Milton Keynes Water Cycle Study

Milton Keynes Council

FINAL

February 2018

Quality information

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List of Acronyms

AMP	Asset Management Plan
AWS	Anglian Water Services
BAP	Biodiversity Action Plan
BGS	British Geological Society
BOD	Biochemical Oxygen Demand
BREEAM	Building Research Establishment Environmental Assessment Method
CAMS	Catchment Abstraction Management Strategy
CBA	Cost Benefit Analysis
CFMP	Catchment Flood Management Plan
CIL	Community Infrastructure Levy
CIRIA	Construction Industry Research and Information Association
CLG	Communities and Local Government
CRC	Carbon Reduction Commitment
DEFRA	Department for Environment, Food and Rural Affairs
DWF	Dry Weather Flow
EFI	Environmental Flow Indicator
GI	Green Infrastructure
GWR	Greywater Recycling
HA	Highways Agency
l/h/d	Litres/head/day (a water consumption measurement)
LCT	Limits of Conventional Treatment
LFE	Low Flow Enterprise (low flow model)
LLFA	Lead Local Flood Authority
LNR	Local Nature Reserve
LPA	Local Planning Authority
MKC	Milton Keynes Council
Ml	Mega Litre (a million litres)
NE	Natural England
NPPF	National Planning Policy Framework
OAHN	Objectively Assessed Housing Need
OFWAT	The Water Services Regulation Authority (formerly the Office of Water Services)
ONS	Office for National Statistics
OR	Occupancy Rate
P	Phosphorous
Q95	The river flow exceeded 95% of the time
RAG	Red/Amber/Green Assessment
RBMP	River Basin Management Plan
RoC	Review of Consents (under the Habitats Directive)
RQP	River Quality Planning (tool)
RWH	Rainwater Harvesting
S106	Section 106 (Town and Country Planning Act 1990)
SAC	Special Area for Conservation
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SUDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKCIP02	United Kingdom Climate Impacts Programme 2002
UKCP09	United Kingdom Climate Projections 2009
UKTAG	United Kingdom Technical Advisory Group (to the WFD)
UKWIR	United Kingdom Water Industry Research group
UWWTD	Urban Wastewater Treatment Directive
WCS	Water Cycle Study
WFD	Water Framework Directive
WN	Water Neutrality
WRC	Water Recycling Centre
WRMP	Water Resource Management Plan
WRMU	Water Resource Management Unit (in relation to CAMS)
WRZ	Water Resource Zone (in relation to a water company's WRMP)
WSI	Water Services Infrastructure

Non-Technical Summary

Milton Keynes is expected to experience significant growth, particularly in relation to domestic redevelopment for the period up to 2031. This growth represents a challenge in ensuring that both the water environment and water services infrastructure has the capacity to sustain this level of growth and development proposed.

The Milton Keynes Council Water Cycle Study update forms an important part of the evidence base that will help Milton Keynes Council determine the most appropriate options for development within the Borough (with respect to water infrastructure and the water environment) to be identified in the Council's New Local Plan, referred to as Plan:MK (for the period to 2031). Consultation on the Draft Plan:MK was undertaken during Spring 2017. Currently the consultation responses are being considered, alongside further evidence gathering and sustainability appraisal.

Planned future development throughout the Milton Keynes Borough has been assessd with regards to water supply capacity, wastewater capacity and environmental capacity. Any water quality issues, associated water infrastructure upgrades, and potential constraints have subsequently been identified and reported. This WCS provides information at a level suitable to demonstrate that there are workable solutions to key constraints to deliver future development for all sites (committed and allocations), including recommendtions on the policy required to deliver it.

Wastewater Strategy

The WCS identifies that in total, six Water Recycling Centres (WRCs) will serve the proposed future development across the Borough. Table 0-1 below provides an indication of the WRCs which have available capacity and those that are likely to require changes to permits that control discharge and potentially infrastrucutre upgrades. A green category indicates that growth can be accepted with no significant changes to the WRC infrastructure or permit, whereas an amber category indicates that changes to the discharge permit may be required to either accommodate additional flow or tightening the existing conditions to meet water quality targets with potential upgrades to WRC infrastructure required.

Table 0-1 WRC Summary

WRC	Summary
Castlethorpe	Flow capacity available for planned growth with some flow capacity available for growth beyond the plan period. Current treatment processes and discharge permit are sucfficient.
Cotton Valley	Flow capacity available for planned growth with some flow capacity available for growth beyond the plan period. Treatment process upgrades using conventional treatment technology can ensure compliance with legislative water quality targets as well as meet more stringent, non-statutory river quality targets.
Hanslope	Flow capacity available for planned growth with some flow capacity available for growth beyond the plan period. Current treatment processes and discharge permit are sucfficient.
Olney	No flow capacity, therefore an updated discharge permit may be required along with possible minor infrastructure upgrades to enable the WRC to accommodate additional wastewater flow. Current treatment processes are sufficient.
Newport Pagnell-London Road	Descriptive permit which could be exceeded, therefore appraisal of feasible options and careful development phasing will be required.
Sherington	Flow capacity available for planned growth with some flow capacity available for growth beyond the plan period. Current treatment processes and discharge permit are sucfficient.

Wastewater Treatment

Two WRCs (Cotton Valley and Olney) do not currently have sufficient flow capacity and/or require tighter permit controls (within the limits of conventional treatment) to accept all future development proposed within the plan period. Therefore some intervention will be required in order to accommodate the growth to ensure that the increased wastewater flow discharged does not impact on the current quality of the receiving watercourses, their associated ecological sites and also to ensure that the watercourses can still meet with Water Framework Directive (WFD) requirements.

The WCS has concluded that feasible solutions are possible to ensure legislative objectives are met. However, this WCS recommends that Milton Keynes Council, the Environment Agency, and Anglian Water Services (AWS)

continue to work together to co-ordinate regular updates about the timing and quantity of development that can be accommodated across the Borough in the early phases of the Local Plan delivery period. AWS as sewerage undertaker is responsible for identifying future investment at existing WRCs to accommodate further growth (where required) and applying to the Environment Agency for any revisions to existing permits where necessary.

To ensure that the planned level of development within the Plan period does not result in a negative impact upon wildlife both inside and outside of designated sites, it is recommended that Milton Keynes Council and AWS use the results of this WCS to inform the Local Plan documents and asset management plans respectively. By working together, this will ensure that as developments come online there is sufficient capacity available locally to ensure all objectives of the Water Framework Directive (WFD) continue to be met.

Water Supply Strategy

Based on the growth assessed, the WCS has concluded that, allowing for the preferred plan for resource management within the AWS supply area, there would be adequate water resources to cater for growth over the plan period.

However, the WCS has identified that there are long term limitations on further abstraction from the raw water resources supplying the Borough. Hence there are key drivers requiring that water demand is managed in the Borough for all new development in order to achieve long term sustainability in terms of water resources.

In order to reduce reliance on raw water supplies from rivers and aquifers, the WCS has set out ways in which demand for water as a result of development can be minimised without incurring excessive costs or resulting in unacceptable increases in energy use. In addition, the assessment has considered how far development in the Borough can be moved towards achieving a theoretical 'water neutral' position (i.e. that there is no net increase in water demand between the current use and after development across the plan period has taken place). A pathway for achieving neutrality as far as practicable has been set out, including advice on:

- what measures need to be taken technologically to deliver more water efficient development;
- what local policies need to be developed in addition to existing policies to set the framework for reduced water use through development control;
- how measures to achieve reduced water use in existing and new development can be funded; and
- where parties with a shared interest in reducing water demand need to work together to provide education and awareness initiatives to local communities to ensure that people and business in the Borough understand the importance of using water wisely.

The assessment concluded that measures should be taken to deliver the first step on the neutrality pathway, with the following initial measures suggested by the WCS:

- Encourage a programme of retrofitting and water audits of existing dwellings and non-domestic buildings. Aim to move towards delivery of at least 15% of the existing housing stock, with easy fit water saving devices; and,
- Establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use.

Overall Impact of Development

The WCS sets out recommendations for what is required, when, and where in order to address any emerging issues from investigating the impact of development. These recommendations must take account of potential environmental impacts, and the availability of funding and future management arrangements to ensure that adverse impact on the water environment is minimised as a result of development arising from the Local Plan process.

In order to support the further development of the Local Plan for Milton Keynes Borough with respect to water services infrastructure and the water environment; the WCS provides a site specific assessment of the potential constraints on each of the proposed major development sites within the emerging Local Plan.

1. Introduction

1.1 Background

The Borough of Milton Keynes is located in the County of Buckinghamshire. The Borough has experienced significant growth in the past decade, and is expected to experience a significant increase in housing requirement and economic growth up to 2031.

Milton Keynes Council is currently preparing a new Local Plan which will supersede the current Local Plan (2005) and Core Strategy (2013) and will set out the Council's strategy for future development and growth up to 2031. The Strategic Housing Market Assessment[1] provided an objective assessment of the housing needs for the Borough, which identified 26,500 homes would be required from 2016 to 2031. Therefore, the Local Plan target for new homes in Milton Keynes is 1,766 new homes per year which also takes into account under provision in housing numbers from 2013. These homes will be located primarily in the Milton Keynes urban area, key settlements and a number of strategic growth locations.

The objective of the WCS is to identify any constraints on planned housing growth that may be imposed by the water cycle. The WCS then identifies how these can be resolved by ensuring that appropriate Water Services Infrastructure (WSI) can be provided to support the proposed development. Furthermore, it should provide a strategic approach to the management and use of water which ensures that the sustainability of the water environment in the area is not compromised.

1.2 WCS History

Milton Keynes Council commissioned a Water Cycle Study Outline Strategy (2008) to account for the Local Plan period until 2031. This study helped to provide supporting evidence to inform the Council's Local Development Framework (LDF), by outlining the capacity of water services infrastructure to determine where additional investment for new infrastructure may be required to support development up to 2031.

The previous WCS, with reference to wastewater found that:

- Ongoing improvement work at Cotton Valley Water Recycling Centre (WRC) was expected to greatly increase the capacity of Broughton Brook trunk sewer, and other parts of the network;
- For Newport Pagnell – London Road WRC, it was predicted that increased flows from the proposed east of M1 site could not be accommodated within the existing permitted discharge, and so it would need to be served by a new connection to Cotton Valley;
- Some investment may be required for medium and long term developments, particularly to support the east of M1 site; and
- Cotton Valley WRC was found to have sufficient capacity to accommodate existing flows, but some upgrades and increased flow consents were recommended to accommodate existing planned developments in the long term (2020-2031).

1.3 Study Governance

This WCS has been carried out with the guidance of the Steering Group established at the project inception meeting held in July 2017, comprising the following organisations:

- Milton Keynes Council;
- Environment Agency; and
- Anglian Water.

1.4 WCS Scope

This WCS provides information at a level suitable to ensure that there are solutions to deliver growth for the preferred development allocations, including the policy required to deliver it.

[1] Milton Keynes Council (2017) Strategic Housing Market Assessment. Available at https://www.milton-keynes.gov.uk/planning-and-building/planning-policy/draft-strategic-housing-market-assessment-november-2016

The outcome is the development of a water cycle strategy for the Borough which informs the Councils new Local Plan, sustainability appraisals and appropriate assessments specific to the water environment and WSI issues.

The following sets out the key objectives of the WCS:

- provide a strategy for wastewater treatment across the Borough which determines if solutions to wastewater treatment are required and if the solutions are viable in terms of balancing environmental capacity with cost;
- determine whether any Habitats Directive designated ecological sites have the potential to be impacted by the wastewater treatment strategy via a screening process;
- determine whether additional water resources, beyond those already planned by Anglian Water (AWS) are required to support growth;
- determine upgrades required to water supply infrastructure relative to potential options for growth through collaboration with AWS;
- consider whether growth can be delivered and achieve a 'neutral water use' condition;
- provide a pathway to achievement of water neutrality; and
- provide policy recommendations.

1.5 Key Assumptions and Conditions

1.5.1 Water Company Coverage

AWS is the wastewater undertaker and potable water supplier for the entire Milton Keynes Borough.

1.5.2 Water Use

For the water supply assessment, the measured household consumption for AWS' Ruthamford South Resource Zone is 126 litres per head per day (l/h/d) up to 2020, reducing to 115 l/h/d between 2020-2029 and reducing further to 114 l/h/d from 2030, as published in AWS' Water Resources Management Plan (WRMP)[2]. These consumption rates have been assumed across the whole Borough for new homes. For unmetered household consumption the published rate is 180 l/h/d, with a weighted average (between metered and unmetered households) of 142 l/h/d. The weighted average has been assumed across the Borough for existing households.

It is acknowledged that the 126l/h/d assumption exceeds the current Building Regulations requirement of 125l/h/d for all new homes. However, in their asset planning, AWS will continue to assume this higher water use for new homes built up to 2020 as their records show that even when homes are built to a standard of 125l/h/d, the average household use increases over time, due to various factors. The 125l/h/d requirement is an aspirational target only and AWS are required under their remit to the economic regulator of the water sector (Ofwat) to plan for the expected actual use.

For the wastewater assessments, a different assumption was made on the likely consumption of water per new household going forward in the plan period. A starting assumption of 126l/h/d (litres per head per day) was used to calculate wastewater demand per person. This figure may overestimate the future consumption rate but it provides a precautionary approach allowing the worst case scenario to be assessed in relation to the wastewater assessments. In addition, to account for infiltration of surface water, groundwater and misconnections to the sewer network in the future, an additional proportion (25%[3]) of 'unaccounted for' flows has been included in the calculations.

It is therefore important that conclusions made on infrastructure capacity within this study are consistent with the AWS planning strategies. This represents a precautionary approach and the assessments are based on a 'worst case scenario' for water consumption in the Borough.

[2] Anglian Water Services Final Water Resources Management Plan (2015) http://www.anglianwater.co.uk/_assets/media/WRMP_2015.pdf
[3] As provided by AWS

1.5.3 Household Occupancy Rate

The latest Office for National Statistics (ONS) population projections[4] and household projections[5] have been used to determine the occupancy rate of each household at present and projected towards the end of the plan period, and have been provided in Table 1-1below.

Table 1-1 Calculation of Occupancy Rate

	2017	Projection for 2031
Population	268,050[4]	310,200[4]
Number of households	110,500[5]	128,426[5]
Calculated Occupancy Rate (people per household based on population and number of households)	2.43	2.42

1.5.4 Wastewater Treatment

As a wastewater treatment provider, AWS are required to use the best available techniques (defined by the Environment Agency as the best techniques for preventing or minimising emissions and impacts on the environment) to ensure emission limit values stipulated within each WRCs permit conditions are met.

Through application of the best available technologies in terms of wastewater treatment, the reliable limits of conventional treatment (LCT) have been determined for the key parameters of Biochemical Oxygen Demand (BOD)[6], ammonia and phosphate, and are provided in Table 1-2.

Table 1-2 Reliable limits of conventional treatment technology for wastewater

Water Quality Parameter	LCT
Ammonia	1.0 mg/l 95 percentile limit[7]
BOD	5.0 mg/l 95 percentile limit
Phosphate	0.25 mg/l annual average[8]

1.6 Report Structure

The first stage of the WCS process is set out in Section 3 of this document and outlines the total proposed number of dwellings which will need to be catered for in terms of water supply and wastewater treatment. Understanding what the level of growth is and where it might be located informs the second stage of the study (reported in Section 4), assessing the current wastewater treatment facilities in regards to both capacity and compliance with legislation and environmental permits. The results of the assessment identify the WRCs which are at capacity or have remaining capacity. The wider, supporting environment has also been considered, including climate change and local ecology.

In parallel to the wastewater assessment, Section 5 outlines water resource planning targets, discusses current and proposed water efficient measures and introduces the concept of water neutrality.

The report also covers the proposed major development sites (defined as having more than 10 dwellings) in more detail (Section 6), assessing each site by identifying local receptors such as watercourses, outlining current and future flood risks (inclusive of surface water and groundwater flood risks) and assessing the current wastewater network.

[4] 2014-based Subnational Population Projections (ONS) (May 2016). Available at https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2015-10-29

[5] 2014-based Household Projections to 2039 for England (ONS) (July 2016). Available at https://www.gov.uk/government/statistical-data-sets/live-tables-on-household-projections

[6] Amount of oxygen needed for the biochemical oxidation of the organic matter to carbon dioxide in 5 days. BOD is an indicator for the mass concentration of biodegradable organic compounds

[7] Considered within the water industry to be the current LCT using best available techniques

[8] National Asset Management Plan 6 (AMP6) trials to investigate new sewage treatment technologies to reduce Phosphate treatment were completed in 2017 and a new Technically Achievable Limit (TAL) of 0.25 mg/l for Phosphate has been agreed between water companies and the Environment Agency. This new limit is being used for current AMP7 planning work.

Ultimately, recommendations have been made as part of the WCS (Section 7) in regards to wastewater, water supply, surface water management and flood risk, ecology and stakeholder liaison.

2. Study Drivers

There are two key overarching drivers shaping the direction of the WCS as a whole:

a. Delivering sustainable water management – ensure that provision of WSI and mitigation is sustainable and contributes to the overall delivery of sustainable growth and development and that the Local Plan meets with the requirements of the National Planning Policy Framework (NPPF) with respect to water; and

b. Water Framework Directive (WFD) compliance – to ensure that growth, through abstraction of water for supply and discharge of treated wastewater, does not prevent waterbodies within the Borough (and more widely) from achieving the standards required of them as set out in the WFD River Basin Management Plans (RBMPs).

A full list of the key legislative drivers shaping the study is detailed in a summary table in Appendix A for reference. However, it is important to note that the key driver for this study is WFD compliance.

Other relevant studies that have a bearing on the provision of water services infrastructure for development are provided in Appendix B and include, but are not limited to, key documents including the Milton Keynes Council SFRA Update (AECOM, 2015), AWS WRMP (2015) and the Environment Agency's latest Anglian River Basin Management Plan (RBMP) (2015).

2.1 OFWAT Price Review

The price review is a financial review process governed by the Water Services Regulatory Authority (Ofwat) - the water industry's economic regulator. Ofwat determines the limits that water companies can increase or decrease the prices charged to customers over consecutive five year periods.

Figure 2-1summarises the timescale in the build up towards the next price review. The price limits for the next period (2020 to 2025) will be set at the end of 2019 to take effect on 1st April 2020 and is referred to as Price Review 19 (PR19). Each water company will submit a Business Plan (BP) for the next period which will be assessed by Ofwat, before being agreed. Price limit periods are referred to as AMP (Asset Management Plan) periods, with the current AMP period being referred to as AMP6.

Figure 2-1 Proposed timescales for PR19 (Water 2020) programme[9]

As the wastewater undertaker for the Borough, AWS has a general duty under Section 94 of the Water Industry Act 1991 to provide effectual drainage which includes providing additional capacity as and when required to accommodate planned development. However this legal requirement must also be balanced with the price controls as set by the regulatory body Ofwat which ensure AWS has sufficient funds to finance its functions, and at the same time protect consumers' interests. The price controls affect the bills that customers pay and the sewerage services consumers receive, and ultimately ensure wastewater assets are managed and delivered efficiently.

Consequently, to avoid potential inefficient investment, AWS generally do not provide additional infrastructure to accommodate growth until there is certainty that development is due to come forward.

[9] Water 2020: Regulatory framework for wholesale markets and the 2019 price review (December 2015)

2.2 Water Framework Directive

The environmental objectives of the WFD, as published in the Environment Agency's RBMPs and relevant to this WCS are:

- to prevent deterioration of the status of surface waters and groundwater;
- to achieve objectives and standards for protected areas; and
- to aim to achieve good status for all water bodies or, for heavily modified water bodies and artificial water bodies, good ecological potential and good surface water chemical status.

These environmental objectives are legally binding, and all public bodies should have regard to these objectives when making decisions that could affect the quality of the water environment. The Environment Agency publishes the status and objectives of each surface waterbody on the Catchment Data Explorer[10], and describes the status of each waterbody as detailed in Table 2-1.

Table 2-1 Description of status in the WFD

Status	Description
High	Near natural conditions. No restriction on the beneficial uses of the water body. No impacts on amenity, wildlife or fisheries.
Good	Slight change from natural conditions as a result of human activity. No restriction on the beneficial uses of the water body. No impact on amenity or fisheries. Protects all but the most sensitive wildlife.
Moderate	Moderate change from natural conditions as a result of human activity. Some restriction on the beneficial uses of the water body. No impact on amenity. Some impact on wildlife and fisheries.
Poor	Major change from natural conditions as a result of human activity. Some restrictions on the beneficial uses of the water body. Some impact on amenity. Moderate impact on wildlife and fisheries.
Bad	Severe change from natural conditions as a result of human activity. Significant restriction on the beneficial uses of the water body. Major impact on amenity. Major impact on wildlife and fisheries with many species not present.

Source: Environment Agency RBMPs

[10] http://environment.data.gov.uk/catchment-planning/

3. Proposed Growth

3.1 Preferred Growth Strategy

The purpose of the WCS is to assess the potential impact of increased development upon the water environment and WSI across the Borough, including water resources, wastewater infrastructure, water quality, flood risk, surface water drainage and ecological issues. The increased development is to accommodate the minimum housing requirement for the Borough up to 2031. This level of projected growth has required the Council to revise their spatial approach of future expected development. These growth figures therefore form the basis for the WCS.

The administrative area of Milton Keynes Council covers the Milton Keynes designated urban area and a large rural area which contains the towns of Newport Pagnell, Olney, Woburn Sands and a number of smaller villages. Figure 3-1 illustrates Milton Keynes Councils administrative boundary, main towns, villages and watercourses within the Borough.

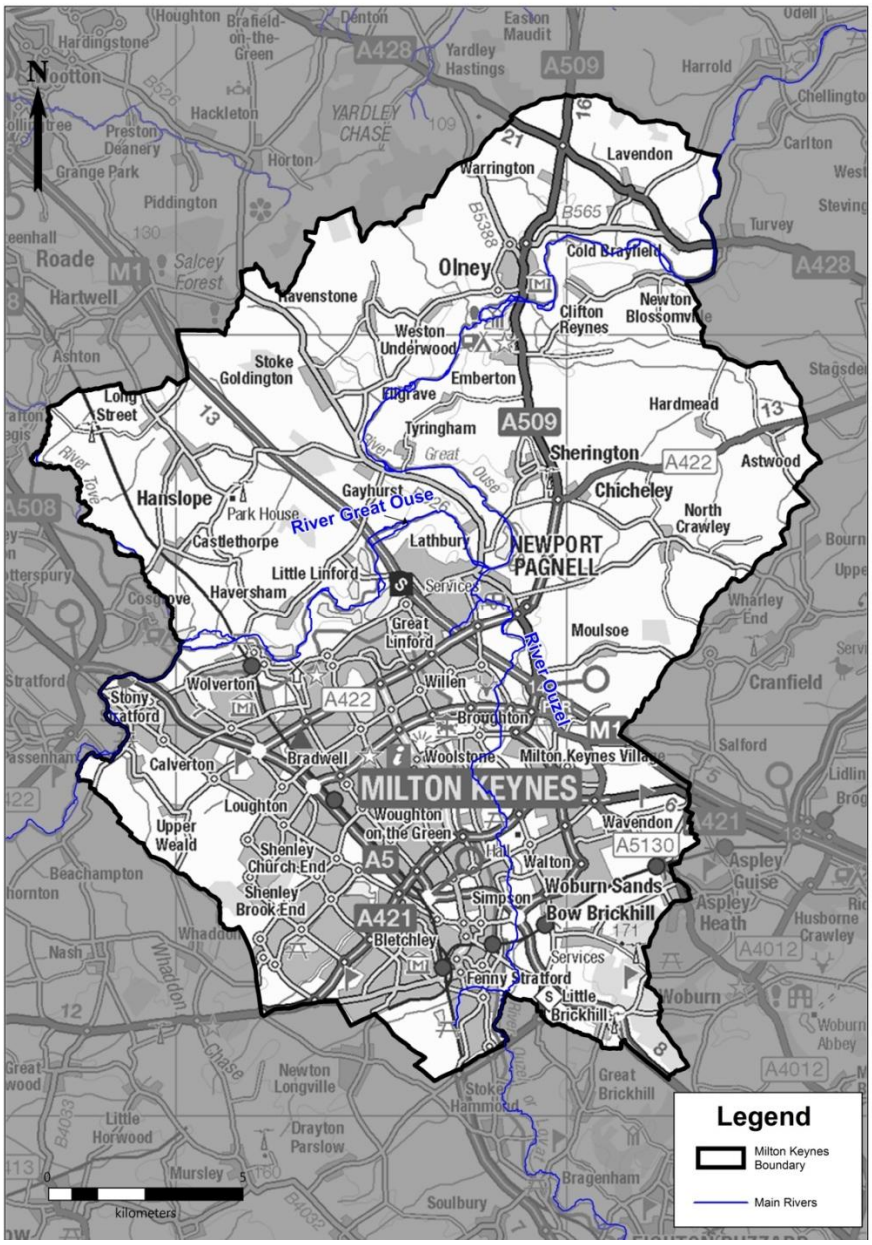

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Figure 3-1 Main Rivers and urban areas within the Milton Keynes Council administrative area

3.2 Housing

The Strategic Housing Market Assessment[11] provided an objective assessment of the housing needs for the Borough, which identified 26,500 homes would be required from 2016 to 2031. This target will be met under the emerging Plan:MK which sets out the strategy for the growth in the Borough up to 2031. The Plan:MK target for new homes in Milton Keynes is now 1,766 new homes per year over the plan period, but it will also take into account under provision in housing numbers from 2013.

The WCS incorporates all proposed major development sites across the Borough at differing stages of development which have been put forward to meet this target, including:

- Existing Commitments (with planning permission, some are already under construction);
- Planned Commitments (some with planning permission, construction not yet started and some already allocated);
- Reserved Site ("East of M1" has been reserved for delivery post 2031, however this could foreseeably come forward within the Plan period if the Council is required to provide for an uplift in housing requirement for the Borough); and
- Windfall Sites.[12]

Table 3-1 provides an overview of the number of dwellings to be built within the plan period within major development sites (>10 dwellings) and therefore assessed as part of the WCS.

Table 3-1 Milton Keynes Council Housing Commitments and Allocations

Type of Site	No. Dwellings
Existing Commitments	20,593
Planned Commitments	6,196
Reserved Site *East of M1*	3,200
Windfall Sites	1,330
Total Potential dwellings to be assessed	**31,319**[13]

Source: Milton Keynes Council

3.3 Employment

The WCS also takes account of the projected increase in employment across the Borough up to 2031; a total of 35,843 new jobs (2,560 jobs per year). Strategic sites for employment identified in the Local Plan have been assessed as part of the WCS, for existing commitments, planned commitments and the reserved site as defined by Milton Keynes Council in Table 3-2.

