Milton Keynes- Integrated Water Management Study Phase 1

Final Report

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This report describes work commissioned by Milton Keynes City Council. Jessica Creber and Richard Pardoe of JBA Consulting carried out this work.

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Executive Summary

JBA was commissioned by Milton Keynes City Council (MKCC) to undertake an Integrated Water Management Study (IWMS) for the administrative area of Milton Keynes.

This report is the first stage in the IWMS. It sets out how Milton Keynes is expected to grow up to 2050 and agrees a set of objectives that can be used in assessing future water management options. Following the IWMS guidance developed by CIRIA, a baseline is presented showing Milton Keynes in the context of the wider catchment and presenting information on the status of water resources, wastewater infrastructure and water quality. An approach to quantifying integrated water management benefits was presented and a preliminary scoring of identified options undertaken.

Integrated Water Management (IWM) is focussed on creating a water management strategy beyond water itself and observing the interdisciplinary actions between energy, carbon, waste, biodiversity, agriculture, and ecosystem services.

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

New homes and employment land require the provision of clean water, safe disposal of wastewater and protection from flooding. The allocation of development in certain locations may result in the capacity of existing available infrastructure being exceeded, a situation that could potentially cause service failures to water and wastewater customers, adverse impacts to the environment, or high costs for the upgrade of water and wastewater assets being passed on to the bill payers.

In addition to increased demands from housing and employment development, future climate change presents further challenges to the existing water infrastructure network, including increased intensive rainfall events and a higher frequency of drought events. Sustainable planning for water must now take this into account.

The IWMS has been carried out in co-operation with Milton Keynes City Council, Anglian Water, and the neighbouring Local Planning Authorities (LPAs).

Baseline

Water resources

The whole of Milton Keynes is the Anglian Water (AW) supply area, within the Ruthamford Central Water Resource Zone (WRZ). This WRZ has no internal water sources and imports its water from Ruthamford North and Ruthamford South (which cover very small areas of the study area). To increase resilience to drought, water trading with Affinity Water is discussed within the WRMP. Both Ruthamford North and South have been identified as being at risk of climate change impacts in the future. As Ruthamford Central is supplied via transfer from this zones, Milton Keynes' water supply is vulnerable to the same climate

risks. Consequently, finding alternative water resources and increase water efficiency maybe important in the future to mitigate these risks.

Within AW's WRMP there is a focus on climate change resilience, the implementation of smart meters and working towards better pipe connections to increase water availability. The objective to increase water availability and water efficiency is mirrored in the Water Resource East (WRE) summary, with the goals for desalination, reservoir design and planning and water re-use. Affordability of bills and viability of housing are also discussed in the WRE report.

The Environment Agency have designated the whole of the Anglian Water region as under serious water stress. Within the Abstraction Licencing Strategy report, it is reported that water resources across the area have consumptive abstraction available less than 30% of the time. In two of the three groundwater management units, no water is available for new consumptive licensing meaning that future water abstraction needs to be carefully considered.

Within the development process, it is important that developers and other stakeholders such as MKCC, the Environment Agency (EA) and the Anglian Water work together to future proof homes and new developments, specifically in water stressed areas. This may include the incorporation of rainwater harvesting and greywater recycling which can lead to the conservation of potable water resources.

Wastewater

Anglian Water are the primary sewerage undertaker for the whole of Milton Keynes. Increased wastewater flows into the wastewater network due to growth in population can increase the pressure on existing infrastructure, increasing the risk of sewer flooding and where present increasing the risk of storm overflow operation. Headroom at Water Recycling Centres (WRCs) can be eroded by growth in population or per-capita consumption, requiring investment in additional treatment capacity.

The Environment Act requires water companies to report and monitor storm overflows as well as reduce the harm caused to the waterbodies they discharge to. Within Milton Keynes there are eleven network storm overflows and six storm tanks overflows located on the sewer network and at WRCs (based on 2022 EDM dataset). Only two network storm overflows and four storm tanks have monitoring data available. In all of these, the frequency of operations between 2020 and 2022 were below the threshold for further investigation by the EA. Whilst below the trigger for an investigation, in the longer term some storm overflows will require investment to meet the 2050 target of 10 or fewer operations per year.

There are opportunities through the planning system to ease pressure on the wastewater network by separating foul and storm flow in existing combined systems, and not allowing new surface water connections. Surface water can also be better managed by retrofitting SuDS in existing residential areas, and in new development, ensuring SuDS are incorporated into designs at the master planning stage to maximise the potential benefits. Redevelopment of brownfield sites with previously combined sewerage systems offer the potential to separate surface water from foul and reduce discharges from sewer overflows.

Location and removal of misconnections (where surface water drainage has been connected to foul sewers or vice versa) can also create headroom in the system and improve water quality.

Environmental permits are used alongside water quality limits as a means of controlling the pollutant load discharged from a water recycling centre to a receiving watercourse. A headroom assessment was carried out comparing the current discharge from each WRC in Milton Keynes to its permit value, taking into account growth already planned. There are 18 WRCs within or serving communities in Milton Keynes. Of these, six are expected to serve committed growth within the period of the adopted Local Plan.

Cotton Valley is the largest WRC in the region serving an estimated population of 313,130 in 2021. AW's DWMP states that they expect this to increase to 358,288 by 2050. This would still be well within the permit limit for the WRC.

Two WRCs (Castlethorpe and Hanslope) are close to, or likely to exceed their permit due to committed growth. Further development in these catchments would require an increase in their flow permit and / or upgrades to treatment processes.

Many of the WRCs outside of the City of Milton Keynes are small works and serve only a modest population. In some cases, they only have a descriptive permit, and others there is no flow data recorded. It is unlikely that they would be able to serve significant development without major upgrades.

Environmental

The latest Water Framework Directive assessment data shows that all the watercourses in the study area have moderate or poor status overall status. The EA reasons for not achieving good (RNAG) dataset indicates that the water industry (sewage discharges) and agriculture and rural land management (livestock, arable and land drainage) are the main reasons for watercourses not achieving good status in this area. Another principal source of pollution is from urban and highway runoff. This can be managed through design of new development and transport infrastructure including nature-based solutions.

Water Quality

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

A sensitivity analysis was carried out using the EA's SIMCAT water quality model. Growth in population was simulated by increasing the discharge from each WRC by 10%. Where water quality downstream of a WRC in any given determinand deteriorates by 10% or more in response to a 10% increase in effluent flow, the sewer catchment can be said to be “more sensitive” to changes in effluent flow, and therefore growth. Where the response is less than 10% the watercourse can be said to be "less sensitive".

The analysis suggested that water courses in Milton Keynes may be less sensitive to increases in effluent flow.

Water balance

Milton Keynes forms 80% of the water demand within Anglian Water's Ruthamford Central Water Resource Zone (WRZ). This zone is entirely supplied from external sources at present, and all wastewater is discharged to watercourses and flows out of the zone. There is no significant exploitation of local water resources or water recycling within the zone for public supply.

Ruthamford Central is one of only two zones in the Anglian Water supply area forecast to have higher demand by 2050, mainly because of the growth of Milton Keynes. The draft Water Resources Management Plan 2024 proposes to meet that growing demand primarily through additional inward transfers of water, facilitated by a new storage reservoir in south Lincolnshire and new pipelines to supply water around the Anglian Water region. Demand management will also contribute to meeting the supply-demand balance by 2050.

Preliminary options assessment

The potential for integrated water management options to deliver against a range of objectives set out in the MK Strategy for 2050 was assessed using a Multi-Objective Decision Analysis (MODA) approach. The main conclusions from this assessment are:

- The scoring at this stage is unweighted, i.e., each objective is given equal weighting. This should be revisited at stage 2.
- The most beneficial options are blue infrastructure and SuDs.

The option with the lowest overall score is leakage reduction. This should not be considered an indication that this is not a valuable option, simply that it is an option with narrowly focussed benefits.

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Abbreviations

1D	One Dimensional (modelling)
AMP	Asset Management Plan
BNG	Biodiversity Net Gain
BOD	Biological Oxygen Demand
CAMS	Catchment Abstraction Management Strategy
CCTV	Closed Circuit Television
CFMP	Catchment Flood Management Plan
CIRIA	Company providing research and training in the construction industry
CIWEM	The Chartered Institution of Water & Environmental Management
CSO	Combined Sewer Overflow
DEFRA	Department of the Environment, Food and Rural Affairs (formerly MAFF)
DS	Downstream
EA	Environment Agency
EC	European Community
EN	English Nature
FRA	Flood Risk Assessment
GI	Ground Investigations
GIS	Geographical Information System
GWMU	Groundwater management unit
HOF	Hands-off flow: river flow below which an abstractor may be required to stop or reduce abstraction
ID	Identifier
JNCC	Joint Nature Conservation Committee
LNR	Local Nature Reserve
LPA	Local Planning Authority
NERC	Natural Environment Research Council
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
PE	Potential Evaporation
PM	Project Manager
PPG	Planning Policy Guidance
PR	Percentage Runoff
Ramsar	The intergovernmental Convention on Wetlands, signed in Ramsar, Iran, in 1971

RBMP	River Basin Management Plan
SAC	Special Area of Conservation, protected under the EU Habitats Directive
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area for birds, protected under the EU Habitats Directive
SSSI	Site of Special Scientific Interest
STW	Sewage Treatment Works
UKWIR	UK Water Industry Research Ltd
US	Upstream
WFD	Water Framework Directive

1 Introduction

1.1 Terms of Reference

JBA Consulting was commissioned by Milton Keynes City Council (MKCC) to undertake an Integrated Water Management Study (IWMS) and a Strategic Flood Risk Assessment (SFRA) for the administrative area of Milton Keynes. The purpose of an IWMS is to form part of a comprehensive and robust evidence base for the preparation of the MK City Plan 2050 to aid in coordinating development and management of water to help in the sustainable building of developments and inform current decision-making processes where appropriate.

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

1.2 Integrated Water Management

The Chartered Institution of Water and Environmental Management (CIWEM) define Integrated Water Management (IWM) as:

"…the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems".

(CIWEM, 2011)

IWM is focussed on creating a water management strategy beyond water itself and observing the interdisciplinary actions between energy, carbon, waste, biodiversity, agriculture, and ecosystem services.

IWMSs emphasise new skills and technologies focusing on restoring ecosystems, mitigating floods, and working towards long term adaptation and planning in water management. This is achieved by taking a holistic approach and considering concepts such as the circular economy and Nature Based Solutions (NBS).

Alongside this report other studies have been commissioned by Milton Keynes City Council such as:

- Land Availability Assessment and Site Selection Work
- Carbon and Climate study
- Nature, Green and Blue Infrastructure Study
- MK Infrastructure Study
- Local Nature Recovery Strategy

The resulting evidence base is intended to support Milton Keynes towards their 2050 sustainability strategy.

1.3 Benefits of IWM

Integrated Water Management (IWM) is known to combine multiple agendas such as cutting carbon emissions and biodiversity net gain. This can help save money, time, and engage a wider range of stakeholders. By engaging stakeholders, it can help with long term planning, resources, and create new innovative ideas producing a broader view of water management.

Benefits of IWM include:

- thinking beyond water into other topics such as carbon, waste, and biodiversity;
- giving a wider perspective looking at the advantages of managing the wider water system;
- can lead to cost savings;
- can be used to restore ecosystems;
- allowing the opportunity for new skills to manage the environment; and
- encourages a wider involvement of all stakeholders putting in place options for the long-term.

(CIWEM, 2011)

Overall, IWM is broader than just water management. It considers benefits to communities by creating opportunities for sustainable living such as reducing consumption of resources and considering factors such as biodiversity net gain and carbon neutrality.

1.3.1 Best practice in IWM

The UK Government guidance on Water Cycle Studies and Integrated Water Management points to the Construction Industry Research and Information Association (CIRIA) guidance: Delivering better water management through the planning system.

The guidance explains the role of effective strategies and local plan policies that should be underpinned by effective engagement and evidence. The guidance also demonstrates how the application of critical success factors, combined with good policies can deliver good water management outcomes.

Four stages to IWM are outlined (reproduced from CIRIA C787):

Baseline

Define the water management baseline conditions, including opportunities and challenges related to physical situations, existing infrastructure, and environmental constraints. This should include:

- Environmental context and constraints
- Constraints of existing and future water supply and wastewater infrastructure

- Flood risk parameters
- Opportunities created by regeneration
- A review of proposed housing and employment numbers

Water balance

Based on the extent of the expected development, the water balance (or water cycle) for baseline (current) and future conditions (post development) is determined, to show how water flows in and out of the area will change with time, and how different inflows and outflows of water can be used and managed efficiently within the development. Components of the water cycle flows include:

- Rainfall
- Surface water runoff from roofs and other impermeable surfaces
- Evapotranspiration
- Infiltration
- Potable and non-potable water consumption
- Greywater (wastewater from hand basins, baths, and showers)
- Blackwater (wastewater from kitchen and laundry use - generally with a higher level of contamination).

Options appraisal and strategy development

This stage of the IWMS integrates the outputs of the baseline assessment with the calculated water balance to identify the IWMS objectives and develop a range of effective measures that can be applied across the area covered by the IWMS. These are:

- Establish options through a review of a range of water management and flood risk measures that can be implemented in combination to meet the IWMS objectives.
- Develop a preferred strategy for water and flood risk management through analysis of a range of option scenarios or combination of measures.

Strategy delivery and testing

The final stage sets out a high-level delivery plan and approach for delivering the preferred option. It provides recommendations on infrastructure delivery, funding mechanisms, and roles and responsibilities of key stakeholders in implementing the IWMS.

The plan identifies how the options identified for the IWMS area could be effectively procured, constructed, and maintained, and which parties might be best placed to deliver these. It should show how the benefits for the IWMS area are derived in terms of:

- Satisfying planning and regulatory requirements
- Optimising costs for the works
- Certainty of delivery of required works to meet the overall programme.
- Placing risk and associated responsibility with the party best placed to manage this effectively.

1.3.2 Good water management in the wider area

As seen in Figure 1.1, IWMSs and Water Cycle Studies (WCS) are influenced by national frameworks, regional plans, WRMPs and Local Plans. Local Plans, IWMSs and WCSs all help influence each other to reach a common agreed goal whereas in the case of WRMPs, IWMSs and WCSs use the information from the WRMP to help inform recommendations to LPAs and do not try to influence or change the water company's plan.

Although this is not a one-way system, any potential change within the higher levels of the water resource planning hierarchy needs to come from Local Plans, Water Companies and other stakeholders.

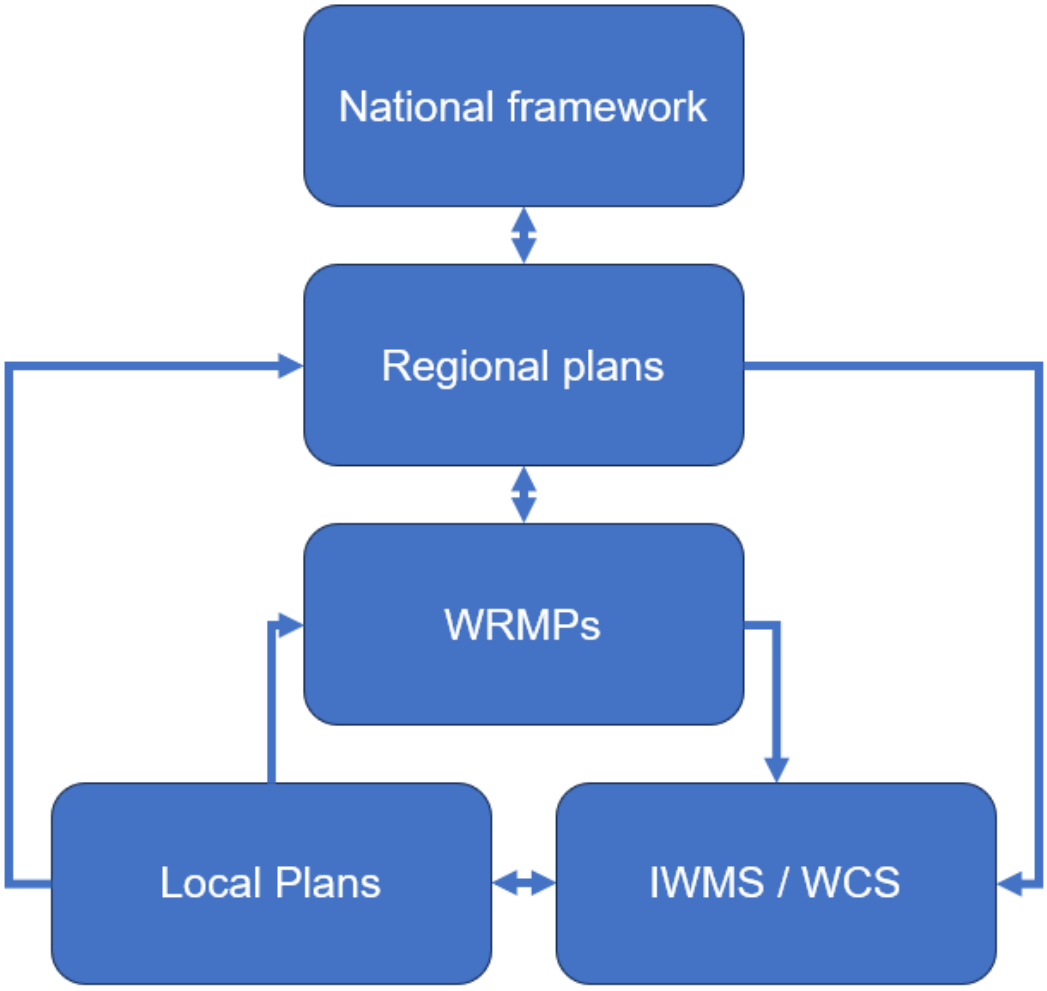


Figure 1.1 Water resource planning hierarchy

Within this IWMS water management is assessed at a local scale such as at the Local Planning Authority (LPA) level. Although it is acknowledged that Milton Keynes is just one of the pieces of the overall puzzle of regional water management, an assessment of the whole region is better carried out by stakeholders that often work at a regional level, such as those working with national frameworks or regional plans.

1.4 Structure of the IWMS

Section 2 - Vision for growth

This section outlines how Milton Keynes is expected to growth during the plan period. It goes on to define a set of objectives to be born in mind when considering measures within an IWMS.

Section 3 - Legislative and policy framework

Relevant national, regional, and local policies relating to environmental and water management are that should be considered by the LPA, water companies and developers. Key extracts from these policies relating to water consumption targets and mitigating the impacts on the water from the new development are summarised.

Section 4 - Baseline

Section four will set out the baseline information for the study area. This shows how Milton Keynes fits into the wider area and includes information on:

- geology
- surface waterbodies
- groundwater
- protected sites
- flood risk
- water resources
- wastewater

Programmes and plans such as the Water Industry National Environment Programme (WINEP), River Basin Management Plan (RBMP), and AW's Water Resources Management Plan (WRMP) have been used to inform this report. They have been presented in relation to Milton Keynes across this section 4 and section 5.

Section 5 - Water quality

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

Water sensitivity and an environmental sites assessment has been undertaken to understand whether any environmental sites may be at risk from a deterioration in water quality.

Surface water runoff from development sites can also impact water quality. This will be taken into account in Stage 2.

Section 6 - Water balance

Understanding supply and demand of water in an area helps anticipate the effects of future growth. The same can be said for understanding the pressures of climate change, future water efficiency measures and water reuse.

Section six lays out the water balance of the study area. This is the amount of water available from the catchment versus the demand of the population. Information on baseline supply and demand is presented from Anglian Waters Water Resource Management Plan (WRMP). Other sources of water and loss of water are discussed such as evapotranspiration and rainfall.

Section 7 - Approach to quantifying integrated water management benefits in spatial planning.

Multi-Objective Decision Analysis (MODA) is a method that allows decisions to be made whilst considering multiple factors, objectives, and trade-offs. This will compare options for water management and the high-level objectives discussed with MKCC represented using radar diagrams. By using MODA to analyse options it can help present which options are most effective in helping reach the high-level objectives presented in section 2.4.2.

Section 8 - Preliminary options scoring

Section eight presents the results of the MODA as well as case studies that show how the options presented have been applied elsewhere.

Section 9 - Conclusions and recommendations for stage 2

An outline of stage 2 will be presented, this includes details of how further analysis of water resources, wastewater management and water quality will take place.

1.5 Stakeholders

1.5.1 Overview

Within the study area, many parties have an interest in how water is managed, and are impacted by it, or are responsible for some aspect of it. The following section identifies these stakeholders and summarises their interest or responsibility. Engagement between stakeholders working in partnership allows the multiple benefits of IWM to be realised. The stakeholder analysis will be developed further in Stage 2.

1.5.2 Stakeholder Identification

Table 1.1 outlines the role of authorities responsible for water and wastewater management in Milton Keynes. In addition to this, other key stakeholders include:

- Local Planning Authority
- Local Lead Flood Authority (LLFA)
- The Parks Trust
- Developers
- Local community
- Local businesses
- Agriculture

Table 1.1 Responsibilities of authorities within Milton Keynes

Authority Name	Key Responsibilities
Environment Agency	The EA are the environmental regulator in the UK with responsibilities for water quality, flood risk and administering licences for water abstraction. They are a statutory consultee for many developments plan documents and for some planning applications. They advise on environmental and infrastructure capacity issues across the water cycle.
Natural England	Natural England are the Government's advisors on the natural environment, which they have a responsibility to protect and enhance. In a IWMS they may provide information on the conservation objectives, and guidance on, the protection of designated sites.
Anglian Water	Anglian Water is the sewerage undertaker and water supplier for the north-east of the district. It is worth noting that although Anglian Water is the water and sewage undertaker for Milton Keynes, there may be some private WRCs in the area as well as septic tanks and Package Treatment Plants (PTPs). As the water supplier for most of the district, they have a statutory duty under the Water Industry Act to maintain an efficient and economical system of water supply within its area and supply households with a reliable and sufficient supply of water.

Authority Name	Key Responsibilities
	Sewerage undertakers have a duty under the Water Industry Act to provide, improve and extend a system of public sewers (for both domestic and trade flows) so as to cleanse and maintain those sewers (and any lateral drain) to ensure that the area that they serve is effectually drained. There is also a duty to make provision for the emptying of those sewers, normally through sewage treatment works or where appropriate through discharges direct to watercourses. Anglian Water are involved in the operation of Milton Keynes' balancing lakes to avoid flood risk.
Developers	Changing the way in which water is managed and used within new developments requires the IWMS approach to be adopted, from an early stage, in masterplans, landscape design and building design. This requires engagement with the development industry.

2 Vision for growth

2.1 Milton Keynes Strategy for 2050

Milton Keynes adopted the Milton Keynes Strategy for 2050 in 2020. This sets out how the City of Milton Keynes will grow and develop over the plan period. Within this plan are seven "big ambitions" for the city:

- Strengthen those qualities that make Milton Keynes special.
- Make Milton Keynes a leading green and cultural city - by global standards.
- Ensure everyone has their own decent home to rent or buy.
- Build safe communities that support health and wellbeing.
- Provide jobs for everyone by supporting out businesses and attracting new ones.
- Offer better opportunities for everyone to learn and develop their skills.
- Make it easier for everyone to travel on foot by bike and with better public transport.

These ambitions were considered further when setting the objectives for the IWMS in section 2.4.2.

The specific ambitions relating to integrated water management in the adopted Plan:MK 2016-31 and the Strategy for 2050 are compared in Appendix A, which includes recommendations for policies in the emerging plan.

2.2 Components of development forecast

2.2.1 Overview

For the purpose of the assessments within the IWMS, a baseline growth forecast is defined for development in Milton Keynes over the Local Plan period. This forecast is made up of the following components:

- Initial site assessment (that will inform the Land Availability Assessment) (LAA)
- Commitments (development sites already in the planning system, but not yet built)
- Windfall
- Neighbouring authority growth

2.2.2 LAA

The Milton Keynes City Council (MKCC) Land Availability Assessment (LAA) is an important piece of evidence in preparing local plans and identifies possible sites for future housing and economic development. It also contains an assessment of development potential, suitability, likelihood, and timing of development. It does not determine whether a site should be allocated; this decision remains part of the local planning process.

2.2.3 Growth in Milton Keynes

The current Local Plan covers the period from 2019 (2016 to 2031). To assess the impact of longer term growth on water infrastructure and the environment, existing growth commitments and allocations from the adopted Local Plan (2016 to 2031) need to be understood, see overall growth in Table 2.1 and overall commitments in Figure 2.1. MKCC provided:

- Residential commitments
- Employment commitments
- Proposed additional employment allocations.

Within the Milton Keynes 2016-2031 plan, a minimum goal of 26,500 new homes was laid out in areas adjacent and within the city. Milton Keynes City Council will provide land for a minimum of 30,900 homes and a buffer of 10% (2,650) (Milton Keynes Council, 2019).

Table 2.1 Overall growth in Milton Keynes

Type of Growth	Number of Houses	Employment floorspace (m^2)
Residential Allocations	1,778	N/a
Residential Commitments	25,215	N/a
Employment Allocations	N/a	714,325
Employment Commitments	N/a	254,400

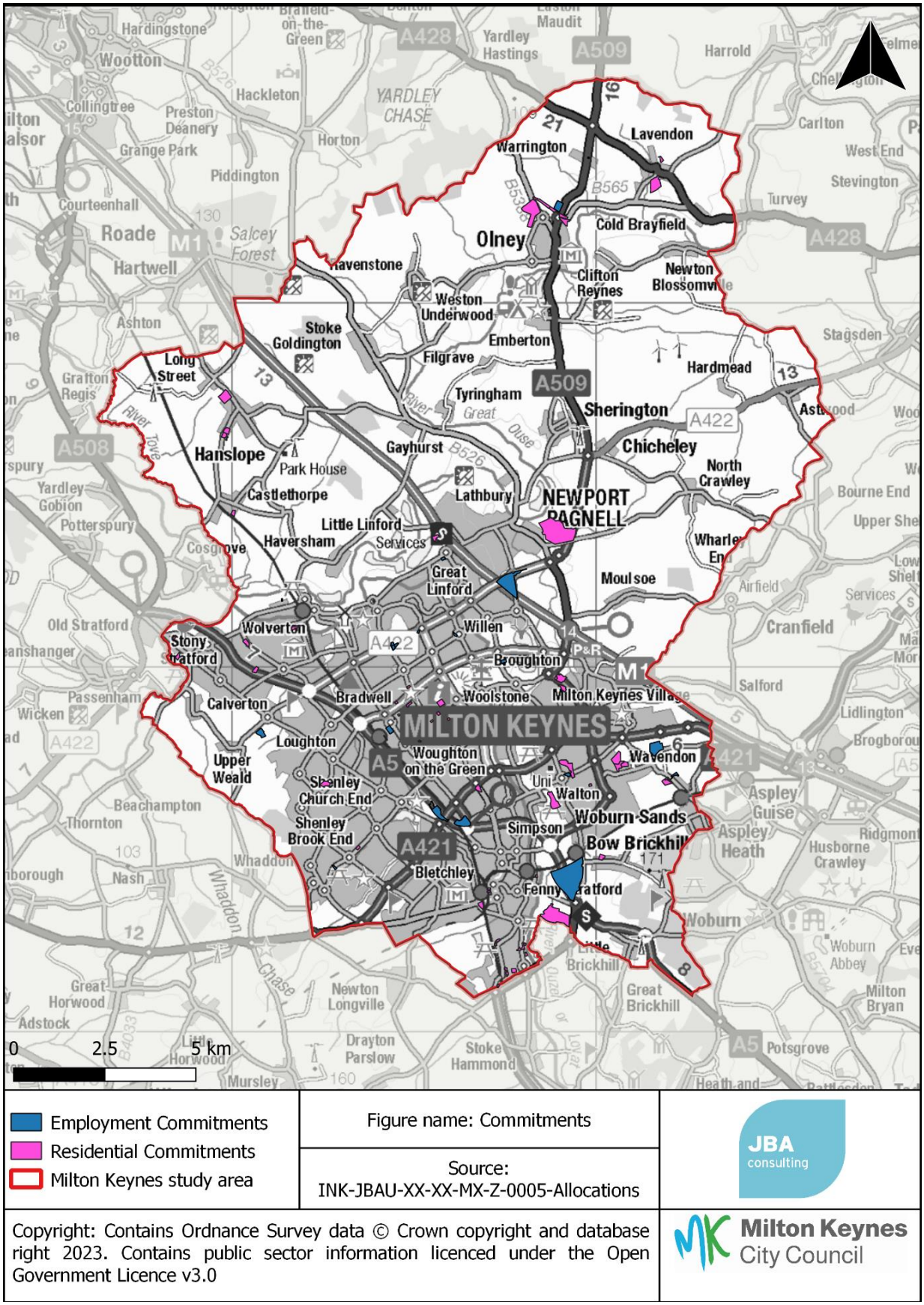


Figure 2.1 Commitments in the Milton Keynes study area

2.2.4 Windfall

Windfall sites are sites that have not been specifically identified in the Local Plan. They normally comprise previously developed sites that have unexpectedly become available. In MKCC provided an estimate of 35 dwellings per year to account for windfall growth. By its nature, it is not known where windfall growth will occur, however in general, windfall growth will occur in built-up areas where other growth is planned. In the case of Milton Keynes, 98% of the housing commitments are likely to be served by Cotton Valley WRC so it is assumed Windfall will follow a similar patten. A small amount of windfall growth has also been assumed to be served by Hanslope and Olney WRCs. This is summarised in in Table 2.2.

Table 2.2 WRC annual windfall growth

Water Recycling Centre	Annual housing windfall growth estimate from WRC catchments
Hanslope	1
Cotton Valley	33
Olney	1
TOTAL	**35**

2.3 Recommended Growth Options

2.3.1 Introduction

The Milton Keynes Strategy for 2050 identifies eight growth areas referred to as the Recommended Growth Options (RGOs). As assessment of the RGOs in relation to potential developable area, flood risk, water and wastewater infrastructure was undertaken and is summarised below. The full assessment is contained in Appendix B.

It is likely that several RGOs would be needed to serve the housing need in Milton Keynes. Many of these would be served by the same water and wastewater infrastructure and so a cumulative assessment is required.

2.3.2 Developable area calculation

Housing capacity has not yet been calculated for each RGO and so the approach was taken where three different housing densities were used to provide an indicative number of houses to test. 35 dwelling per hectare (DPH), 50DPH and 100DPH were assessed.

2.3.3 Water supply and wastewater network

Anglian Water confirmed that they will review the RGO sites in the Stage 2 IWMS and assess the impact on their water supply and wastewater network. It should be noted that

under the Water Industry Act 1991 water and sewerage undertakers have an obligation to provide a connection for new residential development sites to the water supply network and the sewer network as and when required.

2.3.4 Water Resources

All the RGOs are covered by Ruthamford Central WRZ which has no internal water resources and relies on imports from neighbouring WRZs (Ruthamford South and Ruthamford North). From a water resources perspective, it is the overall level of growth and consequently water demand that is important, and not the location. It is not therefore possible to assess the site individually.

While producing their latest Water Resource Management Plan (WRMP24) Anglian Water have accounted for 26,244 dwellings up to 2035, and approximately 58,800 up to 2050. Up to 2035 this is broadly in line with the growth planned by Milton Keynes based on existing commitments and the current Local Plan covering the period up to 2031. Beyond 2035, RGOs developed using the 35DPH scenario would result in a level of growth in line with AW's WRMP24.

Water demand on each site could be reduced by making use of Rainwater Harvesting (RwH) to provide non-potable water for use in toilet flushing, washing machines and garden irrigation. With a lower density of dwellings there could be more space for storage of rainwater, and a lower demand. Whereas a higher density would have less storage space, with a higher demand. There may also be a lower ratio of roof space to population providing less opportunities for collection in the high-density scenario. Therefore, RwH would be better suited to a lower density of dwellings when used as a water resource.

2.3.5 Wastewater treatment capacity

RGOs around Olney (RGO1 and RGO2) would require an increase in the permit limit at Olney WRC in order for either of them to be built to capacity. RGO3 to RGO8 are expected to be served by Cotton Valley WRC. There is considerable headroom at this WRC, which would allow several RGOs to be developed before an increase in the flow permit was required.

2.3.6 Flood risk

Some of the RGOs have areas of flood risk which should be investigated in a Level 2 SFRA should they be taken forward. Sites should be planned sequentially, and opportunities should be taken to incorporate SuDS at the master planning stage to maximise the potential benefits and help manage surface water across the site.

2.4 Growth from outside Milton Keynes

2.4.1 Neighbouring authorities

Where growth within a neighbouring LPA area may be served by infrastructure within or shared with Milton Keynes, the neighbouring LPA was contacted as part of a duty to cooperate request to provide information on growth within the WRC catchment areas which serve MKCC.

Forecast housing growth for each WRC shared with MKCC is summarised in Table 2.3. It should be noted that these figures are the total number of houses and employment land within each WRC catchment should all the sites identified there be delivered. It therefore represents a worse-case scenario for wastewater demand.

Table 2.3 Summary of growth in neighbouring authorities served by infrastructure within or shared with Milton Keynes.

Neighbouring Authority	Data Source	WRC	Employment land	Residential (number of dwellings)
Central Bedfordshire	Requested directly via email (2015-2035)	Cotton Valley	0.69ha	N/A
Buckinghamshire	WCS (2022-2040)	Cotton Valley	0.11ha	1,284
West Northamptonshire	Requested directly via email (2011-2029)	Cotton Valley	16ha	N/A
North Northamptonshire	N/A	No shared infrastructure identified	N/A	N/A
Bedford	NA	No shared infrastructure identified	N/A	N/A

2.4.2 Ox-Cam IWM Framework

The Ox-Cam arc is an area stretching from Oxfordshire to Cambridgeshire across five counties. Originally conceived by a coalition of Regional Development Agencies in 2003, the Arc concept has gone through several iterations, initially focussed around a now defunct Oxford to Cambridge Expressway. In 2023, the Ox-Cam Arc became a "pan-regional partnership", enabling locally led delivery and a "bottom up" approach.

The Ox-Cam arc is one of the most water stressed areas in the country with high levels of unsustainable abstraction. Subsequently, water resource management is highly important to enable future growth. The Environment Agency have prepared an IWM Framework for the Ox-Cam Arc to create the best outcome for the water environment (Environment Agency, 2022). This is designed to be delivered in three phases with the first phase published in 2022. The emphasis in phase 1 was the development of a baseline, identifying which questions and issues the framework should address setting the basis for options appraisal and prioritisation of interventions.

Phase 2 aims to deliver workstreams and activities that will allow a framework to be designed that will enable integrated water management to be delivered. No significant outputs from phase 2 have been published yet, but this will be monitored during the stage 2 IWMS.

The IWM Framework was put together for the Ox-Cam arc to create the best outcome for the water environment. To obtain this goal, there were three overarching objectives stated in the Ox-Cam IWM Framework report:

- Nature recovery
- Rethinking natural resources
- Green growth

Also, according to the Ox-Cam framework, there are four aspects of water planning: water resources, wastewater, flood risk and environment. These objectives and aspects have been considered when putting in place the high levels objectives for this IWMS in Section 2.5.

Within the Ox-Cam IWM Framework it is stated that there are two main ways that water systems can be influenced to deliver better outcomes for the environment and society. These include a more integrated multi-criteria appraisal (MCA) across the forementioned aspects of water planning, and an improved/ tailored IWM standard at all scales such as local planning, Water Resource Management Plans (WRMPs) and Drainage and Wastewater Management Plans (DWMPs).

Within Section 7, a Multi-objective Decision Analysis (MODA) has been carried out assessing the high-level objectives presented in Section 2.5. MODA is like MCA which allows for multiple objectives to be considered alongside multiple options for improving environmental and societal factors within Milton Keynes such as green blue infrastructure.

2.4.3 Cross-Boundary projects: The B&MK Waterway

Projects that span Milton Keynes as well as bordering LPAs such as Bedfordshire and Cambridgeshire have impacts on the environment as well as the community. With projects such as the Bedford and Milton Keynes (B&MK) Waterways which aim to increase biodiversity, connect green spaces and communities as well as improve water management opportunities, it is important to consider how they impact benefit both society and the environment.

The B&MK Waterways is managed by the B&MK Waterways Trust as well as volunteers to increase blue and green infrastructure projects within the OxCam Arc to create green corridors, lengths of greenery to allow wildlife to move, in new developments and creating community spaces. As part of this IWMS, blue and green infrastructure are offered as options within Section 8 against the high-level objectives for this study (see Section 2.5). Collaboration with the B&MK Waterways Trust to implement blue and green infrastructure could be beneficial.

2.5 High level objectives

2.5.1 Overview

Integrated Water Management has been identified as a key component to support the Council's 2050 Strategy and the Ox-Cam IWM framework. This Strategy as well as the Sustainability Strategy and UK's Environmental Improvement Plan were used to derive a set of objectives specific to the IWMS. These can then be used throughout the study to ensure that recommendations within the IWMS are aligned with the overall objectives of the Milton Keynes 2050 Strategy and achieve multiple benefits where possible**.** The following set of objectives were agreed with MKCC:

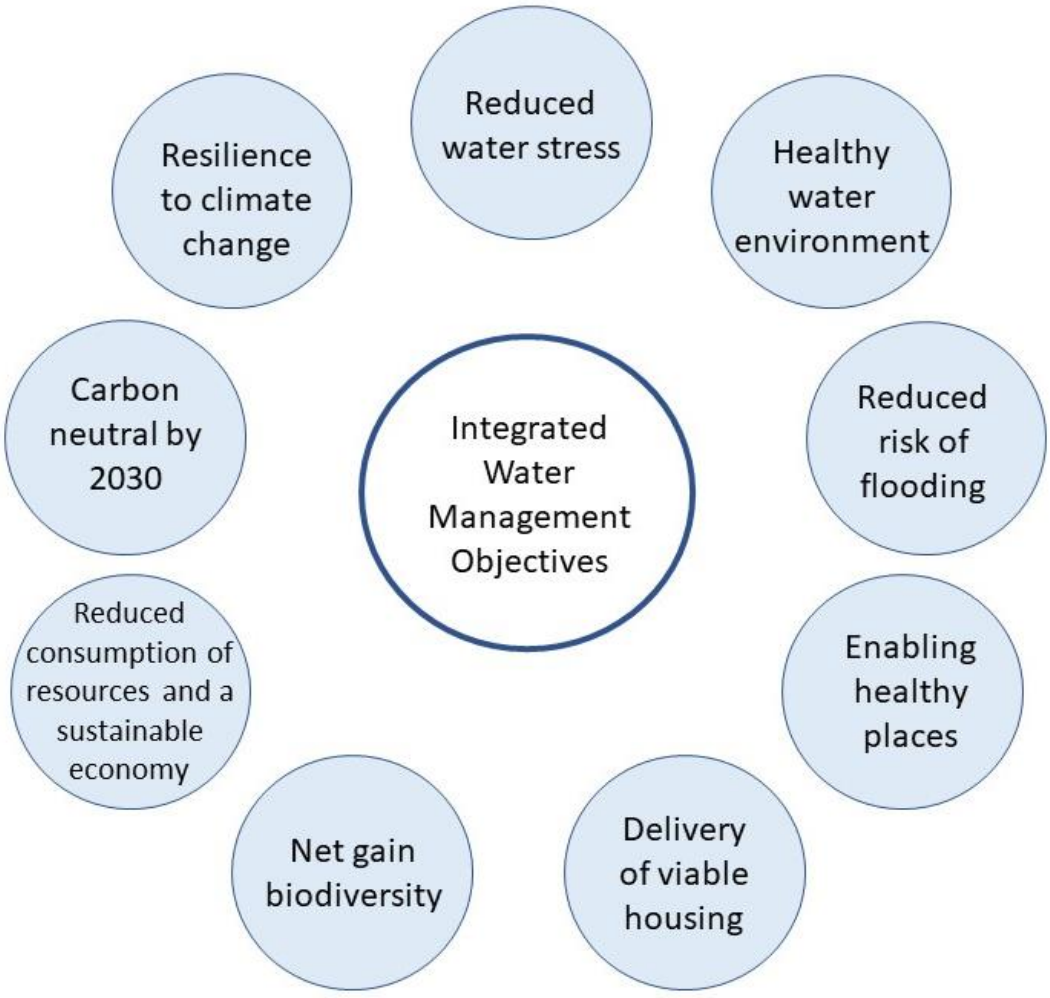


Figure 2.2 Objectives for integrated water management in Milton Keynes

2.5.2 Reduced water stress

Water stress is a measure of the level of demand for water (from domestic, business, and agricultural users) compared to the available freshwater resources, whether surface or groundwater. Water stress causes deterioration of the water environment in both the quality and quantity of water, and consequently restricts the ability of a waterbody from achieving a "Good Status" under the WFD.

The Environment Agency has undertaken an assessment of water stress across the UK (Environment Agency, 2021). This defines a water stressed area as where:

"The current household demand for water is a high proportion of the current effective rainfall which is available to meet that demand; or

The future household demand for water is likely to be a high proportion of the effective rainfall available to meet that demand." The EA define the Anglian Water region, as well as all central, southern and eastern England as under Serious water stress.

Water stress can be reduced by reducing the demand for water through measures such as retrofitting existing houses with water saving devices and incorporating water efficiency measures into newbuilds.

Anglian Water have invested in leakage reduction and linking up reservoirs in the west region to improve resilience. The replacement of pipes linked to the above investments will ultimately improve water efficiency and therefore resilience as well. In 2023 Anglian Water published a position statement on non-domestic water demands that put forward that new or expanding business' requiring over 0.05 M/l/d of potable water for production will need to maximise process efficiency to be considered for supply. This is to ensure future demand availability for domestic water demand as well as domestic growth laid out in Local Plans.

2.5.3 Healthy water environment

An increase in the discharge of effluent from Water Recycling Centres (WRCs) as a result of development and growth in the area in which they serve can deteriorate the water quality of the receiving watercourse. Under the Water Framework Directive (WFD), a watercourse is not allowed to deteriorate from its current WFD classification (either as an overall watercourse or for individual elements assessed).

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

A healthy water environment does not only benefit residents by allowing places to use recreationally but can also leads to an increase in biodiversity.

2.5.4 Reduced risk of flooding

NPPF requires development to consider the risk of flooding from all sources both to the development, and the risk of the development increasing flood risk downstream. Through integrated planning, development can contribute to reducing flood risk, for example by disconnecting surface water from combined sewerage systems when brownfield sites are redeveloped, or improving the storage and management of surface water from a greenfield site which currently causes surface water flooding to neighbouring areas.

Nature-Based Solutions (NBS) as part of individual developments and wider spatial planning can provide a major contribution to flood risk management and reduce the need for high-carbon flood alleviation schemes. NBS includes interventions in rural and landscaped areas (sometimes called natural flood management or NFM) and in urban areas, where they includes sustainable drainage systems (SuDS) and other green and blue infrastructure.

The SFRA provides further detail on positively managing flood risk to and from new developments.

2.5.5 Resilience to climate change

Climate resilience is the ability to recover, or to mitigate vulnerabilities related to climate change such as prolonged periods of dry weather, droughts and heatwaves. This can be worked towards by increasing water efficiency, diversifying water sources, and raising awareness to individuals about behaviour changes that can be made.

Whilst there are significant uncertainties about how climate change will impact future water resources, low-cost, "no-regrets" decisions can be adopted in Local Plans which will contribute to improved resilience, such as Plan:MK.

Within the MK Strategy for 2050 reduction of water consumption is mentioned with goals to reduce water usage to 110 l/p/d. Approaches to this goal include harvesting and storage or rain, storm**,** and grey water (Milton Keynes Council, 2020)**.**

2.5.6 Carbon neutral by 2030

Milton Keynes City Council has an objective to be carbon neutral by 2030 and carbon positive by 2050. The UK water sector has also committed to being operationally carbon neutral by 2030 and net zero by 2050. Carbon neutrality in a IWMS focusses on the water use of an area, how new developments may affect this and how a local plan can reduce whole-life carbon emissions. Water use from houses and drainage are the main two ways carbon neutrality can be incorporated into an IWMS.

Potential methods to incorporate carbon neutrality in new developments through water management are:

- Water efficient fittings - These can reduce the need for water and thus reduce the carbon used to abstract, treat and transfer water, and in the home to heat water.

- SuDS - Especially where developments have been constructed from natural materials, carbon costs can be lower than conventional drainage.
- Consideration of water and wastewater transport via gravity rather than pumping

There are also trade-offs between resilience and carbon. For example, desalination and greywater recycling can have higher carbon costs than water abstracted from the environment or demand management measures.

2.5.7 Enabling healthy places

Healthy Places is a concept introduced by Public Health England to build and design spaces that benefit the natural environment as well as the communities that use them (PHE, 2021). Healthy places can also help the growth of green and blue infrastructure, walking neighbourhoods and areas that will increase flood resilience. Subsequently, those living in the area benefit from the incorporation of physical activity into everyday life and an improvement in mental wellbeing into everyday life.

Healthy Places are to be implemented to approach issues in the UK such as poor mental health and health inequalities. An IWMS aims to coordinate multiple benefits to improve socio-economic and environmental issues such as low biodiversity and suffering mental and physical health. By enabling healthy places, both socio-economic benefits such as amenities for communities and environmental benefits such as biodiversity net gain and habitat creation can occur in tandem.

2.5.8 Delivery of viable housing

Viable homes, in this context, means affordable and well-built homes**.**

Within Milton Keynes' 2050 sustainability plan there is a focus on getting the right mix of housing with the want for more social and affordable rent and private rent or purchase at prices that residents can afford. The definition of affordable within the report is based upon the market values rather than the income levels, so creating affordable housing based on people's income may be a challenge. SuDS have been demonstrated to have, in most cases, lower whole-life costs than conventional drainage, however this assumes they are located within public amenity spaces and so do not reduce the number of dwellings achievable on a site. Water efficiency, in particular where the consumption of hot water is reduced, can provide significantly lower household bills to residents.

2.5.9 Reduced consumption of resources and a sustainable green economy

Within this objective there is focus on water efficiency and green working. Green working in this context means an economy that benefits the environment in a way that helps to reduce consumption of natural resources.

As part of the Milton Keynes 2050 Strategy the reduction of water consumption is mentioned with an overall per-capita consumption goal of 110 l/p/d in new and existing developments. Methods to achieve this are listed as:

- Harvesting and storage of rainwater and storage
- Grey water recycling

There is also a goal for water "smart" communities that are designed specifically to be water efficient. This includes smart water metering and leak detectors to not only help residents cut costs on bills, but also to preserve water resources in the area.

2.5.10 Net gain in biodiversity

Biodiversity Net Gain (BNG) is a pathway to help nature recovery. The Environment Act 2021 requires that, from November 2023, all development will need to demonstrate a 10% net-gain in biodiversity. BNG will be recorded, with landowners, developers and similar stakeholders being able to buy and sell BNG credits to offset biodiversity degradation elsewhere. The biodiversity metric can be used to calculate the BNG credits a development or site produces. This is done by using the credits calculator on the government website. The calculator considers habitat size and quality of habitat as well as its ecological importance. The point of these credits is to help biodiversity increase, despite changing use of land elsewhere.

48Local Nature Recovery Strategies (LNRS) are being prepared across England, with Buckinghamshire Council being responsible for the strategy covering Milton Keynes. LNRS will agree priorities for nature recovery and propose actions in the areas they cover. Responsible authorities will oversee the strategy (UK Government o, 2023). In the case of a net gain in biodiversity, working with the LNRS as an overarching plan would be beneficial.

A net gain in biodiversity can be achieved by creating habitat and green spaces within developments to increase flora and fauna. As mentioned previously, healthy places can help increase green infrastructure, which can benefit net gain in biodiversity.

3 Legislative and Policy framework

3.1 Introduction

The following sections introduce several international, national, regional, and local policies that must be considered by the Local Planning Authority (LPA), water companies and developers during the planning stage. Key extracts from these policies are presented as well as links to the full text. Whilst care has been taken to ensure that the information presented in this report was up to date at the time of writing, policy and guidance can change rapidly and the reader should ensure that the most up to date information is sought.

3.2 Plan-making

The National Planning Policy Framework (NPPF) (Department for Levelling Up, Housing and Communities, 2023) was originally published in 2012, as part of reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth.

Local Plans are the primary mechanism by which plan-led spatial planning is implemented in England. Local Plans must be prepared by Local Planning Authorities (LPAs) and include:

- Strategic policies which set out the "overall strategy for the pattern, scale and design duality of places", including for the provision of infrastructure, transportation and community facilities.
- Non-strategic policies, which "set out more detailed policies for specific areas, neighbourhoods or types of development. This can include allocating sites, the provision of infrastructure and community facilities at a local level."

Under the Localism Act (HM Government, 2011) new rights were provided to allow local communities to come together and shape the development and growth of their area by preparing Neighbourhood Development Plans, or Neighbourhood Development Orders, where the ambition of the neighbourhood is aligned with strategic needs and priorities for the area. Neighbourhood Plans can make non-strategic policies, aligned to the strategic policies of the Local Plan. As neighbourhoods draw up their proposals, Local Planning Authorities are required to provide technical advice and support to communities.

3.3 Water and the Planning System

3.3.1 National Planning Policy Framework and water

The NPPF provides guidance to planning authorities to take account of flood risk and water and wastewater infrastructure delivery in their Local Plans. Key paragraphs include:

- Paragraph 34: “Plans should set out the contributions expected from development. This should include setting out the levels and types of affordable

housing provision required, along with other infrastructure (such as that needed for education, health, transport, flood and water management, green and digital infrastructure). Such policies should not undermine the deliverability of the plan."

- Paragraph 158: "Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply..."
- Paragraph 180e: "…preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans".

3.3.2 Planning Practice Guidance overview

Planning Practice Guidance (PPG) was originally issued in 2014 by the Department for Communities and Local Government, with the intention of providing guidance on the application of the NPPF. The individual guidance documents are updated periodically. The following guidance documents are particularly relevant to a WCS:

- Water Supply, Wastewater and Water Quality (HM Government, 2019)
- Housing - Optional Technical Standards (HM Government, 2015a)
- Flood Risk and Coastal Change (HM Government, 2022)

3.3.3 PPG - Water Supply, Wastewater and Water Quality

Two key passages from the PPG (Para 002) provide an overview of what needs to be considered by plan-making authorities, and provide a basis for the work contained in a WCS or IWMS:

"Early discussions between strategic policy-making authorities and water and sewerage companies can help to ensure that proposed growth and environmental objectives are reflected in company business plans. Growth that requires new water supply should also be reflected in companies' long-term water resources management plans. This will ensure that the necessary infrastructure is funded through the water industry's price review."

"Strategic policy-making authorities will also need to consider the objectives in the government's 25 Year Environment Plan to reduce the damaging abstraction of water from rivers and groundwater, and to reach or exceed objectives for rivers, lakes, coastal and ground waters that are specially protected."

A summary of the advice for plan-makers and for planning applications is contained below but it is recommended that the full text is reviewed.

Plan-making considerations - Infrastructure (Para 005)

- Identification of suitable sites for new or enhanced infrastructure, including the location of existing and proposed development.
- Consider whether new development is appropriate near to water and wastewater infrastructure (for example due to odour concerns).
- Phasing new development so that water and wastewater infrastructure will be in place when needed. Infrastructure should also be in place before any environmental effects occur on designated sites of importance for biodiversity.
- **Plan-making considerations - Water quality (Para 006)**
- How to help protect and enhance local surface water and groundwater in ways that allow new development to proceed and avoids costly assessment at the planning application stage.
- The type or location of new development where an assessment of the potential impacts on water bodies may be required.
- Whether measures to improve water quality, (e.g., SuDS schemes) can be used to address water quality in addition to flood risk.
- **Plan-making considerations - Wastewater (Para 007)**
- The sufficiency and capacity of wastewater infrastructure.
- The circumstances where wastewater from new development would not be expected to drain to a public sewer (such as via a package treatment sewage treatment works or septic tank).
- The capacity of the environment to receive effluent from development without preventing statutory objectives being met.

Early engagement with the LPA, the EA, and relevant water and sewerage companies can help establish whether any particular water and wastewater issues need to be considered.

Considerations for planning applications - Water supply (Para 016)

Water supply planning would normally be addressed through the LPA's strategic policies and reflected in the water companies WRMPs. Water supply is therefore unlikely to be a consideration for most planning applications. However, some exceptions might include:

- Large developments not identified in plans that are likely to require a large volume of water; and/or
- significant works required to connect the water supply; and/or
- where a plan requires enhanced water efficiency in new development as part of a strategy to manage water demand locally.

Considerations for planning applications - Water quality (Para 016)

Water quality is only likely to be a significant planning concern where a proposal would:

- Involve physical modifications to a water body such as flood storage areas, channel diversions and dredging, removing natural barriers, construction of new

locks, new culverts, major bridges, new barrages or dams, new weirs, and removal of existing weirs; and/or

- indirectly affect water bodies, for example:
  - As a result of new development such as the redevelopment of land that may be affected by contamination, mineral workings, water and wastewater treatment, waste management facilities and transport scheme including culverts and bridges.
  - Result in runoff into surface water sewers that drain directly, or via a combined sewer, into sensitive waterbodies e.g., waterbodies with a local, national or international habitat designation.
  - Through a lack of adequate infrastructure to deal with wastewater.

Through a local of adequate infrastructure to deal with wastewater where development occurs in an area where there is strategic water quality plan e.g., a nutrient management plan, River Basin Management Plan, Water Cycle Study, Diffuse Water Pollution plan or sewerage undertakers' drainage strategy which set out strategies to manage water quality locally and help deliver new development.

3.3.4 PPG - Housing - Optional Technical Standards

This guidance advises planning authorities on how to gather evidence to set optional requirements, including for water efficiency. It states that “all new homes already must meet the mandatory national standard set out in the Building Regulations (of 125 litres /person /day). Where there is a clear local need, local planning authorities can set out Local Plan policies requiring new dwellings to meet the tighter Building Regulations optional requirement of 110 litres/person/day. Planning authorities are advised to consult with the EA and water companies to determine where there is a clear local need, and also to consider the impact of setting this optional standard on housing viability.

The evidence for adopting the optional requirements is outlined in section 4.5.8. Viability is reviewed in section 3.4.4.

3.3.5 PPG - Flood Risk and Coastal Change

This guidance (Department for Levelling Up, Housing and Communities, 2022) sets out how spatial planners, planning authorities and developers should manage flood risk to and from proposed developments, including assessing risk, avoiding flood risk, controlling, managing and mitigating flood risk. The main updates in the 2022 version were:

- Natural Flood Management (NFM)
- Surface water flood risk
- Using multifunctional SuDS
- Application of the sequential and exceptional tests to all sources of flood risk
- Safeguarding land of future flood risk management
- Supporting transition in unsustainable locations

Full details of this PPG are set out in the SFRA.

3.3.6 PPG - Climate Change

This guidance (Department for Levelling Up, Housing and Communities, 2019) advises how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change. Planning can help increase resilience to climate change impact through the location, mix and design of development. There is a statutory duty on local planning authorities to include policies in their Local Plan to tackle climate change and its impact.

3.3.7 Levelling-up and Regeneration Act 2023

The Levelling-up and Regeneration (HM Government, 2023) aims to support the Government's commitment to reducing geographical disparities between different parts of the UK. Within the Act are several parts relating to the water environment.

Part 7 relates to nutrient pollution standards. Where the Secretary of State considers that a habitats site that is wholly or partly in England is in an unfavourable condition by virtue of pollution from nutrients in water comprising phosphorus or compounds, or nitrogen or compounds, the Secretary of State may designate the catchment area for the habitats site as a phosphorus or nitrogen sensitive area.

It requires sewerage undertakers in England to upgrade phosphorus or nitrogen significant plants in its sewerage system by 2030 in order to meet phosphorus or nitrogen pollution standards.

A phosphorus or nitrogen significant plant is defined as one that discharges treated effluent into a sensitive catchment area and is not exempt in relation to the pollution standard. Unless otherwise defined, the treatment standard for phosphorous is 0.25mg/l, and for nitrogen is 10mg/l.

3.4 Water and design

3.4.1 Building Regulations

The Building Regulations (2010) Part G was amended in early 2015 to require that all new dwellings must ensure that the potential water consumption must not exceed 125 litres/person/day, or 110 litres/person/day where required under planning conditions (HM Government, 2015b) (see 3.3.4).

