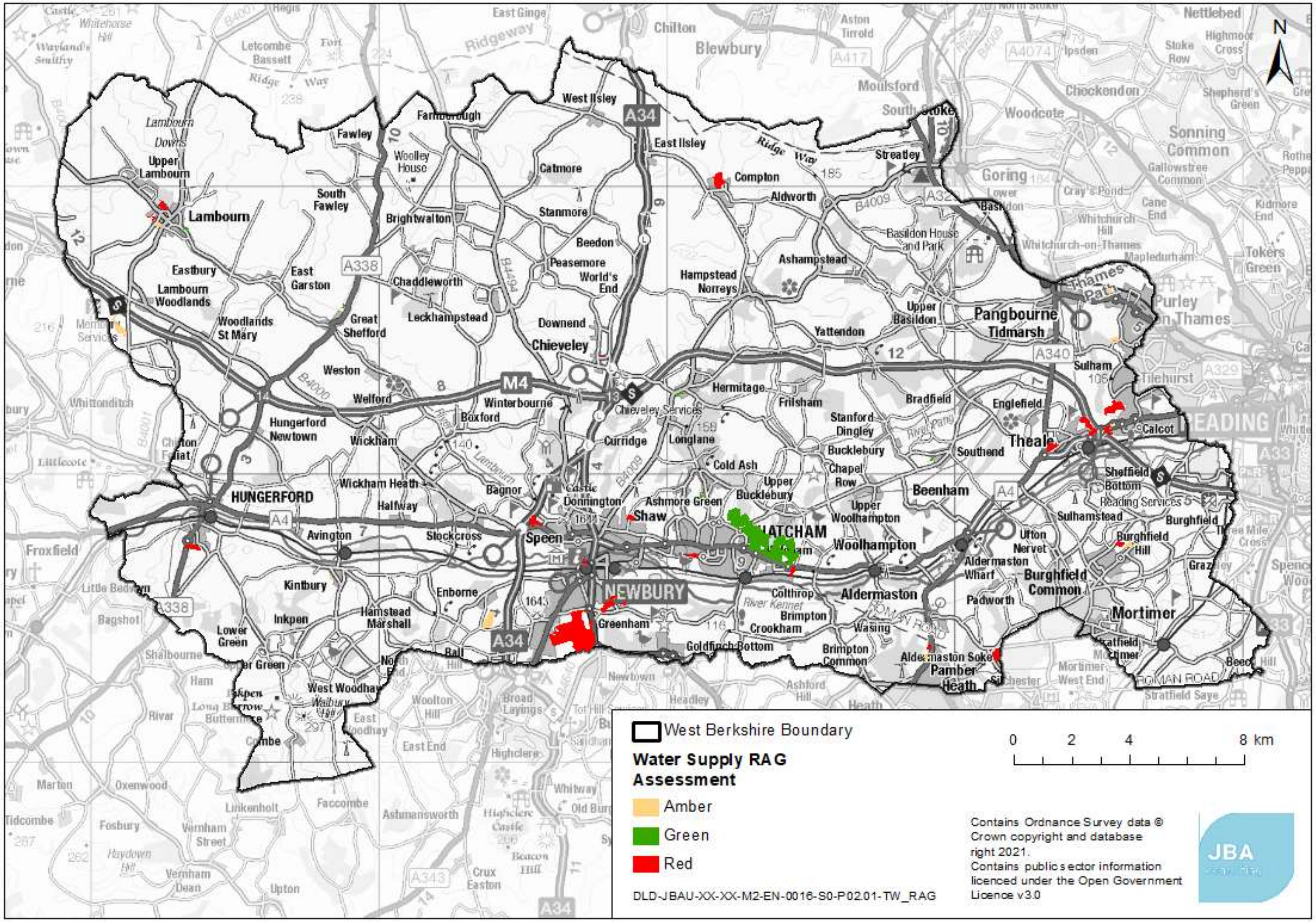

Figure 4.1 Water supply network assessment (Thames Water)

4.4 Conclusions

- Allocations and potential allocations across the study area were reviewed by Thames Water and given a relative scoring based on the impact on the water supply network.
- Thames Water identified a number of sites where further modelling and / or upgrades to the network would be required in order to serve those sites. Should these sites be allocated, delivery must be aligned with provision of these upgrades and WBC should engage with TW early to enable infrastructure upgrades to be constructed prior to occupation of new developments.
- Once the Local Plan Review has been adopted, WBC should provide an update to TW to enable further modelling to be undertaken if necessary.

4.5 Recommendations

Table 4.4: Recommendations for water supply infrastructure

Action	Responsibility	Timescale
Consider the need for additional water supply infrastructure when selecting sites for allocation in the Local Plan Review.	WBC	During Local Plan Review process
Development of sites indicated as requiring further modelling or upgrades to capacity should be aligned with provision of infrastructure. Early collaboration between WBC, developers and TW is required.	WBC TW Developers	Ongoing
TW should advise WBC of any strategic water resource / supply infrastructure required within the study area where these may require safeguarding of land to prevent other types of development occurring.	TW	During Local Plan Review process

5 Wastewater Collection

5.1 Introduction

Thames Water are the Sewerage Undertakers (SU) for the whole of West Berkshire. The role of the sewerage undertaker includes the collection and treatment of wastewater from domestic and commercial premises, and in some areas, it also includes the drainage of surface water from building curtilages to combined or surface water sewers. It excludes, unless adopted by the SU, systems that do not connect directly to the wastewater network, e.g., Sustainable Drainage Systems (SuDS) or highway drainage.

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

Another issue when considering sewer capacity is the volume of groundwater infiltration. This is where groundwater enters the public and private sewerage systems through cracks, holes, or faulty joints. In catchments where there is significant groundwater infiltration, capacity in the sewer is used up in the same way as the presence of a surface water misconnection. Under storm conditions this increases the likelihood of sewer flooding or sewage overflows into watercourses. In some West Berkshire catchments prone to significant groundwater infiltration into sewers, there are 'unavoidable discharges', where water is allowed to flow from, or is pumped from foul sewers overloaded with infiltration, in order to prevent flooding. These are being managed through Infiltration Management Plans, in line with Environment Agency policy.

A site-by-site assessment of the potential allocations was undertaken by Thames Water and presented in Phase 1. This has been updated in Phase 2 to remove sites no longer being considered, and to add sites not assessed in Phase 1.

Information on the frequency of operation of storm overflows in the study area is also presented.

5.2 Methodology

5.2.1 Network Capacity Assessment

As in the water supply network assessment, Thames Water were provided with the list of proposed allocations. Using this information, they were asked to assess each site using the range of datasets they hold. Where appropriate TW also provided site specific comments.

A red RAG score given by Thames Water reflects the presence of sewer flooding, CSO spills or pollution events in the vicinity of the site, on the assumption that an increase in wastewater flows from development would make those occurrences more likely in the future. It also takes into account the size of the site, with larger sites more likely to exacerbate existing issues in the network. Groundwater infiltration in the sewerage network was also taken into account.

A red assessment does not reflect a "showstopper" and the water companies have a statutory duty to serve new development under the Water Industry Act 1991 – but they show where the most amount of new infrastructure or network reinforcement will be required.

An amber assessment indicates where further modelling may be required to understand local capacity in the network, and a green assessment indicates that no constraints have been identified.

It should be noted that this assessment does not replace appropriate assessments or modelling as part of developer engagement with the sewerage undertaker, evidence of which should be demonstrated to the LPA as an application progresses through the planning process.

5.2.2 Storm overflows

The Storm Overflow Taskforce[2] has agreed a long-term goal to end the damaging pollution caused by the operation of storm overflows. An important component of this is the monitoring of overflows, and a target has been set to monitor the frequency and duration of operation at all storm overflows by 2023[3]. This is called Event Duration Monitoring (EDM). The EDM dataset (based on the 12,000 storm overflows monitored in 2020) has been used to provide information on storm overflows in West Berkshire.

The EA have set a threshold of 60 operations per year above which a storm overflow should be investigated. Those identified as operating more than 60 times in 2020 are identified.

5.3 Results

5.3.1 Foul Sewer Network Assessment

Thames Water carried out an assessment of the sewer network capacity at the sewer catchment level, providing a RAG scoring for all the allocations and potential allocations in that catchment. These can be found in full in Appendix A.

It should be noted that this assessment refers to capacity in the sewer network and not capacity at the receiving WwTW.

At many of the sites scored as red or amber, network reinforcement would be required in order to serve growth during the local plan period. Typically, a network upgrade for a large-scale development could take 18 to 24 months to deliver depending on the complexity of the scheme. This needs to be factored in when phasing development, and early engagement with TW is recommended to ensure that any required network reinforcement is in place prior to occupation of development sites.

Table 5.1 Summary of Thames Water assessment of foul sewer network capacity

RAG Score	Number of sites	Number of homes	Employment land (m^2)
Green	11	985	0
Amber	21	3,451	23,032
Red	14	1,908	48,100

2 Made up of Defra, the EA, Ofwat, Consumer Council for Water, Blueprint for Water and Water UK
3 Event Duration Monitoring – lifting the lid on storm overflows, Environment Agency (2021). Accessed online at: https://environmentagency.blog.gov.uk/2021/03/31/event-duration-monitoring-lifting-the-lid-on-storm-overflows/ on: 09/07/2021

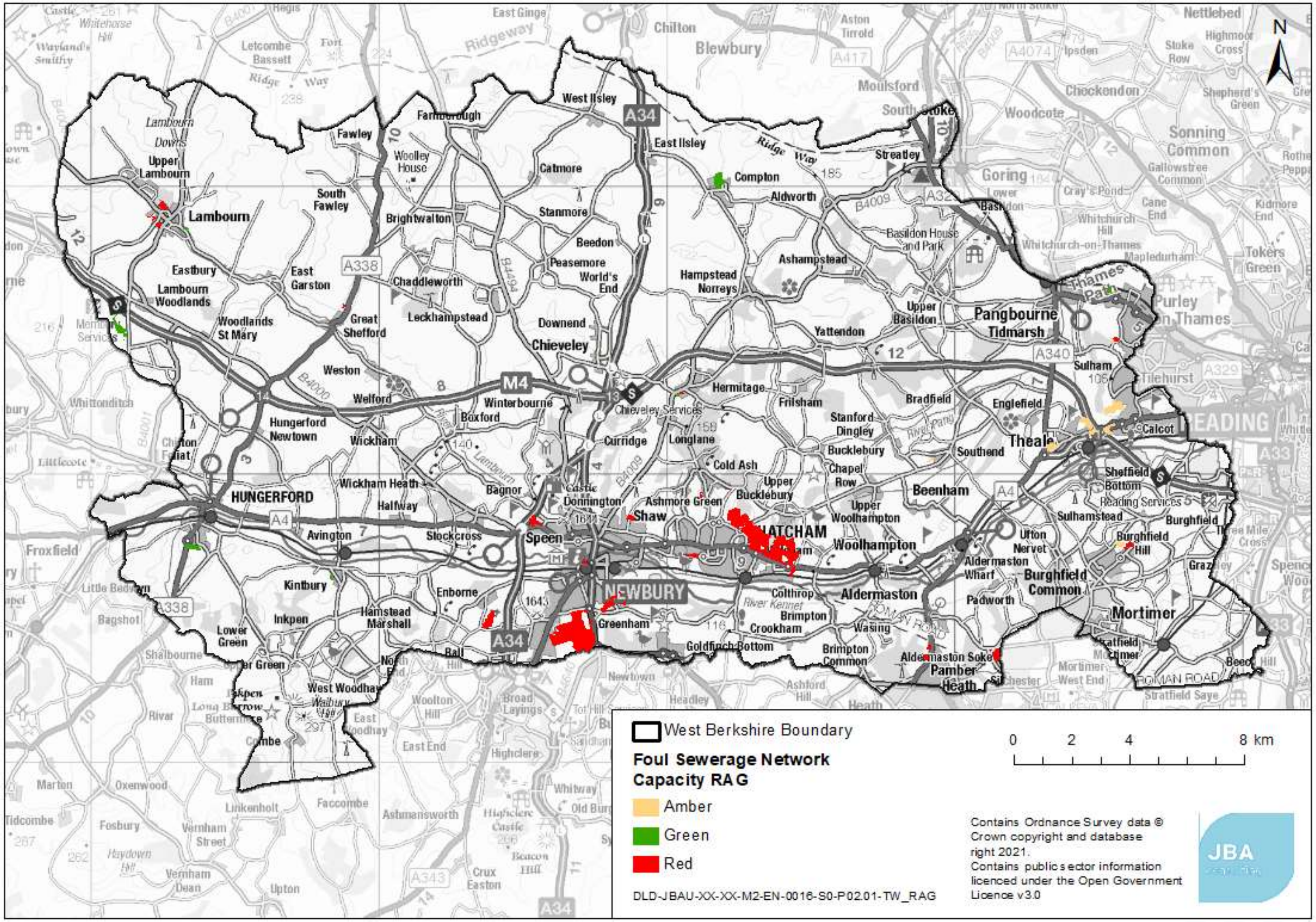

Figure 5.1 Foul sewer network assessment (Thames Water)

5.3.2 Storm overflows

Within the study area there is only one storm overflow recorded on the network in the Consented Discharges to Controlled Waters with Conditions database, but several storm overflows are located at WwTWs. The location of these is shown in Figure 5.2 below.

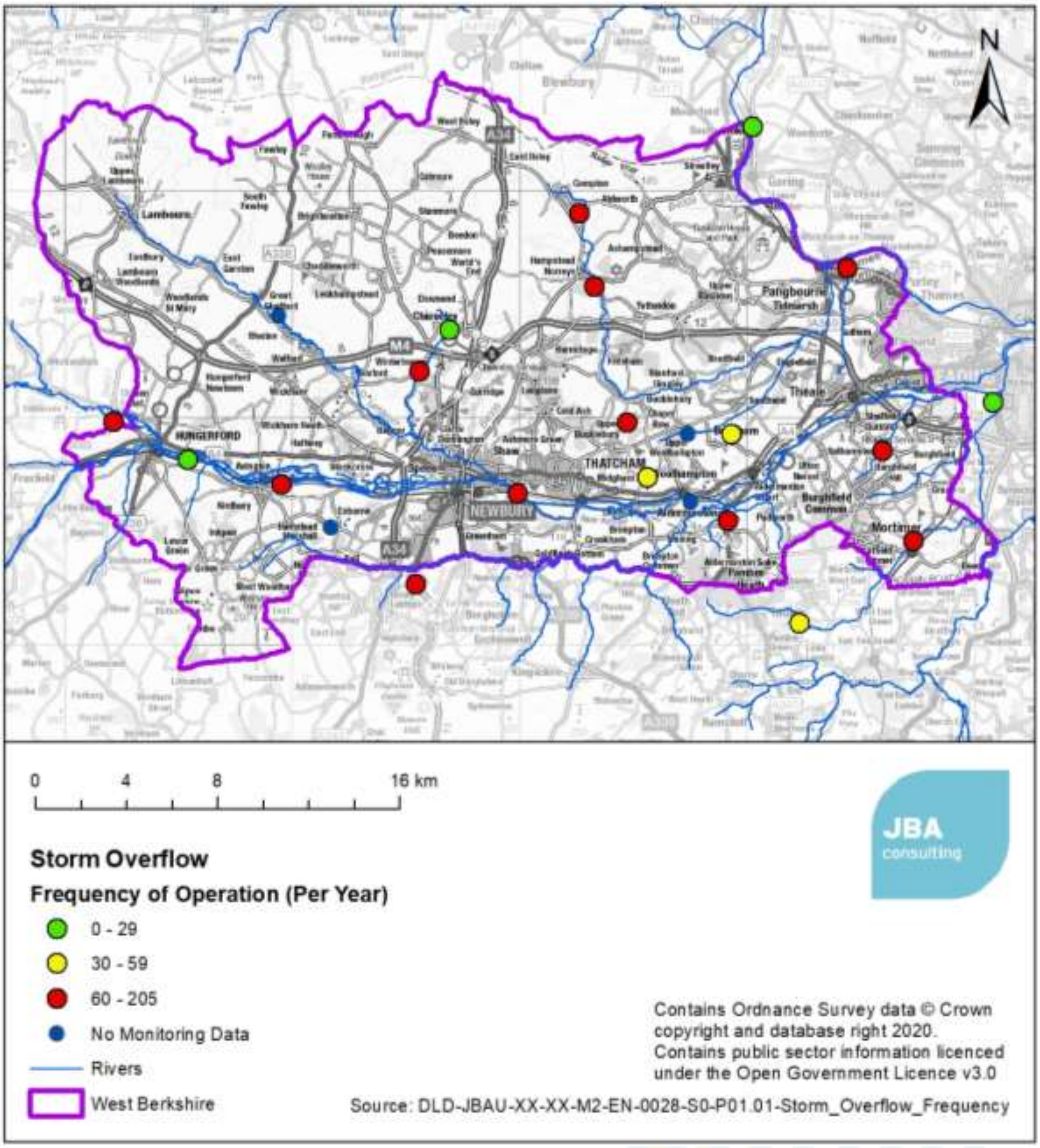

Figure 5.2 Frequency of storm overflow operation

It can be seen that operations of many overflows in West Berkshire are above the threshold of 60 operations in a year which would trigger an investigation. This is summarised in Table 5.2.

Table 5.2 Storm overflow operations and duration

Storm overflow	Permit Ref.	Outlet Grid Ref.	Duration in 2020 (hours)	% of year overflow operated	Number of operations in 2020
Aldermaston	TEMP.2345	SU5912065510	1157.19	13%	141
Beenham (Keales Copse)	TEMP.2382	SU5930069301	172.02	2%	32
Bucklebury	TEMP.2421	SU5470069801	496.61	6%	76
Burghfield	TEMP.2425	SU6592068570	3227.18	37%	143
Chieveley	TEMP.2475	SU4690073901	43.62	0%	4
Chilton Foliat	TEMP.2478	SU3188070100	594.08	7%	71
Compton	CAWM.0012	SU5260079000	1111.44	13%	74
East Shefford	CNTD.0032	SU3940074501	2753	31%	121
Goring	TEMP.2616	SU6020082901	0	0%	0
Hampstead Norreys	TEMP.2647	SU5320075730	4111.95	47%	204
Hungerford	CSSC.2335	SU3538068200	81.25	1%	15
Kintbury	TEMP.2706	SU3950067101	1619.83	18%	83
Midgham	TEMP.2774	SU5567067400	205.52	2%	44
Stratfield Mortimer	TEMP.2783	SU6746064500	3222.12	37%	144
Newbury	TEMP.2805	SU4990066700	929.08	11%	61
Pangbourne	CTCR.2078	SU6440076600	377.84	4%	101
Reading	CAWM.0942	SU7113070720	267.41	3%	16
Silchester	CTCR.0959	SU6230061000	828.18	9%	43
Washwater	TEMP.2994	SU4540062700	1302.59	15%	90
Winterbourne	TEMP.3016	SU4550072080	1199.49	14%	108

Growth in areas where there is already a high level of storm overflow operation, could exacerbate the issue by increasing flows in the sewer network – both directly from wastewater and through runoff from surface water. Infiltration also increases the frequency and duration of storm overflow operation. Thames Water are in the process of preparing Groundwater Impacted Management Plans (GISMPs) in 56 catchments where infiltration is leading to prolonged discharges from WwTW storm tanks, CSOs and "unavoidable discharges." These are required by the Environment Agency to demonstrate how a water company will manage down these discharges over the medium and long-term[4].

4 Environment Agency Regulatory Position Statement for Discharges made from Groundwater Surcharged Sewers. Unpublished.

Within West Berkshire, Thames Water have already published GISMPs[5] in two catchments, as summarised in Table 5.3. Plans for further catchments will be published during 2021.

Table 5.3: Summary of published GISMPs in West Berkshire

Catchment	Overflows	Ongoing investigations / actions	Proposed interventions (subject to regulatory approval)
Compton	Extended periods of discharge at the WwTW and at various "unavoidable discharges" within the network during high groundwater events.	Modelling, water level monitoring, model calibration to refine high-risk zones, lift and look surveys, CCTV.	Minor works (2020-2023). If this is not sufficient to address the infiltration, TW will propose in their next business plan to undertake sealing of all sewers and manholes within high-risk groundwater zones (2023/24).
East Shefford	Extended periods of discharge at the WwTW and at various "unavoidable discharges" within the network during high groundwater events, in particular at Newbury Street and Oxford Street	Modelling, water level monitoring, model calibration to refine high-risk zones, lift and look surveys, CCTV. TW will deploy a mobile water treatment unit at Newbury Street, to treat discharges before they enter the river.	Minor works (2020-2023). If this is not sufficient to address the infiltration, TW will propose in their next business plan to undertake sealing of all sewers and manholes within high-risk groundwater zones (2023/24).

When developing a site, opportunities should be taken to separate foul and storm flow. This is particularly applicable to brownfield development sites with previously combined drainage systems.

5.4 Summary

It should be remembered that Thames Water as Sewerage Undertakers have a duty under Section 94 of the Water Industry Act 1991 to provide sewerage and treat wastewater arising from new domestic development. Except where strategic upgrades are required to serve very large or multiple developments, infrastructure upgrades are usually only implemented following an application for a connection, adoption, or requisition from a developer. Early developer engagement with water companies is essential to ensure that sewerage capacity can be provided without delaying development.

5 Thames Water – Drainage Plans. Accessed online at: https://www.thameswater.co.uk/about-us/regulation/drainage-plans on: 15/07/2021

5.5 Conclusions

Development in areas where there is limited wastewater network capacity will increase pressure on the network, increasing the risk of a detrimental impact on existing customers, and increasing the likelihood of sewer flooding. Early engagement with Thames Water is required, and further modelling of the network may be required at the planning application stage. Furthermore, if there are areas where the current network is a combined sewer system, further separation of foul and surface water may be required, as well as suitably designed SuDS.

The results in section 5.3.1 show that in order to serve the proposed growth in a number of settlements in West Berkshire, wastewater infrastructure and/or treatment upgrades would be required. Early engagement between developers, the Council and TW is recommended to allow time for the strategic infrastructure required to serve these developments to be planned.

5.6 Recommendations

Table 5.4: Recommendations from Wastewater Network Assessment

Action	Responsibility	Timescale
Early engagement between the council and TW is required to ensure that where strategic infrastructure is required, it can be planned in by TW.	WBC TW	Ongoing
Take into account wastewater infrastructure constraints in phasing development in partnership with the SU.	WBC TW	Ongoing
Developers will be expected to work with the sewerage undertaker closely and early in the planning promotion process to develop an outline Foul Drainage Strategy for sites to the satisfaction of the LPA that the development will not increase sewer flooding or the frequency or duration of storm overflow operation. The Outline Foul Drainage strategy should set out: What – What is required to serve the site? Where – Where are the assets / upgrades to be located? When – When are the assets to be delivered (phasing)? Which – Which delivery route is the developer going to use s104 s98 s106 etc. The Outline Drainage Strategy should be submitted as part of the planning application submission, and where required, used as a basis for a drainage planning condition to be set.	TW and Developers	Ongoing
Developers will be expected to demonstrate to the Lead Local Flood Authority (LLFA) that surface water from a site will be disposed using a sustainable drainage system (SuDS) with connection to surface water sewers seen as the last option. New connections for surface water to foul sewers will be resisted by the LLFA.	Developers LLFA	Ongoing

6 Wastewater Treatment

6.1 Wastewater Treatment Works in West Berkshire

Headroom at Wastewater Treatment Works (WwTW) can be eroded by growth in population or per-capita consumption, requiring investment in additional treatment capacity. As the volumes 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 consented effluent consents to achieve a "load standstill", i.e., ensuring that as effluent volume increases, the pollutant discharged does not increase. Again, this would require investment by the water company to improve the quality of the treated effluent.

Thames Water operate all the WwTWs serving growth across West Berkshire. The location of these WwTWs is shown in Figure 6.1 below.

Each development site identified by the council, alongside windfall and neighbouring authority growth was assigned to a WwTW using the sewerage drainage area boundaries provided by TW. Where a development site was not within a boundary, the nearest sewer catchment was chosen.

Actual connection of a development site to a particular WwTW may be different and will depend on the nature of access routes for new pipelines, the capacity of the receiving works, and the local sewer network.

Very small developments in rural areas may be suitable for on-site treatment and discharge, however the Environment Agency will not usually permit this where there is a public sewerage system within a distance calculated as 30m per dwelling.

The Phase 1 assessment assumed that every site identified in each catchment would be developed. The latest growth forecast has been used in Phase 2 to update the wastewater treatment assessment.