Table 3-2 Employment sites

Type of Site	Allocated number of jobs*	Additional flow demand (m^3/d)
Existing Commitments	21,605	346
Planned Commitments	8,520	136
Reserve Site	5,718	92
Total	**35,843**	**574**

**Source: Milton Keynes Council*

[11] Milton Keynes Council (2017) Strategic Housing Market Assessment. Available at https://www.milton-keynes.gov.uk/planning-and-building/planning-policy/draft-strategic-housing-market-assessment-november-2016

[12] As advised by Milton Keynes Council, an assumption on the potential location of Windfall Sites of 60 dwellings per year located in the urban area and a proportion of the remainder, relative to the amount of allocated growth, located in the rural areas was applied to the growth trajectory for the purpose of the wastewater assessments.

[13] The total number of new dwellings assessed differs from the Plan:MK target as it accommodates the under provision in housing numbers from 2013.

4. Wastewater Treatment

4.1 Wastewater in the Borough

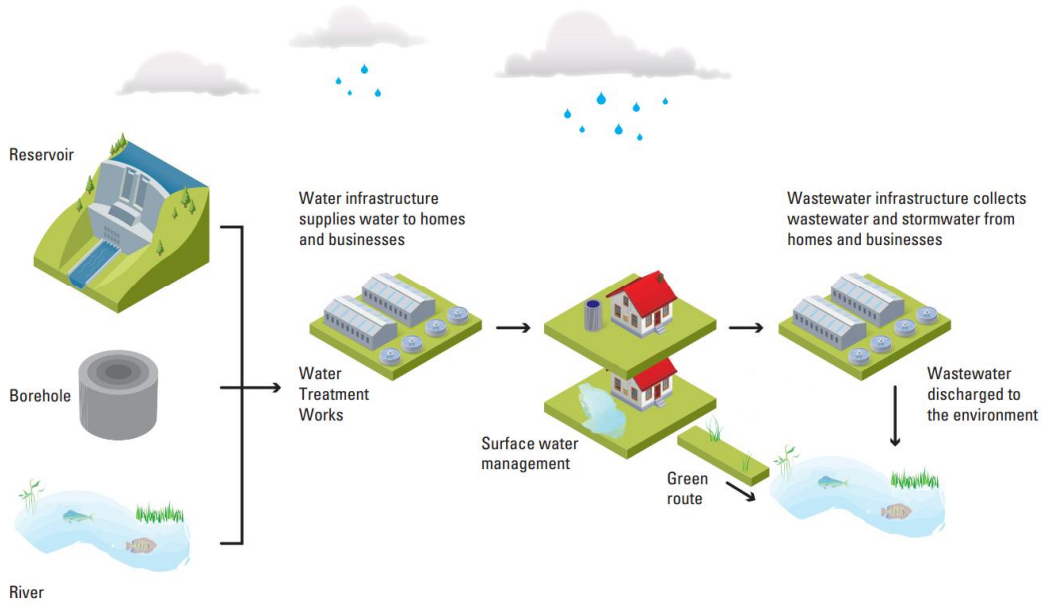

Figure 4-1 The water environment and infrastructure components[14]

A broad overview of the water cycle and the role of water and wastewater infrastructure within the cycle is illustrated in Figure 4-1.Wastewater is generally produced following the use of potable water in homes, businesses, industrial processes and in certain areas can include surface water runoff.

Wastewater treatment in the Borough is provided via wastewater infrastructure (WRCs) operated and maintained by AWS, ultimately discharging treated wastewater to a nearby fluvial watercourse. Each of the WRCs is connected to a network of wastewater pipes (the sewerage system) which collects wastewater generated by homes and businesses to the WRC; this is defined as the WRCs 'catchment'.

Wastewater from the Borough is treated at 19 WRCs. The following 6 WRC catchments are expected to receive additional wastewater as a result of growth and their location illustrated in Figure 4-2:

- Castlethorpe;
- Cotton Valley;
- Hanslope;
- Olney;
- Sherington; and
- Newport Pagnell.

[14] Adapted from the Sustainable Urban Drainage Scottish Working Party's Water Assessment and Drainage Assessment Guide (2016)

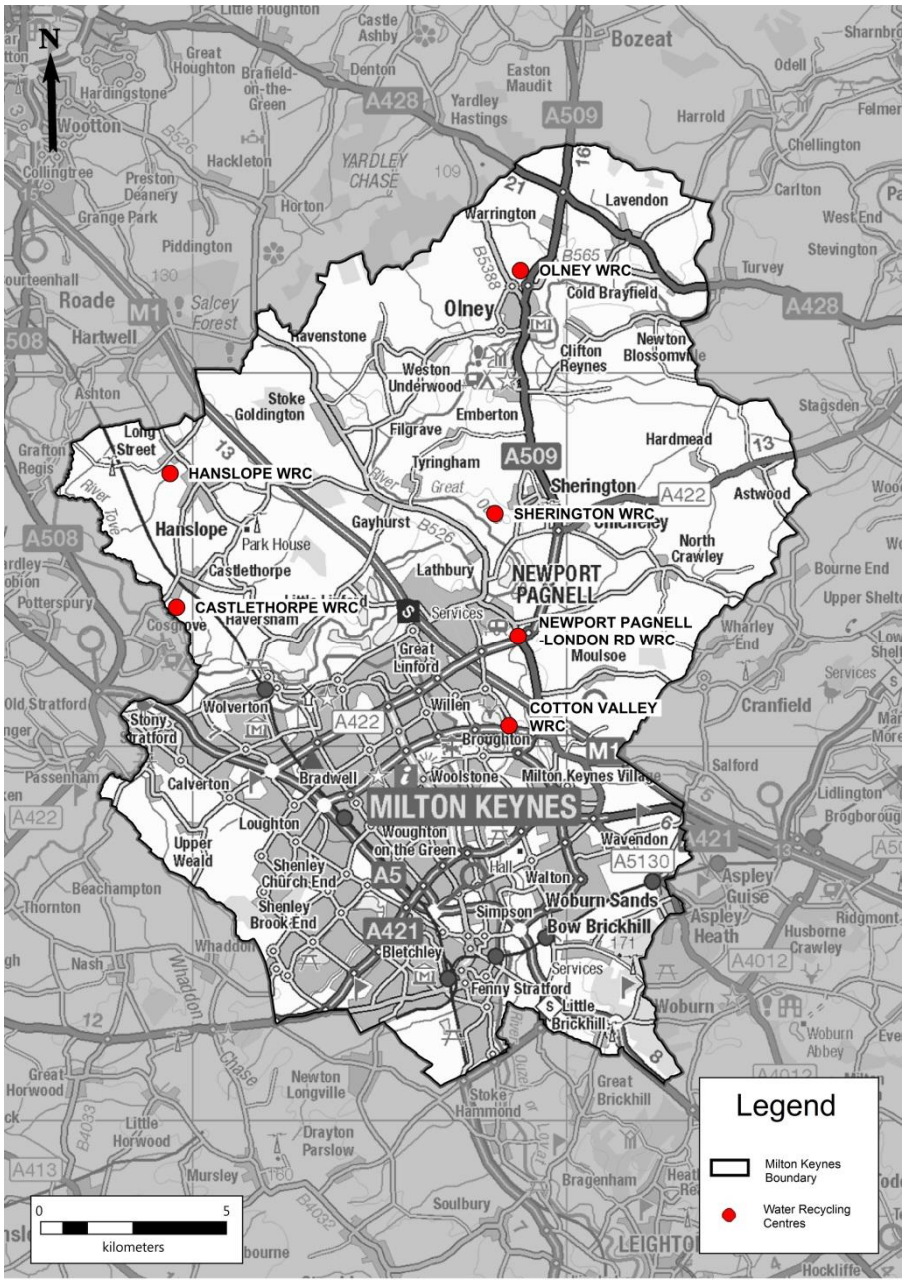

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Figure 4-2 Location of WRC's affected by Local Plan development

4.2 Management of WRC Discharges

All WRCs are issued with a permit to discharge by the Environment Agency, which sets out conditions on the maximum volume of treated wastewater that it can discharge and also limits on the quality of the treated discharge. These limits are set in order to protect the water quality and ecology of the receiving waterbody. They also dictate how much wastewater each WRC can accept, as well as the type of treatment processes and technology required at the WRCs to achieve the quality permit limits.

The flow element of the discharge permit determines an approximation of the maximum number of properties that can be connected to a WRC catchment. When discharge permits are issued, they are generally set with a flow 'headroom', which acknowledges that allowance needs to be made for future development and the additional wastewater generated. This allowance is referred to as 'permitted headroom'. The quality conditions applied to the discharge permit are derived to ensure that the water quality of the receiving waterbody is not adversely affected, up to the maximum permitted flow of the discharge permit.

For the purposes of this WCS, the assumption is applied that the permitted headroom is usable[15] and would not affect downstream water quality. This headroom therefore determines how many additional properties can be connected to the WRC catchment before AWS would need to apply for a new or revised discharge permit (and hence how many properties can connect without significant changes to the treatment infrastructure).

When a new or revised discharge permit is required, an assessment needs to be undertaken to determine what new quality conditions would need to be applied to the discharge. If the quality conditions remain unchanged, the increased flow of wastewater received at the WRC would result in an increase in the pollutant load[16] of some substances being discharged to the receiving waterbody. This may have the effect of deteriorating water quality and hence in most cases, an increase in permitted discharge flow results in more stringent (or tighter) conditions on the quality of the discharge.

The requirement to provide a higher standard of treatment may result in an increase in the intensity of treatment processes at a WRC, which may also require improvements or upgrades to be made to the WRC to allow the new conditions to be met. In some cases, it may be possible that the quality conditions required to protect water quality and ecology are not achievable with conventional treatment processes and as a result, this WCS assumes that a new solution would be required in this situation to allow growth to proceed.

The primary legislative driver which determines the quality conditions of any new permit to discharge are the WFD and the Habitats Directive (HD) as described in the following subsections.

AWS as sewerage undertaker is responsible for identifying future investment at existing WRCs to accommodate further growth (where required) and applying to the Environment Agency for any revisions to existing permits where necessary. In general, where WRC upgrades are required to provide for additional growth, they are wholly funded through the agreed AMP. In addition, AWS are currently in the early stages of preparing a Long Term Recycling Plan which will be the water recycling equivalent to the Water Resource Management Plan (WRMP). This document, once prepared, will be used to inform future business plans and subsequent AMP cycles including further investment at existing WRCs or within the foul sewerage network as part of the next business plan period (2020 to 2025). WRC upgrades will not be the most appropriate solution in all cases.

4.3 WFD Compliance

The definition of a waterbody's overall WFD 'status' is a complex assessment that combines standards for chemical quality and hydromorphology (habitat and flow conditions), with the ecological requirements of an individual waterbody catchment. A waterbody's 'overall status' is derived from the classification hierarchy made up of 'elements', and the type of waterbody will dictate what types of elements are assessed within it. The following is an example of the classification hierarchy and Figure 4-3 illustrates the classifications applied within the hierarchy;

Overall water body status or potential

- Ecological or Chemical status (e.g. ecological)
  - Component (e.g. biological quality elements)
    - Element (e.g. fish)

[15] In some cases, there is a hydraulic restriction on flow within a WRC which would limit full use of the maximum permitted headroom.
[16] Concentration is a measure of the amount of a pollutant in a defined volume of water, and load is the amount of a substance discharged during a defined period of time.

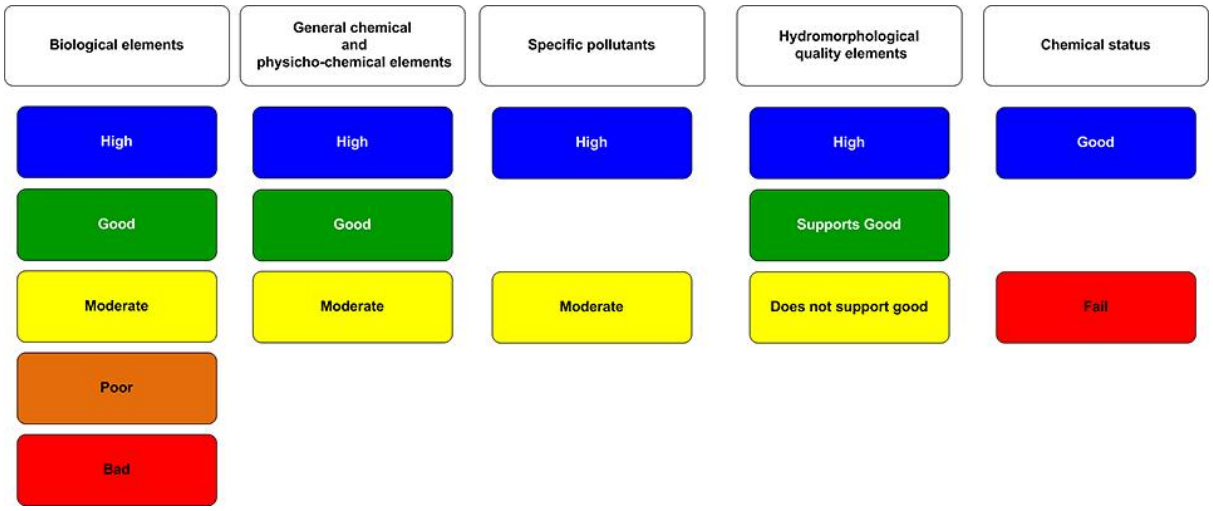


Figure 4-3 WFD status classifications used for surface water elements

The two key aspects of the WFD relevant to the wastewater assessment in this WCS are the policy requirements that:

- Development must not cause a deterioration in WFD status of a waterbody[17]; and
- Development must not prevent a waterbody from achieving its future target status (usually at least Good status).

It is not acceptable to allow deterioration from High status to Good status, even though the overall target of Good status as required under the WFD is still maintained, this would still represent a deterioration. In addition, if a waterbody's overall status is less than Good as a result of another element, it is not acceptable to justify a deterioration in another element because the status of a waterbody is already less than Good.

Where permitted headroom at a WRC would be exceeded by proposed growth, a water quality modelling assessment has been undertaken to determine the quality conditions that would need to be applied to a new or revised discharge permit to ensure the two policy requirements of the WFD are met. The modelling process (assumptions and modelling tools) is described in detail in Appendix C.

4.4 Habitats Directive

The Habitats Directive and the associated UK Habitats Regulations has designated some sites as areas that require protection in order to maintain or enhance the rare ecological species or habitat associated with them. A retrospective review process has been on-going since the translation of the Habitats Directive into the UK Habitats Regulations called the Review of Consents (RoC). The RoC process requires the Environment Agency to consider the impact of the abstraction licences and discharge permit it has previously issued on sites which became protected (and hence designated) under the Habitats Regulations.

If the RoC process identifies that an existing licence or permit cannot be ruled out as having an impact on a designated site, then the Environment Agency are required to either revoke or alter the licence or permit. As a result of this process, restrictions on some discharge permits have been introduced to ensure that any identified impact on downstream sites is mitigated. Although the Habitats Directive does not directly stipulate conditions on discharge, the Habitats Regulations can, by the requirement to ensure no detrimental impact on designated sites, require restrictions on discharges to (or abstractions) from water dependent habitats that could be impacted by anthropogenic manipulation of the water environment.

Where permitted headroom at a WRC would be exceeded by proposed levels of growth, a Habitats Regulations assessment exercise has been undertaken in this WCS to ensure that Habitats Directive sites which are hydrologically linked to watercourses receiving wastewater flows from growth would not be adversely affected. The scope of this assessment also includes non-Habitats Directive sites such as nationally designated Sites of Special Scientific Interest (SSSI) and Local Nature Reserves (LNRs). This assessment is reported in Section 4.8 (Ecological Appraisal) of this report.

[17] i.e. a reduction High Status to Good Status as a result of a discharge would not be acceptable, even though the overall target of good status as required under the WFD is still maintained

4.5 Wastewater Assessment Overview

4.5.1 Approach

An increase in residential and employment growth will have a corresponding increase in the volume and flow of wastewater generated within the Borough and hence it is essential to consider infrastructure and environmental capacity.

4.5.1.1 Infrastructure Capacity

Infrastructure Capacity is defined in this WCS as the ability of the wastewater infrastructure to collect, transfer and treat wastewater from homes and business. The following objectives are answered in the results section:

- What new infrastructure is required to provide for additional wastewater treatment?
- Is there sufficient treatment capacity within existing wastewater infrastructure treatment facilities (WRCs)?

4.5.1.2 Environmental Capacity

Environmental Capacity is defined in this WCS as the water quality needed in the receiving waterbodies to maintain the aquatic environments. The following objectives are answered in the results section:

- Could development cause greater than 10% deterioration in water quality?
- Can a feasible solution be implemented to limit deterioration to 10%? To ensure that all the environmental capacity is not taken up by one phase of development and there is remaining environmental capacity for future growth beyond the plan period.
- Could development cause deterioration in WFD status of any element? This is a requirement of the WFD to prevent status deterioration.
- Could development alone prevent the receiving water from achieving its Future Target Status or Potential? Also a requirement of the WFD, which can be separated into the following two objectives:
    - Is the future target status possible now assuming adoption of best available technology? To determine if it is limits in conventional treatment that would prevent the future target status being achieved.
    - Is the future target status technically possible after development and adoption of best available technology? To determine if it is growth that would prevent the future target status being achieved.

4.5.2 Methodology

A stepped assessment approach has been developed for the WCS to determine the impact of the proposed growth on infrastructure capacity and the environmental capacity of the receiving watercourse. The assessment steps are outlined below.

4.5.2.1 WRC Headroom Assessment

This assessment is a scoping exercise to determine which WRCs will require water quality assessment as a result of growth. A WRC flow headroom calculator has been developed and used in Section 4.6.

The first step identifies which WRCs within the Borough will receive future growth and what the quantity of growth is in order to determine the additional wastewater flow generated at each WRC. The remaining permitted flow headroom at each WRC is then calculated. In addition, the quantity of growth has also been compared against the existing flow permit of each WRC. A detailed explanation of this methodology is provided in Appendix C.

The scoping criteria detailed in Table 4-1 have therefore been applied to determine whether the quantity of growth will trigger the requirement for a WRC to undergo a water quality assessment and subsequent review of its current discharge permit.

Table 4-1 WRC Headroom Assessment scoping criteria

Scope In	Scope Out
WRCs where permitted flow headroom capacity is exceeded as a result of growth	-
WRCs which are already at or exceed their permitted flow headroom capacity and will also receive additional flow from growth	WRCs which are already at or exceed their permitted flow headroom capacity but do not receive any additional flow from growth
WRCs which remain within their permitted flow headroom capacity but the total growth is >=10% of the WRCs current flow permit	WRCs which remain within their permitted flow headroom capacity but the total growth is <10% of the WRCs current flow permit

4.5.2.2 Water Quality Assessment

AECOM has determined that River Quality Planning (RQP) software (as used by the Environment Agency) is a suitable tool to undertake the required water quality modelling for determining the required discharge permit quality condition for each individual WRC (Section 4.7). There are limitations associated with the RQP software which have been acknowledged in this WCS (Appendix C) and a stepped methodology has been developed to ensure uncertainty which may arise as a result of these limitations is minimal.

The stepped methodology (provided in Appendix C) sets out modelling scenarios which have been developed in line with the water quality assessment approach listed in Section 4.5.1 and was agreed with the Environment Agency (Appendix C). The modelling scenarios undertaken are detailed in Table 4-2.

Table 4-2 Water Quality Modelling Scenarios

Scenario	Description	Objective
10% Deterioration Limit	Limiting deterioration to 10% based on the current river quality for the physico-chemical sub-element (determinant) after growth.	Aligns with the Environment Agency's aspirational target to ensure that all the environmental capacity is not taken up by one phase of development.
Maintain Current Quality	Maintaining the current river quality for the physico-chemical sub-element (determinant) after growth.	Where there is considered to be significant risk that a 10% deterioration could lead to a deterioration in status, this scenario is applied as a precautionary approach.
Status Deterioration Limit	Ensuring no deterioration from the current WFD status for the sub-element (determinant) after growth. Applied where it is not technically feasible to limit deterioration to 10%.	Aligns with the WFD policy requirement 'development must not cause deterioration in WFD status'.
Future Target Status	Where a future target WFD status has been set for the sub-element and is not currently being achieved by the waterbody.	Aligns with the WFD policy requirement 'development must not prevent a waterbody from achieving its future target status'.

4.5.3 Assessment Results

The results for each WRC assessment are presented in a Red/Amber/Green (RAG) Assessment for ease of planning reference. The RAG code refers broadly to the following categories and the process is set out in Figure 4-4:

- **Green** – WFD objectives will not be adversely affected. Growth can be accepted with no significant changes to the WRC infrastructure or permit required.
- **Amber** – in order to meet WFD objectives, changes to the discharge permit are required, and upgrades may be required to WRC infrastructure which may have phasing implications;

- **Red** - in order to meet WFD objectives changes to the discharge permit are required which are beyond the limits of what can be achieved with conventional treatment. An alternative solution needs to be sought.

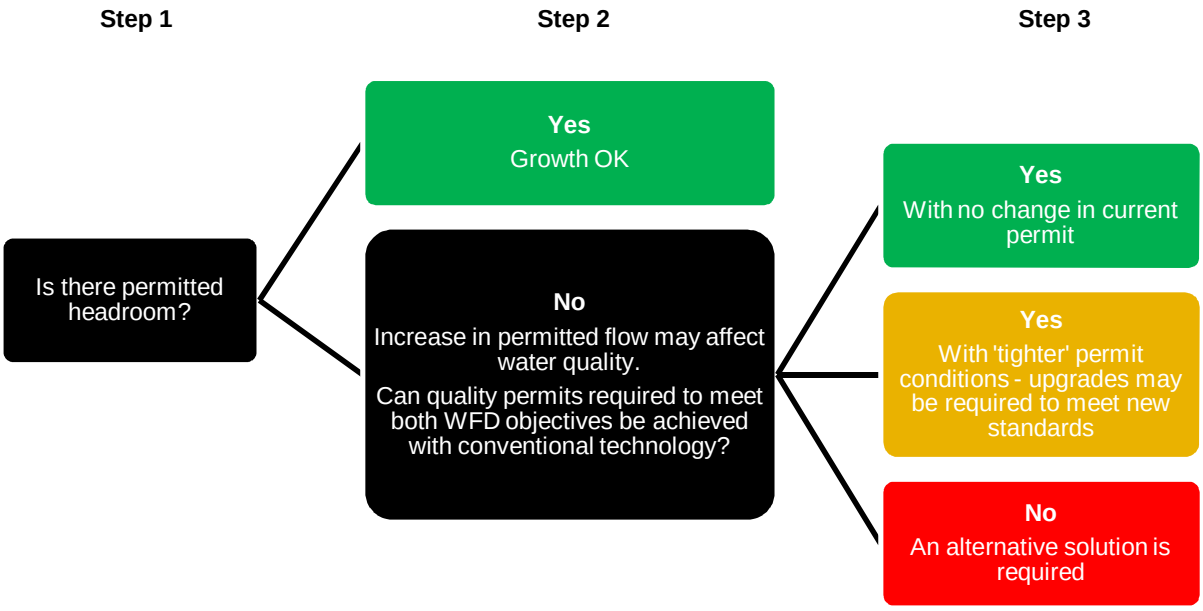


Figure 4-4 RAG Assessment process diagram for infrastructure capacity

4.6 WRC Headroom Assessment

The volume of wastewater, measured as Dry Weather Flow (DWF), which would be generated from the proposed housing and employment growth over the plan period within each WRC catchment has been calculated and compared to the treatment capacity at each WRC. DWF is a measure of the flow of foul water only to a WRC (excludes additional flow as a result of excessive rainfall or groundwater infiltration entering the sewer network).

A summary of these assessments has been provided in Table 4-3 below with further explanation provided in the following subsections in the following order;

- Further detail on WRC catchments where growth is within the permitted headroom, however it is found to be significant and hence a water quality assessment has been undertaken and reported in Section 4.6.1 and 4.7;
- Further detail on WRC catchments requiring a new discharge permit and hence a water quality assessment has been undertaken and reported in Section 4.6.2 and 4.7.

4.6.1 Available Permitted Headroom – Significant Growth

Significant growth has been defined as the quantity of the development within a WRC catchment which would be equal to or greater than 10% of the current permitted DWF consent. This is due to certain WRCs discharge permits having flow headroom capacity, but if operated to their full permitted discharge volumes (i.e. all permitted headroom is used up by growth), there is a high risk of significant deterioration in water quality and potentially deterioration in WFD status.

The WRCs which have been identified as having headroom but receiving significant growth, as defined above, are:

- Castlethorpe WRC;
- Cotton Valley WRC; and
- Hanslope WRC.

To ensure that the significant quantity of growth proposed within these WRC catchments and the use of available permitted headroom does not impact on downstream water quality objectives, these WRCs have been scoped in for the water quality assessment to determine whether theoretically achievable quality conditions for ammonia, BOD and phosphate can be applied to revised discharge permits.

4.6.2 No available Permitted Headroom

The calculations of flow headroom capacity found that Olney WRC would not have sufficient headroom once all the growth within the WRC catchment is accounted for. Olney WRC would exceed the maximum permitted DWF under the existing discharge permit. Additional headroom can be made available through an application by AWS for a new or revised discharge permit from the Environment Agency.

To ensure that the increase in permitted DWF required to serve the proposed growth would not impact on downstream WFD requirements, water quality modelling has been undertaken to determine whether theoretically achievable quality conditions can be applied to a revised discharge permit.

4.6.3 Exceedance of Descriptive Permit

One of the WRC's that has the potential to be affected by growth currently has a descriptive rather than numeric permit. Capacity at WRCs with descriptive permits is generally based on estimates of 'Population Equivalent' (PE) rather than a measured DWF. Once the arbitrary limit of 250 PE is exceeded for a WRC with a descriptive permit as a result of growth, it was agreed with the Environment Agency that the permit would potentially need to be varied to a numeric consent.

The calculations of PE headroom capacity found that the Newport Pagnell WRC would likely exceed the 250 PE limit, and hence would not have sufficient headroom once all the growth within the WRC catchment is accounted for.

The current discharge from this WRC is very small and therefore will have very limited, if any, impact on the WFD status of the receiving waterbody. However, the impact of growth at this WRC is likely to require further consideration of options and potential investment to prevent an increase in discharge which could result in deterioration of water quality within the receiving watercourse. AWS as sewerage undertaker is responsible for identifying future investment at existing WRCs to accommodate further growth (where required) and applying to the Environment Agency for any revisions to existing permits where necessary. AWS would undertake an appraisal of all feasible options, including the option to close the descriptive works and convert it to a pumping station to convey all foul flows to a larger WRC catchment if new numerical standards were uneconomical to meet.

4.6.4 Summary

The WRC headroom assessment has identified four WRCs, as shown in Table 4-3, which will require water quality assessment to determine whether theoretically achievable quality conditions can be applied to revised discharge permits in order to meet the WFD objectives of the receiving waterbody.

The results of the water quality modelling are provided in Section 4.7, with detailed results from the modelling provided in Appendix C.