The Environmental Improvement Plan (discussed in 3.7.2) contains a commitment to consider a new standard for new homes in England of 105 litres per person per day (l/p/d) and 100 l/p/d where there is a clear local need, such as in areas of serious water stress. Whilst this new standard is only under consideration, it demonstrates the direction of travel for water efficiency standards, and it is highly likely that this or a similar standard will be adopted.

3.4.2 Building Research Establishment

The Building Research Establishment (BRE) publish an internationally recognised environmental assessment methodology for assessing, rating, and certifying the sustainability of a range of buildings.

New homes are most appropriately covered by the Home Quality Mark (BRE, BRE, 2023a), and commercial, leisure, educational facilities and mixed-use buildings by the Building Research Establishment Environmental Assessment Methodology (BREEAM) UK New Construction Standard (BRE, BREEAM, 2018b).

Using independent, licensed assessors, BREEAM/HQM assesses criteria covering a range of issues in categories that evaluate energy and water use, health and wellbeing, pollution, transport, materials, waste, ecology, and management processes.

In the Homes Quality Mark, 400 credits are available across 11 categories and lead to a star rating. 18 credits are available for water efficiency and water recycling. A greater number of credits are awarded for homes using water efficient fittings (with the highest score achieving 100l/p/d or less), and further credits are awarded for the percentage of water used in toilet flushing that is either sourced from rainwater or from grey water.

The BREEAM New Construction Standard awards credits across nine categories, four of which are related to water: water consumption, water monitoring, leak detection and water efficient equipment. This leads to a percentage score and a rating from “Pass” to “Outstanding”.

Through the Local Plan, the Council has the opportunity to seek BREEAM or HQM status for all new, residential, and non-residential buildings.

3.4.3 Energy and Water

18% of the UK’s domestic energy usage is for water heating (Department for Energy Security and Net Zero, 2022). If less water was being used within the home, for instance through more water efficient showers, less water would need to be heated, and overall domestic energy usage would be reduced.

The Government is currently analysing the results of a 2019 consultation on a Future Homes Standard that will involve changes to Part L (conservation of fuel and power) of the Building Regulations for new dwellings. Whilst there is no direct mention of water efficiency in this consultation, there is an important link between water use and energy use, and therefore between water use and the whole-life carbon cost of developments.

3.4.4 Viability

The evidence for the costs of meeting the optional 110l/p/d water efficiency target in new homes indicate that the costs are minimal:

- A 2014 study into the cost of implementing sustainability measures in housing found that meeting a standard of 110 litres per person per day would cost only £12 (at 2023 prices) for a four-bedroom house (EC Harris, 2014).
- The Committee on Climate Change report - UK Housing: Fit for the Future - stated that the cost of "requiring all homes in England to be built to 110 l/p/d is possible under Part G of regulations and would be no additional cost."(Committee on Climate Change, 2019)
- Heating water accounts for 18% of energy used in the home (Department for Energy Security and Net Zero, 2022) This would cost a 2-3 person, 3-bed household an average of £352 per year in energy at 2023 costs (British Gas, 2023). Water efficiency is therefore not only viable but of positive economic benefit to both private homeowners and tenants.

There is less evidence available on the costs of going below 110l/p/d. The Sussex North Water Neutrality Strategy (JBA Consulting, 2022) found that the additional cost to meet 85l/p/d using water efficient fittings would be between £349 and £431 per dwelling, or £1,049 to £1,531 where white-goods appliances would not otherwise have been installed in the dwelling (2022 prices).

3.5 The Water Industry

3.5.1 The Water Industry in England

Water and sewerage services in England and Wales are provided by eleven Water and Sewerage Companies (WaSCs) and six ‘water-only’ companies. The central legislation relating to the industry is the Water Industry Act 1991. The companies operate as regulated monopolies within their supply regions, although very large water users and developments are able to obtain water and/or wastewater services from alternative suppliers - known as inset agreements.

The Water Act 2014 aims to reform the water industry to make it more innovative and to increase resilience to droughts and floods. Key measures could influence the future provision of water and wastewater services include:

- Non-domestic customers are able to switch their water supplier and/or sewerage undertaker;
- new businesses will be able to enter the market to supply these services;
- measures to promote a national water supply network; and
- enabling developers to make connections to water and sewerage systems.

The water industry is primarily regulated by three regulatory bodies:

- **Economic regulation:** Office of Water Services (Ofwat) are the economic regulator. They have a statutory duty to protect the interests of consumers, ensuring water companies carry out their functions (customer service standards,

environmental rules, drinking water standards etc) and can finance them. Part of this role is setting the limits on pricing of water and sewerage services.

- **Environmental regulation:** The Environment Agency are the environmental regulator. They are responsible for monitoring the impact of the water industry (as well as others) on the environment and issuing permits for abstraction of water and discharge of wastewater.
- **Drinking water regulation:** Finally, the Drinking Water Inspectorate (DWI) implement standards for drinking water and can take enforcement measures against water companies if those standards are not met.

3.5.2 Planning and funding of the water industry

The water industry works on a five-year cycle called the Asset Management Plan period or AMP periods. Every five years a water company submits a Business Plan to Ofwat for a Price Review. These plans set out the companies' operational expenditure (OPEX) and capital expenditure (CAPEX) required to maintain service standards, enhance service (for example where sewer flooding occurs), to accommodate growth and to meet environmental objectives defined by the Environment Agency. Ofwat assesses and compares the plans with the objective of ensuring what are effectively supply monopolies are operating efficiently, and that the company is meeting its obligations. It then sets the allowable price increase for consumers based on the retail prices index, the business plan, and taking into consideration affordability for consumers. The current AMP period is AMP 7 (2020-2025), and the price of water for this period was set by Ofwat late in 2019 in a process referred to as Price Review 19 (PR19). The new price came into effect in April 2020. The next price review will be 2024 (PR24) and will set prices from 2025 to 2030. This system gives stability in pricing. Within this price review process there may also be incentives and penalties on the water company for exceeding or failing to meet targets.

When considering investment requirements to accommodate growing demand, water companies are required to ensure a high degree of certainty that additional assets will be required before funding them. Longer term growth is, however, considered by the companies in their internal asset planning processes and in their 25-year Strategic Direction Statements and Water Resource Management Plans (WRMPs).

The Water Industry National Environment Programme (WINEP) is a set of actions that are defined by the EA and given to all water companies operating in England for completion during a particular AMP period. The aim of the programme is to support the objectives in the Environment Act, Water Framework regulations, Habitats regulations and other environmental objectives. Examples of typical actions could include investigations into the sustainability of an abstraction, a reduction in an abstraction to support river flows, or new permit limits at a wastewater treatment works.

Water and wastewater infrastructure requires significant lead-times to plan, obtain planning and other permissions, finance and construct. The time required to provide new or

upgraded infrastructure to serve a development or a larger spatial plan is highly locally specific. The following is provided as an indicative guide to lead-times.

Table 3.1: Indicative lead-times (years) for new infrastructure to serve development

Scale of development	Water supply	Water resources	Wastewater network	Wastewater treatment
Minor	1	N/A	1	N/A
Major	1-3	5-10	1-5	3-5
Strategic / Plan	3-5	10-20	5-10	5-10

3.5.3 Planning for Water

Water resource management plans

Water Resource Management Plans (WRMPs) are 25-year strategies that water companies are required to prepare, with updates every five years. In reality, water companies prepare internal updates more regularly. WRMPs are required to assess:

- Future demand (due to population and economic growth).
- Future water availability (including the impact of sustainability reductions).
- Demand management and supply-side measures (e.g., water efficiency and leakage reduction, water transfers and new resource development).
- How the company will address changes to abstraction licences.
- How the impacts of climate change will be mitigated.
- Where necessary, they set out the requirements for developing additional water resources to meet growing demand and describe how the balance between water supply and demand will be balanced over the period 2015 to 2040.
- Using cost-effective demand management, transfer, trading and resource development schemes to meet growth in demand from new development and to restore abstraction to sustainable levels.
- In the medium to long term, ensuring that sufficient water continues to be available for growth and that the supply systems are flexible enough to adapt to climate change.

Anglian Water's final WRMP is published here and is reviewed in detail for the study area in section 4.5.3.

Drought Plan

Linked to the WRMP is a water company's drought plan. This is a requirement under the Water Industry Act 1991 (as amended by the water Act 2003). A water company must state how it will maintain a secure water supply and protect the environment during dry weather and drought. The plan will contain:

- Drought triggers - these are points where a water company will take action to manage supply and demand. They are based on monitoring of rainfall levels, river flows, groundwater levels and reservoir stocks.
- Demand management actions - how a water company will reduce demand for water during a drought. Actions that save water before taking more water from the environment must be prioritised. These could include:
  - reducing leakage;
  - carrying out water efficiency campaigns with customers;
  - reducing mains pressure; and
  - restricting water use, for example through temporary use bans which limit hosepipe and sprinkler use.
- Supply management actions - how a water company will maintain water supply during a drought. Actions that have the least effect on the environment must be prioritised. This could include:
  - carrying out engineering work to improve its supply;
  - transferring water in bulk from other water companies;
  - using drought permits and drought orders to abstract more water;
  - using desalination - permanent or temporary plants; and
  - using tankers to supply customers with water directly.
- Extreme drought management actions - the actions it could take in an extreme drought. These could delay the need to use emergency restrictions standpipes and rota cuts.
- Communicating during a drought - a water company must set out how it will communicate in a clear and timely way during a drought with customers, partners or other stakeholders.
- Environmental assessment, monitoring and mitigation. A drought plan must include:
  - an environmental assessment;
  - an environmental monitoring plan for each supply management action; and
  - details of mitigation measures the company plans to take for each supply management action.
- End of a drought - a water company must explain how it will identify when a drought is over or ending and the actions it will take during this stage, communicate this information to customers, and review its performance.

Regional water resource planning

Water resource planning is taking an increasingly regional focus, recognising the need for collaboration between water companies and sectors in order to address the challenges of climate change, increasing demand for water and protecting the water environment. Five regional groupings having been formed, including the Water Resources East (WRE) group

which covers Milton Keynes. An advisory group consisting of their regulators (Environment Agency and Ofwat) and Defra regularly attend meetings of WRE.

WRE are preparing a regional water resource plan for publication in 2023, which in turn will inform the next round of company WRMPs to be published in 2024. As part of this process, they have published an initial water resource position statement which sets out the water resources challenges and opportunities within the region.

The WRE emerging plan can be found here and is further mentioned in Section 4.5.5

3.5.4 Planning for Wastewater

21st Century Drainage

The UK Water Industry Research (UKWIR) "21st Century Drainage" programme has brought together water companies, governments, regulators, local authorities, academics, and environmental groups to consider how planning can help to address the challenges of managing drainage in the future. These challenges include climate change, population growth, urban creep and meeting the Water Framework Directive.

The group recognised that great progress has been made by the water industry in its drainage and wastewater planning over the last few decades, but that, in the future, there needs to be greater transparency and consistency of long-term planning. The Drainage and Wastewater Management Plan (DWMP) framework (Water UK, 2018) sets out how the industry intends to approach these goals. Companies were required to published finalised DWMPs in 2023 to inform their business plans for the 2024 Price Review. More information can be found here.

Drainage and Wastewater Management Plans (DWMPs)

DWMPs are consistently structured plans delivered at three spatial scales; company-wide, regional groupings and individual wastewater catchments. The framework defines drainage to include all organisations and all assets which have a role to play in drainage, although, as the plans will be water company led, it does not seek to address broader surface water management within catchments.

LPAs and LLFAs are recognised as key stakeholders and are invited to join, alongside other stakeholders, the Strategic Planning Groups (SPGs) organised broadly along river basin district catchments.

DWMPs aim to provide more transparent and consistent information on sewer flooding risks and the capacity of sewerage networks and treatment works, and this should be taken into account in SFRAs, Water Cycle Studies, as well as in site-specific FRAs and Drainage Strategies.

Anglian Water's final DWMP, including interactive mapping, is published here, and is reviewed in detail for the study area in section 4.7.2.

3.5.5 Developer Contributions and connection charges

A significant part of water company business is the interface with developers to facilitate connection to the public water supply and sewerage systems, through their developer services functions. Developments with planning permission have a right to connect to the public water and sewerage systems, (where this is for domestic use), however, there is no guarantee that the capacity exists to serve a development.

Developers may requisition a water supply connection or sewerage system or self-build the assets and offer these for adoption by the water company or sewerage undertaker. Self-build and adoption are usually practiced for assets within the site boundary, whereas requisitions are normally used where an extension of upgrading the infrastructure requires construction on third party land. The cost of requisitions is shared between the water company and developer as defined in the Water Industry Act 1991.

The above arrangements are third party transactions because the Town and Country Planning Act Section 106 agreements and Community Infrastructure Levy agreements may not be used to obtain funding for water or wastewater infrastructure.

OfWAT, the water industry's economic regulator, published revised rules covering how water and wastewater companies may charge customers for new connections (OfWAT, 2020). These rules have applied to all companies in England since April 2018. The key changes include:

- More charges will be fixed and published on water company websites. This will provide greater transparency to developers and will also allow alternative connection providers to offer competitive quotations more easily.
- There will be a fixed infrastructure charge for water and one for wastewater.
- The costs of network reinforcement will no longer be charged directly to the developer in their connection charges. Instead, the combined costs of all of the works required on a company's networks, over a five-year rolling period, will be covered by the infrastructure charges paid for all new connections.
- The definition of network reinforcement has changed and will now apply only to works required as a direct consequence of the increased demand due to a development. Where the water company has not been notified of a specific development, for example when developing long-term strategic growth schemes, the expenditure cannot be recovered through infrastructure charges.

Anglian Water publish their charging arrangements annually here. These include incentives to encourage good design by developers, including:

- A 50% reduction in the 2023-24 sewerage infrastructure charge if a sustainable surface water discharge method (limited to rainwater harvesting / reuse, infiltration methods, discharge to an open surface waterbody, discharge to surface water sewer, highway drain or other drainage system at a restricted rate) is used as an alternative to a previous surface water connection to a foul or combined sewer.

3.5.6 Water companies and the planning system

Water companies are currently not statutory consultees to planning applications, although they do monitor planning applications and respond to potentially significant applications, or where requested to do so by the LPA. Defra are intending to consult on making water companies statutory consultees for some applications (Department for Environment, Food & Rural Affairs, 2023).

Where a water company is concerned that a new development may impact upon their service to customers or the environment (for example by causing foul sewer flooding or pollution) they may request the LPA to impose a Grampian condition, whereby the planning permission cannot be implemented until a third-party secures the necessary upgrading or contributions.

Defra has issued National Policy Statements (NPSs) on Nationally Significant Infrastructure Projects (NSIPs) for wastewater (Department of Environment, Food & Rural Affairs, 2012) and water (Department of Environment, Food & Rural Affairs, 2023), to be used as the primary basis when considering applications for Development Consent Orders (DCOs).

3.6 Flood Risk and Surface Water

3.6.1 Flood and Water Management Act 2010

The Flood and Water Management Act (FWMA) aims to improve both flood risk management and the way water resources are managed (HM Government, 2010).

The FWMA has created clearer roles and responsibilities and helped to define a more risk-based approach to dealing with flooding. This included the creation of a lead role for LAs, as LLFAs, designed to manage local flood risk (from surface water, ground water and ordinary watercourses) and to provide a strategic overview role of all flood risk for the EA.

The content and implications of the FWMA provide considerable opportunities for improved and integrated land use planning and flood risk management by LAs and other key partners. The integration and synergy of strategies and plans at national, regional, and local scales, is increasingly important to protect vulnerable communities and deliver sustainable regeneration and growth.

Schedule 3 of the Act has not been enacted in England, but this is expected to be implemented in 2024. The enactment of schedule 3 will have the following implications for the planning process:

- Designation of local authorities as SuDS Approval Bodies (SAB) which have a duty to adopt new drainage systems.
- The cessation of the automatic right for new developments to connect to the existing sewer system.

- Developers must ensure that drainage systems are built as per the approved drainage plan that complied with mandatory national standards as outlined in the NPPF and the PPG.

3.6.2 Local Flood Risk Management Strategy (LFRMS)

Local Flood Risk Management Strategies set out how Lead Local Flood Authorities (LLFA) will manage local flood risk from surface water runoff, groundwater and ordinary watercourses, for which they have a responsibility as LLFA. They also sets out the work that other Risk Management Authorities are doing to manage flood risk within the area.

The Milton Keynes Local Flood Risk Management Strategy sets out the following objectives:

- Ensure that drainage management is tailored to Milton Keynes unique drainage system.
- Improve the Council's understanding of flood risk from all sources.
- Ensure future development does not have a negative impact on flood risk and lowers the risk where possible.
- Improve public awareness of flooding and helps communities to become more resilient to flooding.

3.6.3 Strategic Flood Risk Assessment (SFRA)

All LPAs are required, under NPPF, to prepare a SFRA, which forms a key part of the evidence base for their Local Plan. The SFRA must consider flood risks from all sources, collating up-to-date flood risk data and in some cases developing new flood risk modelling. The SFRA is used to inform the Sequential Test, by which Local Plan allocations should be sequentially selected to direct development towards areas of lower flood risk, taking into consideration the vulnerability to flooding of the proposed land use. Milton Keynes City Council's current SFRA was published in 2015.

3.6.4 Surface Water Management Plan

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location and establish a long-term action plan to manage surface water. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. Milton Keynes City Council has published SWMPs for Milton Keynes in 2016.

3.6.5 Sustainable Drainage Systems

From April 2015, Local Planning Authorities (LPA) have been given the responsibility for ensuring that sustainable drainage is implemented on developments of ten or more homes or other forms of major development through the planning system. Under the new

arrangements, the key policy and standards relating to the application of SuDS to new developments are:

- The National Planning Policy Framework, which requires that development in areas already at risk of flooding should give priority to sustainable drainage systems.
- The House of Commons written statement (Pickles, 2014) setting out governments intentions that LPAs should "ensure that sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate" and "clear arrangements in place for ongoing maintenance over the lifetime of the development." This requirement is also now incorporated in the 2019 update of the NPPF (paragraph 165). In practice, this has been implemented by making Lead Local Flood Authorities (LLFAs) statutory consultees on the drainage arrangements of major developments.
- The Defra non-statutory technical standards for sustainable drainage systems (HM Government, 2015c). These set out the government's high-level requirements for managing peak flows and runoff volumes, flood risk from drainage systems and the structural integrity and construction of SuDS. This very short document is not a design manual and makes no reference to the other benefits of SuDS, for example water quality, habitat, and amenity.

Milton Keynes City Council are the LLFA and play a key role in ensuring that the proposed drainage schemes for all new developments comply with technical standards and policies in relation to SuDS. Further information on surface water drainage can be found here.

An updated version of the CIRIA SuDS Manual was published in 2015. The guidance covers the planning, design, construction and maintenance of SuDS for effective implementation within both new and existing developments. The guidance is relevant for a range of roles with the level of technical detail increasing throughout the manual. The guidance does not include detailed information on planning requirements, SuDS approval and adoption processes and standards, as these vary by region and should be checked early in the planning process. The manual itself can be found here.

CIRIA also publish "Guidance on the Construction of SuDS" (C768), which contains detailed guidance on all aspects of SuDS construction, with specific information on each SuDS component available as a downloadable chapter. The downloadable chapter is available here.

Anglian Water provides guidance on their website in their Sustainable Drainage Systems available here. Applications for SuDS adoptions should be made through their website.

3.6.6 Design and Construction Guidance

The Design and Construction Guidance (DCG), part of a new Codes for Adoption covering the adoption of new water and wastewater infrastructure by water companies, contains details of the water sector's approach to the adoption of SuDS, which meet the legal

definition of a sewer. This replaces the formerly voluntary Sewers for Adoption The new guidance came into force in April 2020 and compliance by water companies in England is mandatory.

The previous standards, up to and including Sewers for Adoption Version 7, included a narrow definition of sewers to mean below-ground systems comprising of gravity sewers and manholes, pumping stations and rising mains. This essentially excluded the adoption of SuDS by water companies, except for below-ground storage comprising of oversized pipes or chambers.

The new guidance provides a mechanism for water companies to secure the adoption of a wide range of SuDS components which are now compliant with the legal definition of a sewer. There are however several non- adoptable components such as green roofs, pervious pavements, and filter strips. These components may still form part of a drainage design so long as they remain upstream of the adoptable components.

The Design and Construction Guidance states that the drainage layout of a new development should be considered at the earliest stages of design. It is hoped that the new guidance will lead to better managed and more integrated surface water systems which incorporate amenity, biodiversity, and water quality benefits.

3.7 Environmental Protection and Biodiversity

3.7.1 The Environment Act 2021

The Environment Act (HM Government, 2021) came into UK law in November 2021 with the aim of protecting and enhancing the environment. The Act has objectives to improve air and water quality, biodiversity, waste reduction and resource efficiency. The implementation of the policies within the Environment Act has begun and legally binding environmental targets are being developed. This will be enforced by the newly created Office for Environmental Protection (OEP, more information available here).

The Environment Act (Part 5) contains policies concerning improvements to the water environment. These policies have the following aims:

- Effective collaboration between water companies through statutory water management plans.
- Minimise the damage that water abstraction may cause on environment.
- Modernise the process for modifying water and sewerage company licence conditions.

Further to this, there is specific legislation regarding storm overflows aiming to reduce the discharge of untreated sewage into waterways. This plan includes requirements for water companies to:

- report on the discharges from storm overflows;
- monitor the quality of water potentially affected by discharges;

- progressively reduce the harm caused by storm overflows; and
- report on elimination of discharges from storm overflows.

3.7.2 25-year Environment Plan

The Environmental Improvement Plan (EIP) is the first revision of the 25-year environment plan (25YEP) published in 2018. It contains ten goals which are shown in Figure 3.1. The full text of the EIP can be found here. Government must review and revise the plan, if needed, every five years to ensure continued progress against the ten 25YEP goals.

Of particular importance to a IWMS is Goal 3 - Clean and plentiful water.

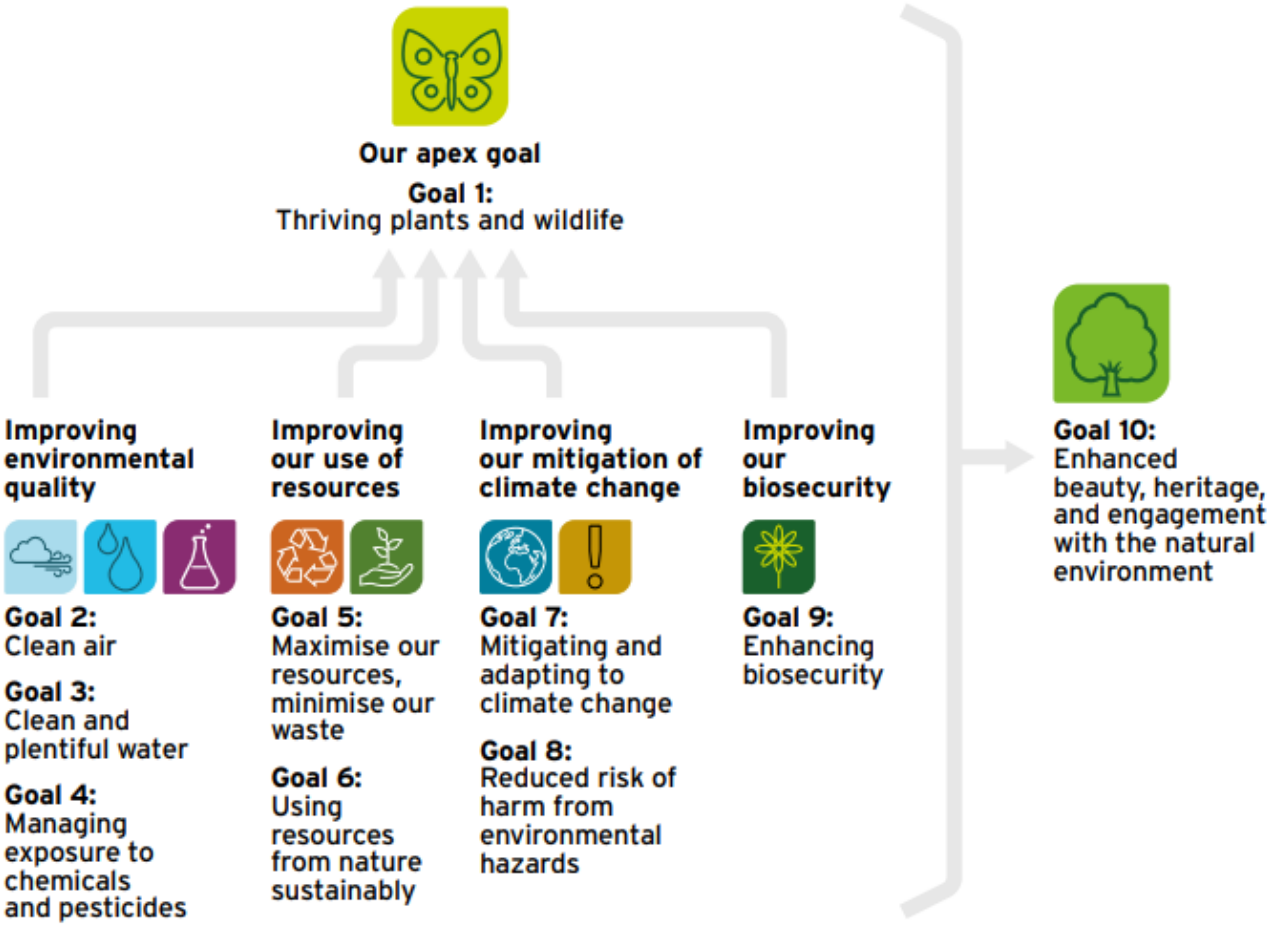


Figure 3.1: The 10 Environmental Improvement Plan goals

Under Goal 3 - Clean and plentiful water, there are eight sets of targets and commitments relating to different aspects of the water environment:

- "Reduce nitrogen, phosphorus, and sediment pollution from agriculture into the water environment by at least 40% by 2038, compared to a 2018 baseline, with an interim target of 10% by 31 January 2028, and 15% in catchment containing protected sites in unfavourable condition due to nutrient pollution by 2028.

- Reduce phosphorus loadings from treated wastewater by 50% by 2028 and 80% by 2038 against a 2020 baseline.
- Halve the length of rivers polluted by harmful metals from abandoned mines by 2038, against a baseline of around 1,500km (approximately 930 miles).
- Reduce the use of public water supply in England per head of population by 20% from the 2019-20 baseline, 2038, with interim targets of 9% by 2027 and 14% by 2032, and to reduce leakage by 20% 2027 and 30% by 2032.
- Restore 75% of our water bodies to good ecological status.
- Require water companies to have eliminated all adverse ecological impact from sewage discharges at all sensitive sites by 2035, and at all overflows by 2050.
- Target a level of resilience to drought so that emergency measures are needed only once in 500-years."

To deliver these goals, the EIP outlines action across these areas:

Improving wastewater infrastructure and water company environmental performance.

- Reducing pressures on the water environment from agriculture.
- Enabling the sustainable use of water for people, business and the environment
- Tackling pressures from chemicals and pollutants.
- Restoring natural function and iconic water landscapes.
- Joined-up management of the water system.

Progress towards delivering the EIP will be monitored annually.

3.7.3 Defra Plan for Water

Defra's Plan for Water (Department for Environment, Food & Rural Affairs, 2023) provides further detail on the actions towards achieving Goal 3 of the EIP23. It promotes an integrated approach to water management as the foundation of the plan. Whilst many of the actions contained within the Plan for Water are outside of the responsibilities of areas of influence of the LPAs, the following summarises those actions that LPAs should have regard to:

- Require standardised sustainable drainage systems (SuDS) in new housing developments in 2024, subject to final decisions on scope, threshold, and process following consultation in 2023.
- Designate all chalk catchments as water stressed and high priority under the sewer overflows reduction plan, driving action to improve water management.
- The plan reflects the predicted 4 billion litre per day (4,000 ml/d) gap between supply and demand across England and contains measures to both boost supply and reduce demand. Of interest to LPAs is the plan to reduce demand which will address half of the gap.
- A key component in reducing demand for water is improving water efficiency and there is a target under the Environment Act to reduce the use of public water supply in England per head of population by 20% by 2038.**A road map on water**

efficiency in new developments and retrofits has been developed with ten actions to improve water efficiency:

- **Action 1 - Implement schedule 3 to the Flood and Water Management Act 2010.** The 2024 consultation will consider rainwater harvesting in developing the statutory SuDS National Technical Standards.
- **Action 2 -** Review the Water Supply (Water Fittings) Regulations 1999, the Water Supply (Water Quality) Regulations 2016 and/or any other relevant legislation to address wasteful product issues with toilets and enable new water efficient technologies.
- **Action 3 –** Develop clear guidance on 'water positive' or 'net zero water' developments and roles for developers and water companies.
- **Action 4 –** Review water efficiency options in planning, building regulations and through voluntary schemes for non-household buildings.
- **Action 5 –** Work with Ofwat to ensure the water industry can play a central role in retrofitting water efficient products in households, businesses, charities and the public sector.
- **Action 6 –** Work across government to integrate water efficiency into energy efficiency advice and retrofit programmes.
- **Action 7 -** Review the Building Regulations 2010, and the water efficiency, water reuse and drainage standards including considering a new standard for new homes in England of 105l/p/d and 100 l/p/d where there is a clear local need.
- **Action 8 –**Mandatory water efficiency labelling scheme.
- **Action 9 –** Investigate dual pipe systems (rainwater harvesting) and water reuse options for new housing development as part of the review of the planning framework.
- **Action 10 –** Enable innovative water efficiency approaches in buildings, including technologies and approaches to funding and maintenance.

3.7.4 Biodiversity Net Gain

Biodiversity net gain (BNG) is designed to contribute to the recovery of nature while developing land. The principle is that the natural environment is in measurably better state after development than it was before. The Environment Act 2021 requires all planning permissions granted in England (except for small sites) to achieve 10% BNG since January 2024. This will be required on small sites from April 2024.

Defra publishes a biodiversity metric tool, the latest version of which must be used for calculating the BNG deriving from a proposed development.

3.7.5 Local Nature Recovery Strategy

The Environment Act (HM Government, 2021) also established a duty to prepare, by March 2025, Local Nature Recovery Strategies (LNRS), recognising that England is one of the

most nature-depleted countries in the world. Buckinghamshire Council are the authority responsible for preparing the LNRS for Buckinghamshire and Milton Keynes. They are tasked with working with local partners to agree priorities for nature recover and identify "practical, achievable proposals" (Department for Environment Food & Rural Affairs, 2023) to address these priorities. The LNRS should also co-ordinate with neighbouring strategies to form a national Nature Recovery Network.

There is a close linkage with BNG, as developments proposing to create, enhance or recover habitat in locations mapped by the LNRS receive a higher value in the biodiversity metric calculator than in other locations.

3.7.6 Storm Overflow Reduction Plan

The Environment Act placed a legal duty on water companies to progressively reduce the adverse impacts of discharges from storm overflows. The storm overflow reduction plan (Department for Environment, Food & Rural Affairs, 2023) sets the following targets:

- By 2035, water companies will have: improved all overflows discharging into or near every designated bating water; and improved 75% of overflows discharging to high priority sites.
- By 2050, no storm overflows will be permitted to operate outside of unusually heavy rainfall or to cause any adverse ecological harm.

There is also an expectation that water companies ensure their infrastructure keeps pace with increasing external pressures, such as urban growth and climate change, without these pressures leading to greater numbers of discharges.

3.7.7 The Water Framework Directive (WFD) and Water Environment Regulations

Introduction

The European Union Water Framework Directive (WFD) 2000 is currently transposed into English and Welsh law by the Water Environment Regulations (HM Government, 2017). They apply to all waterbodies (watercourses, canals, lakes, estuaries and coastal waters), with the objective of meeting Good Ecological Status (GES) or, where heavily modified, Good Ecological Potential (GEP) To meet GES or GEP, a water body must achieve a good or high score for all elements - in the case of surface water, these are biological, physico-chemical, specific pollutants and hydromorphology (Figure 3.2). UK policy remains to meet GES or GEP for all waterbodies by 2027.

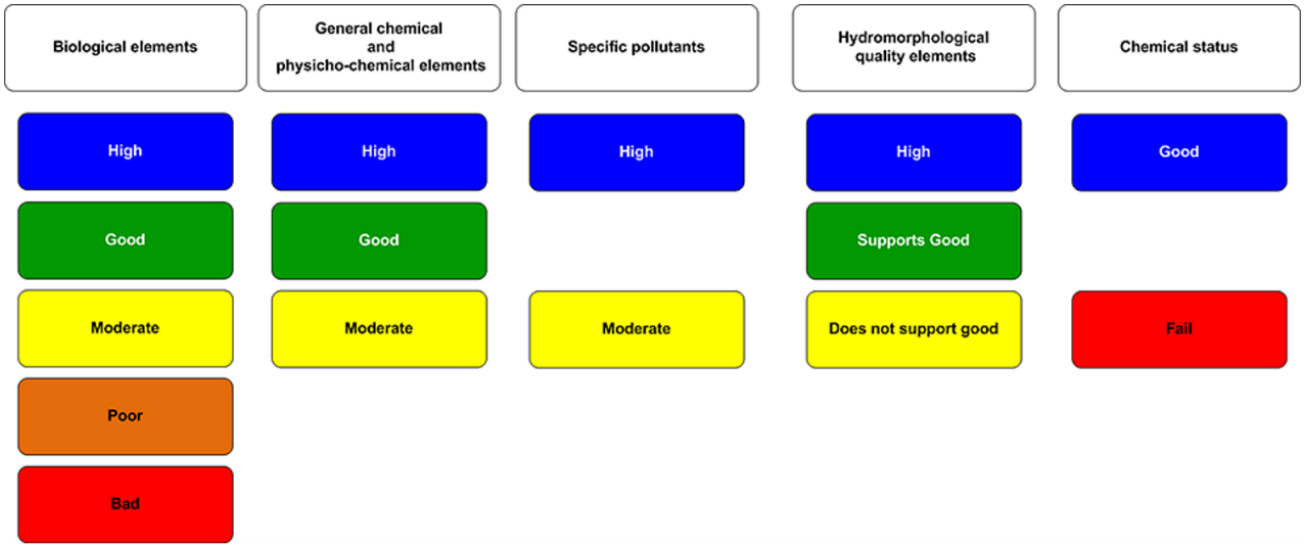


Figure 3.2: Status classification for surface water (Environment Agency, 2023a)

Chemical Status is separately assessed. The Water Framework Directive and the EA recognise a group of ubiquitous chemicals which are persistent, bioaccumulative or toxic (uPBT), and without which over 90% of England's waterbodies would achieve Good Chemical Status. Mercury, PFOS and PBDE are the most ubiquitous causes of failures. Due to the persistent nature of these chemicals, the date for getting all waterbodies to Good Chemical Status is set for 2063.

River Basin Management Plans

River Basin Management Plans (RBMP) are required under the WFD and document the baseline classification of each waterbody in the plan area, the objectives, and a programme of measures to achieve those objectives. Milton Keynes falls within the Anglian RBD .The third cycle RBMPs were published in 2022. A primary WFD objective is to ensure 'no deterioration' in environmental status, therefore all water bodies must meet the class limits for their status class as declared in the Anglian and Thames River Basin Management Plan. Another equally important objective requires all water bodies to achieve good ecological status. Future development needs to be planned carefully so that it helps towards achieving the WFD and does not result in further pressure on the water environment and compromise WFD objectives. The WFD objectives as outlined in the updated RBMPs are summarised below:

- Preventing deterioration of the status of surface waters and groundwater.
- Achieving objectives and standards for protected areas.
- Aiming to achieve good status for all water bodies.
- Reversing any significant and sustained upward trends in pollutant concentrations in groundwater.
- Cessation of discharges, emissions and losses of priority hazardous substances into surface waters.

- Progressively reducing the pollution of groundwater and preventing or limiting the entry of pollutants.
- Local Planning Authorities (LPAs) must have regard to the Water Framework Directive as implemented in the RBMPs. It is of primary importance when assessing the impact of additional wastewater flows on local river quality.
- Alongside the RBMP documents, the data behind them can be explored further using the Catchment Data Explorer (Environment Agency, 2023a) and map viewer (Environment Agency, 2023b).

Protected Area Objectives

The Water Environment Regulations specify that areas requiring special protection under other EC Directives, and waters used for the abstraction of drinking water, are identified as protected areas. These areas have their own objectives and standards.

Some areas may require special protection under more than one piece of EU-derived legislation or may have additional (surface water and/or groundwater) objectives. In these cases, all the objectives and standards must be met.

The types of protected areas are:

- Areas designated for the abstraction of water for human consumption (Drinking Water Protected Areas);
- areas designated for the protection of economically significant aquatic species (Freshwater Fish and Shellfish);
- bodies of water designated as recreational waters, including Bathing Waters;
- nutrient-sensitive areas, including areas identified as Nitrate Vulnerable Zones under the Nitrates Directive or areas designated as sensitive under Urban Waste Water Treatment Regulations; and
- areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection including relevant Natura 2000 sites.

3.7.8 Conservation of Habitats Regulations 2017 (as amended)

The Conservation of Habitats and Species Regulations 2010 (commonly referred to as the Habitats Regulations) consolidated the Conservation (Natural Habitats, &c.) Regulations 1994, and transposed the EU Habitats Directive in England and Wales which was aimed at protecting plants, animals and habitats that make up the natural environment. The regulations were further amended in 2017.

The Habitats Regulations define the requirement for a Habitats Regulations Assessment (HRA) to be carried out. The purpose of this is to determine if a plan or project may affect the protected features of a “habitats site”. These include:

- A Special Area of Conservation (SAC) or candidate SAC.
- A Site of Community Importance (SCI).

- A site hosting a priority natural habitat type or priority species protected in accordance with Article 5(4) of the Habitats Directive.
- A Special Protection Area (SPA) or potential SPA.
- Ramsar sites.

All plans and projects (including planning applications) which are not directly connected with, or necessary for the conservation management of a habitat site require consideration of whether the plan or project is likely to have significant effects on that site.

This is referred to as the “Habitats Regulations Assessment screening” and should take into account the potential effects of both the plan/project itself and in combination with other plans or projects.

Part 6 of the conservation of Habitats and Species Regulations 2017 states that where the potential for likely significant effects cannot be excluded, a competent authority must make an appropriate assessment of the implications of the plan or project for that site, in view of the site’s conservation objectives.

The competent authority may agree to the plan or project only after having ruled out adverse effects on the integrity of the habitats site.

If adverse effects cannot be ruled out, and where there are no alternative solutions, the plan or project can only proceed if there are imperative reasons of over-riding public interest and if the necessary compensatory measures can be secured.

The “People over Wind” ECJ ruling (C-323/17) clarifies that when making screening decisions for the purposes of deciding whether an appropriate assessment is required, competent authorities cannot take into account any mitigation measures. This must be part of the appropriate assessment itself.

The implementation of the Conservation of Habitats Regulations have had particular significant implications in two areas related to water and planning:

- Nutrient Neutrality. Natural England (NE) has identified a number of catchment areas where Habitats Sites are in unfavourable condition due to eutrophication (an excess of the nutrients phosphorous and/or nitrogen in water). NE have advised that developments in these catchments must demonstrate that they do not cause harm, and that one way to do this is to introduce mitigation measures in the catchment area which offset the additional nutrients emitted as a result of the development, an approach known as nutrient neutrality. There are no parts of the study area which are currently within a nutrient neutrality catchment area, however NE may designate additional areas in the future.
- Water Neutrality. Natural England (NE) has issued a position statement that it cannot be concluded with sufficient certainty that groundwater abstractions in the Arun Valley, West Sussex are causing no adverse effect on Habitats Sites. NE have advised that developments in Sussex North Water Resource Zone must demonstrate that they do not cause harm, and that one way to do this is to

introduce mitigation measures in the zone which offset the additional water consumed as a result of the development, an approach known as water neutrality. [There are no parts of the study area which are currently within a water neutrality zone, however NE may designate additional areas in the future.

Both nutrient and water neutrality designations have resulted in significant impacts on the granting of planning permission in the designated areas.

3.7.9 Wildlife and Countryside Act

Sites of Special Scientific Interest (SSSI) are designated and legally protected under the Wildlife and Countryside Act 1981, Section 28G places a duty to take reasonable steps, consistent with the proper exercise of the authority's functions, to "further to the conservation and enhancement of the flora, fauna or geological or physiographical features by reason of which the site is of special scientific interest." (HM Government, 1981).

The Government's 25-year Environment Plan has a target of "restoring 75% of our one million hectares of terrestrial and freshwater protected sites to favourable condition, securing their wildlife value for the long term." In line with this, and the Wildlife and Countryside Act 1981, Local Authorities should look put forward options that contribute to conservation or restoration of favourable condition, and at the very least must not introduce policies that hinder the restoration of favourable condition by increasing existing issues.

A site is said to be in "favourable condition" when the designated feature(s) within a unit are being adequately conserved and the results from monitoring demonstrate that the feature(s) in the unit are meeting all the mandatory site-specific monitoring targets set out in the favourable condition targets (FCT).

3.7.10 Ramsar

The Convention on Wetlands of International Importance, more commonly known as the Ramsar convention, aims to protect important wetland sites. Member counties commit to:

- Wise use of all their wetlands.
- Designating sites for the Ramsar list of "Wetlands of International Importance" (Ramsar Sites) and their conservation.
- Cooperating on transboundary wetlands and other shared interests.
- "Wise use" of wetlands is defined under the convention as "the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development". (Ramsar Convention Secretariat, 2010)
- In the UK, Ramsar Sites are designated by the Joint Nature Conservation Committee (JNCC).

In general, the designation of UK Ramsar sites is underpinned through prior notification of these areas as Sites of Special Scientific Interest (SSSIs). Additionally, the NPPF states

that Ramsar sites should be given the same protection in the planning process as sites designated under the EU Habitats Directive.

3.7.11 Bathing Water Regulations

The Bathing Water Directive was first published in 2006 and are currently transposed into English and Welsh law through the Bathing Water Regulations 2013. The aims of the directive are the protection of public health whilst bathing, standardisation of publicly available water quality information and to improve management practices at bathing waters.

The UK has over 600 designated bathing waters defined as areas of inshore waters designated for public swimming, these areas are typically characterised by large numbers of swimmers and visitors per year. The Environment Agency are required to monitor water quality at these sites regularly (usually weekly) throughout the Bathing Water season, between 15th May and 30th September.

Water quality standards are based on the incidence of potentially harmful bacteria, E. coli and intestinal enterococci and are categorised as ‘excellent’, ‘good’, ‘sufficient’ or ‘poor’ on the basis of bacteria levels. Sites are rated annually and on a short-term basis in response to any temporary pollution incidents.

Achieving compliance with the Bathing Water Directive has driven some £2.5bn of investment by UK water companies since the early 1990s to reduce the impact of sewerage systems and treated wastewater discharges. Measures have included storage and surface water management to reduce storm overflow spills, moving or extending effluent outfalls and improving wastewater treatment, including ultra-violet (UV) treatment of final effluent.

In contrast to some other European nations, the UK has not previously designated stretches of river as bathing waters, however five new inland bathing waters have been designated since 2021, and across England there are numerous campaigns by NGOs and members of the public to designate other stretches of river. Defra has published guidance on applying for bathing water status, including a requirement for at least 100 bathers per day during the season (Department for the Environment, Food and Rural Affairs, 2023).

3.7.12 Environmental Permitting Regulations

Environmental permitting is a process used to manage and regulate activities which may cause harm to the environment. The Environmental Permitting Regulations (HM Government, 2016) were introduced in order to streamline a wide-ranging number of environmental permitting laws under one set of regulations. These include permits for emissions to air, water and land, and cover a range of industrial sectors and waste management streams.

Of particular relevance to this study are the regulations for permitting sewage effluent discharges to surface waters and groundwaters, known as water discharge activities (Environment Agency, 2022).

- The regulations are used to permit discharges from water company and private wastewater treatment works, and for sewer overflows.
- The Environment Agency will usually object to applications for a new private Package Treatment Plan (PTP) or septic tank where it is feasible to connect the development to a public sewerage system. A general rule of 30m per dwelling is used to define a reasonable distance from the site boundary to a public sewer. Hence a development of 10 homes should connect to a public sewer within 300m of the boundary, unless there are significant barriers, such as a river or motorway.
- Where an existing or new development treats its own wastewater, a PTP must be installed if the discharge is directly to surface water. Where the discharge is to ground, a PTP or septic tank may be used, but must be connected to a suitably designed drainage field.

3.7.13 Groundwater protection

Under the regulations, the EA have published a set of position statements on protecting groundwater from various activities (Environment Agency, 2018). The position statements that are relevant to this study with regard to discharges to groundwaters, include surface water drainage and the use of SuDS, discharges from contaminated surfaces (e.g., lorry parks) and from treated sewage effluent.

The EA also maintain a set of maps of Source Protection Zones (SPZs) to help identify high risk areas within which pollution prevention measures should be implemented. The SPZs show the risk of contamination to public water supplies from activities that may cause pollution in the area, the closer the activity, the greater the risk:

- **Zone 1 (Inner protection zone)** This zone is designed to protect against the transmission of toxic chemicals and water-borne disease. It indicates the area in which pollution can travel to the borehole within 50 days from any point within the zone and applies at and below the water table. There is also a minimum 50 metre protection radius around the borehole.
- **Zone 2 (Outer protection zone)** This zone indicates the area in which pollution takes up to 400 days to travel to the borehole, or 25% of the total catchment area, whichever area is the largest. This is the minimum length of time the Environment Agency think pollutants need to become diluted or reduce in strength by the time they reach the borehole.
- **Zone 3 (Total catchment)** This is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.
- **Zone of special interest** This is defined on occasions, usually where local conditions mean that industrial sites and other polluters could affect the groundwater source even though they are outside the normal catchment.

3.8 Summary of key new and emerging policy and legislation

The policy and legislation covering the water environment, water and wastewater services and planning is wide and frequently changing. The new and emerging policy and legislation below have been identified as particularly important for consideration in the development of the Local Plan:

- Schedule 3 of the Flood and Water Management Act is expected to be enacted in England in 2024. This will designate Lead Local Flood Authorities as SuDS Approval Bodies (SABs) with a duty to adopt new SuDS and removing the automatic right to connect to public sewers.
- Defra have signalled their intention, with the Plan for Water, to review the water efficiency standards for new homes, including consideration of a new national 105l/p/d standard and 100l/p/d where there is a clear local need.
- All development sites will be expected to demonstrate at least a 10% net-gain in biodiversity from 2024.
- The designation of specific catchments in England as requiring to demonstrate Nutrient Neutrality under the Conservation of Habitats Regulations has led to significant limitations to development in these areas, as well as the development of offsetting schemes to enable nutrient-neutral development. The government (Defra, 2024) has instructed competent authorities (including LPAs) undertaking HRAs for development draining via a sewer to a wastewater treatment works in nutrient sensitive areas to consider that the nutrient pollution standard will be met by 2030. At the time of writing, this notice was the subject of a legal challenge.
- Similarly, the availability of water resources, and the impact of new water demand on the environment, has led to restrictions on granting planning permission in Sussex North WRZ and a requirement to demonstrate water-neutral development in Cambridge Water WRZ. It is anticipated that LPAs will be increasingly required to demonstrate that there will be sufficient water resources to supply development without causing further harm to the environment through the life of their Local Plans.

3.9 Links to other plans

3.9.1 Phase 1 Water Cycle Study recommendations

In 2018 AECOM undertook a Phase 1 Water Cycle Study (WCS) for Milton Keynes Council (MKC). The purpose of a WCS was to form part of a comprehensive and robust evidence base for the preparation of Plan:MK Phase 1 of that WCS is a scoping study and focusses on identifying issues and considerations which can be later built upon in phase 2. The report produced set out a vision and framework for development in the area up to 2036. to the report has been used to inform decisions on the location of future development.

Recommendations from the Phase 1 WCS included a review of the WRC capacity, communication, and SuDS. There report an emphasises on keeping the lines of

communication open between neighbouring councils, MKC (now MKCC) and Anglian Water to ensure supply demand balance is met.

Another theme of the WCS, produced by AECOM, is the move towards having a more 'water neutral position' including water efficiency retrofitting and encouraging individuals to retrofit their properties.

It needs to be noted that there has been significant change in the status of water resources since 2018 in the Anglian Water supply zone. Subsequently, this Phase 1 WCS overview is included for consistency, to show previous work carried out for Milton Keynes and to be shown in contrast to AWs current rdWRMP and DWMP.

3.9.2 Overview of Milton Keynes 2050 Strategy

Built in the late 1960s, Milton Keynes was created to increase housing availability in the south of England. In the 2016-2031 Milton Keynes local plan a deadline of 2022 was adopted to present and adopt its sustainability strategy for 2050; this strategy is the current Milton Keynes 2050 strategy plan which can be found here.

In response to concerns over climate change and needs for adaptation, MKCC declared a Climate Emergency and adopted the MK Sustainability Strategy 2019 - 2050 on the 23rd January 2019. The strategy notes that the climate change is real, and its detrimental impact is recognised. The ambition to become the 'Greenest City in the World' was set and elaborated in the strategy in the form of a framework with key aims and priorities for action. The priorities are goals for Council teams to work towards, so carbon emissions are brought down to zero by 2050. Work to deliver the Sustainability Strategy is ongoing, with annual updates on the Sustainability Strategy Action Plan provided to Cabinet (latest update was given on 7 February 2023).

Although the plan does not lay out strategies for specific developments, due to them being the responsibility of individual councils, the plan highlights the council's vision and goals leading up to 2050.

Milton Keynes' plan for addressing climate change is presented. This includes the promotion of reusing "brownfield" sites and connecting them with electric transport and the sustainable building. Sustainable builds will incorporate maximising solar gain by building position and the installation of water and energy efficient appliances and technologies.

In March 2018 the Milton Keynes Waste Recovery Park was opened, working towards recycling material and water. The average resident in Milton Keynes uses 131 l/p/d compared to the national average of 150 l/p/d. The Milton Keynes 2050 strategy aims to decrease this to 110 l/p/d by increasing reliance on Rainwater Harvesting (RwH) and Grey Water Recycling (GwR).

The 2050 strategy also recognises water management and prevention of flooding as subjects to be worked upon. Acknowledgement is taken that some of the older sewage and water management systems may not be up to current day standards and lack capacity for

the growing population. Subsequently, this report was commissioned to lay out an integrated water management strategy.

3.9.3 Anglian Water Drought Plan

Managing drought can reduce water stress in warmer weather. The AW drought plan was published in 2022 and identifies AWs drought prone areas and how AW plan for drought. The plan identified AWs main issues as aquifer recharge and reservoir refill in warmer, dry weather. In spring and summer surface water flows are also identified as an issue. Knowing this, diversifying water resources may not be the best way to manage water within Milton Keynes. Actions such as increasing water efficiency via retrofitting and water recycling would be more beneficial.

Although the area AW covers is drought prone, Milton Keynes itself is not. Milton Keynes's neighbouring Water Resource Zones (WRZs) are prone to drought and at risk from impact of climate change. This is important to note because of water transfers between the WRZs.

4 Baseline

4.1 Study area

The Local Planning Authority (LPA) area of Milton Keynes City Council is shown in Figure 4.1. The study area covers the whole of Milton Keynes city as well as some land to the north of the city. It is in the water supply area of Anglian Water who also provide wastewater services.

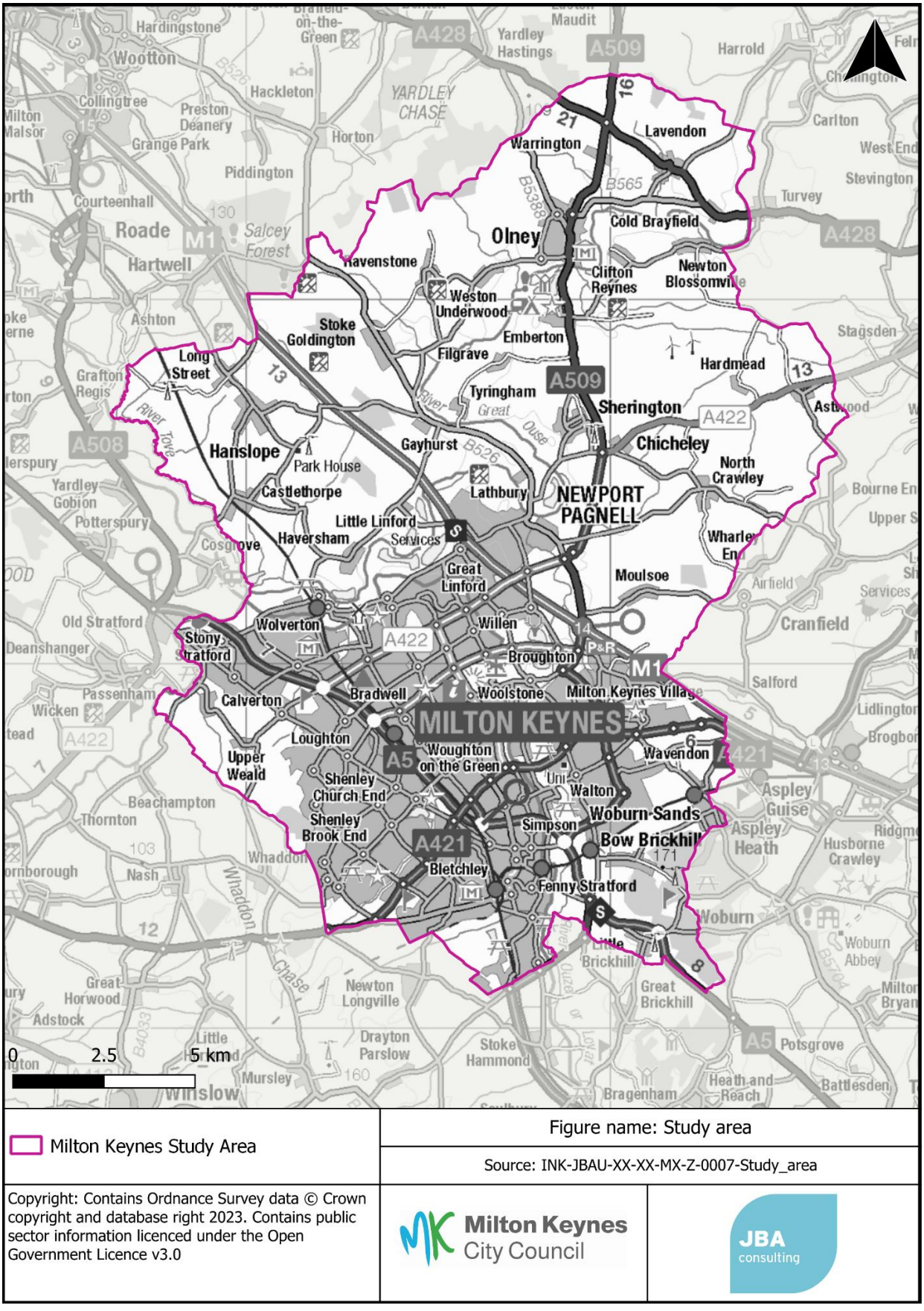


Figure 4.1 Milton Keynes study area

4.2 Milton Keynes in the wider area

4.2.1 Overview

This section provides an understanding of how Milton Keynes fits into the wider catchment. By understanding Milton Keynes' position in the catchment, it can help in understanding how best to implement an IWMS.

4.2.2 River basin district

Waterbodies in the UK are divided up into catchments following the hierarchy below in Figure 4.2.