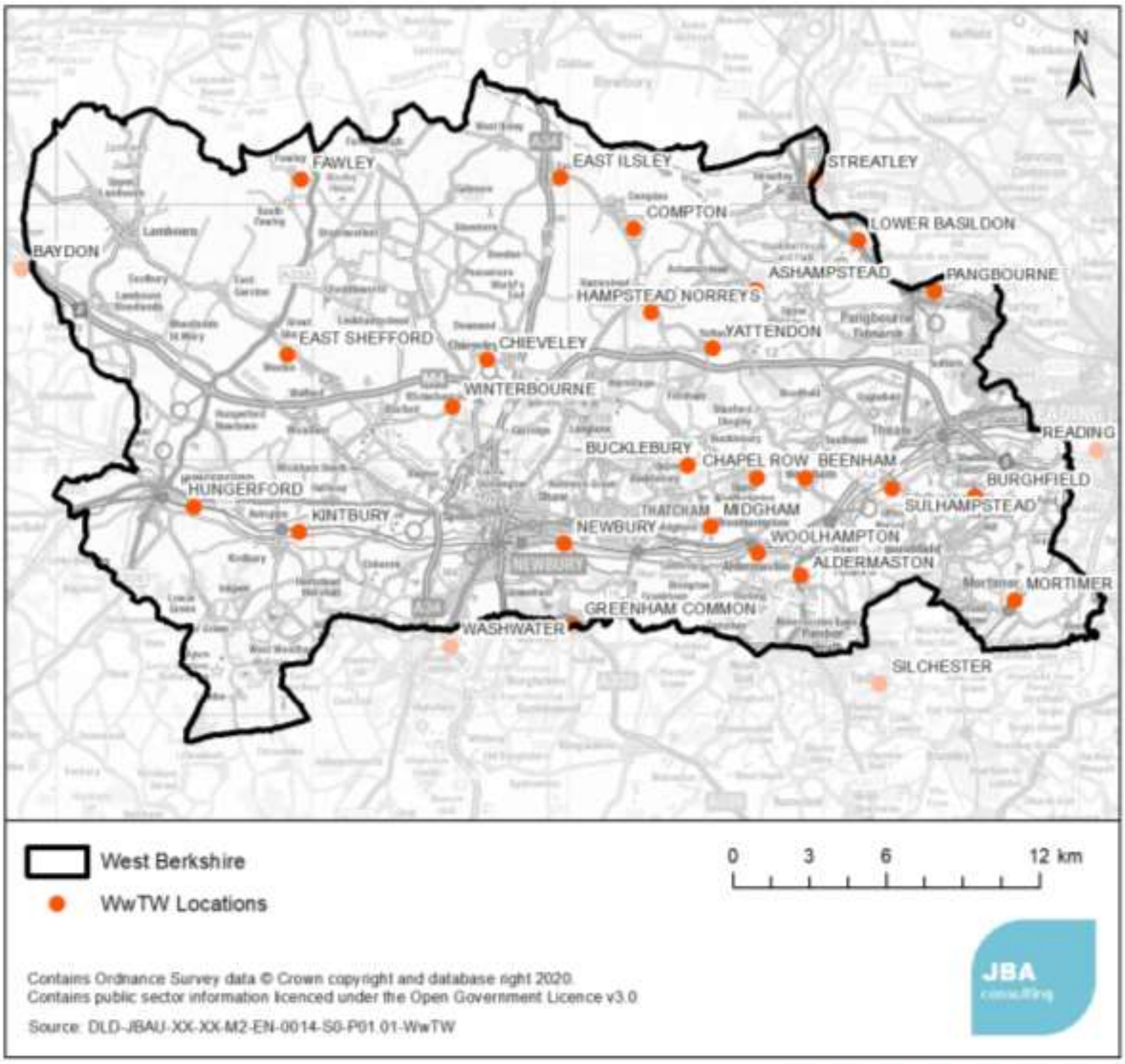

Figure 6.1 Location of WwTW serving growth in the study area

6.2 Methodology

Thames Water were provided with the proposed sites and the potential housing numbers and employment space for each site (see Appendix A). TW were then invited to provide an assessment of the receiving WwTW and provide any additional comments about the impacts of development.

The TW assessment consists of two factors, the hydraulic capacity of the WwTW (consented flow vs current flow) and the capacity of the WwTW to treat a given load. The assessment may also reflect upgrades already planned at WwTW.

A parallel assessment of WwTW capacity was carried out by JBA using measured flow data supplied by the water companies. The process was as follows:

- TW provided their Dry Weather Flow (DWF) statistics, and from this the 20th percentile (80% exceedance flow) for 2017-2019 was calculated. The flow data was cleaned to remove zero values and low outlier values which would bring the measured DWF down.
- Growth was assigned to a WwTW using the sewerage drainage area boundaries as described above.

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. Where sufficient headroom during the plan period exists, a green assessment was given. Should headroom be exceeded, an amber assessment was given to the WwTW. This assessment also takes into account the frequency of operation of storm overflows at WwTWs. Where the number of operations in 2020 is greater than or equal to 60, a red assessment was given. This reflects the likelihood that additional growth in this catchment will increase the frequency of storm overflow operation and increases the risk of environmental damage without appropriate measures by Thames Water.

6.3 Results

Thames Water provided a relative ranking – red to green – based on available capacity as well as other issues such as infiltration, water quality and odour. This is summarised in Table 6.1 below, and the full site by site assessment can be found in Appendix A.

Sites with a "green" assessment Thames Water consider to be most suitable, "amber" next suitable, and "red" least suitable from a wastewater treatment perspective. It can be thought of as an indication that further modelling and/or provision of upgrades would be required in order to serve that development. It does not mean that development could or should not take place in that location.

JBA also carried out a headroom assessment based on a comparison of the current discharge and permitted discharge, and whether future growth could be accommodated purely from a flow permit perspective. Both assessments are summarised by WwTW in Table 6.2. In many cases the two assessments differ as the JBA assessment only takes into account headroom in the flow permit. Three WwTWs were identified as likely to exceed or be close to exceeding their flow permit during the plan period.

It should be remembered that this assessment assumes that every existing allocation which has not yet been built out or proposed allocation within each sewer catchment is allocated representing a worst-case for each WwTW. In many cases the amount of development in each catchment will be less.

Within Table 6.2, two figures for housing growth and employment growth are quoted. The first is the total from allocations or potential allocations, the second in brackets is the total growth in that catchment including sites already in the planning system, recent completions, windfall and neighbouring authority growth.

Table 6.1 Summary of Thames Water assessment of WwTW capacity

RAG Score	Number of sites	Number of homes	Employment land (m^2)
Green	2	120	0
Amber	11	848	20,000
Red	33	5,376	48,100

Many of the WwTW would require an upgrade and / or an increase in the flow permit in order to accommodate growth (based on every identified site being delivered). Some of these are already included in TW's "go to green" plan – an investment programme to improve compliance and performance at WwTWs.

If an upgrade to a WwTW is already committed to within TW's business plan (water companies operate on a five-year investment cycle, the current cycle being AMP7 – 2020 to 2025) delivery of an WwTW could typically take 2-3 years as a general guide. This is highly dependent on the nature and complexity of the scheme. If it is not already contained within the business plan, it would need to be included in the next AMP period starting in 2025.

This has implications for phasing of development sites and early engagement with Thames Water is recommended so that infrastructure can be planned appropriately and delivered prior to occupation of development sites.

Thames Water provided an additional comment on growth around Newbury:

"Newbury is undergoing growth projects over the next 2+ years to accommodate more development. Any proposed development sites (that are too large for the network) will have to have a modelling study, which will take into account the Newbury growth project. Phasing of the sites will be able to begin at a pace that will not overtake the growth upgrades. Details on phasing amounts and timescales will be given once the development sites have gone through their modelling studies"

TW commentated that land may need to be safeguarded at Hungerford WwTW to provide the required upgrades to serve growth. An approximate area was defined and shown in Figure 6.2.

Safeguarding in this context is where an upgrade at a WwTW requires additional land and needs to be protected from other forms of development that may prevent the upgrade from being delivered.

Figure 6.2 Approximate area for safeguarding at Hungerford WwTW

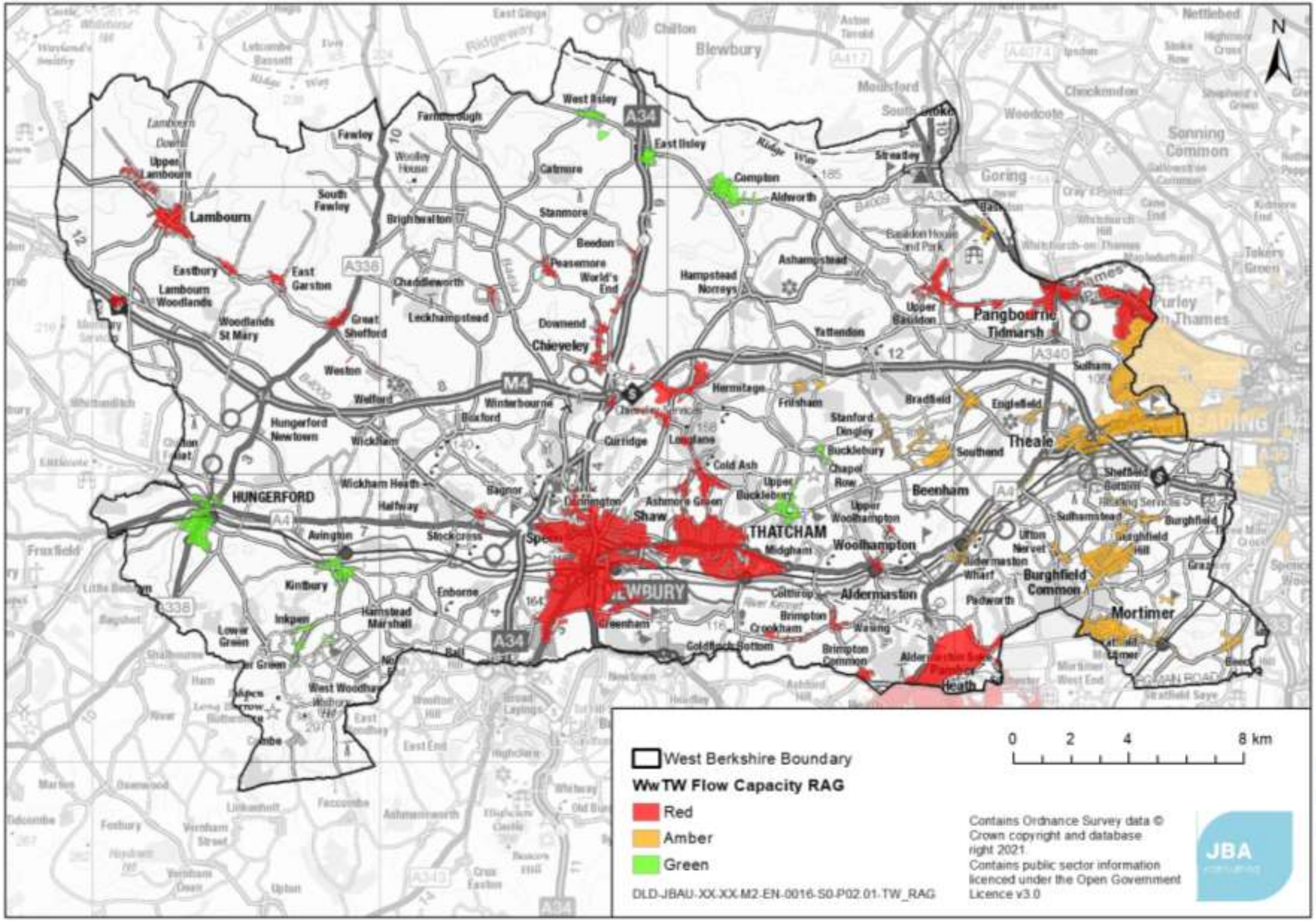

Figure 6.3 Thames Water treatment capacity assessment

Table 6.2: Summary of WwTW Flow Assessment

WwTW	Housing growth from allocations	Employment floor space from allocations (m^2)	JBA Headroom Assessment	TW RAG Assessment	Comments
Aldermaston	0 (1 total)	0 (1,005 total)	Green	Not assessed	No proposed allocations - no assessment required from TW Red assessment from JBA reflects high frequency of storm overflow operation
Ashampstead	0 (1 total)	0	Green	Not assessed	No proposed allocations - no assessment required from TW
Baydon	0	0 (440 total)	Green	Not assessed	No proposed allocations - no assessment required from TW
Beenham	0 (6 total)	0	Green	Not assessed	No proposed allocations - no assessment required from TW
Bucklebury	0 (6 total)	0	Red	Not assessed	No proposed allocations - no assessment required from TW Red assessment from JBA reflects high frequency of storm overflow operation
Burghfield	160 (467 total)	0 (861 total)	Red	Red	TW advised that there are actions planned to improve water quality for water framework directive compliance and "*System suffers from groundwater infiltration which manifests at the STW during wet winters*" Red assessment from JBA reflects high frequency of storm overflow operation
Chapel Row	0 (1 total)	0	Green	Not assessed	No proposed allocations - no assessment required from TW
Chieveley	40 (231 total)	0 (12,765 total)	Amber	Red	TW advised of a project under "Go to Green" to reduce risk of exceeding flow permit planned in 2020-25. This permit is being negotiated with the EA and actions planned to improve water quality for Habitats Directive Compliance. This may require land to be safeguarded.
Compton	140	0	Red	Red	TW advised of a scheme to improve the discharge from this WwTW as population growth has tipped this

WwTW	Housing growth from allocations	Employment floor space from allocations (m^2)	JBA Headroom Assessment	TW RAG Assessment	Comments
	(196 total)	(1,503 total)			WwTW into a higher threshold and it must comply with more stringent regulations under the Urban Waste Water Treatment Regulations (UWWTR). Additionally, the "*Network upstream suffers from groundwater infiltration which manifests itself at the works in wet winters*" Red assessment from JBA reflects high frequency of storm overflow operation
East Ilsley	0 (12 total)	0 (0 total)	Green	Not assessed	No proposed allocations - no assessment required from TW
East Shefford	172 (236 total)	0 (33,608 total)	Green	Red	TW - "*Network suffers from groundwater infiltration which manifests itself at the works during prolonged winters*" TW also advised that there is a "Go to Green" scheme at this WwTW and land may need to be safeguarded.
Fawley	0 (1 total)	0	Green	Not assessed	No proposed allocations - no assessment required from TW
Froxfield	0 (1 total)	0	Green	Not assessed	No proposed allocations - no assessment required from TW
Greenham Common	0 (1 total)	0 (72,067 total)	Green	Not assessed	No proposed allocations - no assessment required from TW
Hampstead Norreys	0 (1 total)	0 (1,795 total)	Red	Not assessed	No proposed allocations - no assessment required from TW Red assessment from JBA reflects high frequency of storm overflow operation
Hungerford	100 (322 total)	0 (12,864 total)	Amber	Green	TW advised of a scheme under "Go to Green" in AMP7 to "*improve compliance risk which will have a design horizon of 2026. Land would be safeguarded for Go to Green*" Flow compliance risk refers to the risk of

WwTW	Housing growth from allocations	Employment floor space from allocations (m^2)	JBA Headroom Assessment	TW RAG Assessment	Comments
					discharges from this WwTW exceeding the permitted discharge.
Kintbury	20 (58 total)	0 (958 total)	Red	Green	TW advised of a scheme under "Go to Green" in AMP7 to "*improve compliance risk which will have a design horizon of 2026*" Red assessment from JBA reflects high frequency of storm overflow operation
Leckhampstead	0 (1 total)	0 (360 total)	Green	Not assessed	No proposed allocations - no assessment required from TW
Lower Basildon	0 (3 total)	0	Green	Not assessed	No proposed allocations - no assessment required from TW
Midgham	0 (1 total)	0 (215 total)	Green	Not assessed	No proposed allocations - no assessment required from TW
Mortimer	0 (35 total)	0 (3,543)	Red	Not assessed	No proposed allocations - no assessment required Red assessment from JBA reflects high frequency of storm overflow operation
Newbury	4817 (10,641 total)	20,400 (116,901 total)	Red	Red	TW advised a "Go to Green" scheme is being planned but "*not yet briefed for AMP7. Awaiting impact assessment of increased development flows on the STW from Process modelling. Likely to need some kind of upgrade in AMP7 but do not have business approval at this stage*" Red assessment from JBA reflects high frequency of storm overflow operation
Pangbourne	95 (260 total)	0	Red	Red	TW advised of a scheme under "Go to Green" in AMP7 to "*improve compliance risk which will have a design horizon of 2026*" and "*Go to Green will require safeguarded land*" Red assessment from JBA reflects high frequency of storm overflow operation

WwTW	Housing growth from allocations	Employment floor space from allocations (m^2)	JBA Headroom Assessment	TW RAG Assessment	Comments
Reading	748 (28,190 - 2,229 total from WBC)	20,0000 (34,539 total)	Green	Amber	TW – "*Given the odour limits for the site, any encroachment nearer the current works would be risky*" The odour assessment did not identify any sites encroaching closer to the WwTW than current urban area.
Silchester	8 (15 total)	27,700 (53,932 total)	Green	Red	TW advised "*Site will require an upgrade in due course – would safeguard land*"
Streatley	0 (5 total)	0	Green	Not assessed	No proposed allocations - no assessment required from TW
Washwater	24 (34 total)	0 (268 total)	Red	Red	No comments provided by TW Red assessment from JBA reflects high frequency of storm overflow operation
Woolhampton	20 (87 total)	0 (891 total)	Green	Red	TW advised "*Requires an upgrade – would safeguard land*"

Note: The total number of homes and employment floor space includes recent completions, sites already in the planning system and growth within neighbouring authority areas.

6.3.1 Conclusions

Two assessments of WwTW capacity were undertaken:

- JBA performed a headroom assessment comparing the current DWF at each WwTW to the permitted flow and adding the additional effluent from growth in the local plan period.

  Three WwTWs in West Berkshire are predicted to, or already exceeding their flow permit during the plan period:

  - Chieveley
  - Hungerford
  - Newbury
- The JBA assessment also took into account the frequency of operation of storm overflows at WwTWs. At ten WwTWs, storm overflows operated more than 60 times in 2020. Further growth in these catchments, without the appropriate measures by Thames Water could increase the risk of environmental damage through increased operation.
- Thames Water carried out an assessment based on the relative suitability of development sites within each wastewater catchment, with the least suitable sites (those where the WwTW would require investment in order to serve growth) given a red or amber score, and those where minimal investment is required, or where investment is already planned, were given a green score. This assessment took into account capacity at the WwTW, water quality, odour and infiltration within the catchment.

Many of the WwTWs in the study area would require upgrades in order to serve growth during the plan period. WBC should consider the time taken to undertake these upgrades when phasing development and early engagement with TW is recommended to ensure required upgrades are in place prior to occupation.

6.4 Recommendations

Table 6.3: Recommendations for Wastewater Treatment

Action	Responsibility	Timescale
Consider WwTW capacity when selecting allocations for inclusion the Local Plan Review.	WBC	During Local Plan Review process
Consider the available WwTW capacity when phasing development going to the same WwTW.	WBC, TW, EA	Ongoing
Provide Annual Monitoring Reports to TW detailing projected housing growth.	WBC	Ongoing
TW to assess growth demands alongside other pressures on the wastewater network e.g. infiltration, as part of their wastewater asset planning activities, and feedback to the Council if concerns arise.	TW	Ongoing
TW to advise WBC of requirements for safeguarding land to enable WwTW expansions, in particular at East Shefford, Hungerford, Lower Basildon, Newbury, Pangbourne, Silchester and Woolhampton WwTWs.	TW	During Local Plan Review process

7 Odour Assessment

7.1 Introduction

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 fitted 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 nuisance. Phase 1 highlighted six sites that may be risk of nuisance odour, no new sites were identified in Phase 2. For completeness the sites identified in Phase 1 are listed below.

7.2 Results

Table 7.1 identifies the six sites within West Berkshire which fall within 800m of WwTW. The 800m buffer does not take into account the size of the works, the treatment processes present or the condition of the WwTW which can all affect the magnitude of the odour. Where there is already urban area closer to the treatment works than the proposed site, the nature of odour on the new site is likely to be known and reported so these sites represent are lower risk. There are no proposed sites which are closer to the WwTW than existing urban areas.

Sites that are given an amber assessment will not necessarily experience nuisance odour but should undergo an odour assessment as part of the planning process.

Table 7.1: Sites within 800m of WwTWs in West Berkshire

WCS Site Ref.	Site Address	WwTW	Distance (m)	WwTW Location in Relation to Site	Closer than existing urban area?
BAS1	Land off Reading Road, Lower Basildon	Lower Basildon WwTW	540	NW	No
BAS2	Land adjacent Reading Road, Lower Basildon	Lower Basildon WwTW	692	NW	No
KIN3	Land east of Kiln Farm, Kintbury, RG17 9XD	Kintbury WwTW	767	SW	No
THA9	Land at Lower Way Farm, Thatcham, RG19 3TL	Newbury WwTW	449	N	No
MID4	Land north of the A4 Bath Road, junction of New Hill Rd, Woolhampton	Woolhampton WwTW	594	NW	No
EI2	Land south of Fidler's Lane, East Ilsley	East Ilsley WwTW	480	W	No

7.3 Conclusions

Six sites across West Berkshire are close enough to a WwTW for there to be a risk of nuisance odour. If these sites were to be allocated in the Local Plan Review, an odour assessment is recommended as part of the planning process, funded by developers. The remaining sites have been given a rating of green.

7.4 Recommendations

Table 7.2: Recommendations from the Odour Assessment

Action	Responsibility	Timescale
Consider odour risk in the sites identified to be potentially at risk from nuisance odour	WBC	Ongoing
Carry out an odour assessment for sites identified as amber as part of the planning process and paid for by the developer.	Site Developers	Ongoing

8 Water Quality

8.1 Introduction

The Phase 1 WCS presented the current Water Framework Directive status of the waterbodies in West Berkshire recommending water quality modelling be undertaken in Phase 2 to assess the impact of growth on water quality.

8.2 Water quality modelling requirement

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.

The Environment Agency operational instructions on water quality planning and no-deterioration are currently being reviewed. Previous operational instructions[6] (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 ensures 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"[7] 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.
- **Could the development alone prevent the receiving watercourse from reaching Good Ecological Status (GES) or Potential?** Is GES possible with current technology or is GES technically possible after development with any potential WwTW upgrades.

The overall WFD classification of a water body is based on a wide range of ecological and chemical classifications. This assessment focuses on three physico-chemical quality elements; Biochemical Oxygen Demand (BOD), Ammonia, and Phosphate.

BOD – Biochemical Oxygen Demand

BOD is a measure of how much organic material – sewage, sewage effluent or industrial effluent – is present in a river. It is defined as the amount of oxygen taken up by micro-organisms (principally bacteria) in decomposing the organic material in a water sample

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6 Water Quality Planning: no deterioration and the Water Framework Directive, Environment Agency (2012). Accessed online at: http://www.fwr.org/WQreg/Appendices/No_deterioration_and_the_WFD_50_12.pdf on: 02/06/21

7 PRESS RELEASE No 74/15, European Court of Justice (2015). Accessed online at: https://curia.europa.eu/jcms/upload/docs/application/pdf/2015-07/cp150074en.pdf on: 02/06/21

stored in darkness for 5 days at 20°C. Water with a high BOD has a low level of dissolved oxygen. A low oxygen content can have an adverse impact on aquatic life.

Ammonia

Nitrogen is an essential nutrient required by all plants and animals for the formation of amino acids. In its molecular form nitrogen cannot be used by most aquatic plants, and so it is converted into other forms. One such form is ammonia (NH_3). This may then be oxidized by bacteria into nitrate (NO3) or nitrite (NO2). Ammonia may be present in water in either the unionized form NH_3 or the ionized form NH_4. Taken together these forms are called Total Ammonia Nitrogen.

Although ammonia is a nutrient, in high concentrations it can be toxic to aquatic life, in particular fish, affecting hatching and growth rates.

The main sources in rivers include agricultural sources, (fertilizer and livestock waste), residential sources (ammonia containing cleaning products and septic tank leakages), industrial processes and WwTWs.

Phosphate

Phosphorus is a plant nutrient and elevated concentrations in rivers can lead to accelerated plant growth of algae and other plants. Its impact on the composition and abundance of plant species can have adverse implications for other aspects of water quality, such as oxygen levels. These changes can cause undesirable disturbances to other aquatic life such as invertebrates and fish.

Phosphorus (P) occurs in rivers mainly as Phosphate (PO_4), which are divided into Orthophosphates (reactive phosphates), and organic Phosphates.

Orthophosphates are the main constituent in fertilizers used in agriculture and domestic gardens and provide a good estimation of the amount of phosphorus available for algae and plant growth and is the form of phosphorus that is most readily utilized by plants.

Organic phosphates are formed primarily by biological processes and enter sewage via human waste and food residues. Organic phosphates can be formed from orthophosphates in biological treatment processes or by receiving water biota.

Although it is phosphorus in the form of phosphates that is measured as a pollutant, the term phosphorus is often used in water quality work to represent the total phosphorus containing pollutants.

8.3 Summary of WFD status

Figure 8.1 shows the overall WFD classification for waterbodies in West Berkshire, showing that the majority currently have Moderate status, with the exception of the river Pang catchment that is mostly at Good status. Section 9 of the scoping report contains a detailed breakdown by waterbody of the current status for BOD, Ammonia and Phosphate.