Table 4-3 WRC headroom capacity assessment

WRC Catchment	Current DWF Permit (m^3/d)	Current Headroom Capacity		Quantity of proposed dwellings	Future 2031 DWF after growth (m^3/d)	Headroom Assessment after growth (2031)		Total additional flow as a % of current DWF permit	Outcome
		Current DWF (m^3/d)	Calculated Headroom (m^3/d)			Headroom Capacity (m^3/d)	Approx. residual housing capacity		
Castlethorpe	151	118	33	48	136	**15**	**48**	**12%**	Sufficient headroom but significant growth: **scoped in** for water quality assessment
Cotton Valley	78,000	49,289	28,711	29,981[18]	61,411	**16,589**	**54,507**	**16%**	
Hanslope	440	309	131	260	408	**32**	**106**	**22%**	
Olney	1,822	1,605	217	609	1,837	**-15**	**-49**	**13%**	Insufficient headroom and significant growth**: scoped in** for water quality assessment
Sherington	206	158	48	36	172	**34**	**113**	**7%**	Sufficient headroom and insignificant growth: **scoped out** for water quality assessment
Newport Pagnell	Descriptive permit	Current flow is 32 Population Equivalent (PE)		385	962 PE	PE after growth exceeds the limit of PE (250) before numeric consent is required			Appraisal of feasible options would be required to manage growth but **scoped out** for water quality assessment[19]

[18] A number of larger development sites (> 1000 dwellings) are located on the periphery of Cotton Valley WRC catchment area, within the catchment of neighbouring smaller WRCs, however, in discussion with Milton Keynes Council and Anglian Water it has been assumed that these sites will drain to Cotton Valley WRC when they are brought forward for development due to the limited capacity within the smaller WRCs. These sites include East of M1, Tickford Fields and SLA.

[19] There is not sufficient capacity available to serve an additional 385 dwellings based on the descriptive permit for Newport Pagnell WRC. Anglian Water will assess the feasible options for providing sufficient treatment capacity to serve these future homes when the proposed sites come forward to pursue planning permission.

4.7 Water Quality Assessment

The WRCs which have been identified as requiring water quality modelling all discharge to freshwater, inland waterbodies. Therefore, statistical based water quality modelling (using RQP software) has been performed to check for compliance with the WFD objectives in terms of permit conditions for ammonia, phosphate and BOD. This approach follows Environment Agency guidelines and best practice, with further details of the modelling requirements outlined in detail in Appendix C.

A summary of the results and proposed infrastructure upgrades required are included in the following subsections for each of the WRCs (listed in Table 9) where:

- There is sufficient headroom in the WRC catchment for development, however the growth will be significant as it will be more than 10% of the current DWF permit; or
- Development will use up all available flow headroom capacity in the existing DWF permit and will cause the DWF permit to be exceeded.

4.7.1 Castlethorpe WRC

4.7.1.1 Environmental Baseline

The River Tove, DS Greens Norton (GB105033038180), receives treated effluent from the Castlethorpe WRC and currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' by 2021. The current overall status is limited to 'Moderate' due to the less than 'Good' status of the elements listed in Table 4-4. The current status for ammonia and BOD is High.

Table 4-4: Classification elements of less than Good status for River Tove, DS Greens Norton waterbody (GB105033038180)

Classification Element	Current Status (2016)	Objective	Justification for alternative objective
Phosphate	Poor	Moderate by 2021	No known technical solution is available – Technically infeasible

The Reasons for Not Achieving Good (RNAG) as outlined in the Anglian RBMP, relevant to the River Tove, DS Greens Norton waterbody have been provided in Table 4-5 below.

Table 4-5 Reasons for Not Achieving Good status for the River Tove, DS Greens Norton (GB105033038180)

Category	Activity	Activity Certainty	Classification Element
Water Industry	Sewage discharge (continuous)	Confirmed	Phosphate
Agriculture	Livestock field	Probable	

4.7.1.2 Revised Permit Conditions – Modelling Results

The revised discharge permit quality conditions required by the end of the plan period for each determinand and for each modelled scenario are presented in Table 4-6.

Table 4-6 Required permit quality conditions for Castlethorpe WRC throughout the plan period

Determinand	Current permit quality condition (mg/l)	Future permit quality condition required (mg/l)			
		Limit to 10% deterioration	No deterioration in status	Maintain Current Quality	Achieve Future Target Status
Ammonia (mg/l 95%ile)	-	20.77	60.16	N/A	N/A
BOD (mg/l 95%ile)	50	157.58	1003.7	N/A	N/A

Determinand	Current permit quality condition (mg/l)	Future permit quality condition required (mg/l)			
		Limit to 10% deterioration	No deterioration in status	Maintain Current Quality	Achieve Future Target Status
Phosphate (mg/l annual average)	-	26.25	221.7	N/A	51.32

4.7.1.3 WRC Assessment Summary

Table 4-7 Castlethorpe WRC Assessment Summary

Assessment Criteria	Yes / No	Additional Comments
1. Is there sufficient permitted headroom to accept, treat and discharge the expected volume of wastewater as a result of growth proposed by the end of the plan period?	Yes	Calculated headroom capacity post-growth of 15m^3/d.
2. Has the water quality assessment demonstrated that utilising the headroom would risk non-compliance with water quality objectives?	**Yes**	Due to significant level of growth in catchment during plan period.
3. Has the water quality assessment demonstrated that to accept and treat all of the additional wastewater flow expected from development without impacting on water quality objectives, the quality conditions of the discharge permit would need to be altered compared to the current discharge permit and treatment process upgrades required?	Yes	No change to BOD permit required and it is unlikely that an Ammonia or Phosphate permit condition would need to be applied.
a. Can deterioration be limited to 10% based on the current river quality after growth with current conventional treatment technology?	Yes	No permit required for Ammonia. No permit change required for BOD. No permit required for Phosphate.
b. Can the WFD objective of 'no deterioration' be achieved after growth with current conventional treatment technology?	Yes	'No deterioration' can be achieved for Ammonia and is readily achievable within the current limits of conventional treatment. No permit limit is recommended for Ammonia. 'No deterioration' can be achieved for BOD through the existing permit condition. 'No deterioration' can be achieved for Phosphate and is readily achievable within the current limits of conventional treatment. No permit limit is recommended for Phosphate.
c. Where 'no deterioration' cannot be achieved, can the current river quality be maintained after growth with current conventional treatment technology?	**Not Assessed**	No assessment was required because it is demonstrated in Criteria 3b that the WFD objective of 'no deterioration' can be achieved within the current limits of conventional treatment.
d. Can the WFD Future Target Status be achieved after growth with current conventional treatment technology?	Yes	Ammonia is already at High status – therefore ensuring no deterioration is adequate. BOD is already at High status – therefore ensuring no deterioration is adequate. Phosphate - An alternative objective of Moderate status by 2021 has been set by the Environment Agency in place of the default objective to reach Good status. The alternative objective has been set since no known technical solution is available to resolve the less than Good status of Phosphate (see Appendix F for details). Modelling suggests that future status can be readily achieved within the current limits of conventional treatment. No permit limit is recommended for Phosphate.
4. Is there the potential for a cumulative impact on water quality upstream of the WRC from growth proposed in the study area?	**Yes**	Hanslope WRC is located on a tributary of the River Tove upstream from Castlethorpe. However, the contributing flow of the WRC upstream into the River Tove is likely to be small in comparison. Therefore, the River Tove provides significant dilution of the WRC discharge and it has been concluded that the impact of growth on water quality upstream of Castlethorpe WRC would be minimal.
5. Are WRC infrastructure upgrades required?	**No**	Modelling suggests that no new permit conditions need to be applied.

4.7.2 Cotton Valley WRC

4.7.2.1 Environmental Baseline

The River Great Ouse from Newport Pagnell to Roxton (GB105033047923) receives treated effluent from the Cotton Valley WRC and currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' by 2021. The current overall status is limited to 'Moderate' due to the less than 'Good' status of the elements listed in Table 4-8. The current status for ammonia and BOD is High.

Table 4-8: Classification elements of less than Good status for Ouse from Newport Pagnell to Roxton waterbody (GB105033047923)

Classification Element	Current Status (2016)	Objective	Justification for alternative objective
Phosphate	Poor	Moderate by 2021	No known technical solution is available – Technically infeasible

The Reasons for Not Achieving Good (RNAG) as outlined in the Anglian RBMP, relevant to the River Great Ouse waterbody have been provided in Table 4-9 below.

Table 4-9 Reasons for Not Achieving Good status for the River Great Ouse (Newport Pagnell to Roxton) waterbody (GB105033047923)

Category	Activity	Activity Certainty	Classification Element
Water Industry	Sewage discharge (continuous)	Confirmed	Phosphate
Agriculture	Livestock field	Confirmed	

4.7.2.2 Revised Permit Conditions – Modelling Results

The revised discharge permit quality conditions required by the end of the plan period for each determinand and for each modelled scenario are presented in Table 4-10

Table 4-10 Required permit quality conditions for Cotton Valley WRC throughout the plan period

Determinand	Current permit quality condition (mg/l)	Future permit quality condition required (mg/l)			
		Limit to 10% deterioration	No deterioration in status	Maintain Current Quality	Achieve Future Target Status
Ammonia (mg/l 95%ile)	**5**	**3.37**	**1.08**[20]	N/A	N/A
BOD (mg/l 95%ile)	**12**	**7.09**	**15.84**	N/A	N/A
Phosphate (mg/l annual average)	**1**	**2.58**	**4.94**	N/A	**0.76**

[20] RQP models river quality at the mixing point (ie the point of discharge into the river). The results above are demonstrating that a more stringent permit condition would be required for the "No Deterioration" test compared to the "Limit to 10% deterioration" test. This because RQP indicates the current mixing point ammonia quality (with current discharge volumes and quality) is at Moderate status compared to the overall water body status of High. However, the no deterioration test is applied to achieve overall water body status at the point of mixing, in this case, RQP has been used to determine what permit is required to achieve High Status at the point of mixing after growth. Because mixing point quality is currently Moderate, the modelling shows it requires a significant improvement in the current permit condition with current volumes to obtain High status, which is also therefore reflected in the permit required once growth is also considered. This permit for no deterioration is therefore more stringent that what is required to limit the deterioration from current mixing point quality to only 10%.

4.7.2.3 WRC Assessment Summary

Table 4-11 Cotton Valley WRC Assessment Summary

Assessment Criteria	Yes / No	Additional Comments
1. Is there sufficient permitted headroom to accept, treat and discharge the expected volume of wastewater as a result of growth proposed by the end of the plan period?	Yes	Calculated headroom capacity post-growth of 16,589m^3/d.
2. Has the water quality assessment demonstrated that utilising the headroom would risk non-compliance with water quality objectives?	**Yes**	Due to significant level of growth in catchment during plan period.
3. Has the water quality assessment demonstrated that to accept and treat all of the additional wastewater flow expected from development without impacting on water quality objectives, the quality conditions of the discharge permit would need to be altered compared to the current discharge permit and treatment process upgrades required?	Yes	
a. Can deterioration be limited to 10% based on the current river quality after growth with current conventional treatment technology?	Yes	Ammonia permit condition will need to be tightened from 5 mg/l to 3.37 mg/l to ensure deterioration is limited to 10%. BOD permit condition will need to be tightened from 12 mg/l to 7.09 mg/l to ensure deterioration is limited to 10%. No permit change required for Phosphate and deterioration can be limited to 10% under the current permit conditions.
b. Can the WFD objective of 'no deterioration' be achieved after growth with current conventional treatment technology?	Yes	Ammonia permit condition will need to be tightened from 5 mg/l to 1.08 mg/l. 'No deterioration' can be achieved for BOD through the existing permit condition. 'No deterioration' can be achieved for Phosphate through the existing permit condition.
c. Where 'no deterioration' cannot be achieved, can the current river quality be maintained after growth with current conventional treatment technology?	**Not Assessed**	No assessment was required because it is demonstrated in Criteria 3b that the WFD objective of 'no deterioration' can be achieved within the current limits of conventional treatment.
d. Can the WFD Future Target Status be achieved after growth with current conventional treatment technology?	Yes	Ammonia is already at High status – therefore ensuring no deterioration is adequate. BOD is already at High status – therefore ensuring no deterioration is adequate. Phosphate - An alternative objective has been set by the Environment Agency in place of the default objective to reach Good status. The alternative objective has been set due to disproportionately expensive to resolve the less than Good status of Phosphate (see Appendix F for details). Future status can be achieved within the current limits of conventional treatment but the permit condition will need to be tightened from 1 mg/l to 0.77 mg/l.
4. Is there the potential for a cumulative impact on water quality upstream of the WRC from growth proposed in the study area?	**No**	Cotton Valley WRC is located on the River Great Ouse with no other significant WRC discharges upstream within the Milton Keynes area. There are significant discharges upstream, outside of the Milton Keynes area, but in order to address these a catchment wide study would be required.
5. Are WRC infrastructure upgrades required?	**Yes**	The exact technical specification of the upgrades required should be determined by AWS for the AMP7 (2020 – 2025) asset planning period, in line with revised quality conditions for Ammonia, BOD and Phosphate. The Environment Agency and AWS should plan work to determine the exact requirements of the future discharge permit and the specific treatment upgrades that would need to be applied in order to inform AWS's PR19 Business Plan and subsequent price reviews, as relevant.

4.7.3 Hanslope WRC

4.7.3.1 Environmental Baseline

The River Tove, DS Greens Norton (GB105033038180), receives treated effluent from the Hanslope WRC and currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' by 2021. Its current overall status is limited to 'Moderate' due to the 'Poor' status of phosphate. The current status for ammonia and BOD is High.

The Reasons for Not Achieving Good (RNAG) as outlined in the Anglian RBMP, relevant to the River Tove, DS Greens Norton waterbody are outlined in Table 4-5 in Section 4.7.1.1.

4.7.3.2 Revised Permit Conditions – Modelling Results

The revised discharge permit quality conditions required by the end of the plan period for each determinand and for each modelled scenario are presented in Table 4-12.

Table 4-12 Required permit quality conditions for Hanslope WRC throughout the plan period

Determinand	Current permit quality condition (mg/l)	Future permit quality condition required (mg/l)			
		Limit to 10% deterioration	No deterioration in status	Maintain Current Quality	Achieve Future Target Status
Ammonia (mg/l 95%ile)	-	6.85	22.56	N/A	N/A
BOD (mg/l 95%ile)	20	43.34	268.26	N/A	N/A
Phosphate (mg/l annual average)	-	11.57	72.15	N/A	16.67

4.7.3.3 WRC Assessment Summary

Table 4-13 Hanslope WRC Assessment Summary

	Assessment Criteria	Yes / No	Additional Comments
1.	Is there sufficient permitted headroom to accept, treat and discharge the expected volume of wastewater as a result of growth proposed by the end of the plan period?	Yes	Calculated headroom capacity post-growth of 32 m^3/d.
2.	Has the water quality assessment demonstrated that utilising the headroom would risk non-compliance with water quality objectives?	Yes	Due to significant level of growth in catchment during plan period.
3.	Has the water quality assessment demonstrated that to accept and treat all of the additional wastewater flow expected from development without impacting on water quality objectives, the quality conditions of the a new discharge permit would need to be altered compared to the current discharge permit and treatment process upgrades required?	Yes	No change to BOD permit required and it is unlikely that an Ammonia or Phosphate permit condition would need to be applied.
a.	Can deterioration be limited to 10% based on the current river quality after growth with current conventional treatment technology?	Yes	No permit limit for Ammonia is required; however, a permit condition of 6.85 mg/l could be applied. No permit change required for BOD. No permit limit is required for Phosphate.
b.	Can the WFD objective of 'no deterioration' be achieved after growth with current conventional treatment technology?	Yes	'No deterioration' can be achieved for Ammonia and is readily achievable within the current limits of conventional treatment. No permit limit is recommended for Ammonia. 'No deterioration' can be achieved for BOD through the existing permit condition. 'No deterioration' can be achieved for Phosphateand is readily achievable within the limits of conventional treatment. No permit limit is recommended for Phosphate.

Assessment Criteria		Yes / No	Additional Comments
	c. Where 'no deterioration' cannot be achieved, can the current river quality be maintained after growth with current conventional treatment technology?	**Not Assessed**	No assessment was required because it is demonstrated in Criteria 3b that the WFD objective of 'no deterioration' can be achieved within the current limits of conventional treatment.
	d. Can the WFD Future Target Status be achieved after growth with current conventional treatment technology?	**Yes**	Ammonia is already at High status – therefore ensuring no deterioration is adequate. BOD is already at High status – therefore ensuring no deterioration is adequate. Phosphate - An alternative objective of Moderate status by 2021 has been set by the Environment Agency in place of the default objective to reach Good status. The alternative objective has been set since no known technical solution is available to resolve the less than Good status of Phosphate (see Appendix F for details). Modelling suggests that future status can be readily achieved within the current limits of conventional treatment. No permit limit is recommended for Phosphate.
4.	Is there the potential for a cumulative impact on water quality upstream of the WRC from growth proposed in the study area?	**No**	Hanslope WRC is located on a tributary of the River Tove with no other significant WRC discharges upstream.
5.	Are WRC infrastructure upgrades required?	**No**	Modelling suggests that no new permit conditions need to be applied

4.7.4 Olney WRC

4.7.4.1 Environmental Baseline

The River Great Ouse from Newport Pagnell to Roxton (GB105033047923) receives treated effluent from the Olney WRC and currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' by 2021. Its current overall status is limited to Moderate due to the 'Poor' status of phosphate. The current status for ammonia and BOD is High.

The Reasons for Not Achieving Good (RNAG) as outlined in the Anglian RBMP, relevant to the River Great Ouse from Newport Pagnell to Roxton are outlined in Table 4-9 in Section 4.7.2.1.

4.7.4.2 Revised Permit Conditions – Modelling Results

The revised discharge permit quality conditions required by the end of the plan period for each determinand and for each modelled scenario are presented in Table 4-14.

Table 4-14 Required permit quality conditions for Olney WRC throughout the plan period

Determinand	Current permit quality condition (mg/l)	Future permit quality condition required (mg/l)			
		Limit to 10% deterioration	No deterioration in status	Maintain Current Quality	Achieve Future Target Status
Ammonia (mg/l 95%ile)	-	7.32	20.5	N/A	N/A
BOD (mg/l 95%ile)	30	63.79	272.04	N/A	N/A
Phosphate (mg/l annual average)	-	8.07	106.1	N/A	18

4.7.4.3 WRC Assessment Summary

Table 4-15 Olney WRC Assessment Summary

Assessment Criteria		Yes / No	Additional Comments
1.	Is there sufficient permitted headroom to accept, treat and discharge the expected volume of wastewater as a result of growth proposed by the end of the plan period?	**No**	Calculated headroom deficit post-growth of 15 m^3/d.

Assessment Criteria		Yes / No	Additional Comments
2.	Has the water quality assessment demonstrated that utilising the headroom would risk non-compliance with water quality objectives?	**Not Applicable**	The WRC does not have sufficient permitted headroom to accommodate the growth and therefore a new permit will be required.
3.	Has the water quality assessment demonstrated that to accept and treat all of the additional wastewater flow expected from development without impacting on water quality objectives, the quality conditions of the discharge permit would need to be altered compared to the current discharge permit and treatment process upgrades required?	**Yes**	No change to BOD permit required and it is unlikely that an Ammonia or Phosphate permit condition would need to be applied.
	a. Can deterioration be limited to 10% based on the current river quality after growth with current conventional treatment technology?	**Yes**	No permit change required for Ammonia. No permit change required for BOD. No permit change required for Phosphate.
	b. Can the WFD objective of 'no deterioration' be achieved after growth with current conventional treatment technology?	**Yes**	'No deterioration' can be achieved for Ammonia and is readily achievable within the limits of conventional treatment. No permit limit is recommended for Ammonia. 'No deterioration' can be achieved for BOD through the existing permit condition. 'No deterioration' can be achieved for Phosphate and is readily achievable within the limits of conventional treatment. No permit limit is recommended for Phosphate.
	c. Where 'no deterioration' cannot be achieved, can the current river quality be maintained after growth with current conventional treatment technology?	**Not Assessed**	No assessment was required because it is demonstrated in Criteria 3b that the WFD objective of 'no deterioration' can be achieved within the current limits of conventional treatment.
	d. Can the WFD Future Target Status be achieved after growth with current conventional treatment technology?	**Yes**	Ammonia is already at High status – therefore ensuring no deterioration is adequate. BOD is already at High status – therefore ensuring no deterioration is adequate. Phosphate - An alternative objective has been set by the Environment Agency in place of the default objective to reach Good status. The alternative objective has been set due to disproportionately expensive to resolve the less than Good status of Phosphate (see Appendix F for details). Modelling suggests that future status can be readily achieved within the current limits of conventional treatment. No permit limit is recommended for Phosphate.
4.	Is there the potential for a cumulative impact on water quality upstream of the WRC from growth proposed in the study area?	**Yes**	Cotton Valley WRC discharges to the River Great Ouse approximately 10km upstream from Olney. Cotton Valley WRC is likely to receive significant growth during the plan period. However, modelling indicates that even with the significant additional flow expected at Cotton Valley WRC as a result of growth proposals, WFD objectives can still be met. In addition, the flow of the River Great Ouse is considered to provide significant dilution of the Cotton Valley WRC discharge. Therefore, the cumulative impact is thought to be negligible.
5.	Are WRC infrastructure upgrades required?	**Yes**	Modelling suggests that no new water quality permit conditions need to be applied. However, a new DWF condition on the permit may be required along with possible minor upgrades to enable the WRC to accommodate additional wastewater flow. The exact technical specification of the upgrades required should be determined by AWS for the AMP7 (2020 – 2025) asset planning period and subsequent asset planning periods, as relevant.

4.8 Ecological Appraisal

WRCs that do not need to change their current discharge permits are not discussed in the analysis below. This is on the basis that the ecological impacts of those permits that do not require change will have already been considered as part of the consenting process and/or (for internationally important wildlife sites) through the Environment Agency's Review of Consents process.

To undertake this assessment, those WRCs that would need to exceed current discharge permits to accommodate the planned future development were identified. Having done this, the receiving watercourses for those WRCs were traced downstream from the discharge point. Where a receiving watercourse enters, or passes adjacent to a wildlife site that has potential to be vulnerable to changes in hydrology (based on the information available such as citations), these are identified and discussed in the following section. The discussion relating to individual WRCs includes, where required, recommendations to ensure that future development does not adversely affect wildlife sites. Where available, reasons for designation of the wildlife sites have been gathered primarily from the following sources:

- Joint Nature Conservation Committee www.jncc.defra.gov.uk;
- Natural England www.naturalengland.org.uk;
- Local Councils; and,
- Freely available online aerial photography and mapping.

For non-statutory wildlife sites, it is common for them to lack specific citations which can create difficulty in identifying the specific interest features. Consequently non-statutory sites are not included within the below assessment.

Following this process, five statutory designated sites have been identified as being hydrologically connected to the WRC that is unable to meet expected development needs during the Plan period without a change to its discharge permits. The designated sites connected to this WRC (even if just located adjacent to the watercourse but not confirmed to be hydrologically dependent upon it) are (listed alphabetically):

- Harrold Odell Country Park Local Nature Reserve;
- Felmersham Gravel Pits Site of Special Scientific Interest; and
- Stevington Marsh Site of Special Scientific Interest.

The locations of these wildlife sites are illustrated in Figure 4-5. All other designated sites identified within the district are remote from watercourses into which WRCs discharge treated effluent. The ecological background to the statutory designated sites, including the details of the interest features and relevant condition assessments (where available), is provided in Appendix E.

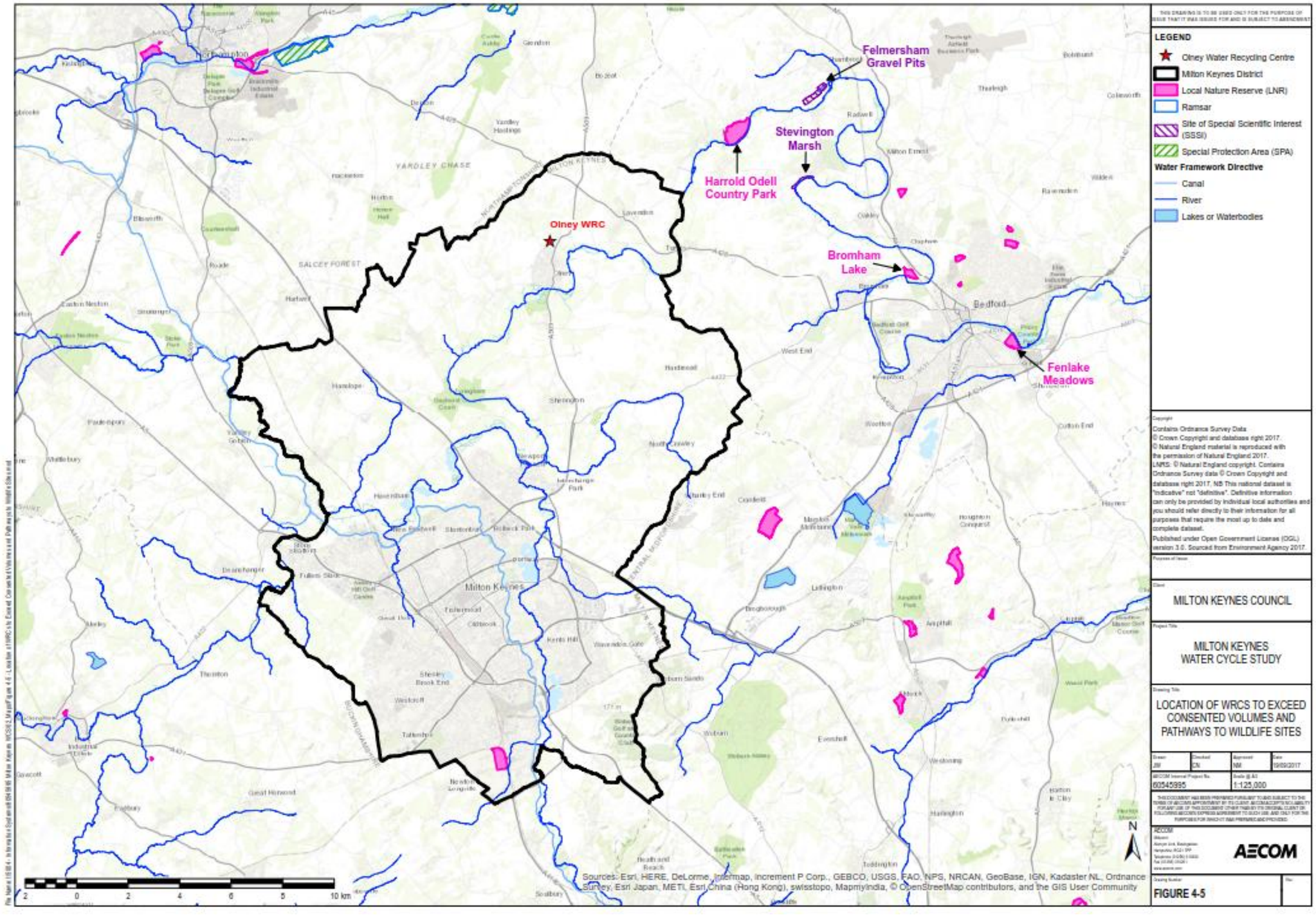


Figure 4-5 Location of WRCs to Exceed Consented Volumes and Pathways to Wildlife Sites

4.8.1 Impact on Designated Sites

Table 4-16 identifies that one WRC will not have sufficient headroom capacity to accommodate the proposed future increase in development within their catchments. As such, the volumetric permit will be exceeded. This is Olney WRC. The location of Olney WRC is illustrated in

Figure 4-5.