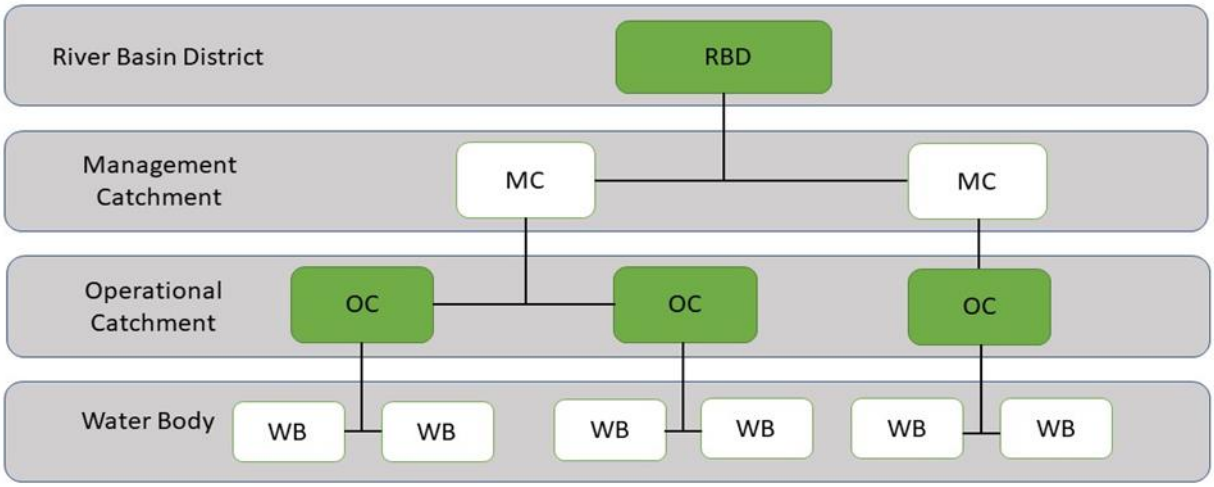


Figure 4.2 WFD catchment hierarchy

Milton Keynes is within the Anglian River Basin District (RBD) shown in Figure 4.3.

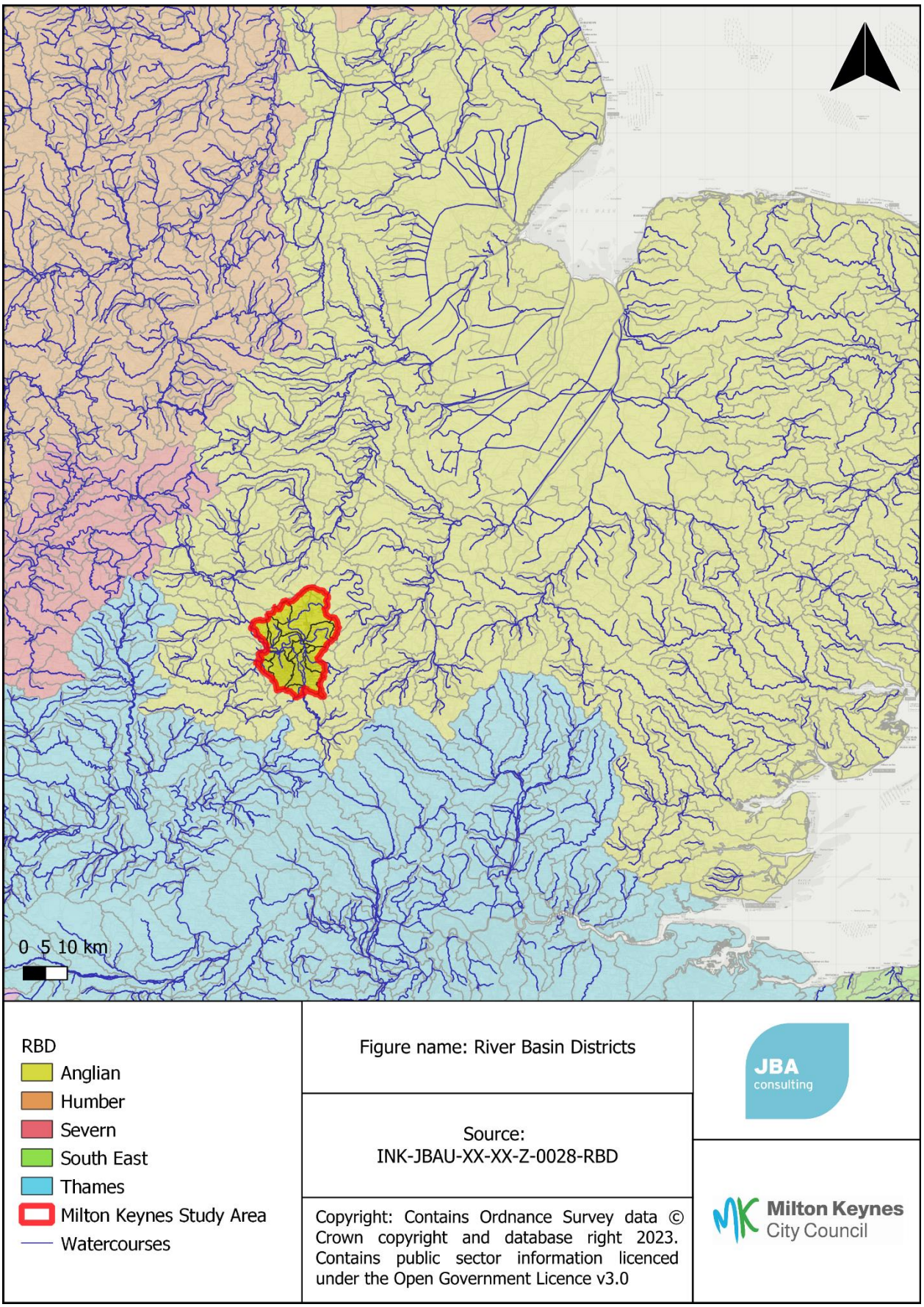


Figure 4.3 Location of Milton Keynes in the Anglian River Basin District (RBD)

One of the challenges identified in the River Basin Management Plan (RBMP) for the Anglian Basin is alterations to “natural flow levels of water”. The management recommendations from both RBMP’s are listed below:

Government and agencies (Environment Agency) grant licences under the Water Resources Act 1991 to regulate how much water is taken from rivers, lakes estuaries and groundwater. The Environment Agency reviews the sustainability of time-limited abstraction licences as they expire, and the licence holders seek replacement licences.

All sectors take up or encourage water efficiency measures, including water industry work on metering, leakage, audits, providing water efficient products, promoting water efficiency and education.

- Local Government sets out local plan policies requiring new homes to meet the tighter water efficiency standard of 110 litres per person per day as described in Part G of Schedule 1 to the Building Regulations 2010.
- Industry manufacturing and other business implement tighter levels of water efficiency, as proposed by changes to the Building Regulations.
- Agriculture and rural land management manage demand for water and use water more efficiently to have a sustainable water supply for the future.
- Local government commissions water cycle studies to inform spatial planning decisions around local water resources.
- The RBMP goes on to state that “dealing with unsustainable abstraction and implementing water efficiency measures is essential to prepare and be able to adapt to climate change and increased water demand in the future.”

4.2.3 Management Catchments

Three management catchments are present within Milton Keynes:

- Great Ouse Bedford
- Great Ouse Upper
- Ouzel and Milton Keynes

These are broken down further into operational catchments shown in Figure 4.4**.**

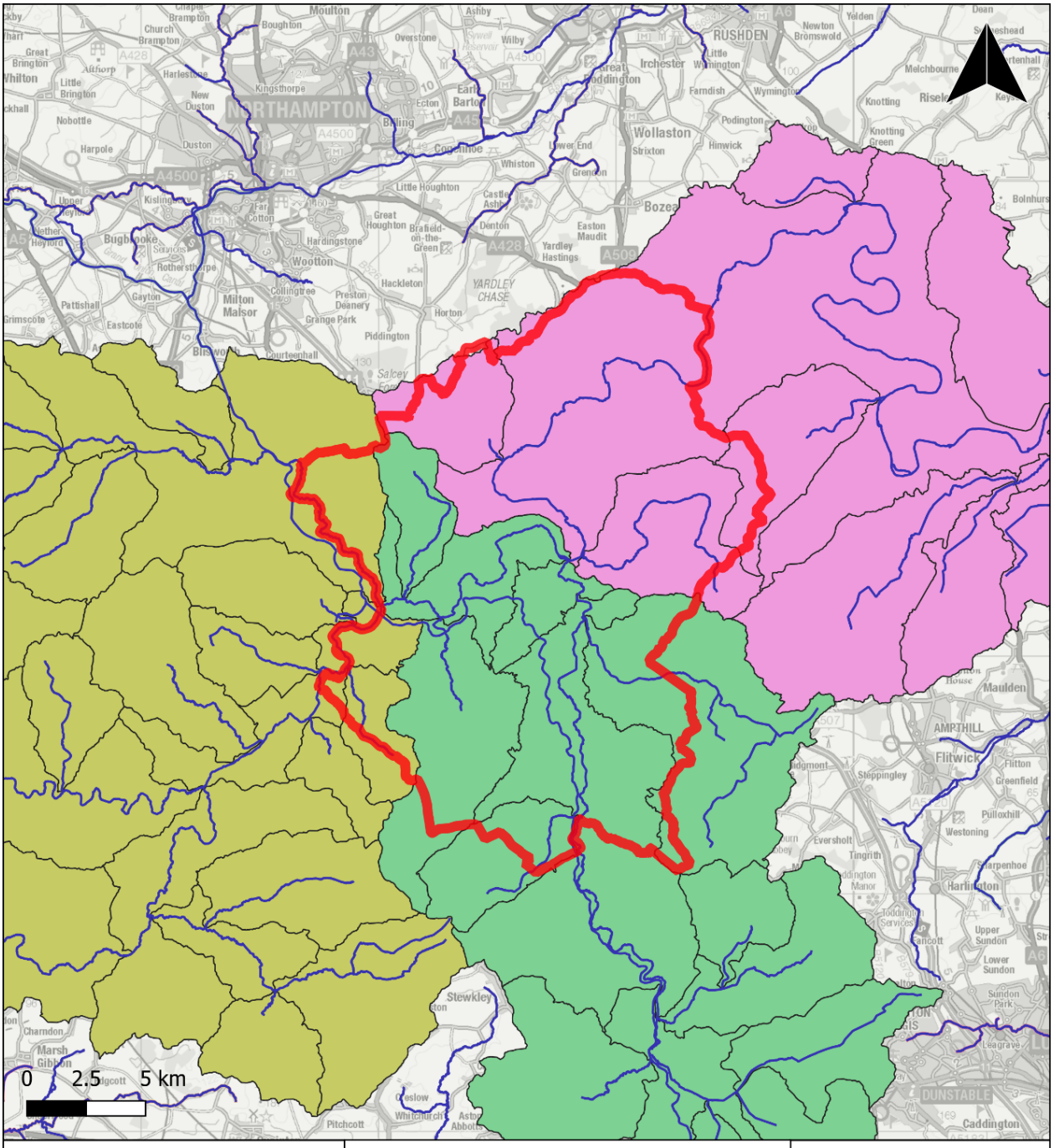


Figure 4.4 Management catchments covering Milton Keynes

4.2.4 Surface waterbodies

Figure 4.5 shows the main watercourses within the study area (Anglian Water b, 2022).

Tributaries of the river Great Ouse and Ouzel run throughout the Milton Keynes study area. The Ouzel US Caldecott Mill also runs through the centre of the city flowing towards the north of the city.

There are several brooks that feed the watercourses in Milton Keynes. The Loughton brook drains west out of the study area with the Tathall brook draining into the Ouse River (Wolverton to Newport Pagnell). Broughton Brook is also located to the east of the study area; remedial action has been identified here to offset the effects of Anglian Water's abstraction from Woburn Sands aquifer.

Most rivers in the catchment are classified as Heavily Modified Water Bodies (HMWB) because of the structures implemented to control flows (UK Government l, 2014). The Grand Union Canal is a man-made waterbody that runs through the centre of Milton Keynes, linking northwards to Coventry, Birmingham and the wider canal network and south to London.

Chalk streams are an important and rare habitat and are particularly sensitive to abstraction of water. The recently published Natural England chalk stream mapping was used to identify if there were chalk streams present within the study area. The dataset uses 1:50,000 Biodiversity Action Plan (BAP) chalk river data, BGS geology, the World Wide Fund for Nature (WWF) report "The State of England’s Chalk Streams" and stakeholder knowledge to produce an updated chalk river network for England. The nationally defined Natural England dataset may not include all chalk streams within Milton Keynes, and therefore coverage of chalk streams within Milton Keynes will be reviewed in the Stage 2 WCS. This will consider any local designations, which are currently being assessed by conservation groups. Designation of a chalk stream depends on the interaction between the stream and the underlying geology and the resulting characteristics of the river. The presence of chalk geology does not necessarily mean the river will be classified as a chalk

stream.

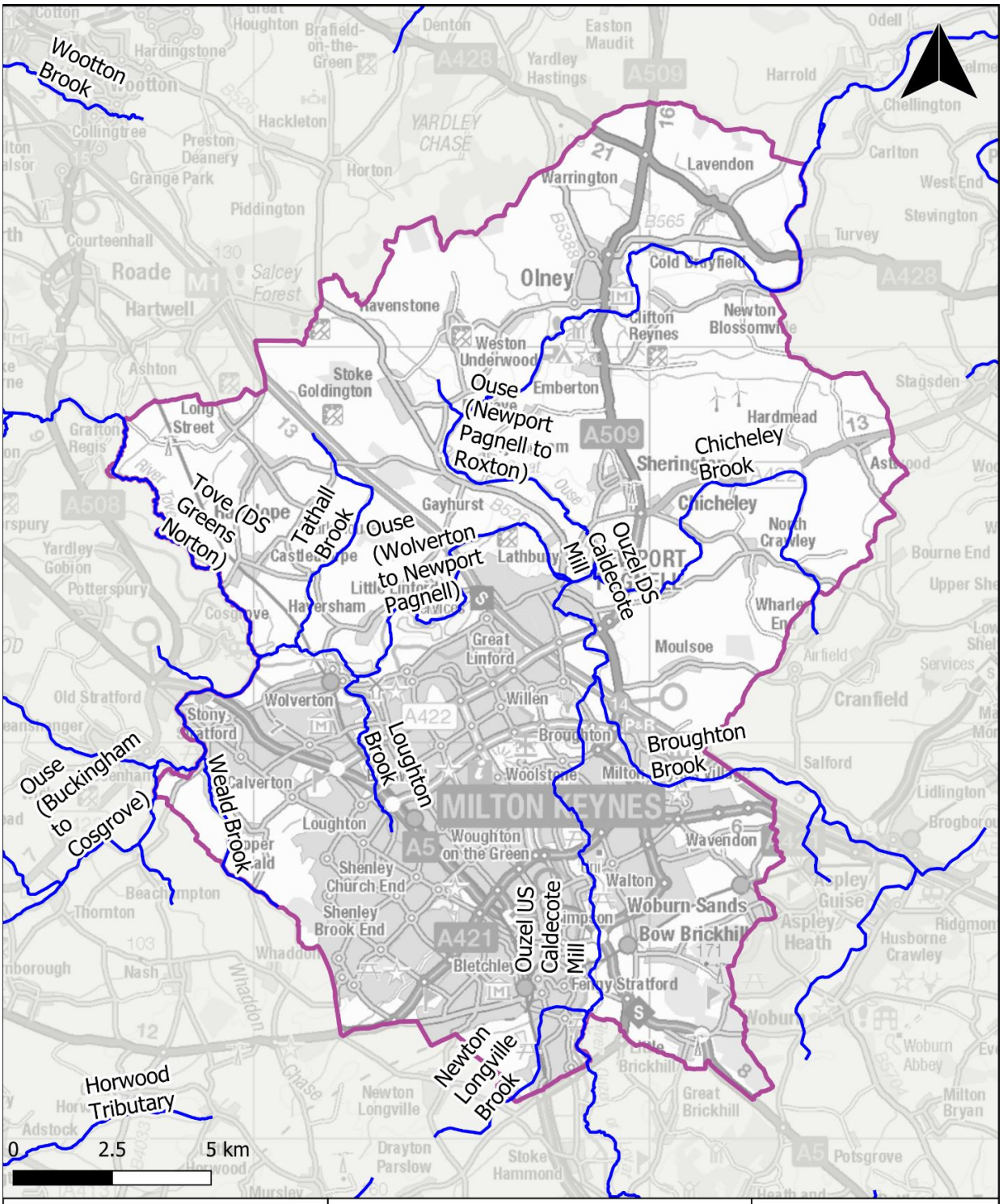


Figure 4.5 Significant watercourses within Milton Keynes.

4.3 Geology

4.3.1 Geology overview

The geology of a catchment can be important influencing factor in the way that water runs off the ground surface. This is primarily due to variation in the permeability of the surface material and bedrock stratigraphy. Figure 4.6 shows the bedrock geology of the Milton Keynes study area which has two distinct geological bands. To the north of the study area there is mainly mudstone, siltstone, and sandstone with a pocket of chalk to the southwest. In the south there is a band of mudstone, siltstone, and sandstone with a small section of sandstone and mudstone to the southeast.

Figure 4.7 shows superficial (at the surface) deposits of till are predominantly present with alluvium deposits along the river Ouzel tributaries. There are two small glacial sand and gravel deposits to the south and the west of the study area.

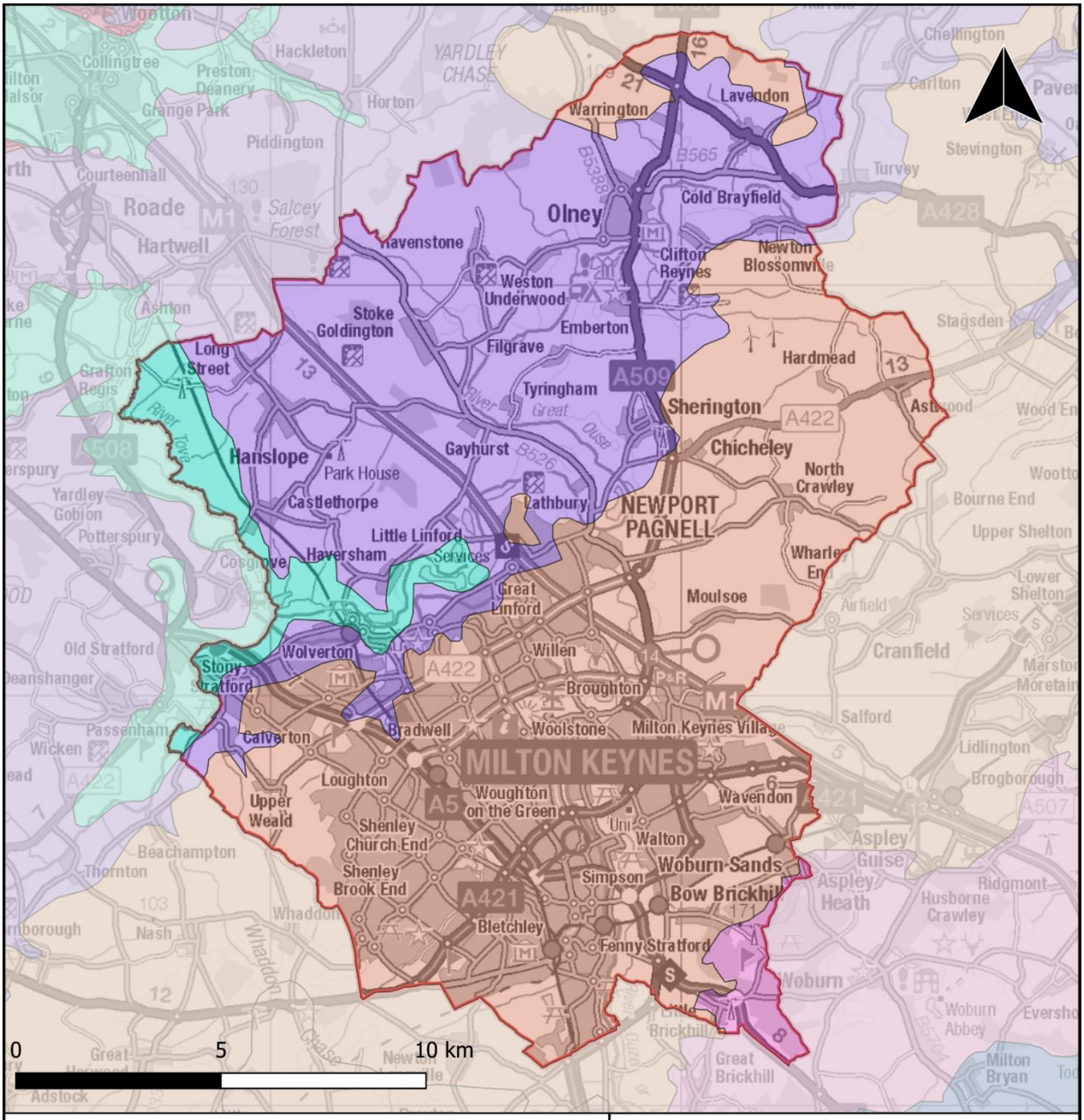


Figure 4.6 Milton Keynes Bedrock Geology

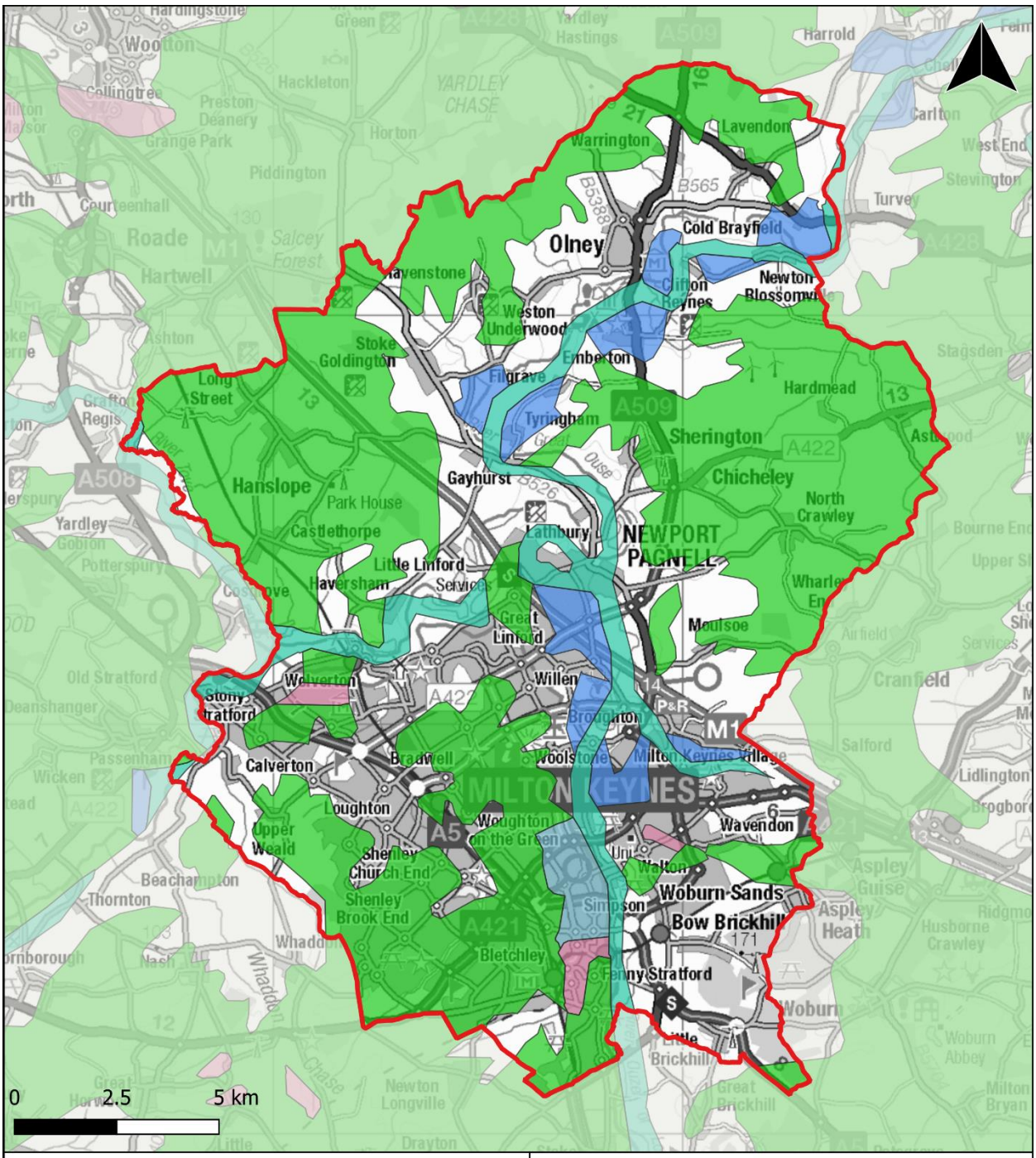


Figure 4.7 Milton Keynes superficial (at surface) geology.

4.3.2 Groundwater

There are three main groundwater sources within the Milton Keyes study area shown in Figure 4.8.

To the south-west of the study area there is the Upper Bedford Ouse Woburn Sands. Above Newport Pagnell there are two groundwater sources called the Upper Bedford Ouse Principle Oolite 2 and Upper Bedford Ouse Oolite Secondary. To the south outside of the study area there is the Northampton Sands groundwater body.

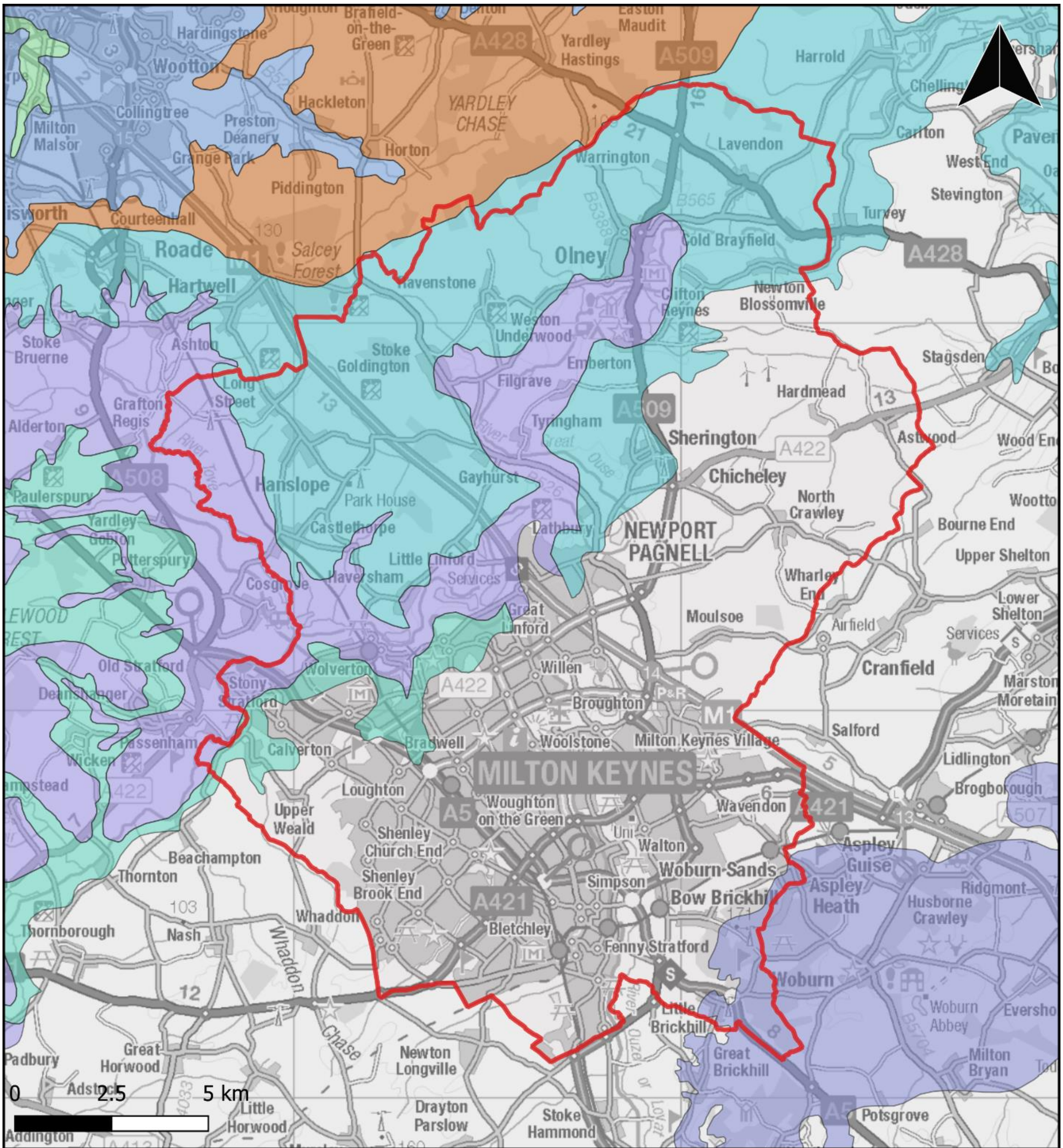


Figure name: Groundwater

Source: INK-JBAU-XX-XX-MX-Z-0012-Groundwater

Figure 4.8 Groundwater in Milton Keynes

4.3.3 Groundwater Protection

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

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

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

The EA have published a position paper outlining its approach to groundwater protection which includes direct discharges to groundwater, discharges of effluents to ground and surface water runoff (Environment Agency f, 2018). This is of relevance to this water cycle study where a development may manage surface water through SuDS.

Groundwater is an important source of water in England and Wales, and half of Milton Keynes water supply is derived from groundwater sources.

Sewage and trade effluent

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

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

Generally, the Environment Agency will only agree to developments involving release of sewage effluent, trade effluent or other contaminated discharges to ground if it is satisfied that it is not reasonable to make a connection to the public foul sewer. The developer would have to provide evidence of why the proposed development cannot connect to the foul sewer in the planning application. This position will not normally apply to surface water run-off via sustainable drainage systems and discharges from sewage treatment works operated by sewerage undertakers with appropriate treatment and discharge controls.

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

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

Discharge of clean water

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

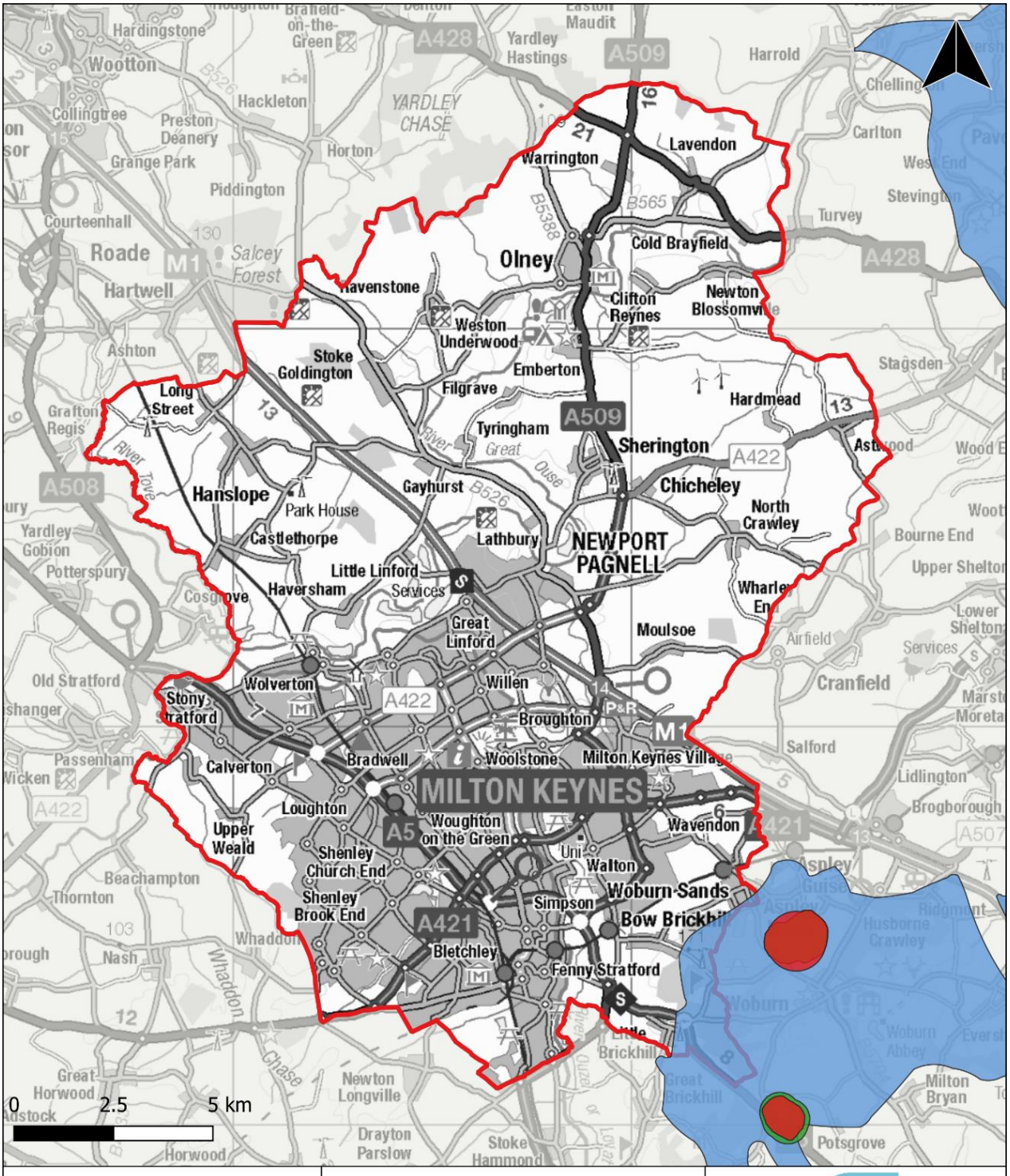
Where infiltration SuDS schemes are proposed to manage surface runoff they should:

- be suitably designed.
- meet Government non-statutory technical standards for sustainable drainage systems (UK Government m, 2015) – these should be used in conjunction with the NPPF and PPG
- and use a SuDS management treatment train (see section 8.4)

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

Source Protection Zones in Milton Keynes

The Source Protection Zones (SPZs) that are present in the study are shown in Figure 4.9. There are minimal SPZs in the study area. A small part covers the south side of the study area over Woburn and Aspley Guise. Outside of the study area to the north, there is another patch of SPZs over Pavenham and Bromham.



Source Protection Zones
- Zone 1 inner protection zone
- Zone 2 outer protection zone
- Zone 3 total catchment
- Milton Keynes Study Area

Figure name:
Source protection zones

Source: INK-JBAU-XX-XX-MX-Z-0002-Milton_Keynes_Catchments

Figure 4.9 Source Protection Zones in Milton Keynes

4.4 Flooding

Depending on the proximity to watercourses, topography and geology, risk of flooding can vary. The Anglian River Basin District Flood Risk Management Plan (Environment Agency a, 2022) has identified that the Bletchley area is a Flood Risk Area (FRA) due to the risk of surface water flooding. Although the FRA is 9km^2 over Bletchley, the wider area of Milton Keynes should be incorporated because of flood risk varying with topography of the area.

Within the stage 1 Strategic Flood Risk Assessment (SFRA) JBA has carried out for MKCC, a number of flood risks have been identified, see Table 4.1.

Table 4.1 Flood risk to Milton Keynes from JBAs Level 1 SFRA.

Flood type	Sources of flood type in Milton Keynes
Fluvial	The primary fluvial flood risk in Milton Keynes is along the River Great Ouse and its tributaries, including the River Ouzel and River Tove. Areas where there are properties at risk from Main River flooding include Newport Pagnell, New Bradwell, Bletchley and Water Eaton, Stoney Stratford and Tongwell.
Surface Water	Surface water flooding mainly follow topographical flow paths as well as existing watercourses or dry valleys. Milton Keynes is designated as a FRA due to surface water flooding.
Sewer	Most of the 2,342 Anglian Water historic sewer flooding data points in Milton Keynes are located to the south of the borough boundary in the city centre. There are also small clusters to the north of the study area in Castlethorpe, Hanslope, Ravenstone, Olney and Sherington.
Groundwater	The areas with the highest risk of groundwater flooding generally follow the flow paths of the major watercourses in Milton Keynes, particularly along the River Great Ouse and its tributaries.
Canals	There is one canal in Milton Keynes Borough: the Grand Union Canal. This has the potential to interact with other watercourses and become a flow path during flood events or in a breach scenario. There have been 2 recorded incidents of breach and 2 of overtopping on the Grand Union Canal.
Reservoirs	There is a risk of reservoir flooding in and around the study area. Inspection and maintenance required under the Reservoir Act means that the risk of flooding is relatively low.

4.5 Water Resources

4.5.1 Water Resource Management Plans Summary

Water Resource Management Plans (WRMPs) are 50-year strategies that water companies are required to prepare, with full updates every five years. WRMPs are required to assess:

- Future demand (due to population and economic growth).
- Future water availability (including the impact of sustainability reductions).
- Demand management and supply-side measures (e.g., water efficiency and leakage reduction, water transfers and new resource development).
- How the company will address changes to abstraction licences.
- How the impacts of climate change will be mitigated.
- Where necessary, they set out the requirements for developing additional water resources to meet growing demand and describe how the balance between water supply and demand will be balanced over the next 50 years.
- Using cost-effective demand management, transfer, trading, and resource development schemes to meet growth in demand from new development and to restore abstraction to sustainable levels.
- In the medium to long term, ensuring that sufficient water continues to be available for growth and that the supply systems are flexible enough to adapt to climate change.

4.5.2 Water Resource Zones

A Water Resource Zone (WRZ) represents the largest area in which all resources can be shared effectively. They are usually self-contained and defined by their infrastructure connectivity and geographic or physical boundaries. Customers within a WRZ share the same level of resilience.

Anglian Water provides both water supply and wastewater management to 27,500 km^2 of the east of England. Anglian Water manages the provision of water to 4.3 million people through 28 WRZs. The WRZs covering Milton Keynes are shown in Figure 4.10.

Anglian Waters supply is split 50/50 between surface water and groundwater. Surface water is supplied by 8 raw water reservoirs and 8 direct supply rivers intakes. The other 50% supplied by groundwater is made up by 200 water sources and 400 boreholes varying from 10m-500m depths. The WRMP identifies this 50/50 split as complex, with rock type often effecting the chemical composition of the water meaning tailored water management is necessary.

Ruthamford Central WRZ covers most of the MK study area and has no internal water supply, subsequently relying on imports from Ruthamford North and Ruthamford South WRZs which cover a small part of the study area.

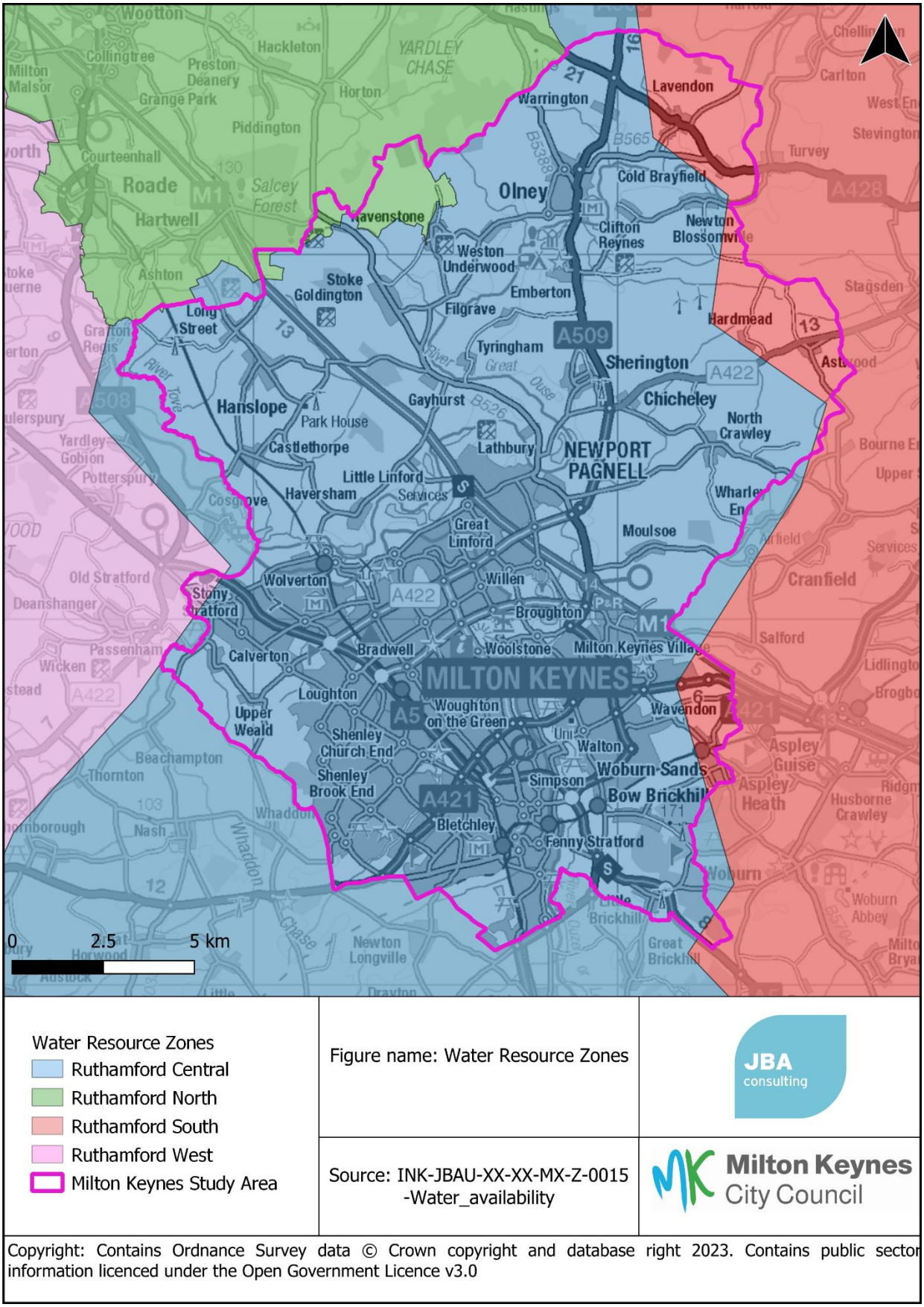


Figure 4.10 Water Resource Zones covering Milton Keynes

4.5.3 Anglian Water's WRMP

Anglian Water's WRMP was published in 2019, covering the period 2020-2045 (Anglian Water c, 2023). Anglian Water are in the process of developing their WRMP24 for the period 2025-2050, and the revised draft WRMP (rdWRMP) has been reviewed within the Stage 1 IWMS. It should therefore be noted that information presented from the revised draft WRMP may be subject to change upon finalisation.

The rdWRMP reports that by 2050 therefore will be 38% less water to supply customers driven by the implementation of abstraction licence capping across the region, reducing the volume of water taken from sensitive catchments, achieving enhanced resilience to drought and adaptation to climate change. During the same period, water demand is expected to increase as the population is forecast to increase by 18% by 2050. In the baseline scenario, Anglian Water predicts a shortfall of 593 megalitres of water a day by 2050 if no action is taken.

In the baseline supply-demand balance, Ruthamford Central is not predicted to be in deficit in the Dry Year Annual Average (DYAA) planning scenario but is expected to be in deficit by 2033 in the Dry Year Critical Period (DYCP) scenario (a water company planning scenario where supply-demand is at its lowest). This zone is expected to be in balance in their final plan incorporating their preferred portfolio of measures to reduce demand and increase supply.

As Ruthamford Central does not have water sources of its own, it receives transfer from Ruthamford North and Ruthamford South.

Ruthamford North WRZ covers an area of 2,894km^2 serving Peterborough, Northampton, Wellingborough, Corby, Daventry and Kettering. It obtains its water solely from surface water sources with abstractions in the Rivers Nene and Welland. In the baseline supply-demand balance, this zone is expected to be in deficit by 2025 in both the DYAA and DYCP scenarios.

Ruthamford South WRZ covers an area of 1,419km^2 serving Bedford and Huntingdon. The zone obtains most of its water from surface water sources with a direct abstraction from the River Great Ouse. There is also a small groundwater contribution from the Woburn Sands aquifer. In the baseline supply-demand balance, this zone is expected to be in deficit by 2035 in the DYAA scenario and 2034 in the DYCP scenario.

Both Ruthamford North and South are expected to be in balance in their final plan.

The WRMP outlines how a supply-demand balance is achieved across each zone with the main measures outlined including:

- Demand management.
- Progression of strategic resource options (SROs).
- Increasing resilience of the public water supply against climate change, especially drought.

The demand management measures include:

- Continue the investment into smart metering across the region, reaching the maximum feasible meter penetration by 2030, achieving a demand saving of 25 Ml/d.
- Investigate how to pursue a compulsory metering strategy to be implemented by 2030.
- Promotion of water efficiency to homes by providing smart devices to monitor shower duration and volume.
- Continuous engagement with customers and community to embed behavioural changes within homes, with targeted communication during times of drought and peak summer demand.
- Implementing a "Water Demand Reduction Discovery Fund" to increase understanding of customer behaviours and explore future water efficiency initiatives.

Two Strategic Resource Options (SROs) are being progressed - the Fens and Lincolnshire reservoirs. Both are raw water storage reservoirs taking surplus water when available in the environment. Both are classed as Nationally Significant Infrastructure Projects and will require a Development Consent Order (DCO), expected to be applied for in 2026.

According to Anglian Water, both SROs will supply 43% of the water needed to maintain a supply-demand balance. The benefits of these reservoirs will not be felt until at least the mid-2030s.

Other water supply options included in the rdWRMP, although not within WRZs supplying MK are a water reuse scheme at Colchester WRC (treated effluent from a WRC is discharged to a reservoir where it is subsequently abstracted and treated to drinking water standards) and desalination (abstraction of seawater and removal of salt).

Although not mentioned in the WRMP24, the Environment Agency have raised the opportunity for further extraction possibilities from the 'Offord Loop'. This is where water is abstracted from Offord, in Cambridgeshire, and then pumped to MK for customer use, it is then discharged into the Great River Ouse and abstracted at Offord. Although there is possible opportunity for further abstraction, potential knock-on effects need to be considered, including whether service demand that doesn't discharge treated wastewater back to the Great River Ouse could impact Offord abstraction.

Within the newest iteration of AWs dWRMP there is an increased focus on the non-household sectors water usage. A portfolio of non-household options which are expected to save 10 Ml/d of water by 2029/30 and 50 Ml/d by 2049/50. The portfolio represents AWs most extensive programme of water efficiency including, but not limited to, smart metering and smart home device retrofitting (Anglian Water h, 2023).

Non-household demand management options are also presented in the newest iteration of the dWRMP. These options are laid out in Table 4.2 from the dWRMP below.

Table 4.2 Non-household water efficiency options. Table adopted from Anglian Waters dWRMP24 September 2023 iteration.

Type of visit	Size of customer (consumption)	Expected no. properties impacted per year (based upon AWs customer base)	Expected saving (per property per day)
Delivery of smart meter targeted water saving efficiency packages, similar to household drop20 campaigns. This will be undertaken on a scaled basis (dependent on the size of water consumption).	Low consumption	3000	86 litres per water efficiency package
Specialist water efficiency audits, with find and fix for consumers using approximately 25,000 litres per property per day.	Medium consumption	79	2,127 litres per property
Specialist water efficiency audits with find and fix for larger consumers (approx. 500,000 litres per property per day).	High consumption	10	43,775 litres per property
Retailer incentives for plumbing loss reduction A £100 incentive to retailers to reduce plumbing losses.	All users	3000	59 litres per property
Smart meter identified plumbing loss fix Non-household plumbing loss repairs for properties identified, through smart metering, to have continuous flow. These visits will be aligned with water efficiency visits.	All users	3000	240
Smart meter identified customer supply pipe leakage (cspl) fix. Non-household repairs for properties identified, through smart metering, to have continuous flow. These visits will be aligned with water efficiency visits.	All users	3000	9 litres per property

Another factor which is identified within the WRMP is the severity of drought that the area experiences. Subsequently, water trading with Affinity Water has been mentioned within the

report to diversify water sources in the future. The study area for this project does not fall into a severely impacted drought area so is not vulnerable to drought.

Abstractions by water companies are limited by abstraction licences, which were set based on assumptions about sustainability at the time they were written. Investigations into future sustainability of water resources, based on modelling conducted by the EA has produced an assessment of the reductions required in deployable output of individual water resources to ensure long term sustainability. Early identification of these reductions will allow replacement water supply resources to be identified.

4.5.4 Impact of climate change

Climate change impact modelling has been carried out within the Environment Agency 2017 climate change assessment methodology. Multiple WRZs have been identified as vulnerable and impacted by climate change. Within the dWRMP24 climate change is said to decrease current water supply by 6 Ml/d.

By 2050, Ruthamford South's Deployable Output (DO) will reduce by 7.1 Ml/d because of climate change and Ruthamford North's DO will reduce by 7.7 Ml/d (Anglian Water f, 2022).

4.5.5 The Water Resources East Plan

As mentioned in section 3.5.4, water resource planning is taking an increasingly regional focus. 85% of abstraction in WRE goes towards public water supply, with Milton Keynes being the 4th largest urban area within Anglian Water's management area. The other 15% is used by:

- Agriculture
- the paper/ pulp industry
- food and drink
- chemicals
- other industry.

Of these sectors, Milton Keynes' main growth sectors for water demand are energy and agriculture.

Between now and 2025, the WRE emerging plan focuses on developing future actions such as desalination research and development and reservoir design and planning. In the shorter term, water company demand and water leakage control are mentioned.

From 2025-30 storage, keeping bills affordable and increasing household water efficiency are the main themes. For 2030 onwards a continued focus on water efficiency is mentioned as well as wider water re-use and green energy goals (WRE a, 2022).

Within the EAs response to the WRE regional plan, WRE were asked to investigate further imports from other regions especially to see if it resolved the short, medium, and long-term challenges or reduced dependency on other supply options such as desalination, reuse, and large reservoirs. WREs responded that the region is extremely water stressed with unique geographical and environmental constraints and as such the number of feasible

options in that region were limited, and had been included in their portfolio of supply options. The WRE consultation response can be found here.

4.5.6 Abstraction Licensing Strategy

The Upper Ouse and Bedford Ouse Abstraction Licensing Strategy (ALS) covers a 3,043km^2 area from Brackley in the South to Letchworth in the East and Earith in the North. Across the ALS there are 20 Assessment Points (AP) which are significant points in the river such as where rivers join, or where gauging stations are located. 11 of these APs have gauging stations. Apart from Earith and Brampton APs all other points are given a low flow condition to protect the public water abstraction at Offord and other Hands-Off-Flows (HOFs) may be applied. The water resources across the ALS have consumptive abstraction available less than 30% of the time.

There are three Groundwater Management Units (GWMU) in this ALS area:

- Upper Bedford Ouse Woburn Sands
- Upper Bedford Ouse Oolite
- Upper Bedford Ouse Chalk

The Upper Bedford Ouse Woburn Sands and Upper Bedford Ouse Chalk units have no water available for new consumptive licenses, whereas the Upper Bedford Ouse Oolite is assessed case by case because of restricted water available linked to surface water status. The EA commented that the Upper Bedford Ouse Oolite unit is currently under review and is likely to change status to 'no consumptive water available', although it is yet to be confirmed.

Because of the status of abstraction licenses within the Upper Ouse and Bedford Ouse area demand management is important to ensure protection of water resources. Anglian Water have laid out a Preferred Demand Management Plan to present how they are planning to conserve sustainable supplies in the future.

There is an absence of short-term supply options. This underlines the potential benefits arising from required water efficient design from the potential changes made within the MK local plan.

4.5.7 Resource Availability Assessment

To abstract surface water, it is important to understand what water resources are available within a catchment and where abstraction for consumptive purposes may pose a risk to resources or the environment. The Environment Agency has developed a classification system which shows:

- The relative balance between the environmental requirements for water and how much has been licensed for abstraction.
- Whether there is more water available for abstraction in the area.
- Areas where abstraction may need to be reduced.

The availability of water for abstraction is determined by the relationship between the fully licensed (all abstraction licences being used to full capacity) and recent actual flows (amount of water abstracted in the last six years) in relation to the Environmental Flow Indicator (EFI). Results are displayed using different water resource availability colours, further explained in Table 4.3. In some cases, water may be scarce at low flows, but available for abstraction at higher flows. Licences can be granted that protect low flows, this usually takes the form of a "Hands-off Flow" (HOF) or Hands-off Level (HOL) condition on a licence, which mean abstractions have to stop when the river flow or level falls below a particular value. This value is known as the HOF or HOL and ensures there is always a minimum flow in the river. Surface Water Flows can be assessed at Assessment Points (APs) which are significant points on the river, often where two main rivers join or at a gauging station.

Groundwater availability as a water resource is assessed similarly, unless better information on principle aquifers is available or if there are local issues that need to be considered.

Table 4.3 Implications for surface water availability

Water Resource Availability Colour	Implications for licensing
BLUE- High hydrological regime	There is more water than required to meet the needs of the environment. Due to the need to maintain the near pristine nature of the water body, further abstraction is severely restricted.
GREEN-Water available for licensing	There is more water than required to meet the needs of the environment. Licences can be considered depending on local/downstream impacts.
YELLOW-Restricted water available for licensing	Fully Licensed flows fall below the Environmental Flow Indicator (EFI). 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 via licence trading.
RED- Water not available for licensing	Recent Actual flows are below the Environmental Flow Indicator (EFI). This scenario highlights water bodies where flows are below the indicative flow requirement to help support Good Ecological Status. No further licences will be granted. Water may be available via licence trading.

Water Resource Availability Colour	Implications for licensing
GREY-HMWBs (and /or discharge rich water bodies)	These water bodies have a modified flow that is influenced by reservoir compensation releases, or they have flows that are augmented. There may be water available for abstraction in discharge rich catchments.

Water resource availability is assessed under four different flow conditions:

- Q95 – very low flows which are exceeded 95% of the time.
- Q70 – low flows which are exceeded 70% of the time.
- Q50 – median flows which are exceeded 50% of the time.
- Q30 – high flows which are exceeded 30% of the time.

The resource availability for the Upper Ouse and Bedford Ouse ALS is summarised below in Figure 4.11. The Upper Ouse and Bedford Ouse ALS covers all of the study area.

In some catchments this assessment may show that there is limited or no water available for abstraction at Q50 or Q70 but show that there is water available at lower flows. This is likely to be because most abstraction licences are limited using a ‘Hands off Flow’ or ‘Hands off Level’, therefore within the catchment less water is being abstracted at very low flows and there is water available.

This may not be the case across all catchments and, particularly in heavily modified catchments, there may be other artificial influences impacting on catchment flows. For example, if there are many discharges within the catchment or the flow is artificially augmented then this would artificially elevate flow particularly at lower flows. In some cases, the EA doesn't include this water in the amount available for licensing because it isn't guaranteed, but flow can potentially be more available.