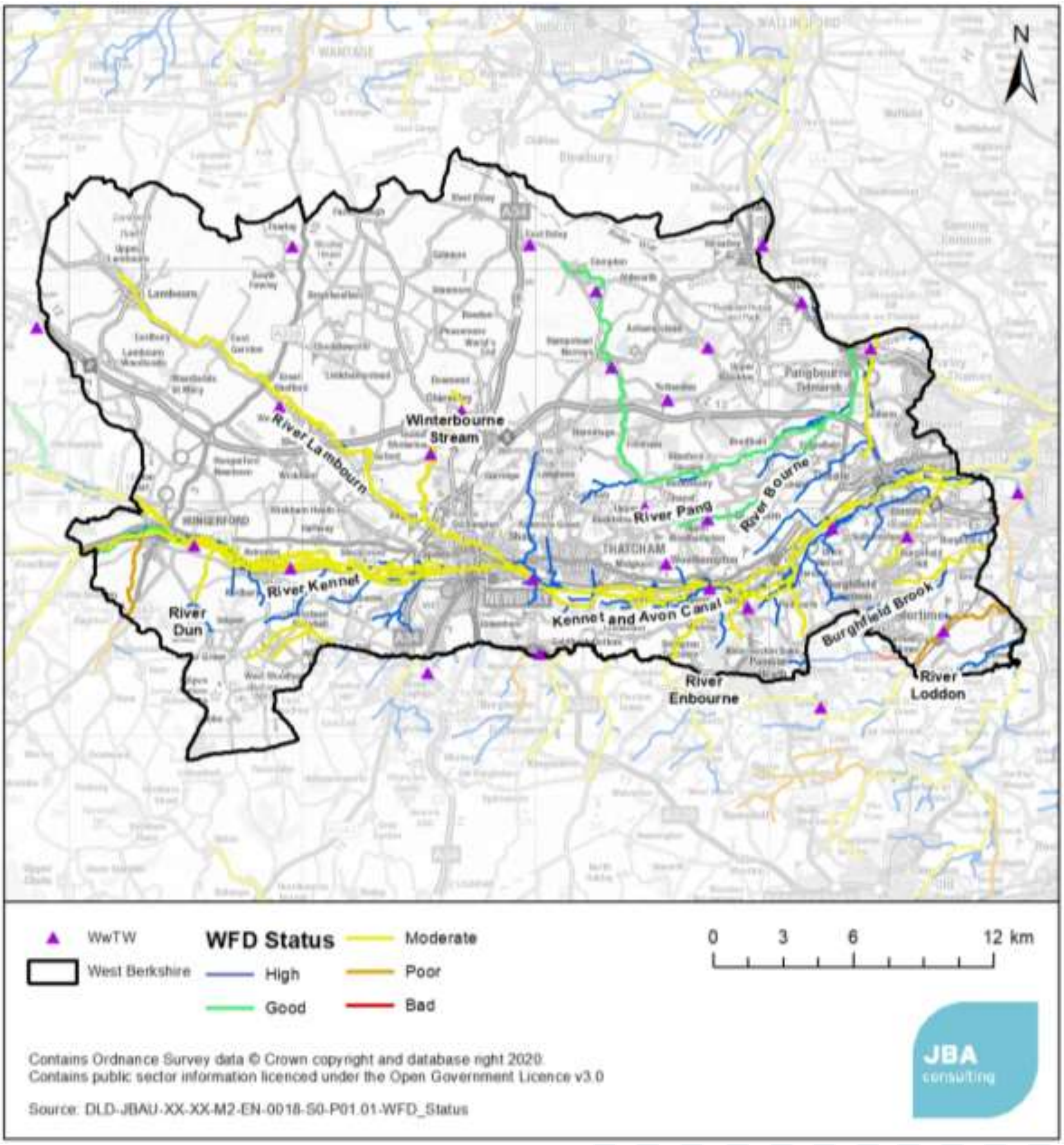

Figure 8.1: WFD status for waterbodies in the study area

8.4 Methodology

8.4.1 General Approach

SIMCAT is used by the Environment Agency to model water quality in rivers and identify where permit changes are needed to prevent deterioration or improve water quality as well as supporting decision-making to guide development to locations where environmental deterioration will be reduced. SIMCAT is a 1D stochastic, steady state model which represents inputs from point-score effluent discharges and the behaviour of solutes in the river.[8]

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

8 Cox. B. A. (2003) A Review of Currently Available in-Stream Water-quality models their applicability for simulating dissolved oxygen in lowland rivers. The Science of the Total Environment. 314 -316, 355 -377. Elsevier

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.

Within SIMCAT, the determinands modelled were Biochemical Oxygen Demand (BOD), Ammonia (NH_4) and Phosphorus (P).

The methodology followed is summarised in Figure 8.2 below. In this flow chart, all of the questions in the top row must be answered.

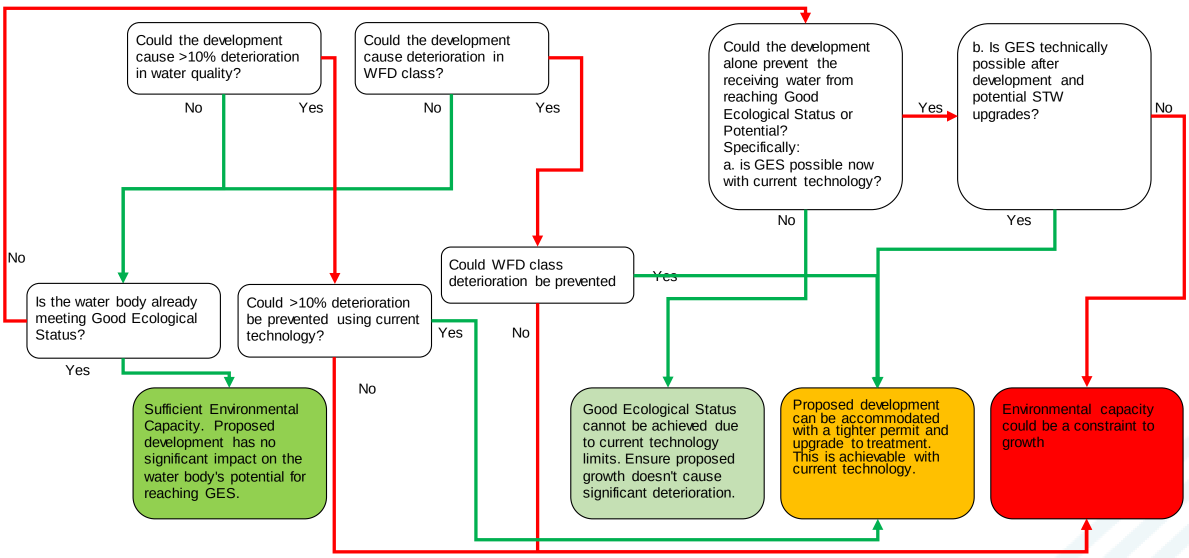

Figure 8.2 Water quality impact assessment following EA guidance

Where modelling indicated growth may lead to a deterioration in the watercourse, or where the watercourse is not currently meeting at least a 'Good' class for each determinant, the models were used to test whether this could be addressed by applying stricter discharge limits. In such cases, a Technically Achievable Limit (TAL) was considered.

The EA advised that the following permit values are achievable using treatment at 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 (90%ile): 1 mg/l
- BOD (90%ile): 5 mg/l
- Phosphorus (mean): 0.25 mg/l

This assessment did not take into consideration whether it is feasible to upgrade each existing WwTW to TAL due to constraints of costs, timing, space, carbon costs etc.

8.5 Data Sets

The datasets used to assess the water quality impact were as follows:

- Water quality, river and effluent flow data from within the Environment Agency SIMCAT model
- Current effluent flow data from Thames Water
- Future wastewater demand calculated from site information provided by West Berkshire Councils and a mean occupancy rate and per capita consumption provided by Thames Water

- Current reach specific WFD class limits for each determinant and tighter common standards monitoring guidance (CSMG) where appropriate for river reaches designated as SACs or SSSIs.
- TAL limits for each contaminant

8.6 SIMCAT Modelling Approach

8.6.1 Model setup

The study area is covered by the Thames SIMCAT model developed by the Environment Agency. Separate model files are used to represent Ammonia and BOD in one model, and Phosphate in the other. The models have been largely based on observed flow and quality data for the period 2010 to 2012. A widespread update of the models, and the resultant recalibration were not within scope of this project. It was therefore agreed with the EA to update just the effluent flow at WwTWs receiving growth in the study area. Consequently, the modelling work presented should be used to identify areas at risk of water quality deterioration, but not for permit setting.

Flow data from the last three years for each WwTW in the study area was supplied by Thames Water and used to update the model. Several of the WwTWs in the study area already had upgrades completed in AMP6 or planned in AMP7, which would be expected to improve water quality at those locations. These were therefore factored into the model by applying the updated permit limit where it was less than the current discharge in the model. The model was then run in its updated form to set a 2020 baseline.

Additional effluent flow from growth during the Local Plan Review period was added to current flow at WwTWs receiving growth and the model re-run as a future scenario.

Some smaller WwTWs within the model have descriptive permits which do not set specific numerical limits for DWF and effluent quality, and do not have flow monitoring in place. The models are calibrated to observed water quality measurements and represent the overall water quality in the catchment well, however at a local scale some of these smaller WwTWs are not well represented and do not have discharge data or have pollutant discharges modelled as a load in kilograms rather than an effluent flow and concentration. Four WwTWs that serve growth discharge via groundwater, and therefore have not been updated within the model.

8.6.2 No deterioration test

The results from the baseline and future versions of the model were compared to assess the predicted percentage deterioration for each of the modelled determinands. WFD targets for each river reach were provided by the EA and used to determine if there was a risk of a class deterioration.

Where a deterioration of 10% or greater was predicted or a change in class, a further version of the model was created where treatment processes at each WwTW were upgraded to the Technically Achievable Limit (TAL).

8.6.3 Good Ecological Status assessment

Where treatment at TAL and reductions in diffuse sources in the present day could improve water quality to achieve Good Ecological Status (GES), it is important to understand whether this could be compromised as a result of future growth within the catchment.

Guidance from the EA suggests breaking this down in to two questions:

a) Is GES possible now with current technology?

b) Is GES technically possible after development and any potential WwTW upgrades?

If the answer to questions a) and b) are both 'Yes' or 'No' then the development can be assessed as having no significant impact on the water bodies potential for reaching GES, i.e. the development alone is not preventing GES from being achieved. However, if the answer to a) is 'Yes' and the answer for b) is 'No' then development is having a significant impact, i.e., before development GES could be achieved with upstream improvements, and after growth the additional effluent from growth prevents GES being achieved.

Run type 9 within SIMCAT was used which assumes that upstream flow at each treatment works is at good ecological status. This simulates improvements being made in upstream water quality. The water quality of the discharge from each WwTW in order to maintain GES is then calculated by the model.

8.7 Summary of Modelling Results

The first test applied compares the future scenario to the baseline and assesses whether a significant deterioration in water quality occurs - either a 10% deterioration in water quality or a deterioration in WFD class. Where, a significant deterioration is predicted, the TAL scenario then assesses whether this deterioration could be prevented by improvements in treatment processes.

Table 8.2 below summarises the results of the water quality assessments. Where a "green" score is given, deterioration was less than 10% for each determinand, and no change in WFD class is predicted. Where an "amber assessment is given, a 10% deterioration or change in WFD class is predicted, but this could be prevented by improvements in treatment technology. In these cases, upgrades may therefore me required at that WwTW or at WwTW upstream.

A "red" assessment would be given where a significant deterioration in water quality is predicted, and it cannot be prevented by improvements in treatment processes.

Two of the 22 WwTWs serving growth during the plan period are predicted to experience a significant deterioration in one determinand, but there is no deterioration in WFD class. In both cases, this could be prevented by improvements in treatment processes.

Appendix B shows the predicted deterioration in water quality visually for Ammonia, BOD and Phosphate in the future, and the predicted deterioration if WwTWs were treating at the technically achievable limit.

Table 8.3 summarises the results of the GES assessment outlined in 8.6.3. Four different assessments are possible which are shown in Table 8.1 below:

Table 8.1 GES possible assessment results

Predicted to achieve GES after growth	Could achieve GES today with improvements in upstream water quality?	Could achieve GES in the future with improvements in upstream water quality?	Assessment Result
YES	N/A	N/A	**Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for meeting GES.**
NO	YES	YES	**Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.**
NO	NO	NO	**Good ecological status cannot be achieved due to current technology limits.**

Predicted to achieve GES after growth	Could achieve GES today with improvements in upstream water quality?	Could achieve GES in the future with improvements in upstream water quality?	Assessment Result
			Ensure proposed growth doesn't cause significant deterioration.
NO	YES	NO	**Environmental capacity could be a constraint to growth.**

If good ecological status is predicted to be achieved within the receiving waterbody following growth during the plan period, a green assessment is given. In this case, it can be said that there is environmental capacity to accommodate growth.

Where GES is not currently being achieved but could be achieved if upstream water quality were improved, then an amber score is given – growth could be accommodated without impacting the possibility of a waterbody achieving GES in the future.

Where GES cannot be achieved either today or in the future, despite upgrades in treatment processes to TAL, and improvements in upstream water quality, then a yellow assessment is given – and it can be said that GES cannot be achieved due to the limits of current technology. Growth alone is not predicted to prevent GES being achieved in the future.

Should GES be achievable today, but not in the future due to growth, a red assessment would be given, and it can be said that environmental capacity could be a constraint to growth, i.e. growth alone could prevent good ecological status being achieved in the future. This was not the case at any of the WwTWs in West Berkshire.

Table 8.2: Water Quality Model Results

WwTW	Housing growth over plan period (dwellings)	Employment growth over plan period (m^2)	Could the development cause a greater than 10% deterioration in WQ for one or more determinands?	Could the development cause a deterioration in WFD class of any element?	Can a deterioration of >10% or in class be prevented by treatment at TAL?
ALDERMASTON STW	1	1005	No	No	N/A
BEENHAM STW	6	0	No	No	N/A
Bucklebury Upper Common STW	6	0	No	No	N/A
BURGHFIELD STW	467	861	No	No	N/A
CHAPEL ROW STW	1	270	No	No	N/A
CHIEVELEY STW	231	12765	No	No	N/A
COMPTON STW	196	1506	Predicted deterioration is >10% for Phosphorous	No	Yes
EAST SHEFFORD STW	236	33608	No	No	N/A
FROXFIELD STW	1	0	No	No	N/A
GREENHAM COMMON STW	1	72067	Predicted deterioration is >10% for Ammonia	No	Yes
HAMPSTEAD NORREYS STW	1	1795	No	No	N/A
HUNGERFORD STW	322	12864	No	No	N/A

WwTW	Housing growth over plan period (dwellings)	Employment growth over plan period (m^2)	Could the development cause a greater than 10% deterioration in WQ for one or more determinands?	Could the development cause a deterioration in WFD class of any element?	Can a deterioration of >10% or in class be prevented by treatment at TAL?
KINTBURY STW	58	959	No	No	N/A
MIDGHAM	1	215	No	No	N/A
Stratfield Mortimer STW	35	3543	No	No	N/A
NEWBURY STW	10641	116901	No	No	N/A
PANGBOURNE STW	260	0	No	No	N/A
READING STW	28190	34539	No	No	N/A
SILCHESTER STW	15	53932	No	No	N/A
STREATLEY STW	5	0	No	No	N/A
WASHWATER	34	268	No	No	N/A
WOOLHAMPTON STW	87	891	No	No	N/A

Table 8.3: GES Assessment Results

WwTW	Predicted to achieve GES after growth?			Could GES be achieved today with improvements in upstream WQ?			Could GES be achieved in the future with improvements in upstream WQ?			GES assessment result	
	Ammonia	BOD	Phosphate	Ammonia	BOD	Phosphorous	Ammonia	BOD	Phosphorous	Ammonia / BOD model	Phosphate model
ALDERMASTON STW	YES	YES	NO	YES	YES	YES	YES	YES	YES	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for meeting GES.	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.
BEENHAM STW	NO	NO	NO	YES	YES	YES	YES	YES	YES	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.	
BRIFF LANE (BUCKLEBURY) STW	YES	NO	NO	YES	YES	YES	YES	YES	YES	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.	
BURGHFIELD STW	YES	YES	NO	YES	YES	NO	YES	YES	NO	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for meeting GES.	Good ecological status cannot be achieved due to current technology limits. Ensure proposed growth doesn't cause significant deterioration.
CHAPEL ROW STW	NO	NO	NO	YES	YES	YES	YES	YES	YES	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with	

WwTW	Predicted to achieve GES after growth?			Could GES be achieved today with improvements in upstream WQ?			Could GES be achieved in the future with improvements in upstream WQ?			GES assessment result	
	Ammonia	BOD	Phosphate	Ammonia	BOD	Phosphorous	Ammonia	BOD	Phosphorous	Ammonia / BOD model	Phosphate model
										current technology.	
CHIEVELEY STW	YES	YES	NO	NO	YES	YES	NO	YES	YES	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for meeting GES.	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.
COMPTON STW	NO	NO	NO	YES	YES	YES	YES	YES	YES	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.
EAST SHEFFORD STW	YEs	YES	NO	YES	YES	YES	YES	YES	YES	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for meeting GES.	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.
FROXFIELD STW	YES	YES	NO	YES	YES	YES	YES	YES	YES	Sufficient environmental capacity. Proposed	Proposed development can be accommodated with a tighter

WwTW	Predicted to achieve GES after growth?			Could GES be achieved today with improvements in upstream WQ?			Could GES be achieved in the future with improvements in upstream WQ?			GES assessment result	
	Ammonia	BOD	Phosphate	Ammonia	BOD	Phosphorous	Ammonia	BOD	Phosphorous	Ammonia / BOD model	Phosphate model
										development has no significant impact on the water body's potential for meeting GES.	permit and upgrade to treatment. This is achievable with current technology.
GREENHAM COMMON STW	YES	YES	NO	YES	YES	YES	YES	YES	YES	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for meeting GES.	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.
HAMPSTEAD NORREYS STW	NO	NO	NO	YES	YES	YES	YES	YES	YES	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.	
HUNGERFORD STW	YES	YES	NO	YES	YES	YES	YES	YES	YES	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for meeting GES.	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.
KINTBURY STW	YES	YES	NO	YES	YES	YES	YES	YES	YES	Sufficient environmental capacity. Proposed	Proposed development can be accommodated with a tighter

WwTW	Predicted to achieve GES after growth?			Could GES be achieved today with improvements in upstream WQ?			Could GES be achieved in the future with improvements in upstream WQ?			GES assessment result	
	Ammonia	BOD	Phosphate	Ammonia	BOD	Phosphorous	Ammonia	BOD	Phosphorous	Ammonia / BOD model	Phosphate model
										development has no significant impact on the water body's potential for meeting GES.	permit and upgrade to treatment. This is achievable with current technology.
MIDGHAM STW	YES	YES	NO	YES	YES *	YES	YES	YES	YES	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for meeting GES.	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.
MORTIMER STW	YES	YES	NO	YES	YES	YES	YES	YES	YES	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for meeting GES.	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.
NEWBURY STW	YES	YES	NO	YES	YES	YES	YES	YES	YES	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.

WwTW	Predicted to achieve GES after growth?			Could GES be achieved today with improvements in upstream WQ?			Could GES be achieved in the future with improvements in upstream WQ?			GES assessment result	
	Ammonia	BOD	Phosphate	Ammonia	BOD	Phosphorous	Ammonia	BOD	Phosphorous	Ammonia / BOD model	Phosphate model
										meeting GES.	
PANGBOURNE STW	NO	NO	NO	NO	YES	NO	NO	YES	NO	Good ecological status cannot be achieved due to current technology limits. Ensure proposed growth doesn't cause significant deterioration.	
READING STW	YES	YES	NO	YES	YES	NO	YES	YES	NO	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for meeting GES.	Good ecological status cannot be achieved due to current technology limits. Ensure proposed growth doesn't cause significant deterioration.
SILCHESTER STW	YES	YES	NO	NO	YES	NO	NO	YES	NO	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for meeting GES.	Good ecological status cannot be achieved due to current technology limits. Ensure proposed growth doesn't cause significant deterioration.
STREATLEY STW	YES	YES	NO	YES	YES	YES	YES	YES	YES	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for	Proposed development can be accommodated with a tighter permit and upgrade to treatment. This is achievable with current technology.

WwTW	Predicted to achieve GES after growth?			Could GES be achieved today with improvements in upstream WQ?			Could GES be achieved in the future with improvements in upstream WQ?			GES assessment result	
	Ammonia	BOD	Phosphate	Ammonia	BOD	Phosphorous	Ammonia	BOD	Phosphorous	Ammonia / BOD model	Phosphate model
										meeting GES.	
WASH WATER STW	NO	NO	NO	NO	NO	NO	NO	NO	NO	Good ecological status cannot be achieved due to current technology limits. Ensure proposed growth doesn't cause significant deterioration.	
WOOLHAMPTON STW	YES	YES	YES	YES	YES	YES	YES	YES	YES	Sufficient environmental capacity. Proposed development has no significant impact on the water body's potential for meeting GES.	
Note: WwTWs with an * have an effluent load too small to model within SIMCAT and so the model assumes no change in water quality downstream of the WwTW											

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8.7.1 Priority substances

As well as the physico-chemical water quality elements (BOD, Ammonia, Phosphate etc.) addressed above, a watercourse can fail to achieve Good Ecological Status due to exceeding permissible concentrations of hazardous substances. Currently 33 substances are defined as hazardous or priority hazardous substances, with others under review. Such substances may pose risks both to humans (when contained in drinking water) and to aquatic life and animals feeding in aquatic life. These substances are managed by a range of different approaches, including EU and international bans on manufacturing and use, targeted bans, selection of safer alternatives and end-of-pipe treatment solutions. There is considerable concern within the UK water industry that regulation of these substances by setting permit values which require their removal at wastewater treatment works will place a huge cost burden upon the industry and its customers, and that this approach would be out of keeping with the "polluter pays" principle.

We also consider how the planning system might be used to manage priority substances:

- Industrial sources – whilst this report covers potential employment sites, it doesn't consider the type of industry and therefore likely sources of priority substances are unknown. It is recommended that developers should discuss potential uses which may be sources of priority substances from planned industrial facilities at an early stage with the EA and, where they are seeking a trade effluent consent, with the sewerage undertaker.
- Agricultural sources - There is limited scope for the planning system to change or regulate agricultural practices. UK water companies are involved in a range of "Catchment-based Approach" schemes aimed at reducing diffuse sources of pollutants, including agricultural pesticides.
- Surface water runoff sources - some priority substances e.g. heavy metals, are present in urban surface water runoff. It is recommended that future developments would manage these sources by using SuDS that provide water quality treatment, designed following the CIRIA SuDS Manual. This is covered in more detail in sections 10.6.3 and 10.6.4.
- Domestic wastewater sources - some priority substances are found in domestic wastewater as a result of domestic cleaning chemicals, detergents, pharmaceuticals, pesticides or materials used within the home. Whilst an increase in the population due to housing growth could increase the total volumes of such substances being discharged to the environment, it would be more appropriate to manage these substances through regulation at source, rather than through restricting housing growth through the planning system.

No further analysis of priority substances will be undertaken as part of this study.

8.8 Conclusions

The water quality modelling undertaken in this study uses a model calibrated with water quality data and assumptions from 2010-12, and updated with the latest effluent flows at WwTWs within the study area, and incorporating AMP6 and AMP7 improvements provided by the EA. It should be used to identify areas at risk of deterioration but should not be used to set permit limits or definitively rule-out growth in particular catchments.

At two WwTWs (Compton and Greenham Common), water quality modelling identified a risk that planned growth could cause a deterioration in water quality, however, the modelling also showed that this could be mitigated with treatment at the technically achievable limit.

Where a WwTW is shared with a neighbouring authority, coordination of growth plans in collaboration with Thames Water is essential to ensure that infrastructure is in place prior to development to prevent a breach of the environmental permit.

The modelling indicates that treatment upgrades would be required at several of the WwTWs in order to accommodate growth without deterioration in water quality downstream. Extensive engagement with Thames Water is required in order to understand the phasing of growth with WwTW upgrades to ensure capacity and upgrades to treatment processes are aligned. There may be options to consolidate growth within catchments that have more environmental capacity, and this should be considered alongside the capacity assessment in section 6.

A further water quality test was performed which investigated whether, if improvements in water quality were made elsewhere in the catchment, growth alone could be the reason that good ecological status under the Water Framework Directive was not achieved in the future. At no WwTW was this the case.

8.9 Recommendations

Table 8.4 Water quality recommendations

Action	Responsibility	Timescale
Provide annual monitoring reports to TW detailing projected housing growth in West Berkshire	WBC	Ongoing
Take into account the full volume of growth (from West Berkshire and neighbouring authorities) within the catchment when considering WINEP schemes or upgrades at WwTW	TW	Ongoing

9 Flood Risk from Effluent Discharge

9.1 Introduction

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 was carried out in Phase 1 to quantify such an effect. This has been updated in Phase 2 based on the latest growth forecast.

9.2 Methodology

The following process has been used to assess the potential increased risk of flooding due to the 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, identify the FEH v1.0 catchment descriptors associated with the WwTW;
- Use FEH Statistical method to calculate peak 1 in 30 (Q30) and 1 in 100 (Q100) year fluvial flows;
- Calculate the additional foul flow as a percentage of the Q30 and Q100 flow.
- Note: WwTWs where the additional flow is lower than 0.432Ml have been filtered out as these flows are too small for JFes (JBA's flood estimation software) to resolve.

A red/amber/green rating 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 hydrological assessment of river flows applied 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.