Table 4-16 Wildlife Sites with Linking Pathways to Olney WRC

WRC	Wildlife Site	Comments
Olney Water Recycling Centre (discharges into an unknown stream which flows into the River Great Ouse)	Harrold Odell Country Park Local Nature Reserve	10.7km downstream of the River Great Ouse
	Felmersham Gravel Pits Site of Special Scientific Interest	15.5km downstream of the River Great Ouse
	Stevington Marsh Site of Special Scientific Interest	28km downstream of the River Great Ouse

The headroom capacity exceedance of this one WRCs therefore pose implications for water quality (and thus ecology) downstream and are discussed further below.

In freshwater environments phosphates are a growth-limiting nutrient. Increases in phosphate levels in freshwater environments can result in the death of aquatic plants and animals via the process of eutrophication. Increased levels of Biochemical Oxygen Demand (BOD) can result in lower oxygen levels in watercourses which in turn can result in death of plants and animals. Further, in addition to phosphate related concerns, even relatively low levels of ammonia can be toxic to plants and animals resulting in death. Nitrogen and phosphate are both growth-limiting nutrient in terrestrial habitats. Elevated levels of either nutrient can result in increased plant growth of species that can readily take advantage of the increased levels of nutrients. Ammonia is the principal source of nitrogen in treated sewage effluent.

4.8.1.1 Olney

Olney WRC discharges into a stream which flows into the River Great Ouse, a freshwater system. After 10.7km the River Great Ouse flows past Harrold Odell Country Park LNR. The Harrold-Odell Country contains 58 hectares of river meadows, woodland and two lakes.

This LNR is likely to receive some flood water from the River Great Ouse and consequently is vulnerable to changes in levels of phosphate and nitrate (from nitrification of ammonia) carried within the floodwaters.

Approximately 15km downstream of the WRC discharge is the **Felmersham Gravel Pits SSSI**. This site consists of a series of flooded pits which were active until about 1945. The SSSI contains several habitats including tall fen communities, open water, neutral grassland, scrub and broadleaved woodland. Similar to Harrold Odell Country Park LNR this site has potential to be vulnerable to changes in both phosphate and nitrate from nitrification of ammonia. At 28km downstream of the WRC discharge point is **Stevington Marsh SSSI**. Stevington Marshes are situated next to the River Great Ouse and supports wetland communities. Similar to the above two wildlife sites, this freshwater site has potential to be vulnerable to changes in phosphate and ammonia levels.

The current volumetric permit for Olney WRC will be exceeded when new growth is taken into account. However, the '10% Deterioration Assessment' identifies that the WRC is able to treat effluent to a sufficient standard to ensure there is a less than 10% deterioration in ammonia, phosphate or BOD concentrations in the treated effluent, notwithstanding the need to increase the volumetric permit. For example, the existing available treatment level for BOD is 30 mg/l, far exceeding the 63.79 mg/l required to achieve less than 10% deterioration. Moreover, the 'future WFD status' assessment indicates that BOD (the only parameter with a current target status below 'good' in the receiving watercourse) can be treated to a sufficient extent that it will facilitate the achievement of the future target status of 'moderate'.

Coupled with the substantial distances between the point of discharge and the designated wildlife sites (minimum 10km) and the associated large dilution factors involved, it is therefore considered that there would be no negative impact upon the designated features of theses wildlife sites.

4.8.2 Impacts on Ecology outside Designated Sites

Whilst the above assessment is primarily focused on the impact on ecologically designated sites, the following section discusses ecology outside of designated sites. The limitations of a Water Cycle Study report make it impossible for such a discussion to be exhaustive or spatially specific.

In addition to impacts on designated sites, a range of other UK species listed under the Natural Environment and Rural Communities (NERC) Act (2006) Section 41 and / or Buckinghamshire and Milton Keynes Biodiversity Action Plan (BAP) species or otherwise protected/notable species that are found in Milton Keynes can be affected by wastewater discharge. These include:

- Water vole (Arvicola amphibious) (protected through Wildlife & Countryside Act 1981 and a NERC S41 species BAP species);
- Grass snake (Natrix natrix)(partially protected through Wildlife & Countryside Act 1981);
- Common toad (Bufo bufo) (NERC S41 species);
- Great crested newt (Triturus cristatus) (legally protected through Conservation of Habitats & Species Regulations 2010, Wildlife & Countryside Act 1981 and a NERC S41 species);
- Birds such as bittern (Botaurus stellaris)(a NERC S41 species), kingfisher (Alcedo atthis), lapwing (Vanellus vanellus) and snipe (Gallinago gallinago) (protected through Wildlife & Countryside Act 1981); and
- Otter (Lutra lutra) (legally protected through Conservation of Habitats & Species Regulations 2010, Wildlife & Countryside Act 1981 and a NERC S41 species).

Similarly, important habitats (all listed in the Buckinghamshire and Milton Keynes BAP) include:

- Coastal and floodplain grazing marsh;
- Ponds; and
- Reedbeds.

All of these habitats and species are present (or possibly present) in the Milton Keynes Borough.

It is not possible within the scope of this commission to undertake a detailed investigation and evaluation of the impacts of the changes in water quality/flow and infrastructure to be delivered under the water cycle study on wildlife generally, since it would be necessary to undertake detailed species surveys of each watercourse and utilise detailed flow and quality data/modelling which has not been available for this commission for most watercourses.

4.8.3 Ecological Opportunities Associated with Proposed Development Locations

To ensure that the planned level of development within the plan period does not result in a negative impact upon wildlife within and outside of designated sites it is recommended that policy is included within the Plan to ensure that these matters are addressed at a strategic level and water quality at these locations will be improved to suitable quality levels and consent levels. This may include the requirement for new infrastructure to be in place prior to the delivery of new development or the need for phased infrastructure to ensure that the WRC can accommodate the increased capacity (this is not an exhaustive list) and not result in a detrimental impact upon wildlife features. Further to recommended policy it is recommended that:

- Where ecological risks resulting from proposed water cycle changes have been identified, these are considered within the relevant flood risk and surface water management proposals. These opportunities and the reduction of identified risks can be incorporated into the detailed design of the developments and local green infrastructure plans.

4.9 Wastewater Summary

WRCs which are shown to exceed their volumetric permits, or experience significant growth, have undergone water quality modelling (Castlethorpe, Cotton Valley, Hanslope and Olney). The results demonstrate that there is environmental capacity for the proposed options for growth as long as permit changes and any required process upgrades are undertaken. Therefore, from a WFD and Habitats Directive perspective there is capacity to accept growth and comply with current WFD targets based on the limits achievable with current technology.

For some waterbodies environmental capacity should be considered to be ultimately limited on the basis that limitations on current treatment technologies are preventing the optimal target of future good status from being achieved, however, this is not evident in relation to Milton Keynes in relation to the current proposed growth to 2031. The capability and performance of treatment technologies are likely to improve over time, and hence capacity for additional wastewater flow would need to be reconsidered in the context of achieving good status up to the end of the plan period and beyond.

4.10 Overall RAG Assessment

Table 4-17 provides a RAG assessment of the WRCs within the Borough which have been assessed and the results against the full range of water quality objectives tested. The key for the RAG assessment is shown below:

- **Green** – water quality objectives will not be adversely affected. Growth can be accepted with no changes to the WRC infrastructure or quality permit required.
- **Amber** – in order to meet the required water quality objectives, changes to the quality permit are required, and upgrades may be required to WRC infrastructure which may have phasing implications.
- **Red** - in order to meet water quality objectives changes to the quality permit are required which are beyond the limits of what can be achieved with conventional treatment.

The water quality modelling results demonstrate that, subject to the revision or issuing of new discharge permits and the necessary treatment process upgrades (using conventional treatment technologies) being implemented, there is environmental capacity for the proposed growth to ensure WFD water quality objectives can be met.

Whilst the WCS has shown technical solutions are possible to maintain WFD objectives, it should be noted that all water bodies are not expected to be able to meet overall requirement of ‘Good’ status as set out in the WFD. Therefore, the assessments undertaken should be considered within the context of the lower current and future baseline quality of the waterbodies assessed.

As published in the latest Anglian RBMP by the Environment Agency, current wastewater discharges are believed to be one of the causes for high phosphate concentrations in the River Great Ouse and River Tove, and therefore they are currently contributing to the waterbodies not meeting the required ‘Good’ status under the WFD. As stated in the WRC assessments above, the reason is due to no technical solution currently available (i.e. beyond current limits of conventional treatment technology), or disproportionately expensive and consequently alternative (lower) WFD objectives have been set.

Table 4-17 Wastewater assessment summary

WRC	Watercourse	Is Headroom available for anticipated growth?	Is a revised quality condition required?	Limit deterioration to 10% or less?	Ensure no deterioration in status?	Future Status	Overall RAG
Castlethorpe	River Tove	Yes – But levels of growth significant for this WRC	Ammonia	Yes	Yes	N/A	Available headroom capacity and WFD waterbody quality targets can be met therefore no upgrades are considered necessary.
			BOD	Yes	Yes	N/A	
			Phosphate	Yes	Yes	Yes	
Cotton Valley	River Great Ouse	Yes – But levels of growth significant for this WRC	Ammonia	Yes	Yes	N/A	Available headroom capacity, however WFD waterbody quality targets can be met through tightening permit conditions which can be achieved using conventional treatment technologies.
			BOD	Yes	Yes	N/A	
			Phosphate	Yes	Yes	Yes	
Hanslope	River Tove	Yes – But levels of growth significant for this WRC	Ammonia	Yes	Yes	N/A	Available headroom capacity and WFD waterbody quality targets can be met therefore no upgrades are considered necessary.
			BOD	Yes	Yes	N/A	
			Phosphate	Yes	Yes	Yes	
Olney	River Great Ouse	No	Ammonia	Yes	Yes	N/A	No headroom capacity, however WFD waterbody quality targets can be met therefore no upgrades are considered necessary.
			BOD	Yes	Yes	N/A	
			Phosphate	Yes	Yes	Yes	

5. Water Supply Strategy

5.1 Introduction

Water supply for the study area is provided by AWS. An assessment of the existing environmental baseline with respect to locally available resources in the aquifers and the main river systems has been completed. The assessment has been based on the Environment Agency's Upper Ouse and Bedford Catchment Abstraction Licensing Strategy.

This study has also used AWSs 2015 WRMP[21] to determine available water supply against predicted demand and has considered how water efficiency can be further promoted and delivered for new homes beyond that which is planned for delivery in AWS's WRMP.

5.2 Abstraction Licensing Strategies

The Environment Agency manages water resources at the local level through the use of abstraction licensing strategies. Within the abstraction licensing strategies, the Environment Agency's assessment of the availability of water resources is based on a classification system that gives a resource availability status which indicates:

- The relative balance between the environmental requirements for water and how much is licensed for abstraction;
- Whether water is available for further abstraction; and,
- Areas where abstraction needs to be reduced.

The categories of resource availability status are shown in Table 5-1. The classification is based on an assessment of a river system's ecological sensitivity to abstraction-related flow reduction. This classification can then be used to assess the potential for additional water resource abstractions.

Table 5-1 Water resource availability status categories

Indicative Resource Availability Status	License Availability
Water available for licensing	**There is more water than required to meet the needs of the environment. New licences can be considered depending on local and downstream impacts.**
Restricted water available for licencing	**Full Licensed flows fall below the Environmental Flow Indictors (EFIs). If all licensed water is abstracted there will not be enough water left for the needs of the environment. No new consumptive licences would be granted. It may also be appropriate to investigate the possibilities for reducing fully licensed risks. Water may be available if you can 'buy' (known as licence trading) the entitlement to abstract water from an existing licence holder.**
No water available for licencing	**Recent actual flows are below the EFI. This scenario highlights water bodies where flows are below the indicative flow requirement to help support Good Ecological Status (as required by the Water Framework Directive (Note: we are currently investigating water bodies that are not supporting GES / GEP). No further consumptive licences will be granted. Water may be available if you can buy (known as licence trading) the amount equivalent to recently abstracted from an existing licence holder.**

The Environment Agency aims to protect the annual flow variability in rivers, from low to high flow conditions through the application of flow statistics derived from flow data collected at river gauging stations. Flow statistics are expressed as the percentage of time that flow is exceeded. Resource availability is calculated by the Environment Agency at four different flow scenarios:

- Q95 (lowest);

[21] Anglian Water Limited Final Water Resources Management Plan (2015) http://www.anglianwater.co.uk/_assets/media/WRMP_2015.pdf

- Q70;
- Q50; and
- Q30 (highest).

Q95 is the flow exceeded for 95% of the time, and is used as a low flow indicator. Q30 is the flow exceeded for 30% of the time; and is considered to be a high flow. Figure 5-1 below illustrates an example gauged daily flow across a period of time and the calculated flow percentiles associated to the flow measured in the river.

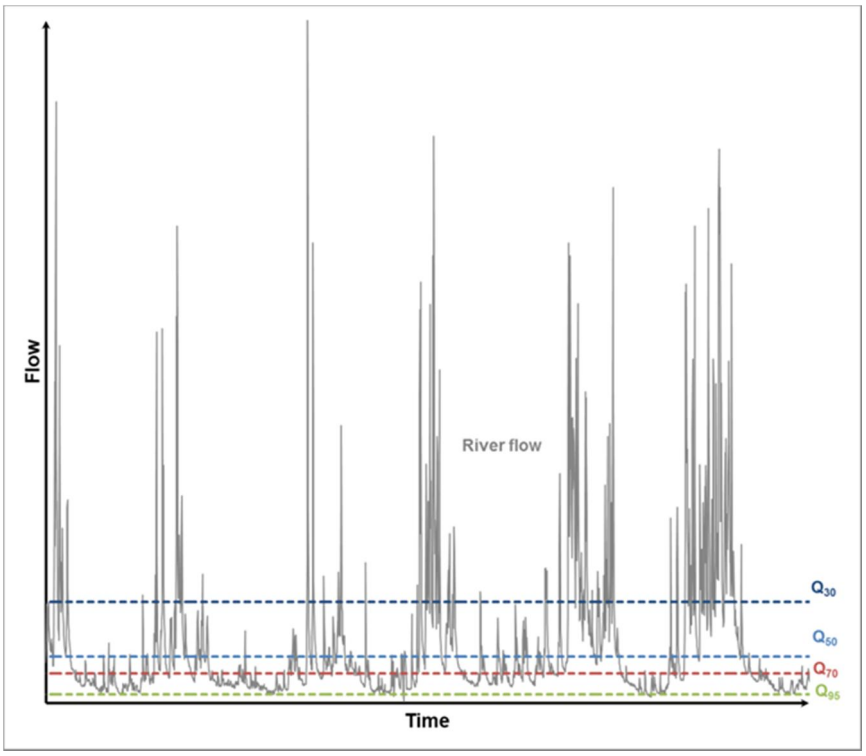


Figure 5-1 Example of gauged daily flow and calculated flow statistics

The classification for each of the Water Resource Management Units (WRMU) in the Borough has been summarised for surface waterbodies in Table 5-2.

Table 5-2 Resource availability classification

River – WRMU	Surface Water (flow exceedance scenarios)			
	Q30	Q50	Q70	Q95
AP 12 Newport Pagnell				
AP13 Broughton Brook				
AP14 Ouzel				
AP17 Tove				
AP18 Ouse				

All rivers are defined as having no water available for licencing during periods of average to low flow (Q70-Q95). One site has no water available for licencing during periods of higher flow (Q30). This analysis indicates that there is limited potential for local abstraction to support major site development at a local level and therefore, reliance on strategic water resource management and movement of water into the area is required to sustain growth and demand for potable water.

5.3 Water Resource Planning

Water companies have a statutory duty to undertake medium to long term planning of water resources in order to demonstrate that a there is a long-term plan for delivering sustainable water supply within its operational area to meet existing and future demand. This is reported via WRMPs on a 5 yearly cycle.

WRMPs are a key document for a WCS as they set out how future demand for water from growth within a water company's supply area will be met, taking into account the need to for the environment to be protected. As part of the statutory approval process, the plans must be approved by both the Environment Agency and Natural England (as well as other regulators) and hence the outcomes of the plans can be used directly to inform whether growth levels being assessed within a WCS can be supplied with a sustainable source of water supply.

Water companies manage available water resources within key zones, called Water Resource Zones (WRZ). These zones share the same raw resources for supply and are interconnected by supply pipes, treatment works and pumping stations. As such the customers within these zones share the same available 'surplus of supply' of water when it is freely available; but also share the same risk of supply when water is not as freely available during dry periods (i.e. deficit of supply). For current WRMPs, water companies have undertaken resource modelling to calculate if there is likely to be a surplus of available water or a deficit in each WRZ by 2040, once additional demand from growth and other factors such as climate change are taken into account.

5.4 Water Resource Planning in the Borough

In reviewing AWS's Final 2015 WRMP it has been established that the growth figures assessed for this WCS study are largely catered for in the 2040 prediction of supply and demand deficits in the relevant WRZs under average conditions. Therefore, the conclusions of the WMRP can be used to inform the assessment of water availability for the WCS. AWS recently commenced a review of the existing WRMP which will be informed by an update on the scale of growth proposed within the AWS supply area, which includes the Milton Keynes Borough.

5.5 Planned Water Availability Summary

The final 2015 WRMPs for AWS has been used to summarise water availability to meet the projected demand for the Milton Keynes study area covering the planning period to 2040. The Milton Keynes Borough is located in the Ruthamford South WRZ.

5.5.1 Ruthamford South Water Resource Zone

The AWS Ruthamford South WRZ is supplied using a combination of sources including surface water from the River Ouse and groundwater from the Lower Greensand. The Ruthamford South WRZ is predicted to have a baseline supply-demand deficit of 10.82Ml/d (during the Dry Year Annual Average) by the end of AMP9 (2034/35) and a deficit of 18.04 Ml/d by 2040. A deficit of 4.19 Ml/d exists during peak conditions by 2040 for the Ruthamford South WRZ.

Supply-Demand Strategy

The WRMP has considered one or more of the following schemes for the Ruthamford WRZ to maintain a supply-demand balance:

- RHFA1 Ruthamford North WRZ transfer 1 (24Ml/d) - This option provides for transfer of water from the Ruthamford North RZ to Ruthamford South via 21km long new pipeline;
- RHFA7 Grafham dam raising -This option provides for an increase in the capacity of the existing reservoir by raising the dam and an increase in the capacity of the treatment works;
- RHFA8 New Ruthamford South WRZ Reservoir -This option provides for a new reservoir supplied from the existing river abstraction point for Graham reservoir. New water treatment works capacity would be required along with the associated infrastructure to transfer water between the new assets;
- RHFA11 Recommission Ruthamford South WRZ Reservoir- Recommissioning of the existing Foxcote reservoir and water treatment works to the south of Ruthamford South WRZ;
- RHFA13 Ruthamford North WRZ transfer 2 (39Ml/d) -This option is similar to option RHFA1 but provides a larger capacity transfer and requires an additional 21km of pipeline to boost supplies to Milton Keynes; and

- RHFA14 Huntingdon water reuse -Effluent from Huntingdon Water Recycling Centre would be treated to an extremely high (near potable) standard and transferred via a 12km pipeline. It would be re-abstracted and treated by a new treatment works.

Both transfer options (RHFA1 and RHFA13) are supplied by Ruthamford North WRZ which is in surplus. However the capacity of the transfers out of Ruthamford North WRZ (to either Ruthamford South WRZ or Fenland WRZ) will require a new resource/s to be developed in Ruthamford North WRZ. The new resource options are described in the Ruthamford North WRZ summary in the AWS WRMP (2015).

Water Efficiency Plan

As well as providing additional supply resource, it is important to ensure that the existing resources are used as efficiently as possible to reduce demand. AWS is planning a series of demand management measures and a number of improvements to existing infrastructure and resources. The majority of these measures will be undertaken in AMP6 (2019-2020). Lowering water consumption levels is considered to be a priority in offsetting resource development.

Proposed demand management measures across both WRZs include:

- Completing water efficiency audits;
- Water metering (AWS expect 30,000 customers will opt in for metered billing in the Ruthamford South WRZ); and,
- Leakage reduction.

Preferred Plan

An overview of the investment planned to maintain the supply demand balance in the AWS Ruthamford South WRZ, as identified in the AWS WRMP (2015), are provided in Table 5-3.

Table 5-3 Ruthamford South WRZ – Preferred Plan

Scheme Type	AMP6 (2015-20)	AMP7 (2020-25)	AMP8 (2025-30)	AMP9 (2030-35)
Resources side	-	-	RHFA1 – Ruthamford North RZ transfer (24Ml/d)	
Distribution side	· Reduce Ruthamford North RZ raw water export ES10 – South Essex RZ transfer to East Suffolk RZ.	-	-	-
Customer (Demand) side	Water efficiency plan: · Approx. 30,000 water efficiency audits · Estimated 30,000 customers will opt onto metered billing · Fit 20,000 meters · Leakage reduction	-	-	-

It is noted that the preferred plan is sensitive to the transfer requirements for adjacent WRZs, including those in adjacent water company areas. Any change in the supply-demand balance in these areas, for example as a result of clarification about sustainability reductions, is likely to lead to the development of an alternative plan.

5.6 Demand for Water

There are several key drivers (outlined in Section 5.7) for ensuring that water use in the development plan period is minimised as far as possible through the adoption of water efficiency policy. This WCS therefore includes an assessment of the feasibility of achieving a ‘water neutral’ position after growth across the Borough.

Likely increases in demand in the study area have been calculated using five different water demand projections based on different rates of water use for new homes that could be implemented through potential future policy.

The projections were derived as follows:

- **Projection 1** – Average AWS metered consumption[22] – New homes would use 126 l/h/d up to 2020, reducing to 115 l/h/d between 2020-2029 and reducing further to 114 l/h/d from 2030, which reflects the planning consumption used by AWS to maintain security of supply;
- **Projection 2** – Low Scenario (Building Regulations) – New homes would conform to (and not use more than) Part G of the Building Regulations requirement of 125 l/h/d;
- **Projection 3** – Medium Scenario (Building Regulations Optional Requirement) - Only applies where a condition that the new home should meet the optional requirement imposed as part of the process of granting planning permission. Where it applies, new homes would conform to (and not use more than) Part G of the Building Regulations optional requirement of 110 l/h/d;
- **Projection 4** – High Efficiency Scenario – New homes would achieve 80 l/h/d (to reflect the now superseded Code for Sustainable Homes Level of 5 or 6); and,
- **Projection 5** – Very High Efficiency Scenario – New homes would include both greywater recycling and rainwater harvesting reducing water use to a minimum of 62 l/h/d.

Using these projections, the increase in demand for water, due to new developments, could range between 5.28 and 10.07 Ml/d by 2031. The projections are shown in Figure 5-2.

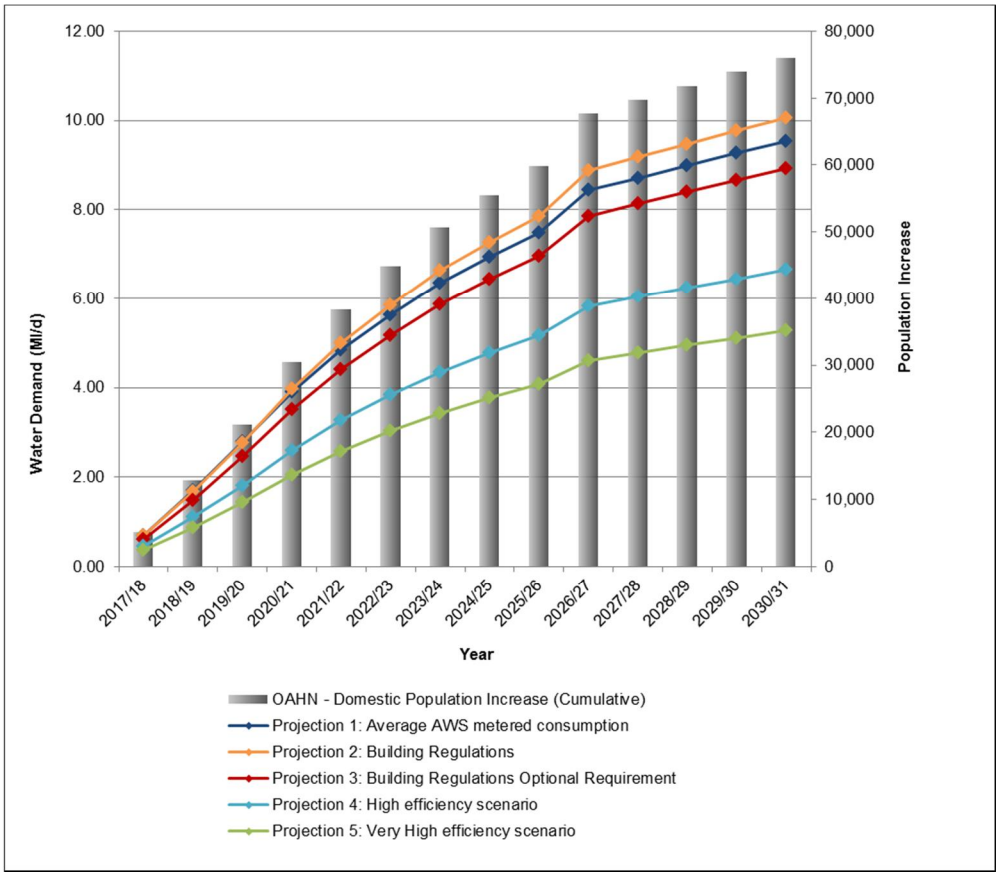


Figure 5-2 Range of water demands across plan period in Milton Keynes depending on efficiency levels of new homes

5.7 Drivers and Justification for Water Efficiency

The Borough is surrounded by a number of different authorities that each has different environments and plans for future development. It is important to ensure that development and other additional factors do not have a damaging effect on the water environment for other authorities within the region.

[22] Anglian Water Services Final Water Resources Management Plan (2015) http://www.anglianwater.co.uk/_assets/media/WRMP_2015.pdf

The Anglian Water supply area, which includes Milton Keynes Borough, is designated as"Areas of serious water stress", as classified by the Environment Agency[23]. Any growth and increase in population could exacerbate this issue. In order to ensure surplus raw water supply for growth in the Borough, AWS's current WRMP covering the next 25 years takes an approach of more efficient use of existing resources and demand reduction from customers. This creates a very strong driver for new homes in the next 25 years to be made as efficient as economically possible to safeguard the future resources to be made available by AWS in the Borough.