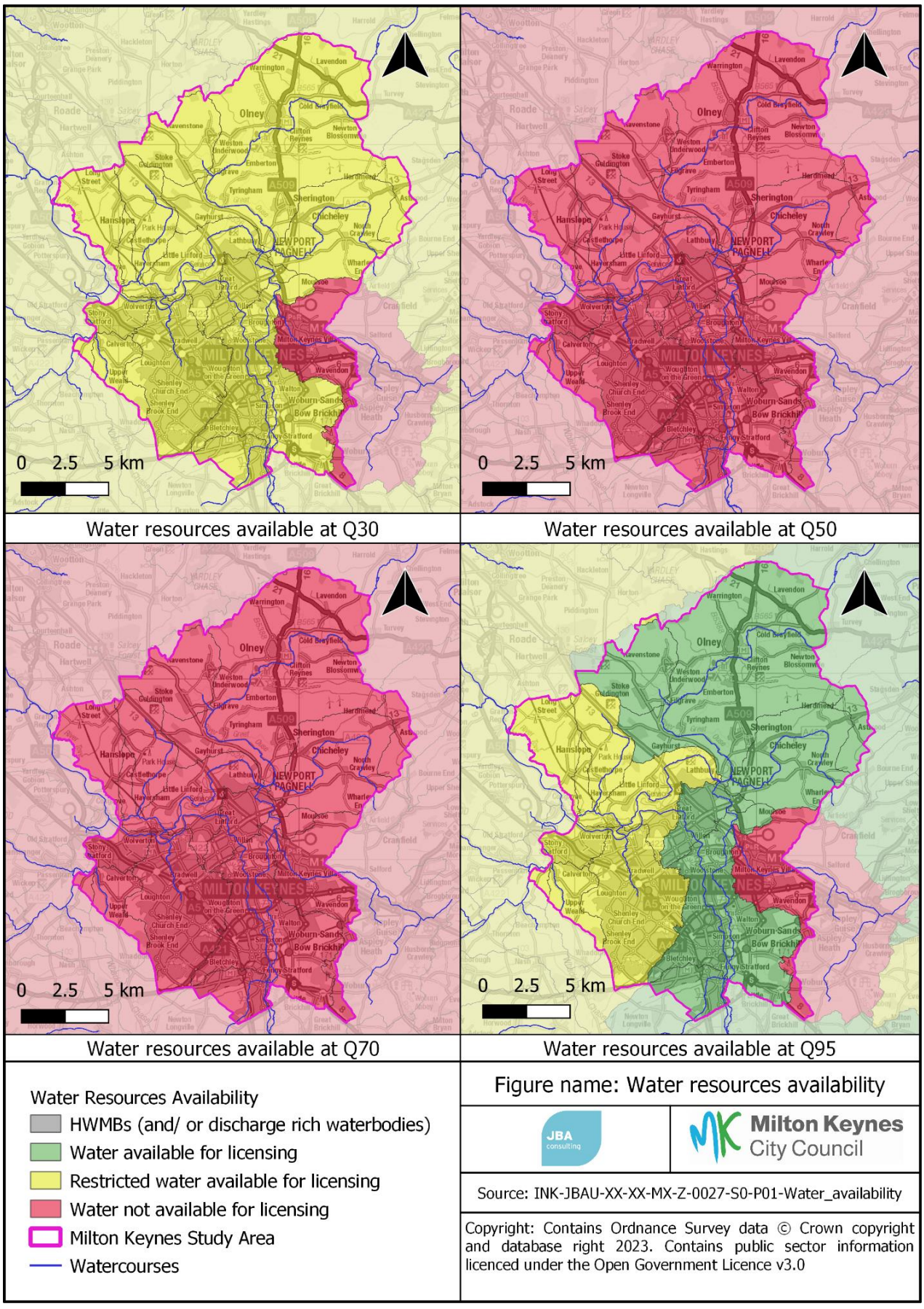


Figure 4.11 Water resources available in Milton Keynes

4.5.8 Water efficiency standards for Milton Keynes

The strategic direction in the UK set out in the new National Water Resources Framework is to attain an average household water efficiency of 110 l/p/d by 2050. This also aligns with the recommendation in the River Basin Management Plan aimed at reducing the impact of abstraction. There would also be a positive economic impact for residents in terms of reduced energy and water bills.

The Strategy for 2050 has set out an aim to reduce domestic water consumption to less than 110l/person/day for all new and existing housing. This policy therefore goes beyond the optional Building Regulations standard of 110l/p/d by covering existing housing as well as new. Evidence in support of this strategy includes:

- The lack of water available for use Milton Keynes (section 4.5.7)
- The Environment Agency have designated the whole of the Anglian Water region as under Serious water stress (section 2.5.2).
- There is evidence that 110l/p/d is of low cost to achieve and can deliver savings to residents, especially where consumption of energy to heat water is reduced (section 3.4.3and 3.4.4).

Policies to reduce water demand from new developments, or to go further and achieve water neutrality in certain areas, should be defined to reduce the potential environmental impact of additional water abstractions in Milton Keynes, and help to achieve reductions in carbon emissions in the district by reducing the volume of water needing to be treated and distributed.

The Government's Environmental Improvement Plan published in January 2023 contains a roadmap for improving water efficiency in new developments and retrofits. This contains an action to review Building Regulations (2010) and consider a new standard for new homes in England of 105 l/p/d and 100 l/p/d where there is a clear local need, such as in areas of serious water stress. Whilst this is not current policy, it is likely that a tighter standard than the 110 l/p/d will be adopted in Building Regulations during the lifetime of the MK City Plan 2050.

Anglian Water support the 100 l/p/d approach. AW is updating their Joint Protocol with the EA and Natural England (NE) to go beyond 110 l/p/d and towards 80 l/p/d. AW also welcome joint work with MKCC to demonstrate the costs and viability of measures including:

- fixtures and fittings standards
- smart water meters
- education
- rainwater and greywater use

MKCC should include as a minimum the 100l/p/d target within their MK City Plan 2050, with an expectation that larger strategic development should go further. Stage 2 should include work with Anglian Water on the impact of different water efficiency targets on water demand in Ruthamford Central WRZ, and the potential to achieve water neutrality.

4.5.9 Water Supply Infrastructure

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

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

In addition to the work undertaken by water companies, there are opportunities for the local authority and other stakeholders to relieve pressure on the existing water supply system by increasing water efficiency in existing properties. This can contribute to reducing water consumption targets and help to deliver wider aims of achieving water neutrality.

A cost-effective solution can be for local authorities to co-ordinate with water supply companies and “piggyback” on planned leakage or metering schemes, to survey and retrofit water efficient fittings into homes (Waterwise a, 2009). This is particularly feasible within property owned or managed by the local authorities, such as social housing.

4.6 Wastewater Collection

4.6.1 Sewerage undertakers

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

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

Headroom at Water Recycling Centres (WRCs) can be eroded by growth in population or per-capita consumption, requiring investment in additional treatment capacity. As the volumes of treated effluent rises, even if the effluent quality is maintained, the pollutant load discharged to the receiving watercourse will increase. In such circumstances the Environment Agency as the environmental regulator, may tighten consented effluent

consents to achieve a “load standstill”, i.e., ensuring that as effluent volume increases, the pollutant discharged does not increase. Again, this would require investment by the water company to improve the quality of the treated effluent. Consents can also be tightened to prevent a deterioration in water quality due to growth, or to achieve environmental objectives.

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

Within AW's DWMP there is a proposal to reduce wastewater volumes going to WRC through reducing surface water connections using SuDS. This also reduces the amount of carbon used by the wastewater management because of surface water not being treated or pumped to the WRC.

4.6.2 Storm overflows

Storm overflows are an essential component in the sewer network – however when they operate frequently, they can cause environmental damage. They occur on combined sewer systems where the sewer takes both foul flow (sewage from homes and offices) and rainwater runoff. In normal conditions, see Figure 4.12, all of this flow passed through the sewer network and is treated at a wastewater treatment works.

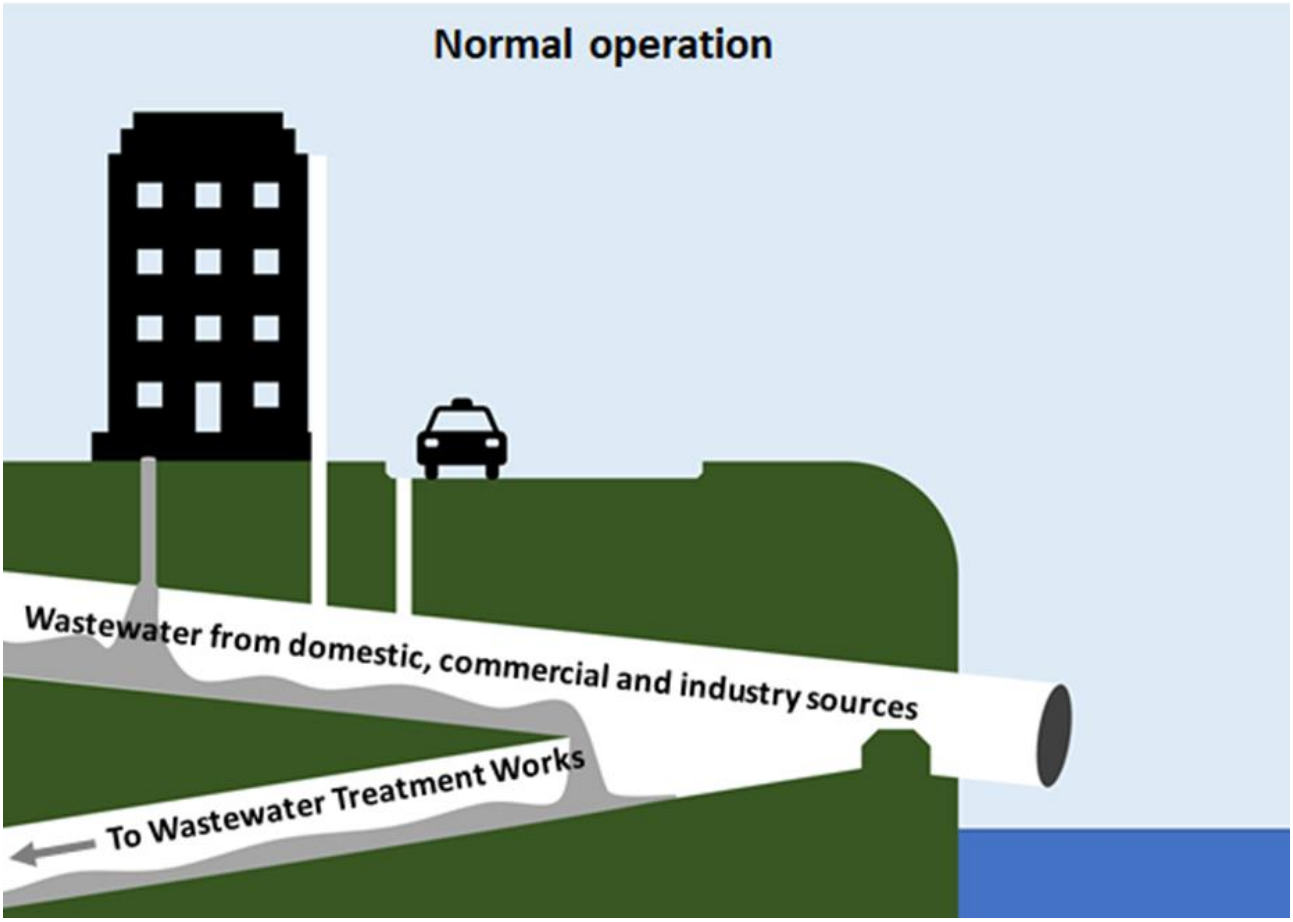


Figure 4.12 Storm overflow operation in normal conditions

In periods of exceptional rainfall, see Figure 4.13, the capacity in a combined sewer may be used up by the additional flow from rooftops and storm drains. Once the capacity is exceeded, wastewater would back up into homes, businesses and on to roads. A storm overflow acts as a relief valve, preventing this from happening.

Storm overflows become problematic when they operate frequently in moderate or light rainfall, or for long periods because of groundwater infiltration in the sewerage system – possibly in breach of their permit.

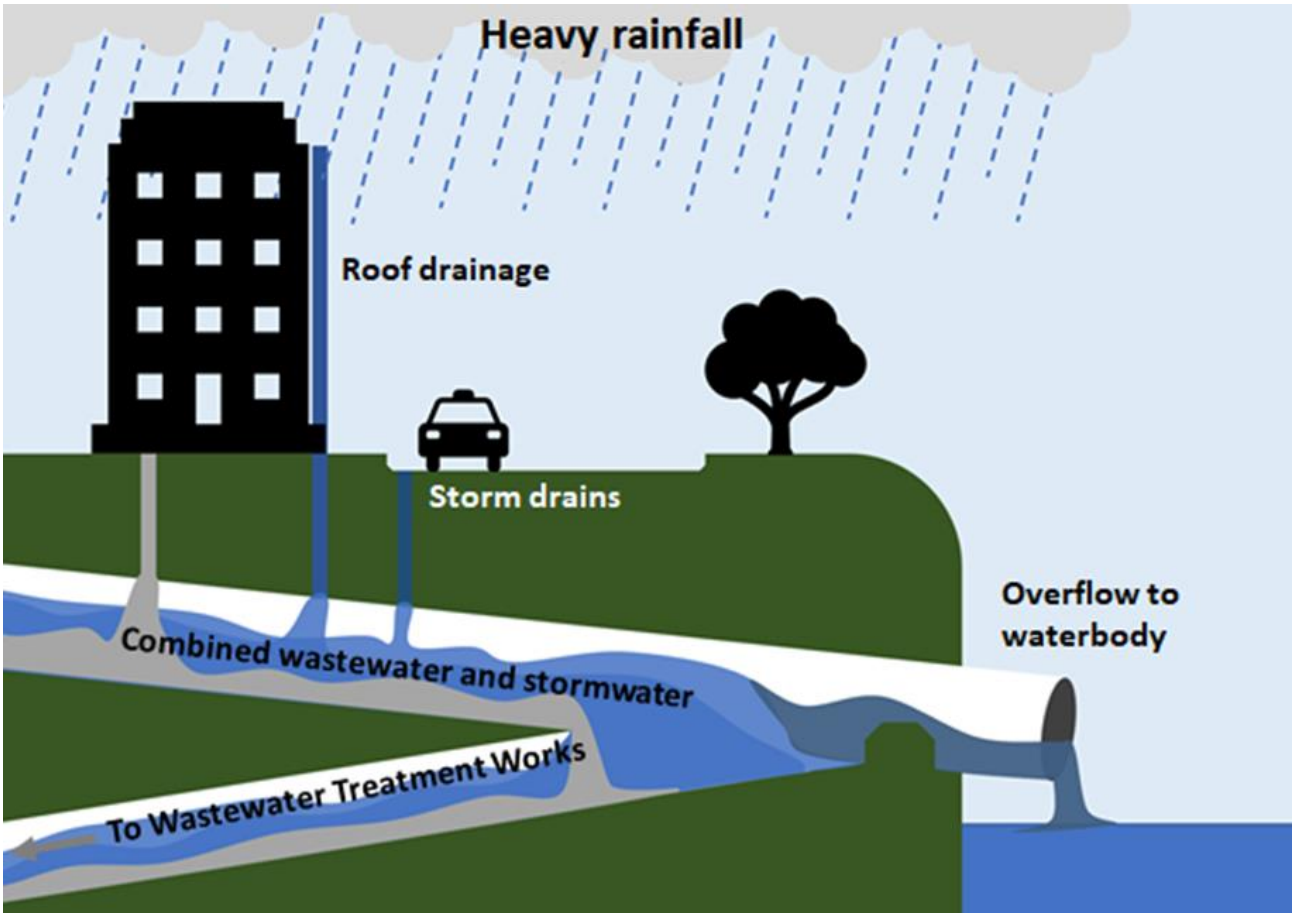


Figure 4.13 Storm overflow operation in exceptional rainfall

Where a storm tank overflow is operating in periods of moderate or light rainfall, or even in dry conditions it indicates either an infiltration problem within the network, or that the WRC or its storm tanks are undersized for the population served. Further development within a catchment that has a poorly performing storm tank overflow is likely to exacerbate the issue.

4.6.3 Storm overflow assessment

The Environment Act now requires water companies to report and monitor storm overflows as well as reduce the harm caused to the rivers they discharge to. Sewer overflows are operated under environmental permits issued by the Environment Agency. Currently, a spill frequency of >50 discharges per year over 2 years, or >40/year over 3 years, is used to trigger an investigation. The government's Storm Overflow Reduction, has set a target to ensure that storm overflows only operate in unusually heavy rainfall events, and this has been defined as an average of 10 events or less per year by 2050. An important component of this is the monitoring of overflows, and a target has been set to monitor the frequency and duration of operation at all storm overflows by 2023 (Gov.uk, 2021). This is called Event Duration Monitoring (EDM). The EDM dataset (which contains performance data on the 16,639 storm overflows monitored in 2021) has been used to provide information on storm overflows in Milton Keynes.

There are eleven network storm overflows and six storm tanks overflows located on the sewer network and at WRCs in Milton Keynes (based on 2022 EDM dataset). The location of these is shown in Figure 4.14. In 2022 only two of the network storm overflows were monitored in 2022. Data from these overflows is summarised in Table 4.4 and displayed in Figure 4.15.

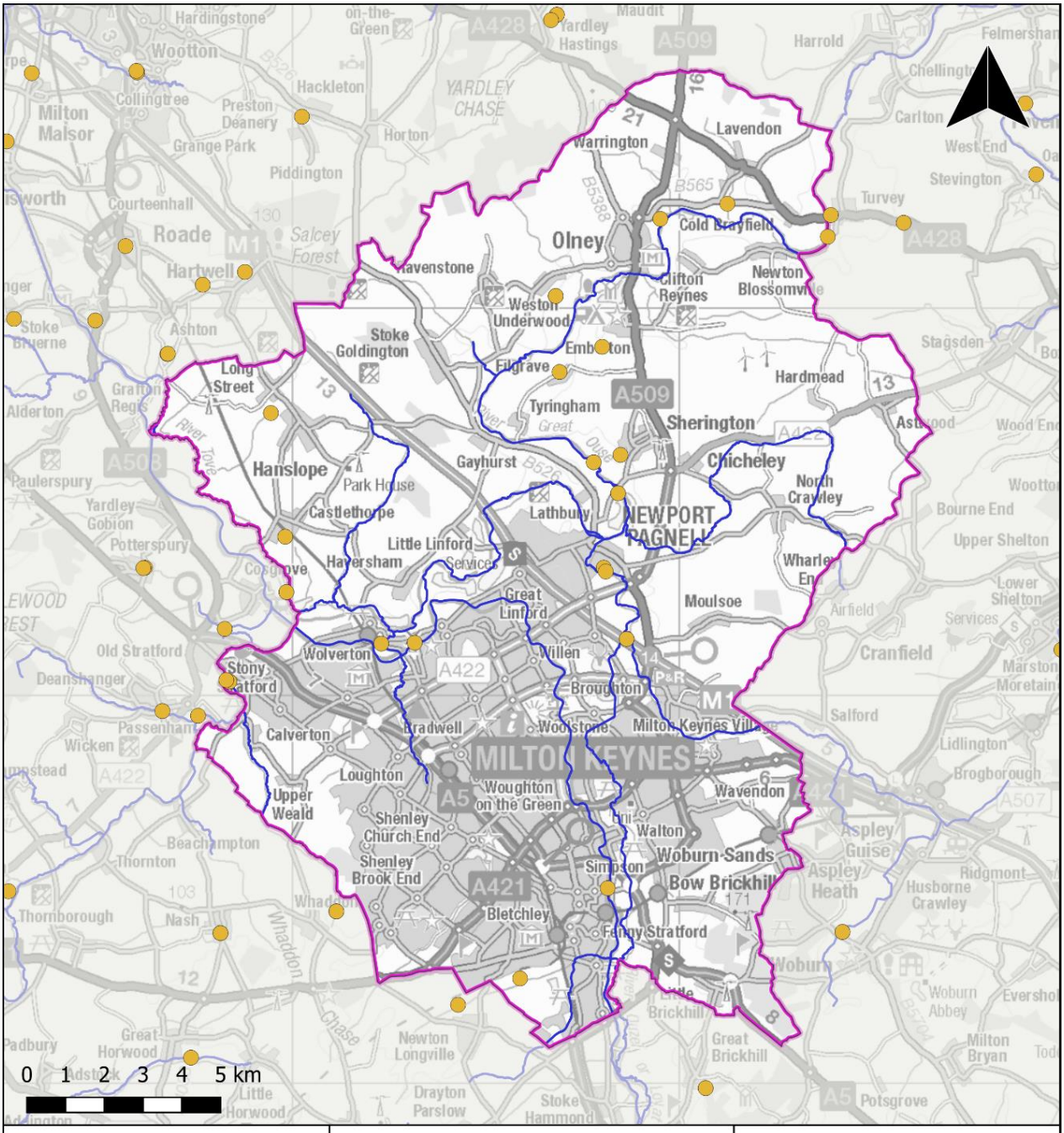


Figure 4.14 Location of storm overflows

Table 4.4 WRC storm overflow frequency of operation and duration

Overflow	Number of operations in 2020	Duration of operation in 2020 (hours)	Number of operations in 2021	Duration of operation in 2021 (hours)	Number of operations in 2022	Duration of operation in 2022 (hours)	Average number of operations per year	RAG
Lavendon water recycling centre/ AW1NF1012	n/a	n/a	40	102.50	7	23.25	23.5	Green
Cotton Valley STW/ Cotton Valley Water recycling centre/ AWCNF10296	10	115.25	10	68.75	1	0.5	7	Green
Hanslope STW/ AW1NF1066A	n/a	n/a	n/a	n/a	32	409.5	32	Green
Newport Pagnall/ Willen Road CSO/ AW1NF187	1	7.75	0	0	0	0	1	Green
Castlethorpe STW/ PR3NF395	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Olney STW/ AW1NF1165A	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

No overflows in Milton Keynes exceed the threshold for an investigation based on available data between 2020 and 2022, but Lavendon WRC and Hanslope STW may require improvement in order to meet the longer-term target of 10 or fewer operations per year. This analysis will be updated in Stage 2 once 2023 data is available.

Although most of the storm overflows do not exceed current threshold for investigation, it is important that development does not increase this frequency or make it harder to achieve the longer-term objective. The local plan can contribute to this by encouraging the use of SuDS to divert storm water away from the sewer network, reducing the volume that reaches the WRC.

There are opportunities through the planning system to ease pressure on the wastewater network by separating foul and storm flow in existing combined systems, and not allowing new surface water connections. Surface water can also be better managed by retrofitting SuDS in existing residential areas, and in new development, ensuring SuDS are incorporated into designs at the master planning stage to maximise the potential benefits. Redevelopment of brownfield sites with previously combined sewerage systems offer the potential to separate surface water from foul and reduce discharges from sewer overflows.

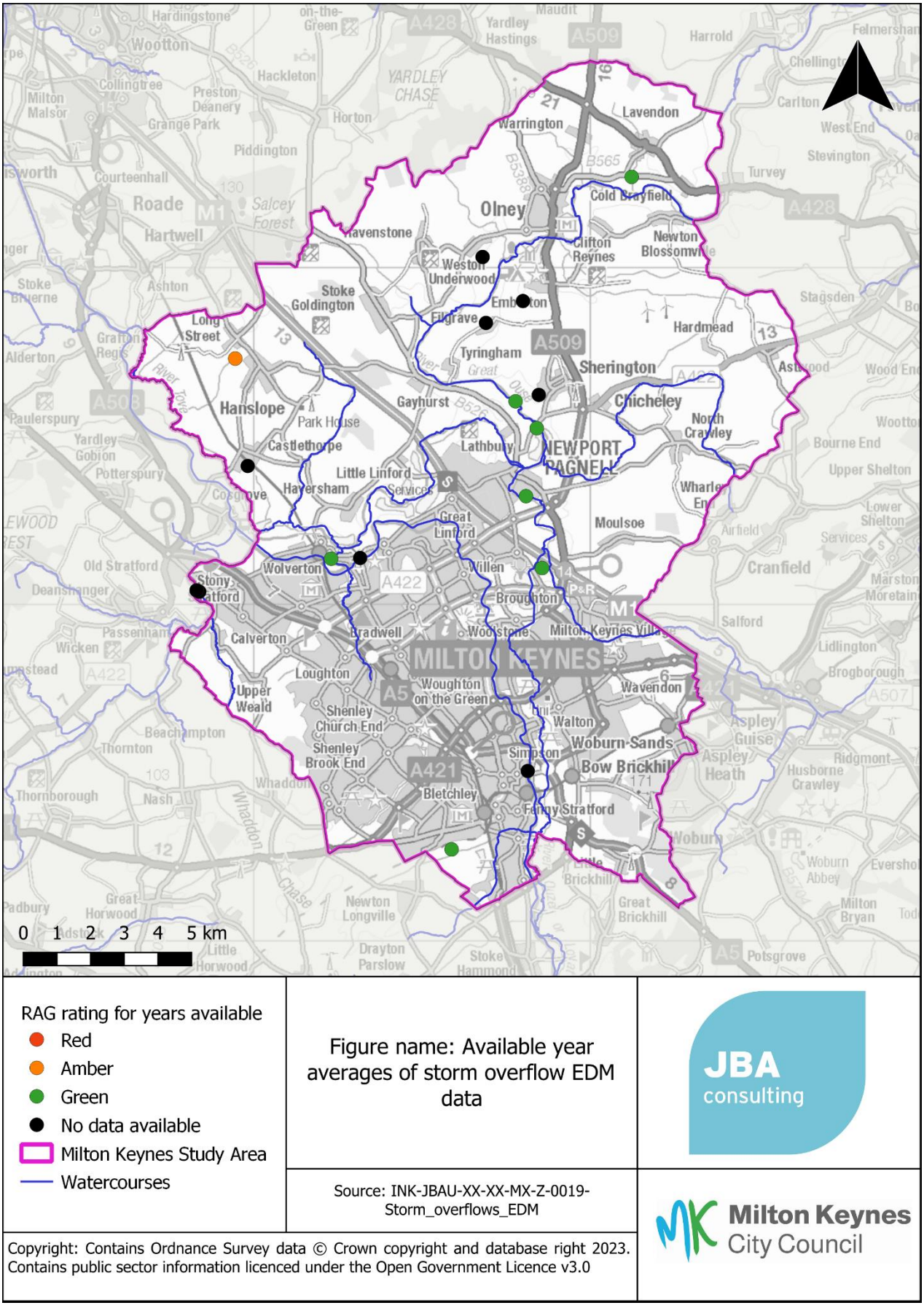


Figure 4.15 Available year average storm overflow operations from EDM information

4.7 Wastewater treatment

4.7.1 Water Recycling Centres in Milton Keynes

AW provide wastewater services for development in Milton Keynes. Anglian Water refer to their Wastewater Treatment Works (WwTW) as Water Recycling Centres (WRCs). They may also be referred to as Sewage Treatment Works (STW) in some documents and data sources. For this report, they will be referred to as WRCs. There are 18 WRCs that are within or currently serving communities in Milton Keynes. Six of these are expected to serve growth from commitments or adopted plans. The WRCs and catchments they serve are shown in Figure 4.16.

Sites already allocated in the adopted local plan, or already in the planning system (commitments) as well as an allowance for windfall, were assigned to a WRC using the sewerage drainage area boundaries provided by AW to set a baseline for WRC capacity. Actual connection of a development site to a particular WRC may be different and will depend on the capacity of the receiving works, and the local sewer network.

Historically, wastewater from very small communities or isolated individual properties is managed by septic tanks. Discharge from septic tanks directly to surface waters is no longer permitted and both existing and new systems must either connect to the public sewer, use a small sewage treatment plant also known as a Package Treatment Plan (PTP), or install a drainage field (an array of pipes set in a permeable bedding material). Discharges to groundwater may use septic tanks or PTPs, but in either case the discharge should also be via a drainage field.

Very small developments in rural areas may be suitable for on-site treatment and discharge, however the Environment Agency will not usually permit this where there is a public sewerage system within a distance calculated as 30m per dwelling. There is therefore a localised risk to water quality if all of these small developments were to be served by septic tanks, especially where there are clusters of small-scale new development.

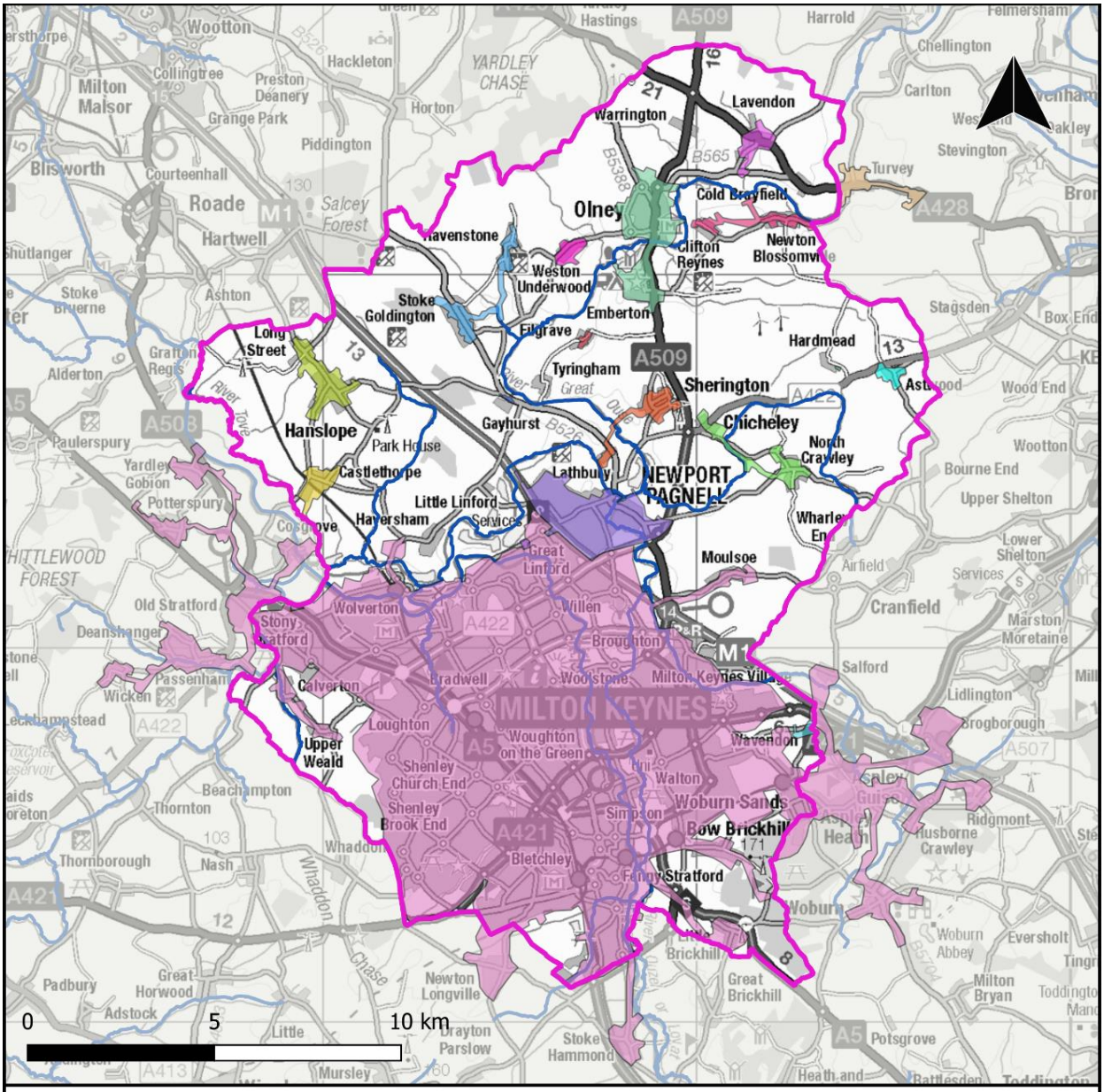


Figure name: Milton keynes WRC catchments

Source: INK-JBAU-XX-XX-MX-Z-0004-Milton_Keynes_WwTW

Figure 4.16 Water Recycling Centres in Milton Keynes that serve growth

4.7.2 DWMP summary

AWs new Drainage and Wastewater Management Plan (DWMP) was published in May 2023. This sets out how AW's wastewater systems and drainage networks will be maintained and extended over the next 25 years addressing the pressures of population growth, climate change and responding to environmental requirements.

Anglian Water's main planning objectives in their DWMP are:

- Increase in drought and flood resilience.
- Enable sustainable economic and housing growth.
- To be a carbon neutral business by 2030
- Cooperating with others to improve ecological quality.

Milton Keynes sits within the Upper Bedford and Ouse Catchment Based Approach Area (CaBA). Risk Based Catchment Screening (RBCS) was performed on each of the 154 WRCs in the area, and 84 progressed to the next level of assessment within the DWMP process. Each WRC catchment was provided a score of 0 (low risk), 1 (medium risk) or 2 (high risk) for each of the planning objectives contained in the table below. The outcome aggregated at the CaBA level is presented in Table 4.5 below. It can be seen that sewer flooding (both internal and external) is seen as a growing risk within the catchment, as are pollution incidents (number of pollution incidents classed as category 1-3 by the EA).

Table 4.5 DWMP change in risk in Upper Bedford Ouse area

Planning Objective	2020	2050
Flooding in a storm (1 in 50)	0 - low	0 - low
External flooding	0 - low	2 - high
Internal flooding	0 - low	2 - high
Pollution incidents	0 - low	2 - high
Sewer collapses	1 - medium	-
DWF compliance	1 - medium	1 - medium
Quality compliance	1 - medium	1 - medium
Access to amenity areas	1 - medium	1 - medium
Green infrastructure	0 - low	0 - low

4.7.3 Sewerage System Capacity

New residential developments and new employment land add pressure to the existing sewerage systems. An assessment is required to identify the available capacity within the existing systems, and the potential to upgrade overloaded systems to accommodate future growth. The scale and cost of upgrading works may vary significantly depending upon the location of the development in relation to the network itself and the receiving WRC.

It may be the case that an existing sewerage system is already working at its full capacity and further investigations have to be carried out to define which solution is necessary to implement an increase in its capacity. New infrastructure may be required if, for example, a

site is not served by an existing system. Such new infrastructure will normally be secured through private third-party agreements between the developer and utility provider.

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

4.7.4 Wastewater Treatment Works Flow Permit Assessment

Water companies monitor operational compliance and the EA monitor Environmental Permit (EP) compliance by the water company and undertake enforcement and prosecution when this passes the EAs expediency rules. Figure 4.17 summarises the different types of wastewater releases that might take place, although precise details vary from works to works depending on the design.

During dry weather, the final effluent from the WRC should be the only discharge (1). With rainfall, the storm tanks fill and eventually start discharging to the watercourse (2) and Combined Sewer Overflows (CSOs) upstream of the storm tanks start to operate (3). The discharge of storm sewage from treatment works is allowed only under conditions of heavy rain or snow melt, and therefore the flow capacity of treatment systems is required to be sufficient to treat all flows arising in dry weather and the increased flow from smaller rainfall events. After rainfall, storm tanks should be emptied back to full treatment, freeing their capacity for the next rainfall event.

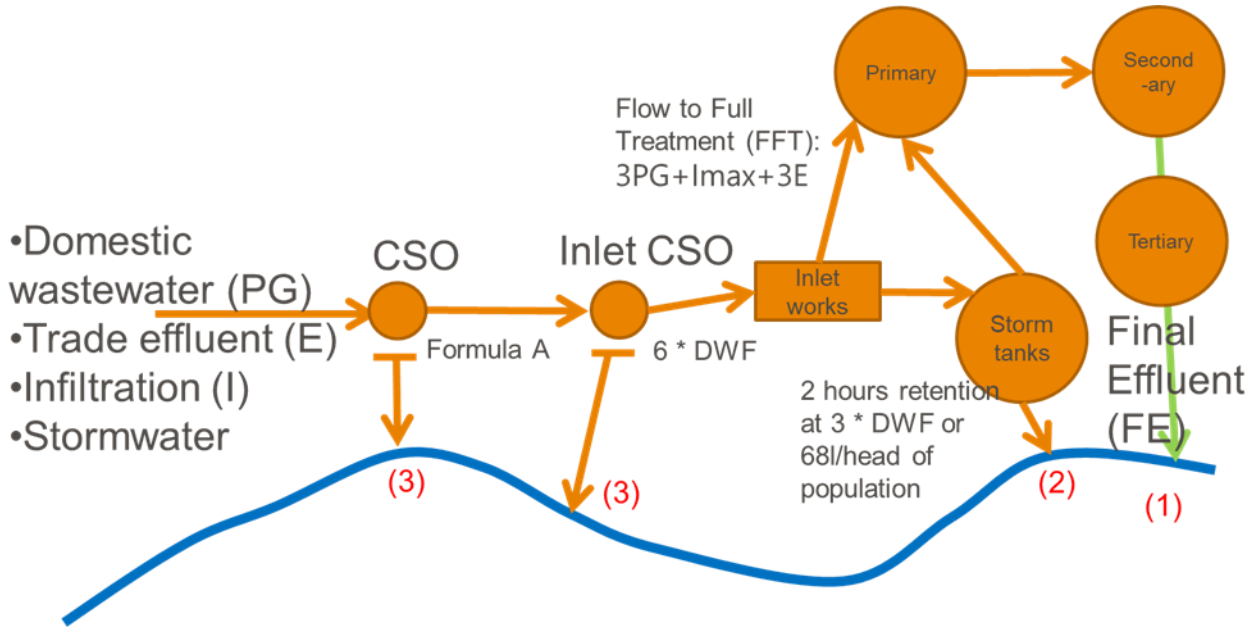


Figure 4.17 Overview of typical combined sewerage system and WRC discharges

Environmental permits are used alongside water quality limits as a means of controlling the pollutant load discharged from a water recycling centre to a receiving watercourse. Sewage flow rates must be monitored for all WRCs where the permitted discharge rate is greater than 50 m^3/day in dry weather.

Permitted discharges are based on a statistic known as the Dry Weather Flow (DWF). As well as being used in the setting and enforcement of effluent discharge permits, the DWF is used for WRC design, as a means of estimating the 'base flow' in sewerage modelling and for determining the flow at which discharges to storm tanks will be permitted by the permit (Flow to Full Treatment, FFT).

WRC Environmental Permits also consent for maximum concentrations of pollutants, in most cases Suspended Solids (SS), Biochemical Oxygen Demand (BOD) and Ammonia (NH_4). Some works (usually the larger works) also have permits for Phosphorous (P). These are determined by the Environment Agency with the objective of ensuring that the receiving watercourse is not prevented from meeting its environmental objectives and that the water quality is improved over time. There is also specific regard to the Chemical Status element of the Water Framework Directive (WFD) classification.

Increased domestic population and/or employment activity can lead to increased wastewater flows arriving at a WRC. Where there is insufficient headroom at the works to treat these flows, this could lead to failures in flow consents.

AW provided data on the performance of their WRCs over the last three years (2020, 2021, 2022). From this, the 80th percentile exceedance flow statistic was calculated. This is current flow at each WRC.

Sites already in the planning system (commitments), adopted allocations, windfall and neighbouring authority growth was assigned to each WRC using the sewerage drainage area boundaries provided by AW. For each site, the future DWF was calculated using the occupancy rates and per-capita consumption values obtained from the Water Resource Management Plans, and the assumption that 95% of water used is returned to sewer. Permitted headroom was used as a substitute for actual designed hydraulic capacity for each WwTW being assessed.

For employment sites, wastewater was demand was estimated based on the predicted number of new employees. Floor space, employment use types, and employment densities were used to estimate the number of employees.

The predicted water demand from committed growth was then added to the current observed flow at each WRC and then compared to the permitted flow. An estimated remaining capacity for growth (before an increase in permit and/or upgrades are required) was then calculated. This is summarised in Table 4.6. A red-amber-green assessment of headroom was then applied to each WRC. Sites with more than 10% of their flow permit remaining were given a "green" score. Sites within 10% of their flow permit or exceeding their permit were given an amber score. Smaller WRCs with no flow monitoring or a descriptive permit were also given an amber score reflecting their limited capacity to accommodate growth. A WRC with an amber score may require an increase in its permit,

and / or upgrades to treatment processes in order to accommodate further growth within the catchment. A red score would be applied where there were significant constraints to providing those upgrades. These scores are shown in Figure 4.18.For WRCs such as Hanslope and Castlethorpe plans have been laid out in AW's DWMP to increase the permit limit. For example, it is planned that Hanslope, in the medium term, will have new process streams and a mixed strategy approach. In the long term Hanslope is planned to have surface water removal. As for Castlethorpe, process optimisation is planned in the medium term.

Table 4.6 Headroom assessment for WRC in Milton Keynes

WRC	Current permit limit (m^3/d)	Observed 80%ile DWF (m^3/d) 2020-2022	Committed growth in catchment (no. of dwellings)	Approximate remaining headroom after committed growth (no. dwellings)	Comments
Astwood	50	22	0	112	Unlikely to serve significant growth
Castlethorpe AW1NFA31A	151	146	31	0	Data suggests this WRC is close to or exceeding its permit limit. Due to the size of this WRC it is unlikely to serve significant growth.
Cotton Valley AWCNF10296	78,000	57,516	29,676	28,925	Large headroom available for growth
Filgrave	N/A	N/A	0	Unknown	Unlikely to serve significant growth
Gayhurst	N/A	N/A	0	Unknown	Unlikely to serve significant growth
Great Linford	N/A	N/A	0	Unknown	Unlikely to serve significant growth
Hanslope AW1NF1066A	840	842	137	0	WRC is currently at or close to its permit limit. Further growth could not be accommodated without an increase in its permit limit and / or upgrades to treatment processes.

WRC	Current permit limit (m^3/d)	Observed 80%ile DWF (m^3/d) 2020-2022	Committed growth in catchment (no. of dwellings)	Approximate remaining headroom after committed growth (no. dwellings)	Comments
Hardmead	9		0	Unknown	Unlikely to serve significant growth
Lavendon AW1NF1012A	295	160	63	461	Headroom available for small development.
Newton Blossomville	75	N/A	0	Unknown	Unlikely to serve significant growth
North Crawley	123	97	0	104	Headroom available for small development
Olney AW1NF1165A	1822	1,351	329	1,069	Headroom available for growth
Ravenstone-Stk Goldington	160	142	0	72	Headroom available for small development
Sherington AW1NF1079	620	262	0	1,433	Unlikely to serve significant growth
Turvey-Cottage N Blovil R	272	250	0	88	Headroom available for small development
Wavendon - Lower End	N/A	N/A	N/A	Unknown	Unlikely to serve significant growth
Weston Underwood	N/A	N/A	N/A	Unknown	Unlikely to serve significant growth

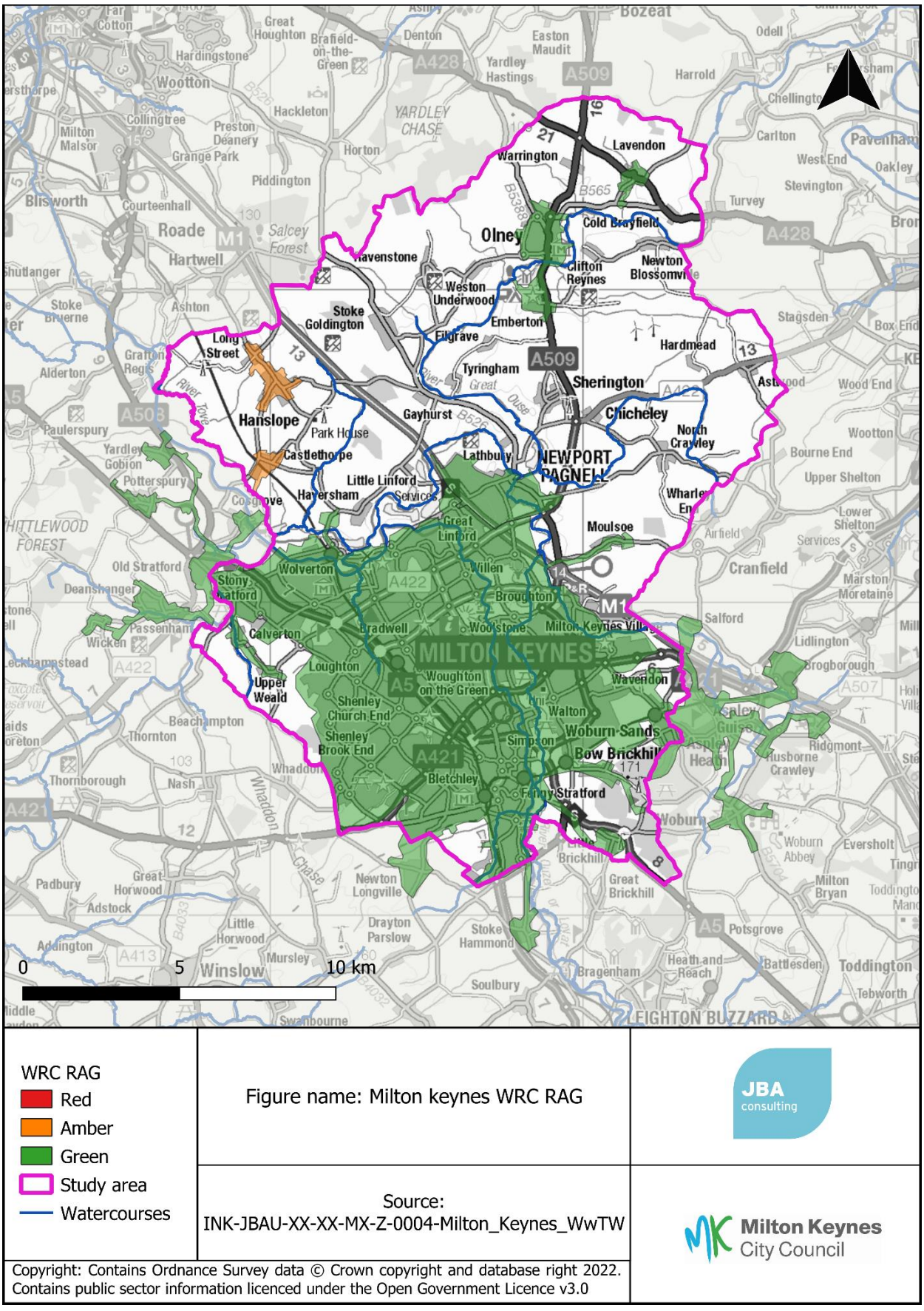


Figure 4.18 Headroom assessment for WRCs in Milton Keynes

There are 18 WRCs within or serving communities in Milton Keynes. Of these, six are expected to serve committed growth within the period of the adopted Local Plan.

Cotton Valley is the largest WRC in the region serving an estimated population of 313,130 in 2021. In Level 3 of AWs new DWMP, it states that they expect this to increase to 358,288 by 2050. This would still be well within the permit limit for the WRC.

Two WRCs (Castlethorpe and Hanslope) are close to, or likely to exceed their permit due to committed growth. Further development in these catchments would require an increase in their flow permit and / or upgrades to treatment processes.

Many of the WRCs outside of the City of Milton Keynes are small works and serve only a modest population. In some cases, they only have a descriptive permit, and others there is no flow data recorded. It is unlikely that they would be able to serve significant development without major upgrades.

Where a WRC is likely to exceed its permit, the permit would be reviewed by the EA and if a higher flow consent was agreed, a tighter permit limit for substance concentrations is very likely to be required. In some cases, this may not be possible if that means concentrations tighter than the Technically Accepted Limit (TAL) which is 0.25 mg/l for P for example. This will be assessed in the Stage 2 study.

4.7.5 Nuisance odour from WRCs

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

Sewerage undertakers recommend that an odour assessment may be required if the site of a proposed development is close to a WRC and is encroaching closer to the WRC than existing urban areas. Anglian Water have advised 400m should be used as a buffer from WRC to development sites. Within this distance, a relative risk is defined based on the size of the treatment works and the proximity of a development site, and a red-amber-green (RAG) scoring is applied (Anglian Water d, 2012). (See Table 4.7).

Table 4.7 Anglian Water asset encroachment RAG rating

Population served by STW (PE)	STW Category	Distance of proposed development from STW (metres)						
		50	100	150	200	250	300	400
0 - 1,000	1							
1,001 - 2,500	2							
2,501 - 5,000	3							
5,001 - 10,000	4							
10,001 - 50,000	5							
50,001 - 100,000	6							
>100,001	7							

(Source: Anglian Water)

The above RAG ratings may be impacted by factors such as if the WRC is a primary handler of sludge or if the WRC has permanent odour control measures. These require and additional 15m to the buffer.

4.8 Environmental baseline

4.8.1 Introduction

Development has the potential to cause an adverse impact on the environment through a number of routes, such as worsening of air quality, pollution to the aquatic environment or disturbance to wildlife. In the context of IWM, the impact of development on the aquatic environment is assessed. This chapter considered both water quantity (impact of abstraction) and water quality (impact of wastewater discharge and runoff) on protected sites. Protected sites considered in this report are:

- Special Areas of Conservation (SAC) (and candidate SACs)
- Special Protection Areas (SPA) (and candidate SPAs)
- Sites of Special Scientific Interest (SSSI)
- Ramsar sites (and potential Ramsar sites)

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

4.8.2 Impact of abstraction

Abstraction of water within a catchment, either from groundwater or surface water sources, is necessary to provide a public water supply, for industrial processes and for agriculture. When the volume of water being abstracted becomes too high, it can cause environmental damage by reducing river flow, or lowering the water table.

Changes in river flow can impact sensitive ecosystems, for example trout require a clean gravel bed to lay their eggs. A reduction in river flow can cause sediment to build up, blocking the spaces the fish require to lay their eggs impacting their reproductive cycle. Changes in groundwater levels can also affect the flow regime in rivers and can cause drying of wetland sites.

The precise location of abstraction points for public water supply in England is not available for reasons of national security. Furthermore, water demand within a WRZ can be met by sources located anywhere within that WRZ, or from a neighbouring WRZ if the transfer between WRZs is used to provide some of the water available for use. It is therefore not possible, in all but the simplest of WRZs, to trace an impact of an individual development site back to a particular water abstraction and therefore to an environmental impact. The assessments in this report therefore rely on information in the public domain.

Milton Keynes is served by Anglian Water via their Ruthamford Central WRZ (via transfer from Ruthamford North and Ruthamford South WRZs). Abstraction either from surface water sources or from groundwater sources can occur anywhere within these zones. However, the impact of the abstraction could be felt outside of the WRZ within the same groundwater body, or downstream in surface waterbodies. In both cases this could be well outside the LPA boundary.

Groundwater Dependent Terrestrial Ecosystems

Figure 4.19 shows a schematic of how Groundwater Dependent Terrestrial Ecosystems (GWDTEs) were identified. The LPA boundary is within a WRZ. Water abstracted anywhere within that WRZ could be used to serve growth within the LPA. In the diagram below, there are two abstraction points. Abstraction 1 could impact an area outside of both the LPA boundary and the WRZ. However, there are no protected sites within that groundwater body. Abstraction 2 also impacts an area both within and outside of the LPA boundary. Protected site A is within the WRZ, but may not be impacted directly by an abstraction. Protected site B is outside of the WRZ and outside of the groundwater body containing an abstraction and is therefore unlikely to be impacted by growth. Protected site C is within a groundwater body containing an abstraction, hence there is a risk that an increase in abstraction could impact this site.

The location of abstraction points within the study area is not known, and so the approach must be taken that GWDTE anywhere within the combined extent of the WRZ and groundwater bodies overlapping the WRZ could be impacted by an increase in abstraction.

A further check was done on whether abstraction may already be an issue in those GWDTEs. The Water Framework Directive (WFD) records "Significant Water Management Issues" (SWMIs) in each water body. These are the pressures on the water environment that put our ability to achieve the environmental objectives of the WFD most at risk.

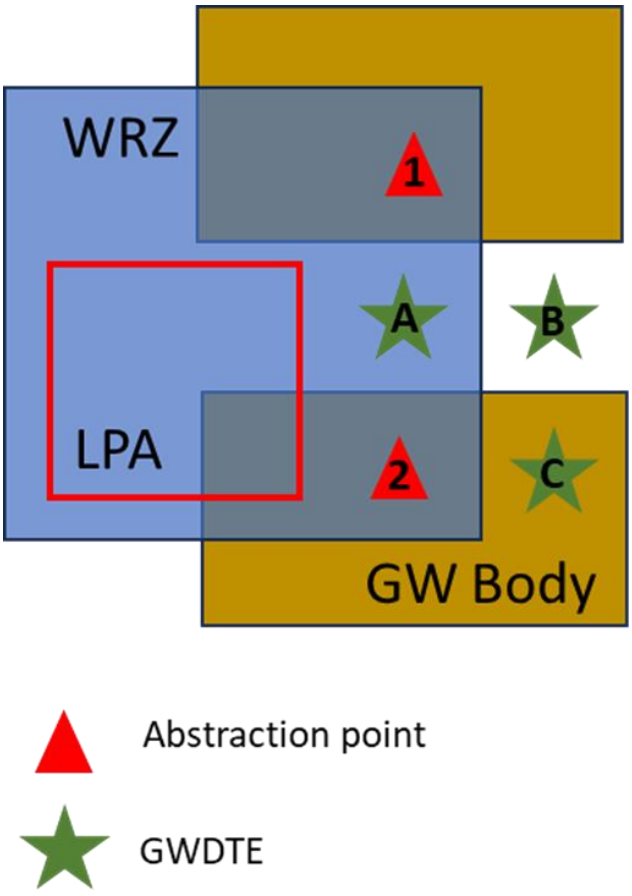


Figure 4.19 Definition of groundwater study area

The steps taken to identify GWDTEs that may be impacted by abstraction to serve Milton Keynes were as follows:

- Define study area for Milton Keynes - based on extent of WRZ and WFD Groundwater bodies that overlap with the WRZs.
- Identify Groundwater Dependent Terrestrial Ecosystems (GWDTE) within the study area using the EA's GWDTE dataset.
- Identify GWDTEs that are within groundwater bodies with flow identified as a Significant Water Management Issue (SWMI).

Surface water based ecosystems

Figure 4.20 shows a schematic of how protected sites on surface waterbodies were identified. As in the groundwater example, water could be abstracted from anywhere within the WRZ. Protected site A is downstream of an abstraction and so could be impacted by changes in river flow resulting from the abstraction. Protected site B whilst further downstream in the river basin, it is on a tributary not connected with the WRZ, so abstraction is unlikely to have an impact. Protected site C is upstream of the abstraction so would not be impacted.

As with the groundwater abstractions, the location of surface water abstractions was not available to inform this study. The approach was therefore taken that any protected site directly on a waterbody that flows through or is downstream of the WRZ could be impacted by abstraction. Protected sites upstream or on tributaries that have not flowed through the WRZ are ignored.

In order to identify protected sites that may be at risk, Flood Zone 2 from the Risk of Flooding from Rivers and the Sea mapping was used to define an area that was either adjacent to a river or could be reasonably expected to receive surface water from a river.

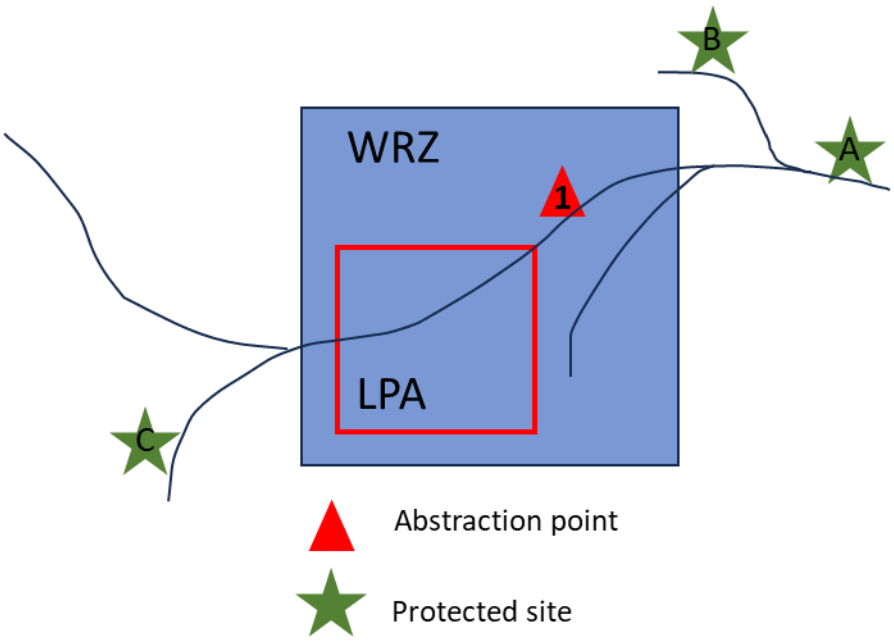


Figure 4.20 Definition of surface water study area

4.8.3 Results

There are 133 Groundwater Dependent Terrestrial Ecosystems that are within a groundwater body that overlaps with water resource zones serving MKCC. These are listed in Appendix C. 24 of these (across four groundwater bodies) are in groundwater bodies where flow is noted as a significant water management issue - either due to groundwater or surface water abstraction.

There are 32 SSSIs that are adjacent to waterbodies within the WRZs serving Milton Keynes (based on flood zone 2). These are listed in Appendix D. None of these have flow (either from groundwater or surface water abstraction) noted as a significant water management issue. Some of these SSSIs are also designated as Ramsar, SACs or SPAs.

4.8.4 Water quality impact

Sources of pollution

Water pollution is usually categorised as either diffuse or point source. Point source sources come from a single well-defined point, an example being the discharge from a WRC.

Diffuse pollution is defined as “unplanned and unlicensed pollution from farming, old mine workings, homes and roads. It includes urban and rural activity and arises from industry, commerce, agriculture and civil functions and the way we live our lives.”