9.3 Results

The flood risk tool used in this assessment can only resolve flows of 5l/s or higher, equivalent to 0.432Ml/d. Any WwTW with additional effluent flows less than this were therefore screened out of the flood risk assessment and considered to have a negligible impact on downstream flood risk. Where additional effluent is greater than 0.432Ml/d (5l/s) these are shown in Table 9.1 below.

Table 9.1 reports the additional flow from each WwTW as a percentage of the Q30 and Q100 peak flow. This shows that for the largest WwTW in the study area, Newbury and Reading WwTWs, additional flows from the WwTWs post development would have a negligible effect on the predicted peak flow events with return periods of 30 and 100 years.

Table 9.1: Summary of additional effluent as a % of Q30 and Q100 Peak Flows

WwTW	FEH stat Q30 (m^3/s)	FEH stat Q100 (m^3/s)	Additional effluent (m^3/d)	% increase in effluent during plan period	Flow increase as % of Q30	Flow increase as % of Q100
Newbury	46.69	60.23	5677.5	18.5%	0.11%	0.09%
Reading	29.83	41.86	14510.5	18.8%	0.40%	0.28%

9.4 Conclusions

The impact of increased effluent flows is not predicted to have a significant impact upon flood risk in any of the receiving watercourses.

Increases in discharges of treated wastewater effluent as a result of growth are not expected to significantly increase flood risk.

9.5 Recommendations

Table 9.2: Recommendations from the Flood Risk Assessment

Action	Responsibility	Timescale
Proposals to increase discharges to a watercourse may also require a flood risk activities environmental permit from the EA (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).	TW	During design of WwTW upgrades

10 Environmental Opportunities and Constraints

10.1 Introduction

Development has the potential to cause an adverse impact on the environment through a number of routes, such as worsening of air quality, pollution to the aquatic environment or disturbance to wildlife. In the context of a Water Cycle Study, the impact of development on the aquatic environment is under assessment.

A source-pathway-receptor approach can be taken to investigate the risk and identify where further assessment or action is required.

In Phase 1 a screening exercise was carried out which identified protected sites (SSSIs, SPAs, SACs and Ramsar sites) that are on or adjacent to a river. Those sites with a WwTW serving growth upstream were screened in for further assessment as there is a risk that additional effluent discharge from those WwTW due to growth could cause a deterioration in water quality.

Phase 2 uses the results of the water quality modelling undertaken in section 8 to predict the deterioration in water quality in the waterbody adjacent to the protected site, and whether this could be prevented by improvements in treatment processes at upstream WwTW.

10.2 Protected sites in the study area

A receptor in this study is a habitat or species that is adversely impacted by a pollutant. Both the rivers and groundwater as well as being pathways, can also be considered to be receptors. Groundwater bodies are also given a status under the WFD which is reported in Section 4.1.3 of the Phase 1 report for the groundwater bodies across West Berkshire.

The following sites with environmental designations are considered in this study:

- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)
- Sites of Special Scientific Interest (SSSI)
- Ramsar sites (Wetlands of International Importance)
- Priority Habitats and Priority Headwaters

A description of these, and the relevant legislation that defines and protects them, can be found in section 3.5 to 3.7 of the Phase 1 report.

10.3 Summary of screening exercise

10.3.1 Methodology

In order to identify protected sites that may be at risk, Flood Zone 2 from the Risk of Flooding from Rivers and the Sea mapping was used to define an area that was either adjacent to a river or could be reasonably expected to receive surface water from a river. Where a WwTW was present in the catchment upstream of the protected site, it was considered that there was a risk of deterioration in water quality due to growth during the local plan period. Where there were no WwTWs serving growth upstream, risk of deterioration is considered to be low, and would not be shown by water quality modelling. However, in these cases the overall catchment water quality should be considered where for example they are designated for migratory fish species that may spend part of their lifecycle elsewhere in the catchment.

Priority Habitats have been mapped, but due to the large number of sites, these have not been assessed individually.

10.3.2 Screening result

Table 10.1 contains a list of the protected sites (SSSIs, SACs, SPAs and Ramsar sites) that are within or downstream of West Berkshire, and adjacent to a watercourse. The final column in the table indicates if there is a WwTW serving growth during the plan period upstream of the site. Where the answer is no, they are not considered further. Where the answer is yes, the deterioration in water quality is predicted in section10.5.

Table 10.1 Screening of protected sites within and downstream of West Berkshire

Type of Receptor	Name	Reference	WwTW Upstream – further Assessment required? Y/N
SSSI	Aldermaston Gravel Pits	SU596668	YES
SSSI	Ashford Hill Woods and Meadows		NO
SSSI	Bisham Woods	SU857849	YES
SAC	Chilterns Beechwoods	UK0012724	YES
SSSI	Bowdown and Chamberhouse Woods	SU508654	YES
SSSI	Boxford Water Meadows	SU428718	YES
SSSI	Bray Meadows	SU898800	YES
SSSI	Bray Pennyroyal Field	SU915782	YES
SSSI	Brimpton Pit	SU565650	YES
SSSI	Bushy Park and Home Park	TQ159692	YES
SSSI	Chiltern Foliat Meadows	SU311704	NO
SSSI	Cock Marsh	SU882866	YES
SSSI	Decoy Pit , Pools & Woods	SU611632	NO
SSSI	Dumsey Meadow	TQ056665	YES
SSSI	Easton Farm Meadow	SU418721	YES
SSSI	Freeman's Marsh	SU329686	YES
SSSI	Greenham and Crookham Commons	SU483641	YES
SSSI	Hartslock	SU619790	YES
SAC	Hartslock Wood	UK0030164	YES
SAC	Kennet & Lambourn Floodplain	UK0030044	YES
SSSI	Kennet and Lambourn Floodplain	SU345687	YES
SAC	Kennet Valley Alderwoods	UK0030175	YES
SSSI	Kennet Valley Alderwoods	SU399675	YES
Ramsar	South West London Waterbodies	UK11065	YES
SPA	South West London Waterbodies	UK9012171	YES
SSSI	Langham Pond	TQ002720	YES
SSSI	Little Wittenham	SU572928	NO
SSSI	Pamber Forest and Silchester Common	SU616612	YES
SSSI	Redhill Wood	SU422645	NO

Type of Receptor	Name	Reference	WwTW Upstream – further Assessment required? Y/N
SSSI	River Kennet	SU337695	YES
SSSI	River Lambourn	SU405733	YES
SAC	River Lambourn	UK0030257	YES
SSSI	Rodbed Wood	SU803836	YES
SSSI	South Lodge Pit	SU905819	YES
SSSI	Staines Moor	TQ043731	YES
SSSI	Sulham and Tidmarsh Woods and Meadows	SU635741	YES
SSSI	Temple Island Meadows	SU768846	YES
SSSI	Thatcham Reed Beds	SU507664	YES
SSSI	Woolhampton Reed Bed	SU578666	YES
SSSI	Wraysbury & Hythe End Gravel Pits	TQ009735	YES
SSSI	Wraysbury No. 1 Gravel Pit	TQ003747	YES
SSSI	Wraysbury Reservoir	TQ025745	YES

10.4 Impact assessment methodology

Where a designated site was identified for further study, the SIMCAT water quality model was investigated to provide the nearest point in the model where a prediction of water quality could be obtained in the adjacent watercourse.

Where possible this was taken as close as possible to the upstream end of the protected site, but where a tributary joined the watercourse along the length of the protected site, a further assessment point was taken to ensure this additional pathway was accounted for.

Protected sites within the tidal River Thames are in transitional waters that are outside the SIMCAT model. The nearest upstream modelled watercourse was therefore used as a proxy for downstream water quality.

At each point, the predicted concentration of phosphate, ammonia and biochemical oxygen demand (BOD) in the adjacent waterbody was taken from the results of the water quality model. The future scenario (taking into account growth during the plan period) was compared to the baseline results to provide a predicted deterioration. A further test was then applied to ascertain whether deterioration could be prevented by improvements in upstream treatment processes. This version of the model assumes that every WwTW is treating at the technically achievable limit (TAL).

10.5 Impact assessment results

Full results from the environmental impact assessment are provided in Appendix D.

The results from the impact assessment showed that whilst a significant deterioration was predicted in waterbodies adjacent to many protected sites such as SACs, SSSIs and Ramsar sites, in every case, this deterioration could be prevented by improvements in treatment processes at WwTWs upstream. This includes meeting the tighter CSMG standards specific to the River Kennet and River Lambourn SAC and SSSIs.

The River Kennet and River Lambourn are designated as a SAC and SSSI along much of their length. In this assessment, the predicted deterioration at every modelled point was investigated, but the highest deterioration predicted is presented in the results table.

The frequency of storm overflow operation should also be taken into account, where an overflow is upstream of a protected site. Development in a catchment where storm overflow operation is already high may exacerbate existing issues and risk environmental damage (see section 6).

10.6 Protection and mitigation

10.6.1 Groundwater Protection

Groundwater is an important source of water in England and Wales.

The Environment Agency is responsible for the protection of "controlled waters" from pollution under the Water Resources Act 1991. These controlled waters include all watercourses and groundwater contained in underground strata.

The zones are based on an estimate of the time it would take for a pollutant which enters the saturated zone of an aquifer to reach the source of abstraction or discharge point (Zone 1 = 50 days, Zone 2 = 400 days, Zone 3 is the total catchment area). The Environment Agency will use SPZs (alongside other datasets such as the Drinking Water Protected Areas (DrWPAs) and aquifer designations as a screening tool to show:

- Areas where the EA would object in principle to certain potentially polluting activities, or other activities that could damage groundwater,
- Areas where additional controls or restrictions on activities may be needed to protect water intended for human consumption,
- How it prioritises responses to incidents.

The EA have published a position paper[9] outlining its approach to groundwater protection which includes direct discharges to groundwater, discharges of effluents to ground and surface water runoff. This is of relevance to this water cycle study where a development may manage surface water through SuDS.

Sewage and Trade Effluent

Discharge of treated sewage of $2m^3$ per day or less to ground are called small sewage discharges (SSDs). The majority of SSDs do not require an environmental permit if they comply with certain qualifying conditions. A permit will be required for all SSDs in source protection zone 1 (SPZ1).

For treated sewage effluent discharges, the EA encourages the use of shallow infiltration systems, which maximise the attenuation within the drainage blanket and the underlying unsaturated zone. Whilst some sewage effluent discharges may not pose a risk to groundwater quality individually, the cumulative risk of pollution from aggregations of discharges can be significant. Improvement or pre-operational conditions may be imposed before granting an environmental permit. The EA will only agree to developments where the addition of new sewage effluent discharges to ground in an area of existing discharges is unlikely to lead to an unacceptable cumulative impact.

Generally, the Environment Agency will only agree to developments involving release of sewage effluent, trade effluent or other contaminated discharges to ground if it is satisfied that it is not reasonable to make a connection to the public foul sewer. The EA would normally expect to only permit new private discharges where the distance to connect to the nearest public sewer exceeds the number of dwellings * 30m. So, for example, a development of 100 dwellings would need to be more than 3km from a public sewer. The developer would have to provide evidence of why the proposed development cannot connect to the foul sewer in the planning application. This position will not normally apply to surface water run-off via sustainable drainage systems and discharges

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9 The Environment Agency's approach to groundwater protection, Environment Agency (2018). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/692989/Envirnment-Agency-approach-to-groundwater-protection.pdf on: 02/06/2021

from sewage treatment works operated by sewerage undertakers with appropriate treatment and discharge controls.

Deep infiltration systems (such as boreholes and shafts) are not generally accepted by the EA for discharge of sewage effluent as they bypass soil layers and reduce the opportunity for attenuation of pollutants.

Discharges of surface water run-off to ground at sites affected by land contamination, or from sites for the storage of potential pollutants are likely to require an environmental permit. This could include sites such as garage forecourts and coach and lorry parks. These sites would be subject to a risk assessment with acceptable effluent treatment provided.

Discharge of Clean Water

"Clean water" discharges such as runoff from roofs or from roads, may not require a permit. However, they are still a potential source of groundwater pollution if they are not appropriately designed and maintained.

Where infiltration SuDS schemes are proposed to manage surface runoff they should:

- Be suitably designed;
- Meet Government non-statutory technical standards[10] for sustainable drainage systems – these should be used in conjunction with the NPPF and PPG; and
- Use a SuDS management treatment train

A hydrogeological risk assessment is required where infiltration SuDS is proposed for anything other than clean roof drainage in a SPZ1.

Source Protection Zones in West Berkshire

Source protection zones (SPZs) form a key part of the Environment Agency's approach to controlling the risk to groundwater supplies from potentially polluting activities and accidental releases of pollutants.

The Source Protection Zones (SPZs) that are present in the West Berkshire area are shown in Figure 10.1 and show that:

- The majority of West Berkshire is covered by SPZs.
- Western areas of West Berkshire are not within a designated SPZ.
- Large areas in the east of West Berkshire are within Zone 2 of an SPZ.

The Environment Agency's Manual for the Production of Groundwater Source Protection Zones[11], details position statements which provide information about the Environment Agency's approach to managing and protecting groundwater.

In each Local Authority area, proposed developments location within or close to Source Protection Zones, should be assessed in relation to the relevant Environment Agency position statements.

Thames Water confirmed that they are not aware of any issues with wastewater from the foul sewer network entering a source protection zone within the study area.

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10 Sustainable Drainage Systems: non-statutory technical standards, Department for Environment, Food & Rural Affairs (2015). Accessed online at: https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards on: 02/06/2021

11 Manual for the Production of Groundwater Source Protection Zones, Environment Agency (2019). Accessed online at: https://www.gov.uk/government/publications/groundwater-source-protection-zones-spz-production-manual on: 02/06/2021

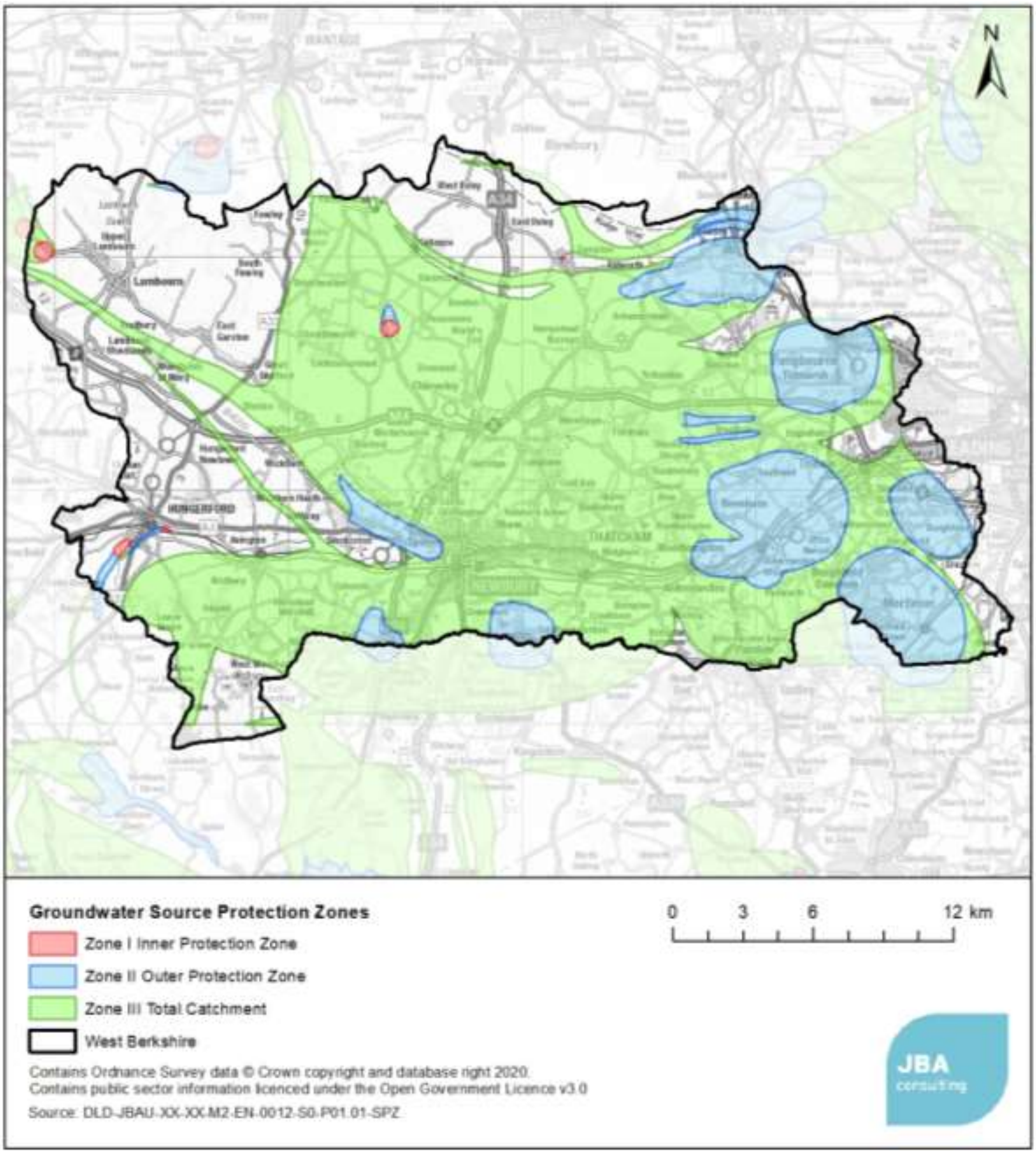

Figure 10.1: Source Protection Zones in the Study Area

10.6.2 Surface Water Drainage and SuDS

Since April 2015[12], management of the rate and volume of surface water has been a requirement for all major development sites, through the use of Sustainable Drainage Systems (SuDS).

Lead Local Flood Authorities (LLFAs) are the statutory consultees to the planning system for surface water management within major development, which covers the following development scenarios:

- 10 or more dwellings
- a site larger than 0.5 hectares, where the number of dwellings is unknown
- a building greater than 1,000 square metres
- a site larger than 1 hectare

SuDS are drainage features which attempt to replicate natural drainage patterns, through capturing rainwater at source, and releasing it slowly into the ground or a water body. They can help to manage flooding through controlling the quantity of surface water generated by a development and improve water quality by treating urban runoff. SuDS can also deliver multiple benefits, through creating habitats for wildlife and green spaces for the community. SuDS also have the advantage of providing effective Blue and Green infrastructure and ecological and public amenity benefits when designed and maintained properly.

National standards on the management of surface water are outlined within the Defra Non-statutory Standards for Sustainable Drainage Systems[13]. The CIRIA C753 SuDS Manual[14] and Guidance for the Construction of SuDS[15] provide the industry best practice guidance for design and management of SuDS

Local guidance, provided by the Lead Local Flood Authorities covering the study area, is detailed below:

- West Berkshire Council (WBC) is a Lead Local Flood Authority. The WBC SuDS Supplementary Planning Document[16] contains advice from the LLFA relating to surface water drainage and sets out the minimum operating requirements as required in the National Planning Policy Framework (NPPF). The SPD provides guidance on the approach that should be taken to SuDS in new developments in West Berkshire so as to manage and mitigate surface water flood risk.

10.6.3 Use of SuDS in Water Quality Management

SuDS allow the management of diffuse pollution generated by urban areas through the sequential treatment of surface water reducing the pollutants entering lakes and rivers, resulting in lower levels of water supply and wastewater treatment being required. This treatment of diffuse pollution at source can contribute to meeting WFD water quality targets, as well as national objectives for sustainable development.

This is usually facilitated via a SuDS Management Train of a number of components in series that provide a range of treatment processes delivering gradual improvement in

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12 House of Commons: Written Statement (HCWS161) Written Statement made by: The Secretary of State for Communities and Local Government (Mr Eric Pickles) on 18 Dec 2014. Accessed online at: https://www.parliament.uk/documents/commons-vote-office/December%202014/18%20December/6.%20DCLG-sustainable-drainage-systems.pdf on: 02/06/2021

13 Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems, DEFRA (2015). Accessed online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf on: 02/06/2021

14 CIRIA Report C753 The SuDS Manual, CIRIA (2015). Accessed online at: https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx on: 02/06/2021

15 Guidance on the Construction of SuDS (C768), CIRIA (2017), Accessed online at: https://www.ciria.org/ItemDetail?iProductcode=C768&Category=BOOK on: 02/06/2021

16 SuDS Supplementary Planning Document, West Berkshire Council (2018). Accessed online at: https://info.westberks.gov.uk/CHttpHandler.ashx?id=46526&p=0 on: 02/06/2021

water quality and providing an environmental buffer for accidental spills or unexpected high pollutant loadings from the site. Considerations for SuDS design for water quality are summarised in Figure 10.2 below.

The non-statutory technical standards for SuDS are currently being updated. Feedback on the draft text highlighted the need for the update to place a greater emphasis on multiple benefits with water quality being the most desired benefit not currently included[17]. A new standard has therefore been created for water quality: *"Apply a 'SuDS approach' that manages the quality of the surface water runoff to prevent pollution and protect both groundwater and surface water"*.

17 News article on draft NSTS, HR Wallingford (2020). Accessed online at: http://www.uksuds.com/news/draft-updated-standards on: 02/06/2021

Manage surface water close to source

- Where practicable, treatment systems should be designed to to be close to source of runoff
- It is easier to design effective treatment when the flow rate and pollutant loadings are relatively low
- Treatment provided can be proportionate to pollutant loadings
- Accidental spills or other pollution events can be isolated more easily without affecting the downstream drainage system
- Encourages ownership of pollution
- Poor treatment performance or component damage/failure can be dealt with more effectively without impacting on the whole site

Treat surface water runoff on the surface

- Where practicable, treatment systems should be designed to be on the surface
- Where sediments are exposed to UV light, photolysis and volatilisation processes can act to break down contaminants
- If sediment is trapped in accessible parts of the SuDS, it can be removed more easily as part of maintenance
- It enables use of evapotranspiration and some infiltration to the ground to reduce runoff volumes and associated total contamination loads (provided risk to groundwater is managed appropriately)
- It allows treatment to be delivered by vegetation
- Sources of pollution can be easily identified
- Accidental spills or misconnections are visible immediately and can be dealt with rapidly
- Poor treatment performance can be easily identified during routine inspections, and remedial works can be planned efficiently

Treat surface water runoff to remove a range of contaminants

- SuDS design should consider the likely presence and significant of any contaminant that may pose a risk to the receiving environment
- The SuDS component or combination of components selected should include treatment processes that, in combination, are likely to reduce this risk to acceptably low levels

Minimise risk of sediment remobilisation

- The SuDS design should consider and mitigate the risks of sediments (and other contaminants) being remobilised and washed into receiving surface waters during events greater than those which the component has been specifically designed for

Minimise impacts from accidental spills

- By using a number of components in series, SuDS can help insure that accidental spills are trapped in/on upstream component surfaces, facilitating contamination management and removal.
- The selected SuDS components should deliver a robust treatment design that manages risks appropriately - taking into account the uncertainty and variability of pollution loadings and treatment processes

Figure 10.2 Considerations for Suds Design for Water Quality

Managing pollution close to its source can help keep pollutant levels and accumulation rates low, allowing natural processes to be more effective. Treatment can often be delivered within the same components that are delivering water quantity design criteria, requiring no additional cost or land-take.

SuDS designs should control the 'first flush' of pollutants (usually mobilised by the first 5mm of rainfall) at source, to ensure contaminants are not released from the site. Best practise is that no runoff should be discharged from the site to receiving watercourses or sewers for the majority of small (e.g., less than 5mm) rainfall events.

Infiltration techniques will need to consider Groundwater Source Protection Zones and are likely to require consultation with the Environment Agency. Early consideration of SuDS within master planning will typically allow a more effective scheme to be designed.

10.6.4 Additional Benefits

Flood Risk

The Strategic Flood Risk Assessment contains recommendations for SuDS to manage surface water on development sites, with the primary aim of reducing flood risk.

SuDS are most effective at reducing flood risk for relatively high intensity, short and medium duration events, and are particularly important in mitigating potential increases in surface water flooding, sewer flooding and flooding from small and medium sized watercourses resulting from development.

Water Resources

A central principle of SuDS is the use of surface water as a resource. Traditionally, surface water drainage involved the rapid disposal of rainwater, by conveying it directly into a sewer or wastewater treatment works.

SuDS techniques such as rainwater harvesting, allow rainwater to be collected and re-used as non-potable water supply within homes and gardens, reducing the demand on water resources and supply infrastructure.

Climate Resilience

Climate projections for the UK suggest that winters may become milder and wetter, and summers may become warmer, but with more frequent higher intensity rainfall events, particularly in the south east. This would be expected to increase the volume of runoff, and therefore the risk of flooding from surface water, and diffuse pollution, and reduce water availability.

SuDS offer a more adaptable way of draining surfaces, controlling the rate and volume of runoff leaving urban areas during high intensity rainfall, and reducing flood risk to downstream communities through storage and controlled release of rainwater from development sites.

Through allowing rainwater to soak into the ground, SuDS are effective at retaining soil moisture and groundwater levels, which allows the recharge of the watercourses and underlying aquifers. This is particularly important where water resource availability is limited, and likely to become increasingly scare under future drier climates.