5.7.1 Managing Climate Change and Availability of Water

It is predicted that climate change will further reduce the available water resources in the Borough. Rainfall patterns are predicted to change to less frequent, but more extreme, rainfall events.

AWS have recognised the risk climate change poses to the three crucial areas of their business; abstraction, treatment and distribution of water. The impact of climate change on groundwater poses the most significant risks to long term supply/demand balance due to reductions in rainfall, particularly during consecutive seasons, reducing the amount of groundwater recharge that occurs.

Customers expect AWS to provide a continuous supply of water, but the resilience of the supply systems have the potential to be affected by the impact of climate change with severe weather-related events, such as flooding.

In planning for future water resources availability, AWS have accounted for the impacts of climate change within their supply-demand forecasts.

5.7.1.1 Impact on Supplies

AWS have undertaken analysis of the impacts of climate change on the future availability of their water resources on both their groundwater and surface water sources, and incorporated these results into their assessment of deployable output.

The impact of a worst case climate change scenario on water resources over the plan period within the Ruthamford South WRZ is estimated at 61.1 Ml/d by 2040.

5.7.1.2 Impact on Demand

The main impact of climate change on demand is related to periods of extremely hot and dry weather that will increase the peak demand for water. AWS have accounted for the impact on the peak demand and the longer duration effect of a dry year through forecasting the increased demand of water and accounting for it in their plans.

Although AWS have planned for the anticipated impacts of climate change, the view of AWS and other water companies is that, in order to manage the effects of climate change effectively, the single most cost effective step in water resources climate change resilience is to manage demand downwards. The reduction in demand will also help to reduce carbon emissions which aids in reducing impacts of climate change. Planning policy has a significant role to play in helping to achieve this.

5.7.2 Sustainability reductions

Water abstraction can contribute to low flows in some rivers, which in turn can contribute to ecological damage in the river. To ensure compliance with the Water Framework Directive, AWS is required to reduce existing abstractions. The WRMP explains that a reduction of 2.37Ml/d (dry year annual average) may be likely and requires further option appraisal for the existing abstraction at Broughton Brook (Ruthamford South WRZ). Whilst sustainability reductions in licenced abstraction have been considered within the WRMP, they indicate the pressure on existing sources and the limits to which they can be managed further.

5.8 Water Neutrality

Water neutrality is a concept whereby the total demand for water within a planning area after development has taken place is the same (or less) than it was before development took place[24]. If this can be achieved, the overall

[23] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf
[24] Water Neutrality is defined more fully in the Environment Agency report 'Water Neutrality: An improved and expanded water resources management definition' (2009)

balance for water demand is 'neutral', and there is considered to be no net increase in demand as a result of development. In order to achieve this, new development needs to be subject to planning policy which aims to ensure that where possible, houses and businesses are built to high standards of water efficiency through the use of water efficient fixtures and fittings, and in some cases rainwater harvesting and greywater recycling.

It is theoretically possible that neutrality can be achieved within a new development area, through the complete management of the water cycle within that development area. In addition to water demand being limited to a minimum, it requires:

- all wastewater to be treated and re-used for potable consumption rather than discharged to the environment;
- maximisation of rainwater harvesting (in some cases complete capture of rainfall falling within the development) for use in the home; and
- abstraction of local groundwater or river flow storage for treatment and potable supply.

Achieving 'total' water neutrality within a development remains an aspirational concept and is usually only considered for an eco-town or eco-village type development, due to the requirement for specific catchment conditions to supply raw water for treatment and significant capital expenditure. It also requires specialist operational input to maintain the systems such as wastewater re-use on a community scale.

For the majority of new development, in order for the water neutrality concept to work, the additional demand created by new development needs to be offset in part by reducing the demand from existing population and employment. Therefore, a 'planning area' needs to be considered where measures are taken to reduce existing or current water demand from the current housing and employment stock. The planning area in this case is considered to be the Borough as a whole.

5.8.1 Twin-Track Approach

Attainment of water neutrality requires a 'twin track' approach whereby water demand in new development is minimised as far as possible, whilst at the same time taking measures, such as retrofitting of water efficient devices on existing homes and business to reduce water use in existing development.

In order to reduce water consumption and manage demand for the limited water resources within the Borough, a number of measures and devices are available[25]. Generally, these measures fall into two categories due to cost and space constraints, as those that should be installed in new developments and those which could be retrofitted. Appendix D provides more detail on the different types of device or system along with the range of efficiency savings they could lead to.

5.8.2 Achieving Total Neutrality – is it feasible?

When considering neutrality within an existing planning area, it is recognised by the Environment Agency[26] that achievement of total water neutrality (100%) for new development is often not possible, as the levels of water savings required in existing stock may not be possible for the level of growth proposed. A lower percentage of neutrality may therefore be a realistic target, for example 50% neutrality.

This WCS therefore considers four water neutrality targets and sets out a 'pathway' for how the most likely target (or level of neutrality) can be achieved. Appendix D discusses the pathway concept in more detail, and highlights the importance of developing local policy in the study area for delivering aspirations like water neutrality as well as understanding the additional steps required beyond 'business as usual' required to achieve it.

5.8.3 Metering Assumptions

Installing water meters within existing residential properties is an important element of both water companies WRMPs to manage their customers' demand for water. Each of the water companies metering programmes as described in the WRMP has been applied to the four water neutrality scenarios (outlined in Section 5.9.4) and details the level of additional metering that could be undertaken.

[25] Source: Water Efficiency in the South East of England, Environment Agency, April 2007.
[26] Environment Agency (2009) Water Neutrality, an improved and expanded water management definition

The existing level of metering within the AWS WRZs is 72.2%. AWS's future target for meter penetration[27] on domestic water meters is 97.5% by 2040. As no projection has been made within the AWS WRMP for the end of the Local Plan period (2031), a linear projection has been set with a target of 87.6% meter penetration by 2031.

5.8.4 Water Neutrality Scenarios

5.8.4.1 Very High Scenario

The scenario has been developed as a context to demonstrate what is required to achieve the full aspiration of water neutrality. In reality, achieving 100% meter penetration across the Borough is unlikely, due to a proportion of existing properties which either have complicated plumbing or whose water is supplied by bulk (i.e. flats), making it difficult for meter installation. It is also implausible to retrofit so many houses across the Borough.

The key assumptions for this scenario are that water neutrality is achieved; however it is considered as aspirational only as it is unlikely to be feasible based on:

- Existing research into financial viability of such high levels of water efficiency measures in new homes;
- Uptake of retrofitting water efficiency measures considered to be at the maximum achievable (40%) in the Borough; and
- Future non-household use is assumed at a benchmark rate of consumption per person (16 l/h/d)[28].

It would require:

- Meter installation into all existing residential properties (100% meter penetration);
- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the extremely high percentage of retrofitting measures required;
- Strong local policy within the Local Plan on restriction of water use in new homes on a local authority scale which is currently unprecedented in the UK; and
- All new development to include water recycling facilities across the Borough.

5.8.4.2 High Scenario

The key assumptions for this scenario are that a high water neutrality percentage[29] is achieved but requires significant funding and partnership working, and adoption of new local policy which is currently unprecedented in the UK. Future non-household use is assumed at a benchmark rate of consumption of 16l/h/d.

It would require:

- Meter installation up to the maximum planned (up to 2040) as per AWS WRMP by 2031 (97.5% meter penetration);
- Uptake of retrofitting water efficiency measures to be very high (25%) in relation to studies undertaken across the UK into feasibility of retrofitting;
- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required; and,
- All new development would need to include rainwater harvesting.

It is considered that, despite being at the upper scale of percentage uptake of retrofitting measures, it is technically and politically feasible to obtain this level of neutrality if a fully funded joint partnership approach could be developed.

5.8.4.3 Medium Scenario

The key assumptions for this scenario are that the water neutrality achieved is a balance between cost and realistic retrofit targets as it would require funding, partnership working, and adoption of new local policy which

[27] proportion of properties within the AWS WRZ which have a water meter installed
[28] CIRIA (2006) Water Key Performance Indicators and benchmarks for offices and hotels. CIRIA C657. London 2006
[29] Water neutrality percentage refers to the percentage of water use savings made by various measures against the total new demand if the business as usual demand were to continue

has only been adopted in a minimal number of Local Plans in the UK. Future non-household use is assumed at a benchmark rate of consumption of 16l/h/d.

It would require:

- Meter installation estimated as a linear projection between 2014 and 2040 AWS WRMP figures (87.6% meter penetration by 2031);
- New housing development should go beyond mandatory Building Regulations requirements, ideally to 110 l/h/d optional Building Regulations requirements;
- Uptake of retrofitting water efficiency measures to be reasonably high (15%) in the Borough; and
- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required.

It is considered that it is technically and politically feasible to obtain this level with a relatively modest funded joint partnership approach and with new developers contributing relatively standard, but high specification water efficient homes.

5.8.4.4 Low Scenario

The key assumptions for this scenario are that the water neutrality percentage[29] achieved is low but would require small scale level of funding and partnership working, and adoption of new local policy which is likely to be easily justified and straightforward for developers to implement. Future non-household use is assumed at a benchmark rate of consumption of 16l/h/d.

It would require:

- Meter installation estimated as a linear projection between 2014 and 2040 AWS WRMP figures (87.6% meter penetration by 2031);
- New housing development should meet Building Regulations requirements of 125 l/h/d;
- Uptake of retrofitting water efficiency measures to be fairly low (10%); and
- A relatively small funding pool and a partnership working not moving too far beyond 'business as usual' for stakeholders.

It is considered that it is technically and politically straightforward to obtain this level with a small funded joint partnership approach and with new developers contributing standard, but water efficient homes with a relative low capital expenditure.

5.8.5 Neutrality Scenario Assessment Results

To achieve total water neutrality, the demand post growth must be the same as, or less than existing demand. Based on estimates of population size, current demand in the Borough was calculated to be 38.13 Ml/d.

For each neutrality option and neutrality scenario, an outline of the required water efficiency specification was developed for new houses, combined with an estimate of the savings that could be achieved through metering and further savings that could be achieved via retrofitting of water efficient fixtures and fittings in existing property. This has been undertaken utilising research undertaken by groups and organisations such as Waterwise, UKWIR[30], the Environment Agency and OFWAT to determine realistic and feasible efficiency savings as part of developer design of properties, and standards for non-residential properties (Appendix D).

For each neutrality scenario, total demand was calculated at three separate stages for housing as follows:

- Stage 1 – total demand post growth without any assumed water efficiency retrofitting of existing housing stock for the differing levels of water efficiency in new homes;
- Stage 2 – total demand post growth with effect of metering applied to the existing housing stock for the differing levels of water efficiency in new homes; and,
- Stage 3 – total demand post growth (additional household and non-household use) with metering and water efficient retrofitting applied to existing homes for the differing levels of water efficiency in new homes. The

[30] UKWIR – The United Kingdom Water Industry Research group, attended and part funded by all major UK water companies

results are provided in Table 5-4. If neutrality is achieved, the result is displayed as green. If it is not, but is within 5%, it is displayed as amber and red if neutrality above the 5% threshold is not achieved. The percentage of total neutrality achieved per scenario is also provided.

Table 5-4 Results of the Neutrality Scenario Assessments

Neutrality Scenario	New Homes demand projections	New homes consumption rate (l/h/d)	% of existing properties to be retrofitted	Demand from Growth (Ml/d)	Total demand post growth* (Ml/d)	Total demand after metering (Ml/d)	Total demand after metering & retrofitting (Ml/d)	% Neutrality Achieved
Baseline	Baseline Projection: Average AWS metered consumption	126 (up to 2020) 115 (2020-2030) 114 (2030 onwards)	0	9.54	47.67	**46.82**	**46.82**	9%
Low	Projection 1a: Building Regulations	125	0	10.07	48.20	**47.34**	**47.34**	3%
	Projection 1b:Building Regulations + retrofit	125	10	10.07	48.20	**47.34**	**47.20**	5%
Medium	Projection 2a: Building Regulations optional requirement	110	0	8.93	47.06	**46.21**	**46.21**	15%
	Projection 2b: Building Regulations optional requirement + retrofit	110	15	8.93	47.06	**46.21**	**45.32**	25%
High	Projection 3: High efficiency + retrofit	80	25	6.65	44.78	**43.38**	**41.03**	70%
Very High	Projection 4: Very High efficiency + retrofit	62	37	5.28	43.41	**41.87**	**38.11**	100%

* prior to demand management for existing housing stock

The results show that total neutrality is only achieved by applying the Very High water neutrality scenario, requiring new homes to use water at a rate of 62 l/h/d with retrofitting a minimum of 40% of the existing housing stock with water efficiency fittings. The Medium water neutrality scenario would give a minimum of 15% neutrality which would require only new homes to be designed to use water at a rate of 110 l/h/d (Projection 2a). Further 10% neutrality (up to 25%) could be achieved through retrofitting 15% of the existing housing stock with water efficiency fittings equivalent to the optional requirement standard.

5.8.6 Financial Cost Considerations

There are detailed financial and sustainability issues to consider in deciding on a policy for water neutrality. Whilst being water efficient is a key consideration of this study, due to the wider vision for sustainable growth in the Borough, reaching neutrality should not be at the expense of increasing energy use and potential increasing the carbon footprint of development.

Using the information compiled, the financial costs per neutrality scenario has been calculated and are included in Table 5-5. It should be noted that these are only estimated costs based on strategic level research into water efficiency implementation and cost.

Table 5-5 Estimated Cost of Neutrality Scenarios

Neutrality Scenario	New Homes		Existing Properties					Costs Summary		
	No.	Efficiency cost	No. to be metered	Metering cost	Population Retrofit %	No. to retrofit	Retrofit cost	Developer	Non developer	Total
Low	31,319	£-	13,702	£6,851,000	10%	11,050	£552,500	£-	£7,403,500	£7,403,500
Medium	31,319	£281,871	13,702	£6,851,000	15%	16,575	£3,149,250	£281,871	£10,000,250	£10,282,121
High	31,319	£84,467,343	13,702	£6,851,000	25%	27,625	£6,077,500	£84,467,343	£12,928,500	£97,395,843
Very High	31,319	£128,313,943	13,702	£6,851,000	40%	44,200	£9,724,000	£128,313,943	£16,575,000	£144,888,943

5.8.7 Preferred Strategy – Delivery Pathway

The assessment of water neutrality in this WCS has been undertaken to demonstrate whether moving towards neutrality is feasible and what the cost, and technological implications might be to get as close to neutrality as possible.

To achieve any level of neutrality, a series of policies, partnership approaches and funding sources would need to be developed. This WCS has assumed a 'medium' scenario would be favoured and sets out what would be required to support this strategy. This 'medium' scenario would allow a water neutrality target of between 16% and 26% to be reached. The medium scenario is considered to require a significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures, as well as the adoption of new local policy within the Local Plan on restriction of water use in new homes on a Borough scale which goes beyond that seen generally in the UK. It would require:

- Meter installation estimated as a linear projection between 2015 and 2040 AWS WRMP figures (87.6% meter penetration by 2031);
- New housing development to adhere to the requirements of draft Plan:MK Policy SC1, being designed to limit water use to 110 l/h/d (in line with the optional Building Regulations requirements);
- Uptake of retrofitting water efficiency measures to be reasonably high (15%) in the Borough; and
- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required.

It is considered that it is technically and politically feasible to obtain this level of neutrality with a relatively modest funded joint partnership approach and with new developers contributing relatively standard, but high spec water efficient homes.

Depending on the success of the first step to neutrality, higher water neutrality scenarios could be aspired to by further developing policies and partnership working to deliver greater efficiencies.

5.8.8 Delivery Requirements – Policy

Milton Keynes Council has already included a requirement in the draft Plan:MK (Policy SC1) that all new developments incorporate water efficiency measures in order to limit water use to 110 l/h/d (as per the optional Building Regulations requirements); therefore, this policy element of the preferred strategy is in place. It is recommended that the Council consider ways to support developer implementation of this policy via information sources on their website. Measures can include (but not necessarily limited to) garden water butts, low flush toilets, low volume baths, aerated taps, and water efficient appliances.

5.8.9 Delivery Requirements – Partnership Approaches

Housing association partners should be targeted with a programme of retrofitting water efficient devices, to showcase the policy and promote the benefits. This should be a collaborative scheme between Milton Keynes Council, AWS, and Waterwise. In addition, Rainwater harvesting and/or greywater recycling schemes could be implemented into larger council owned and maintained buildings, such as schools or community centres. Rainwater harvesting could be introduced to public toilets.

The retrofitting scheme should then be extended to non-Council owned properties, via the promotion and education programme.

A programme of water audits should be carried out in existing domestic and non-domestic buildings, again showcased by council owned properties, to establish water usage and to make recommendations for improving water efficiency measures. The water audits should be followed up by retrofitting water efficient measures in these buildings, as discussed above. In private non-domestic buildings water audits and retrofitting should be funded by the asset owner, the cost of this could be offset by the financial savings resulting from the implementation of water efficient measures. Funding options for domestic properties are discussed above.

In order to ensure the uptake of retrofitting water efficient devices for non-council properties, the council should implement an awareness and education campaign, which could include the following:

- working with AWS to help with its water efficiency initiative, which has seen leaflets distributed directly to customers and at events across the region each year;
- a media campaign, with adverts/articles in local papers and features on a local news programme;
- a media campaign could be supplemented by promotional material, ranging from those that directly affect water use e.g. free cistern displacement devices, to products which will raise awareness e.g. fridge magnets with a water saving message;
- encouraging developers to provide new residents with 'welcome packs', explaining the importance of water efficiency and the steps that they can take to reduce water use;
- working with retailers to promote water efficient products;
- carrying out educational visits to schools and colleges, to raise awareness of water efficiency amongst children and young adults;
- working with neighbourhood trusts, community groups and local interest groups to raise awareness of water efficiency; and,
- carrying out home visits to householders to explain the benefits of saving water, this may not be possible for the general population of the Borough, but rather should be used to support a targeted scheme aimed at a specific residential group.

5.8.9.1 Responsibility

The recommendations above are targeted at Milton Keynes Council and AWS as these are the major stakeholders, although the Environment Agency and other statutory consultees can also influence future development to ensure the water neutrality target is achieved.

It is therefore suggested that responsibility for implementing water efficiency policies be shared as detailed in Table 5-6.

Table 5-6 Responsibility for implementing water efficiency

Responsibility	Responsible stakeholder
Ensure planning applications are compliant with the recommended policies	Milton Keynes Council
Fitting water efficient devices in accordance with policy	Developers
Provide guidance and if necessary enforce the installation of water efficient devices through the planning application process	Milton Keynes Council
Ensure continuing increases in the level of water meter penetration	AWS
Retrofit devices within council owned housing stock	Milton Keynes Council
Retrofit devices within privately owned housing stock (via section 106 agreements)	Developers
Promote water audits and set targets for the number of businesses that have water audits carried out. Allocate a specific individual or team within each of the local authorities to be responsible for promoting and undertaking water audits and ensuring the targets are met. The same team or individual could also act as a community liaison for households (council and privately owned) and businesses where water efficient devices are to be retrofitted, to ensure the occupants of the affected properties understand the need and mechanisms for water efficiency.	Milton Keynes Council
Educate and raise awareness of water efficiency	Milton Keynes Council, and AWS

A major aim of the education and awareness programmes is to change peoples' attitude to water use and water saving and to make the general population understand that it is everybody's responsibility to reduce water use. Studies have shown that the water efficiencies in existing housing stock achieved by behavioural changes, such as turning off the tap while brushing teeth or reducing shower time, can be as important as the installation of water efficient devices.

5.8.9.2 Retrofitting funding options

Water companies are embarking on retrofit as part of their response to meeting OFWAT's mandatory water efficiency targets. These programmes are funded out of operational expenditure. If a company has, or is forecasting, a supply-demand deficit over the planning period, water efficiency programmes can form part of a preferred option(s) set to overcome the deficit. However, these options are identified as part of the company's water resource management plans and will have to undergo a cost-benefit analysis.

Part 11 of the Planning Act 2008[31] (c. 29) ("the Act") provides a mechanism for the imposition of a charge on new developments to be known as the Community Infrastructure Levy (CIL). This is a local levy that authorities can choose to introduce to help fund infrastructure in their area. CIL will help pay for the infrastructure required to serve new development, and although CIL should not be used to remedy pre-existing deficiencies, if the new development makes the deficiency more severe than the use of CIL is appropriate.

Section 106 (S106) of the Town and Country Planning Act 1990[32] allows a local planning authority (LPA) to enter into a legally-binding agreement or planning obligation with a landowner in association with the granting of planning permission, known as a Section 106 Agreement. These agreements are a way of delivering or addressing matters that are necessary to make a development acceptable in planning terms. They are increasingly used to support the provision of services and infrastructure, such as highways, recreational facilities, education, health and affordable housing.

Milton Keynes Council could consider developer contributions through CIL, S106 agreements or even through development of an offset policy. However, there are considerable existing demands on developer contributions and it is unlikely that all of the retrofitting required in the Borough could be funded through these mechanism; they therefore need to look beyond developer contributions, possibly to the water companies, for further funding sources. Some councils offer council tax rebates to residents who install energy efficient measures (rebates jointly funded by the Council and Energy Company)[33]. Milton Keynes Council should consider a similar scheme, although this would require the agreement of AWS.

5.8.9.3 Retrofitting monitoring

During delivery stage, it will be important to ensure sufficient monitoring is in place to track the effects of retrofitting on reducing demand form existing housing stock. The latest research shows that retrofitting can have a significant beneficial effect and can be a cost effective way of managing the water supply-demand balance[34]. However, it is acknowledged that savings from retrofitting measures do diminish with time. This means that a long-term communication strategy is also needed to accompany any retrofit programme taken forward. This needs to be supported by monitoring, so that messages can be targeted and water savings maintained in the longer-term. The communication and monitoring message also applies to new builds to maintain continued use of water efficient fixtures and fittings.

[31] http://www.legislation.gov.uk/ukpga/2008/29/contents
[32] http://www.legislation.gov.uk/ukpga/1990/8/contents
[33] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010
[34] Waterwise (2011): Evidence base for large-scale water efficiency, Phase II Final report

6. Major Development Site Assessment

6.1 Introduction

Following the assessment of wastewater treatment capacity and water resources, this section of the WCS addresses infrastructure capacity issues, flood risk, surface water management and SuDS suitability for each of the major development sites (sites containing more than 10 dwellings). The results are presented for each of the major development sites in Appendix G.

6.2 Assessment Methodologies

6.2.1 Wastewater Network

The wastewater strategy to cater for growth requires an assessment of the capacity of the wastewater network (sewer system) to accept and transmit wastewater flows from the new development to the WRC for treatment.

The capacity of the existing sewer network is an important consideration for growth, as in some cases the existing system is already at, or over its design capacity. Further additions of wastewater from growth can result in sewer flooding in the system (affecting property or infrastructure) or can increase the frequency with which overflows to river systems occur, resulting in ecological impact and deterioration in water quality.

As the wastewater undertaker for the Borough, AWS has a general duty under Section 94 of the Water Industry Act 1991 to provide effectual drainage which includes providing additional capacity as and when required to accommodate planned development. However, this legal requirement must also be balanced with the price controls as set by the regulatory body OFWAT which ensure AWS has sufficient funds to finance its functions, and at the same time protect consumers' interests. The price controls affect the bills that customers pay and the sewerage services consumers receive, and ultimately ensure wastewater assets are managed and delivered efficiently.

Consequently, to avoid potential inefficient investment, AWS generally do not provide additional capacity until there is certainty that the development is due to commence. Where development proposals are likely to require additional capacity upgrades to accommodate new development flows, it is highly recommended that potential developers contact AWS as early as possible to confirm flow rates and intended connection points. This will ensure the provision of additional capacity is planned into AWS's investment programme to ensure development is not delayed.

AWS have undertaken an internal assessment of the capacity of the network system using local operational knowledge.

The results are presented for each of the Preferred Sites in Appendix G. A RAG assessment has been undertaken; a key indicating the coding applied to each assessment is provided in Table 6-1.

Table 6-1 Key for wastewater network RAG assessment

Capacity available to serve the proposed growth	**Infrastructure and/or treatment upgrades required to serve proposed growth or diversion of assets may be required**	**Major Constraints to provision of infrastructure and/or treatment to serve proposed growth**

6.2.2 Water supply network capacity

In addition to available water resources, there is a requirement to consider whether there is the infrastructure capacity to move water to where the demand will increase.

AWS have undertaken an assessment of the capacity of the water supply system using local operational knowledge. A RAG assessment has been undertaken; a key indicating the coding applied to each assessment is provided in Table 6-2.

Table 6-2 Key for water supply network RAG assessment

Capacity available to serve the proposed growth	**Infrastructure and/or treatment upgrades required to serve proposed growth or diversion of assets may be required**	**Major constraints to the provision of infrastructure and/or treatment to serve proposed growth**

6.2.3 Flood Risk

6.2.3.1 Fluvial

The flood risk to each of the major development sites has been considered using the Environment Agency Flood Maps for Planning. The percentage of development site area within each Flood Zone has been provided. The Milton Keynes Strategic Flood Risk Assessment (SFRA) (2015)[35] has also been used to help identify the risk of fluvial flooding at each development site.

6.2.3.2 Surface Water Flood Risk

Surface water flooding has been reviewed for each of the large development sites using the Risk of Flooding from Surface Water (RoFSW)[36] mapping produced by the Environment Agency.

6.2.4 Main Rivers and Ordinary Watercourses

6.2.4.1 Main Rivers

Under the Water Resources Act, the Environment Agency is the permitting Authority for work affecting main rivers, and certain activities or works in, over, under or near a main river or a flood defence associated with a main river will need a permit. A main river is a watercourse that is shown on a main river map and includes any structure or appliance for controlling or regulating the flow of water into, in or out of the channel. For certain activities, developers need to obtain an Environmental Permit (Flood Risk Activity Permit) from the Environment Agency to ensure that their activities do not cause or make existing flood risk worse, interfere with Environment Agency work, and do not adversely affect the local environment, fisheries or wildlife.

6.2.4.2 Ordinary Watercourses

Under the Flood and Water Management Act 2010 (FWMA) Milton Keynes Council is designated the LLFA, and has a duty to lead and coordinate the management of local flood risk, which includes flood risk from ordinary watercourses.

As of 6th April 2012 responsibility for the consenting of works by third parties on Ordinary watercourses under Section 23 of the Land Drainage Act 1991 (as amended by the Flood and Water Management Act 2010) transferred from the Environment Agency to the LLFA and Milton Keynes Council is now responsible for the consenting of works to ordinary watercourses and has powers to enforce un-consented and non-compliant works. This includes any works (including temporary) that will affect the cross sectional area of the channel (such as in channel structures or diversion of watercourses). It is advised that Milton Keynes Council is consulted early in the process of pursuing any proposed alterations.