Examples of diffuse sources of water pollution include:

- Contaminated runoff from roads – this can include metals, chemicals and microplastics
- Drainage from housing estates
- Misconnected sewers (foul drains to surface water drains)
- Accidental chemical/oil spills from commercial sites
- Surplus nutrients, pesticides and eroded soils from farmland
- Septic tanks and non-mains sewer systems

The most likely sources of diffuse pollution from new developments include drainage from housing estates, runoff from roads and discharges from commercial and industrial premises. The pollution risk posed by a site will depend on the sensitivity of the receiving environment, the pathway between the source of the runoff and the receiving waters, and the level of dilution available. After or during heavy rainfall, the first flush of water carrying accumulated dust and dirt is often highly polluting. Interception of this polluted water can be carried out by SuDS such as swales or permeable paving.

Whilst the threat posed by an individual site may be low, several sites together may pose a cumulative impact within the catchment.

Runoff from development sites should be managed by a suitably designed SuDS scheme. Potential impacts on receiving surface waters include the blanketing of riverbeds with sediment, a reduction in light penetration from suspended solids, and a reduction in natural oxygen levels, all of which can lead to a loss in biodiversity.

Pathways

Pollutants can take a number of different pathways from their source to a “receptor” – a habitat or species that can be impacted. This could be overland via surface water flow paths, via the river system, or via groundwater or a combination of all three. For the purpose of this study, it should be assumed at any protected site has the potential to be impacted by surface runoff from adjacent development sites. Linkages between development sites and protected sites will be explored further in Stage 2 once potential allocations are identified. The potential for a protected site to be impacted by pollution from WRCs via the river system will be explored by a screening exercise in stage 1 and water quality modelling in stage 2.

Receptors

A receptor in this case is a habitat or species that is adversely impacted by a pollutant. Both rivers and groundwater as well as being pathways, can also be considered to be receptors. Groundwater bodies are also given a status under the WFD which is reported in section 4.3.2. Within the study area and downstream are many sites with environmental designations such as:

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

A description of these, and the relevant legislation that defines and protects them, can be found in sections 3.7.7 to 3.7.10.

To identify protected sites that may be at risk from an increase in discharge from WRCs, Flood Zone 2 from the Risk of Flooding from Rivers and the Sea mapping was used to define an area that was either adjacent to a river or could be reasonably expected to receive surface water from a river. This method has limitations in that pathways between ordinary watercourses and protected sites may not be identified. A manual check will be performed in stage 2 before water quality modelling is undertaken. With excess wastewater in watercourses, flooding can disperse wastewater causing possible deterioration of protected areas such as SSSIs and Ramsar sites. Where a WRC was present in the catchment upstream of the protected site, it was considered that there was a risk of deterioration in water quality due to growth during the local plan period, and the first WRC upstream of the site is reported in the table (other WRCs must also be considered in future analysis). Where there were no WRCs serving growth upstream, risk of deterioration is considered to be low, and would not be shown by water quality modelling. However, in these cases the overall catchment water quality should be considered where for example they are designated for migratory fish species that may spend part of their lifecycle elsewhere in the catchment. When screening for protected sites in the study area, a 5km buffer was used to identify sites external to the study area that could potentially deteriorate

from excess wastewater discharges. In stage 2, protected sites down to the tidal extent of the Ouse will be identified.

Priority Habitats are available to view on the DEFRA Magic Map website, which can be accessed here.

Screening results

There are 15 SSSIs that the screening process identified that are downstream of WRCs serving growth in Milton Keynes. These are also within flood zone 2 which is used as a proxy for indicating if they may be hydraulically linked. Three SSSIs are within the Milton Keynes study area itself, with Yardley close is partially in the study area to the north and Oxley Mead and Howe Park Woods are to the south of the study area. These are displayed in Figure 4.21.

Three Ramsar sites (the Wash, Ouse Washes, and Upper Nene Valley Gravel Pits) were identified that had the potential to be impacted by growth in Milton Keynes. Two of these are also designated as a Special Protection Area (SPA) and Special Area of Conservation (SAC) (The Wash and Ouse Washes). There are a further two SACs (Portholme and Roydon Common & Dersingham Bog) identified downstream of Milton Keynes.

The full list of sites identified is shown in Appendix E.

As well as SSSIs there are a number of Local Nature Reserves (LNR) in and around the study area. The Blue Lagoon is a LNR to the south of the study area. It is an old excavation site which stopped being used as a quarry in the 1990s. Blue Lagoon is owned by Milton Keynes City Council and has two main lakes as well as wooded areas and grassland. Although it is not a SSSI, it is a designated LNR meaning the council designated it and manages it.

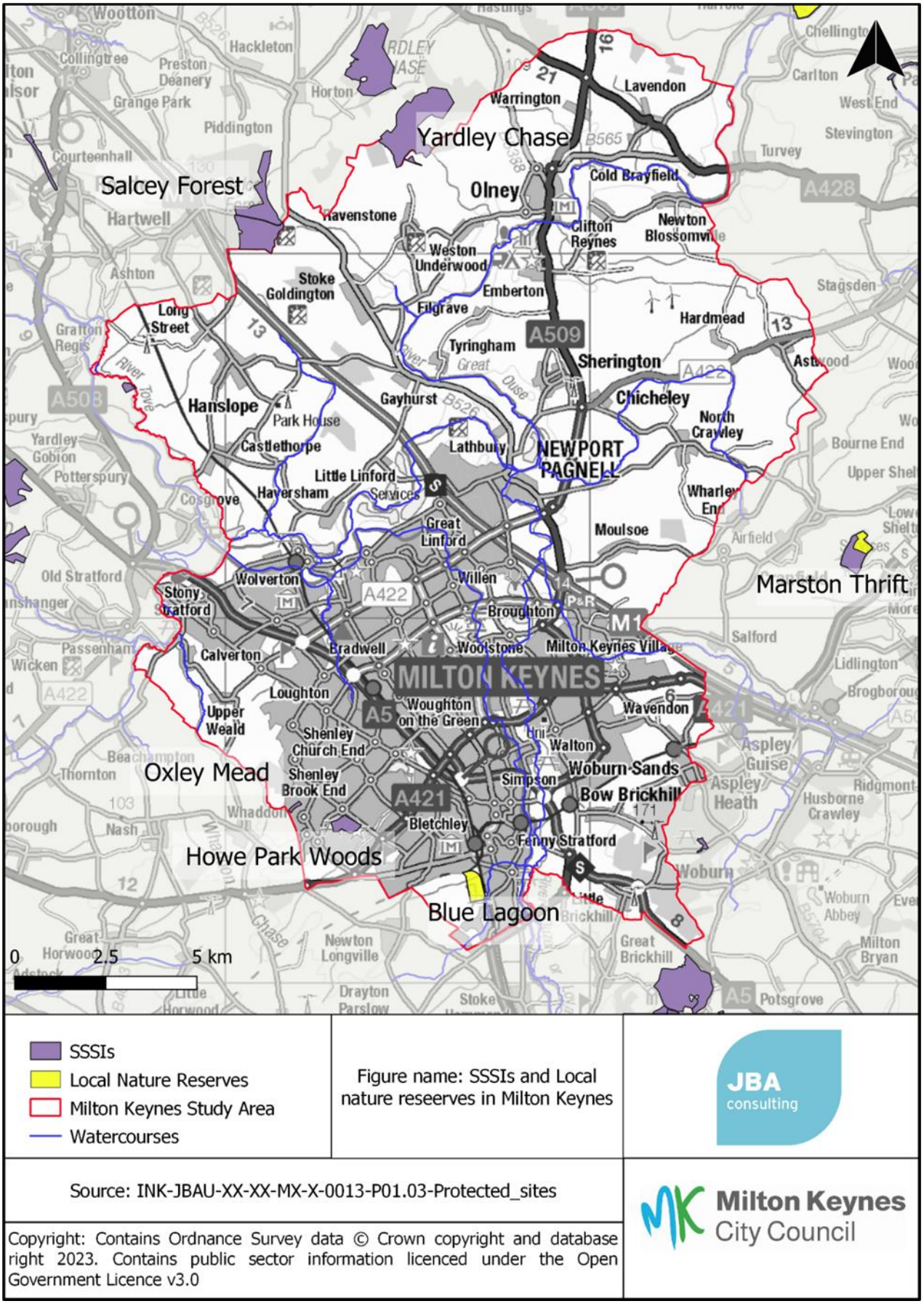


Figure 4.21 SSSIs and Local Nature Reserves in and around the study area

4.8.5 Bathing waters

Good water quality for bathing and unpolluted water is required for ecosystems and to support economic and recreational activities such as tourism. There are no designated bathing water areas in Milton Keynes but several sites which are still used for public bathing as seen in Figure 4.22 (Environment Agency i, 2021). These include:

- Great Ouse at Stony Stratford (CaBA, 2023)
- The Blue Lagoon Local Nature Reserve near Bletchley (MKCC, 2023)
- Willen Lake, Aqua Parc (not a registered site, but water quality is tested regularly (LOW, 2023))

Undesignated sites which are downstream of Milton Keynes are:

- Felmersham
- Cardington Lock
- Great Barford

(CaBA, 2023)

The foul and surface water drainage of new developments upstream of bathing waters should be carefully planned, where there is a potential to increase the frequency or volume of discharges from network sewer overflows and storm tanks at WRCs. Furthermore, most inland WRCs are not designed to reduce pathogens in treated effluent down to safe levels. Many coastal WRCs which discharge into or close to bathing waters operate ultra-violet (UV) treatment to achieve this.

The Park Trust, one of the authorities responsible for water and wastewater management in Milton Keynes is funding an 'optimisation scheme' for Willen Lake, also known as Aqua Parc. As of 2020, funding was granted for changes to Willen Lake including additional facilities and improvements to the lake.

In Figure 4.22 storm overflows within the Milton Keynes study area are shown in comparison to registered and unregistered bathing waters. The Great Ouse and Stony Stafford is upstream of Wolverton Rail Freight CSO and Blue Lagoon Nature Reserve is upstream of Newport Pagnell-Willen Road TPS WRC. Increased growth could affect the water quality of both bathing areas. Aqua Park potentially has some connectivity with the River Ouzel, which has an overflow upstream, but further investigation would be required to check connectivity.

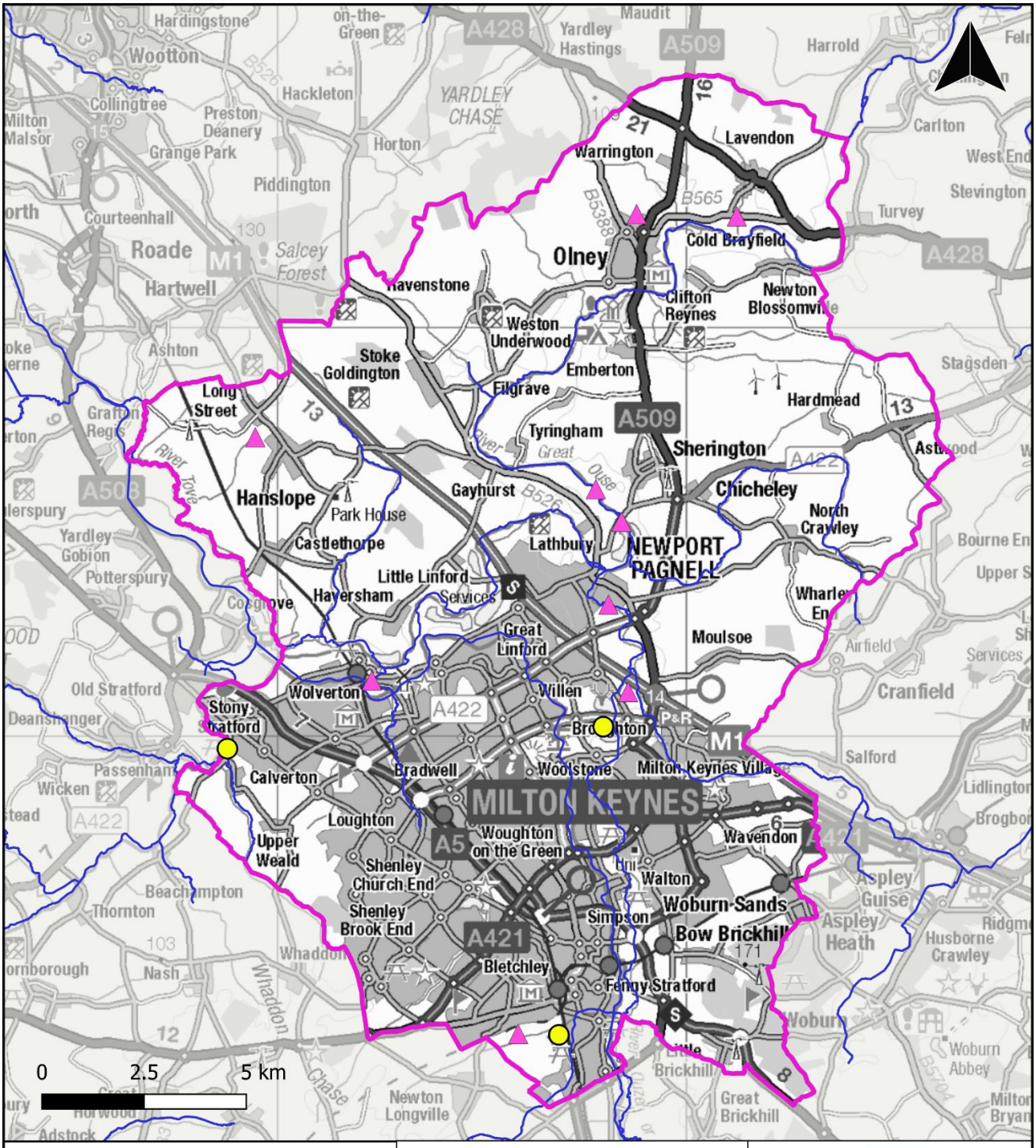


Figure name: Bathing waters in Milton Keynes in comparison to storm overflows

Source: ...K-JBAU-XX-XX-MX-Z-0017-SO-P01-bathing_wat

Figure 4.22 Undesignated sites used for bathing and water sports in Milton Keynes

4.8.6 Water Framework Directive Overview

Water Framework Directive Overview

The Water Framework Directive (WFD) aims to ensure "no deterioration" in the environmental status of rivers and sets objectives to improve rivers to meet "good" status. LPAs must have regard to the WFD and associated statutory objectives as implemented in the EA's River Basin Management Plans (RBMPs).

Figure 4.23 shows the overall WFD classification (2022) for waterbodies in Milton Keynes. This is assessed for each of the waterbodies that are predicted to receive additional effluent from growth during the plan period. Several of the WRCs discharge to small watercourses which are not within the WFD classifications.

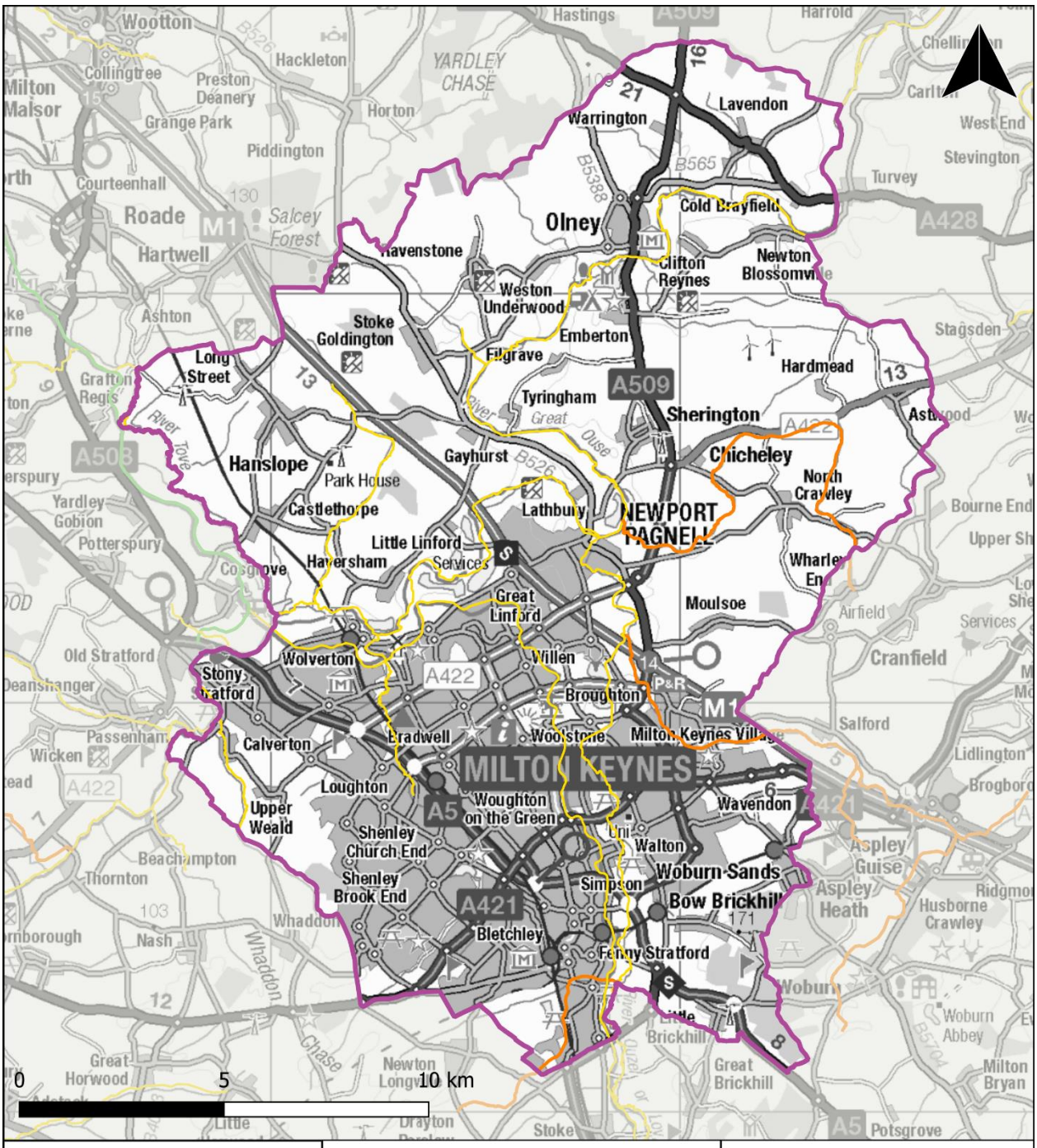


Figure 4.23 WFD waterbody overall health

The overall WFD status is made of Ecological and Chemical status, which are further broken down into sub-elements, the measurement of which is prioritised for each waterbody based on its characteristics and risk, hence not all elements are reported for each river. Invertebrate status can be used as an indicator of the overall health of the aquatic ecology.

The overall status of watercourses in the study area are presented in Table 4.8.

Table 4.8 WFD overall status and invertebrate class

Name	Waterbody ID	Overall Status	Invertebrate Class
Newton Longville Brook	GB105033037840	Poor	Moderate
Weald Brook	GB105033037870	Moderate	Moderate
Ravenstone Brook	GB105033038160	Moderate	Moderate
Tove (DS Greens Norton)	GB105033038180	Moderate	High
Ouse (Newport Pagnell to Roxton)	GB105033047923	Moderate	Good
Grand Union Canal, Tring summit to Milton Keynes	GB70510191	Moderate	N/A
Grand Union Canal, Milton Keynes trough pound	GB70510192	Moderate	N/A
Loughton Brook	GB105033037900	Moderate	Moderate
Ouse (Buckingham to Cosgrove)	GB105033037920	Moderate	High
Broughton Brook	GB105033037930	Poor	Good
Ouzel US Caldecote Mill	GB105033037971	Moderate	Good
Ouzel DS Caldecote Mill	GB105033037972	Moderate	Good
Ouse (Wolverton to Newport Pagnell)	GB105033038000	Moderate	High
Chicheley Brook	GB105033038040	Poor	Moderate
Tathall Brook	GB105033038070	Moderate	Moderate

The physio-chemical quality of watercourses in the study area are presented in Table 4.9.

Table 4.9 WFD physio-chemical quality elements

Name	Waterbody ID	Dissolved oxygen status	Phosphate status	Ammonia status
Newton Longville Brook	GB105033037840	Poor	Poor	Bad
Weald Brook	GB105033037870	High	Poor	High
Ravenstone Brook	GB105033038160	Good	Poor	Good
Tove (DS Greens Norton)	GB105033038180	High	Poor	High
Ouse (Newport Pagnell to Roxton)	GB105033047923	High	Poor	High
Grand Union Canal, Tring summit to Milton Keynes	GB70510191	N/A	N/A	N/A
Grand Union Canal, Milton Keynes trough pound	GB70510192	N/A	N/A	N/A
Loughton Brook	GB105033037900	High	Good	High
Ouse (Buckingham to Cosgrove)	GB105033037920	High	Moderate	High
Broughton Brook	GB105033037930	Good	Moderate	High
Ouzel US Caldecote Mill	GB105033037971	High	Poor	High
Ouzel DS Caldecote Mill	GB105033037972	High	Moderate	High
Ouse (Wolverton to Newport Pagnell)	GB105033038000	High	Moderate	High
Chicheley Brook	GB105033038040	Good	Bad	High
Tathall Brook	GB105033038070	High	Poor	High

4.8.7 Priority Substances

As well as the physico-chemical water quality elements (Dissolved Oxygen, Ammonia, Phosphate etc.), a watercourse can fail to achieve Good Ecological Status due to exceeding permissible concentrations of hazardous substances. Currently 33 substances are defined as hazardous or priority hazardous substances, with others under review. Such

substances may pose risks both to humans (when contained in drinking water) and to aquatic life and animals feeding in aquatic life. These substances are managed by a range of different approaches, including EU and international bans on manufacturing and use, targeted bans, selection of safer alternatives and end-of-pipe treatment solutions. There is considerable concern within the UK water industry that regulation of these substances by setting permit values which require their removal at wastewater treatment works will place a huge cost burden upon the industry and its customers, and that this approach would be out of keeping with the "polluter pays" principle.

Consideration should be given to how the planning system might be used to manage priority substances:

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

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

4.8.8 Reasons for not achieving good status.

The Environment Agency’s ‘Reason for Not Achieving Good’ database indicates that the water industry (sewage discharges) and agriculture and rural land management (livestock, arable and land drainage) are the main reasons for watercourses not achieving good status in this area.

Issues from agricultural land management include pollution from fertilisers, manures, pesticides, and soils washing into streams when it rains or percolating into the groundwater.

Other pressures from agriculture include deepening, widening or re-routing of streams for land drainage, gravel removal and bankside erosion.

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

Potential schemes could include:

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

There is considerable overlap with NFM measures, and the challenges are also very similar. Exact impacts are difficult to measure, although modelling tools such as Farmscoper exist to help with this (ADAS, 2023). Once a scheme is implemented it relies on the landowner to continue to maintain it in order to maintain the mitigation benefit.

The Upper and Bedford Ouse Catchment Partnership identify agriculture pollution and industry are two main polluters in Milton Keynes (UBOCP, 2023). Funding for agricultural interventions could come from Catchment Sensitive Farming or a Payment for Ecosystem Services approach.

5 Water quality

5.1 Introduction

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

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

The Environment Agency operational instructions on water quality planning and no-deterioration are currently being reviewed. Previous operational instructions (Environment Agency b, 2012) (now withdrawn but with no published replacement) set out a hierarchy for how the no-deterioration requirements of the WFD should be implemented on inland waters.

The potential impact of development should be assessed in relation to the following objectives:

- **Could the development cause a greater than 10% deterioration in water quality?** This objective is to ensure that all the environmental capacity is not taken up by one stage of development and there is sufficient capacity for future growth.
- **Could the development cause a deterioration in WFD class of any element assessed?** This is a requirement of the Water Framework Directive to prevent a deterioration in class of individual contaminants. The "Weser Ruling" (CURIA, 2015)by the European Court of Justice in 2015 specified that individual projects should not be permitted where they may cause a deterioration of the status of a water body. If a water body is already at the lowest status ("bad"), any impairment of a quality element was considered to be a deterioration. Emerging practice is that a 3% limit of deterioration is applied.
- **Could the development alone prevent the receiving watercourse from reaching Good Ecological Status (GES) or Potential?** Is GES possible with current technology or is GES technically possible after development with any potential WRC upgrades.
- The overall WFD classification of a water body is based on a wide range of ecological and chemical classifications. This assessment focuses on three physico-chemical quality elements; Biochemical Oxygen Demand (BOD),

Ammonia, and Phosphate as set out in the EA guidance (Environment Agency c, 2014).

5.2 Methodology

5.2.1 General Approach

In the Phase 1 IWMS, a sensitivity analysis of the waterbodies in Milton Keynes to changes in the volume of treated effluent was undertaken. A detailed modelling study will form part of Phase 2, when the preferred locations and types of development to be allocated will be modelled.

5.2.2 Water quality sensitivity assessment

SIMCAT is used by the Environment Agency to model water bodies and identify where permit changes are needed to prevent deterioration or improve water quality as well as supporting decision making to guide development to locations where environmental deterioration will be reduced. SIMCAT is a 1D model which represents inputs from both point-source effluent discharges and diffuse sources, and the behaviour of solutes in the river (Cox, 2003).

SIMCAT can simulate inputs of discharge and water quality data and statistically distribute them from multiple effluent sources along the river reach. It uses the Monte Carlo method for distribution that randomly models up to 2,500 boundary conditions. The simulation calculates the resultant water quality as the calculations cascade further downstream.

Once the distribution results have been produced, an assessment can be undertaken on the predicted mean and ninetieth percentile concentrations or loads.

The study area is covered by the Wash SIMCAT model.

Within SIMCAT, the determinands modelled were Biochemical Oxygen Demand (BOD), Ammonia (NH_4) and Phosphorus (P). In fresh waterbodies, phosphate is usually the limiting nutrient for algal growth. However, in marine environments, nitrogen is considered to be the limiting nutrient.

The following methodology was used:

- An updated baseline model was created by taking the baseline model as supplied by the EA and updating the WRCs within Milton Keynes with the latest flow data.
- Effluent flows at every WRC in the model were increased by 10% to simulate future increases in population and the model was re-run as a future scenario.
- River quality data (for ammonia, biochemical oxygen demand (BOD) and phosphate) was extracted.
- Results from the two models were then compared and the percentage change calculated. Where water quality downstream of a WRC in any given determinand deteriorates by 10% or more in response to a 10% increase in effluent flow, the sewer catchment can be said to be “more sensitive” to changes in effluent flow,

and therefore growth. It should be noted that this assessment takes the existing SIMCAT model based on 2014-2020 data and increases flow by a consistent figure across the whole model. In some cases, a WRC may be able to accommodate a higher flow, in other cases, a 10% increase may not be likely or feasible. This assessment therefore just highlights the relative risk of deterioration.

This analysis also does not take into account planned changes in permits at WRCs that would have the effect of improving water quality.

5.3 WINEP

The actions from the Water Industry National Environment Programme that relate to water quality are presented in Table 5.1and show that most WRCs in the study area have an action against them. In most cases these include monitoring of storm overflows and the volume of sewage being treated. In many, a permit condition to limit the concentration of phosphate in the treated effluent is being applied in order to improve downstream water quality.

Table 5.1 WINEP Actions relating to water quality.

Waterbody name	WINEP ID	Unique ID	Scheme name	Type of scheme/ notes
Tove (DS Greens Norton)	EAN00485	7AW200068	Castlethorpe STW	Proposed phosphorous permit limit of 1mg/l (AA)
Tove (DS Greens Norton)	EAN01383 EAN01384 EAN00503 EAN02406 EAN00711	7AW200959 7AW200960 7AW200086 7AW300465 7AW200289	Hanslope STW	Monitoring Proposed phosphorous permit limit of 1mg/l (AA) Proposed ammonia permit limit of 27mg/l (UT) (90th percentile) Schemes to meet requirements to prevent deterioration in phosphorous (5mg/l AA)
Ouse (Newport Pagnell to	EAN01531 EAN01532	7AW201107 7AW201108	Lavendon STW	Monitoring

Waterbody name	WINEP ID	Unique ID	Scheme name	Type of scheme/ notes
Roxton)				
Ouse (Newport Pagnell to Roxton)	EAN00671 EAN01059 EAN01060 EAN01061	7AW200249 7AW200635 7AW200636 7AW200637	Cotton Valley STW	Schemes to meet requirements to prevent deterioration in phosphorous (1mg/l AA), monitoring, and increase in storm storage
Ouse (Newport Pagnell to Roxton)	EAN00517	7AW200100	Olney STW	Proposed phosphorous permit limit of 1mg/l (AA)

5.4 Water quality sensitivity analysis

The sensitivity analysis was conducted using the EA's SIMCAT model and the full results are shown in Appendix F. The modelling results suggest changes in the volume of treated wastewater in Milton Keynes do not cause a significant response in the concentrations of ammonia, BOD or phosphate within Milton Keynes. Higher sensitivity is observed for the Ouse (Newport Pagnell to Roxton) for Ammonia. A deterioration of greater than 3% is observed at Hanslope WRC which is at "Bad" WFD status for Ammonia.

For BOD, most waterbodies are moderately sensitive with a 0 to 10% deterioration, concentrated more in the north-east and north-west. Generally, sensitivity of BOD across waterbodies in Milton Keynes is less than 3%.

For phosphate, most waterbodies are moderately sensitive with a 0 to 10% deterioration, with higher sensitivity concentrated more in the north-west. A deterioration of greater than 3% is observed at Hanslope WRC which is at "Bad" WFD status for Phosphate.

5.5 Conclusions

Growth during the local plan period will increase the discharge of treated wastewater from WRCs in Milton Keynes. There is a potential for this to cause a deterioration in water quality in the receiving watercourses and this must be carefully considered. A deterioration in water quality is not acceptable under the Water Framework Directive. The sensitivity analysis suggests that watercourses within Milton Keynes may be less sensitive to increases in the discharge of treated wastewater. Further modelling should be conducted in a Stage 2 IWMS.

6 Water balance

6.1 Introduction

Water balance is the sum of water entering, stored within, and leaving a system. In a natural system it is usually expressed as:

Precipitation = Streamflow + evapotranspiration + change in storage in ground or surface stores.

In this context, we are interested in the urban water balance of Milton Keynes. As previously discussed, Milton Keynes is located within Anglian Water's Ruthamford Central WRZ, which receives all of its water supply from outside of the zone. We have chosen, therefore, to analyse water balance at this zonal level.

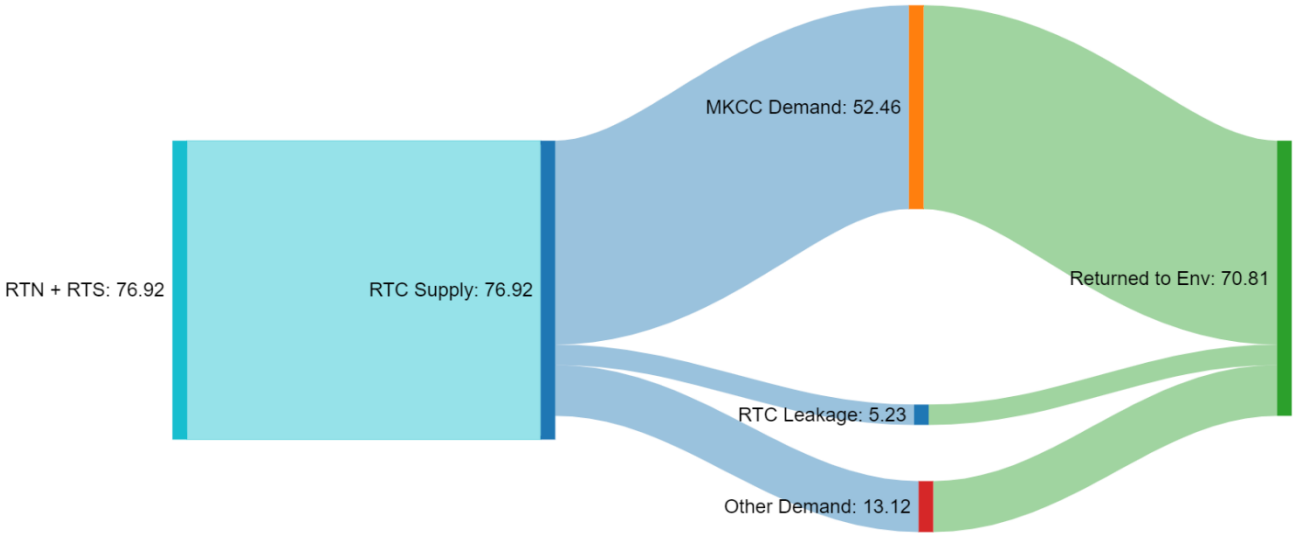
In studying integrated water management, analysing the water balance can be a useful tool to illustrate where Milton Keynes draws its water resources from, where these are discharged to and how these are forecast to change over time. At stage 2 we will extend this approach to explore how planning policies might impact the water balance.

6.2 Water balance baseline for 2024-25

6.2.1 Overview

Figure 6.1 shows the present-day Dry Year Annual Average (DYAA) water balance of Ruthamford Central WRZ, using data from the rdWRMP24 for a base year of 2024-25, the start of AMP8 (Anglian Water c, 2023).

The individual components of the water balance are summarised in the following sections. The figure illustrates that, at present, water is brought in from outside of the WRZ, used in homes and workplaces and discharged to sewers and the environment and out of the zone. In other words, there is no use of local water resources and no recycling of water within the system, at least in ways that are managed by or visible to Anglian Water.



RTN = Ruthamford North, RTS = Ruthamford South, RTC = Ruthamford Central

Figure 6.1 Supply-demand balance in Ruthamford Central WRZ for base year 2024-25

6.2.2 Demand

Demand for Milton Keynes alone is not specified in the dWRMP, but, based on the projected number of households of 110,773 in 2024-25 (Office for National Statistics, 2020), 80% of households within Ruthamford Central are in Milton Keynes. We have assumed that Milton Keynes also comprises 80% of the water demand.

During AMP7, demand management using a range of water efficiency initiatives contributed 0.4Ml/d, whilst leakage reduction will contribute 1.2Ml/d. AW plan to reduce leakage by 38% between 2025 and 2050.

6.2.3 Supply

All Ruthamford Central's public water supply is sourced from transfers from Ruthamford North and South. During AMP7 (2020-2025) there will be a small increase (0.8Ml/d) in the volume transferred.

6.2.4 Returned to sewer and the environment.

The model assumes that all household and non-household water use is returned to sewer or, where used on garden-watering and other outdoor uses, to the environment. It is commonly assumed in the industry that 95% of all water used is discharged to foul and combined sewers and therefore is discharged to rivers following treatment. Evaporative losses are assumed to be negligible within this model of urban water balance.

When considering water return to the environment, disparity between the water body the water is abstracted from and the water body that the water is returned to needs to be considered.

6.3 Water balance in 2049-50

6.3.1 Overview

There are no significant changes planned to the overall operation of the WRZ: all water will continue to be supplied from outside of the zone, and all wastewater returned to the environment to flow out of the zone. The plan relies primarily on increased supplies to meet the additional demand because of growth in Milton Keynes and the rest of Ruthamford South. In other words, the plan is not water neutral.

6.3.2 Demand

The dWRMP forecasts a 48% increase in the number of households within Ruthamford Central between 2024 and 2050, to 209,680. This is significantly higher than the ONS prediction of 10% growth of households in Milton Keynes (2024 to 2043) but is in line with the Strategy for 2050 population growth estimate of 51% growth between 2020 and 2050 (Milton Keynes Council, 2020)

Anglian Water predict a 28% increase in demand in Ruthamford Central by 2050, one of only two zones in their area where demand is forecast to increase over this period. The growth of Milton Keynes is the key driver for this increased demand.

Leakage in the zone is forecast to reduce from 5.23ML/d to 3.03Ml/d This is in line with AW's overall leakage reduction plan.

Other demand management, comprising of the smart metering programme and a suite of water efficiency measures will contribute approximately 5Ml/d to the supply-demand balance by 2050.

The EA have recommended sensitivity testing of the effectiveness of demand management measures. This will be included in the phase 2 study.

6.3.3 Supply

An additional 13.1Ml/d is planned to be transferred into Ruthamford Central from the neighbouring zones by 2050. So, increasing supply will contribute more than demand management measures to keeping the zone in a supply-demand balance by 2050. The additional supply from Ruthamford North and Ruthamford South is proposed to be met via the following schemes:

- RTN17 South Lincolnshire reservoir SRO. This is a major new source option, in the dWRMP for delivery in 2039, which will abstract and store flow from the River Witham during periods of higher river flow. Predicted to be operational by 2050.
- RTN13 Lincolnshire Central to Ruthamford North potable transfer (100 Ml/d)- construction commencing 2040.
- RTS11 Ruthamford North to Ruthamford South potable transfer (50 Ml/d)- to be delivered 2024-25.
- RTS16 Ruthamford South Drought permit (2.07 Ml/d)- unknown delivery date.

- RTS21 Ruthamford South Surface water enhancement- to be operational by 2032-33. (9.5 Ml/d up to 2040 and 6 Ml/d after 2040).

Anglian Water has stated in its WRMP that in combination these schemes with deliver future demand whilst also meeting sustainability reductions required to reduce the environmental damage caused by over-abstraction. The Environment Agency is a statutory consultee to the WRMP and has a statutory duty to secure the proper use of water resources in England.

Anglian Water are aware of the planned rate of development in Milton Keynes and in other LPAs within Ruthamford Central, and in Ruthamford North and South which supply Ruthamford Central. They have set out a plan to maintain the supply-demand balance through to 2050. This should be checked at stage 2, once further details are available on the planned trajectory of growth in Milton Keynes, particularly if housing growth is highly front-loaded within the plan period.

6.4 Planning and the water balance

The 2024-25 and 2049-50 water balances presented for public water supply are typical of urban water balances within the UK, in that the sources of water are provided by a single water company provider, with water being imported from outside of the zone, and with no substantial recycling of water or alternative, distributed sources of water being utilised within the zone. Anglian Water's plan did include an appraisal of large-scale water reuse options. Their plan has selected one indirect water reuse scheme at Colchester, but this will not impact supply in Milton Keynes. Likewise Anglian Water (and other water companies) place no or limited reliance upon national or local government policies to improve water efficiency. This is a reasonable approach, given that water companies have no direct influence over such policies, and the key Building regulations relating to water efficiency have not been amended since 2010.

Within a water resource planning system which is highly centralised and focused on water industry actions, what is the role of integrated water management in the planning system? As introduced in section 1.2, water management is considered to be an essential element of spatial planning and placemaking. The CIRIA guidance (CIRIA, 2019) identifies a range of positive outcomes from an IWM approach:

1. Reducing risk from flooding.
2. Increased water efficiency and reduced water stress.
3. Clean and good quality water environment.
4. Enabling new housing
5. Facilitating economic growth and regeneration.
6. Enhanced biodiversity.
7. Better blue-green infrastructure.
8. Improved accessible public spaces and places, and well-being.
9. Mitigating and adapting to climate change.
10. Utilising resources more sustainability and effectively.

Adopting an integrated water management approach in spatial planning is not seeking to replace regional plans and water company WRMPs, but to consider and quantify how IWM might deliver multiple benefits which include, but are not limited to, reducing or delaying the need for future development of new water resources by water companies, or potentially bring forward the date when the WRE and dWRMPs long-term environmental objectives (also known as the environmental destination) can be achieved.

We have developed a two-stage approach within this strategy:

Stage 1:

- Quantify the public water supply water balance both now and over the plan period to 2050.
- Identify the objectives of the Milton Keynes Strategy for 2050 to which IWM may be able to positively contribute.
- Using a multi-objective decision analysis (MODA) approach, quantify to what extent a long-list of IWM approaches could contribute to the Council's strategic objectives (see sections 7 and 8).

Stage 2:

- Select a short-list of IWM approaches to meet the aims of the Strategy for 2050 through policies in the emerging New City Plan.
- Quantify the potential contribution of these IWM approaches and build these into a new water balance for 2050.

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7 Approach to quantifying integrated water management benefits in spatial planning.

7.1 Introduction

Multi-Objective Decision Analysis (MODA) is a method that allows decisions to be made whilst considering multiple factors, objectives, and trade-offs. In the context of this strategy, the approach is used to quantify how different approaches to IWM might, if promoted through planning policies in the emerging New City Plan, contribute to meeting the objectives of the Strategy for 2050.

The available literature on MODA illustrates a range of staged approaches (Energize, 2014; Lim and Herrmann, 2012). We have adopted the following six-staged approach:

- Objectives - agree the multiple objectives against which planning policy options for IWM can be evaluated.
- Weighting - determine the relative weighting or importance of each objective.
- Options - identify the IWM options to be evaluated.
- Scoring - score the relative merits of the options against each objective.
- Quantification - quantify the potential contribution of favourable measures to the water balance.
- Decision - evaluate the results and make recommendations for future policy.

7.2 Objectives

A workshop was held with spatial planners from Milton Keynes to identify objectives against which the potential values of IWM approaches could be scored. It was agreed that the objectives should be aligned with those of the Milton Keynes Strategy for 2050:

- Reduced water stress
- Healthy water environment
- Reduced risk of flooding
- Resilience to climate change
- Carbon neutral by 2030
- Enabling healthy places
- Delivery of viable housing
- Reduced consumption of resources and a sustainable green economy
- Net gain in biodiversity

For each IWM approach the question should be asked - to what extent can the approach contribute towards the objectives.

For this stage 1 analysis, each of the objectives has been given an equal weighting. This approach will be reviewed at stage 2.

7.3 Preliminary options

A preliminary list of options was identified as follows:

- SuDS
- Green infrastructure
- Blue infrastructure
- Water efficient fixtures and fittings
- Diversifying water resources
- Leakage reduction
- Rainwater harvesting
- Greywater recycling
- Education

The preliminary options do not consider measures outside of Milton Keynes, or that are outside of Council influence - for instance measures implemented at the point of abstraction for water supply that occur in neighbouring WRZs.

7.4 Scoring

As part of the ranking of each option, a scoring system has been devised to rank each option and how it will benefit each objective, see Table 7.1. The higher the overall score, the better it is for the objective. For example, habitat creation is more beneficial for biodiversity net gain than affordable housing is.

Table 7.1 The scoring system for the MODA

Rank	Description
2	Significant potential to contribute to this objective.
1	Some potential to contribute to this objective.
0	Neutral
-1	Some potential to cause detriment to this objective.
-2	Significant potential to cause detriment to this objective.

8 Preliminary options scoring

8.1 Introduction

Radar diagrams have been used to present the ranking of each option in comparison with the objectives. An overall average is presented in the diagrams as well, to show how all options compare.

8.2 Green Infrastructure (GI)

Green Infrastructure (GI) can include street trees, parks, gardens, SuDS (although these are dealt with separately in section 8.4), and nature reserves. GI are often accessible by the public and benefit the environment at the same time. This can include carbon sequestration from trees, buffer systems for road run off from planted roadside verges and reduction of urban heat islands. Incorporating GI into Healthy Places can help approach socio-economic and environmental issues.

Natural England's Green Infrastructure Framework aims to increase green spaces by 40% in residential urban spaces (Natural England, 2023). The framework is an integrated set of principles to increase accessible GI including features such as green walls and trees. By increasing GI in urban areas other benefits such as carbon sequestration, clean air and better health and wellbeing for individuals in the community.

In a more specific context to Milton Keynes the B&MK Waterways Trust and The Park Trust aim to increase GI in and around new developments. A collaboration with both of these bodies could be a beneficial way of utilising already present pathways to implement further GI into the city.

Consideration should be given to planning GI that requires low or no water. Peak water demand for plant watering / irrigation is likely to coincide with peak customer demands, so anything that can be done to reduce this will contribute to meeting the objectives of "using water resources wisely" and "resilience to climate change".GI can be delivered in numerous ways such as improving already present infrastructure or creating new spaces. Implementing both can help towards:

- Biodiversity Net Gain
- Local Nature Recovery Strategies
- The government's 25-year plan to improve the environment.
- Enabling healthy spaces that have more than one purpose.

8.2.1 Results

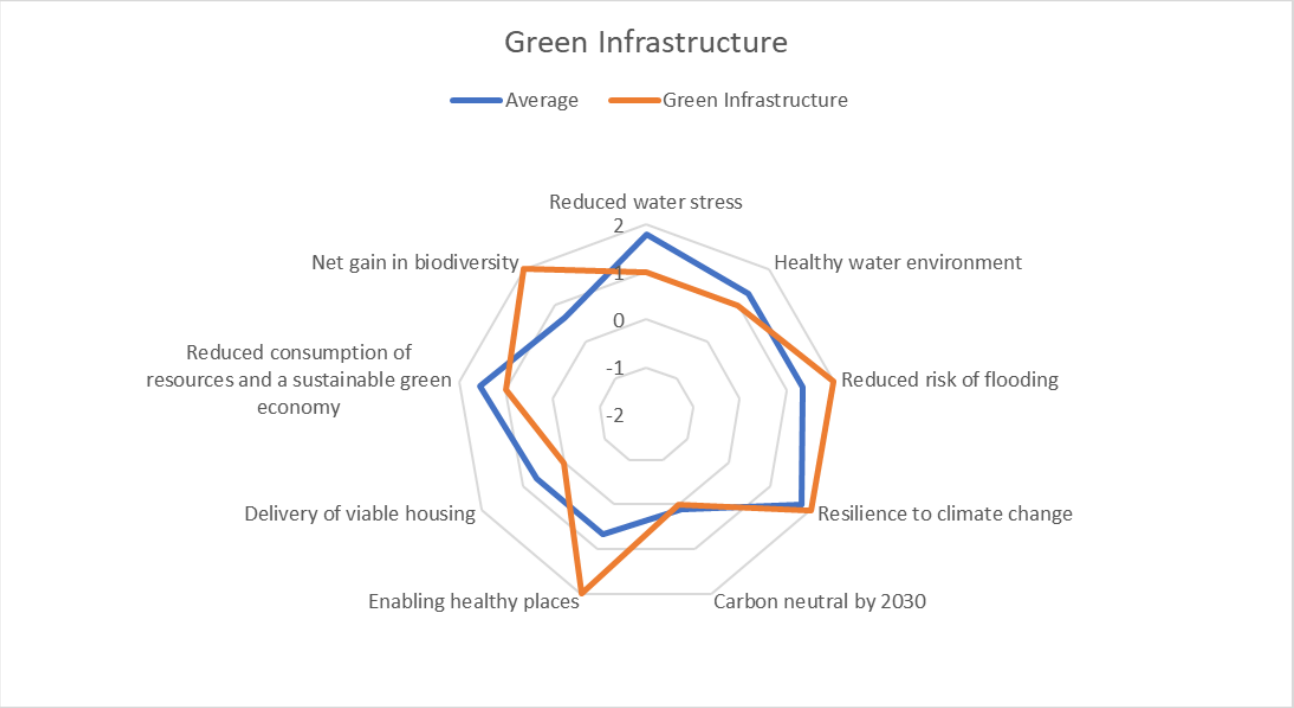

Figure 8.1 Radar diagram showing the MODA for Green Infrastructure

8.3 Blue Infrastructure (BI)

Blue Infrastructure (BI) is more water focussed, with Natural Flood Management (NFM), de-culverting watercourses and stormwater management. BI also encompasses WRCs and how they are managed. Although, like GI, BI can be incorporated into healthy public places, the safety risks of water need to be considered and addressed through good design.

The B&MK Waterways Trust and The Park Trust also aims to increase BI in and around new developments. As well as a collaboration with implementing GI, it could also be beneficial to work together to create further BI within MK.

8.3.1 Results

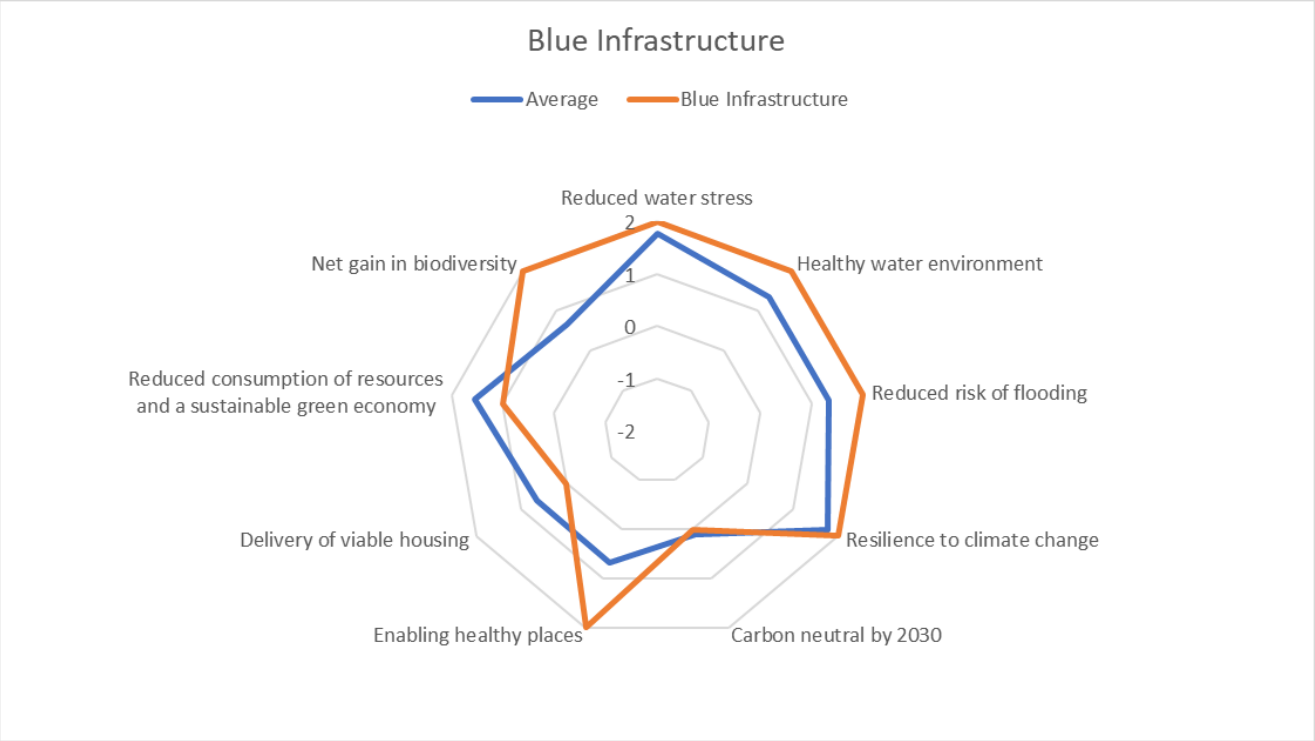

Figure 8.2 Radar diagram showing the MODA for Blue Infrastructure.

8.4 SuDS

8.4.1 Multiple benefits of SuDS

Properly designed SuDS can achieve multiple benefits such as:

Flood Risk

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

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

Water Resources

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

SuDS techniques aim to replicate the natural hydrology of a site, infiltrating rainfall into the ground where local hydrogeological conditions allow or releasing it slowly into watercourses. This in turn helps maintain groundwater levels and river flows during dry periods, maintaining or enhancing the percentage of time during which abstraction can take place.

Climate Resilience

Climate projections for the UK suggest that winters may become milder, and wetter and summers may become warmer. This would be expected to increase the volume of runoff, and therefore the risk of flooding from surface water, and diffuse pollution, and reduce water availability.

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

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

Biodiversity

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

variety of species including plants, amphibians, invertebrates, birds, bats, and other animals.

Amenity

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

8.4.2 Use of SuDS in Water Quality Management

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

This is usually facilitated via a SuDS Management Train of several components in series that provide a range of treatment processes delivering gradual improvement in water quality and providing an environmental buffer for accidental spills or unexpected high pollutant loadings from the site.

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

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

Infiltration techniques will need to consider Groundwater Source Protection Zones (GSPZs) and are likely to require consultation with the Environment Agency.

Early consideration of SuDS within master planning will typically allow a more effective scheme to be designed.

8.4.3 Suitable SuDS Techniques

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

Appropriate SuDS techniques have been categorised into five main groups, as shown in Table 8.1. Further site-specific investigation should be conducted to determine what SuDS techniques could be used on a particular development, informed by detailed ground investigations.

Table 8.1 Examples of SuDS Categories

SuDS Type	Technique
Source Controls	Green Roof, Rainwater Harvesting.
Infiltration	Infiltration Trench, Infiltration Basin.
Detention	Pond, Wetland, Subsurface Storage, Shallow Wetland.
Filtration	Surface Sand filter, Sub-Surface Sand Filter.
Conveyance	Dry Swale, Under-drained Swale, Wet Swale.

8.4.4 Results

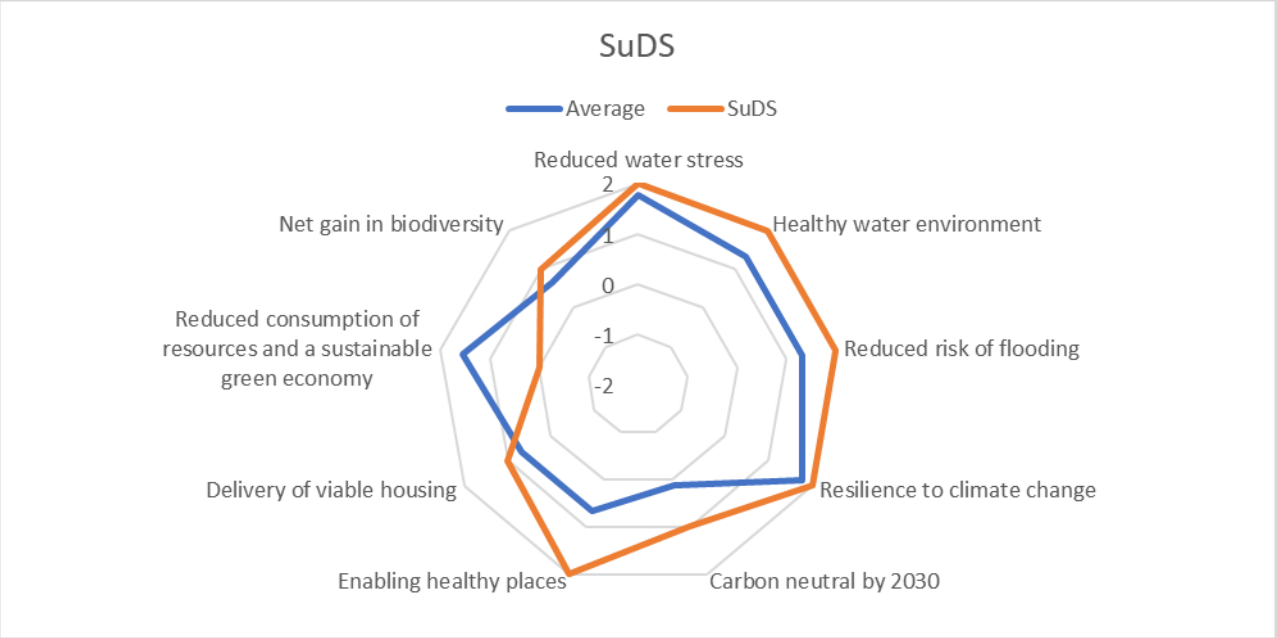

Figure 8.3 Radar diagram showing the MODA for SuDS

8.5 Diversifying water resources

Modelling carried out within the National Framework for Water Resources (Environment Agency h, 2020), assumes that 700 million litres per day of water come from unsustainable abstractions. To replace this unsustainable abstraction, an extra 720 million litres per day would be needed across England. The regional water resource plans and the Regulators' Alliance for Progressing Infrastructure Development (RAPID) process have given an impetus to the search for new water resources in the UK, including regional transfers, direct and indirect water recycling, desalination, and new reservoirs which can abstract river water at times of high flow and store it for use during dryer periods.

As previously discussed, Anglian Water's preferred plan for Ruthamford Central is based primarily on a new reservoir in South Lincolnshire, coupled with new pipelines to supply this water widely within their region and to provide additional transfer supply to Affinity Water. The Lincolnshire and Fens reservoirs will not be able to provide additional water to Milton Keynes until the mid to late 2030s. These reservoirs are also discussed in Section 4.5.3.

Large-scale diversification of water resources is primarily the responsibility of the water companies; however opportunities may exist for smaller-scale local schemes to be developed, for example large industrial users of water sinking their own boreholes. Milton Keynes boasts a large number of lakes, including online lakes in parkland managed by the Parks Trust, and offline lakes along the Great Ouse valley to the north of the city. With careful management, these have the potential to contribute towards water resources.