Biodiversity

The water within a SuDS component is an essential resource for the growth and development of plants and animals, and biodiversity benefits can be delivered even by very small, isolated schemes. The greatest value can be achieved where SuDS are planned as part of a wider green landscape, providing important habitat, and wildlife connectivity. With careful design, SuDS can provide shelter, food, foraging and breeding opportunities for a variety of species including plants, amphibians, invertebrates, birds, bats and other animals.

Amenity

Designs using surface water management systems to help structure the urban landscape can enrich its aesthetic and recreational value, promoting health and well-being and supporting green infrastructure. Water managed on the surface rather than underground can help reduce summer temperatures, provide habitat for flora and fauna and act a resource for local environmental education programmes and working groups and directly influence the sense of community in an area.

10.6.5 Suitable SuDS Techniques

The hydraulic and geological characteristics of each property development site across West Berkshire should be assessed to identify the most appropriate forms of surface water management and any constraining factors to the utilisation of SuDS. These assessments are designed to inform the early-stage site planning process and should be followed up the site-specific detailed drainage assessments.

Appropriate SuDS techniques have been categorised into five main groups, as shown in Table 10.2. This table should be used as an indicative guide of general suitability. Further site-specific investigation should be conducted to determine what SuDS techniques could be used on a particular development, informed by detailed ground investigations.

Table 10.2: Summary of SuDS Categories

SuDS Type	Technique
Source Controls	Green Roof, Rainwater Harvesting, Pervious Pavements, Rain Gardens
Infiltration	Infiltration Trench, Infiltration Basin, Soakaway
Detention	Pond, Wetland, Subsurface Storage, Shallow Wetland, Extended Detention Wetland, Pocket Wetland, Submerged Gravel Wetland, Wetland Channel, Detention Basin
Filtration	Surface Sand filter, Sub-Surface Sand Filter, Perimeter Sand Filter, Bioretention, Filter Strip, Filter Trench
Conveyance	Dry Swale, Under-drained Swale, Wet Swale

10.6.6 Natural Flood Management

Natural Flood Management (NFM) is used to protect, restore and re-naturalise the function of catchments and rivers to reduce flood risk. A wide range of techniques can be used that aim to reduce flooding by working with natural features and processes in order to store or slow down flood waters before they can damage flood risk receptors (e.g. people, property, infrastructure, etc.). NFM involves taking action to manage flood and coastal erosion risk by protecting, restoring and emulating the natural regulating functions of catchments, rivers, floodplains and coasts. Techniques and measures, which could be applied in West Berkshire include:

- Peatland and moorland restoration in upland catchments
- Offline storage areas
- Re-meandering streams
- Targeted woodland planting
- Reconnection and restoration of functional floodplains
- Restoration of rivers and removal of redundant structures
- Installation or retainment of large woody material in river channels

- Improvements in management of soil and land use
- Creation of rural and urban SuDS

In 2017, the Environment Agency published on online evidence base[18] to support the implementation of NFM and with JBA produced maps showing locations with the potential for NFM measures[19]. These maps are intended to be used alongside the evidence directory to help practitioners think about the types of measure that may work in a catchment and the best places in which to locate them. There are limitations with the maps; however, it is a useful tool to help start dialogue with key partners.

10.6.7 Multiple Benefits of NFM

In addition to flood risk benefits, there are also significant benefits in other areas such as habitat provision, air quality, climate regulation and water quality.

Many NFM measures have the ability to reduce nutrient and sediment sources by reducing surface runoff flows from higher ground, reducing soil erosion, trapping sediment at the edge of agricultural land, or encouraging deposition of sediments behind natural dams upstream in watercourses.

Suitable techniques may include:

- Leaky dams
- Woodland planting
- Buffer strips
- Runoff retention ponds
- Land management techniques (soil aeration, cover crops etc)

18 Working with natural processes to reduce flood risk, Environment Agency (2018). Accessed online at: https://www.gov.uk/government/publications/working-with-natural-processes-to-reduce-flood-risk on: 02/06/2021
19 Mapping the potential for working with natural process, Environment Agency and JBA (2017). Accessed online at: https://www.arcgis.com/home/item.html?id=7315f943998847e2b3797a85665f5438 on: 02/06/2021

Case Study – Black Brook Slow the Flow

Four engineered log dams were installed on Black Brook at an estimated cost of £2,000, funded by Natural England and the Environment Agency to restore Stanley Bank SSSI. The scheme aimed to improve habitat and reduce the risk of flooding. However, the scheme also resulted in reduced levels of phosphate and nitrate in Black Brook, with phosphate concentrations falling by 3.6mg/l. By 2035, it is predicted that 792m^3 of sediment will be stored in three ponds retained by the jams.

Reproduced from Case Study 17. Black Brook Slow the Flow, St Helens, Norbury, Rogers and Brown, EA WwNP Evidence Base 2017. Photograph taken on 8 May 2015; courtesy of Matthew Catherall

10.6.8 Integrated Constructed Wetlands

An integrated constructed wetland (ICW) is an artificial wetland created for the purpose of treating polluted water, whether this is municipal wastewater, grey water from residential properties, or agricultural runoff.

They are usually unlined, free surface flow wetlands, designed to contain and treat influents within emergent vegetated areas.

Defra carried out a systematic review of the effectiveness of various wetland types, including ICWs for mitigating agricultural pollution such as phosphate and nitrate. The overall conclusion was that all wetland types are very effective at reducing major nutrients and suspended sediments, with the exception of nitrite in ICWs. Nitrate is only reduced when passing through overland buffer strips and through constructed wetlands with vegetation, where the systematic review showed a mean reduction of 29% across the evidence included in the study.

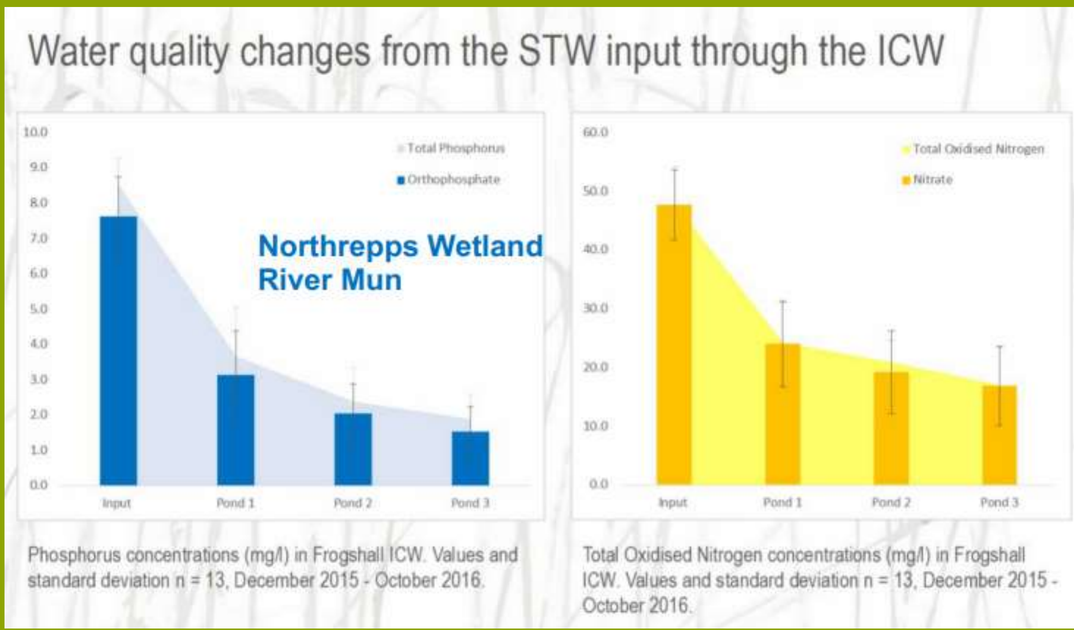
The mean reduction in Total Phosphorus across the evidence base was 78%.

Case Study – Frogshall ICW

The Upper River Mun in Norfolk was experiencing chronic pollution, and a loss in biodiversity in the river. Investigation found that nutrients from a Sewage Treatment Works upstream were contributing to this issue.

A pilot ICW was created consisting of three shallow ponds, filled with 18,000 emergent aquatic plants, and the outfall from the treatment works was diverted to pass through the wetland.

Early monitoring has shown that 90% of the phosphate is being removed by the wetland, and a large increase in biodiversity downstream observed.



Reproduced from "Stripping the Phosphate" a presentation by the Norfolk Rivers Trust (2018).

https://www.theriverstrust.org/media/2018/08/2.-Stripping-the-phosphate-David-Diggens-Norfolk-Rivers-Trust.pdf

10.6.9 Agricultural Management

There is a big potential to improve water quality by interventions aimed at agricultural sources, especially considering the measures already taken by the water companies to reduce their contribution to phosphate load.

Potential schemes could include:

- Buffer strips
- Cross slope tree planting
- Runoff retention basins
- Contour ploughing
- Cover crops

There is considerable overlap with NFM measures, and the challenges are also very similar. Exact impacts are difficult to measure, although modelling tools such as

Farmscoper[20] exist to help with this. Once a scheme is implemented it relies on the landowner to continue to maintain it in order to maintain the mitigation benefit.

Funding for agricultural interventions could come from Catchment Sensitive Farming or a Payment for Ecosystem Services approach.

Case Study – Wessex Water - EnTrade

Wessex Water catchment team used EnTrade to invite farmers to bid to grow cover crops over winter to reduce the nitrogen leaching into the watercourse.

This avoided the need to upgrade Dorchester WwTW to provide the same nitrogen removal capacity.

A trial auction was held in 2015, and two further auctions have since taken place attracting 557 bids from 63 farmers to save 153 tonnes of nitrogen.

"Using EnTrade to create a market in measures to deliver reductions in nitrogen has delivered a 30% saving for Wessex Water compared to traditional catchment approaches."

Ruth Barden, Director of Environmental Strategy, Wessex Water

10.6.10 Barriers

Whilst there are many benefits to implementing NFM and constructed wetlands, or modifying agricultural practises, the impact of these techniques is hard to quantify, and relies on ongoing maintenance to maintain that benefit. Where a potential scheme is not on a development site it will also require permission and support of the landowner. It may not be possible to influence this through planning policy.

10.6.11 Conclusions

- The potential impact of development on a number of protected sites such as SAC, SPAs, Ramsar sites and SSSIs within, or downstream of the study area should be carefully considered in future plan making. There are also a larger number of Priority Habitats and Priority Rivers.

20 Farmscoper webpage, ADAS (2020). https://www.adas.uk/Service/farmscoper Accessed on 02/06/2021

- Water quality modelling using SIMCAT shows that there is a risk that growth during the plan period would cause a significant deterioration in water quality in waterbodies adjacent to protected sites.
- The modelling also shows that this deterioration could be prevented by improvements in treatment processes upstream.
- There are a number of Groundwater Source Protection Zones, primarily in central and eastern areas of the study area. The impact of future development on groundwater should be investigated fully.
- Development sites within the study area could be sources of diffuse pollution from surface runoff.
- SuDS are required on all development sites. Their design should consider both water quantity and water quality and site level investigations should be undertaken to define the most appropriate SuDS types for each specific development.
- Opportunities exist for these SuDS schemes to offer multiple benefits of flood risk reduction, amenity value and biodiversity.
- West Berkshire Council should be consulted at an early stage of development to ensure that SuDS are implemented and designed in response to site characteristics and policy factors.
- In the wider area, opportunities exist to implement natural flood management techniques to achieve multiple benefits of flood risk, water quality and habitat creation.

10.7 Recommendations

Table 10.3: Recommendations from Environmental Constraints and Opportunities Section

Action	Responsibility	Timescale
Consider the environmental impact of development on protected sites downstream of receiving wastewater treatment works in the Habitats Regulations Assessment	WBC	Local Plan Review Development
The Local Plan Review should include policies that require all development proposals with the potential to impact on areas with environmental designations to be considered in line with the relevant legislation and where stated in consultation with Natural England (for national and international designations and priority habitats).	WBC	Ongoing
The Local Plan Review should include policies that require development sites to adopt SuDS to manage water quality of surface runoff.	WBC	Ongoing
In partnership, identify opportunities for incorporating SuDS into open spaces and green infrastructure, to deliver strategic flood risk management and meet WFD water quality targets.	WBC, TW, EA	Ongoing
Developers should include the design of SuDS at an early stage to maximise the benefits of the scheme	Developers	Ongoing

Action	Responsibility	Timescale
Work with developers to discourage connection of new developments into existing surface water and combined sewer networks. Prevent connections into the foul network, as this is a significant cause of sewer flooding.	WBC Developers	Ongoing
Opportunities for Natural Flood Management that include schemes aimed at reducing / managing runoff should be considered to reduce nutrient and sediment pollution within West Berkshire.	WBC EA and NE	Ongoing

11 Climate Change Impact Assessment

11.1 Approach

A qualitative assessment was undertaken in Phase 1 to assess the potential impacts of climate change on the assessments made in this water cycle study. This was done using a matrix which considered both the potential impact of climate change on the assessment in question, and also the degree to which climate change has been considered in the information used to make the assessment.

The impacts have been assessed on an area wide basis; the available climate models are generally insufficiently refined to draw different conclusions for different parts of the study area or doing so would require a degree of detail beyond the scope of this study.

No changes to this assessment have been made in the Phase 2 study, but the results of the assessment are repeated below.

Table 11.1: Climate Change Pressures Scoring Matrix

		Impact of Pressure		
		Low	Medium	High
Have climate change pressures been considered in the assessment?	Yes - quantitative consideration			
	Some consideration but qualitative only			
	Not considered			

11.2 Summary of UK Climate Projections

The UK Climate projections 2018 (UKCP18), released November 2018, provide updated projections of how the climate might change in the UK over the 21st Century. This section provides an overview of the main differences between UKCP18 and UKCP09, and the key issues raised. A detailed analysis can be found in the Final Phase 1 Scoping Study Report. The projections benefit from a new set of emissions scenarios (known as RCPs) that consider mitigation efforts, updated methodology using the newest climate models and climate data and an updated baseline period of 1981-2000.

General climate change trends projected over UK land for the 21st century are broadly consistent with UKCP09 projections, showing an increased chance of milder, wetter winters and hotter, drier summers along with an increase in the frequency and intensity of extremes. Cold, drier winters and cooler, wet summers will still occur due to natural climate variability, but these are likely to become less frequent over the 21st Century. However, there are some differences between UKCP09 and UKCP18 (e.g. temperature and rainfall) that may be important for climate risk assessments. These differences depend on season, location and greenhouse gas emission scenario and there is a large overlap of projected ranges for the majority of climate metrics. The biggest differences are within the highest (95th) and lowest percentiles (5th) (so in the lower probability, extreme range)[21].

The UKCP18 probabilistic projections for the South East of England, for RCP 8.5 (high emissions scenario, to represent a worst-case scenario) by 2080 are as follows:

21 UKCP18 Science Overview Report, Met Office (2018). Accessed online at: https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf on: 02/06/2021

- Drier summers with a change in average summer precipitation of between -2% and -76%. Trends over the 21st century indicate dry summers are going to become much more frequent by 2100.
- Hotter summers will become much more common with a change in average summer temperatures of between 2.9°C and 8.6°C.
- Wetter winters with a change in average winter precipitation of between -2% and 57% (central estimate: 24%). Trends over the 21st century indicate that in general wet winters will become more frequent by 2100.
- Milder winters will become more common with a change in average winter temperatures of between 1.5°C and 5.7°C.

The key differences between UKCP09 and UKCP18 for this region vary dependent on climate metric, season and percentile ranges. For seasonal and annual trends in precipitation, there are some relatively big differences between the two sets of projections in the low and high percentiles. UKCP18 shows slightly larger reductions in precipitation than UKCP09. UKCP18 also shows slightly smaller increases in precipitation (90th percentile) in comparison to UKCP09. For seasonal and annual temperature, the differences between the two sets of projections appear to be dependent on season. The biggest differences are in winter with UKCP18 showing slightly less warming than UKCP09.

11.2.1 Water resources

Drawing from the UKCP18 projections, West Berkshire is likely to experience drier summers than was originally estimated in the UKCP09 by 2080. It can be assumed that hot, dry summers are likely to become more frequent over the 21st Century, which may have an impact on water demand and on the availability of water for abstraction from rivers during summer months. An overall increase in wet winters over the 21st century as consistent with UKCP09, which should be beneficial for aquifer recharge and the availability of groundwater resources. However, dry winters will still occur due to natural climate variability and it is not possible to estimate the relative probability of multiple dry seasons occurring consecutively (both summer and winter) from the data presented and the impact this will have on water availability. A detailed study of UKCP18 data would be required to fully understand the impact that the UKCP18 projections will have on water resources in the study area.

The National Infrastructure Commission has analysed the UK's long-term infrastructure needs in response to predicted drought. In order to maintain the current standard of resilience (the worst historic drought), the system would require 2,700- 3,000 million additional litres of water per day (Ml/day) to account for a rising population and the environmental and climate pressures expected by 2050. Figure 11.1 displays the spatial variation of the need for additional water capacity. Depending on the drought scenario (0.5% to 0.2% annual probability) an additional shortage as large as 1,000 Ml/day may be encountered. The 'Preparing for a Drier Future' report suggests that a 'twin-track' approach of reducing demand and increasing supply is the most cost efficient and sustainable way to deliver resilience. It is suggested that a minimum of 1,300 Ml/day of additional supply infrastructure will be required, which might be achieved using transfers, reservoirs, re-use and desalination. Comparatively, demand can be reduced by introducing additional metering and reducing leakages.

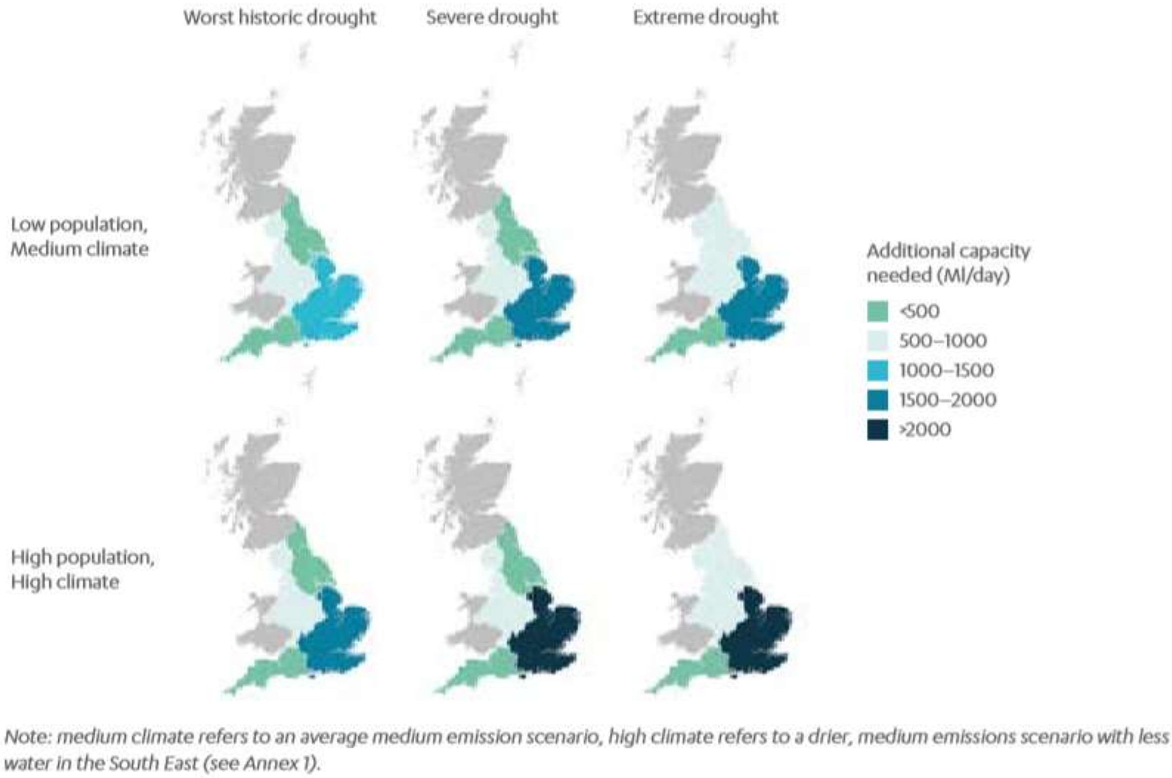


Figure 11.1 NIC Assessment of additional water resources capacity

Source: 'Preparing for a drier future', National Infrastructure Commission[22]

11.2.2 Wastewater infrastructure

The UKCP18 2.2km local projections provide projections for short duration heavy rainfall (i.e. convective storms) which affect urban drainage systems, but additional analysis will be needed before these projections can be translated into any guidance. Again, it is not possible to comment on how this may change wastewater management in the future. At the time of writing, the most up-to-date projections for future short duration high intensity rainfall are those from the UKWIR (UK Water Industry Water Research) 2017 project 'Rainfall intensity for sewer design - Stage 2', which should be used for wastewater management projects. Thames Water was a member of the project steering group for this research and owns a copy of the report.

11.3 Water company assessments

Thames Water have published a risk assessment[23] for both water resources, wastewater treatment and wastewater sewerage networks that identifies the level of threat from climate change in key service areas. In the case of WwTW, the highest perceived risks are in asset performance and pollution incidents, both of which can be attributed to an increased risk of flooding. In the case of the wastewater network, sewer flooding, resulting from increased rainfall intensity overwhelming the sewer network is added to the risks of impacts on asset performance and pollution incidents.

Consideration of the impact of climate change on water resources is included in TW's with the main risk being the increased likelihood of severe drought events. Allowance is made within the baseline supply forecast by adjusting the "Water Available for Use".

22 National Infrastructure Commission (2018) Preparing for a drier future. Accessed Online at: https://www.nic.org.uk/wp-content/uploads/NIC-Preparing-for-a-Drier-Future-26-April-2018.pdf on 02/06/2021

23 Thames Water's progress in planning for climate change, Thame Water (2016). Accessed online at: https://corporate.thameswater.co.uk/-/media/Site-Content/Thames-Water/Corporate/AboutUs/Protecting-our-environment/adaptionreport.pdf on: 21/02/2020

Table 11.2: Climate Change Consequences Scoring for The Water Cycle Study

Assessment	Impact of Pressure (source of information)	Have climate change pressures been considered in the Water Cycle Study?	RAG
Water resources	High	Yes – quantitative assessment within the WRMP. Climate change impacts on consumption have been calculated in accordance with UKWIR report "Impact of Climate Change on Water Demand" (2013).	
Water supply infrastructure	Medium - some increased demand in hot weather	Yes - quantitative assessment within the WRMP.	
Wastewater Collection	High - Intense summer rainfall and higher winter rainfall increases flood risk	Yes – qualitative assessment in climate change adaptation reports by Thames Water. This has not been considered in site by site assessments.	
Wastewater treatment	Medium - Increased winter flows and more extreme weather events reduces flow headroom	Yes – qualitative assessment in the Thames Water climate change adaptation reports. This has not been considered in site by site assessments.	
WwTW odour	Medium – higher temperatures will exacerbate existing odour control issues.	Thames Water have considered odour in WwTW upgrades as part of their climate adaptation plan.	
Water quality	Nutrients: High Sanitary determinands: Medium to High	Qualitative assessments have been included in the climate change adaptation policy papers from Thames Water.	
Flooding from increased WwTW discharge	Low	No - not considered	

(1) River Basin Management Plan

(2) TW WRMPs

11.4 Conclusions and Recommendations

The impact of Climate Change on water resources and water infrastructure are receiving increasing levels of attention by water companies and sewerage undertakers at a strategic level. This has not been included in assessments at a site level as detailed modelling has not been carried out by the water companies. Consideration of changes in water and wastewater demand should be considered when carrying out detailed site assessments in the future.

Table 11.3: Conclusions and Recommendations from Climate Change Assessment

Action	Responsibility	Timescale
When undertaking detailed assessments of environmental or asset capacity, consider how the latest climate change guidance can be included.	EA, TW	As required
Take "no regrets"* decisions in the design of developments which will contribute to mitigation and adaptation to climate change impacts. For example, consider surface water exceedance pathways when designing the layout of developments.	WBC and Developers	As required

* "No-Regrets" Approach: "No-regrets" actions are actions by households, communities, and local/national/international institutions that can be justified from economic, and social, and environmental perspectives whether natural hazard events or climate change (or other hazards) take place or not. "No-regrets" actions increase resilience, which is the ability of a "system" to deal with different types of hazards in a timely, efficient, and equitable manner. Increasing resilience is the basis for sustainable growth in a world of multiple hazards (Heltberg, Siegel, Jorgensen, 2009; UNDP, 2010).

12 Summary and Overall Conclusions

12.1 Summary

A summary of the conclusions for each section of the study are shown in Table 12.1.