6.2.4.3 Policy recommendations

The following policy recommendations are made with respect to sites which have a main river or ordinary watercourse flowing through or in close proximity to the site boundary:

- Watercourses should not be culverted or straightened, as these activities cause deterioration of their quality;
- Where watercourses have in the past been culverted or straightened, reinstatement to a more natural landscape should form part of the development;

[35] Milton Keynes Council (2015) Milton Keynes Level 1 Strategic Flood Risk Assessment. Available at https://www.milton-keynes.gov.uk/planning-and-building/urban-design-and-landscape-architecture-udla/flood-and-water-management-drainage?chapter=3

[36] Previously referred to as the updated Flood Map for Surface Water (uFMfSW)

- Each development should enhance the quality of the local watercourse, and
- For main rivers, a minimum easement of 8 meters from the top of bank of a main river is required to allow maintenance of the watercourse. For ordinary watercourses a minimum easement of 3 meters is required to allow for maintenance. Where possible a larger easement should be provided.

7. Water Cycle Strategy Recommendations and Policy

The following policy recommendations are made and should be considered by Milton Keynes Council to ensure that the Milton Keynes Local Plan considers potential limitations (and opportunities) presented by the water environment and water infrastructure on growth, and phasing of growth.

7.1 Policy Recommendations Overview

7.1.1 Wastewater

Major Development in the Cotton Valley, Olney and Newport-Pagnell catchments
It is recommended that the Council consider embedding a development control policy within their Local Plan that requires developers to provide evidence to them that they have both consulted with AWS regarding wastewater treatment capacity, and the outcome of this consultation, prior to development approval. The Council should consider the response from AWS when deciding if the expected timeframe for the development site in question is appropriate, and should also be taken into consideration for development of the Local Plan.

Where there is uncertainty from AWS that the necessary capacity is available, a Grampian condition could be imposed, prohibiting development authorised by the planning permission or other aspects linked to the planning permission (e.g. occupation of dwellings) until the provision of the necessary treatment infrastructure to accept the additional flows is in place.

Treatment Capacity Review
In addition to the Council publishing its Annual Monitoring Report (AMR) on the Council's website, it is recommended that Milton Keynes Council continues to consult with AWS on Local Plan proposals to ensure that plans for WRC upgrades in response to permit change requirements or flow capacity constraints take account of the most up to date planning position. In addition, it is recommended that Milton Keynes Council provide regular updates about the timing and delivery of strategic sites to AWS, which would assist AWS in planning where further investment in water recycling infrastructure is required to accommodate further growth. Further to this, all Major Development at sites which are located within the catchments of the WRCs assessed as Amber within this WCS should be subject to a pre-development enquiry[37] with AWS at an early stage, and if possible before submitting a planning application, to determine process capacity at the WRC prior to planning permission being granted.

Development and the Sewerage Network
It is recommended that Major Development sites assessed by AWS as part of the WCS as Amber or Red for wastewater network constraints should be subject to a pre-development enquiry[27] with the appropriate sewerage undertaker at an early stage, and if possible before submitting a planning application, to inform the asset management plans prior to planning permission being granted. Assessments made within this WCS consider each site in isolation and network capacity will change depending on when and where sites come forward.

Development Outside of the Borough
It is recommended that communication with neighbouring local authorities, as part of the Milton Keynes Council duty to co-operate, should continue to be pursued, to ensure that future WCS assessments closely represent the future growth scenarios at WRCs which receive growth from within and outside the Borough.

7.1.2 Water Supply

Water Efficiency Retrofitting
In order to move towards a more 'water neutral position' throughout the Borough, the Council should seek to advocate the achievement of further water efficiency savings through their planning policies and development management. This could be considered further through the preparation of the Local Plan. It is recommended that the Council adopts a facilitating role of encouraging private landlords, owner-occupiers and businesses to retrofit existing dwellings and non-domestic buildings with water efficient devices, where sufficient resources are available.

[37] Pre-development enquiries to AWS can be made via the Anglian Water website: http://www.anglianwater.co.uk/developers/pre-development.aspx

Water Supply Demand Balance
It is recommended that the Council continues to update AWS on future development phasing and changes to growth allocations via the Councils Annual Monitoring Reports, to ensure the future supply-demand balance can be appropriately captured in the next asset planning period (AMP7).

7.1.3 Surface Water Management and Flood Risk

SuDS and Green Infrastructure Policy FR2 of the draft Plan:MK covers the use of SuDS in mitigating the risk of flooding. It is recommended that developers should ensure linkage of SuDS in new development sites to provide environmental, biological, social and amenity value. SuDS design should maximise opportunities to create amenity, enhance biodiversity, and contribute to a network of green (and blue) open space. The Department for Environment, Food and Rural Affairs (Defra) funded Local Action Toolkit[38] can be applied to urbanised/urbanising environments to identify how SuDS and Green Infrastructure can be most effectively applied in a constrained urban setting, while also considering the benefits of biodiversity and natural capital.

SuDS and Water Efficiency
Developers should ensure linkage of SuDS to water efficiency measures where possible, including rainwater harvesting.

Linkages to SWMP and SFRA
Developers should ensure the design and long term maintenance of SuDS, supports the findings and recommendations of the Milton Keynes Level 1 SFRA (2015).

Sewer Separation
Developers should ensure foul and surface water from new development and redevelopment are kept separate where possible. Surface water should be discharged as high up the following hierarchy of drainage options as reasonably practicable, before a connection to the foul network is considered:

1. into the ground (infiltration);
2. to a surface waterbody;
3. to a surface water sewer or another drainage system; and
4. to a combined sewer.

Where sites which are currently connected to combined sewers are redeveloped, the opportunity to disconnect surface water and highway drainage from combined sewers must be taken. This approach will also aid in improving capacity constraints at WRCs.

Water Quality Improvements
Developers should ensure, where possible, that discharges of surface water are designed to deliver water quality improvements in the receiving watercourse or aquifer where possible to help meet the objectives of the Water Framework Directive.

7.1.4 Ecology

Biodiversity Enhancement
It is recommended that the Milton Keynes Council include a policy within its Local Plan which commits to seeking and securing (through planning permissions etc.) enhancements to aquatic biodiversity in the Borough through the use of SuDS (subject to appropriate project-level studies to confirm feasibility including environmental risk and discussion with relevant authorities).

7.2 Further Recommendations

Stakeholder Liaison
It is recommended that key partners involved in the development of the WCS maintain regular consultation with each other as development proposals progress.

[38] Available at: http://urbanwater-eco.services/

WCS Review

Development phasing and new sites should continue to be monitored by Milton Keynes Council when future development plans evolve via the Council's Annual Monitoring Reports, to enable continued assessment on water supply and wastewater treatment. Where growth is expected to be significant, the Council should consider carrying out an update to the WCS to account for additional growth. In any future updates to the WCS, note should be taken of changes to the various studies and plans that support it.

Appendix A Policy and Legislative Drivers Shaping the WCS

Directive/Legislation/Guidance	Description
Birds Directive 2009/147/EC	Provides for the designation of Special Protection Areas.
Building Regulations Approved Document G – sanitation, hot water safety and water efficiency (March 2010)	The current edition covers the standards required for cold water supply, water efficiency, hot water supply and systems, sanitary conveniences and washing facilities, bathrooms and kitchens and food preparation areas.
Eel Regulations 2009	Provides protection to the European eel during certain periods to prevent fishing and other detrimental impacts.
Environment Act 1995	Sets out the role and responsibility of the Environment Agency.
Environmental Protection Act 1990	Integrated Pollution Control (IPC) system for emissions to air, land and water.
Flood & Water Management Act 2010	The Flood and Water Management Act 2010 is the outcome of a thorough review of the responsibilities of regulators, local authorities, water companies and other stakeholders in the management of flood risk and the water industry in the UK. The Pitt Review of the 2007 flood was a major driver in the forming of the legislation. Its key features relevant to this WCS are: · To give the Environment Agency an overview of all flood and coastal erosion risk management and unitary and county councils the lead in managing the risk of all local floods. · To encourage the uptake of sustainable drainage systems by removing the automatic right to connect to sewers and providing for unitary and county councils to adopt SuDS for new developments and redevelopments. · To widen the list of uses of water that water companies can control during periods of water shortage, and enable Government to add to and remove uses from the list. · To enable water and sewerage companies to operate concessionary schemes for community groups on surface water drainage charges. · To make it easier for water and sewerage companies to develop and implement social tariffs where companies consider there is a good cause to do so, and in light of guidance that will be issued by the SoS following a full public consultation.
Future Water, February 2008	Sets the Government's vision for water in England to 2030. The strategy sets out an integrated approach to the sustainable management of all aspects of the water cycle, from rainfall and drainage, through to treatment and discharge, focusing on practical ways to achieve the vision to ensure sustainable use of water. The aim is to ensure sustainable delivery of water supplies, and help improve the water environment for future generations.
Groundwater Directive 80/68/EEC	To protect groundwater against pollution by 'List 1 and 2' Dangerous Substances.
Habitats Directive 92/44/EEC and Conservation of Habitats & Species Regulations 2010	To conserve the natural habitats and to conserve wild fauna and flora with the main aim to promote the maintenance of biodiversity taking account of social, economic, cultural and regional requirements. In relation to abstractions and discharges, can require changes to these through the Review of Consents (RoC) process if they are impacting on designated European Sites. Also the legislation that provides for the designation of Special Areas of Conservation provides special protection to certain non-avian species and sets out the requirement for Appropriate Assessment of projects and plans likely to have a significant effect on an internationally designated wildlife site.
Land Drainage Act 1991	Sets out the statutory roles and responsibilities of key organisations such as Internal Drainage Boards, local authorities, the Environment Agency and Riparian owners with jurisdiction over watercourses and land drainage infrastructure.
Making Space for Water, 2004	Outlines the Government's strategy for the next 20 years to implement a more holistic approach to managing flood and coastal erosion risks in England. The policy aims to reduce the threat of flooding to people and property, and to deliver the greatest environmental, social and economic benefit.
National Planning Policy Framework	Planning policy in the UK is set by the National Planning Policy Framework (NPPF). NPPF advises local authorities and others on planning policy and operation of the planning system. A WCS helps to balance the requirements of various planning policy documents, and ensure that land-use planning and water cycle infrastructure provision is sustainable.
Pollution Prevention and Control Act (PPCA) 1999	Implements the IPPC Directive. Replaces IPC with a Pollution Prevention and Control (PPC) system, which is similar but applies to a wider range of installations.
Ramsar Convention	Provides for the designation of wetlands of international importance

Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC	This Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. Its aim is to protect the environment from any adverse effects caused by the discharge of such waters.
Water Act 2003	Implements changes to the water abstraction management system and to regulatory arrangements to make water use more sustainable.
Water Framework Directive (WFD) 2000/60/EC	The WFD, for the first time, combines water quantity and water quality issues together. An integrated approach to the management of all freshwater bodies, groundwaters, estuaries and coastal waters at the river basin level has been adopted. The overall requirement of the directive is that all river basins must achieve 'Good ecological status' by 2015 or by 2027 if there are no grounds for derogation. The Environment Agency is the body responsible for the implementation of the WFD in the UK. The Environment Agency have been supported by UKTAG[39], an advisory body which has proposed water quality, ecology, water abstraction and river flow standards to be adopted in order to ensure that the water bodies in the UK (including groundwater) meet the required status[40]. Standards and waterbody classifications are published via River Management Plans (RBMP) the latest of which were completed in 2015.
Natural Environment & Rural Communities Act 2006	Covering Duties of public bodies – recognises that biodiversity is core to sustainable communities and that Public bodies have a statutory duty that states that "every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity
Water Resources Act 1991	Protection of the quantity and quality of water resources and aquatic habitats. Parts have been amended by the Water Act 2003.
Wildlife & Countryside Act 1981 (as amended)	**Legislation that provides for the protection and designation of SSSIs and specific protection for certain species of animal and plant among other provisions.**

[39] The UKTAG (UK Technical Advisory Group) is a working group of experts drawn from environment and conservation agencies. It was formed to provide technical advice to the UK's government administrations and its own member agencies. The UKTAG also includes representatives from the Republic of Ireland.
[40] UK Environmental Standards and Conditions (Phase I) Final Report, April 2008, UK Technical Advisory Group on the Water Framework Directive.

Appendix B Relevant Planning Documents to the WCS

Category	Author	Document Name	Publication Date
Water	Environment Agency	Anglian River Basin District. River Basin Management Plan	2015
Housing	Milton Keynes Council	Milton Keynes Strategic Housing Market Assessment	2017
Local Plan	Milton Keynes Council	Plan:MK. Draft for consultation	2017
Flood Risk	Milton Keynes Council	Milton Keynes Level 1 Strategic Flood Risk Assessment	2015
Water	Anglian Water Services	Anglian Water: Water Resources Management Plan	2015
Water	Scott Wilson, on behalf of Milton Keynes Council	Milton Keynes Council Outline Water Cycle Study	2008
Climate Change	Met Office	United Kingdom Climate Projections 2009 (UKCP09)	2009

Appendix C WRC Capacity Assessment Results

C.1 Modelling Software

Modelling of the quality permits required to meet the water quality objectives has been undertaken using RQP 2.5 (River Quality Planning), the Environment Agency's software for calculating permit conditions. The software is a monte-carlo based statistical tool that determines the statistical quality required from discharges in order to meet defined downstream targets, or to determine the impact of a discharge on downstream water quality compliance statistics.

It is recognised that RQP has limitations including:

- It can only calculate the river quality at the mixing point, and therefore the downstream sampling point (from which the waterbody status is defined) cannot easily be incorporated without some degree of uncertainty; and
- The tool is unable to assess the cumulative impact of growth of WRCs upstream of each other.

The methodology detailed in this appendix has been developed in order to minimise the effect of the limitations and thereby reducing the uncertainty in the results produced.

C.2 Input Data

Table C-1 RQP input data sources

WRC	Upstream river flow	Upstream river quality	WFD status derived from
Castlethorpe	Estimated using LowFlows Enterprise software	04M06 - R.TOVE BOZENHAM MILL	Overall waterbody River Tove (waterbody GB105033038180)
Cotton Valley	Estimated using LowFlows Enterprise software	05M03 - R.OUSE B526 RD.BR.NEWPORT PAGNELL	Overall waterbody Ouse (waterbody GB105033047923)
Hanslope	Estimated using LowFlows Enterprise software	04M06 - R.TOVE BOZENHAM MILL	Overall waterbody River Tove (waterbody GB105033038180)
Olney	Estimated using LowFlows Enterprise software	11M04 - R.OUSE OLNEY WEIR G/P (Monitoring ceased 2014, but no recent change expected)	Overall waterbody Ouse (waterbody GB105033047923)

C.3 Modelling assumptions

Several key assumptions have been used in water quality and permit modelling as follows:

WRC discharge flow

- WRC current flows were taken as the current measured dry weather flow (DWF) (mean) as provided by AWS;
- The wastewater generation per new household is based on an assumed Occupancy Rate (OR) of 2.42 people per house and an average consumption of 126 l/h/d with an additional allowance value of 25% of additional flow for an increase in infiltration and 16 l/h/d added to factor in employment; and
- WRC future flows were calculated by adding the volume of additional wastewater generated by new dwellings to the current observed DWF value.

WRC discharge quality

- The current discharge quality for each determinand (Ammonia, BOD and Phosphate) was calculated from the available WRC discharge quality monitoring data provided by the Environment Agency and current measured flow data provided by AWS;
- The future discharge quality for each determinand was calculated based on the available WRC discharge quality monitoring data provided by the Environment Agency and future flow data derived from current

measured flow data provided by AWS. Additional calculated flow to represent the proposed level of growth was also used;

- BOD and Ammonia discharge qualities have been reported as 95 percentiles (as per discharge permits);
- Phosphate discharge qualities have been reported as annual averages (as per discharge permits); and
- For the purposes of this study, the limits of conventionally applied treatment processes are considered to be:
  - 5mg/l 95%ile for BOD;
  - 1mg/l 95%ile for Ammoniacal-N; and
  - 0.25mg/l annual average for Phosphate.

River water quality

- River water quality monitoring data was provided by the Environment Agency;
- The Environment Agency provided the published 2016 WFD status for each downstream sampling point (status defined using water quality data collected between 2012 and 2014);
- BOD and Ammonia river water qualities have been reported as 90 percentiles; and
- Phosphate river water qualities have been reported as means.

C.4 Headroom Assessment

The permitted flow headroom capacity within an existing permit is assumed to be usable; therefore the following steps have been applied to calculate approximately how much available headroom each WRC has:

1. Determine the quantity of growth within a WRC catchment to determine the additional flow expected at each WRC;
2. Calculate the additional wastewater flow generated at each WRC;
3. Calculate the remaining permitted flow headroom at each WRC; and
4. Determine whether the growth can be accommodated within existing headroom by applying the scoping criteria detailed in Table C-2.

Table C-2 Scoping criteria

Scoped In	Scoped Out
WRCs where permitted flow headroom capacity is exceeded as a result of growth	-
WRCs which are already at or exceeded their permitted flow headroom capacity and will also receive additional flow from growth	WRCs which are already at or exceed their permitted flow headroom capacity but do not receive any addition al flow from growth
WRCs which remain within their permitted flow headroom But the total additional growth is >=10% of the WRCs permitted flow as monitored by the Environment Agency	WRCs which remain within their permitted flow headroom capacity but the total additional growth is <10% of the WRCs permitted flow [41]

[41] If a WRC does not receive any growth, the assessment for the WRC is not within the scope of a WCS.

C.5 Water Quality Modelling Methodology

For those WRCs which are scoped in, the following steps have been applied:

Baseline Review

Effect of Current Discharge By modelling the current WRC discharge flow (pre-growth) and measured discharge quality, does the current WRC discharge cause the river quality at the mixing point to fall below the status threshold?

Test 1-10% Deterioration

1a. Effect of current WRC discharge Modelling the current WRC discharge flow (pre-growth).	
1b. 10% deterioration limit Determine the 10% deterioration target for the 10% deterioration test.	
1c. 10% deterioration test Modelling of the future WRC discharge flow (post-growth) and 10% deterioration target, is the future permit technically feasible with conventional technology?	
Yes: Limiting deterioration to 10% is possible. A tighter permit and treatment upgrades using conventional technology will be required.	No: Limiting deterioration to 10% is not possible because the tighter permit cannot be achieved with conventional technology.

Test 2- Status Deterioration Target

2a. Current permit required to ensure no deterioration in status Modelling of the current WRC discharge flow (pre-growth) and current status, is the permit required technically feasible with conventional technology?	
2b. Future permit required to ensure no deterioration in status Modelling of the future WRC discharge flow (post-growth) and current status, is the permit required technically feasible with conventional technology?	
Yes: Ensuring no deterioration in status is possible. A tighter permit and treatment upgrades using conventional technology will be required.	No: Ensuring no deterioration in status is not possible because the tighter permit cannot be achieved with conventional technology. Therefore, growth may cause a deterioration in status, unless improvements in technology or non-conventional technologies are used. Test 4.- Maintain current quality test needs to be carried out

Test 3- Future Target Status Target

Applied where the receiving waterbody has a Future Target Status below Good status.

3a. Required discharge quality (Current) to achieve Future Target Status Modelling the current WRC discharge flow and permitted discharge quality, and assuming the upstream water quality is the midpoint of the future target status. Can the river quality achieve the target status at the mixing point now (pre-growth), with a technically feasible future permit and conventional technology?	
3b. Required discharge quality (Future) to achieve Future Target Status Modelling the future WRC discharge flow and permitted discharge quality, and assuming the upstream water quality is the midpoint of the future target status. Can the river quality achieve the future target status at the mixing point now (post-growth), with a technically feasible future permit and conventional technology?	
Yes: The Future Target Status can be achieved.	No: It is not possible to achieve the Future Target Status based on current discharge flow (pre-growth). Therefore it is not growth that would be preventing the Future Target Status from being achieved, but current limits in technology.

Test 4-Maintain Current Quality Target

4. Revised future permit required to maintain current quality Modelling of the future WRC discharge flow (post-growth) and current discharge quality, is the permit technically feasible with conventional technology to maintain current quality?	
Yes: maintaining current quality is possible. A tighter permit and treatment upgrades using conventional technology will be required.	No: maintaining current quality is not possible because the tighter permit cannot be achieved with conventional technology. Catchment modelling is required to provide sufficient confidence there will be no deterioration in status at the downstream sampling point.

C.6 Assessment Tables

Water Recycling Centre	Castlethorpe WRC			Cotton Valley WRC		
Is there flow headroom in the Permit? If so, what is the volume of flow headroom available after growth (m^3/d)	15 m3/d			16,589 m3/d		
Parameters considered	Ammonia (mg/l - 95%ile)	BOD (mg/l - 95%ile)	Phosphate (mg/l - mean)	Ammonia (mg/l - 95%ile)	BOD (mg/l - 95%ile)	Phosphate (mg/l - mean)
Permit condition	-	50	-	5	12	1
Limit of Conventional Treatment (LCT)	1	5	0.25	1	5	0.25
WFD receiving waterbody and ID	**Tove (DS Greens Norton) (GB105033038180)**			**Ouse (Newport Pagnell to Roxton) (GB105033047923)**		
Parameters considered	Ammonia (mgl - 90%ile)	BOD (mgl - 90%ile)	Phosphate (mgl - mean)	Ammonia (mgl - 90%ile)	BOD (mgl - 90%ile)	Phosphate (mgl - mean)
Receiving waterbody Quality Element Published Status (Cycle 2 - 2016)	**High**	**High**	**Poor**	**High**	**High**	**Poor**
Upstream sample point	**04M06 - R.TOVE BOZENHAM MILL**			**05M03 - R.OUSE B526 RD.BR.NEWPORT PAGNELL**		
Test 1 - 10% deterioration	Ammonia (mg/l)	BOD (mg/l)	Phosphate (mg/l)	Ammonia (mg/l)	BOD (mg/l)	Phosphate (mg/l)
Mixing Point Quality with current WRC flow (90 percentile Ammonia & BOD, annual average Phosphate)	0.18	2.02	0.5	0.71	2.46	0.55
Modelled status at mixing point with current flow	**High**	**High**	**Poor**	**Moderate**	**High**	**Poor**
10% deterioration limit (90 percentile Ammonia & BOD, annual average Phosphate)	0.20	2.22	0.55	0.78	2.71	0.61
Permit condition required to be within 10% deterioration target (95 percentile Ammonia & BOD, annual average Phosphate)	**20.77**	**157.58**	**26.25**	**3.37**	**7.09**	**2.58**
Test 2 - WFD Status: no deterioration (waterbody status)	Ammonia (mg/l)	BOD (mg/l)	Phosphate (mg/l)	Ammonia (mg/l)	BOD (mg/l)	Phosphate (mg/l)
Threshold at which status deterioration would occur (90 percentile Ammonia & BOD, annual average Phosphate)	0.30	4.00	1.058	0.30	4.00	1.057
Permit condition required at mixing point - current WRC flow (95 percentile Ammonia & BOD, annual average Phosphate)	**68.85**	**1148.70**	**253.91**	**1.25**	**17.74**	**5.79**
Permit condition required at mixing point - after growth (95 percentile Ammonia & BOD, annual average Phosphate)	**60.16**	**1003.7**	**221.7**	**1.08**	**15.84**	**4.94**
Maintain current quality	N/A - test not required	N/A - test not required	N/A - test not required	N/A - test not required	N/A - test not required	N/A - test not required
Test 3 - Future Status	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)
Is current status less than good for the quality element	No - test not required	No - test not required	Yes - Technically Infeasable	No - test not required	No - test not required	Yes -Test Required
Target future status (2016 Cycle 2 published status target)	N/A	N/A	**Moderate**	N/A	N/A	**Moderate**
Permit condition required - current WRC flow (95 percentile Ammonia & BOD, annual average Phosphate)			**58.78**			**0.89**
Permit condition required - after growth (95 percentile Ammonia & BOD, annual average Phosphate)			**51.32**			**0.76**
Will Growth prevent future target status	N/A	N/A	No	N/A	N/A	No
Key to 'Effluent Quality Required'	**Green Value – no change to current permit required**		**Amber Value – Permit tightening required, but within limits of conventionally applied treatment processes**		**Red Value – not achievable within limits of conventionally applied treatment processes**	

Water Recycling Centre	Hanslope WRC			Olney WRC		
Is there flow headroom in the Permit? If so, what is the volume of flow headroom available after growth (m^3/d)	32 m3/d			None (flow permit exceeded)		
Parameters considered	Ammonia (mg/l - 95%ile)	BOD (mg/l - 95%ile)	Phosphate (mg/l - mean)	Ammonia (mg/l - 95%ile)	BOD (mg/l - 95%ile)	Phosphate (mg/l - mean)
Permit condition	-	20	-	-	30	-
Limit of Conventional Treatment (LCT)	**1**	**5**	**0.25**	**1**	**5**	**0.25**
WFD receiving waterbody and ID	**Tove (DS Greens Norton) (GB105033038180)**			**Ouse (Newport Pagnell to Roxton) (GB105033047923)**		
Parameters considered	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)
Receiving waterbody Quality Element Published Status (Cycle 2 - 2016)	**High**	**High**	**Poor**	**High**	**High**	**Poor**
Upstream sample point	**04M06 - R.TOVE BOZENHAM MILL**			**11M04 - R.OUSE OLNEY WEIR G/P (Monitoring ceased 2014, but no recent change expected)**		
Test 1 - 10% deterioration	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)
Mixing Point Quality with current WRC flow (90 percentile Ammonia & BOD, annual average Phosphate)	0.17	2.02	0.52	0.18	2.27	0.3
Modelled status at mixing point with current flow	**High**	**High**	**Poor**	**High**	**High**	**Poor**
10% deterioration limit (90 percentile Ammonia & BOD, annual average Phosphate)	0.19	2.22	0.57	0.20	2.497	0.33
Permit condition required to be within 10% deterioration target (95 percentile Ammonia & BOD, annual average Phosphate)	**6.85**	**43.34**	**11.57**	**7.32**	**63.79**	**8.07**
Test 2 - WFD Status: no deterioration (waterbody status)	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)
Threshold at which status deterioration would occur (90 percentile Ammonia & BOD, annual average Phosphate)	0.30	4.00	1.058	0.30	4.00	1.064
Permit condition required at mixing point - current WRC flow (95 percentile Ammonia & BOD, annual average Phosphate)	**29.67**	**351.99**	**94.90**	**23.39**	**310.98**	**121.28**
Permit condition required at mixing point - after growth (95 percentile Ammonia & BOD, annual average Phosphate)	**22.56**	**268.26**	**72.15**	**20.50**	**272.04**	**106.17**
Maintain current quality	N/A - test not required	N/A - test not required	N/A - test not required	N/A - test not required	N/A - test not required	N/A - test not required
Test 3 - Future Status	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)	Ammonia 90%ile (mg/l)	BOD 90%ile (mg/l)	Phosphate mean (mg/l)
Is current status less than good for the quality element	No - test not required	No - test not required	Yes - Technically Infeasable	No - test not required	No - test not required	Yes - Test required
Target future status (2016 Cycle 2 published status target)	N/A	N/A	**Moderate**	N/A	N/A	**Moderate**
Permit condition required - current WRC flow (95 percentile Ammonia & BOD, annual average Phosphate)			**21.94**			**20.56**
Permit condition required - after growth (95 percentile Ammonia & BOD, annual average Phosphate)			**16.67**			**18.00**
Will Growth prevent future target status	N/A	N/A	No	N/A	N/A	No
Key to 'Effluent Quality Required'	**Green Value – no change to current permit required**		**Amber Value – Permit tightening required, but within limits of conventionally applied treatment processes**	**Red Value – not achievable within limits of conventionally applied treatment processes**		

Appendix D Water Neutrality

Water Neutrality is defined in Section 5.8 and the assumptions used outlined in Section 1.5. This appendix provides supplementary information and guidance behind the processes followed.