8.5.1 Results

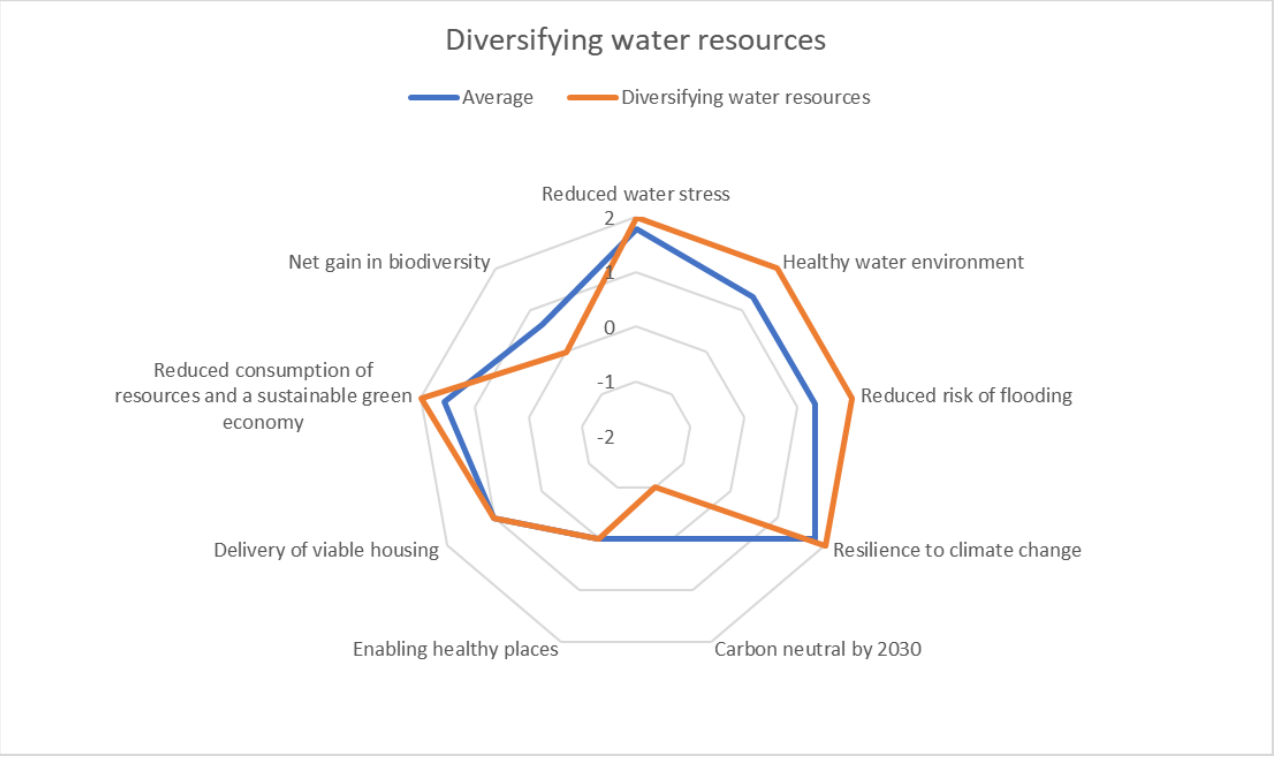

Figure 8.4 Radar diagram showing the MODA for Diversifying water resources.

8.6 Leakage reduction

Water leakage in this case refers to the loss of treated water from distribution systems managed by water companies. Leakage can be impacted by several factors such as:

- Operational strategies e.g., pressure management
- Network characteristics e.g., length of mains
- Asset condition e.g., age
- Customer base composition e.g., rural, or urban areas

(OFWAT, 2023)

Leak detection is the main way to manage leakage. Different technologies help monitor leakage from cracked pipes such as:

- CCTV Inspection- where cameras are sent down pipes to find cracks and deterioration.
- Acoustic leak detection- a speaker is used to send out a noise and using the echo leaks can be detected.
- The next generation of smart water meters will enable detection of customer-side leaks, and to communicate this to the water company and to householders and business customers.

8.6.1 Results

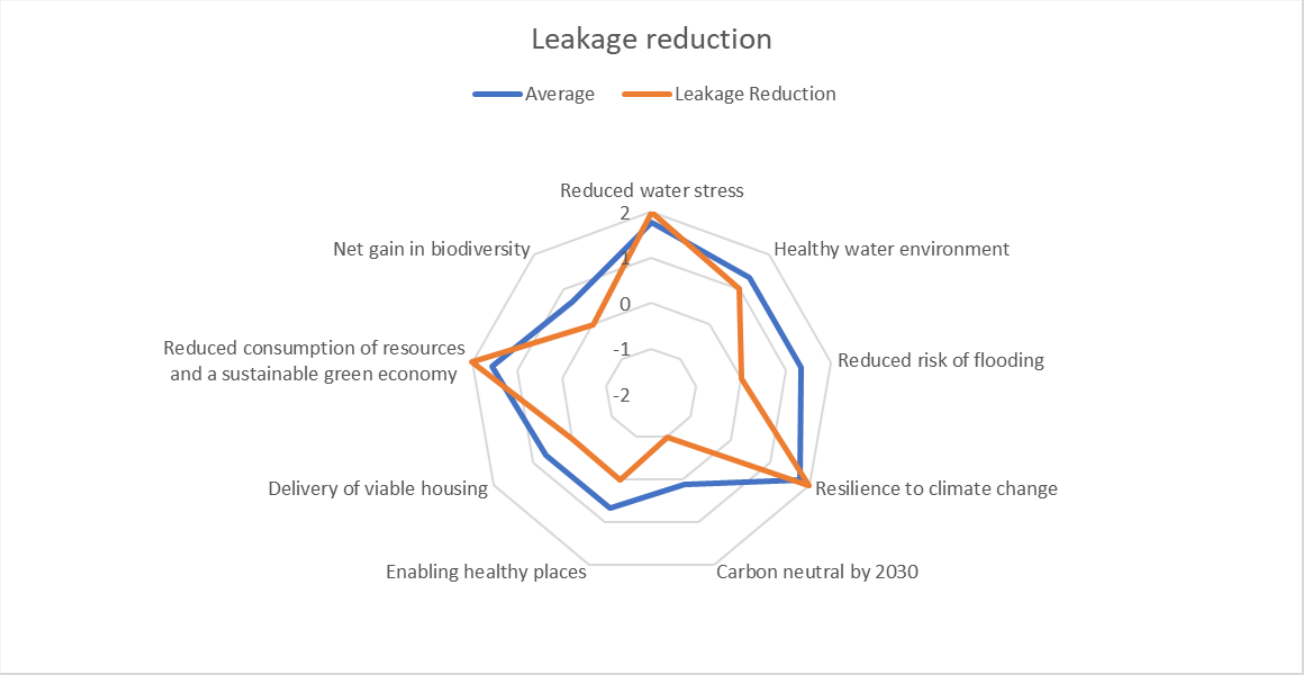

Figure 8.5 Radar diagram showing the MODA for leakage reduction

8.7 Efficient fixtures and fittings

There are several ways to save water within households. Table 8.2 presents different consumer water efficiency measures and how they can be implemented.

In newbuilds the "fittings-based approach" to meeting the building regulations water efficiency target can be required. Smart meter rollout can also help measure the resulting benefits of water efficiency measures. On existing properties, water efficient fixtures and fittings as well as flow restrictors can be retrofitted to reduce demand from existing homes.

Table 8.2 Consumer Water Efficiency Measures

Measure	Examples
Water-efficient measures for toilets	• Cistern displacement devices to reduce volume of water in cistern • Retro-fit or replacement dual flush devices • Retro-fit interruptible flush devices • Replacement low-flush toilets
Water-efficient measures for taps	• Tap inserts, such as aerators • Low flow restrictors • Push taps • Infrared taps
Water-efficient measures for showers and baths	• Low-flow shower heads • Aerated shower heads • Low-flow restrictors • Shower timers • Reduced volume baths (e.g., 60 litres) • Bath measures
Rainwater harvesting and water reuse	• Large-scale rainwater harvesting • Small-scale rainwater harvesting with water butt • Grey water recycling
Water-efficient measures addressing outdoor use	• Hosepipe flow restrictors • Hosepipe siphons • Hose guns (trigger hoses) • Drip irrigation systems • Mulches and composting

8.7.1 Results

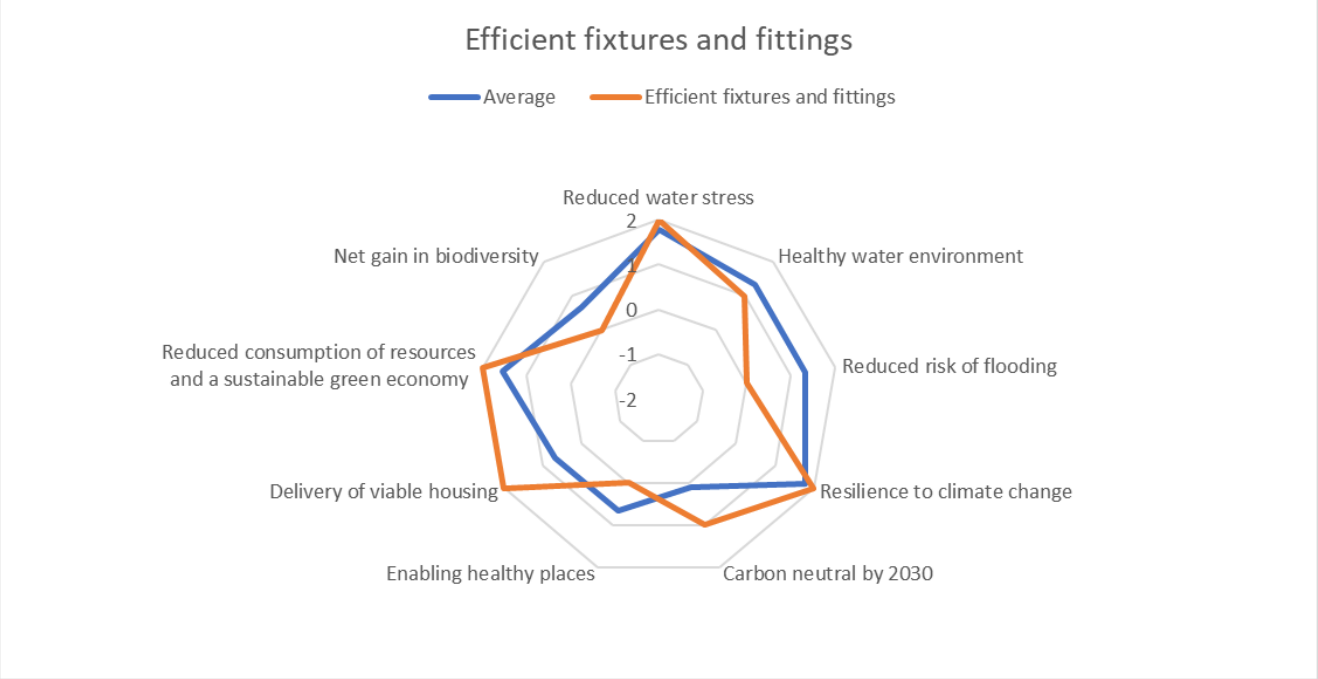

Figure 8.6 Radar diagram showing the MODA for efficient fixtures and fittings

8.8 Education

Education and promotional campaigns can contribute to behaviour changes when considering water use. Water efficiency measures that can help promote behaviour change include:

- encouraging community establishments (e.g., schools and hospitals) to carry out self-audits on their water use;
- delivering water conservation messages in schools and providing visual material for schools;
- delivering water conservation messages to households; and
- discouraging misuse of sewerage systems to dispose of fats, wipes, nappies etc, which lead to blockages, sewer flooding and river pollution from sewer overflow incidents.

Organisations such as Waterwise give information on how to save water in the home as well as information to schools.

8.8.1 Results

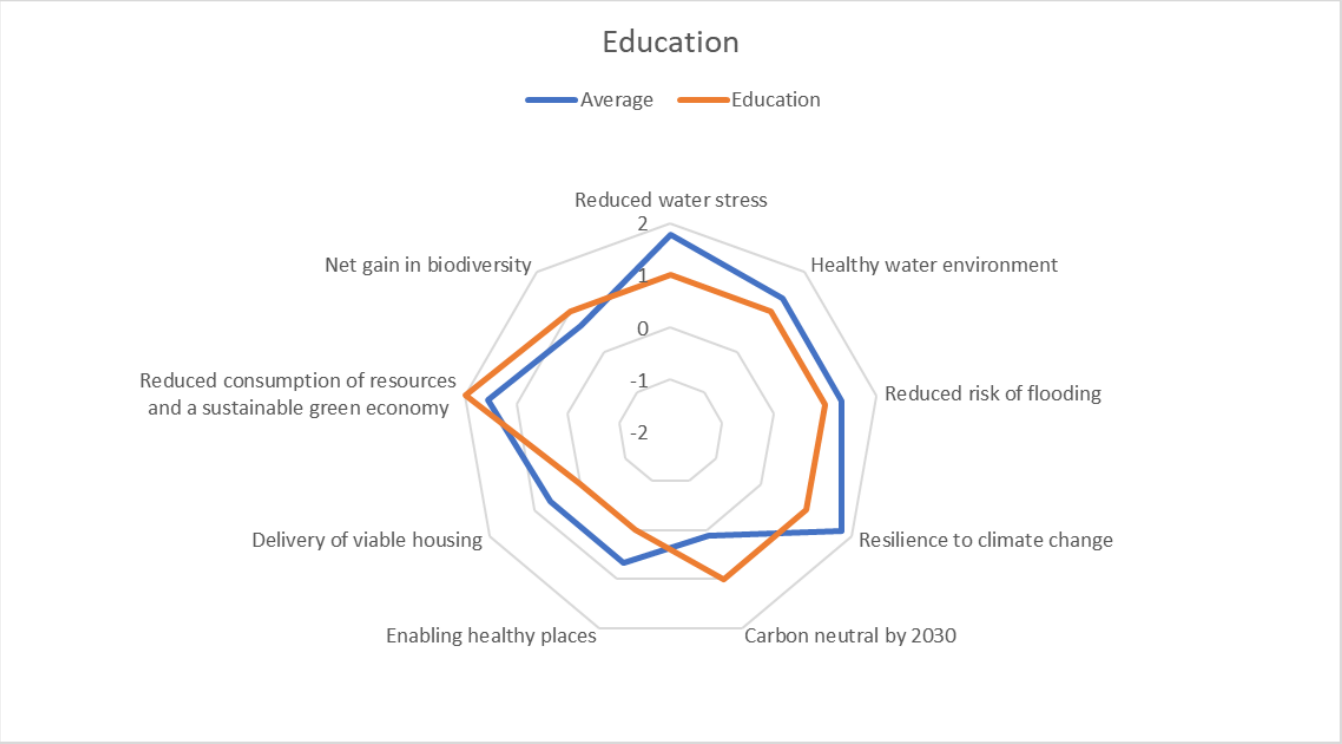

Figure 8.7 Radar diagram showing the MODA for education

8.9 Rainwater Harvesting

Rainwater recycling or rainwater harvesting (RwH) is the capture of water falling on buildings, roads or pathways that would normally be drained via a surface water sewer, infiltrate into the ground or evaporate. In the UK this water cannot currently be used as a drinking water supply as there are strict guidelines on potable water, but it can be used in other systems within domestic or commercial premises, principally for toilet flushing, garden watering and for clothes washing machines.

Systems for collection of rainwater can be simple water butts attached to a drainpipe on a house, or it could be a complex underground storage system, with pumps to supply water for use in toilet flushing and washing machines. By utilising rainwater in this way there is a reduced dependence on mains water supply for a large proportion of the water use in a domestic property.

Benefits of Rainwater Harvesting

- RwH reduces the dependence on mains water supply – reducing bills for homeowners and businesses.
- Less water needs to be abstracted from river, lakes, and groundwater.
- Stormwater is stored in a RwH system reducing the peak runoff leaving a site providing a flood risk benefit (for smaller storms)
- By reducing surface water flow, RwH can reduce the first flush effect whereby polluted materials adhering to pavement surfaces during dry periods are removed by the first flush of water from a storm and can cause pollution in receiving watercourses.

Challenges of RwH

- Dependency on rainfall can limit availability of harvested rainwater during drought and hot weather events.
- Increased capital (construction) costs to build rainwater harvesting infrastructure into new housing (£2,674 for a 3/4bed detached home).
- Payback periods are long as the cost of water is low so there is little incentive for homeowners to invest. Further information available here.
- Carbon costs can be higher than mains water.

8.9.1 Results

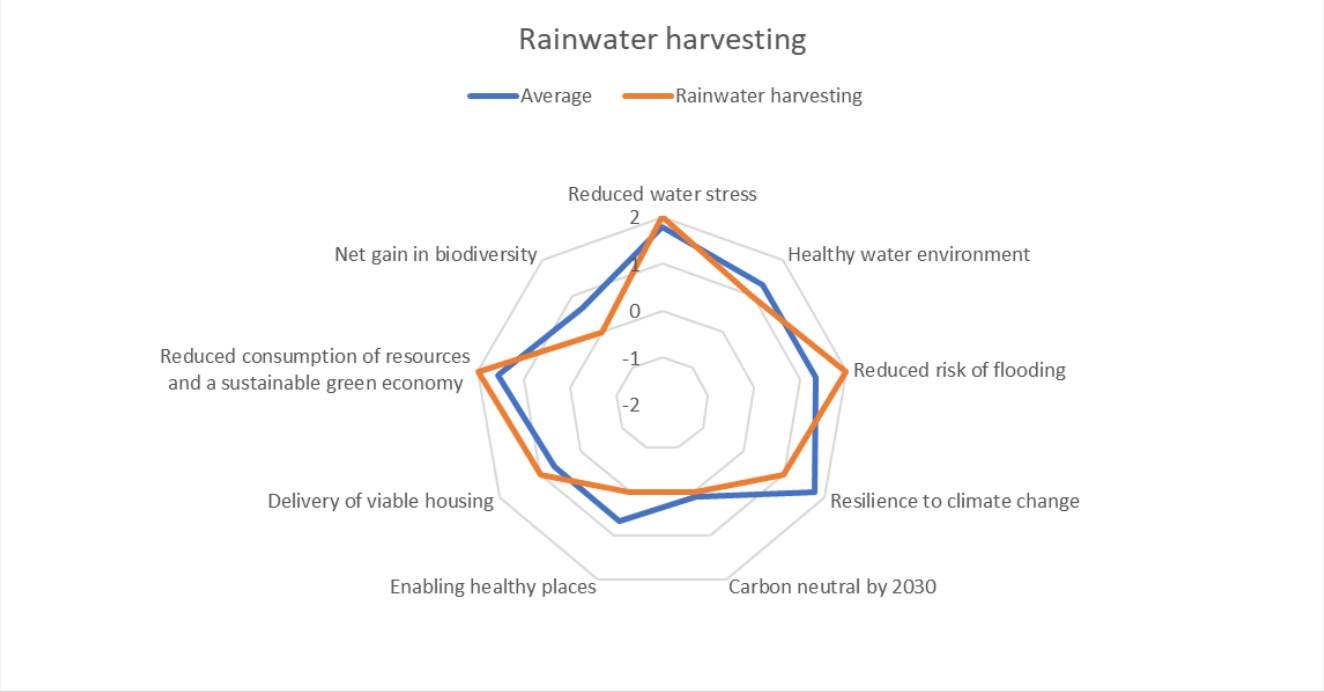

Figure 8.8 Radar diagram showing the MODA for Rainwater Harvesting

8.10 Greywater recycling

Greywater refers to water that has been “used” in the home in appliances such as washing machines, showers, and hand basins. Greywater recycling (GwR) is the treatment and re-use of this water in other systems such as for toilet flushing. By their nature, GwR systems require more treatment and are more complex than RwH systems, and there are limited examples of their use in the UK.

Greywater re-use refers to systems where wastewater is taken from source and used without further treatment. An example of this would be water from a bath or shower being used on plants in the garden. This sort of system is easy to install and maintain, however as mentioned above the lack of treatment to remove organic matter means the water cannot be stored for extended periods.

Greywater recycling refers to systems where wastewater undergoes some treatment before it is used again. These systems are complex and require a much higher level of maintenance than RwH or greywater re-use systems.

Domestic water demand can be significantly reduced by using GwR, and unlike with a RwH system where the availability of water is dependent on the weather, the source of water is usually constant when the building is occupied (for instance if it is from bathing and showering). However, the payback period for a GwR system is usually long, as the initial outlay is large, and the cost of mains water relatively low. Viability of greywater systems for domestic applications is therefore currently limited. Communal systems may offer more opportunities where the cost can be shared between multiple households.

8.10.1 Results

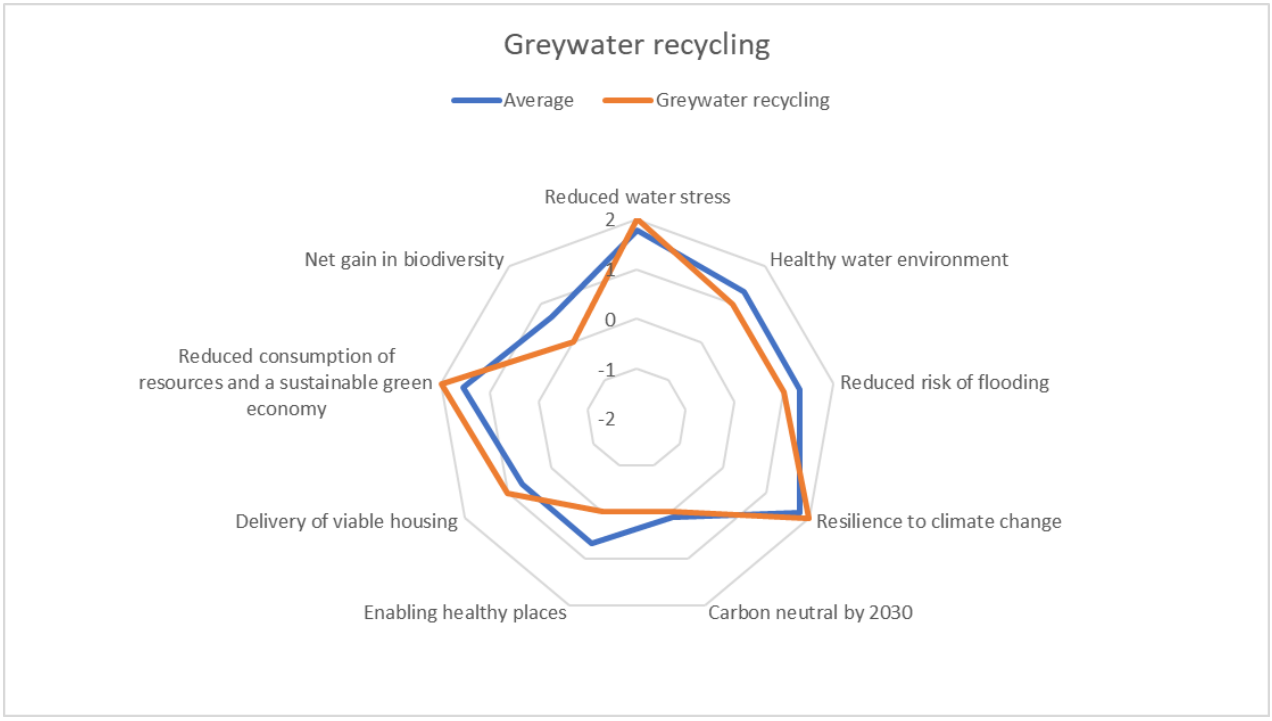

Figure 8.9 Radar diagram showing the MODA for Greywater Recycling

8.11 Conclusion

The MODA provided a baseline understanding of how the objectives relate to and benefit the options presented. The initial conclusions from the MODA are:

- The scoring at this stage is unweighted, i.e., each objective is given equal weighting. This should be revisited at stage 2.
- The most beneficial options are blue infrastructure and SuDS.
- The option with the lowest overall score is leakage reduction. This should not be considered an indication that this is not a valuable option, simply that it is an option with narrowly focussed benefits.

Table 8.3 Summary of MODA scoring for all options

Objectives	Diversify water resources	Efficient fixtures and fittings	Green Infrastructure	Blue Infrastructure	Rainwater harvesting	Greywater recycling	SuDS	Education	Leakage reduction	Average
Reduced water stress	**2**	**2**	1	**2**	**2**	**2**	**2**	1	**2**	1.8
Healthy water environment	**2**	1	1	**2**	1	1	**2**	1	1	1.3
Reduced risk of flooding	**2**	0	**2**	**2**	**2**	1	**2**	1	0	1.3
Resilience to climate change	**2**	**2**	**2**	**2**	1	**2**	**2**	1	**2**	1.8
Carbon neutral by 2030	-1	**1**	0	0	0	0	**1**	**1**	-1	0.1
Enabling healthy places	0	0	**2**	**2**	0	0	**2**	0	0	0.7
Delivery of viable housing	**1**	**2**	0	0	**1**	0	**1**	0	0	0.6
Reduced consumption of resources and a sustainable green economy	**2**	**2**	1	1	**2**	**2**	0	**2**	**2**	1.6
Net gain in biodiversity	0	0	**2**	**2**	0	0	**1**	**1**	0	0.7
Total	**10**	**10**	**11**	**13**	9	8	**13**	8	6	9.8

* Values above the average for each objective or for the total score are highlighted.

9 Conclusions and recommendations for stage 2

9.1 Conclusions

9.1.1 Stage 1 overview

This report is the first stage in the Integrated Water Management Strategy for Milton Keynes. It sets out how the study area is expected to grow up to 2050 and agrees a set of objectives that can be used in assessing future water management options. Following the IWMS guidance developed by CIRIA, a baseline is presented showing Milton Keynes in the context of the wider catchment and presenting information on the current status of water resources, wastewater infrastructure and water quality. An approach to quantifying integrated water management benefits was presented and a preliminary scoring of identified options undertaken.

9.1.2 Water resources

The whole of Milton Keynes is the Anglian Water supply area, within the Ruthamford Central Water Resource Zone (WRZ). This WRZ has no internal water sources and imports its water from Ruthamford North and Ruthamford South (which cover very small areas of the study area). To increase resilience to drought, water trading with Affinity Water is discussed within the WRMP. Both Ruthamford North and South have been identified as being at risk of climate change impacts in the future. As Ruthamford Central is supplied via transfer from this zones, Milton Keynes' water supply is vulnerable to the same climate risks. Consequently, finding alternative water resources and increase water efficiency maybe important in the future to mitigate these risks.

Within AW's WRMP there is a focus on climate change resilience, the implementation of smart meters and working towards better pipe connections to increase water availability. The objective to increase water availability and water efficiency is mirrored in the WRE summary, with the goals for desalination, reservoir design and planning and water re-use. Affordable bills and housing are also discussed in the WRE report.

The Environment Agency have designated the whole of the Anglian Water region as under serious water stress. Within the Abstraction Licencing Strategy report, it is reported that water resources across the area have consumptive abstraction available less than 30% of the time. In 2/3 of the groundwater management units, no water is available for new consumptive licensing meaning that future water abstraction needs to be carefully considered.

9.1.3 Wastewater

Anglian Water are the sewerage undertaker for the whole of Milton Keynes. Increased wastewater flows into the wastewater network due to growth in population can increase the pressure on existing infrastructure, increasing the risk of sewer flooding and where present increasing the risk of storm overflow operation. Headroom at Water Recycling Centres

(WRCs) can be eroded by growth in population or per-capita consumption, requiring investment in additional treatment capacity.

The Environment Act requires water companies to report and monitor storm overflows as well as reduce the harm caused to the rivers they discharge to. Within Milton Keynes there are eleven storm overflows and six storm tanks overflows located on the sewer network and at WRCs (based on 2022EDM dataset). Only two network storm overflows and four storm tanks have monitoring data available. In all of these, the frequency of operations in 2020 and 2021 are below the threshold for further investigation by the EA. The overflow at Lavendon WRC operated 40 times in 2021. Whilst below the trigger for an investigation, in the longer term this may require improvement in order to meet the 2050 target of 10 or fewer operations per year.

There are opportunities through the planning system to ease pressure on the wastewater network by separating foul and storm flow in existing combined systems, and not allowing new surface water connections. Surface water can also be better managed by retrofitting SuDS in existing residential areas, and in new development, ensuring SuDS are incorporated into designs at the master planning stage to maximise the potential benefits. Redevelopment of brownfield sites with previously combined sewerage systems offer the potential to separate surface water from foul and reduce discharges from sewer overflows.

Environmental permits are used alongside water quality limits as a means of controlling the pollutant load discharged from a water recycling centre to a receiving watercourse. A headroom assessment was carried out comparing the current discharge from each WRC in Milton Keynes to its permit value, taking into account growth already planned.

There are 18 WRCs within or serving communities in Milton Keynes. Of these, six are expected to serve committed growth within the period of the adopted Local Plan.

Cotton Valley is the largest WRC in the region serving an estimated population of 313,130 in 2021. AWs DWMP states that they expect this to increase to 358,288 by 2050. This would still be well within the permit limit for the WRC.

Two WRCs (Castlethorpe and Hanslope) are close to, or likely to exceed their permit due to committed growth. Further development in these catchments would require an increase in their flow permit and / or upgrades to treatment processes.

Many of the WRCs outside of the City of Milton Keynes are small works and serve only a modest population. In some cases, they only have a descriptive permit, and others there is no flow data recorded. It is unlikely that they would be able to serve significant development without major upgrades.

9.1.4 Environmental

The latest Water Framework Directive assessment data shows that all of the watercourses in the study area have moderate or poor status overall status The EA reasons for not achieving good (RNAG) dataset indicates that the water industry (sewage discharges) and agriculture and rural land management (livestock, arable and land drainage) are the main reasons for watercourses not achieving good status in this area.

9.1.5 Water Quality

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

A sensitivity analysis was carried out using the EA's SIMCAT water quality model. Growth in population was simulated by increasing the discharge from each WRC by 10%. Where water quality downstream of a WRC in any given determinand deteriorates by 10% or more in response to a 10% increase in effluent flow, the sewer catchment can be said to be “more sensitive” to changes in effluent flow, and therefore growth. Where the response is less than 10% the watercourse can be said to be "less sensitive".

The analysis suggested that water courses in Milton Keynes may be less sensitive to increases in effluent flow.

9.1.6 Water balance

Milton Keynes forms 80% of the water demand within Anglian Water's Ruthamford Central Water Resource Zone (WRZ). This zone is entirely supplied from external sources at present, and all wastewater is discharged to watercourses and flows out of the zone. There is no significant exploitation of local water resources or water recycling within the zone for public supply.

Ruthamford Central is one of only two zones in the Anglian Water supply area forecast to have higher demand by 2050, mainly as a result of the growth of Milton Keynes. The draft Water Resources Management Plan 2024 proposes to meet that growing demand primarily through additional inward transfers of water, facilitated by a new storage reservoir in south Lincolnshire and new pipelines to supply water around the Anglian Water region. Demand management will also contribute to meeting the supply-demand balance by 2050.

9.2 Outline options assessment

The potential for integrated water management options to deliver against a range of objectives set out in the Strategy for 2050 was assessed using a Multi-Objective Decision Analysis (MODA) approach. The main conclusions from this assessment are:

- The scoring at this stage is unweighted, i.e., each objective is given equal weighting. This should be revisited at stage 2.
- The most beneficial options are blue infrastructure and SuDS.
- The option with the lowest overall score is leakage reduction. This should not be considered an indication that this is not a valuable option, simply that it is an option with narrowly focussed benefits.

9.3 Recommendations for the stage 2 IWMS

9.3.1 Growth scenario

The growth information provided by MKCC will be updated in order to allow a revised estimate of water demand in Milton Keynes. This will be used within an updated water balance, and within all the assessments conducted in Stage 2.

9.3.2 Water resources

Evidence presented in the Stage 1 study shows that Milton Keynes is in an area of serious water stress and there is sufficient justification for the tighter water efficiency target currently allowed for under building regulations of 110l/p/d. The direction of travel for water resources in the UK is to go further than this and achieve tighter standards. The Government's Environmental Improvement Plan (EIP) shows a target of 100l/p/d is being considered in water stressed areas, and in some areas, LPAs are now considering water neutrality.

In the Stage 2 IWMS, the options for achieving higher water efficiency standards in new build housing and non-household development will be outlined, including options to achieve or go further than water neutrality. This impact this would have on the baseline water balance presented in the Stage 1 study will be explored.

If available, information from the final WRMP will be incorporated into the Stage 2 IWMS.

At the time of writing, the water companies are undertaking further work on their plans, ahead of publication of final plans later in 2023. Anglian Water have issued a Statement of Response to the dWRMP consultation (Anglian Water h, 2023) which includes an increased leakage reduction target from 24% to 38%, and additional options for non-household demand management. The supply-side strategy, based around the South Lincolnshire and Fens reservoirs, will remain the same. The companies have also been challenged by Defra to undertake further work to reduce delivery, financing and affordability (WRW b, 2023).The final WRMP24 will be reviewed in the stage 2 IWMS.

Finally, as the Local Plan evolves, the trajectory for growth should be checked against the growth trajectory allowed for by Anglian Water, especially if the housing growth trajectory is significantly front-loaded within the plan period.

9.3.3 Water quality

An updated growth scenario developed with MKCC will be tested within the water quality model. The following tests will be applied:

- Does growth cause a 10% or greater deterioration in BOD, Ammonia or Phosphate concentration OR a change in WFD class?
- If a significant deterioration is predicted, can this be prevented by improvements in treatment processes?
- Could growth alone prevent good ecological status being achieved in the future assuming improvements elsewhere in the catchment?

Where upgrades are required to treatment processes in order to accommodate growth within WFD constraints, these will be identified. Whilst water quality modelling may show no significant deterioration in water quality from the local plan. Future changes to river flows from climate change could result in a deterioration in water quality as periods of lower flow in rivers increase concentration of pollutants. This will be assessed using a further climate change sensitivity run of the model where river flow is modified according to recent EA guidance.

9.3.4 Options appraisal and the water balance

The preliminary options discussed in Stage 1 will be reviewed and updated in collaboration with stakeholders. The MODA scoring will be updated and where appropriate weightings added to quantify the relative importance of the objectives.

Aa short-list of IWM approaches will be selected to meet the aims of the Strategy for 2050 through policies in the emerging New City Plan.

The potential contribution of these IWM approaches will be quantified and built into a new water balance model for 2050, which demonstrates the role of planning policies and interventions to reduce demand and exploit sustainable use of local water resources and water recycling.

9.3.5 Environment Agency recommendations

The Environment Agency has made further recommendations for the stage 2 IWMS:

- A carbon assessment to set out capital and operational carbon implications in numerical terms for the preferred spatial options. Anglian Water have stated they will be able to help support this with data and support.
- Looking at the effects of providing potable/ non-potable supplies on the environment.
- Further sensitivity testing has been recommended by the EA to better understand the outcomes of planned growth in the study area.
- Recommendation to engage WRE to investigate deeper engagement of LPAs within the next regional Water Resource Plan.

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11 Appendix

A Appendix A Policy Review

In this section, specific ambitions relating to integrated water management in the adopted Plan:MK 2016-31 and the Strategy for 2050, with recommendations for improving these policies in the emerging plan.

Policy	Plan:MK 2016-31	Strategy for 2050	Considerations for future policies	Link to further evidence
DS6	Linear parks B. Development proposals in the Linear Parks should contribute to achieving the following objectives: 1. Protecting and improving the landscape. 2. Protecting and enhancing features of nature conservation value. 3. Retaining and improving public access to land and water areas for countryside recreation. 4. Flood control. 5. Minimising any adverse impact on local residents and agriculture. 6. Protecting and interpreting areas of archaeological interest.	"We will create more large-scale open spaces as we grow, including new country parks and major extensions to the linear park network to the south, east and west of the city."	Linear parks also have the potential to contribute to water resource management, for example by providing storage for rainwater harvesting.	8.5

Policy	Plan:MK 2016-31	Strategy for 2050	Considerations for future policies	Link to further evidence
SD1	Place-making principles for development. "…Development takes a strategic, integrated and sustainable approach to water resource management (including SUDS and flood risk mitigation)…"	"a growing population and the risk of increased drought through climate change mean we must use our water resources more effectively. Our aim is to reduce use to fewer than 110 litres of water per person per day through approaches like the harvesting and storage of rainwater, stormwater and 'grey' water"	Amend policy to recognise the importance of water resources.	8.5
SD1	"… Development should result in a net gain in biodiversity through use of strategic, connected green infrastructure …"	"We will be more ambitious than national policy requires. So, whilst we will protect Sites of Special Scientific Interest, Local Wildlife Sites and nature reserves, we will go further by creating connected wildlife	Consider changing to "green/blue" infrastructure to emphasise the role of water in biodiversity net-gain. Set a BNG target greater than the 10% minimum national target.	8.2, 8.3, 8.4

Policy	Plan:MK 2016-31	Strategy for 2050	Considerations for future policies	Link to further evidence
		habitats across the borough and beyond."		
CT8	Grid road network	"We will use the grid road principles of safe crossings and paths for pedestrians and cyclists, and green planting and wildlife corridors along routes, and ensure that they are adaptable to future needs"	Highways are a major source of pollution to watercourses and rapid runoff, especially in urban areas. This policy could be used to require the application of SuDS which manage runoff to greenfield runoff rates and treat surface water prior to discharge to water bodies.	Exec summary
FR1	Managing flood risk "A. All new development must incorporate a surface water drainage system with acceptable flood control and demonstrate that water supply, foul sewerage and sewage treatment capacity is available or can be made available in time to serve the development. Suitable access is safeguarded for the maintenance of water supply and drainage infrastructure."	"in some of the older parts of Milton Keynes, the drainage networks can lack the capacity needed to be resilient against the climate changing and future growth, so we also need to assess requirements and solutions for those systems as a priority."	Identify in the plan any strategic drainage schemes that are required to enable allocations within the plan.	SFRA

Policy	Plan:MK 2016-31	Strategy for 2050	Considerations for future policies	Link to further evidence
FR1	“B. Plan:MK will seek to steer all new development towards areas with the lowest probability of flooding. The sequential approach to development, as set out in national guidance, will therefore be applied across the Borough, taking into account all sources of flooding as contained within the Council’s Strategic Flood Risk Assessment (SFRA).”	“We will continue to plan for water management at a city-wide level for existing areas as well as for future development areas, using our green and blue infrastructure network.”	Consider including that this must consider future flood risk as a result of climate change, for all sources of flooding.	SFRA
FR1	“C. Development within areas of flood risk from any source of flooding, will only be acceptable if it is clearly demonstrated that it is appropriate at that location, and that there are no suitable available alternative sites at a lower flood risk”		No comment.	SFRA

FR1	“Development proposed in an area at risk of flooding will be required: 1. To be supported by a site specific Flood Risk Assessment (FRA) (subject to the triggers set out below); 2. To take into account all forms of flooding including, but not limited to: fluvial, groundwater, surface water and reservoir flooding; 3. To ensure that opportunities to reduce the causes and impacts of flooding to the site and the surrounding area are taken as far as possible, in order to improve the existing situation, taking into account climate change. At a minimum, proposals will need to demonstrate no increase in flood risk to the site or surrounding area; 4. To clearly demonstrate that the benefits of the development to the community, outweigh the risk of flooding when applying the sequential test and exception test (where required); 5. When applying the sequential test, to clearly demonstrate that the impacts of climate change are taken into account;		No comment.	SFRA

Policy	Plan:MK 2016-31	Strategy for 2050	Considerations for future policies	Link to further evidence
	6. To demonstrate the application of a sequential approach to the site design and layout to ensure highest vulnerability land uses are located within areas of the site at lowest risk of flooding; 7. To build resilience into a site's design; 8. To ensure that a site's design and any flood mitigation measures implemented are designed with an allowance for climate change and the potential impact it may have over the lifetime of the proposed development; 9. To provide a safe access and egress route for future users of the development; and 10. To attenuate surface water run-off in line with Policy FR2. 11. To consult the Fire and Rescue Service as to the feasibility of undertaking rescue and recovery operations during and in the aftermath of flooding events"			
FR1	"E. A site specific FRA will be required for: 1. All sites of 1ha or more in Flood Zone 1;		No comment.	SFRA

Policy	Plan:MK 2016-31	Strategy for 2050	Considerations for future policies	Link to further evidence
	2. All sites within Flood Zone 2 or 3; 3. All sites highlighted as being at high risk from surface water flooding, or which are located within a Critical Drainage Catchment (CDC), as identified in the Milton Keynes Surface Water Management Plan. In this case the FRA will be required to demonstrate that the development will not increase the flood risk to the CDC and where possible will provide an improvement to the existing situation."			
FR1	"F. The FRA should include an assessment of flood risk to and from the proposed development, and demonstrate how the development will be safe, will not increase flood risk elsewhere and where possible will reduce flood risk overall in accordance with the NPPF and PPG."		No comment.	SFRA
FR2	Sustainable drainage systems (SuDS) and integrated flood risk management "A. Plan:MK advocates the continuation of a strategic, integrated approach to managing flood risk which seeks the management of		Consider how, once Schedule 3 of the FWMA is enacted, the Council will direct developers towards designing and constructing SuDS systems that	SFRA

Policy	Plan:MK 2016-31	Strategy for 2050	Considerations for future policies	Link to further evidence
	surface water to be planned at the largest appropriate scale for the new development and incorporated into the site at the earliest opportunity in the design process.”		offer multiple benefits and will be adopted by the Council.	

	"B. New development is required to incorporate SuDS; in line with national policy and guidance and, which meet the requirements set out in national standards and the Council's relevant local guidance. It is expected that: : 1. Flood risk management and SuDS will be provided at a strategic scale and in an integrated manner, wherever possible; 2. Space will be specifically set aside for SuDS and fluvial flood risk reduction features and used to inform the overall layout of development sites; 3. Above ground attenuation will be provided in preference to below ground attenuation; 4. SuDS will be designed as multi-purpose green infrastructure and open space, to maximise additional environmental, biodiversity, social and amenity value, wherever possible. The use of land to provide flood storage capacity should not conflict with required amenity and recreation provision - floodplains and floodplain habitats should be safeguarded; 5. SuDS will be designed with an allowance for climate change and the potential impact it		Consider setting out the drainage hierarchy in this policy.	SFRA

	may have over the lifetime of the proposed development; 6. Proposals for development within Critical Drainage Catchments, as identified in the Milton Keynes Surface Water Management Plan, should investigate the potential for the scheme to reduce or mitigate existing risk in the surrounding area; 7. All surface water drainage proposals for new development must include full details of the means of achieving future management, maintenance and adoption of the systems, prior to approval of any planning permission, to ensure that it will function effectively over the lifespan of the development. This will include details of funding and should be formulated through discussion with the relevant responsible bodies, including Milton Keynes Council, The Parks Trust, Anglian Water and the Internal Drainage Board; 8. Development will ensure no adverse impact on the functions and setting of a watercourse and its associated corridor; 9. Development should avoid building over or culverting watercourses, encourage the removal of existing culverts and seek opportunities to create wetlands and wet		Consider whether the 2016 SWMP and CDCs require a review and update, considering recent flood events, the growth of the city and once new flood risk mapping is published as part of NaFRA2 in 2024.	

Policy	Plan:MK 2016-31	Strategy for 2050	Considerations for future policies	Link to further evidence
	grasslands and woodlands and restore natural river flows and floodplains."			
FR3	Protecting and enhancing watercourses "A. All new development must be set back at a distance of at least 8 metres from any main rivers, at least 9 metres from all other ordinary watercourses, or at an appropriate width as agreed by the Environment Agency, Lead Local Flood Authority or Internal Drainage Board, in order to provide an adequate undeveloped buffer zone. Development that restricts future de-culverting of waterways should be avoided."		No comment.	SFRA
FR3	"B. The Council will resist proposals that would adversely affect the natural functioning of main rivers, ordinary watercourses and wet or dry balancing lakes, this includes through the culverting of open channels, unless for access purposes."		No comment.	SFRA
NE4	Green infrastructure	"A Green and Blue City Everywhere in Milton Keynes, rich, peaceful landscapes surround our	Use the term "blue-green" or "green and blue" to emphasise the role of water and waterbodies in green infrastructure.	8.2, 8.3

Policy	Plan:MK 2016-31	Strategy for 2050	Considerations for future policies	Link to further evidence
		homes. Our 'green' network of open spaces, parks and woodlands and our 'blue' network of lakes, rivers, canal and brooks are gifts which keep on giving."		
NE6	Environmental pollution "… Proposals which, by their nature, risk contributing to soil and water pollution will be required to demonstrate how this risk will be avoided or mitigated to an acceptable level…"		Ensure that development upstream of sewer overflows will not increase the frequency, duration or volume of discharges to watercourses.	4.5.3
L1	Facilities acceptable in parks		Space may be required in parks to facilitate increased water storage for flood risk management and water resources to address the demands of climate change and growing demand for water.	8.5, SFRA

Policy	Plan:MK 2016-31	Strategy for 2050	Considerations for future policies	Link to further evidence
L4	Public open space provision in new estates. "…Policies of this Plan support the delivery of a linked network of multi-functional, resilient and sustainable green infrastructure…"		As above, use the term "blue-green" or "green and blue".	8.5, SFRA
L6	Criteria for the location of water sports		Consider defining water sports facilities as water compatible.	SFRA
D1	Designing a high quality place "…Soft and hard landscaping that continues the verdant and green character of Milton Keynes, enhances the quality of the public realm, is robust to the demands placed upon the public realm, and is appropriate to their context and can be maintained and managed without significant whole life-costs. In particular, street trees and planting are incorporated to soften the streetscape and ensure the public realm is not dominated by hard surfaces and boundaries and by parked cars …"		Consider expanding the policy to also cover the place of water and SuDS in the public realm.	8.4, SFRA
SC1	Sustainable construction "… L. All newly constructed dwellings will be required to achieve an estimated water	"Our aim is to reduce use to fewer than 110 litres of	Getting to 110l/p/d for the city as a whole will likely require new development to be even more	9.3.2

Policy	Plan:MK 2016-31	Strategy for 2050	Considerations for future policies	Link to further evidence
	consumption of no more than 110 litres/person/day …"	water per person per day…"	efficiency. As a minimum, adapt the policy to the emerging 100l/p/d national standard in water stressed areas.	
SC1	"… M. Water reuse and recycling and rainwater harvesting should also be incorporated wherever feasible to reduce demand on mains water supply, subject to viability. Proposals will be expected to maximise the use of the above measures subject to the outcome of the viability assessment… "	"…through approaches like the harvesting and storage of rainwater, stormwater and 'grey' water… "	As above. Adopt high efficiency standards, but avoid being over-prescriptive about which solutions should be adopted.	8..7, 8.9, 8.10

B Appendix B Recommended Growth Options Assessment

B.1 Introduction

An assessment of the eight Recommended Growth Options (RGOs) was undertaken to understand the potential developable area, flood risk, relative water, and wastewater infrastructure capacity of each option.

Within this assessment three growth densities were investigated:

- 35 dwellings per hectare (DPH)
- 50 DPH
- 100 DPH

B.2 Methodology

B.2.1 Developable area calculation

In order to estimate the potential capacity for housing on each RGO, the three growth densities were applied to the area of the RGO. However, not all land within each RGO can be developed. For example, part of the site may be at risk of flooding and so should be excluded from the calculation.

A GIS analysis was performed in QGIS intersecting the area at risk of flooding (based on the fluvial Flood Zone 2 or 3, and the Risk of Flooding from Surface Water mapping (low, medium or high). This area was subsequently removed from the total site area to give the developable area.

B.2.2 Wastewater Recycling Centre capacity assessment

The Wastewater Recycling Centre (WRC) capacity assessment compared the estimated future flow to the permit limit for the three growth densities. The method was as follows:

- The current measured Dry Weather Flow (DWF) was calculated as the 80-percentile exceedance flow for the period January 2018 to December 2021.
- The flow data provided by Anglian Water (AW) was cleaned to remove zero values and low outlier values which would artificially lower the measured DWF.
- Each RGO was assigned to a WRC using the sewerage drainage area boundaries provided by AW.
- Existing commitments and allocations from the current local plan were also assigned to a WRC in the same way.
- For each site, the future DWF was calculated using the occupancy rates and per-capita consumption values obtained from the Water Resource Management Plans (Table 11.1), and the assumption that 95% of water used is returned to sewer.

- Permitted headroom was used as a substitute for actual designed hydraulic capacity for each WwTW being assessed.

Table 11.1 Values used in water demand calculations

Water Company	Water Resource Zone	Occupancy rate (persons per dwelling)	Per capita consumption (m^3/person/day)
Anglian Water	Ruthamford Central	2.39	0.139

B.2.3 Water supply and wastewater network

Anglian Water will review the RGO sites in the Stage 2 IWMS and assess the impact on their water supply and wastewater network. It should be noted that under the Water Industry Act 1991 water and sewerage undertakers have an obligation to provide a connection for new residential development sites to the water supply network and the sewer network as and when required.

B.3 RGO1 North of Olney: Summary

B.3.1 Location and description

Figure 11.1 shows the location of RGO1 to the north of Olney. The site is currently green field and is bordered by the A509 to the east, and B5388 to the west. Present along the south-west boundary of the site is a tributary of the Great Ouse. Also present at the southern end of the site is Olney WRC.

B.3.2 Dwelling density

RGO1 has an overall area of 41.6 ha, see Figure 11.1. The area at risk of flooding (based on fluvial Flood Zone 2 or 3, or Surface water flood risk (low, medium or high)) has been removed from the RGOs area, leaving the developable area. 4% of the site (1.6 ha) was excluded leaving a developable area of 40ha.

The resulting estimated housing capacity once the developable area is taken into account is shown in Table 11.2.

Table 11.2 Housing capacity of RGO1

Overall developable area (ha)	No. dwellings at 35 DPH	No. dwellings at 50 DPH	No. dwellings at 100 DPH
40	1,400	2,000	4,000

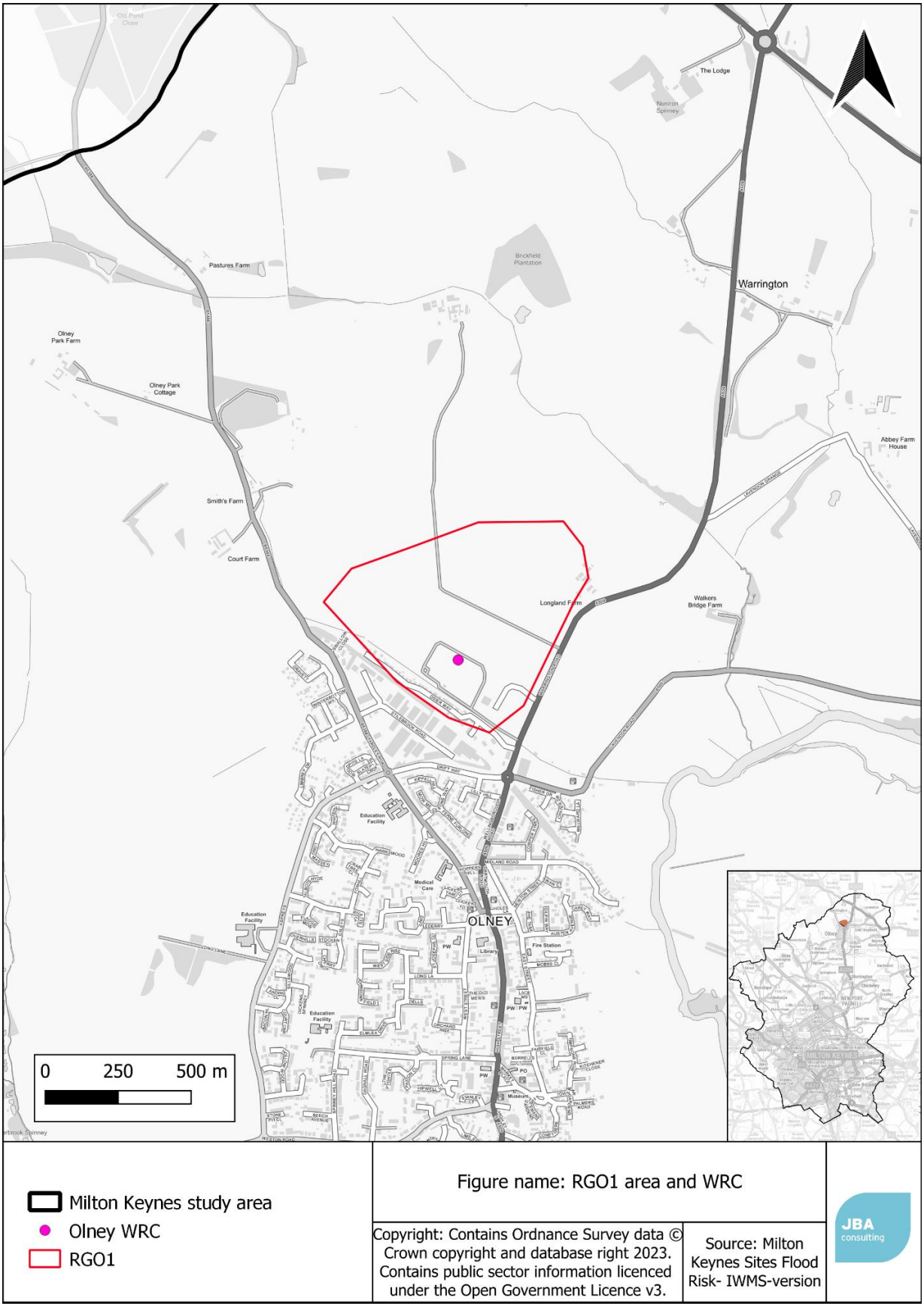


Figure 11.1 Location of RGO1 at North of Olney

B.3.3 Flood risk

Fluvial and surface water flood risk have been considered. A more detailed assessment of these, and other sources of flood risk will be included as part of the SFRA. There are no modelled fluvial extents within the site boundary, however a tributary of the Great Ouse runs along the south-west boundary of RGO1 resulting in an area of surface water flood risk (shown in Figure 11.2). There is also a small area of surface water ponding in the middle of the site. The site should be designed sequentially in such a way as to minimise this risk.

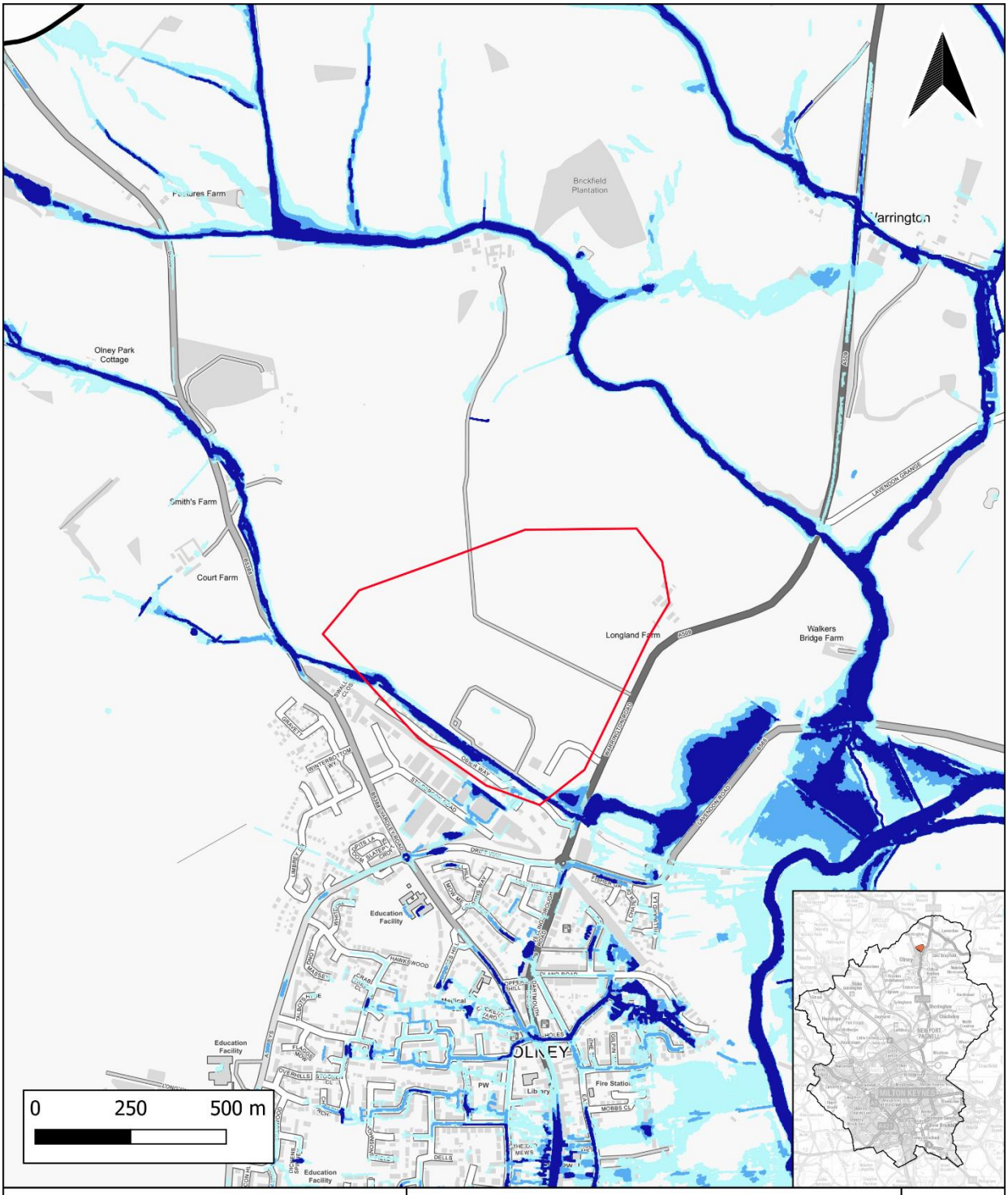


Figure 11.2 Environment Agency Risk of Flooding from Surface Water mapping in comparison to RGO1

B.3.4 SuDS

With higher density development (100 DPH) there is less space for above ground SuDS options such as rainwater harvesting (RwH), swales, and rain gardens. Further consideration is therefore required into how surface water may be managed at this housing density. This could mean more permeable paving, soakaways, below-ground storage and rainwater harvesting being implemented.