Table 12.1: Summary of Conclusions from the Study

Assessment	Conclusion
Water resources	• Both WRZs in the study area are classed as being under serious water stress – justifying the more stringent target of 110 l/p/d under building regulations. • WBC may want to consider going further than the 110l/p/d water efficiency target particularly in larger strategic developments. • Policies to reduce water demand from new developments, or to go further and achieve water neutrality in certain areas, could be defined to reduce the potential environmental impact of additional water abstractions in West Berkshire, and also help to achieve reductions in carbon emissions. • The WRMP was found to be broadly in line with growth projections of WBC.
Water supply infrastructure	• Allocations and potential allocations across the study area were reviewed by Thames Water and given a relative scoring based on the impact on the water supply network. • Thames Water identified a number of development sites where further modelling and/or upgrades to the network would be required in order to serve those sites. Should these sites be allocated, delivery must be aligned with provision of these upgrades and WBC should engage with TW early to enable infrastructure upgrades to be constructed prior to occupation of new developments. • Once the Local Plan Review has been published, WBC should provide an update to TW to enable further modelling to be undertaken if necessary.
Wastewater collection	• Development in areas where there is limited wastewater network capacity will increase pressure on the network, increasing the risk of a detrimental impact on existing customers, and increasing the likelihood of sewer flooding. Early engagement with Thames Water is required, and further modelling of the network may be required at the planning application stage. • If there are areas where the current network is a combined sewer system, further separation of foul and surface water may be required, as well as suitably designed SuDS. • The results in section 5.3.1 show that in order to serve the proposed growth in a number of settlements in West Berkshire, wastewater infrastructure and/or treatment upgrades would be required. Early engagement between developers, the Council and TW is recommended to allow time for the strategic infrastructure required to serve these developments to be planned.
Wastewater Treatment Works Flow	• Two assessments of WwTW capacity were undertaken. • JBA performed a headroom assessment comparing the current dry weather flow (DWF) at each WwTW to the permitted flow and adding the additional effluent from

Assessment	Conclusion
Permit assessment	growth in the local plan period. Three WwTWs in West Berkshire are predicted to, or are already exceeding their flow permit (Chieveley, Hungerford, Newbury). • Thames Water carried out an assessment based on the relative suitability of development sites within each wastewater catchment. The least suitable sites (those where the WwTW would require investment in order to serve growth) given a red or amber score, and those where minimal investment is required, or where investment is already planned, were given a green score. This assessment took into account capacity at the WwTW, water quality, odour and infiltration within the catchment. • Many of the WwTWs in the study area would require upgrades in order to serve growth during the plan period. WBC should consider the time taken to undertake these upgrades when phasing development and early engagement with TW is recommended to ensure required upgrades are in place prior to occupation. TW should advise which WwTW would require safeguarding of land.
Odour Assessment	• Six sites across West Berkshire are close enough to a WwTW for there to be a risk of nuisance odour. If these sites were to be allocated in the Local Plan Review, an odour assessment is recommended as part of the planning process, funded by developers. The remaining sites have been given a rating of green.
Water quality impact assessment	• Growth during the local plan period will increase the discharge of treated wastewater from WwTWs in West Berkshire. There is a potential for this to cause a deterioration in water quality in the receiving watercourses. • At two WwTWs (Compton and Greenham Common), water quality modelling identified a risk that planned growth could cause a deterioration in water quality, however, the modelling also showed that this could be mitigated with treatment at the technically achievable limit. • The modelling indicates that treatment upgrades would be required at several of the WwTWs in order to accommodate growth without deterioration in water quality downstream. Extensive engagement with Thames Water is required in order to understand the phasing of growth with WwTW upgrades to ensure capacity and upgrades to treatment processes are aligned. There may be options to consolidate growth within catchments that have more environmental capacity, and this should be considered alongside the capacity assessment in section 6 • A further water quality test was performed which investigated whether if improvements in water quality were made elsewhere in the catchment, growth alone could be the reason that good ecological status under the Water Framework Directive was not achieved in the future. At no WwTW was this the case.
Flood risk from	• The impact of increased effluent flows at WwTW from any of the proposed developments is not predicted to have a

Assessment	Conclusion
additional WwTW flow	significant impact upon flood risk in any of the receiving watercourses.
Environmental Constraints and Opportunities	• The potential impacts of development on a number of protected sites such as SAC, SPAs, SSSIs and Ramsar sites within, or downstream of the study area should be carefully considered in future plan making. There are also a larger number of Priority Habitats and Priority Rivers. • Water quality modelling using SIMCAT shows that there is a risk that growth during the plan period would cause a significant deterioration in water quality in waterbodies adjacent to protected sites. • The modelling also shows that this deterioration could be prevented by improvements in treatment processes upstream. • There are a number of Groundwater Source Protection Zones, primarily in central and eastern areas of the study area. The impact of future development on groundwater should be investigated fully. • Development sites within the study area could be sources of diffuse pollution from surface runoff. • SuDS are required on all development sites. Their design must consider both water quantity and water quality and site level investigations should be undertaken to define the most appropriate SuDS types for each specific development. • Opportunities exist for these SuDS schemes to offer multiple benefits of flood risk reduction, amenity value and biodiversity. • In the wider area, opportunities exist to implement natural flood management techniques to achieve multiple benefits of flood risk, water quality and habitat creation.

12.2 Recommendations

Table 12.2 below summarises the recommendations from each section of the report.

Table 12.2: Summary of Recommendations

Aspect	Action	Responsibility	Timescale
Water Resources	Continue to regularly review forecast and actual household growth across the supply region through WRMP Annual Update reports, and where significant change is predicted, engage with Local Planning Authorities.	TW	Ongoing
	Provide yearly profiles of projected housing growth to water companies to inform the WRMP.	WBC	Annually
	The concept of water neutrality has potentially a lot of benefit in terms of resilience to climate change and enabling all waterbodies to be brought up to Good status. Explore further with the water companies and the Environment Agency how the Council's planning and climate change policies can encourage this approach.	WBC, EA, TW	In Local Plan Review and Climate Change Action Plan
	Strategic residential developments, and commercial developments should consider incorporating greywater recycling and/or rainwater harvesting into development at the master planning stage in order to reduce water demand.	WBC, TW	In Local Plan Review
Water Supply	Consider the need for additional water supply infrastructure when selecting sites for allocation in the Local Plan Review.	WBC	During Local Plan Review process
	Development of sites indicated as requiring further modelling or upgrades to capacity should be aligned with provision of infrastructure. Early collaboration between WBC, developers and TW is required.	WBC TW Developers	Ongoing
	TW should advise WBC of any strategic water resource / supply infrastructure required within the study area where these may	TW	During Local Plan Review process

Aspect	Action	Responsibility	Timescale
	require safeguarding of land to prevent other types of development occurring.		
Wastewater Collection	Early engagement between the council and TW is required to ensure that where strategic infrastructure is required, it can be planned in by TW.	WBC TW	Ongoing
	Take into account wastewater infrastructure constraints in phasing development in partnership with the sewerage undertaker	WBC TW	Ongoing
	Developers will be expected to work with the sewerage undertaker closely and early in the planning promotion process to develop an outline Foul Drainage Strategy for sites to the satisfaction of the LPA that the development will not increase sewer flooding or the frequency or duration of storm overflow operation. The Outline Foul Drainage strategy should set out: What – What is required to serve the site? Where – Where are the assets / upgrades to be located? When – When are the assets to be delivered (phasing)? Which – Which delivery route is the developer going to use s104 s98 s106 etc. The Outline Drainage Strategy should be submitted as part of the planning application submission, and where required, used as a basis for a drainage planning condition to be set.	TW and Developers	Ongoing
	Developers will be expected to demonstrate to the Lead Local Flood Authority (LLFA) that surface water from a site will be disposed using a sustainable drainage system (SuDS) with connection to surface water sewers seen as the last option. New connections for surface water	Developers LLFA	Ongoing

Aspect	Action	Responsibility	Timescale
	to foul sewers will be resisted by the LLFA.		
Wastewater Treatment	Consider WwTW capacity when selecting allocations for the Local Plan Review.	WBC	During Local Plan Review process
	Consider the available WwTW capacity when phasing development going to the same WwTW.	WBC, TW, EA	Ongoing
	Provide Annual Monitoring Reports to TW detailing projected housing growth.	WBC	Ongoing
	TW to assess growth demands alongside other pressures on the wastewater network e.g. infiltration, as part of their wastewater asset planning activities , and feedback to the Council if concerns arise.	TW	Ongoing
	TW to advise WBC of requirements for safeguarding land to enable WwTW expansions.	TW	During Local Plan Review process
Odour	Consider odour risk in the sites identified to be potentially at risk from nuisance odour	WBC	Ongoing
	Carry out an odour assessment for sites identified as amber as part of the planning process and paid for by the developer.	Site Developers	Ongoing
Water Quality	Provide annual monitoring reports to TW detailing projected housing growth in West Berkshire	WBC	Ongoing
	Take into account the full volume of growth (from West Berkshire and neighbouring authorities) within the catchment when considering WINEP schemes or upgrades at WwTW	TW	Ongoing
Flood Risk Management	Proposals to increase discharges to a watercourse may also require a flood risk activities environmental permit from the EA (in the	TW	During design of WwTW upgrades

Aspect	Action	Responsibility	Timescale
	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).		
Environment	Consider the environmental impact of development on protected sites downstream of receiving wastewater treatment works in the Habitats Regulations Assessment	WBC	Local Plan Review development
	The Local Plan Review should include policies that require all development proposals with the potential to impact on areas with environmental designations to be considered in line with the relevant legislation and where stated in consultation with Natural England (for national and international designations and priority habitats).	WBC	Local Plan Review development
	The Local Plan Review should include policies that require development sites to adopt SuDS to manage water quality of surface runoff.	WBC	Local Plan Review development
	In partnership, identify opportunities for incorporating SuDS into open spaces and green infrastructure, to deliver strategic flood risk management and meet WFD water quality targets.	WBC TW EA	Ongoing
	Developers should include the design of SuDS at an early stage to maximise the benefits of the scheme	Developers	Ongoing
	Work with developers to discourage connection of new developments into existing surface water and combined sewer networks. Prevent connections into the foul network, as this is a significant cause of sewer flooding.	WBC Developers	Ongoing

Aspect	Action	Responsibility	Timescale
	Opportunities for Natural Flood Management that include schemes aimed at reducing / managing runoff should be considered to reduce nutrient and sediment pollution within West Berkshire	WBC, EA, NE	Ongoing

Appendices

A Site tracker spreadsheet

B Water quality results

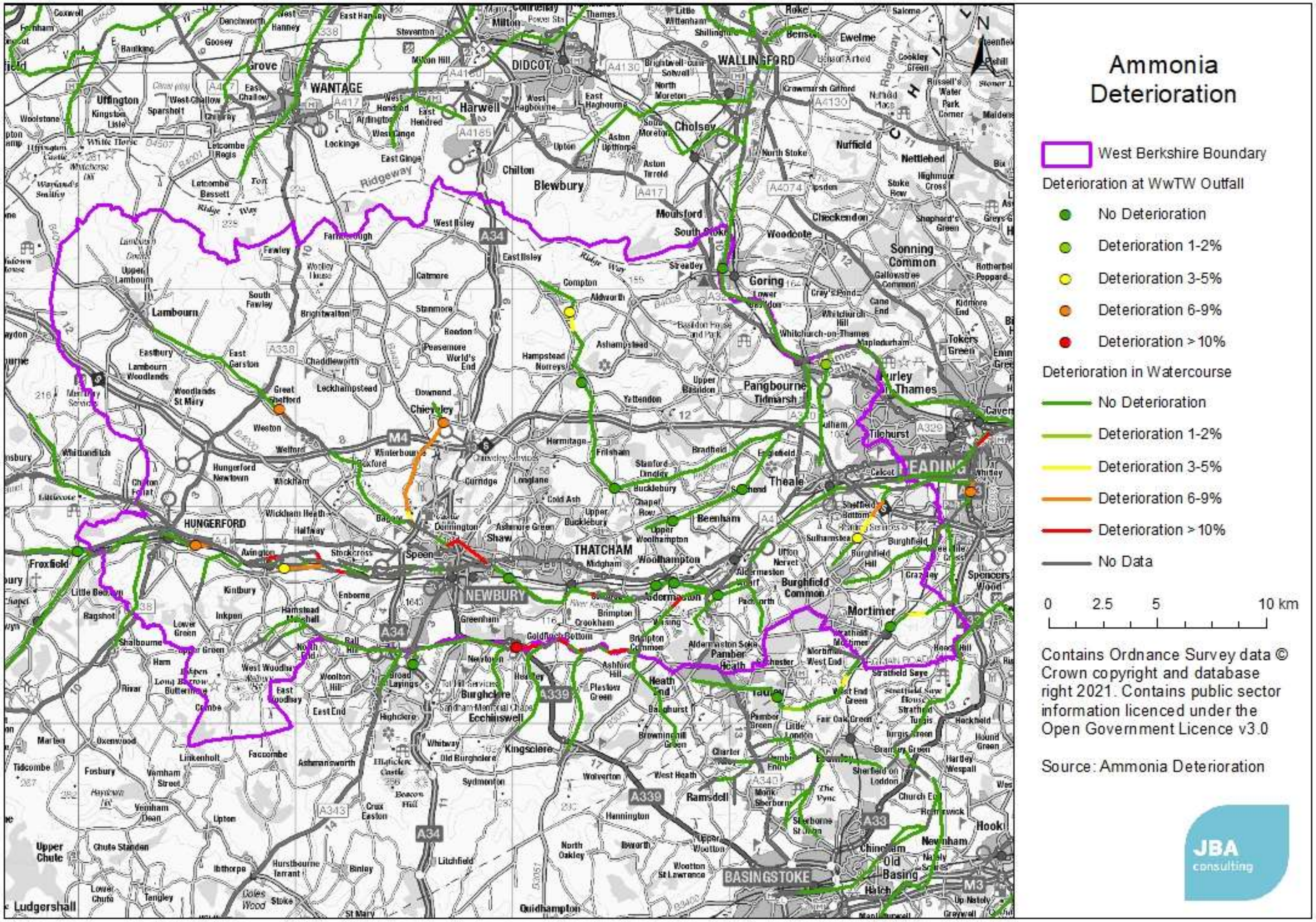


Figure 12.1 Predicted deterioration in Ammonia (unmitigated)

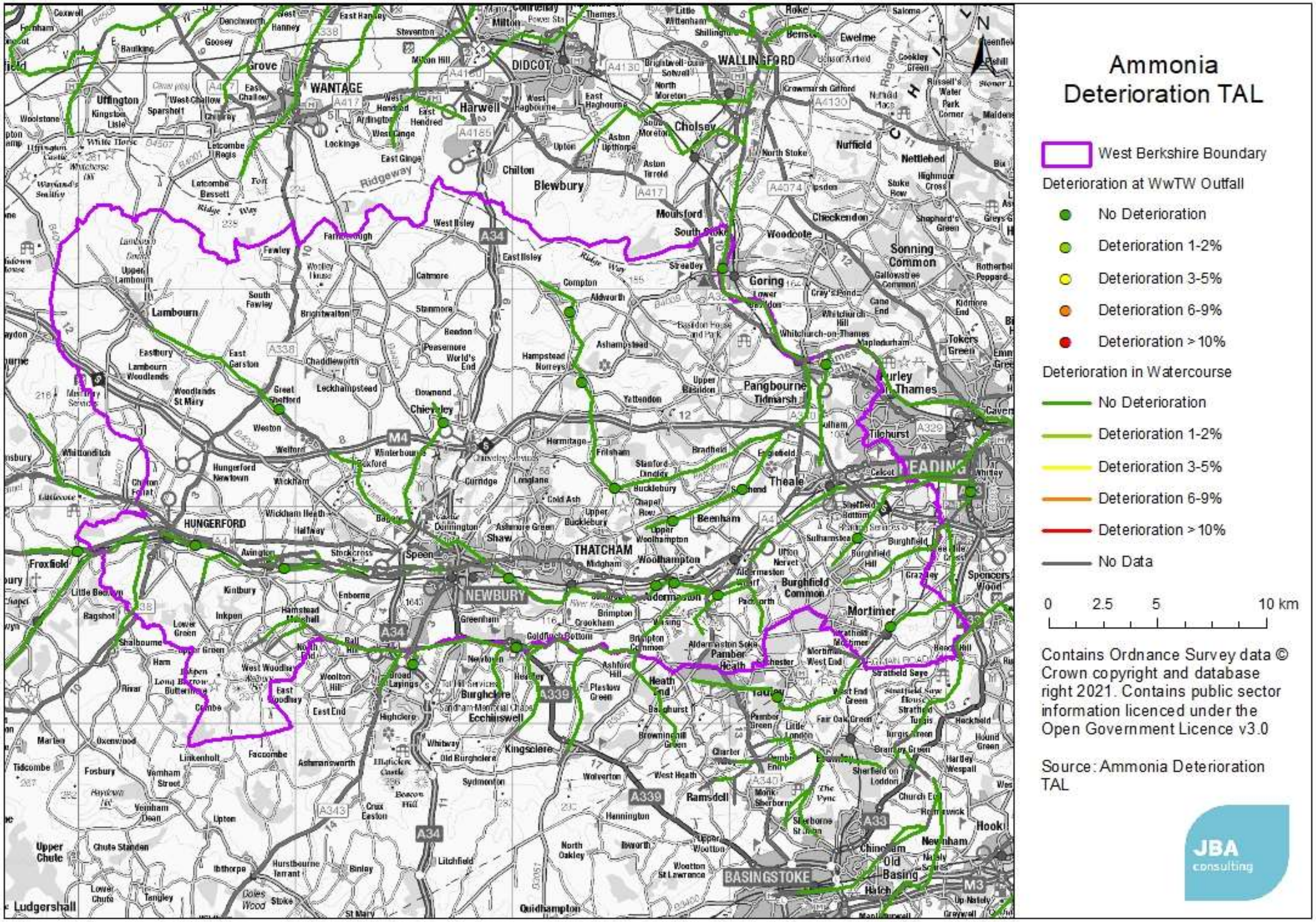


Figure 12.2 Predicted deterioration in Ammonia after WwTW improvements to the Technically Achievable Limit (TAL)

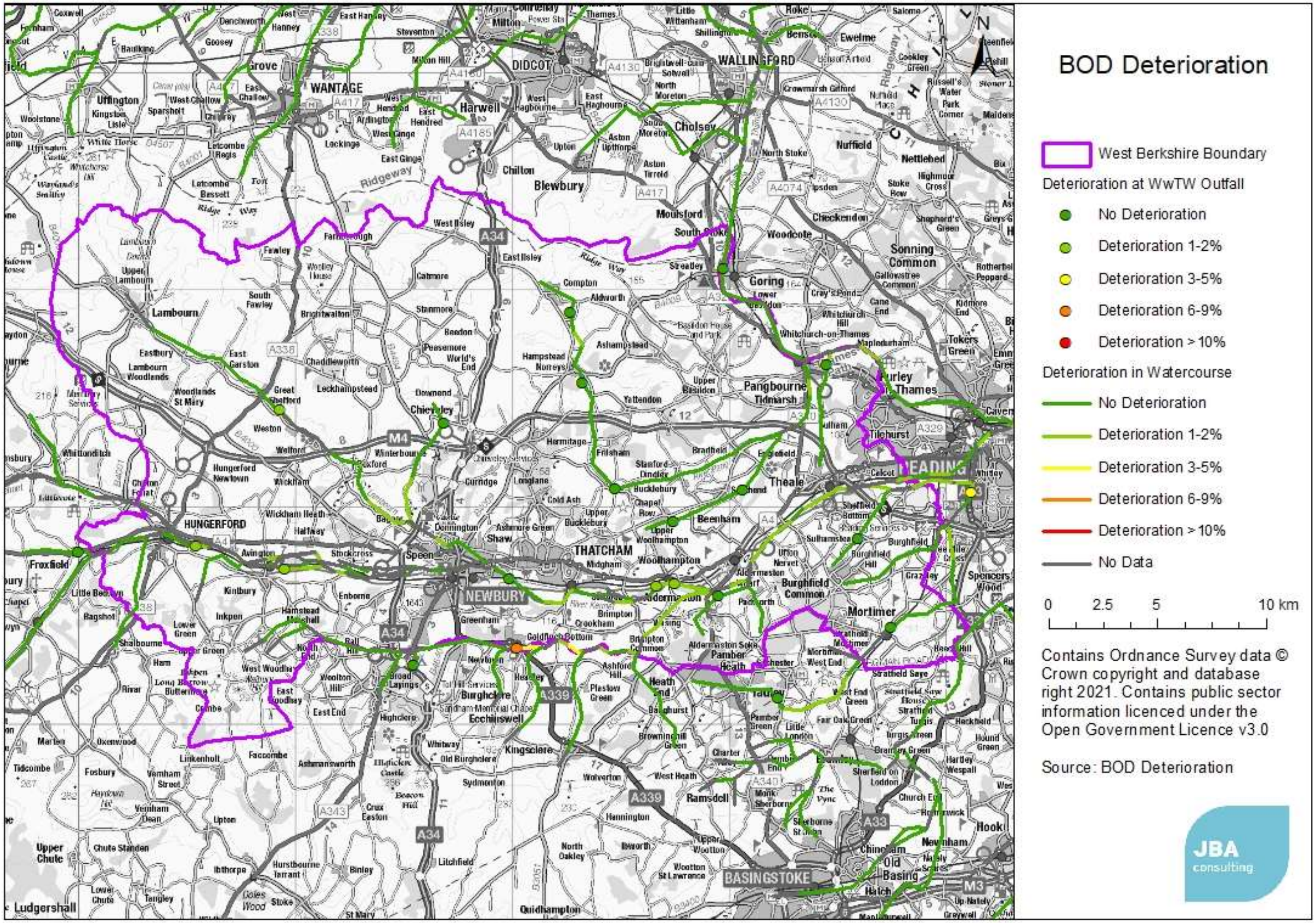


Figure 12.3 Predicted deterioration in BOD (unmitigated)

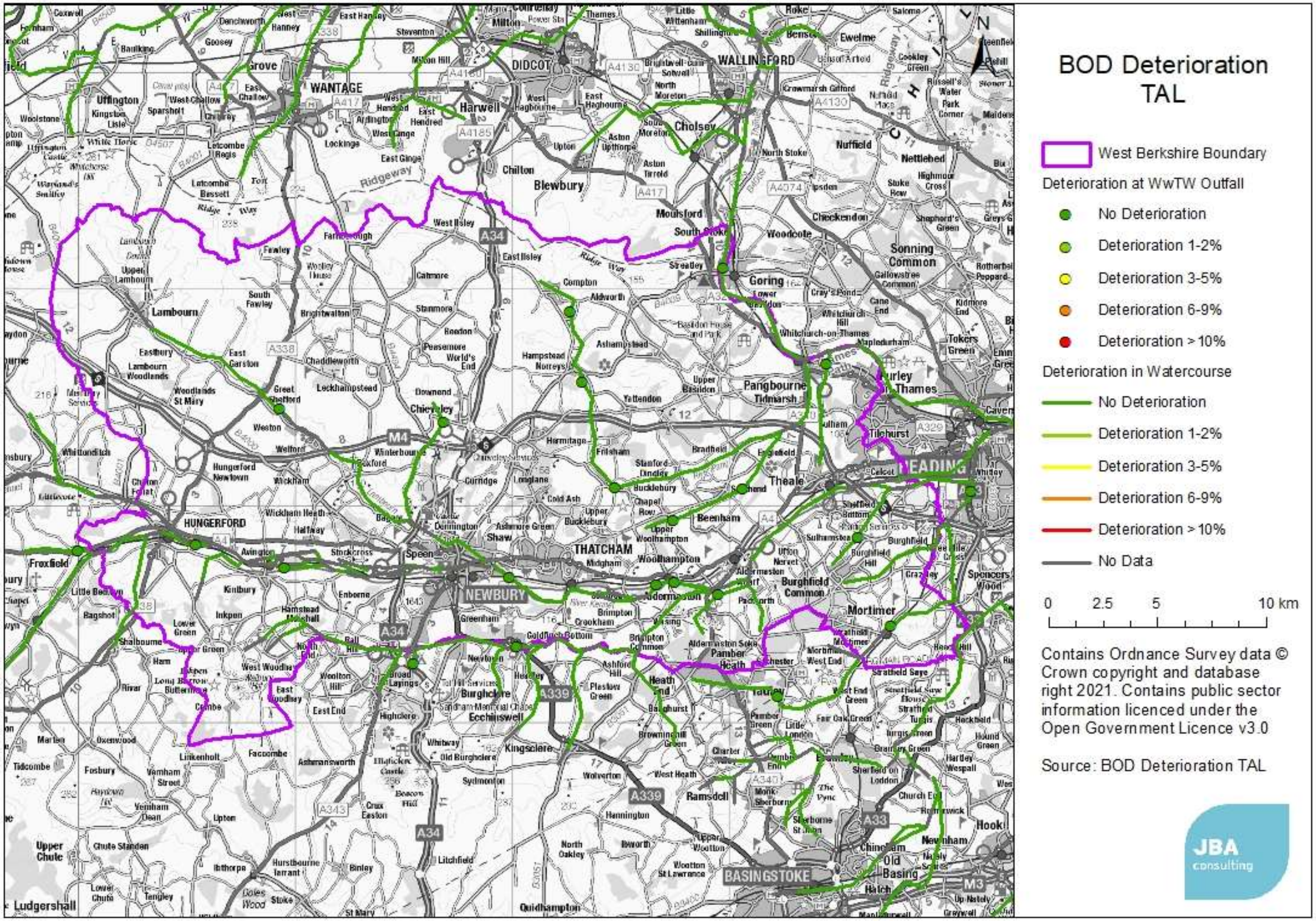


Figure 12.4 Predicted deterioration in BOD after WwTW improvements to the Technically Achievable Limit (TAL)