D.1 Twin-Track Approach

Attainment of water neutrality requires a 'twin track' approach whereby water demand in new development is minimised as far as possible. At the same time measures are taken, such as retrofitting of water efficient devices on existing homes and business to reduce water use in existing development.

In order to reduce water consumption and manage demand for the limited water resources within the study area, a number of measures and devices are available[42], including:

- cistern displacement devices;
- flow regulation;
- greywater recycling;
- low or variable flush replacement toilets;
- low flow showers;
- metering;
- point of use water heaters;
- pressure control;
- rainwater harvesting;
- variable tariffs;
- low flows taps;
- water audits;
- water butts;
- water efficient garden irrigation; and,
- water efficiency promotion and education.

The varying costs and space and design constraints of the above mean that they can be divided into two categories, measures that should be installed for new developments and those which can be retrofitted into existing properties. For example, due to economies of scale, to install a rainwater harvesting system is more cost effective when carried out on a large scale and it is therefore often incorporated into new build schools, hotels or other similar buildings. Rainwater harvesting is less well advanced as part of domestic new builds, as the payback periods are longer for smaller systems and there are maintenance issues. To retrofit a rainwater harvesting system can have very high installation costs, which reduces the feasibility of it.

However, there are a number of the measures listed above that can be easily and cheaply installed into existing properties, particularly if part of a large campaign targeted at a number of properties. Examples of these include the fitting of dual-flush toilets and low flow showers heads to social housing stock, as was successfully carried out in Preston by Reigate and Banstead Council in conjunction with Sutton and East Surrey Water and Waterwise[43].

D.2 The Pathway Concept

The term 'pathway' is used here as it is acknowledged that, to achieve any level of neutrality, a series of steps are required in order to go beyond the minimum starting point for water efficiency which is currently mandatory for new development under current and planned national planning policy and legislation.

There are no statutory requirements for new housing to have a low water use specification as previous government proposals to make different levels compulsory have been postponed pending government review. For non-domestic development, there is no statutory requirement to have a sustainability rating with the Building Research Establishment Environmental Assessment Method (BREEAM), only being mandatory where specified by a public body in England such as:

- Local Authorities incorporating environmental standards as part of supplementary planning guidance;
- NHS buildings for new buildings and refurbishments;
- Department for Children, Schools and Families for all projects valued at over £500K (primary schools) and £2million (secondary schools);

[42] Water Efficiency in the South East of England, Environment Agency, April 2007.
[43] Preston Water Efficiency Report, Waterwise, March 2009, www.waterwise.org.uk

- The Homes and Communities Agency for all new developments involving their land; and,
- Office of Government Commerce for all new buildings.

Therefore, other than potential local policies delivered through a Local Plan, the only water efficiency requirements for new development are through the Building Regulations[44] where new homes must be built to specification to restrict water use to 125l/h/d or 110l/h/d where the optional requirement applies. However, the key aim of the Localism Act is to decentralise power away from central government towards local authorities and the communities they serve. It therefore creates a stronger driver for local authorities to propose local policy to address specific local concerns.

In addition to the steps required in new local policy, the use of a pathway to describe the process of achieving water neutrality is also relevant to the other elements required to deliver it, as it describes the additional steps required beyond 'business as usual' that both developers and stakeholders with a role (or interest) in delivering water neutrality would need to take, for example:

- the steps required to deliver higher water efficiency levels on the ground (for the developers themselves); and,
- the partnership initiative that would be required beyond that normally undertaken by local authorities and water companies in order to minimise existing water use from the current housing and business stock.

Therefore, the pathway to neutrality described in this section of the WCS requires a series of steps covering:

- technological inputs in terms of physically delivering water efficiency measures on the ground;
- local planning policies which go beyond national guidance; and,
- partnership initiatives and partnership working.

The following sections outline the types of water efficiency measures which have been considered in developing the technological pathway for the water neutrality target scenarios.

D.3 Improving Efficiency in Existing Development

Metering

The installation of water meters in existing housing stock has the potential to generate significant water use reductions because it gives customers a financial incentive to reduce their water consumption. Being on a meter also encourages the installation and use of other water saving products, by introducing a financial incentive and introducing a price signal against which the payback time of new water efficiency measures can be assessed. Metering typically results in a 5-10 per cent reduction from unmetered supply, which equates to water savings of approximately 16l per person per day, assuming an occupancy rate of 2.43[45] for existing properties.

In 2009, DEFRA instructed Anna Walker (the Chair of the Office of Rail Regulation) to carry out an independent review of charging for household water and sewerage services (the Walker view)[46]. The typical savings in water bills of metered and unmetered households were compared by the Walker review, which gives an indication of the levels of water saving that can be expected (see Table D-1).

Table D-1: Change in typical metered and unmetered household bills

2009-10 Metered	2009-10 Unmetered	2014-15 Metered	2014-15 Unmetered	% change Metered	% change Unmetered
348	470	336	533	-3	13

Low or Variable Flush Toilets

Toilets use about 30 per cent of the total water used in a household[47]. An old style single flush toilet can use up to 13 litres of water in one flush. New, more water-efficient dual-flush toilets can use as little as 2.6 litres[48]per

[44] Part G of the Building Regulations
[45] Calculated by dividing the projected 2017 population number by the projected 2017 existing housing numbers for Milton Keynes.
[46] Independent Walker Review of Charging and Metering for Water and Sewerage services, DEFRA, 2009, http://www.defra.gov.uk/environment/quality/water/industry/walkerreview/
[47] http://www.waterwise.org.uk/reducing_water_wastage_in_the_uk/house_and_garden/toilet_flushing.html
[48] http://www.lecico.co.uk/

flush. A study carried out in 2000 by Southern Water and the Environment Agency[49] on 33 domestic properties in Sussex showed that the average dual flush saving observed during the trial was 27 per cent, equivalent to a volumetric saving of around 2.6 litres per flush. The study suggested that replacing existing toilets with low or variable flush alternatives could reduce the volume of water used for toilet flushing by approximately 27 per cent on average.

Cistern Displacement Devices
These are simple devices which are placed in the toilet cistern by the user, which displace water and therefore reduce the volume that is used with each flush. This can be easily installed by the householder and are very cheap to produce and supply. Water companies and environmental organisations often provide these for free.

Depending on the type of devices used (these can vary from a custom made device, such bag filled with material that expands on contact with water, to a household brick) the water savings can be up to 3 litres per flush.

Low Flow Taps and Showers
Flow reducing aerating taps and shower heads restrict the flow of water without reducing water pressure. Thames Water estimates that an aerating shower head can cut water use by 60 per cent with no loss of performance[50].

Pressure Control
Reducing pressure within the water supply network can be an effective method of reducing the volume of water supplied to customers. However, many modern appliances, such as Combi boilers, point of use water heaters and electric showers require a minimum water pressure to function. Careful monitoring of pressure is therefore required to ensure that a minimum water pressure is maintained. For areas which already experience low pressure (such as those areas with properties that are included on a water company's DG2 Register) this is not suitable. Limited data is available on the water savings that can be achieved from this method.

Variable tariffs
Variable tariffs can provide different incentives to customers and distribute a water company's costs across customers in different ways.

The Walker review assessed variable tariffs for water, including:

5. rising block tariff;
6. a declining block tariff;
7. a seasonal tariff; and,
8. time of day tariff.

A rising block tariff increases charges for each subsequent block of water used. This can raise the price of water to very high levels for customers whose water consumption is high, which gives a financial incentive to not to consume additional water (for discretionary use, for example) while still giving people access to low price water for essential use.

A declining block tariff decreases charges for each subsequent block of water used. This reflects the fact that the initial costs of supply are high, while additional supply has a marginal additional cost. This is designed to reduce bills for very high users and although it weakens incentives for them to reduce discretionary water use, in commercial tariffs it can reflect the economies of scale from bulk supplies.

A seasonal tariff reflects the additional costs of summer water supply and the fact that fixed costs are driven largely by the peak demand placed on the system, which is likely to be in the summer.

Time-of-day tariffs have a variable cost per unit supply according to the time of the day when the water is used; this requires smart meters. This type of charging reflects the cost of water supply and may reduce an individual household's bill; it may not reduce overall water use for a customer.

[49] The Water Efficiency of Retrofit Dual Flush Toilets, Southern Water/Environment Agency, December 2000
[50] http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/9047.htm

Water Efficient Appliances

Washing machines and dishwashers have become much more water efficient over the past twenty years; whereas an old washing machine may use up to 150 litres per cycle, modern efficient machines may use as little as 35 litres per cycle. An old dishwasher could use up to 50 litres per cycle, whereas modern models can use as little as 10 litres. However, this is partially offset by the increased frequency with which these are now used. It has been estimated[51] that dishwashers, together with the kitchen tap, account for about 8-14 per cent of water used in the home.

The Water Efficient Product Labelling Scheme provides information on the water efficiency of a product (such as washing machines) and allows the consumer to compare products and select the efficient product. The water savings from installation of water efficient appliances therefore vary, depending on the type of machine used.

Non-Domestic Properties

There is also the potential for considerable water savings in non-domestic properties; depending on the nature of the business water consumption may be high e.g. food processing businesses. Even in businesses where water use is not high, such as B1 Business or B8 Storage and Distribution, there is still the potential for water savings using the retrofitting measures listed above. Water audits are useful methods of identifying potential savings and implementation of measures and installation of water saving devices could be funded by the asset owner; this could be justified by significant financial savings which can be achieved through implementation of water efficient measures. Non-domestic buildings such as warehouses and large scale commercial (e.g. supermarkets) property have significant scope for rainwater harvesting on large roof areas.

Water Efficiency in New Development

The use of efficient fixtures and fittings as described in above also apply to the specification of water use in the building of new homes. The simplest way of demonstrating the reductions that use of efficient fixtures and fitting has in new builds is to consider what is required in terms of installation of the fixtures and fittings at different ranges of specification to ensure attainment of building regulation and building regulation optional water use requirements. Part G of The Building Regulations 2010 has been used to develop these figures. For 80l/h/d and 62l/h/d houses, The Building Regulations Water Efficiency Calculator has been used in association with the Department of Communities and Local Government – Housing Standard Review (September 2014). These are shown below in Table D-2.

[51] Water Efficiency Retrofitting: A Best Practice Guide, Waterwise, 2009, www.waterwise.org.uk

Table D-2: Summary of water savings borne by water efficiency fixtures and fittings

Component	126 l/h/d Standard Home	Building Regulations 125 l/h/d	Building Regulations Optional Target 110 l/h/d	High 80 l/h/d	62 l/h/d (water recycling)
Toilet flushing	25.4	18.7 b	12.3 d	12.3 d	12.3 d
Taps	21.7 a	22.7 a	20.5 a	15.3 a	15.3 a
Shower	39.42	39.8	31.8	23.9	23.9
Bath	16.7f	18.5 c	17.0 f	14.5 h	14.5 h
Washing Machine	14.07	15.6	15.6	15.6	15.6
Dishwasher	3.7	4.1	4.1	4.1	4.1
Recycled water				-13.4 e	-26.8 g
External Use	5	5	5	0	0
Total per head	125.98	124.4	106.3	77.3	63.9
Total per household	304.3	300.6	256.8	186.8	154.4

- a Combines kitchen sink and wash hand basin
- b 6/4 litre dual-flush toilet (f) recycled water
- c 185 litre bath
- d 4/2.6 litre dual flush toilet
- e Rainwater harvesting for external and toilet use
- f 170 litre bath
- g Rainwater/greywater harvesting for toilet, external and washing machine
- h 145 litre bath

Table D-2 highlights that in order for high and very high efficiencies to be achieved for water use under 80 l/h/d; water re-use technology (rainwater harvesting and/or greywater recycling) needs to be incorporated into the development.

In using the BRE Water Demand Calculator[52], the experience of AECOM BREEAM assessors is that it is theoretically possible to get close to 80l/h/d through the use of fixture and fittings, but that this requires extremely high specification efficiency devices which are unlikely to be acceptable to the user and will either affect the saleability of new homes or result in the immediate replacement of the fixtures and fittings upon habitation. This includes baths at capacity below 120 litres, and shower heads with aeration which reduces the pressure sensation of the user. For this reason, it is not considered practical to suggest that 80l/h/d or lower can be reached without some form of water recycling.

Rainwater Harvesting

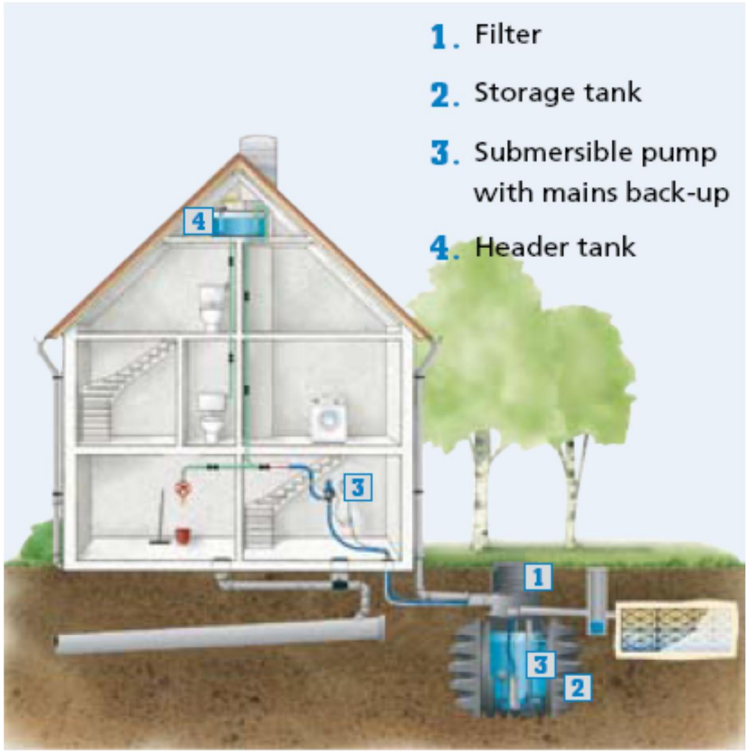
Rainwater harvesting (RWH) is the capture and storage of rain water that lands on the roof of a property. This can have the dual advantage of both reducing the volume of water leaving a site, thereby reducing surface water management requirements and potential flooding issues, and be a direct source of water, thereby reducing the amount of water that needs to be supplied to a property from the mains water system.

RWH systems typically consist of a collection area (usually a rooftop), a method of conveying the water to the storage tank (gutters, down spouts and pipes), a filtration and treatment system, a storage tank and a method of conveying the water from the storage container to the taps (pipes with pumped or gravity flow). A treatment system may be included, depending on the rainwater quality desired and the source. Figure D-1 below gives a diagrammatic representation of a typical domestic system[53].

[52] http://www.thewatercalculator.org.uk/faq.asp
[53] Source: Aquality Intelligent Water management, www.aqua-lity.co.uk

The level to which the rainwater is treated depends on the source of the rainwater and the purpose for which it has been collected. Rainwater is usually first filtered to remove larger debris such as leaves and grit. A second stage may also be incorporated into the holding tank; some systems contain biological treatment within the holding tank, or flow calming devices on the inlet and outlets that will allow heavier particles to sink to the bottom, with lighter debris and oils floating to the surface of the water. A floating extraction system can then allow the clean rainwater to be extracted from between these two layers[54].

Figure D-1: A typical domestic rainwater harvesting system



A recent sustainable water management strategy carried out for a proposed EcoTown development at Northstowe[55], approximately 10 km to the north west of Cambridge, calculated the size of rainwater storage that may be required for different occupant numbers, as shown below in Table D-3.

Table D-3: Rainwater Harvesting Systems Sizing

Number of occupants	Total water consumption	Roof area (m2)	Required storage tank (m3)	Potable water saving per head (l/d)	Water consumption with RWH (l/h/d)
1	110	13	0.44	15.4	94.6
1	110	10	0.44	12.1	97.9
1	110	25	0.88	30.8	79.2
1	110	50	1.32	57.2	52.8
2	220	25	0.88	15.4	94.6
2	220	50	1.76	30.8	79.2
3	330	25	1.32	9.9	100.1
3	330	50	1.32	19.8	90.2
4	440	25	1.76	7.7	102.3
4	440	50	1.76	15.4	94.6

A family of four, with an assumed roof area of 50m^3, could therefore expect to save 61.6 litres per day if a RWH system were installed.

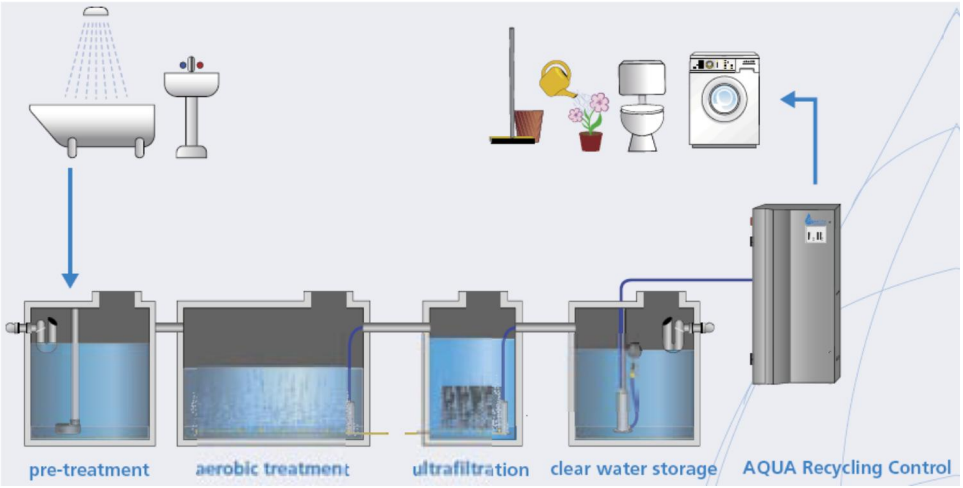
[54] Aquality Rainwater Harvesting brochure, 2008
[55] Sustainable water management strategy for Northstowe, WSP, December 2007

Greywater Recycling

Greywater recycling (GWR) is the treatment and re-use of wastewater from shower, bath and sinks for use again within a property where potable quality water is not essential e.g. toilet flushing. Recycled greywater is not suitable for human consumption or for irrigating plants or crops that are intended for human consumption. The source of greywater should be selected by available volumes and pollution levels, which often rules out the use of kitchen and clothes washing waste water as these tend to be most highly polluted. However, in larger system virtually all non-toilet sources can be used, subject to appropriate treatment.

The storage volumes required for GWR are usually smaller than those required for rainwater harvesting as the supply of greywater is more reliable than rainfall. In domestic situations, greywater production often exceeds demand and a correctly designed system can therefore cope with high demand application and irregular use, such as garden irrigation. Figure D-2 below gives a diagrammatic representation of a typical domestic system[56].

Figure D-2: A typical domestic greywater recycling system



Combined rainwater harvesting and greywater recycling systems can be particularly effective, with the use of rainwater supplementing greywater flows at peak demand times (e.g. morning and evenings).

The Northstowe sustainable water management strategy calculated the volumes of water that could be made available from the use GWR. These were assessed against water demand calculated using the BRE Water Demand Calculator[57].

Table D-4 demonstrates the water savings that can be achieved by GWR. If the toilet and washing machine are connected to the GWR system a saving of 37 litres per person per day can be achieved.

Table D-4: Potential water savings from greywater recycling

Appliance	Demand with Efficiencies (l/h/day)	Potential Source	Greywater Required (l/h/day)	Out As	Greywater available (80% efficiency) (l/h/day)	Consumptions with GWR (l/h/day)
Toilet	15	Grey	15	Sewage	0	0
Wash hand basin	9	Potable	0	Grey	7	9
Shower	23	Potable	0	Grey	18	23
Bath	15	Potable	0	Grey	12	15
Kitchen Sink	21	Potable	0	Sewage	0	21
Washing Machine	17	Grey	17	Sewage	0	0
Dishwasher	4	Potable	0	Sewage	0	4
TOTAL	103		31		37	72

[56] Source: Aquality Intelligent Water management, www.aqua-lity.co.uk
[57] http://www.thewatercalculator.org.uk/faq.asp

The treatment requirements of the GWR system will vary, as water which is to be used for flushing the toilet does not need to be treated to the same standard as that which is to be used for the washing machine. The source of the greywater also greatly affects the type of treatment required. Greywater from a washing machine may contain suspended solids, organic matter, oils and grease, detergents (including nitrates and Phosphates) and bleach. Greywater from a dishwasher could have a similar composition, although the proportion of fats, oils and grease is likely to be higher; similarly for wastewater from a kitchen sink. Wastewater from a bath or shower will contain suspended solids, organic matter (hair and skin), soap and detergents. All wastewater will contain bacteria, although the risk of infection from this is considered to be low[58].

Treatment systems for GWR are usually of the following four types:

- basic (e.g. coarse filtration and disinfection);
- chemical (e.g. flocculation);
- physical (e.g. sand filters or membrane filtration and reverse osmosis); and,
- biological (e.g. aerated filters or membrane bioreactors).

Table D-5 below gives further detail on the measures required in new builds and from retrofitting, including assumptions on the predicted uptake of retrofitting from the existing housing and commercial building use.

[58] Centre for the Built Environment, www.cbe.org.uk

Table D-5: Water Neutrality Scenarios – specific requirements for each scenario

WN Scenario	New development requirement			Retrofitting existing development	
	New development Water use target (l/h/d)	Water Efficient Fixtures and Fittings	Water Recycling technology	Metering Penetration assumption	Water Efficient Fixtures and Fittings
Low (Building Regulations)	125	- WC 6/4 litres dual flush or - 4.5 litres single flush - Shower 10 l/min - Bath 185 litres - Basin taps 6 l/min - Sink taps 8 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	None	87.6%	None
Low (Building Regulations + Retrofit)	125	- WC 6/4 litres dual flush or - 4.5 litres single flush - Shower 10 l/min - Bath 185 litres - Basin taps 6 l/min - Sink taps 8 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	None	87.6%	10% take up across study area: - WC 6/4 litres dual flush or - 4.5 litres single flush - Shower 10 l/min - Basin taps 6 l/min - Sink taps 8 l/min
Medium (Building Regulations Optional Requirement)	110	- WC 4/2.6 litres dual flush - Shower 8 l/min - Bath 170 litres - Basin taps 5 l/min - Sink taps 6 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	None	87.6%	None
Medium (Building Regulations Optional Requirement + Retrofit)	110	- WC 4/2.6 litres dual flush - Shower 8 l/min - Bath 170 litres - Basin taps 5 l/min - Sink taps 6 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	None	87.6%	15% take up across study area: - WC 4/2.6 litres dual flush - Shower 8 l/min - Basin taps 5 l/min - Sink taps 6 l/min
High	80	- WC 4/2.6 litres dual flush;	Rainwater harvesting	97.5%	25% take up across study area:

WN Scenario	New development requirement			Retrofitting existing development	
	New development Water use target (l/h/d)	Water Efficient Fixtures and Fittings	Water Recycling technology	Metering Penetration assumption	Water Efficient Fixtures and Fittings
		- Shower 6 l/min - Bath 145 litres - Basin taps 2 l/min - Sink taps 4 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram			- WC 4/2.6 litres dual flush; - Shower 6 l/min - Basin taps 2 l/min - Sink taps 4 l/min
Very High	62	- WC 4/2.6 litres dual flush; - Shower 6 l/min - Bath 145 litres - Basin taps 2 l/min - Sink taps 4 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	Rainwater harvesting and Greywater recycling	100%	40% take up across study area: - WC 4/2.6 litres dual flush; - Shower 6 l/min - Basin taps 2 l/min - Sink taps 4 l/min

D.4 Financial Cost Considerations for Water Neutrality scenarios

The financial cost of delivering the technological requirements of each neutrality scenario have been calculated from available research and published documents.

New Build Costs

The Department for Communities and Local Government (DCLG) published the Housing Standards Review in September 2014. A cost impacts report[59] formed part of this publication, providing the costs of the proposed standards, including the proposed Building Regulations optional requirement water efficiency standard.

Costs for water efficiency in new property have been provided based on homes achieving different code levels under the CSH based on the cost analysis undertaken by DCLG and as set out in Table D-6.

Table D-6: Building Regulation Specification and costs

	1B Apartment	2B Apartment	2B Terrace	3B Semi-detached	4B Detached
Cost all dwellings (extra over usual industry practice)					
Water, Code Level 1	-	-	-	-	-
Water, Code Level 2	-	-	-	-	-
Water, Code Level 3	£6	£6	£6	£9	£9
Water, Code Level 4	£6	£6	£6	£9	£9
Water, Code Level 5	£900	£900	£2,201	£2,697	£2,697
Water, Code Level 6	£900	£900	£2,201	£2,697	£2,697
Alternative standards					
Rainwater only	£887	£887	£2,181	£2,674	£2,674

An additional cost was required for the 'very high' neutrality scenario that included for greywater recycling as well as rainwater harvesting and this is detailed in the following section.

Water Recycling

Research into the financial costs of installing and operating GWR systems gives a range of values, as show in Table D-7.

59 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/353387/021c_Cost_Report_11th_Sept_2014_FINAL.pdf

Table D-7: Costs of greywater recycling systems

Cost	Cost	Comments
Installation cost	£1,750	Cost of reaching Code Level 5/6 for water consumption in a 2-bed flat[60]
	£2,000	For a single dwelling[61]
	£800	Cost per house for a communal system[62]
	£2,650	Cost of reaching Code Level 3/4 for water consumption in a 3-bed semi-detached house[63]
Operation of GWR	£30 per annum[64]	
Replacement costs	£3,000 to replace23	It is assumed a replacement system will be required every 25 years

There is less research and evidence relating to the cost of community scale systems compared to individual household systems, but it is thought that economies of scale will mean than larger scale systems will be cheaper to install than those for individual properties. As shown above, the Cost review of the Code for Sustainable Homes indicated that the cost of installing a GWR system in flats is less than the cost for a semi-detached house. Similarly, the Water Efficient Buildings website estimates the cost of installing a GWR system to be £2,000 for a single dwelling and £800 per property for a share of a communal system.