Where a development density of 35 to 50 DPH, a mixture of above and below ground SuDS could be implemented.

The British Geological Society (BGS) mapping shows that the site lies on a bedrock geology of sandstone, limestone, and argillaceous rocks, and soils are freely draining lime-rich loamy soils. This means that infiltration SuDS are likely to be applicable to this site.

B.3.5 Water resources

RGO1 is covered by Ruthamford Central WRZ which has no internal water resources and relies on imports from neighbouring WRZs (Ruthamford South and Ruthamford North). From a water resources perspective, it is the overall level of growth and consequently water demand that is important, and not the location. It is not therefore possible to assess the site individually. A cumulative assessment is included in section 0.

Water demand on the site could be reduced by making use of Rainwater Harvesting (RwH) to provide non-potable water for use in toilet flushing, washing machines and garden irrigation. With a lower density of dwellings there could be more space for storage of rainwater, and a lower demand. Whereas a higher density would have less storage space, with a higher demand. There may also be a lower ratio of roof space to population providing less opportunities for collection in the high-density scenario. Therefore, RwH would be better suited to a lower density of dwellings when used as a water resource.

B.3.6 Water Recycling

The sewerage undertaker for RGO1 is Anglian Water and it is anticipated that the site would be served by Olney Water Recycling Centre (WRC). Figure 11.3 shows a comparison of predicted wastewater discharge from Olney WRC to its permit limit under the three housing density scenarios. It can be seen that beyond AMP7, the 100 DPH growth scenario may cause the permit limit to be exceeded. At 50 DPH, growth is only below permit until AMP9, and at DPH35 until AMP10.

Table 11.3 shows the remaining capacity (number of dwellings) in each scenario. At all growth densities an increase in the flow permit at Olney WRC and/or upgrades to treatment capacity may be required.

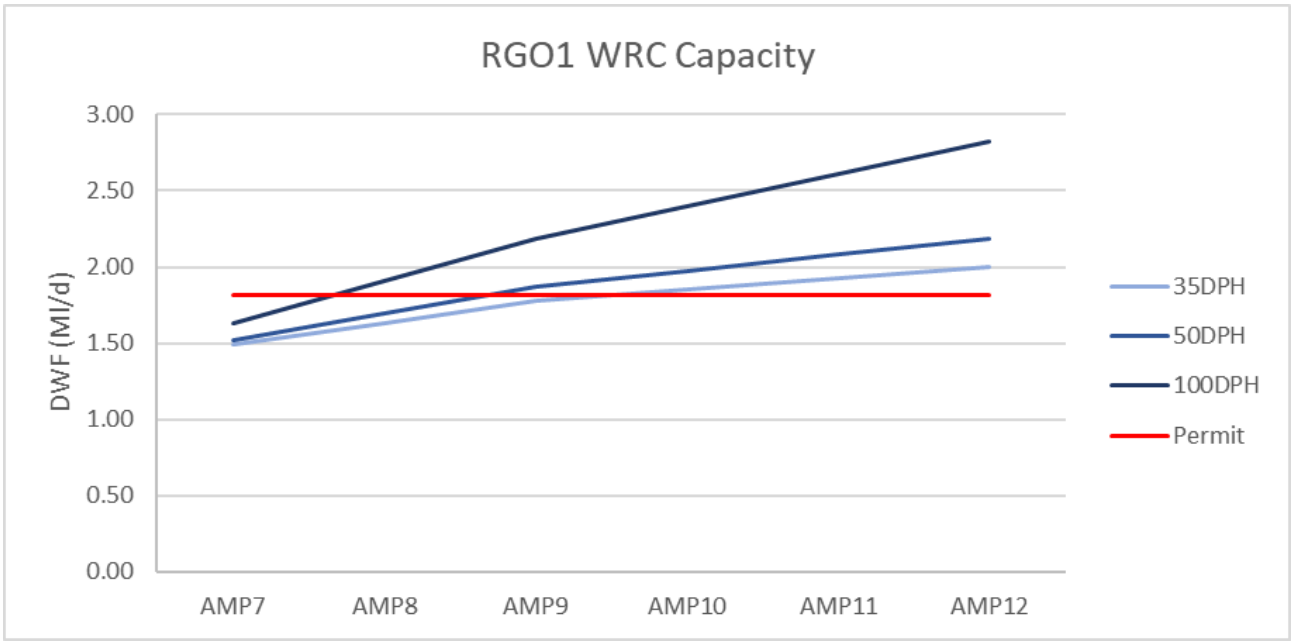


Figure 11.3 Capacity assessment of Olney WRC

Table 11.3 WRC capacity assessment for RGO1 at all three DPH growth densities.

DPH	Estimated spare hydraulic capacity (number of dwellings)
35	-703
50	-1,462
100	-3,993

B.3.7 Water quality

RGO1 falls into the catchment of the Ouse (Newport Pagnell to Roxton) which has a Water Framework Directive (WFD) Ecological status of moderate (Table 11.4).

Table 11.4 WFD status for Ouse Newport Pagnell to Roxton

Ecological	Physio-chemical quality elements	Chemical
Moderate	Moderate	Does not require assessment

Based on results from the Water Quality sensitivity analysis undertaken as part of the Phase 1 IWMS, there is a moderate deterioration (<10%) in ammonia, BOD and phosphate concentrations at Olney WRC outfall as a result of a 10% increase in flow at all treatment works within the study area. Within the Ouse (Newport Pagnell to Roxton) catchment, there is deterioration along the entire reach upstream and downstream of Olney.

An analysis of results shows the percentage deterioration of all three determinands decreases from Cotton Valley towards Olney. At Olney there is a small increase in concentration of each determinand at the outfall from the WRC, however concentrations continue to decrease further downstream of the treatment works. Whilst concentrations decrease downstream, there is moderate deterioration in BOD downstream to Filmersham, and in phosphate and ammonia downstream to King's Lynn as a result of additional flow at WRCs in the study area.

It is proposed to assess the impact of TAL improvements on effluent treatment at WRCs at Stage 2.

B.3.8 Odour

Olney WRC is within the site boundary of RGO1. Dwellings close to the WRC may suffer periodically from nuisance odour. An odour assessment is therefore recommended to determine an appropriate buffer around the WRC.

B.3.9 Summary

- RGO1 has a small area at risk of flooding (4%).
- An initial desk study of the site geology indicates that infiltration SuDS may be appropriate on this site.
- At 35 DPH, there is capacity to accommodate growth within the existing permit for Olney WRC, but at 50 and 100 DPH an increase in the permit limit and / or upgrades to treatment processes may be required.
- The waterbodies immediately downstream of Olney WRC have a moderate status for Ecological and physio-chemical quality elements.
- The risk from nuisance odour is high.

B.4 RGO2 West of Olney: Summary

B.4.1 Location and description

Figure 11.4 shows the location of RGO2 to the west of Olney. The site is currently greenfield and is contains Barn Field Local Wildlife Site with Olney Beacon in the centre. To the eastern boundary there is an urban area, excluding the Ousedale School Olney Campus. The southern boundary meets Weston Road, and the western boundary borders agricultural land.

B.4.2 Dwelling density

RGO2 has an overall area of 75.8 ha, see Figure 11.4. The area at risk of flooding (based on fluvial Flood Zone 2 or 3, or Surface water flood risk (low, medium or high)) has been removed from the RGOs area, leaving a developable area of 75.79ha with <1% of the site (0.0008 ha) excluded.

The resulting estimated housing capacity once the developable area is taken into account is shown in Table 11.5.

Table 11.5 Housing capacity of RGO2

Overall developable area (ha)	No. dwellings at 35 DPH	No. dwellings at 50 DPH	No. dwellings at 100 DPH
75.79	2,653	3,790	7,580

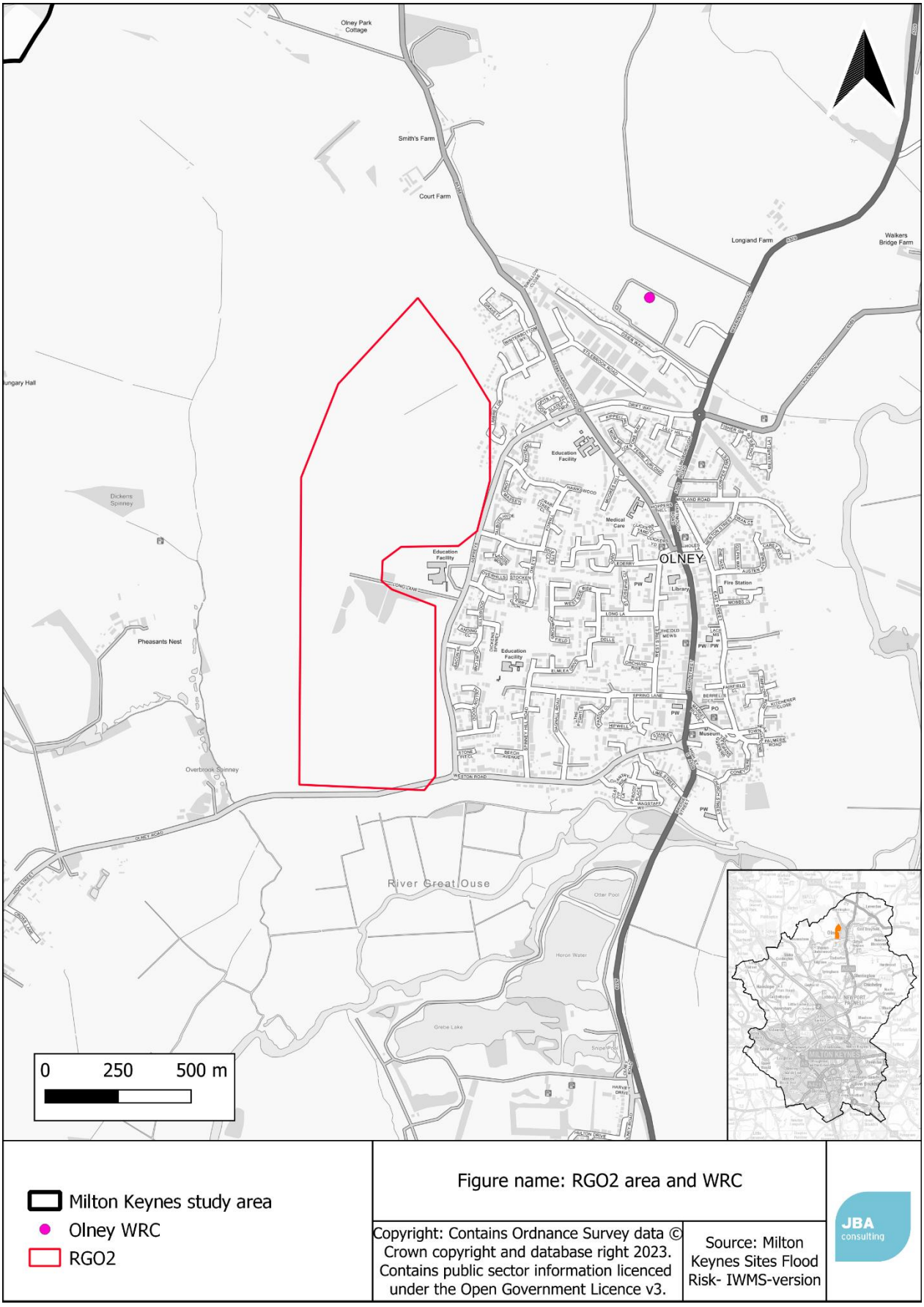


Figure 11.4 Location of RGO2, West of Olney

B.4.3 Flood risk

Fluvial and surface water flood risk have been considered. A more detailed assessment of these, and other sources of flood risk will be included as part of the SFRA. The Great River Ouse runs outside of RGO2 250m to the south of the site boundary. The surface water flood risk is shown in Figure 11.5. A small area in the north east of the site is at risk of flooding in a 0.1%AEP event.

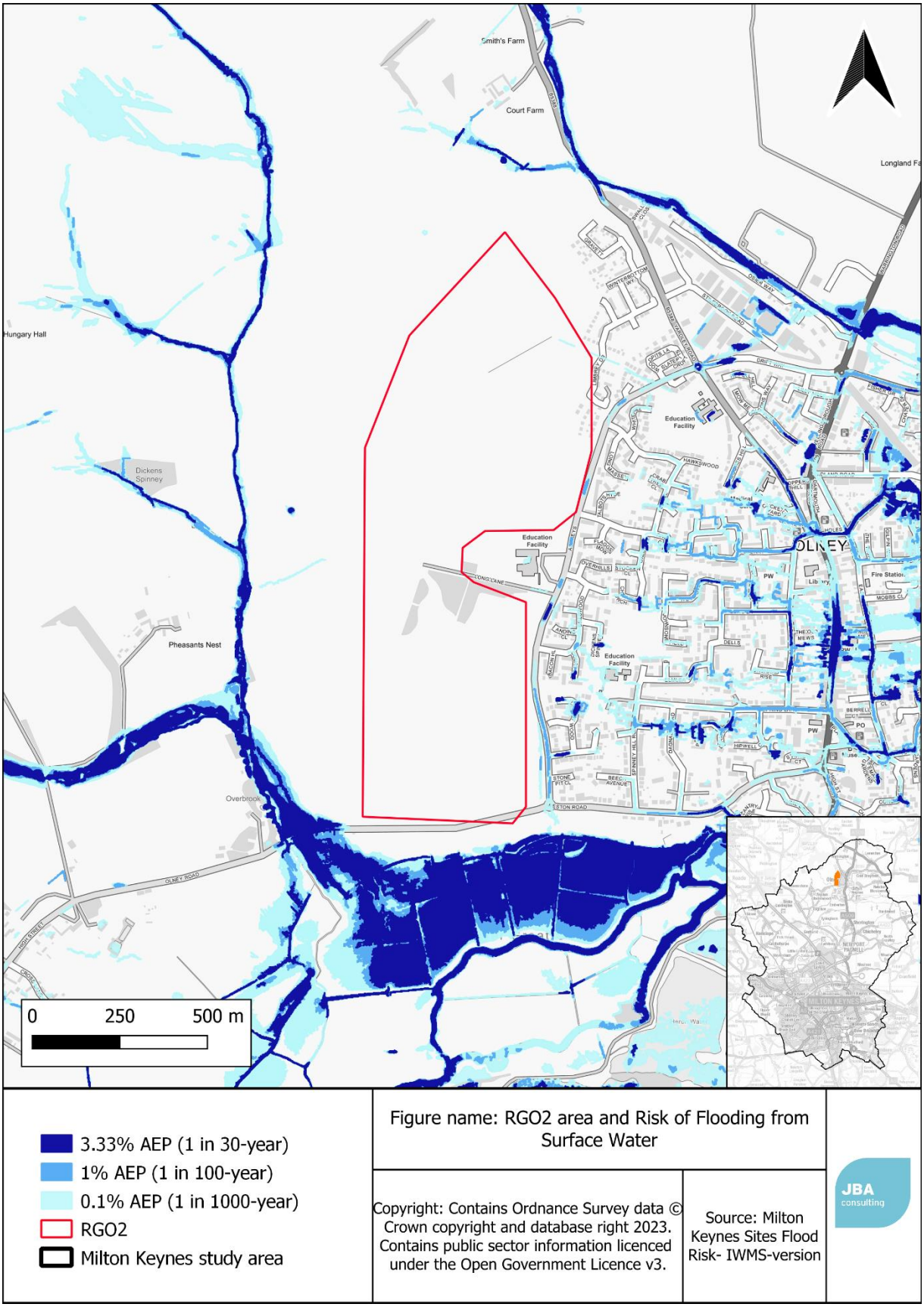


Figure 11.5 Environment Agency Risk of Flooding from Surface Water mapping in comparison to RGO2.

B.4.4 SuDS

With higher density development (100 DPH) there is less space for above ground SuDS options such as rainwater harvesting (RwH), swales, and rain gardens. Further consideration is therefore required into how surface water may be managed at this housing density. This could mean more permeable paving, soakaways, below-ground storage and rainwater harvesting being implemented.

Where a development density of 35 to 50 DPH, a mixture of above and below ground SuDS could be implemented.

The British Geological Society (BGS) mapping shows that the site lies on a bedrock geology of sandstone, limestone, and argillaceous rocks, and soils are freely draining lime-rich loamy soils. This means that infiltration SuDS are likely to be applicable to this site.

B.4.5 Water resources

RGO2 is covered by Ruthamford Central WRZ which has no internal water resources and relies on imports from neighbouring WRZs (Ruthamford South and Ruthamford North). From a water resources perspective, it is the overall level of growth and consequently water demand that is important, and not the location. It is not therefore possible to assess the site individually. A cumulative assessment is included in section 0.

Water demand on the site could be reduced by making use of Rainwater Harvesting (RwH) to provide non-potable water for use in toilet flushing, washing machines and garden irrigation. With a lower density of dwellings there could be more space for storage of rainwater, and a lower demand. Whereas a higher density would have less storage space, with a higher demand. There may also be a lower ratio of roof space to population providing less opportunities for collection in the high-density scenario. Therefore, RwH would be better suited to a lower density of dwellings when used as a water resource.

B.4.6 Water Recycling

The sewerage undertaker for RGO2 is Anglian Water and it is anticipated that the site would be served by Olney Water Recycling Centre (WRC). Figure 11.6 shows a comparison of predicted wastewater discharge from Olney WRC to its permit limit under the three housing density scenarios. It can be seen that past AMP7 all the DPH scenarios assessed could cause the permit limit to be exceeded. There is therefore limited capacity for housing in this catchment without increasing the permit limit and potentially upgrading the WRC.

Table 11.6 shows the remaining capacity (number of dwellings) post development in each scenario.

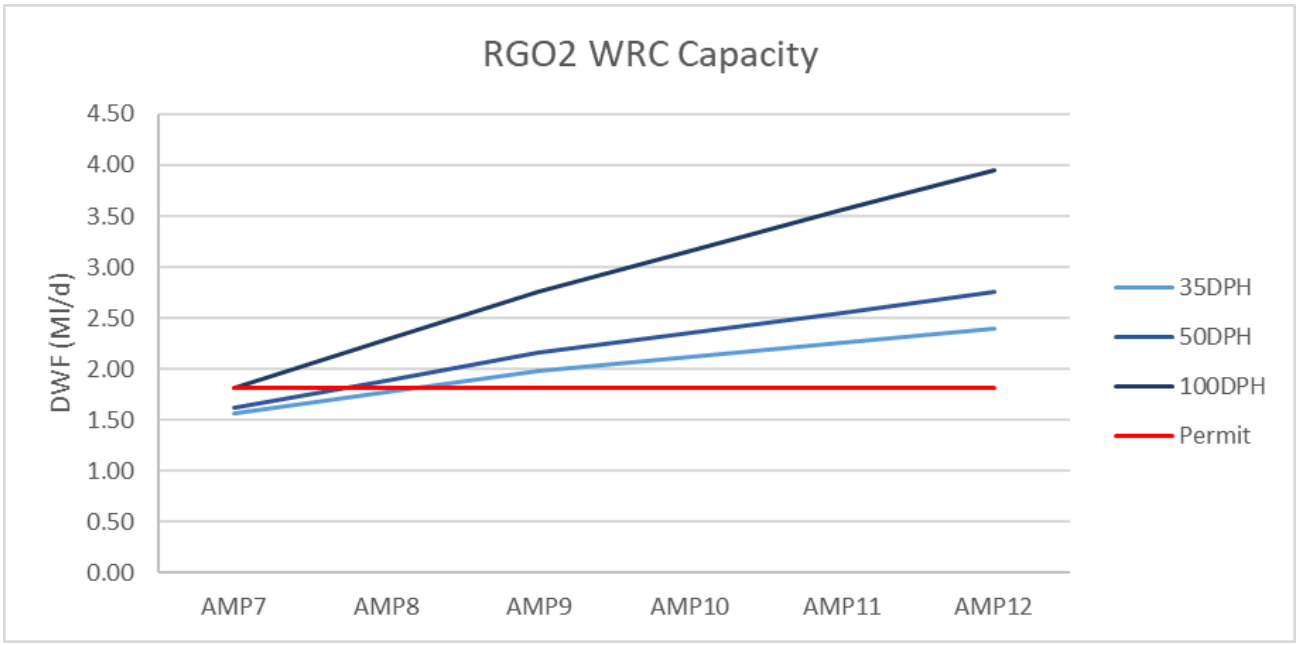


Figure 11.6 Capacity assessment of Olney WRC

Table 11.6 WRC capacity assessment for RGO2 at all three DPH growth densities.

DPH	Estimated spare hydraulic capacity (number of dwellings)
35	-2,297
50	-3,740
100	-8,549

B.4.7 Water quality

RGO2 falls into the catchment of the Ouse (Newport Pagnell to Roxton). See WFD status below, Table 11.7.

Table 11.7 WFD status for Ouse Newport Pagnell to Roxton

Ecological	Physio-chemical quality elements	Chemical
Moderate	Moderate	Does not require assessment

Based on results from the Water Quality sensitivity analysis undertaken as part of the Phase 1 IWMS, there is a moderate deterioration (<10%) in ammonia, BOD and phosphate concentrations at Olney WRC outfall as a result of a 10% increase in flow at all treatment works within the study area. Within the Ouse (Newport Pagnell to Roxton) catchment, there is deterioration along the entire reach upstream and downstream of Olney.

An analysis of results shows the percentage deterioration of all three determinands decreases from Cotton Valley towards Olney. At Olney there is a small increase in concentration of each determinand at the outfall from the WRC, however concentrations continue to decrease further downstream of the treatment works. Whilst concentrations decrease downstream, there is moderate deterioration in BOD downstream to Filmersham, and in phosphate and ammonia downstream to King's Lynn as a result of additional flow at WRCs in the study area.

It is proposed to assess the impact of improvements in treatment processes on pollutant concentrations in detailed water quality modelling in Stage 2.

B.4.8 Odour

There are no WRCs within the RGO2 development boundary, however Olney WRC is to the north east of the site. Anglian Water use a risk assessment process to consider any planning application within 400m of a WRC. In this case RGO3 is 540m away from Olney WRC so odour is unlikely to be an issue.

B.4.9 Summary

- RGO2 has a small area at risk of flooding (<1%).
- An initial desk study of the site geology indicates that infiltration SuDS may be appropriate on this site.
- There is no capacity at any of the DPH growth scenarios within the existing permit for Olney WRC.
- The waterbodies immediately downstream of Olney WRC have a moderate status for Ecological and physio-chemical quality elements.

B.5 RGO3 North East of Newport Pagnell: Summary

B.5.1 Location and description

Figure 11.9 shows the location of RGO3 to the Northeast of Newport Pagnell. The site is currently greenfield. To the west, RGO3 is near the River Great Ouse, and the southern boundary is close to Chicheley Brook. The A509 runs through RGO3 with Hill Farm located in the eastern area.

B.5.2 Dwelling density

RGO3 has an overall area of 110 ha, see Figure 11.7. The area at risk of flooding (based on fluvial Flood Zone 2 or 3, or Surface water flood risk (low, medium or high)) has been removed from the RGOs area, leaving the developable area. 15.5% of the site (17 ha) was excluded leaving a developable area of 93ha.

The resulting estimated housing capacity once the developable area is taken into account is shown in Table 11.8.

Table 11.8 Housing capacity of RGO3

Overall developable area (ha)	No. dwellings at 35 DPH	No. dwellings at 50 DPH	No. dwellings at 100 DPH
93	3,255	4,650	9,300

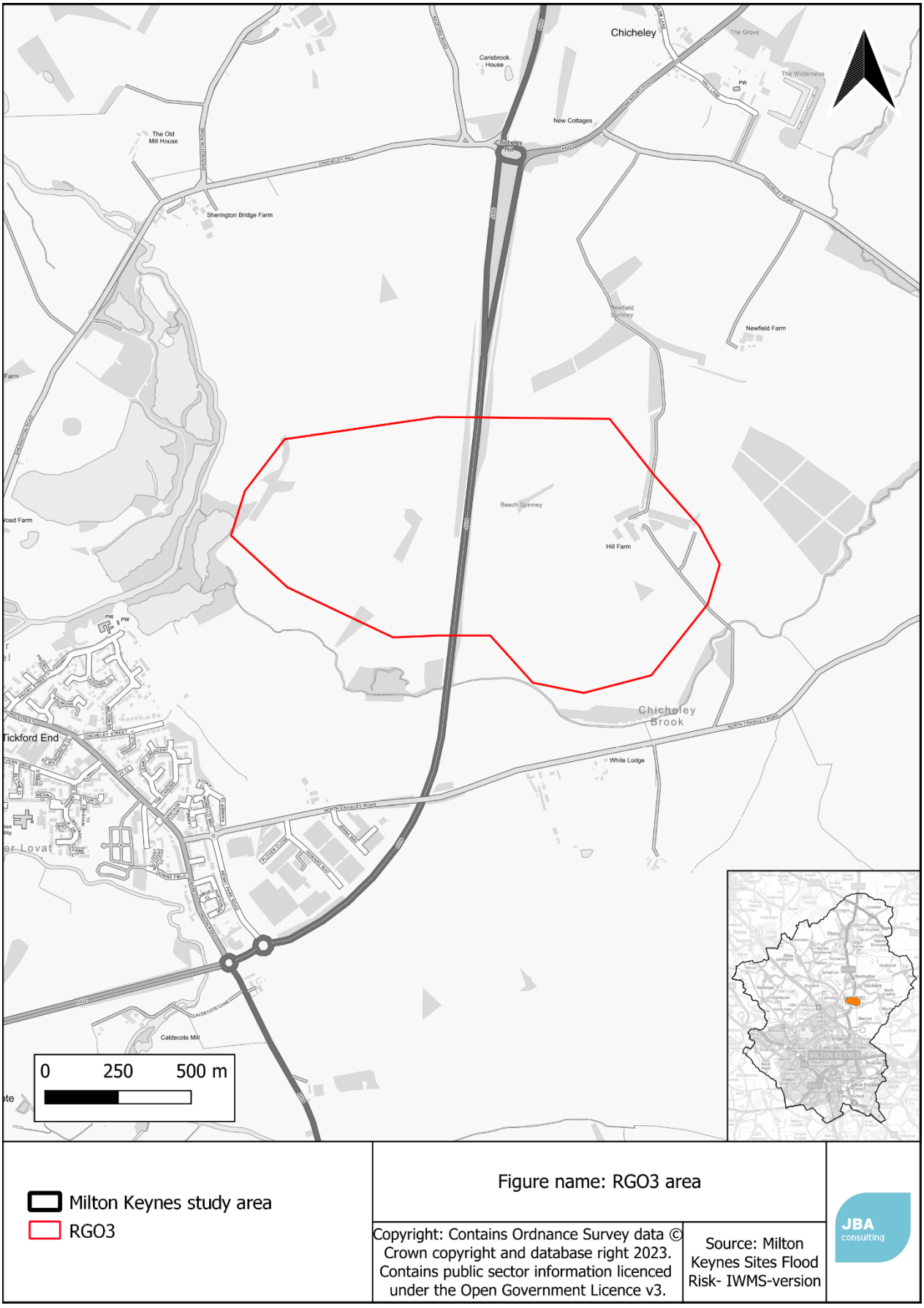


Figure 11.7 Location of RGO3, North East of Newport Pagnell.

B.5.3 Flood risk

Fluvial and surface water flood risk have been considered. A more detailed assessment of these, and other sources of flood risk will be included as part of the SFRA. Areas to the south and west of the study area fall into Flood Zone 3 associated with the River Great Ouse and Chicheley Brook. The surface water flood risk is shown in Figure 11.8 and Flood Zone 2 is shown in Figure 11.9. Two surface water flow paths are also present through the middle of RGO3 each side of the A509.

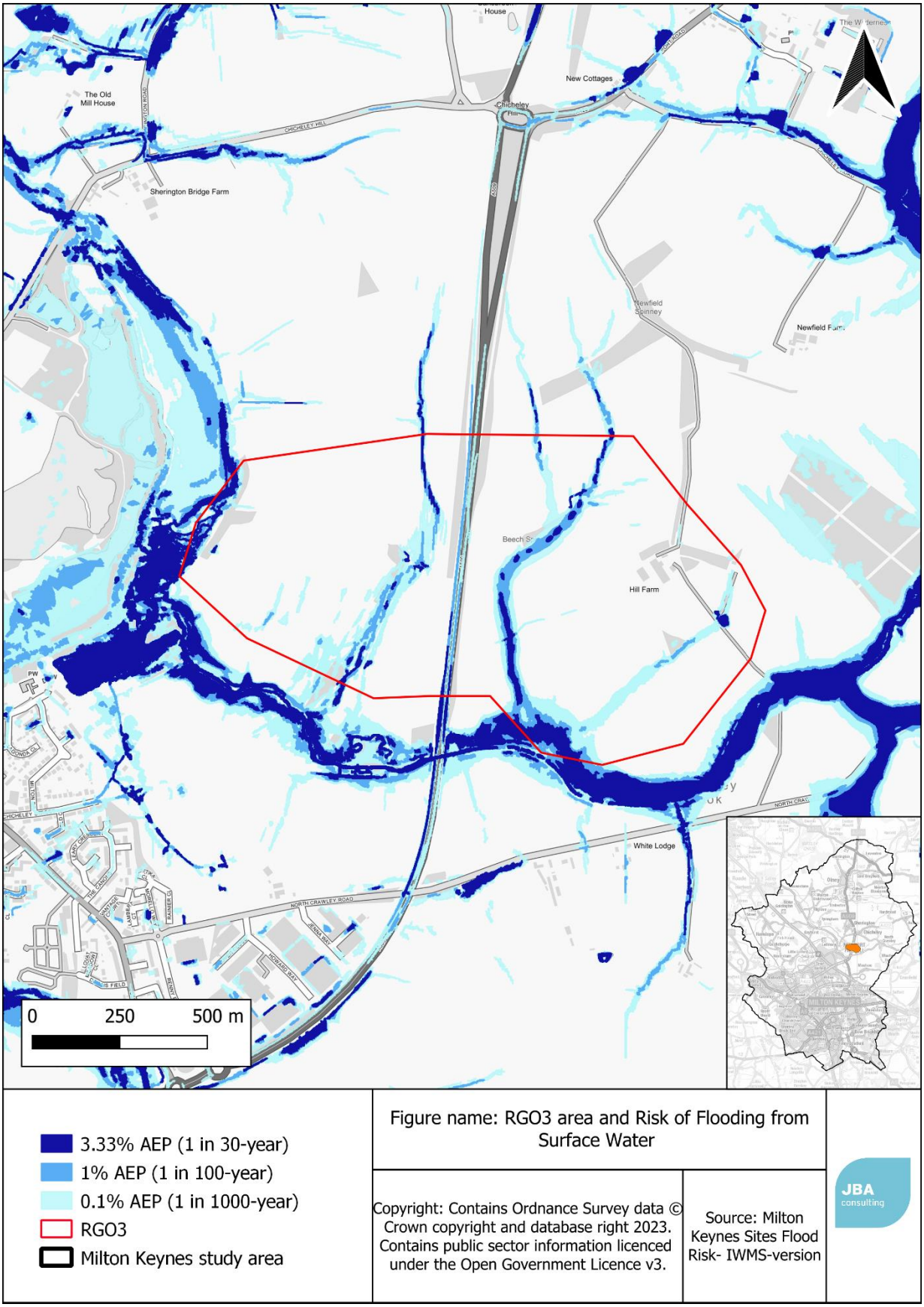


Figure 11.8 Environment Agency Risk of Flooding from Surface Water mapping in comparison to RGO3.

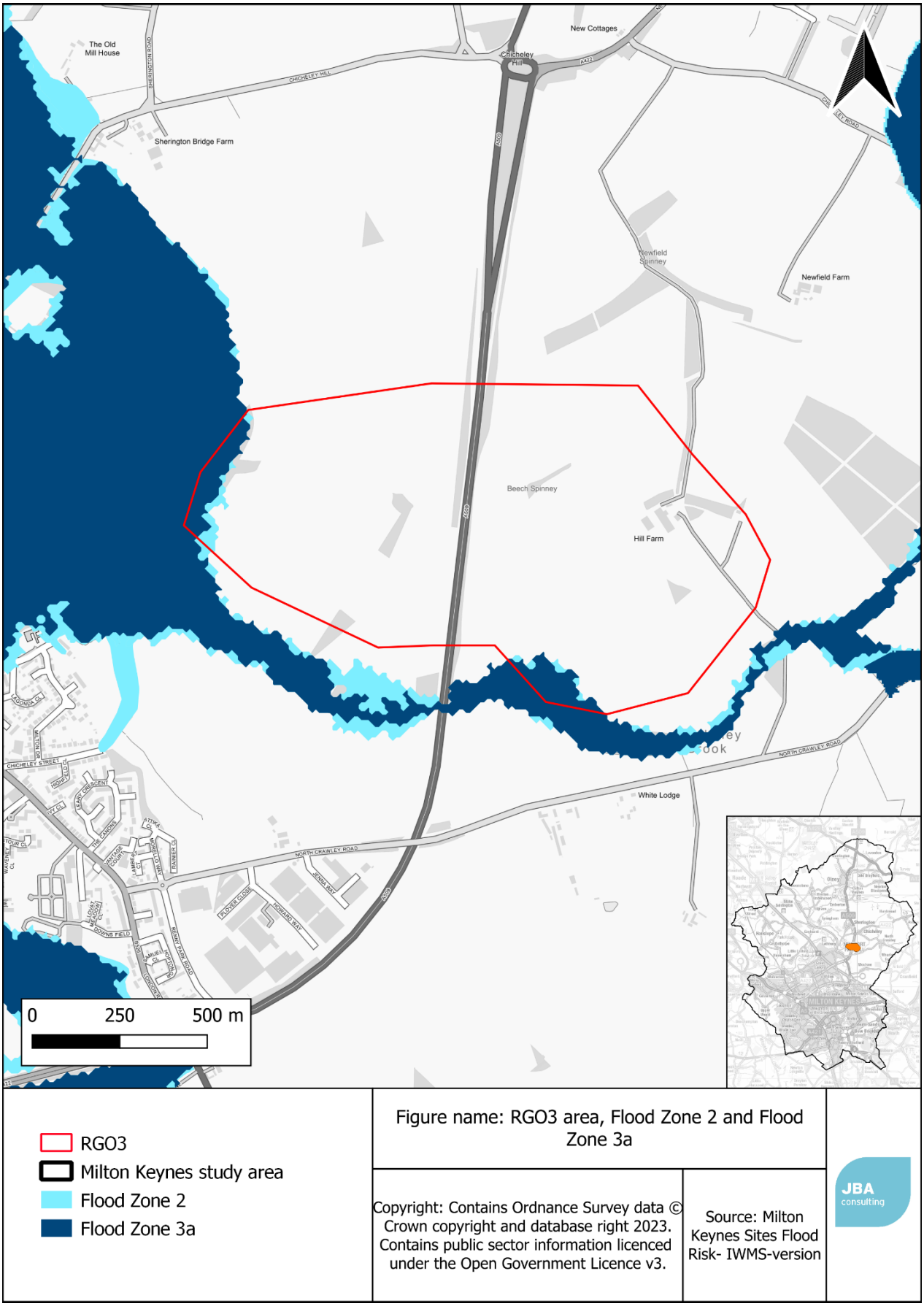


Figure 11.9 RGO3 in comparison to Flood Map for Planning

B.5.4 SuDS

With higher density development (100 DPH) there is less space for above ground SuDS options such as rainwater harvesting (RwH), swales, and rain gardens. Further consideration is therefore required into how surface water may be managed at this housing density. This could mean more permeable paving, soakaways, below-ground storage and rainwater harvesting being implemented. Where flow paths are prominent across the RGO, there is a possibility for SuDS features such as swales to manage surface water. These should be planned in at the master planning stage to maximise their potential.

Where a development density of 35 to 50 DPH, a mixture of above and below ground SuDS could be implemented.

The British Geological Society (BGS) mapping shows that the site lies on a bedrock geology of mudstone, siltstone and sandstone, and soils have slightly impeded draining lime-rich loamy and clayey soils. This means that infiltration SuDS may not be applicable to this site.

B.5.5 Water resources

RGO3 is covered by Ruthamford Central WRZ which has no internal water resources and relies on imports from neighbouring WRZs (Ruthamford South and Ruthamford North). From a water resources perspective, it is the overall level of growth and consequently water demand that is important, and not the location. It is not therefore possible to assess the site individually. A cumulative assessment is included in section 0.

Water demand on the site could be reduced by making use of Rainwater Harvesting (RwH) to provide non-potable water for use in toilet flushing, washing machines and garden irrigation. With a lower density of dwellings there could be more space for storage of rainwater, and a lower demand. Whereas a higher density would have less storage space, with a higher demand. There may also be a lower ratio of roof space to population providing less opportunities for collection in the high-density scenario. Therefore, RwH would be better suited to a lower density of dwellings when used as a water resource.

B.5.6 Water Recycling

The sewerage undertaker for RGO3 is Anglian Water and it is anticipated that the site would be served by Cotton Valley Water Recycling Centre (WRC). Figure 11.10 shows a comparison of predicted increase in wastewater discharge from Cotton Valley WRC to its permit limit under the three housing density scenarios. There is considerable headroom at this WRC, even after planned growth is factored in, suggesting that Cotton Valley WRC could accommodate several RGOs within its catchment. Section 0 contains a cumulative assessment of the RGOs that would be served by Cotton Valley WRC.

Table 11.9 shows the remaining capacity (number of dwellings) in each scenario.

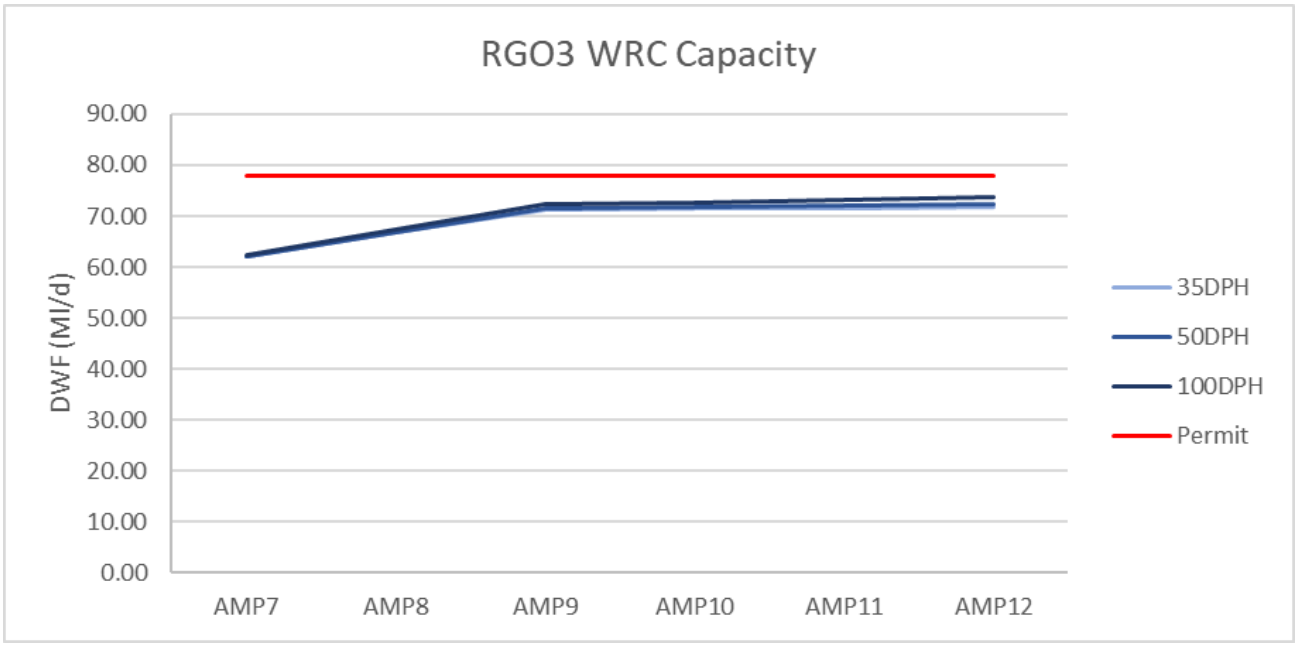


Figure 11.10 Capacity assessment of Cotton Valley WRC

Table 11.9 WRC capacity assessment for RGO3 at all three DPH growth densities.

DPH	Estimated spare hydraulic capacity (number of dwellings)
35	24,806
50	23,041
100	17,157

B.5.7 Water quality

RGO3 falls into the catchment of Chicheley Brook, see WFD status below, Table 11.10.

Table 11.10 WFD status for Chicheley Brook

Ecological	Physio-chemical quality elements	Chemical
Poor	Moderate	Does not require assessment

Based on results from the Water Quality sensitivity analysis undertaken as part of the Phase 1 IWMS, there is a moderate deterioration (<10%) in ammonia, BOD and phosphate concentrations at Cotton Valley WRC outfall as a result of a 10% increase in flow at all treatment works within the study area. Within the Ouse (Newport Pagnell to Roxton) catchment, there is deterioration along the entire reach upstream and downstream of Cotton Valley WRC.

At Cotton Valley there is an increase in concentration of each determinand at the outfall from the WRC, however concentrations continue to decrease further downstream of the treatment works. Whilst concentrations decrease downstream, there is moderate deterioration in BOD downstream to Emberton, and in phosphate and ammonia downstream to Olney WRC and beyond as a result of additional flow at WRCs in the study area.

It is proposed to assess the impact of improvements in treatment processes on pollutant concentrations in detailed water quality modelling in Stage 2.

B.5.8 Odour

There are no WRCs within the site boundary or within 400m of the RGO3 area. Cotton Valley WRC is to the 3.45 km southwest of RGO. Nuisance odour is unlikely to be an issue on this site.

B.5.9 Summary

- RGO3 has a moderate area at risk of flooding (15.5%).
- An initial desk study of the site geology indicates that infiltration SuDS may not be appropriate on this site.
- There is a large amount of capacity at any of the DPH growth scenarios within the existing permit for Cotton Valley WRC.
- The waterbodies immediately downstream of Cotton Valley WRC have a moderate status for Ecological and physio-chemical quality elements.
- Not at risk of nuisance odour.

B.6 RGO4 North of Moulsoe: Summary

B.6.1 Location and description

Figure 11.11 shows the location of RGO4 to the North of Moulsoe. The site is currently greenfield. In the northern are of the RGO4, North Crawley Road and associated residential properties.

B.6.2 Dwelling density

RGO4 has an overall area of 166.7 ha, see Figure 11.11. The area at risk of flooding (based on fluvial Flood Zone 2 or 3, or Surface water flood risk (low, medium or high)) has been removed from the RGOs area, leaving the developable area. 9% of the site (14.7 ha) was excluded leaving a developable area of 152 ha.

The resulting estimated housing capacity once the developable area is taken into account is shown in Table 11.11.

Table 11.11 Housing capacity of RGO4

Overall developable area (ha)	No. dwellings at 35 DPH	No. dwellings at 50 DPH	No. dwellings at 100 DPH
152	5,320	7,600	15,200

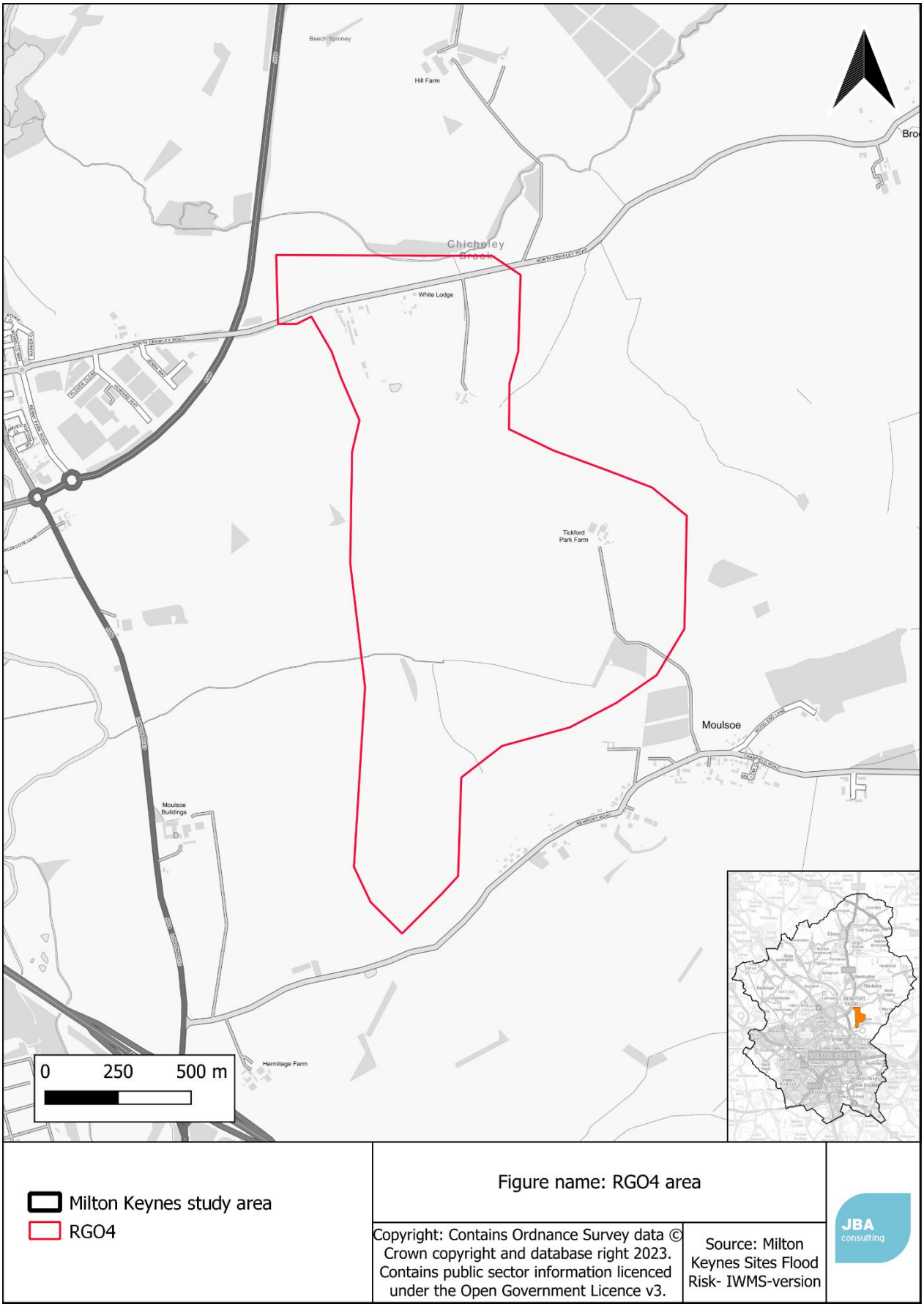


Figure 11.11 Location of RGO4, North of Moulsoe

B.6.3 Flood risk

Fluvial and surface water flood risk have been considered. A more detailed assessment of these, and other sources of flood risk will be included as part of the SFRA. Parts of RGO4 falls into the modelled fluvial flood extent associated with Chicheley Brook (in the north).

An unnamed tributary to the River Ouzel runs east to west across the site. This has not been modelled but is represented in the surface water flood risk mapping. The surface water flood risk is shown in Figure 11.12 and Flood Map for Planning is shown in Figure 11.13. The site should be designed sequentially in such a way as to minimise this risk.

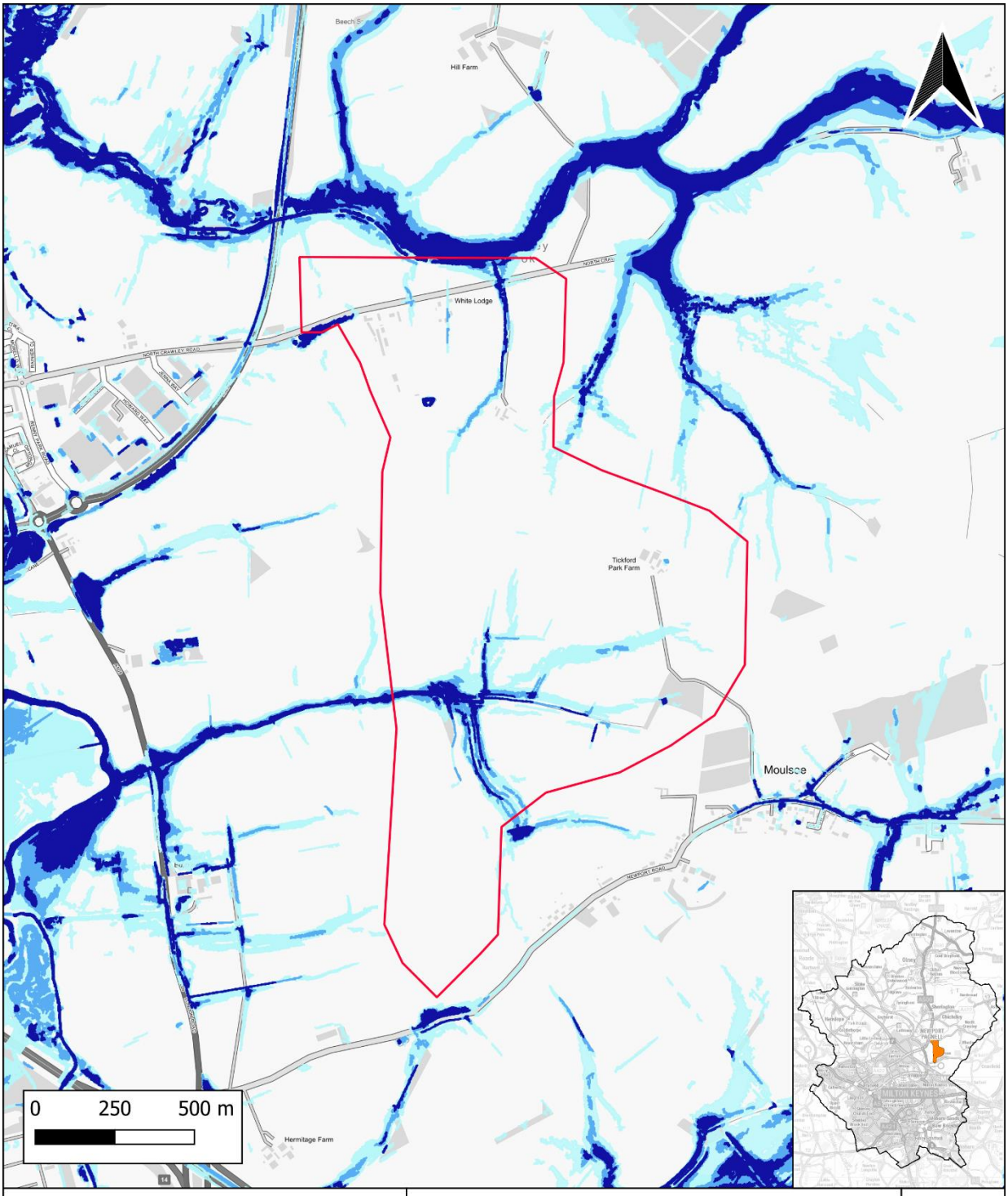


Figure 11.12 Environment Agency Risk of Flooding from Surface Water mapping in comparison to RGO4.

RGO4
Milton Keynes study area
Flood Zone 2
Flood Zone 3a

Figure name: RGO4 area, Flood Zone 2 and Flood Zone 3a

Source: Milton Keynes Sites Flood Risk- IWMS-version

JBA consulting

Figure 11.13 RGO4 in comparison to the Flood Map for Planning.

B.6.4 SuDS

With higher density development (100 DPH) there is less space for above ground SuDS options such as rainwater harvesting (RwH), swales, and rain gardens. Further consideration is therefore required into how surface water may be managed at this housing density. This could mean more permeable paving, soakaways, below-ground storage and rainwater harvesting being implemented. Where flow paths are prominent across the RGO, there is a possibility for SuDS features such as swales to manage surface water. These should be planned in at the master planning stage to maximise their potential.

Where a development density of 35 to 50 DPH, a mixture of above and below ground SuDS could be implemented.

The British Geological Society (BGS) mapping shows that the site lies on a bedrock geology of mudstone, siltstone and sandstone, and soils have slightly impeded draining lime-rich loamy and clayey soils. This means that infiltration SuDS may not be applicable to this site.

B.6.5 Water resources

RGO4 is covered by Ruthamford Central WRZ which has no internal water resources and relies on imports from neighbouring WRZs (Ruthamford South and Ruthamford North). From a water resources perspective, it is the overall level of growth and consequently water demand that is important, and not the location. It is not therefore possible to assess the site individually. A cumulative assessment is included in section 0.

Water demand on the site could be reduced by making use of Rainwater Harvesting (RwH) to provide non-potable water for use in toilet flushing, washing machines and garden irrigation. With a lower density of dwellings there could be more space for storage of rainwater, and a lower demand. Whereas a higher density would have less storage space, with a higher demand. There may also be a lower ratio of roof space to population providing less opportunities for collection in the high-density scenario. Therefore, RwH would be better suited to a lower density of dwellings when used as a water resource.

B.6.6 Water Recycling

The sewerage undertaker for RGO4 is Anglian Water and it is anticipated that the site would be served by Cotton Valley Water Recycling Centre (WRC). Figure 11.14 shows a comparison of predicted wastewater discharge from Cotton Valley WRC to its permit limit under the three housing density scenarios. There is considerable headroom at this WRC, even after planned growth is factored in, suggesting that Cotton Valley WRC could accommodate several RGOs within its catchment. Section 0 contains a cumulative assessment of the RGOs that would be served by Cotton Valley WRC.

Table 11.12 shows the remaining capacity (number of dwellings) in each scenario.