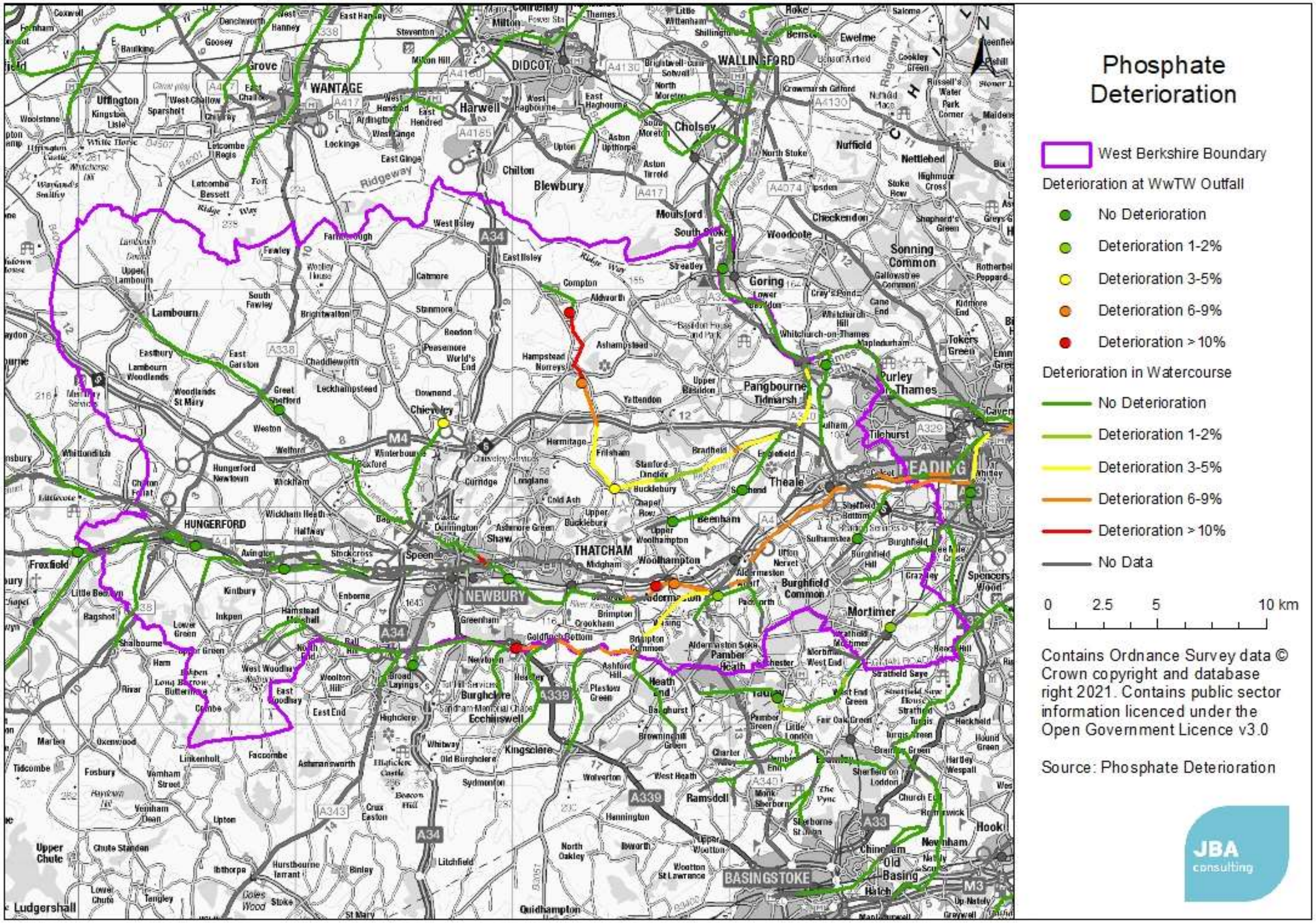


Figure 12.5 Predicted deterioration in Phosphate (unmitigated)

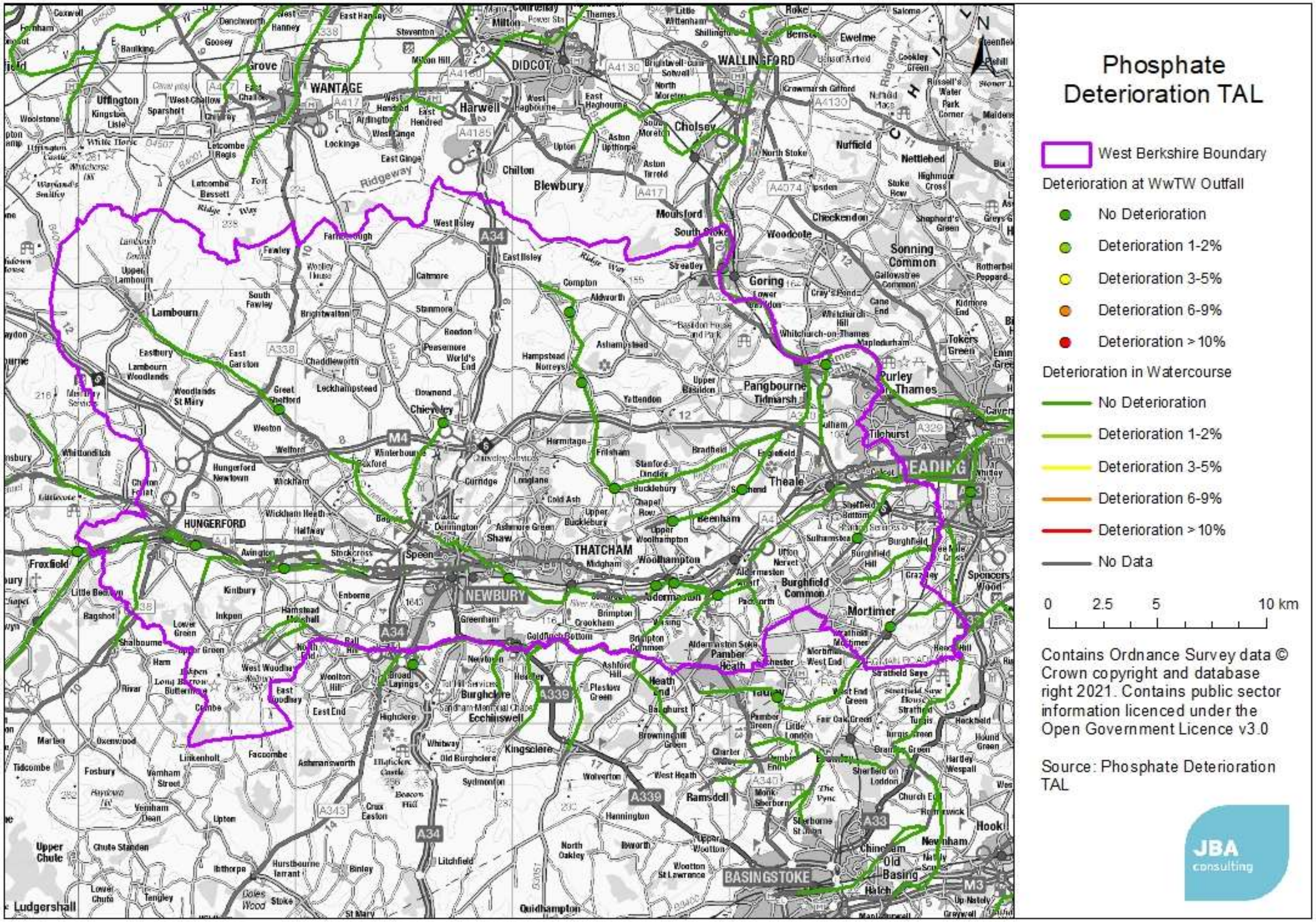


Figure 12.6 Predicted deterioration in BOD after WwTW improvements to the Technically Achievable Limit (TAL)