As it is not possible to determine how many of the outstanding housing developments in Colchester Borough will be of a size large enough to consider communal recycling facilities, an approximation has been made of an average per house cost (£1,400) using the cost of a single dwelling (at £2,000) and cost for communal (at £800). This has been used for the assessment of cost for a greywater system in a new property required for the 'very high' neutrality scenario.

Installing a Meter

The cost of installing a water meter has been assumed to be £500 per property. It is assumed that the replacement costs will be the same as the installation costs (£500), and that meters would need to be replaced every 15 years.

Retrofitting of Water Efficient Devices

Findings from the Environment Agency report Water Efficiency in the South East of England, costs have been used as a guide to potential costs of retrofitting of water efficient fixtures and fittings and are presented in Table D-8 below.

Table D-8: Water saving methods

Water Saving Method	Approximate Cost per House (£)	Comments/Uncertainty
Variable flush retrofit toilets	£50 - £140	Low cost for 4-6 litre system and high cost for 2.6-4 litre system. Needs incentive to replace old toilets with low flush toilets.
Low flow shower head scheme	£15 - £50	Low cost for low spec shower head; high costs for high spec. Cannot be used with electric, power or low pressure gravity fed systems.
Aerating taps	£10 - £20	Low cost is med spec, high cost is high spec.

Toilet cistern displacement devices are often supplied free of charge by water companies and this is therefore also not considered to be an additional cost.

[60] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008
[61] http://www.water-efficient-buildings.org.uk/?page_id=1056
[62] http://www.water-efficient-buildings.org.uk/?page_id=1056
[63] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008
[64] Environment Agency Publication - Science Report – SC070010, Greenhouse Gas Emissions of Water Supply and Demand Management Options, 2008

Appendix E Designated Site Background Detail

E.1 Harrold Odell Country Park Local Nature Reserve

The Harrold-Odell Country Park is owned and managed by Bedford Borough Council and contains 58 hectares of land including river meadows, woodland and two lakes. The River Great Ouse also runs through the park. The Park contains over 160 species of birds including greylag geese and rarer visitors such as bittern and little egret. The lakes are an important habitat for wildlife with the Grebe Lake and River Great Ouse supporting terns and kingfishers. Waders and birds of prey are also regular visitors.

The nature reserve supports numerous species of wildflowers including bee, common spotted and marsh orchids. The park supports a range of mammals including fox, weasel, shrew, rabbits as well as otters. The woodlands also support populations of bats.

E.2 Felmersham Gravel Pits Site of Special Scientific Interest

Felmersham gravel pits is located on River Gravels between Sharnbrook and Felmersham, this site consists of a series of flooded pits which were active until about 1945. The gravel pits are approximately 21.64 hectares in size. The SSSI contains several habitats including tall fen communities, open water, neutral grassland, scrub and broadleaved woodland. This variety of habitat supports a very diverse flora, including several species rare and declining in the county and an exceptionally high number of dragonfly species.

The SSSI contains locally rare water-plants, whorled water-milfoil Myriophyllum verticillatum and bladderwort Utricularia australis are recorded for this site.

Additional habitats are provided by the recent development of scrub and broadleaved woodland. These habitats are dominated by willows, alder and hawthorn with occasional field maple , ash and wild cherry. Common spotted orchid Dactylorhiza fuchsii and broadleaved helleborine Epipactis helleborine are included in the ground flora.

E.3 Stevington Marsh Site of Special Scientific Interest

Stevington Marshes are situated next to the River Great Ouse about 9 km north-west of Bedford. They have developed below a spring line formed at a juncture of the underlying Greater Oolite and are a unique feature in the county. The site is important not only for supporting wetland communities, a habitat uncommon in Bedfordshire and much reduced in extent and quality nationally, but also the surrounding pastures of Jurassic Limestone grassland which are very restricted in distribution throughout eastern England. The marshes and surrounding pastures, together with the river which has retained a natural character with deep pools and shallow riffles and supports a characteristic lowland river plant community, represent a rich combination of wildlife habitats; few such areas remain along the county's river valleys.

The site comprises a section of the river Great Ouse and the adjacent meadows which overly the oolitic limestone and slope down steeply to the river. A series of small marshes, which vary in character, have developed along the spring line. The most extensive marsh, with its associated spring-fed stream, is particularly distinctive being largely dominated by great horsetail Equisetum telmateia. The adjacent meadows support areas of herb-rich calcareous grassland which merge into the marshy grassland.

Appendix F Reason for Alternative Objective

Where certain conditions apply and are met then alternative WFD objectives have been set by the Environment Agency for water bodies; these involve taking an extended time period to reach the objective or meeting a lower status or a combination of both. In some water bodies it is recognised that time constraints on putting actions in place, or the time taken for the environment to respond once actions are implemented, mean that the objective will only be achieved over more than one river basin management planning cycle. An objective of less than good status is set where:

- there is currently no solution to the problem;
- the costs of taking action exceed the benefits; and/or
- background conditions in the environment mean achieving good status is not possible.

F.1 Justification for alternative Ecological Status Objective

Section 5.4 of the Anglian RBMP Part 2: River basin management planning overview and additional information[65] sets out the specific circumstances for the particular elements and the justification behind the alternative objective. The individual sub-elements and the alternative objectives for each waterbody are set out in Table F-1 below.

Table F-1: Alternative objectives for each waterbody

Waterbody	Element	Alternative objective for 2021 and 2027
Ouse	Phosphate	Poor
Tove	Phosphate	Moderate

The reason the alternative objective has been set is described as '**Technically infeasible – No known technical solution is available'**.

The explanation for the use of this exemption, as detailed in Table 6 of the Anglian RBMP, is provided below.

This reason has been used to justify setting less stringent objectives for water bodies under Article 4(5) and in a limited number of cases it has been used to justify extending the deadline for achieving protected area objectives under Article 4(4).

As well as being applied where there is no known practical technique for making the necessary improvement, this reason has also been used in cases where:

- *techniques are under development but are not yet known to be effective in practice*
- *there is a known technical solution but that solution cannot be applied in a specific location due to specific local conditions*

Phosphate[66]
In England it is generally currently considered to be technically infeasible to build a sewage treatment works that will reduce Phosphate in discharges to less than 0.5mg/l.

If a waterbody requires discharges of less than 0.5mg/l Phosphate to achieve good status then this reason has been used to justify a less stringent objective under Article 4(5).

The exemptions apply to the Phosphate and the impacted biological elements such as phytobenthos and macrophytes.

[65] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/500573/Part_2_River_basin_management_planning_process_overview_and_additional_information.pdf
[66] Alternative objectives reported in the current RBMP will be reassessed based on the new TAL of 0.25 mg/l, but will not be reported until the next RBMP in 2021.Therefore, the WCS has used the extant objectives.

Trials are underway involving water and sewerage companies to investigate sewage treatment technologies that could be used to reduce Phosphate below 0.5 mg/l. The trials will determine how effective these technologies are and are due to be completed by 2017. The results of the trials will inform the review and update of River Basin Management Plans in 2021.

This exemption has been used when the environmental and socioeconomic needs served by the sewage treatment works to dispose of sewage cannot be achieved by other means which are a significantly better environmental option not entailing disproportionate costs, as required by article 4(5)(a).

Appendix G Development Site Assessment

Site Details				Wastewater and Water Supply			Flood Risk						
Site reference	Site Name	Locality	Total Dwellings	Catchment	Wastewater Network Constraints	Water Supply Network Constraints	Flood Zone 1 (%)	Flood Zone 2 (%)	Flood Zone 3 (%)	High SW Flood Risk (%)	Medium SW Flood Risk (%)	Low SW Flood Risk (%)	No SW Flood Risk (%)
C1		BROOKLANDS	1,549	Cotton Valley		Offsite mains reinforcements required	85	2	14	3	3	15	79
C2		BROUGHTON	224	Cotton Valley		Offsite mains reinforcements required	93	4	3	1	2	10	88
C3	BROUGHTON ATTERBURY (former employment allocation)	BROUGHTON	130	Cotton Valley			100	0	0	0	0	4	95
C4		KINGSMEAD SUMMARY	353	Cotton Valley		Offsite mains reinforcements required	100	0	0	3	2	8	87
C5		TATTENHOE PARK SUMMARY	1,009	Cotton Valley		Offsite mains reinforcements required	100	0	0	1	1	4	94
C6		WEA SUMMARY	6009	Cotton Valley		Offsite mains reinforcements required	100	0	0	2	1	7	90
C7		SLA	3079	Cotton Valley		Offsite mains reinforcements required	100	0	0	3	3	13	82
C8		ASHLAND SUMMARY	34	Cotton Valley			100	0	0	1	2	14	84
C9		OAKGROVE SUMMARY	278	Cotton Valley		Offsite mains reinforcements required	94	2	4	1	1	12	86
C10		OXLEY PARK SUMMARY	122	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	1	3	96
C11		NEWTON LEYS SUMMARY	661	Cotton Valley		Offsite mains reinforcements required	94	1	5	2	1	8	90
C12	YMCA REDEVELOPMENT	CENTRAL MILTON KEYNES	261	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	1	5	94
C13	LAND AT 809 TO 811 SILBURY BOULEVARD	CENTRAL MILTON KEYNES	139	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	0	100
C14	SITE B1.1	CENTRAL MILTON KEYNES	24	Cotton Valley			100	0	0	0	9	22	69
C15	CAMPBELL PARK REMAINDER	CAMPBELL PARK	1500	Cotton Valley		Offsite mains reinforcements required	100	0	0	1	1	6	91
C16	BLOCKS 14A AND 14B	CAMPBELL PARK	40	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	7	93
C17	CANALSIDE - MARINA	CAMPBELL PARK	380	Cotton Valley		Offsite mains reinforcements required	100	0	0	1	0	13	85
C18	PHEONIX LODGE	MIDDLETON	21	Cotton Valley		Offsite mains reinforcements required	100	0	0	1	2	9	88
C19	SITE 4, VERNIER CRESESNT	MEDBOURNE	10	Cotton Valley			100	0	0	0	5	11	84
C20	LAND NORTH OF VERNIER CRESCENT (SAP5)	MEDBOURNE	14	Cotton Valley			100	0	0	0	0	0	100
C21	RESERVE SITE 3	WESTCROFT	22	Cotton Valley			100	0	0	0	1	1	98
C22	RESERVE SITE OFF HENDRIX DRIVE	CROWNHILL	10	Cotton Valley			100	0	0	0	0	20	80
C23	RESERVE SITE (off Nicholson Grove)	GRANGE FARM	19	Cotton Valley			100	0	0	2	2	8	88
C24	LAND OFF SINGLETON DRIVE (SAP3)	GRANGE FARM	22	Cotton Valley			100	0	0	0	0	1	99
C25	LILLESHALL AVENUE	MONKSTON	24	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	0	100
C26	LAND OFF LADBROKE GROVE (SAP21)	MONKSTON PARK	25	Cotton Valley			100	0	0	0	0	5	95
C27	RESERVE SITES A & D HINDHEAD KNOLL	WALNUT TREE	25	Cotton Valley		Offsite mains reinforcements required	100	0	0	2	1	20	78
C28	LAND AT BERGAMOT GARDENS (SAP8)	WALNUT TREE	15	Cotton Valley			100	0	0	0	0	1	99
C29	76 TO 83 SHEARMANS	FULLERS SLADE	14	Cotton Valley			100	0	0	0	0	9	91
C30	SUFFOLK PUNCH SITE	HEELANDS	27	Cotton Valley			100	0	0	0	0	0	100
C31	LAND AT OUR LADY OF LOURDES CHURCH (SAP 1)	COFFE HALL	11	Cotton Valley			100	0	0	0	0	0	100
C32	GURNARDS AVENUE (SAP6)	FISHERMEAD	14	Cotton Valley			100	0	0	0	0	1	99
C33	LAND OFF HANPSTEAD GATE (SAP12)	BRADWELL COMMON	16	Cotton Valley			100	0	0	0	0	2	98
C34	LAND OFF HARROWDEN (SAP14)	BRADVILLE	27	Cotton Valley			100	0	0	10	16	36	38
C35	MANIFOLD LANE (SAP16)	SHENLEY BROOK END	18	Cotton Valley			100	0	0	0	3	16	81
C36	LAND AT TOWERGATE, GROVEWAY (SAP18)	WAVENDON GATE	150	Cotton Valley			100	0	0	0	2	13	85
C37	LAND AT WALTON MANOR, GROVEWAY/SIMPSON ROAD (SAP19)	WALTON MANOR	135	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	4	96
C38	5 AND 6 COPPERHOUSE COURT	CALDECOTTE	11	Cotton Valley			100	0	0	0	0	0	100
C39	82 TO 84 NEWPORT ROAD	NEW BRADWELL	34	Cotton Valley			100	0	0	0	10	63	27
C40	STRATFORD HOUSE	STONY STRATFORD	13	Cotton Valley			53	16	31	0	2	7	92
C41	AGORA REDEVELOPMENT	WOLVERTON	100	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	13	87
C42	RAILCARE MAINTENANCE DEPOT, STRATFORD ROAD	WOLVERTON	375	Cotton Valley		Offsite mains reinforcements required	100	0	0	5	11	27	57
C43	EATON LEYS	BLETCHLEY	600	Cotton Valley		Offsite mains reinforcements required	91	1	9	5	2	12	81
C44	LEISURE CENTRE PHASE 2	BLETCHLEY	50	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	2	34	64
C45	OFF PENN ROAD	BLETCHLEY	39	Cotton Valley			100	0	0	2	2	21	75

Site Details				Wastewater and Water Supply			Flood Risk						
Site reference	Site Name	Locality	Total Dwellings	Catchment	Wastewater Network Constraints	Water Supply Network Constraints	Flood Zone 1 (%)	Flood Zone 2 (%)	Flood Zone 3 (%)	High SW Flood Risk (%)	Medium SW Flood Risk (%)	Low SW Flood Risk (%)	No SW Flood Risk (%)
C46	LATHAMS BUILDBASE	BLETCHLEY	75	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	0	100
C47	25 to 27 AYLESBURY STREET	BLETCHLEY	14	Cotton Valley			100	0	0	0	0	0	100
C48	7 & 7A AYLESBURY STREET	BLETCHLEY	14	Cotton Valley			100	0	0	0	0	0	100
C49	LAND AT SKEW BRIDGE COTTAGE, DRAYTON ROAD	BLETCHLEY	10	Cotton Valley			100	0	0	0	0	0	100
C50	SW OF BWMC, DUNCOMBE STREET	BLETCHLEY	12	Cotton Valley			100	0	0	0	0	4	96
C51	LAKES ESTATE NEIGHBOURHOOD PLAN SITES	BLETCHLEY	130	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	0	100
C52	LAND TO SOUTH OF PRINCES WAY & WEST OF ALBERT STREET	BLETCHLEY	184	Cotton Valley			100	0	0	2	2	10	87
C53	LAND EAST OF TILLBROOK FARM	BOW BRICKHILL	36	Cotton Valley			100	0	0	0	0	2	98
C54	BLIND POND FARM, WOBURN SANDS ROAD	BOW BRICKHILL	14	Cotton Valley			100	0	0	0	0	0	100
C55	POLICE STATION HOUSES, HIGH STREET	NEWPORT PAGNELL	14	Newport Pagnell			51	48	1	0	0	17	83
C56	TICKFORD FIELDS	NEWPORT PAGNELL	1200	Cotton Valley		Offsite mains reinforcements required	86	6	8	4	3	14	79
C57	NETWORK HOUSE	NEWPORT PAGNELL	73	Newport Pagnell		Offsite mains reinforcements required	100	0	0	1	1	6	93
C58	FORMER ASTON MARTIN/TESCO SITE	NEWPORT PAGNELL	86	Newport Pagnell		Offsite mains reinforcements required	99	1	0	0	1	4	95
C59	FORMER EMPLOYMENT ALLOCATION PHASE 1	OLNEY	33	Olney		Offsite mains reinforcements required	100	0	0	3	11	29	58
C60	FORMER EMPLOYMENT ALLOCATION PHASE 2	OLNEY	33	Olney		Offsite mains reinforcements required	100	0	0	12	3	30	55
C61	LAND OFF EAST ST	OLNEY	14	Olney			100	0	0	0	0	10	90
C62	OLNEY NEIGHBOURHOOD PLAN SITES	OLNEY	250	Olney		Offsite mains reinforcements required	90	8	3	1	1	7	91
C63	LAND SOUTH OF LAVENDON ROAD FARM	OLNEY	50	Olney		Offsite mains reinforcements required	100	0	0	0	0	0	100
C64	NAMPAK	WOBURN SANDS	95	Cotton Valley			100	0	0	0	0	5	95
C65	GREENS HOTEL	WOBURN SANDS	9	Cotton Valley			100	0	0	0	15	25	61
C66	FROSTS GARDEN CENTRE, WAIN CLOSE	WAVENDON	53	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	2	98
C67	LAND NORTH OF WAVENDON BUSINESS PARK	WAVENDON	134	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	1	98
C68	LAND BETWEEN 36 AND 38 LONG STREET ROAD	HANSLOPE	12	Hanslope			100	0	0	1	1	6	92
C69	CASTLETHORPE ROAD	HANSLOPE	150	Hanslope		Offsite mains reinforcements required	100	0	0	0	0	0	100
C70	LAND WEST OF HIGH STREET	SHERINGTON	36	Sherington			100	0	0	0	1	2	97
C71	MALTINGS FIELD	CASTLETHORPE	30	Castlethorpe			100	0	0	0	0	2	98
C72	TOWERGATE HOUSE, 352 AVEBURY BOULEVARD	CENTRAL MILTON KEYNES	32	Cotton Valley			100	0	0	0	0	0	100
C73	TERNION COURT	CENTRAL MILTON KEYNES	23	Cotton Valley			100	0	0	0	0	1	99
C74	BRICKHILL HOUSE 1ST & 2ND FLOORS	CENTRAL MILTON KEYNES	10	Cotton Valley			100	0	0	0	0	0	100
C75	GRANT THORNTON HOUSE, 210 SILBURY	CENTRAL MILTON KEYNES	35	Cotton Valley			100	0	0	0	0	0	100
C76	MILBURN AVENUE	OLDBROOK	14	Cotton Valley			100	0	0	0	0	0	100
C77	CLYDE HOUSE	OLDBROOK	24	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	1	98
C78	18A ST GEORGES ROAD	BLETCHLEY	10	Cotton Valley			100	0	0	0	0	1	99
C79	QUEENSWAY HOUSE	BLETCHLEY	28	Cotton Valley			100	0	0	0	0	18	82
C80	MAYBROOK HOUSE	BLETCHLEY	13	Cotton Valley			100	0	0	0	0	0	100
C81	86 TO 96 QUEENSWAY	BLETCHLEY	10	Cotton Valley			100	0	0	0	0	0	100
R1		East of M1	3200	Cotton Valley		Offsite mains reinforcements required	85	5	11	4	3	15	79
U1	Cavendish Site	Fullers Slade	37	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	0	100
U2	Southern Windemere Drive	Lakes Estate	11	Cotton Valley			100	0	0	0	0	0	100
U3	Former MFI Store	Bletchley	28	Cotton Valley			100	0	0	0	0	2	98
U4	Wellington Place Car Park	Bletchley	11	Cotton Valley			100	0	0	0	16	80	3
U5	Phelps Road	Bletchley	11	Cotton Valley			100	0	0	0	0	1	99
U6	Chepstow Drive	Bletchley	11	Cotton Valley			100	0	0	0	0	0	100
U7	S of Vernier Crescent	Medbourne	18	Cotton Valley			100	0	0	6	6	24	64
U8	Independent School	Shenley Church End	50	Cotton Valley		Offsite mains reinforcements required	100	0	0	8	3	24	65

Site Details				Wastewater and Water Supply			Flood Risk						
Site reference	Site Name	Locality	Total Dwellings	Catchment	Wastewater Network Constraints	Water Supply Network Constraints	Flood Zone 1 (%)	Flood Zone 2 (%)	Flood Zone 3 (%)	High SW Flood Risk (%)	Medium SW Flood Risk (%)	Low SW Flood Risk (%)	No SW Flood Risk (%)
U9	Springfield Bouelvard 1	Springfield	15	Cotton Valley			100	0	0	0	0	0	100
U10	High Street	Stony Stratford	24	Cotton Valley		Offsite mains reinforcements required	40	43	17	0	0	14	86
U11	Howe Rock Place	Tattenhoe	17	Cotton Valley			100	0	0	0	0	0	100
U12	Winfold Lane	Tattenhoe	24	Cotton Valley			100	0	0	0	0	0	100
U13	Holborn Crescent	Tattenhoe	12	Cotton Valley			100	0	0	0	3	8	89
U14	R/O Morrisons	Westcroft	25	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	3	97
U15	Powis Lane	Westcroft	24	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	7	93
U16	Site C	Caldecotte	67	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	3	5	92
U17	Redbridge	Stantonbury	19	Cotton Valley			100	0	0	0	0	0	100
U18	Rowle Close	Stantonbury	18	Cotton Valley			100	0	0	0	0	0	100
U19	Berwick Drive	West Bletchley	16	Cotton Valley			100	0	0	33	9	78	-20
U20	Kellan Drive 1	Fishermead	10	Cotton Valley			100	0	0	0	0	0	100
U21	Coltsfoot Place	Conniburrow	18	Cotton Valley			100	0	0	0	0	0	100
U22	Timbold Drive	Kents Hill Park	150	Cotton Valley			100	0	0	0	0	8	91
U23	Isaacson Drive	Wavendon Gate	14	Cotton Valley			100	0	0	0	0	6	94
U24	Byrd Crescent	Old Farm Park	25	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	0	100
U25	Hockcliffe Brae	Walnut Tree	35	Cotton Valley		Offsite mains reinforcements required	78	17	5	2	1	5	93
U26	Lichfield Down	Walnut Tree	19	Cotton Valley			92	0	8	0	0	3	97
U27	Lindisfarne Drive	Monkston	20	Cotton Valley			100	0	0	0	3	59	38
U28	Wadhurst Lane	Monkston	17	Cotton Valley			100	0	0	0	0	1	99
U29	E of John Lewis Car Park	CMK	93	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	1	5	95
U30	Wyevale Garden Centre	CMK	162	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	0	100
U31	R/O Central Library	CMK	98	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	1	99
U32	R/O Saxon Court	CMK	85	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	1	5	94
U33	R/O Westminster House	CMK	63	Cotton Valley			100	0	0	0	0	0	100
U34	C4.2	CMK	93	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	0	100
U35	D3.4	CMK	250	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	1	99
U36	C3.2	CMK	135	Cotton Valley		Offsite mains reinforcements required	100	0	0	5	8	32	55
U37	C3.3	CMK	113	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	7	93
U38	Food Centre	CMK	298	Cotton Valley		Offsite mains reinforcements required	100	0	0	4	3	5	87
U39	F4.3	Campbell Park	51	Cotton Valley		Offsite mains reinforcements required	100	0	0	4	3	35	59
U40	G4.1	Campbell Park	141	Cotton Valley		Offsite mains reinforcements required	100	0	0	7	4	18	71
U41	G4.2	Campbell Park	202	Cotton Valley		Offsite mains reinforcements required	100	0	0	2	1	8	89
U42	G4.3	Campbell Park	166	Cotton Valley		Offsite mains reinforcements required	100	0	0	7	3	18	71
SG1	South East MK	Strategic Site	1000	Cotton Valley		Offsite mains reinforcements required	100	0	0	2	4	10	85
SG2	South East MK	Strategic Site	2000	Cotton Valley			100	0	0	2	1	7	91
EU1	Pavilion	Furzton Lake	13	Cotton Valley			95	5	0	0	0	0	100
EU2	Milton Keynes Rugby Club	Greenleys	57	Cotton Valley			100	0	0	2	1	4	93
EU3	Frithwood Crescent	Kents Hill	19	Cotton Valley			100	0	0	0	0	0	100
EU4	Noon Layer Road	Middleton	34	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	0	100
EU5	Milton Keynes Music Service	Simpson	21	Cotton Valley			78	0	21	3	3	8	86
EU6	Marlborough Street	Peartree Bride	15	Cotton Valley			100	0	0	3	3	13	81
EU7	Briar Hill	Stacey Bushes	0	Cotton Valley			100	0	0	1	3	30	66
EU8	Tattenhoe Lane	West Bletchley	30	Cotton Valley		Offsite mains reinforcements required	100	0	0	5	11	24	60
EU9	Queen Eleanor Primary School	Stony Stratford	24	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	0	100

Site Details				Wastewater and Water Supply			Flood Risk						
Site reference	Site Name	Locality	Total Dwellings	Catchment	Wastewater Network Constraints	Water Supply Network Constraints	Flood Zone 1 (%)	Flood Zone 2 (%)	Flood Zone 3 (%)	High SW Flood Risk (%)	Medium SW Flood Risk (%)	Low SW Flood Risk (%)	No SW Flood Risk (%)
EU10	Simpson Road	Fenny Stratford	13	Cotton Valley			100	0	0	0	0	1	99
EU11	Brickhill Street	Willen	37	Cotton Valley			100	0	0	1	2	20	77
EU12	High Park Drive	Wolverton	68	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	0	100
EU13	Kirkstall Place	Oldbrook	13	Cotton Valley			100	0	0	0	0	0	100
EU14	Sutcliffe Avenue	Oldbrook	10	Cotton Valley			100	0	0	0	0	7	92
EU15	Denbigh Hall Drive	West Bletchley	43	Cotton Valley		Offsite mains reinforcements required	100	0	0	0	0	2	98
EU16	The Walnuts	Redhouse Park	67	Newport Pagnell-Lond			100	0	0	2	1	10	88
EU17	Independent School Site 2	Shenley Church End	36	Cotton Valley		Offsite mains reinforcements required	100	0	0	19	16	43	22

RAG Key

Red	Major Constraints to Provision of infrastructure and/or treatment to serve proposed growth
Amber	Infrastructure and/or treatment upgrades required to serve proposed growth or diversion of assets may be required
Green	Capacity available to serve the proposed growth

PLEASE READ

1. The information and RAG status for each proposed site has been assessed considering existing commitments but on an individual site basis. The cumulative impact from all of the proposed sites on the allocated treatment or network resource is not indicated by the RAG status. It should be noted therefore that the cumulative effect of all of the identified allocated sites may require enhancement to capacity.

2. Please note that where dwelling numbers have not been stated, capacity assessment has been based on a 30 properties per hectare.

3. Should all the available capacity be taken up at the WRC then upgrade to the works may be required that may involve seeking consent from the Environment Agency for an increase in discharge of final effluent.

4. All new development sites will reduce the wastewater network capacity. Therefore mitigation measures will be required to ensure flooding risk is not increased.

5. Available capacity in Foul Water networks will be determined by more detailed analysis. For developments of greater than 10 properties it is assumed that some enhancement to capacity may be required

6. Surface Water capacity has not been assessed. This reflects Anglian Water's preferred method of surface water disposal of using a sustainable drainage system (SuDS) with connection to sewer seen as the last option.