C Protected sites

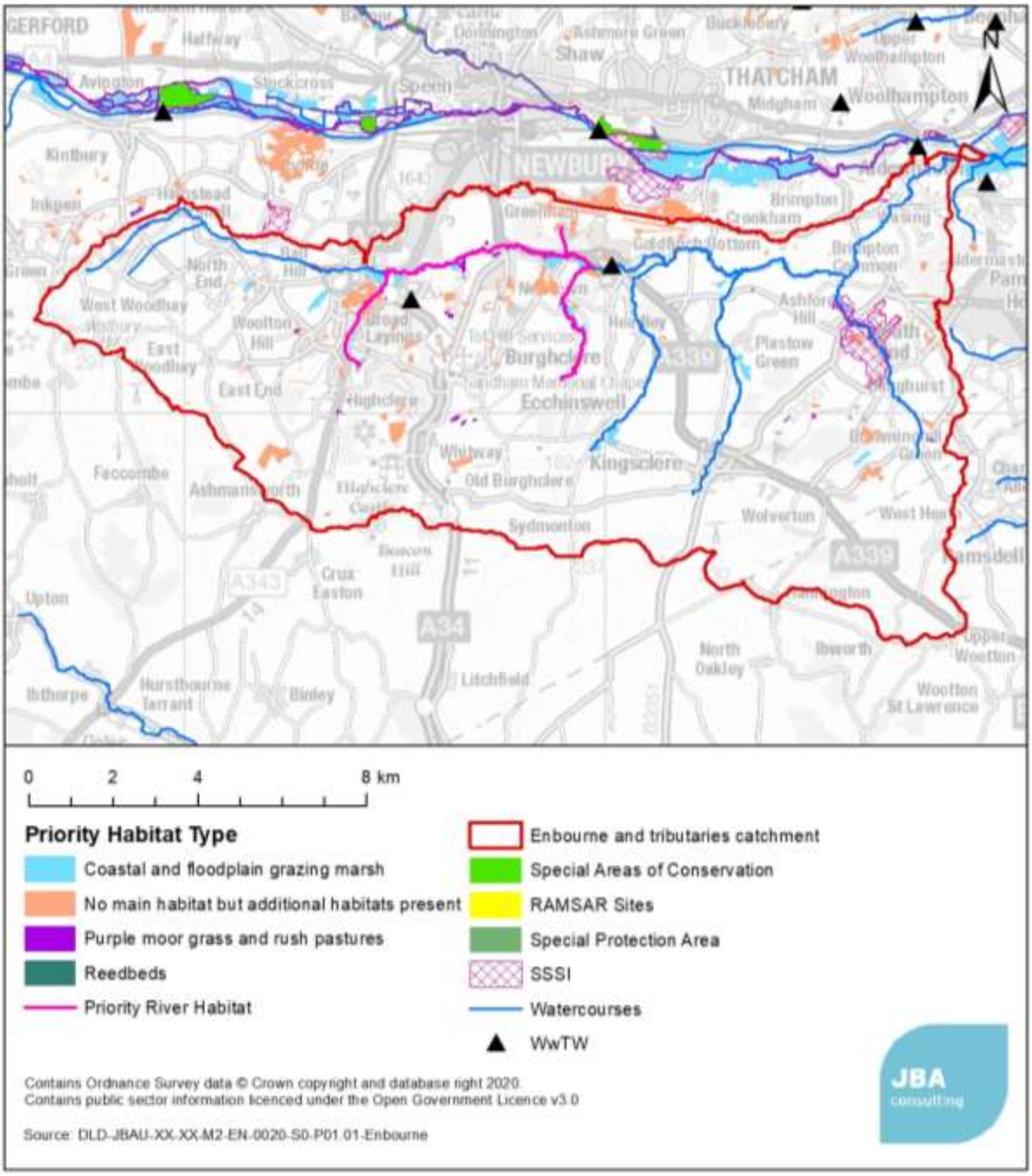


Figure 12.7 Protected sites within the Enborne catchment

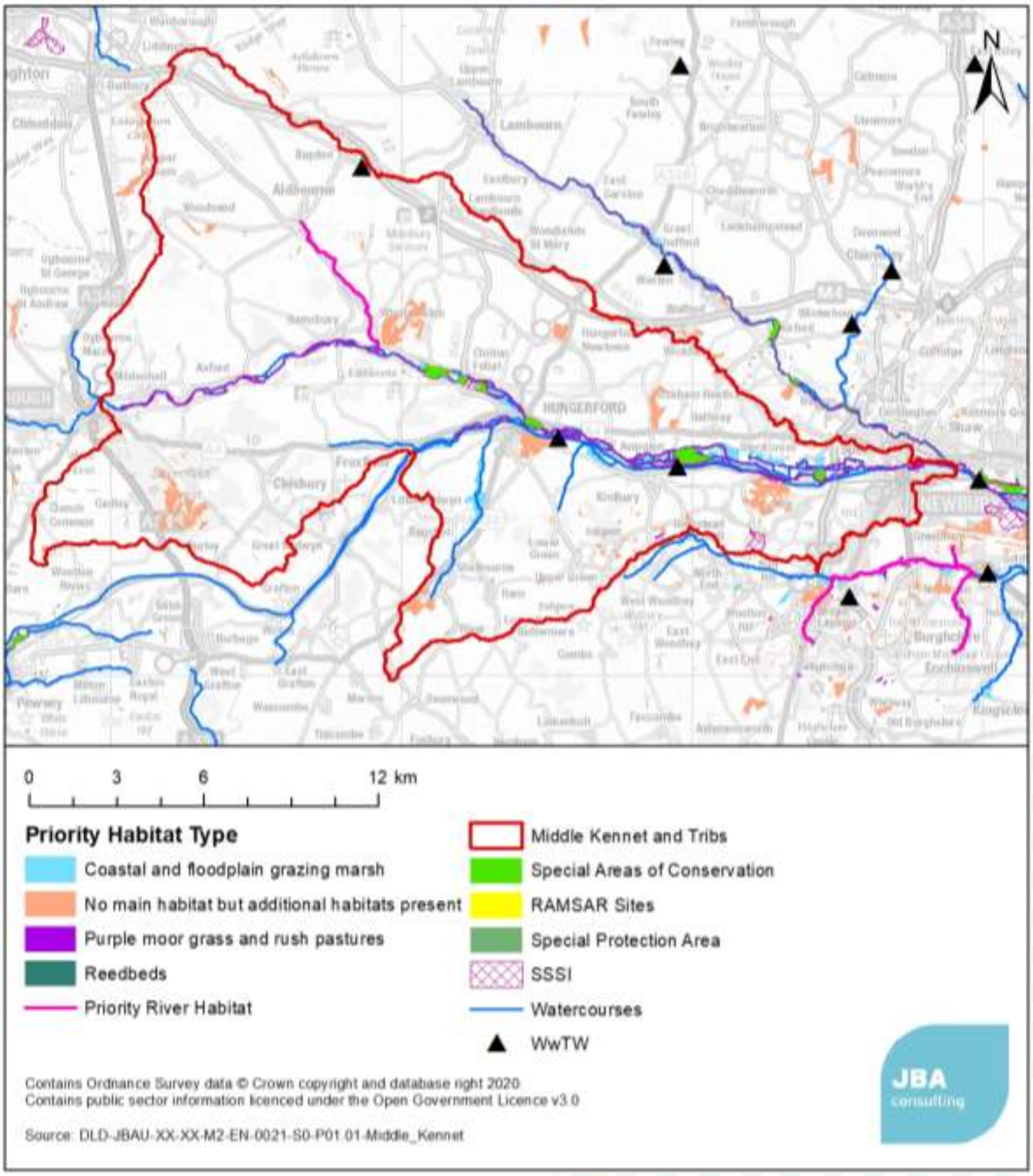


Figure 12.8: Protected sites within the Middle Kennet Catchment

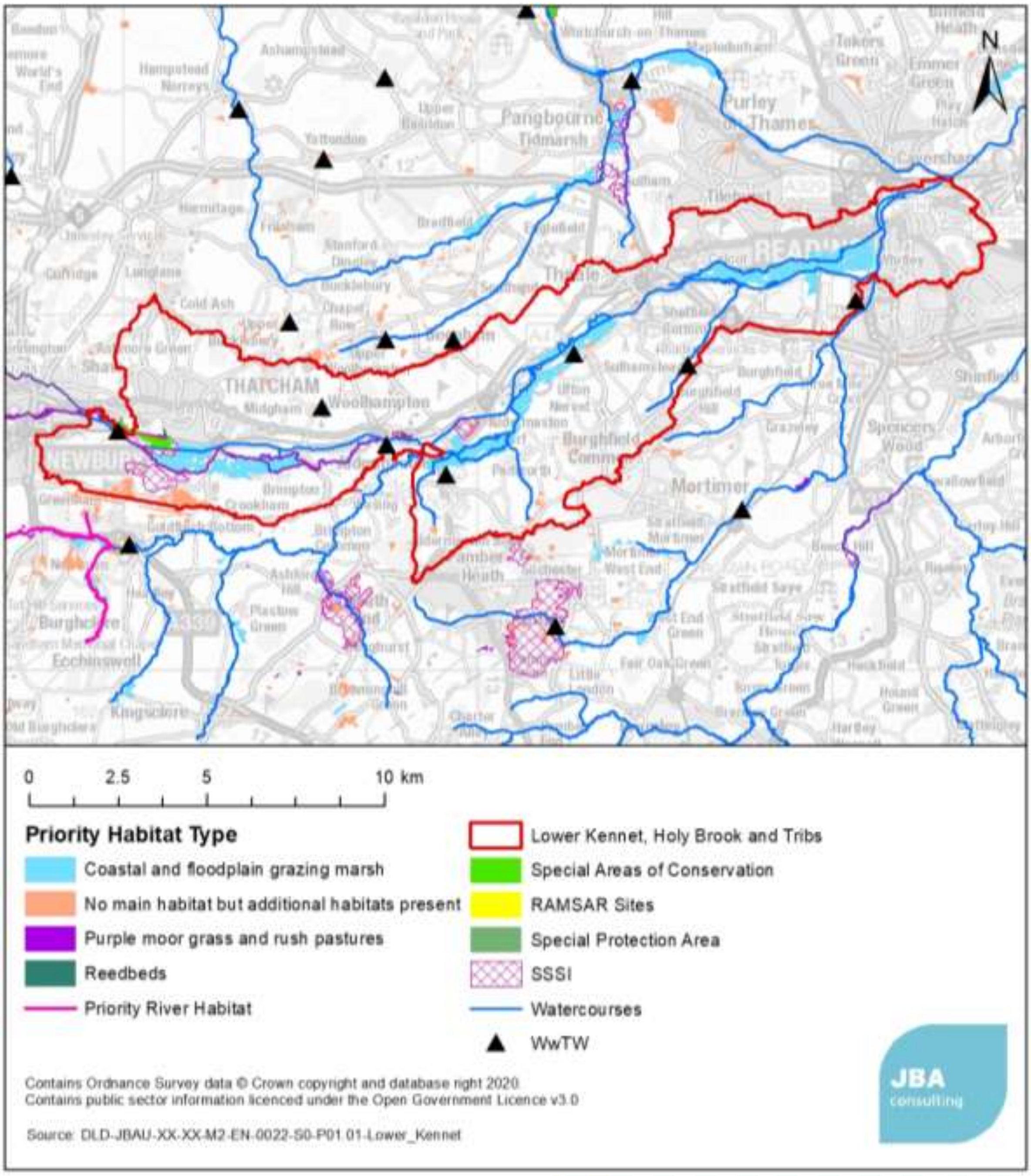


Figure 12.9: Protected areas within the Lower Kennet and Holy Brook Catchment

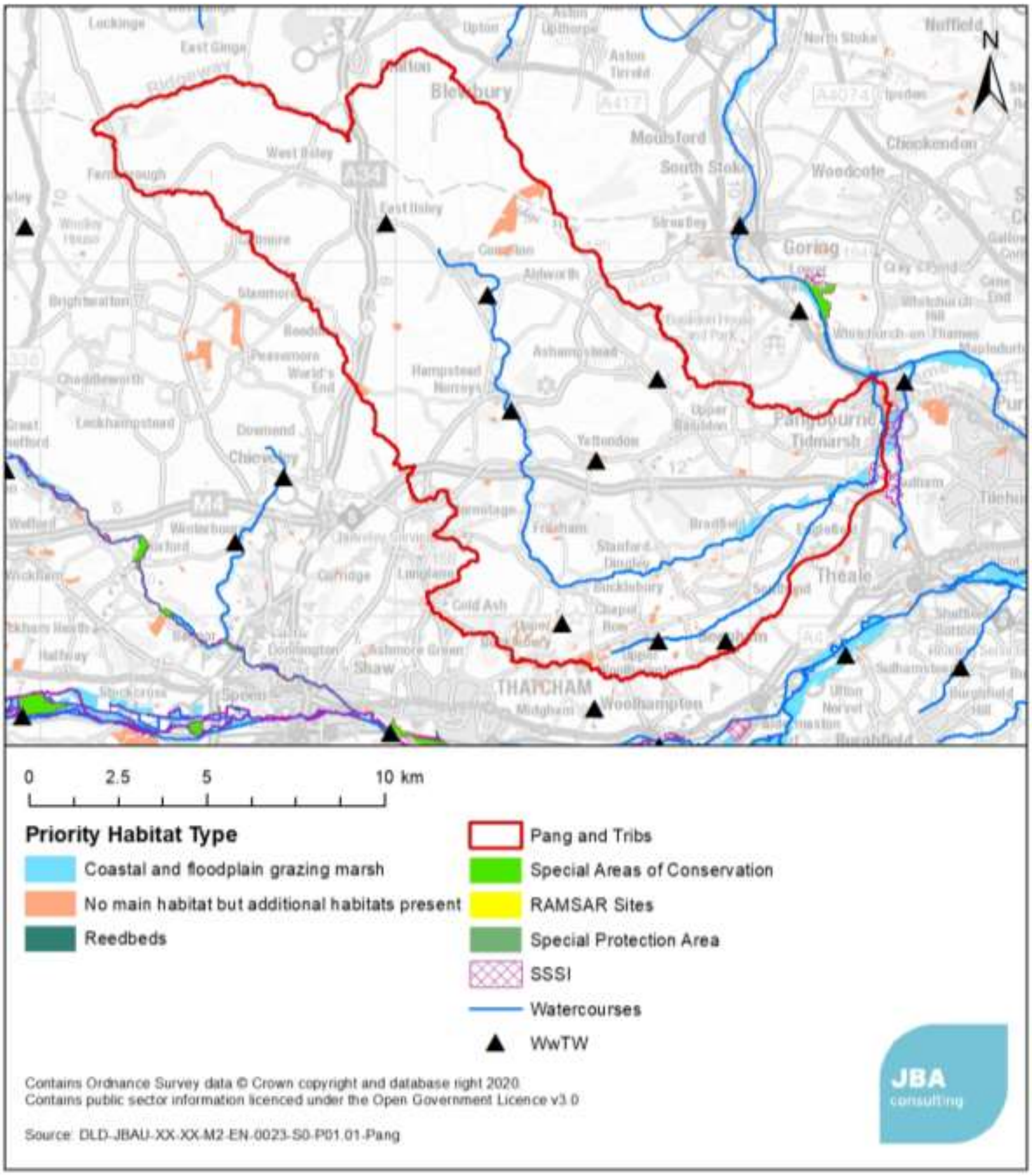


Figure 12.10: Protected areas within the Pang Catchment

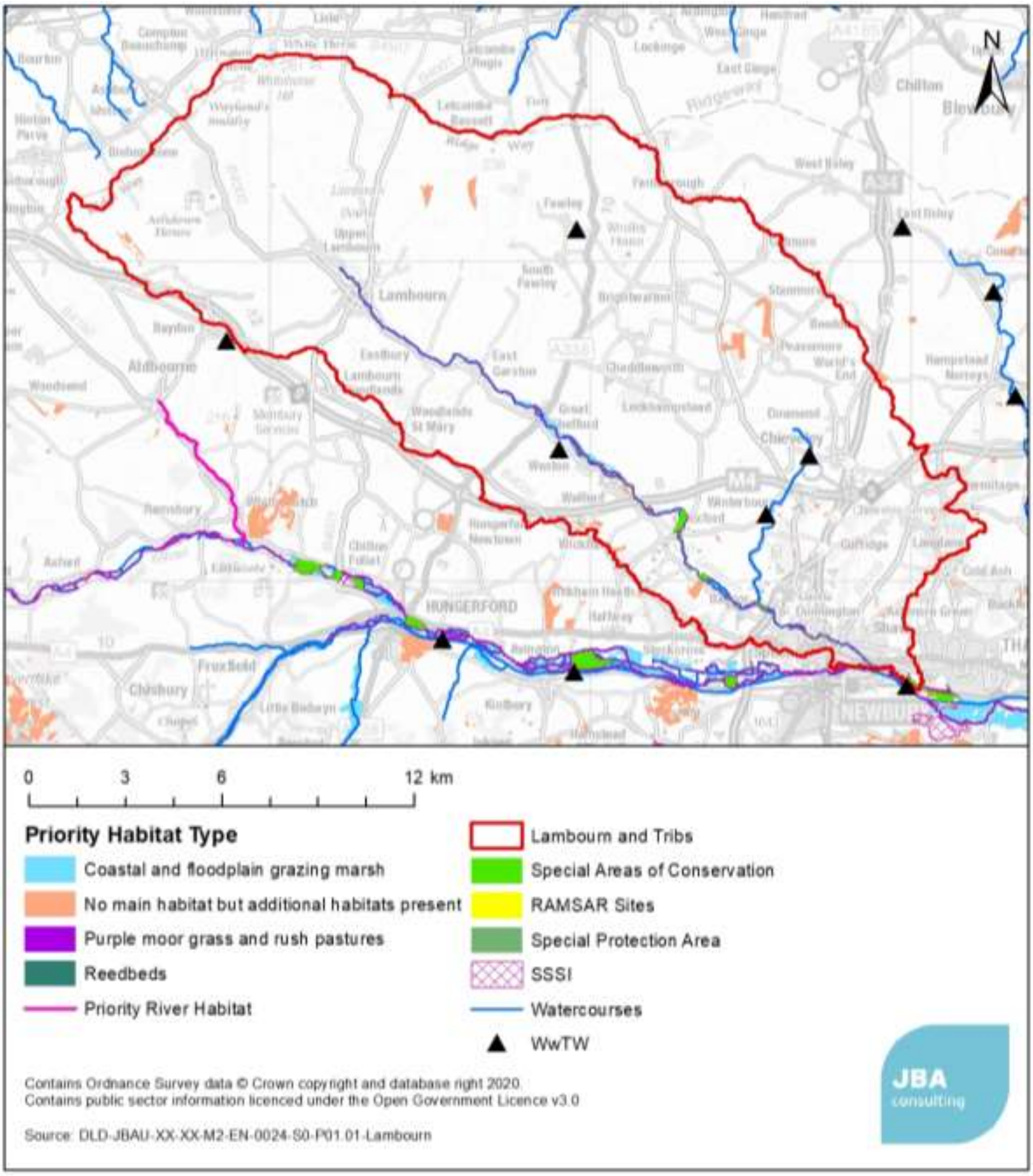


Figure 12.11: Protected areas within the Lambourn Catchment

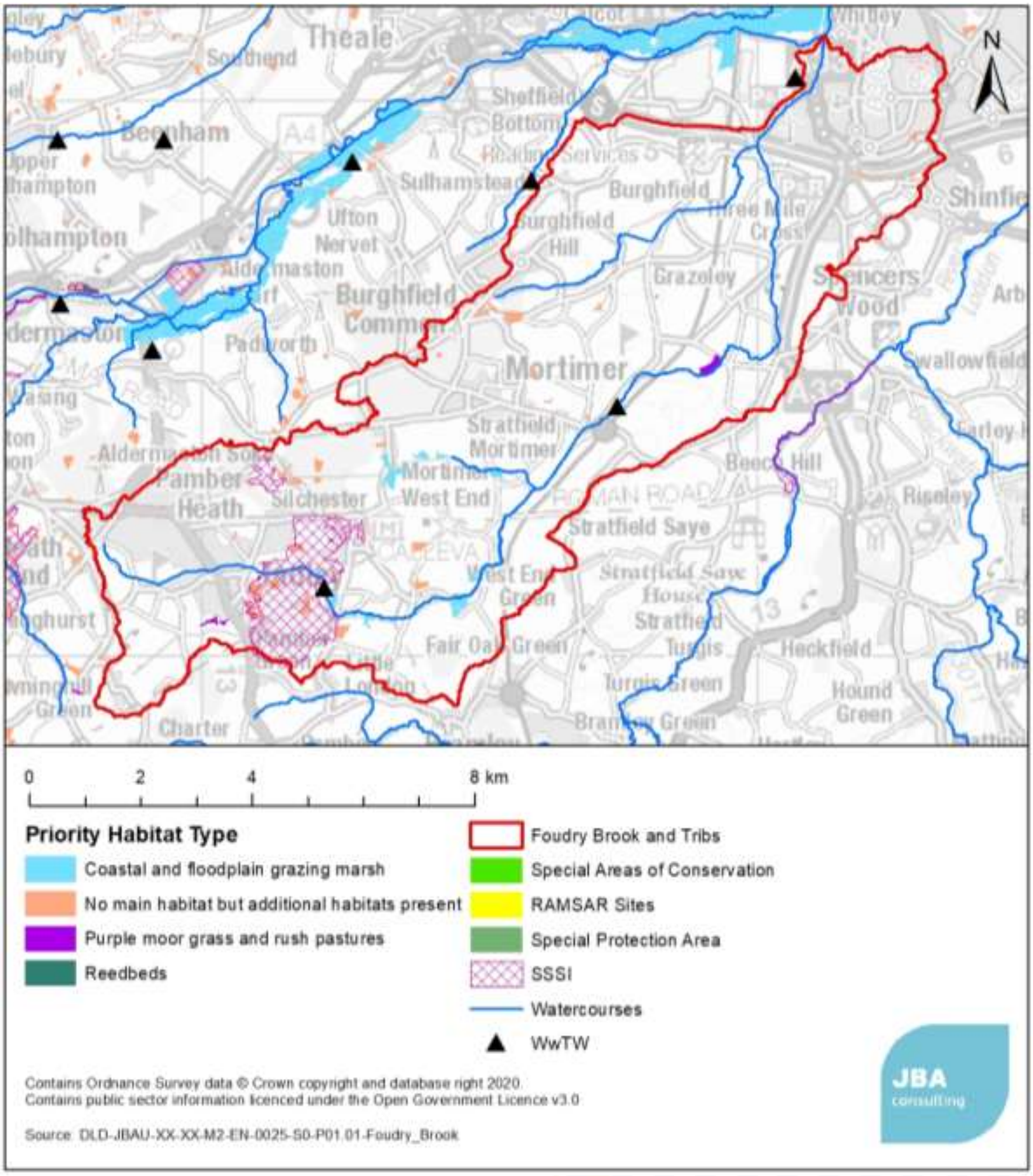


Figure 12.12: Protected areas within the Foudry Brook Catchment

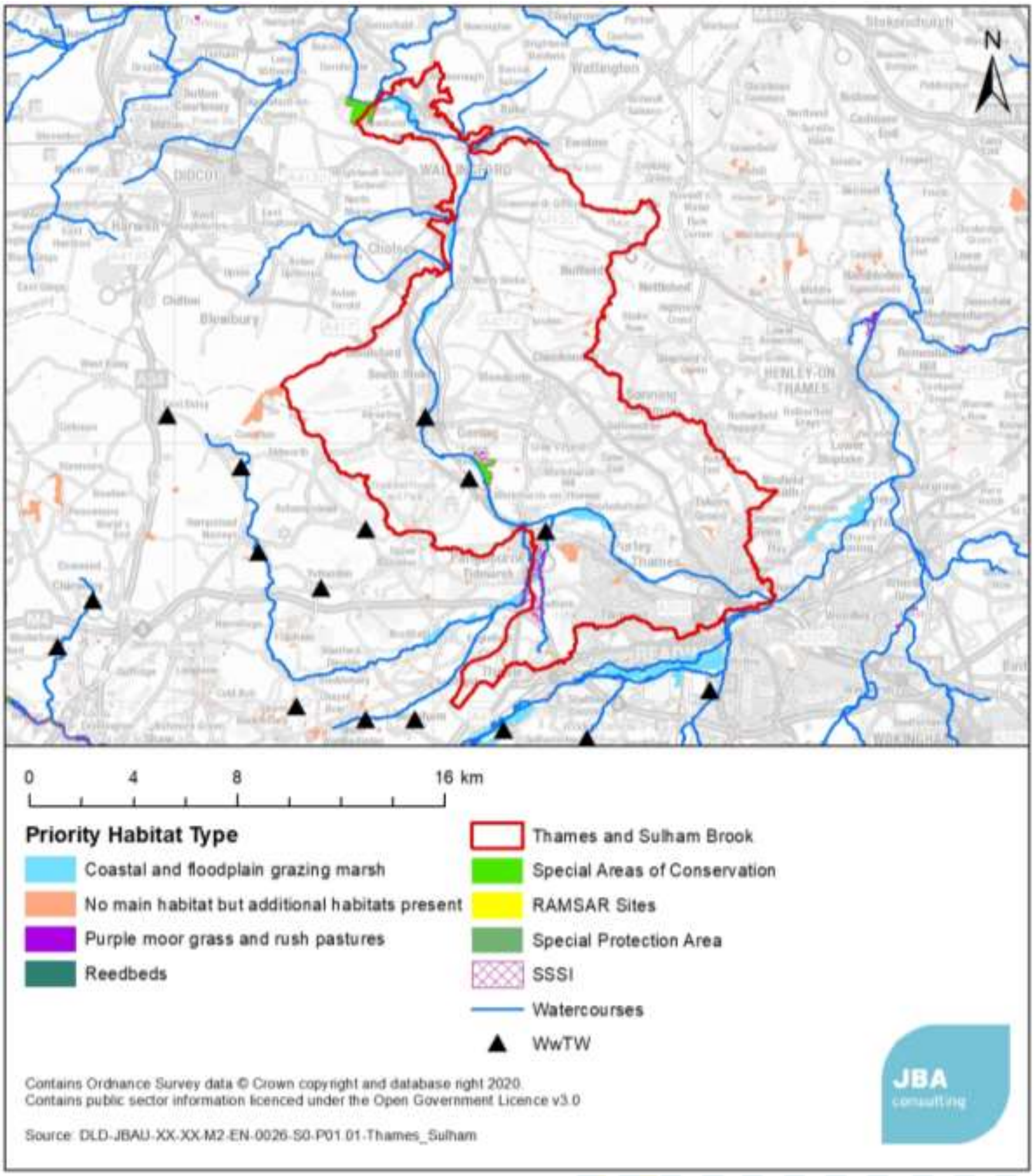


Figure 12.13: Protected areas within the Thames and Sulham Brook Catchment

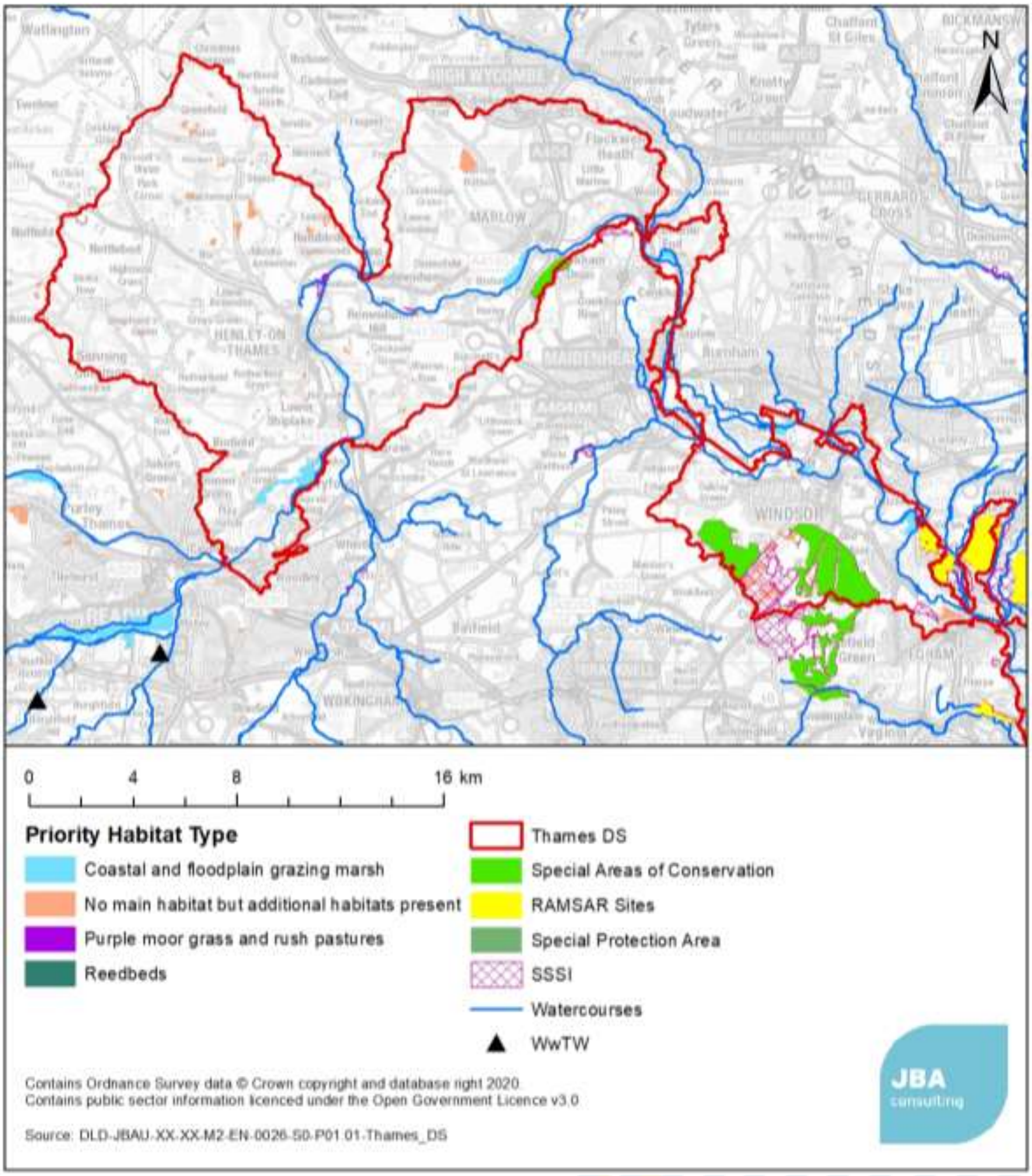


Figure 12.14 Protected areas in the downstream Thames catchment

D Environmental Impact Results

Protected site	Ref.	Adjacent watercourse ID	Adjacent watercourse name	Pollutant	Baseline Conc. (mg/l)	Future Conc. (mg/l)	% Det.	Conc. After treatment at TAL (mg/l)	Can deterioration be prevented?
Aldermaston Gravel Pits SSSI	SU596668	GB106039023140	Kennet and Holy Brook	Phosphate	0.16	0.17	6.25%	0.09	Y
				Ammonia	0.04	0.04	0.00%	0.03	Y
				BOD	1.29	1.32	2.33%	1.26	Y
Bisham Woods SSSI	SU857849	GB106039023233	Thames (Reading to Cookham)	Phosphate	0.23	0.23	0.00%	0.09	Y
				Ammonia	0.07	0.07	0.00%	0.06	Y
				BOD	1.37	1.37	0.00%	1.3	Y
Chilterns Beechwoods SAC	UK0012724	GB106039023233	Thames (Reading to Cookham)	Phosphate	0.23	0.23	0.00%	0.09	Y
				Ammonia	0.07	0.07	0.00%	0.06	Y
				BOD	1.37	1.37	0.00%	1.3	Y
Bowdown and Chamberhouse Woods SSSI	SU508654	GB106039017420	Kennet (Lambourn confluence to Enborne confluence)	Phosphate	0.12	0.12	0.00%	0.08	Y
				Ammonia	0.05	0.05	0.00%	0.03	Y
				BOD	1.53	1.54	0.65%	1.49	Y
Boxford Water Meadows SSSI	SU428718	GB106039023220	Lambourn (Source to Newbury)	Phosphate	0.08	0.08	0.00%	0.08	Y
				Ammonia	0.05	0.05	0.00%	0.02	Y
				BOD	1.44	1.45	0.69%	1.42	Y
Bray Meadows SSSI	SU898800	GB106039023511	Maidenhead Ditch	Phosphate	0.78	0.78	0.00%	0.24	Y
				Ammonia	0.1	0.1	0.00%	0.1	Y
				BOD	2.43	2.43	0.00%	2.43	Y
Bray Pennyroyal Field SSSI	SU915782	GB106039023231	Thames (Cookham to Egham)	Phosphate	0.27	0.27	0.00%	0.1	Y
				Ammonia	0.07	0.07	0.00%	0.06	Y
				BOD	1.53	1.53	0.00%	1.39	Y

Protected site	Ref.	Adjacent watercourse ID	Adjacent watercourse name	Pollutant	Baseline Conc. (mg/l)	Future Conc. (mg/l)	% Det.	Conc. After treatment at TAL (mg/l)	Can deterioration be prevented?
Brimpton Pit SSSI	SU565650	GB106039017340	Lower Enborne	Phosphate	0.58	0.61	5.17%	0.24	Y
				Ammonia	0.05	0.05	0.00%	0.03	Y
				BOD	1.24	1.25	0.81%	1.13	Y
Bushy Park and Home Park SSSI	TQ159692	GB106039023232	Thames (Egham to Teddington)	Phosphate	0.25	0.25	0.00%	0.1	Y
				Ammonia	0.05	0.05	0.00%	0.04	Y
				BOD	1.53	1.53	0.00%	1.32	Y
Cock Marsh SSSI	SU882866	GB106039023233	Thames (Reading to Cookham)	Phosphate	0.24	0.24	0.00%	0.1	Y
				Ammonia	0.07	0.07	0.00%	0.06	Y
				BOD	1.4	1.4	0.00%	1.32	Y
Dumsey Meadow SSSI	TQ056665	GB106039023232	Thames (Egham to Teddington)	Phosphate	0.25	0.25	0.00%	0.1	Y
				Ammonia	0.05	0.05	0.00%	0.04	Y
				BOD	1.41	1.41	0.00%	1.31	Y
Easton Farm Meadow SSSI	SU418721	GB106039023220	Lambourn (Source to Newbury)	Phosphate	0.08	0.08	0.00%	0.08	Y
				Ammonia	0.06	0.06	0.00%	0.03	Y
				BOD	1.5	1.5	0.00%	1.46	Y
Freeman's Marsh SSSI	SU329686	GB106039017390	Kennet and Avon Canal and Dun above Hungerford	Phosphate	0.13	0.13	0.00%	0.09	Y
				Ammonia	0.04	0.04	0.00%	0.02	Y
				BOD	2.14	2.14	0.00%	2.14	Y
Greenham and Crookham Commons SSSI	SU483641	GB106039017310	Enborne (downstream A34 to Burghclere Brook)	Phosphate	0.68	0.68	0.00%	0.18	Y
				Ammonia	0.15	0.15	0.00%	0.04	Y
				BOD	2.12	2.12	0.00%	1.87	Y
	SU619790	GB106039030331		Phosphate	0.31	0.31	0.00%	0.1	Y
				Ammonia	0.04	0.04	0.00%	0.04	Y

Protected site	Ref.	Adjacent watercourse ID	Adjacent watercourse name	Pollutant	Baseline Conc. (mg/l)	Future Conc. (mg/l)	% Det.	Conc. After treatment at TAL (mg/l)	Can deterioration be prevented?
Hartslock SSSI & Hartslock Wood SAC			Thames Wallingford to Caversham	BOD	1.51	1.51	0.00%	1.41	Y
Kennet Valley Alderwoods SSSI / SAC	SU399675	GB106039023174	Middle Kennet (Hungerford to Newbury)	Phosphate	0.07	0.07	0.00%	0.05	Y
				Ammonia	0.07	0.07	0.00%	0.04	Y
				BOD	1.69	1.7	0.59%	1.59	Y
	SU399675	GB106039023174	Middle Kennet (Hungerford to Newbury)	Phosphate	0.07	0.07	0.00%	0.05	Y
				Ammonia	0.07	0.08	14.29%	0.04	Y
				BOD	1.77	1.77	0.00%	1.67	Y
	SU399675	GB106039023174	Middle Kennet (Hungerford to Newbury)	Phosphate	0.07	0.07	0.00%	0.07	Y
				Ammonia	0.06	0.06	0.00%	0.06	Y
				BOD	2.6	2.6	0.00%	2.6	Y
South West London Waterbodies Ramsar	UK11065	GB106039023231	Thames (Cookham to Egham)	Phosphate	0.25	0.25	0.00%	0.1	Y
				Ammonia	0.06	0.06	0.00%	0.05	Y
				BOD	1.47	1.47	0.00%	1.35	Y
South West London Waterbodies SPA	UK9012171	GB106039023231	Thames (Cookham to Egham)	Phosphate	0.25	0.25	0.00%	0.1	Y
				Ammonia	0.06	0.06	0.00%	0.05	Y
				BOD	1.47	1.47	0.00%	1.35	Y
Langham Pond SSSI	TQ002720	GB106039023231	Thames (Cookham to Egham)	Phosphate	0.25	0.25	0.00%	0.1	Y
				Ammonia	0.06	0.06	0.00%	0.05	Y
				BOD	1.47	1.47	0.00%	1.35	Y
Pamber Forest and Silchester Common SSSI	SU616612	GB106039017190	Silchester Brook	Phosphate	0.17	0.17	0.00%	0.16	Y
				Ammonia	0.05	0.05	0.00%	0.05	Y
				BOD	3.6	3.6	0.00%	3.6	Y

Protected site	Ref.	Adjacent watercourse ID	Adjacent watercourse name	Pollutant	Baseline Conc. (mg/l)	Future Conc. (mg/l)	% Det.	Conc. After treatment at TAL (mg/l)	Can deterioration be prevented?
Rodbed Wood SSSI	SU803836	GB106039023233	Thames (Reading to Cookham)	Phosphate	0.24	0.24	0.00%	0.1	Y
				Ammonia	0.08	0.08	0.00%	0.05	Y
				BOD	1.37	1.38	0.73%	1.3	Y
South Lodge Pit SSSI	SU905819	GB806100325	Jubilee River	Phosphate	0.23	0.23	0.00%	0.09	Y
				Ammonia	0.07	0.07	0.00%	0.06	Y
				BOD	1.42	1.42	0.00%	1.34	Y
Staines Moor SSSI	TQ043731	GB106039023231	Thames (Cookham to Egham)	Phosphate	0.25	0.25	0.00%	0.1	Y
				Ammonia	0.06	0.06	0.00%	0.05	Y
				BOD	1.47	1.48	0.68%	1.36	Y
Sulham and Tidmarsh Woods and Meadows	SU635741	GB106039023300	Pang	Phosphate	0.31	0.32	3.23%	0.21	Y
				Ammonia	0.24	0.24	0.00%	0.23	Y
				BOD	3.82	3.8	-0.52%	3.72	Y
Temple Island Meadows SSSI	SU768846	GB106039023233	Thames (Reading to Cookham)	Phosphate	0.24	0.24	0.00%	0.1	Y
				Ammonia	0.08	0.08	0.00%	0.05	Y
				BOD	1.34	1.35	0.75%	1.27	Y
Thatcham Reed Beds SSSI	SU507664	GB106039017420	Kennet (Lambourn confluence to Enborne confluence)	Phosphate	0.12	0.12	0.00%	0.08	Y
				Ammonia	0.05	0.05	0.00%	0.03	Y
				BOD	1.55	1.55	0.00%	1.51	Y
Thatcham Reed Beds SSSI	SU507664	GB106039017420	Kennet (Lambourn confluence to Enborne confluence)	Phosphate	0.12	0.12	0.00%	0.08	Y
				Ammonia	0.05	0.05	0.00%	0.03	Y
				BOD	1.58	1.58	0.00%	1.53	Y
	SU578666	GB106039017420		Phosphate	0.12	0.13	8.33%	0.08	Y

Protected site	Ref.	Adjacent watercourse ID	Adjacent watercourse name	Pollutant	Baseline Conc. (mg/l)	Future Conc. (mg/l)	% Det.	Conc. After treatment at TAL (mg/l)	Can deterioration be prevented?
Woolhampton Reed Bed SSSI			Kennet (Lambourn confluence to Enborne confluence)	Ammonia	0.04	0.04	0.00%	0.03	Y
				BOD	1.38	1.39	0.72%	1.35	Y
Wraysbury & Hythe End Gravel Pits SSSI	TQ009735	GB106039023231	Thames (Cookham to Egham)	Phosphate	0.25	0.25	0.00%	0.1	Y
				Ammonia	0.06	0.06	0.00%	0.05	Y
				BOD	1.47	1.47	0.00%	1.35	Y
Wraysbury No. 1 Gravel Pit SSSI	TQ003747	GB106039023231	Thames (Cookham to Egham)	Phosphate	0.24	0.25	4.17%	0.1	Y
				Ammonia	0.06	0.06	0.00%	0.05	Y
				BOD	1.45	1.45	0.00%	1.36	Y
Wraysbury Reservoir SSSI	TQ025745	GB106039023231	Thames (Cookham to Egham)	Phosphate	0.25	0.25	0.00%	0.1	Y
				Ammonia	0.06	0.06	0.00%	0.05	Y
				BOD	1.47	1.47	0.00%	1.35	Y
The Rivers Kennet and Lamborn have been designated as a SSSI / SAC along their entire lengths. Water quality was checked at all points along its length, and the point with the largest deterioration in Phosphate is shown below. In every case, deterioration could be prevented by improvements in upstream treatment processes.									
River Kennet (SSSI / SAC)	SU337695	N/A	N/A	Phosphate	0.11	0.12	9.09%	0.08	Y
				Ammonia	0.04	0.05	25.00%	0.03	Y
				BOD	1.44	1.46	1.39%	1.41	Y
River Lambourn SSSI and Kennet & Lambourn Floodplain SAC	SU405733	N/A	N/A	Phosphate	0.1	0.11	10.00%	0.1	Y
				Ammonia	0.03	0.04	33.33%	0.02	Y
				BOD	2.06	2.06	0.00%	2.06	Y

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Registered Office
1 Broughton Park
Old Lane North
Broughton
SKIPTON
BD23 3FD
United Kingdom

+44(0)1756 799919
info@jbaconsulting.com
www.jbaconsulting.com
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