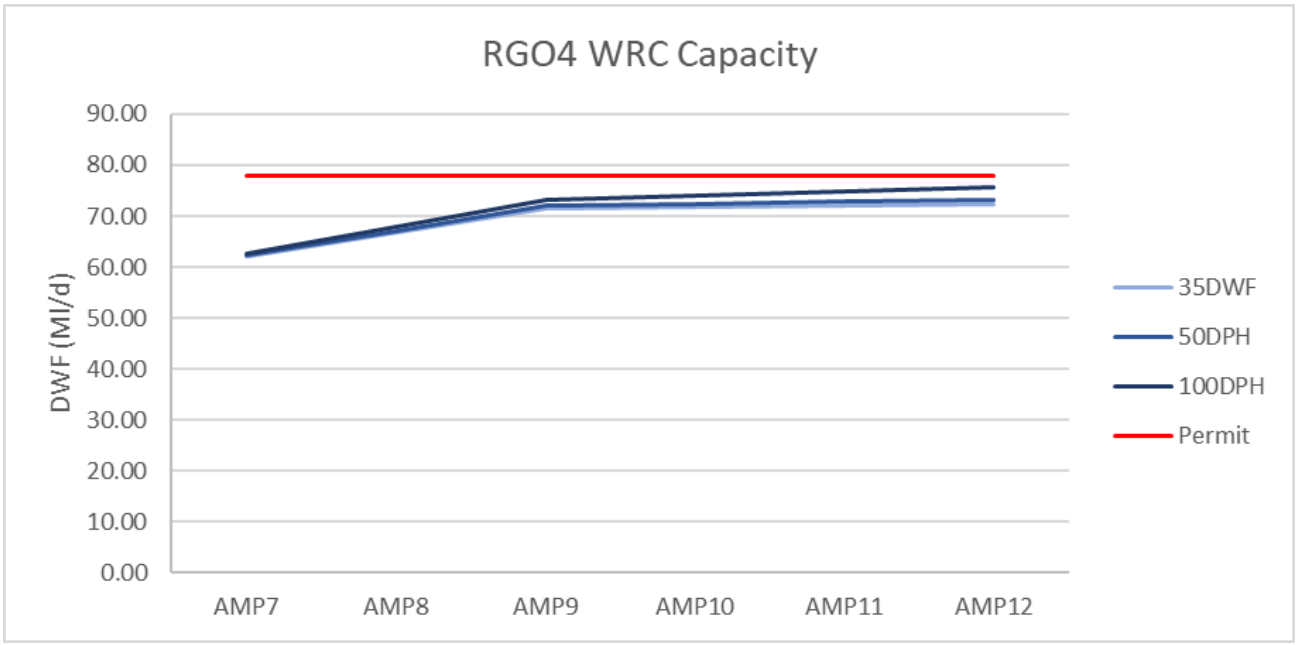


Figure 11.14 Capacity assessment of Cotton Valley WRC

Table 11.12 WRC capacity assessment for RGO4 at all three DPH growth densities.

DPH	Estimated spare hydraulic capacity (number of dwellings)
35	22,193
50	19,308
100	9,691

B.6.7 Water quality

RGO4 falls into the catchment of Chicheley Brook. see WFD status below, see Table 11.13.

Table 11.13 WFD status for Chicheley Brook.

Ecological	Physio-chemical quality elements	Chemical
Poor	Moderate	Does not require assessment

Based on results from the Water Quality sensitivity analysis undertaken as part of the Phase 1 IWMS, there is a moderate deterioration (<10%) in ammonia, BOD and phosphate concentrations at Cotton Valley WRC outfall as a result of a 10% increase in flow at all treatment works within the study area. Within the Ouse (Newport Pagnell to Roxton) catchment, there is deterioration along the entire reach upstream and downstream of Cotton Valley WRC.

At Cotton Valley there is an increase in concentration of each determinand at the outfall from the WRC, however concentrations continue to decrease further downstream of the treatment works. Whilst concentrations decrease downstream, there is moderate deterioration in BOD downstream to Emberton, and in phosphate and ammonia downstream to Olney WRC and beyond as a result of additional flow at WRCs in the study area.

It is proposed to assess the impact of TAL improvements on effluent treatment at WRCs at Stage 2.

B.6.8 Odour

Cotton Valley WRC is 2.8 km to southwest of RGO4. Nuisance odour is unlikely to be an issue.

B.6.9 Summary

- RGO4 has a moderate area at risk of flooding (9%).
- An initial desk study of the site geology indicates that infiltration SuDS may not be appropriate on this site.
- There is a large amount of capacity at any of the DPH growth scenarios within the existing permit for Cotton Valley WRC.
- The waterbodies immediately downstream of Cotton Valley WRC have a moderate status for Ecological and physio-chemical quality elements.
- Not at risk of nuisance odour.

B.7 RGO5 North of M1 Motorway: Summary

B.7.1 Location and description

Figure 11.15 shows the location of RGO5 to the North of M1 Motorway. Located to the North of Broughton Gate Brooklands, (a healthcare centre) RGO5 is a mixture of agricultural land and woodland, divided by hedgerows and trees. RGO5 contains Broughton Grounds Business Park which is located to the far east of the RGO.

B.7.2 Dwelling density

RGO5 has an overall area of 211.5 ha, see Figure 11.15. The area at risk of flooding (based on fluvial Flood Zone 2 or 3, or Surface water flood risk (low, medium or high)) has been removed from the RGOs area, leaving the developable area. 31.5% of the site (66.5 ha) was excluded leaving a developable area of 145 ha.

The resulting estimated housing capacity once the developable area is taken into account is shown in Table 11.14.

Table 11.14 Housing capacity of RGO5

Overall developable area (ha)	No. dwellings at 35 DPH	No. dwellings at 50 DPH	No. dwellings at 100 DPH
145	5,075	7,250	14,500

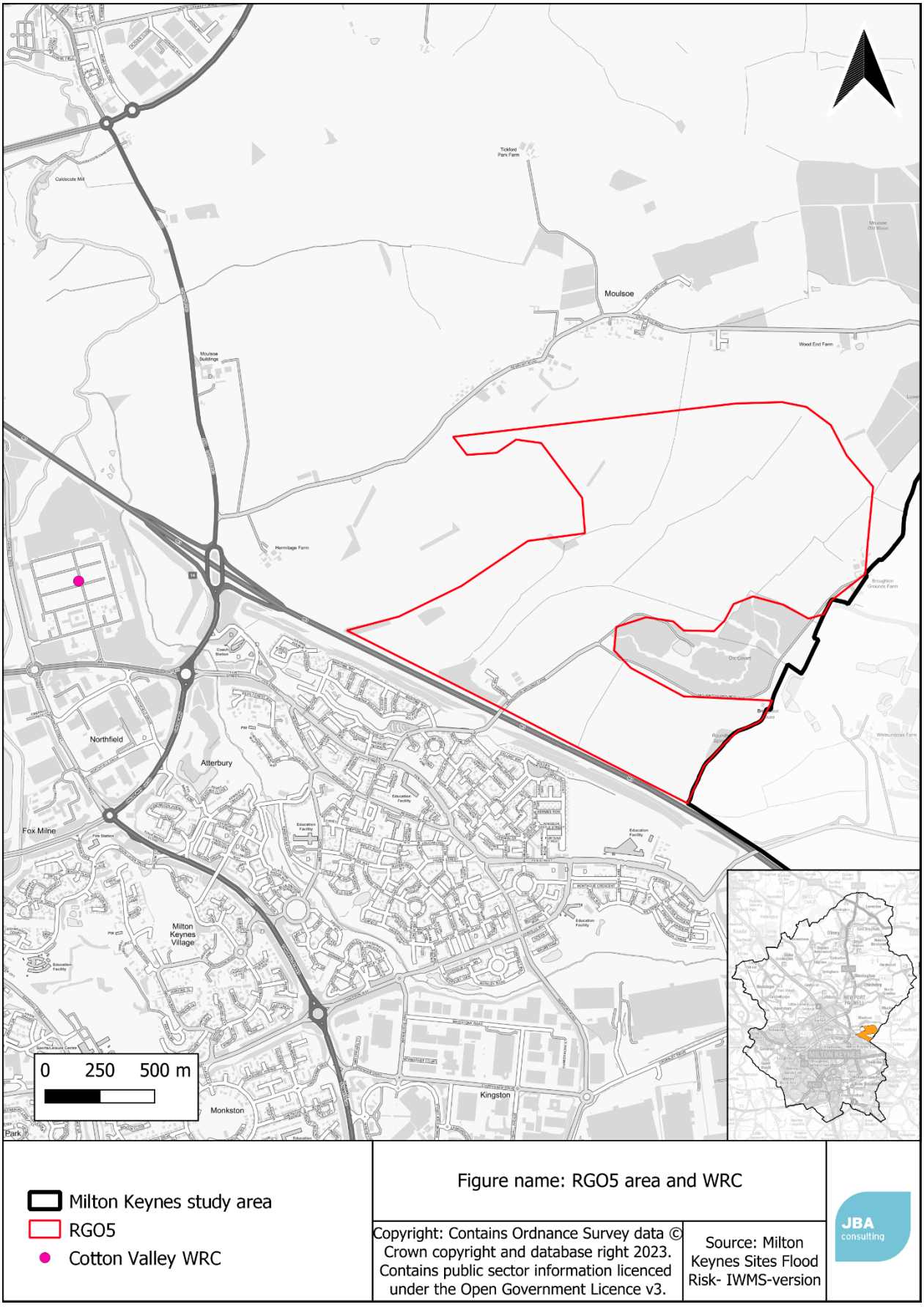


Figure 11.15 Location of RGO5, North of M1 Motorway

B.7.3 Flood risk

Fluvial and surface water flood risk have been considered. A more detailed assessment of these, and other sources of flood risk will be included as part of the SFRA. A large part of south of the site falls into modelled fluvial extents associated with a tributary of Broughton Brook. Several other unmodelled watercourses flow across the site and are represented in the Risk of Flooding from Surface Water mapping.

The surface water flood risk is shown in Figure 11.16 and the Flood Map for Planning is shown in Figure 11.17. The site should be designed sequentially in such a way as to minimise this risk.

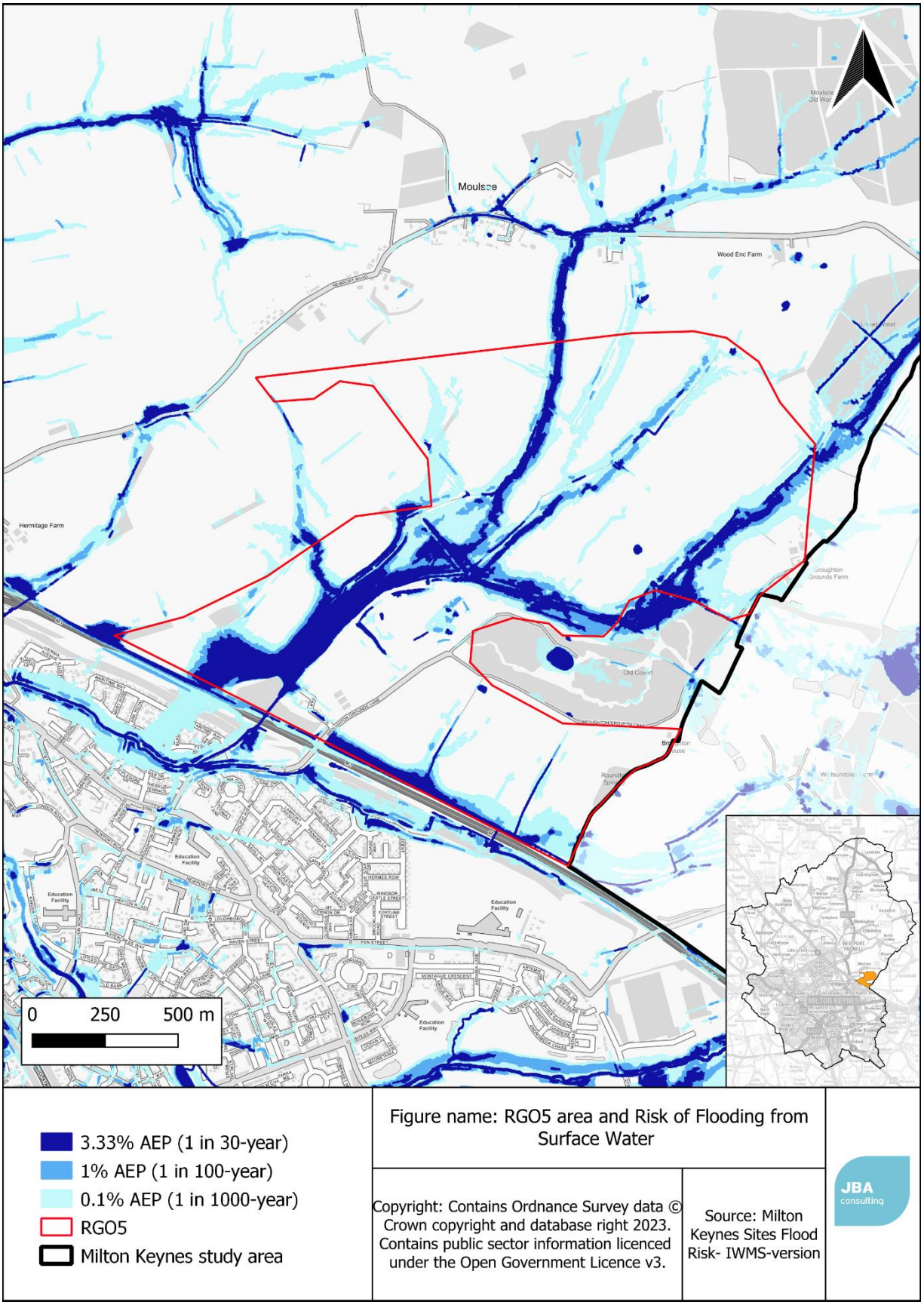


Figure 11.16 Environment Agency Risk of Flooding from Surface Water mapping in comparison to RGO5.

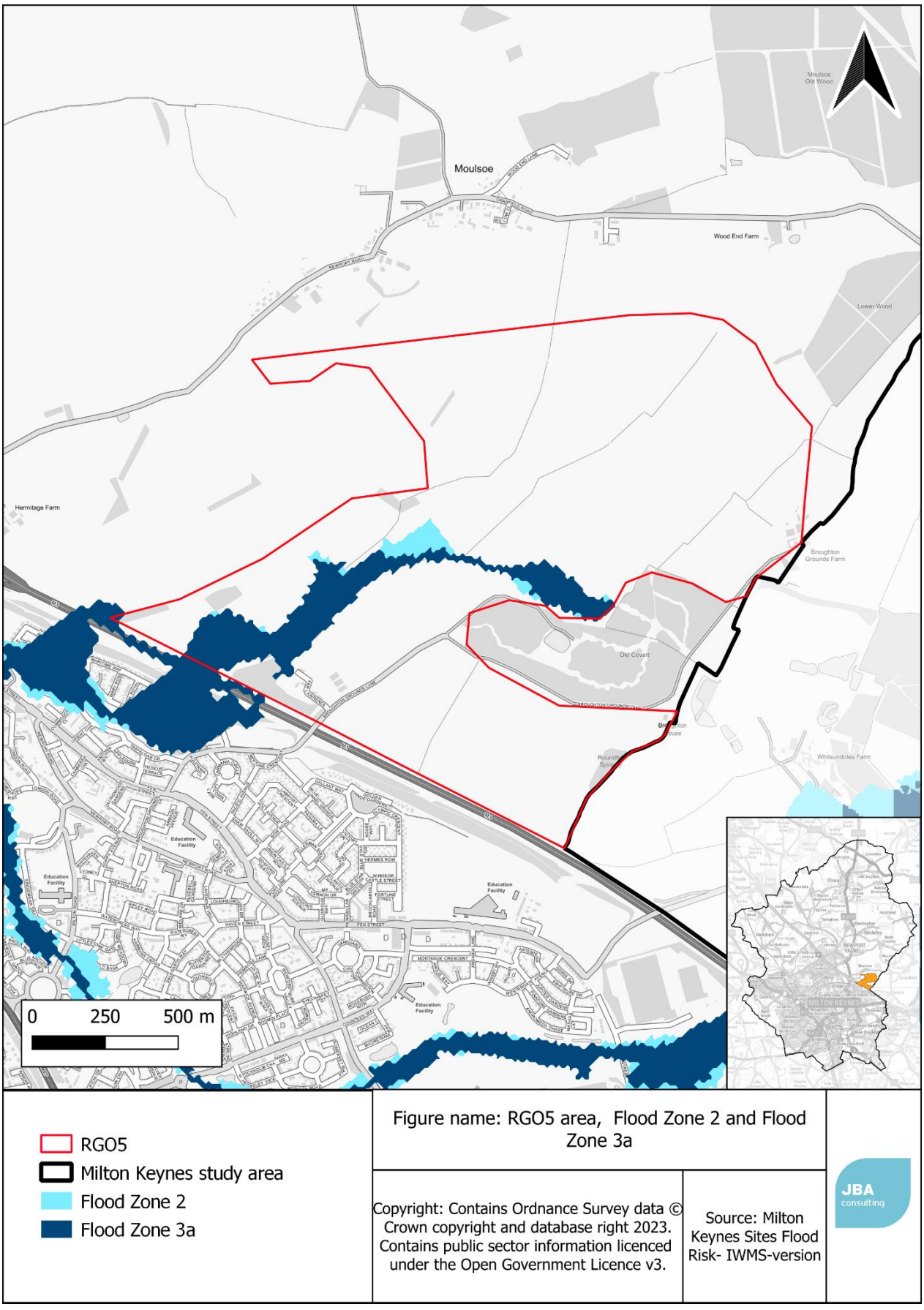


Figure 11.17 RGO5 in comparison to the Flood Map for Planning

B.7.4 SuDS

With higher density development (100 DPH) there is less space for above ground SuDS options such as rainwater harvesting (RwH), swales, and rain gardens. Further consideration is therefore required into how surface water may be managed at this housing density. This could mean more permeable paving, soakaways, below-ground storage and rainwater harvesting being implemented. Where flow paths are prominent across the RGO, there is a possibility for SuDS features such as swales to manage surface water. These should be planned in at the master planning stage to maximise their potential.

Where a development density of 35 to 50 DPH, a mixture of above and below ground SuDS could be implemented.

The British Geological Society (BGS) mapping shows that the site lies on a bedrock geology of mudstone, siltstone and sandstone, and soils have slightly impeded draining lime-rich loamy and clayey soils. This means that infiltration SuDS may not be applicable to this site.

B.7.5 Water resources

RGO5 is covered by Ruthamford Central WRZ which has no internal water resources and relies on imports from neighbouring WRZs (Ruthamford South and Ruthamford North). From a water resources perspective, it is the overall level of growth and consequently water demand that is important, and not the location. It is not therefore possible to assess the site individually. A cumulative assessment is included in section 0.

Water demand on the site could be reduced by making use of Rainwater Harvesting (RwH) to provide non-potable water for use in toilet flushing, washing machines and garden irrigation. With a lower density of dwellings there could be more space for storage of rainwater, and a lower demand. Whereas a higher density would have less storage space, with a higher demand. There may also be a lower ratio of roof space to population providing less opportunities for collection in the high-density scenario. Therefore, RwH would be better suited to a lower density of dwellings when used as a water resource.

B.7.6 Water Recycling

The sewerage undertaker for RGO5 is Anglian Water and it is anticipated that the site would be served by Cotton Valley Water Recycling Centre (WRC). Figure 11.18 shows a comparison of predicted wastewater discharge from Cotton Valley WRC to its permit limit under the three housing density scenarios. There is considerable headroom at this WRC, even after planned growth is factored in, suggesting that Cotton Valley WRC could accommodate several RGOs within its catchment. Section 0 contains a cumulative assessment of the RGOs that would be served by Cotton Valley WRC.

Table 11.15 shows the remaining capacity (number of dwellings) in each scenario.

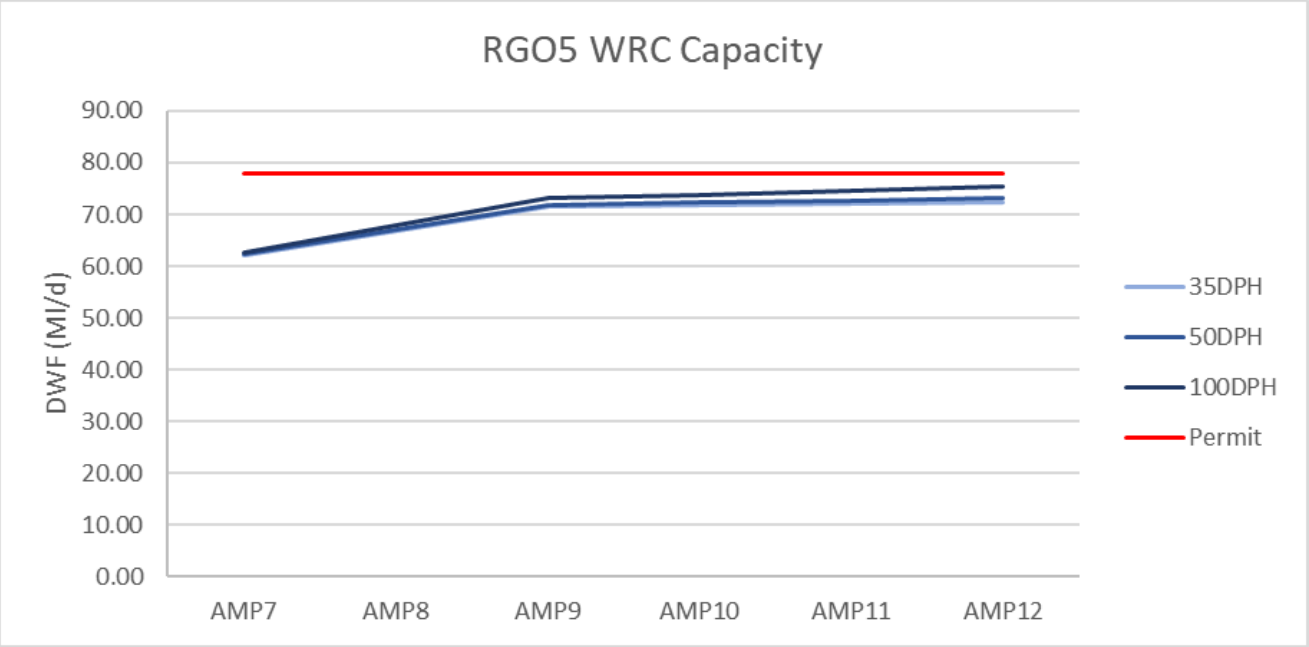


Figure 11.18 Capacity assessment of Cotton Valley WRC

Table 11.15 WRC capacity assessment for RGO5 at all three DPH growth densities.

DPH	Estimated spare hydraulic capacity (number of dwellings)
35	22,503
50	19,751
100	10,576

B.7.7 Water quality

RGO5 falls into the catchment of Broughton Brook, see WFD status below, see Table 11.16.

Table 11.16 WFD status for Broughton Brook.

Ecological	Physio-chemical quality elements	Chemical
Poor	Moderate	Does not require assessment

Based on results from the Water Quality sensitivity analysis undertaken as part of the Phase 1 IWMS, there is a moderate deterioration (<10%) in ammonia, BOD and phosphate concentrations at Cotton Valley WRC outfall as a result of a 10% increase in flow at all treatment works within the study area. Within the Ouse (Newport Pagnell to Roxton) catchment, there is deterioration along the entire reach upstream and downstream of Cotton Valley WRC.

At Cotton Valley there is an increase in concentration of each determinand at the outfall from the WRC, however concentrations continue to decrease further downstream of the treatment works. Whilst concentrations decrease downstream, there is moderate deterioration in BOD downstream to Emberton, and in phosphate and ammonia downstream to Olney WRC and beyond as a result of additional flow at WRCs in the study area.

It is proposed to assess the impact of TAL improvements on effluent treatment at WRCs at Stage 2.

B.7.8 Odour

Cotton Valley WRC is 1000m to the west of RGO5 and is unlikely to cause a nuisance odour issue.

B.7.9 Summary

- RGO5 contains a significant area at risk of flooding (31.5%).
- An initial desk study of the site geology indicates that infiltration SuDS may not be appropriate on this site.
- There is a large amount of capacity at any of the DPH growth scenarios within the existing permit for Cotton Valley WRC.
- The waterbodies immediately downstream of Cotton Valley WRC have a moderate status for Ecological and physio-chemical quality elements.
- Not at risk of nuisance odour.

B.8 RGO6 West of Cranfield University: Summary

B.8.1 Location and description

Figure 11.19 shows the location of RGO6 to the West of Cranfield University. The greenfield land is divided up by hedgerows and trees. To the east is the boundary for the Milton Keynes County Council (MKCC) local authority area, and the west and north boundary is open countryside. Murtland's farm is partially in RGO6 as well as farm buildings located adjacent to Folly Lane within the middle of the RGO.

B.8.2 Dwelling density

RGO6 has an overall area of 159 ha, see Figure 11.19. The area at risk of flooding (based on fluvial Flood Zone 2 or 3, or Surface water flood risk (low, medium or high)) has been removed from the RGOs area, leaving the developable area. 7% of the site (11 ha) was excluded leaving a developable area of 148 ha.

The resulting estimated housing capacity once the developable area is taken into account is shown in Table 11.17.

Table 11.17 Housing capacity of RGO6

Overall developable area (ha)	No. dwellings at 35 DPH	No. dwellings at 50 DPH	No. dwellings at 100 DPH
148	5,180	7,400	14,800

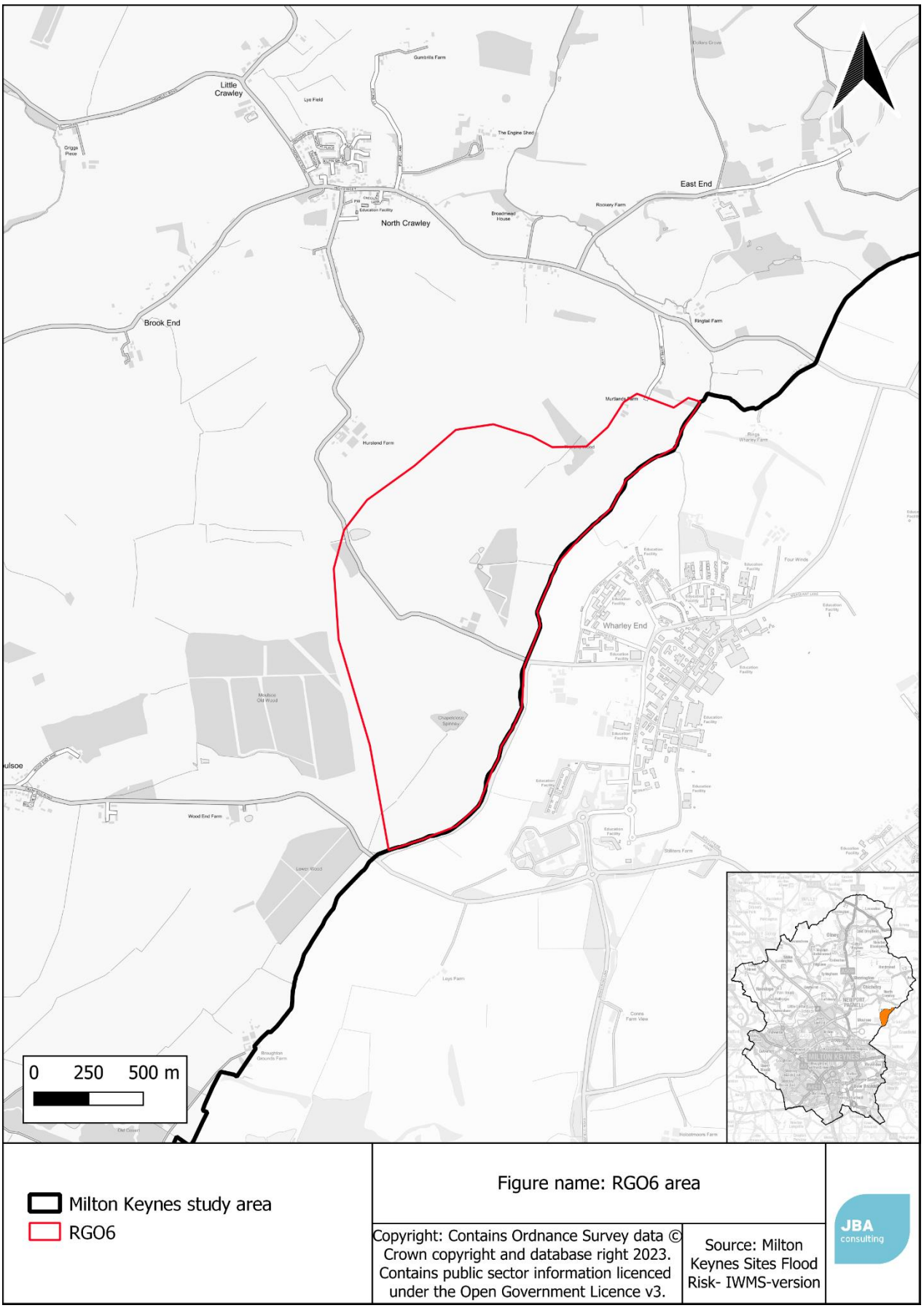


Figure 11.19 Location of RGO6, West of Cranfield University

B.8.3 Flood risk

Fluvial and surface water flood risk have been considered. A more detailed assessment of these, and other sources of flood risk will be included as part of the SFRA. None of RGO6 falls into modelled fluvial extents.

A tributary of the River Ouzel runs to the southwest of RGO6 and Chicheley Brook runs to the North. Both watercourses are external to the study area The surface water flood risk is shown in Figure 11.20. The site should be designed sequentially in such a way as to minimise this risk.

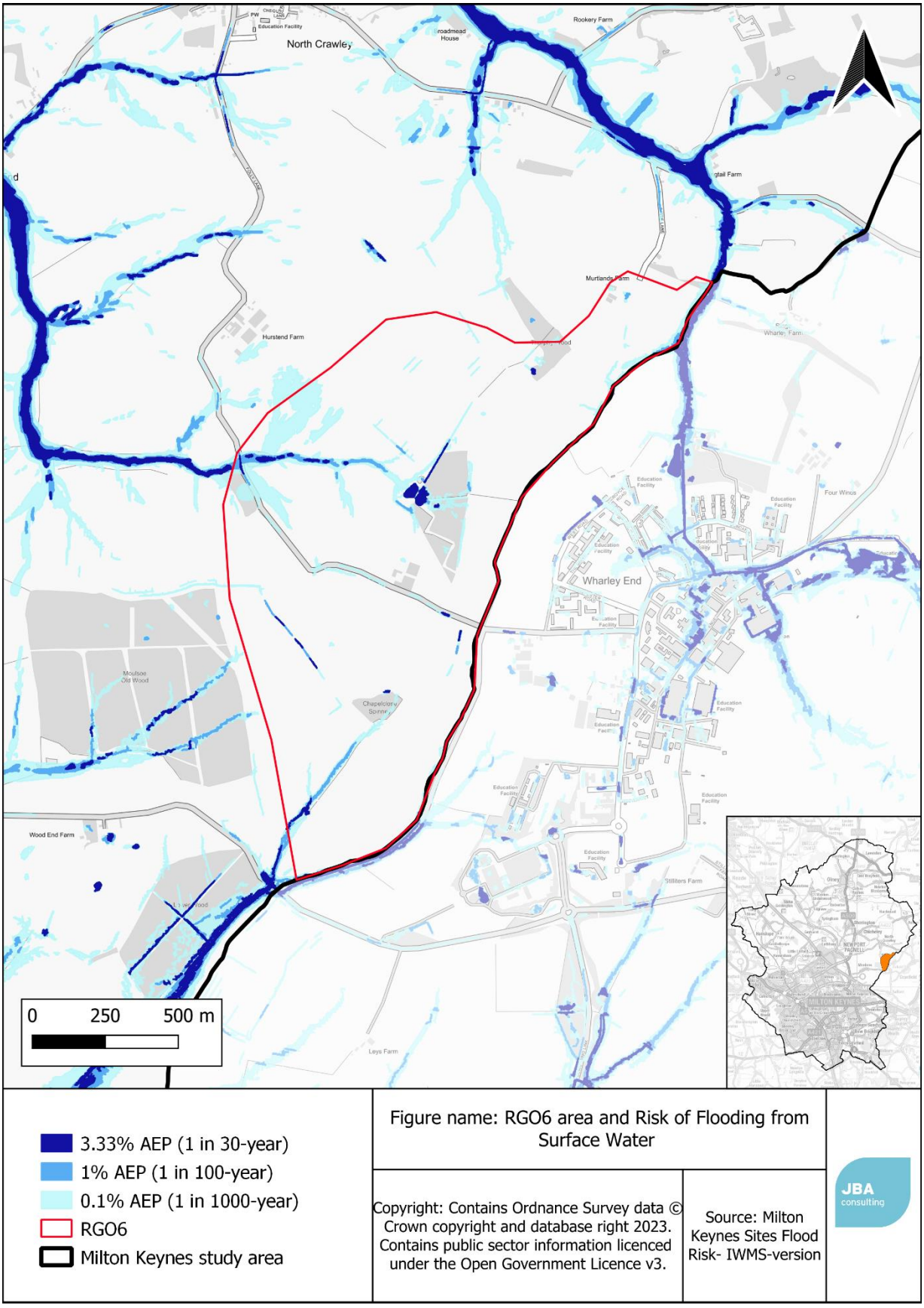


Figure 11.20 Environment Agency at Risk of Flooding from Surface Water mapping in comparison to RGO6.

B.8.4 SuDS

With higher density development (100 DPH) there is less space for above ground SuDS options such as rainwater harvesting (RwH), swales, and rain gardens. Further consideration is therefore required into how surface water may be managed at this housing density. This could mean more permeable paving, soakaways, below-ground storage and rainwater harvesting being implemented. Where flow paths are prominent across the RGO, there is a possibility for SuDS features such as swales to manage surface water. These should be planned in at the master planning stage to maximise their potential.

Where a development density of 35 to 50 DPH, a mixture of above and below ground SuDS could be implemented.

The British Geological Society (BGS) mapping shows that the site lies on a bedrock geology of mudstone, siltstone and sandstone, and soils have slightly impeded draining lime-rich loamy and clayey soils. This means that infiltration SuDS may not be applicable to this site.

B.8.5 Water resources

RGO5 is covered by Ruthamford Central WRZ which has no internal water resources and relies on imports from neighbouring WRZs (Ruthamford South and Ruthamford North). From a water resources perspective, it is the overall level of growth and consequently water demand that is important, and not the location. It is not therefore possible to assess the site individually. A cumulative assessment is included in section 0.

Water demand on the site could be reduced by making use of Rainwater Harvesting (RwH) to provide non-potable water for use in toilet flushing, washing machines and garden irrigation. With a lower density of dwellings there could be more space for storage of rainwater, and a lower demand. Whereas a higher density would have less storage space, with a higher demand. There may also be a lower ratio of roof space to population providing less opportunities for collection in the high-density scenario. Therefore, RwH would be better suited to a lower density of dwellings when used as a water resource.

B.8.6 Water Recycling

The sewerage undertaker for RGO6 is Anglian Water and it is anticipated that the site would be served by Cotton Valley Water Recycling Centre (WRC). Figure 11.21 shows a comparison of predicted wastewater discharge from Cotton Valley WRC to its permit limit under the three housing density scenarios. There is considerable headroom at this WRC, even after planned growth is factored in, suggesting that Cotton Valley WRC could accommodate several RGOs within its catchment. Section 0 contains a cumulative assessment of the RGOs that would be served by Cotton Valley WRC.

Table 11.18 shows the remaining capacity (number of dwellings) in each scenario.

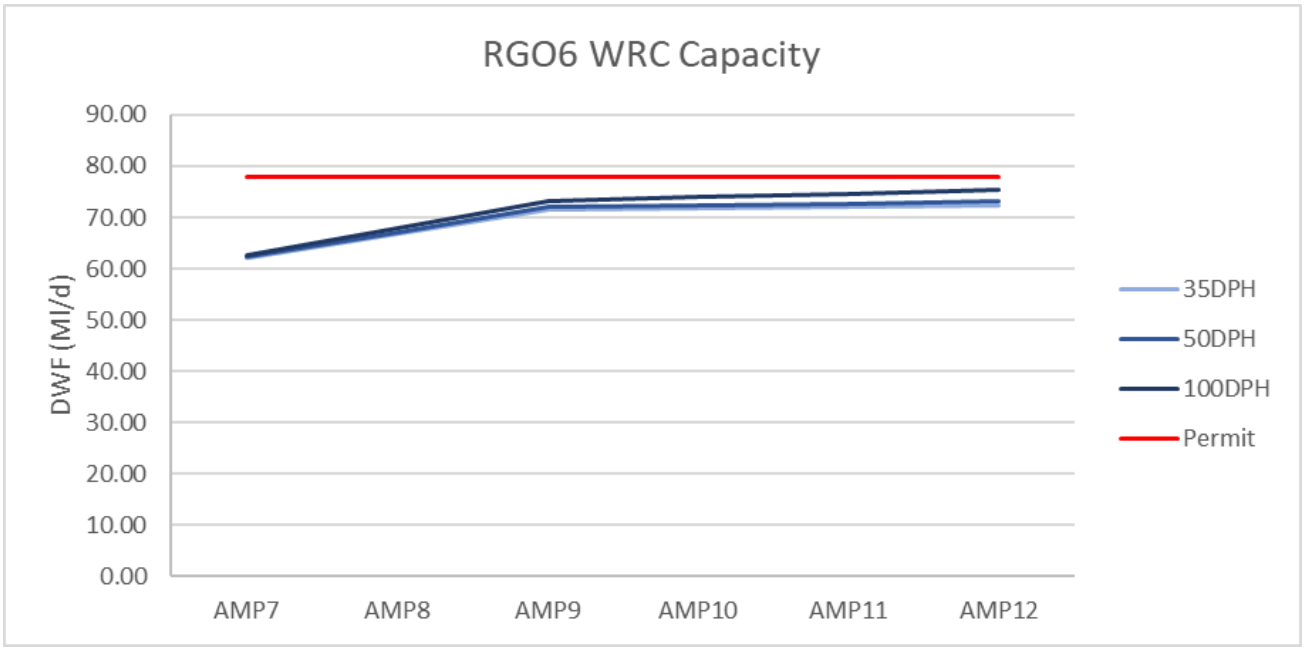


Figure 11.21 Capacity assessment of Cotton Valley WRC

Table 11.18 WRC capacity assessment for RGO5 at all three DPH growth densities.

DPH	Estimated spare hydraulic capacity (number of dwellings)
35	22,370
50	19,561
100	10,197

B.8.7 Water quality

RGO6 falls into the catchment of Chicheley Brook, see WFD status below, Table 11.19.

Table 11.19 WFD status for Chicheley Brook.

Ecological	Physio-chemical quality elements	Chemical
Poor	Moderate	Does not require assessment

Based on results from the Water Quality sensitivity analysis undertaken as part of the Phase 1 IWMS, there is a moderate deterioration (<10%) in ammonia, BOD and phosphate concentrations at Cotton Valley WRC outfall as a result of a 10% increase in flow at all treatment works within the study area. Within the Ouse (Newport Pagnell to Roxton) catchment, there is deterioration along the entire reach upstream and downstream of Cotton Valley WRC.

At Cotton Valley there is an increase in concentration of each determinand at the outfall from the WRC, however concentrations continue to decrease further downstream of the treatment works. Whilst concentrations decrease downstream, there is moderate deterioration in BOD downstream to Emberton, and in phosphate and ammonia downstream to Olney WRC and beyond as a result of additional flow at WRCs in the study area.

It is proposed to assess the impact of TAL improvements on effluent treatment at WRCs at Stage 2.

B.8.8 Odour

Cotton Valley WRC is 4.4 km to the southwest of RGO6. Nuisance odour is unlikely to be an issue.

B.8.9 Summary

- RGO6 has a small area at risk of flooding (7%).
- An initial desk study of the site geology indicates that infiltration SuDS may not be appropriate on this site.
- There is a large amount of capacity at any of the DPH growth scenarios within the existing permit for Cotton Valley WRC.
- The waterbodies immediately downstream of Cotton Valley WRC have a moderate status for Ecological and physio-chemical quality elements.
- Not at risk of nuisance odour.

B.9 RGO7 North of Woburn Sands: Summary

B.9.1 Location and description

Figure 11.22 shows the location of RGO7 to the North of Woburn Sands. The RGO contains grounds of Wavendon House as well as small pockets of broadleaved woodland and agricultural land. There are several residential areas in Woburn Sands located to the south of the RGO adjacent to Cranfield Road which crosses through the centre of RGO7.

B.9.2 Dwelling density

RGO7 has an overall area of 101.6 ha, see Figure 11.22. The area at risk of flooding (based on fluvial Flood Zone 2 or 3, or Surface water flood risk (low, medium or high)) has been removed from the RGOs area, leaving the developable area. 7.5% of the site (7.6 ha) was excluded leaving a developable area of 94 ha.

The resulting estimated housing capacity once the developable area is taken into account is shown in Table 11.20.

Table 11.20 Housing capacity of RGO7

Overall developable area (ha)	No. dwellings at 35 DPH	No. dwellings at 50 DPH	No. dwellings at 100 DPH
94	3,290	4,700	9,400

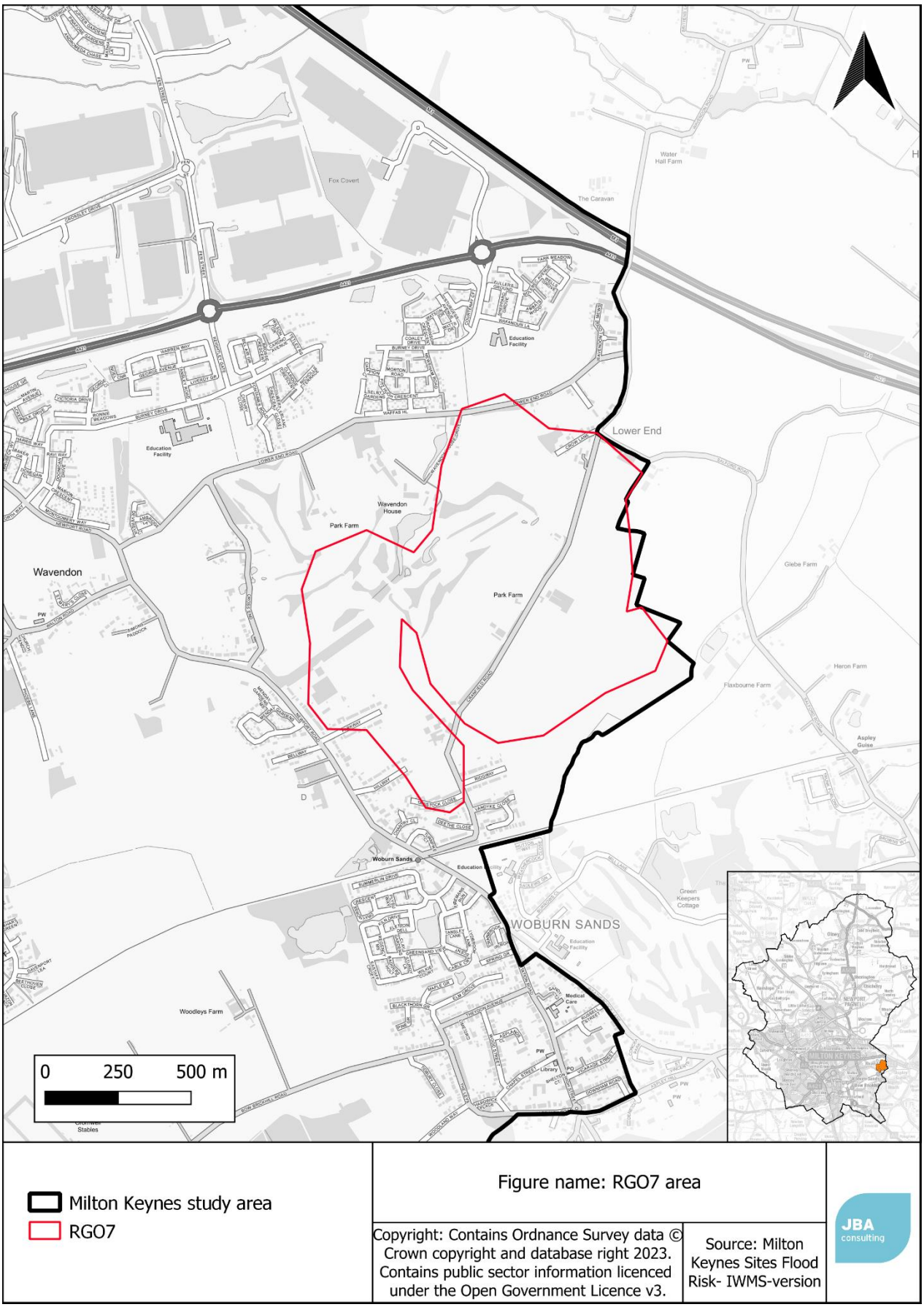


Figure 11.22 Location of RGO7, North of Woburn Sands.

B.9.3 Flood risk

Fluvial and surface water flood risk have been considered. A more detailed assessment of these, and other sources of flood risk will be included as part of the SFRA. None of RGO7 falls into modelled fluvial extents.

There are no watercourses within the RGO, the closest watercourse is a tributary of the River Ouzel 1.4 km to the north of RGO7. The surface water flood risk is shown in Figure 11.23. The site should be designed sequentially in such a way as to minimise this risk.

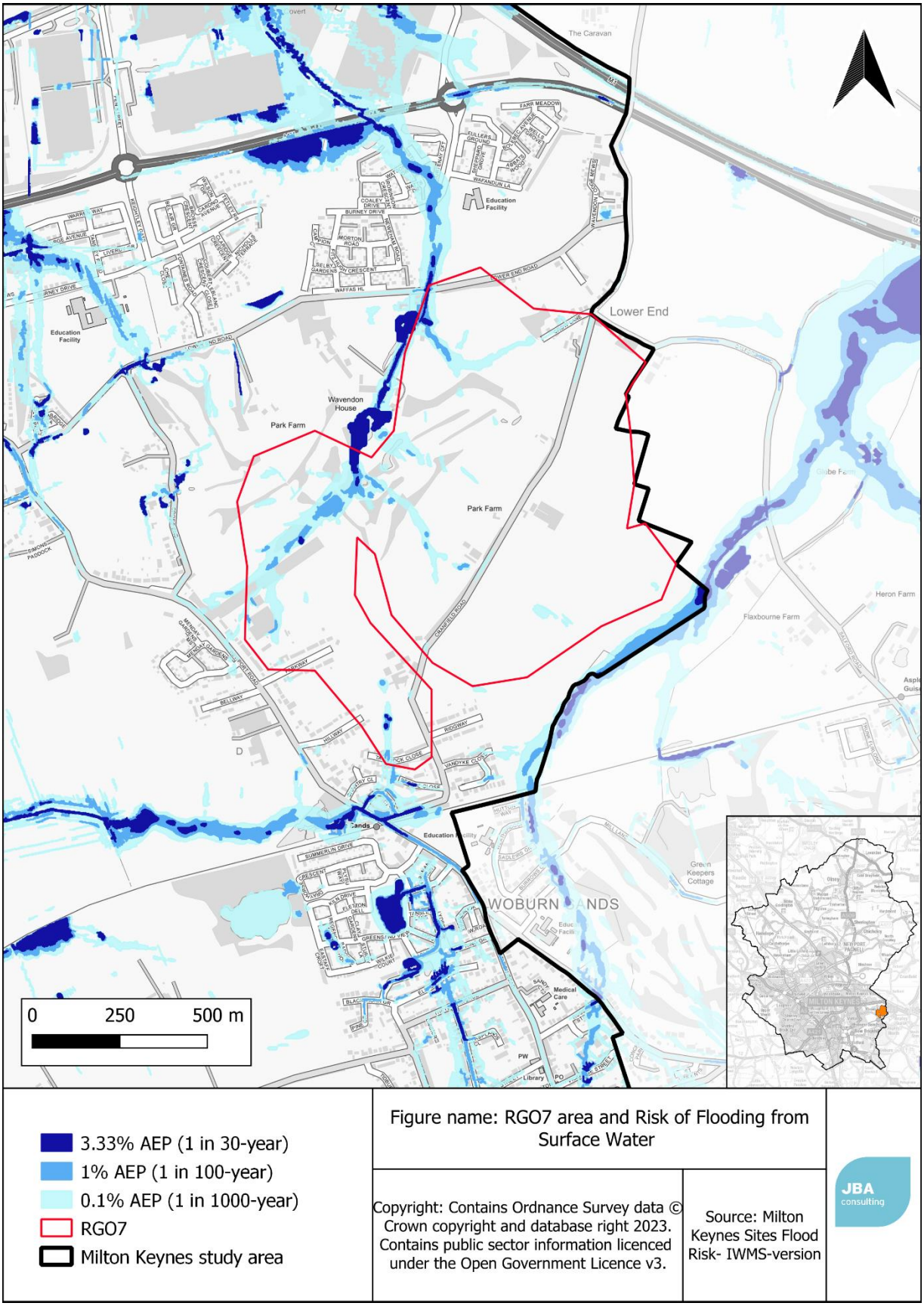


Figure 11.23 Environment Agency at Risk of Flooding from Surface Water mapping in comparison to RGO7.

B.9.4 SuDS

With higher density development (100 DPH) there is less space for above ground SuDS options such as rainwater harvesting (RwH), swales, and rain gardens. Further consideration is therefore required into how surface water may be managed at this housing density. This could mean more permeable paving, soakaways, below-ground storage and rainwater harvesting being implemented. Where flow paths are prominent across the RGO, there is a possibility for SuDS features such as swales to manage surface water. These should be planned in at the master planning stage to maximise their potential.

Where a development density of 35 to 50 DPH, a mixture of above and below ground SuDS could be implemented.

The British Geological Society (BGS) mapping shows that the site lies on a bedrock geology of mudstone, siltstone and sandstone, and soils have slightly impeded draining loamy and clayey soils. This means that infiltration SuDS may not be applicable to this site.

B.9.5 Water resources

RGO5 is covered by Ruthamford Central WRZ which has no internal water resources and relies on imports from neighbouring WRZs (Ruthamford South and Ruthamford North). From a water resources perspective, it is the overall level of growth and consequently water demand that is important, and not the location. It is not therefore possible to assess the site individually. A cumulative assessment is contained in section 0.

Water demand on the site could be reduced by making use of Rainwater Harvesting (RwH) to provide non-potable water for use in toilet flushing, washing machines and garden irrigation. With a lower density of dwellings there could be more space for storage of rainwater, and a lower demand. Whereas a higher density would have less storage space, with a higher demand. There may also be a lower ratio of roof space to population providing less opportunities for collection in the high-density scenario. Therefore, RwH would be better suited to a lower density of dwellings when used as a water resource.

B.9.6 Water Recycling

The sewerage undertaker for RGO7 is Anglian Water and it is anticipated that the site would be served by Cotton Valley Water Recycling Centre (WRC). Figure 11.24 shows a comparison of predicted wastewater discharge from Cotton Valley WRC to its permit limit under the three housing density scenarios. There is considerable headroom at this WRC, even after planned growth is factored in, suggesting that Cotton Valley WRC could accommodate several RGOs within its catchment. Section 0 contains a cumulative assessment of the RGOs that would be served by Cotton Valley WRC.

Table 11.21 shows the remaining capacity (number of dwellings) in each scenario.

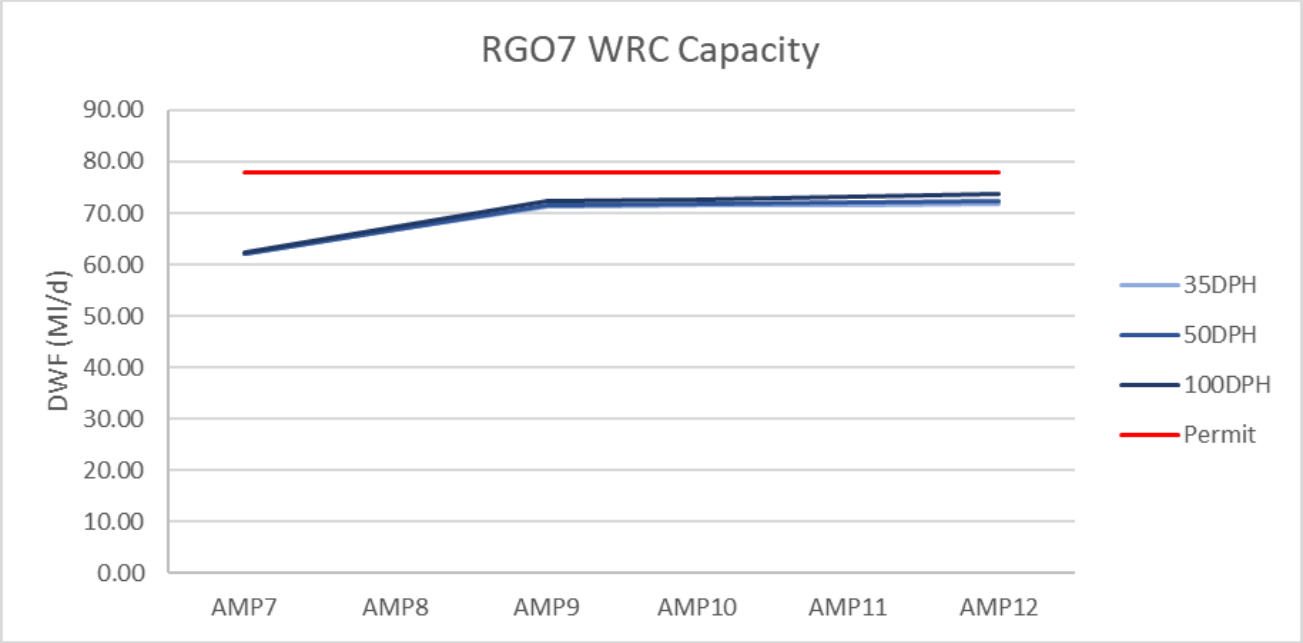


Figure 11.24 Capacity assessment of Cotton Valley WRC

Table 11.21 WRC capacity assessment for RGO5 at all three DPH growth densities.

DPH	Estimated spare hydraulic capacity (number of dwellings)
35	24,762
50	22,978
100	17,030

B.9.7 Water quality

RGO7 falls into the catchment of Chicheley Brook, see WFD status below, see Table 11.22.

Table 11.22 WFD status for Chicheley Brook.

Ecological	Physio-chemical quality elements	Chemical
Poor	Moderate	Does not require assessment

Based on results from the Water Quality sensitivity analysis undertaken as part of the Phase 1 IWMS, there is a moderate deterioration (<10%) in ammonia, BOD and phosphate concentrations at Cotton Valley WRC outfall as a result of a 10% increase in flow at all treatment works within the study area. Within the Ouse (Newport Pagnell to Roxton) catchment, there is deterioration along the entire reach upstream and downstream of Cotton Valley WRC.

At Cotton Valley there is an increase in concentration of each determinand at the outfall from the WRC, however concentrations continue to decrease further downstream of the treatment works. Whilst concentrations decrease downstream, there is moderate deterioration in BOD downstream to Emberton, and in phosphate and ammonia downstream to Olney WRC and beyond as a result of additional flow at WRCs in the study area.

It is proposed to assess the impact of TAL improvements on effluent treatment at WRCs at Stage 2.

B.9.8 Odour

Cotton Valley WRC is 4.9 km to the northwest of RGO7. Nuisance odour is unlikely to be an issue.

B.9.9 Summary

- RGO7 has a small area at risk of flooding (7.5%).
- An initial desk study of the site geology indicates that infiltration SuDS may not be appropriate on this site.
- There is a large amount of capacity at any of the DPH growth scenarios within the existing permit for Cotton Valley WRC.
- The waterbodies immediately downstream of Cotton Valley WRC have a moderate status for Ecological and physio-chemical quality elements.
- Not at risk of nuisance odour.

B.10 RGO8 East of Fenny Stratford: Summary

B.10.1 Location and description

Figure 11.25 shows the location of RGO8, East of Fenny Stratford. The RGO is currently greenfield, to the south is the boundary of the MKCCs local authority area. To the west is the A4146 and Brickhill Road. The A5 crosses through the middle of the RGO as well as commercial buildings adjacent to Watling Street.

B.10.2 Dwelling density

RGO8 has an overall area of 102.8 ha, see Figure 11.25. The area at risk of flooding (based on fluvial Flood Zone 2 or 3, or Surface water flood risk (low, medium or high)) has been removed from the RGOs area, leaving the developable area. 8.5% of the site (8.8 ha) was excluded leaving a developable area of 94 ha.

The resulting estimated housing capacity once the developable area is taken into account is shown in Table 11.23.

Table 11.23 Housing capacity of RGO8

Overall developable area (ha)	No. dwellings at 35 DPH	No. dwellings at 50 DPH	No. dwellings at 100 DPH
94	3,290	4,700	9,400

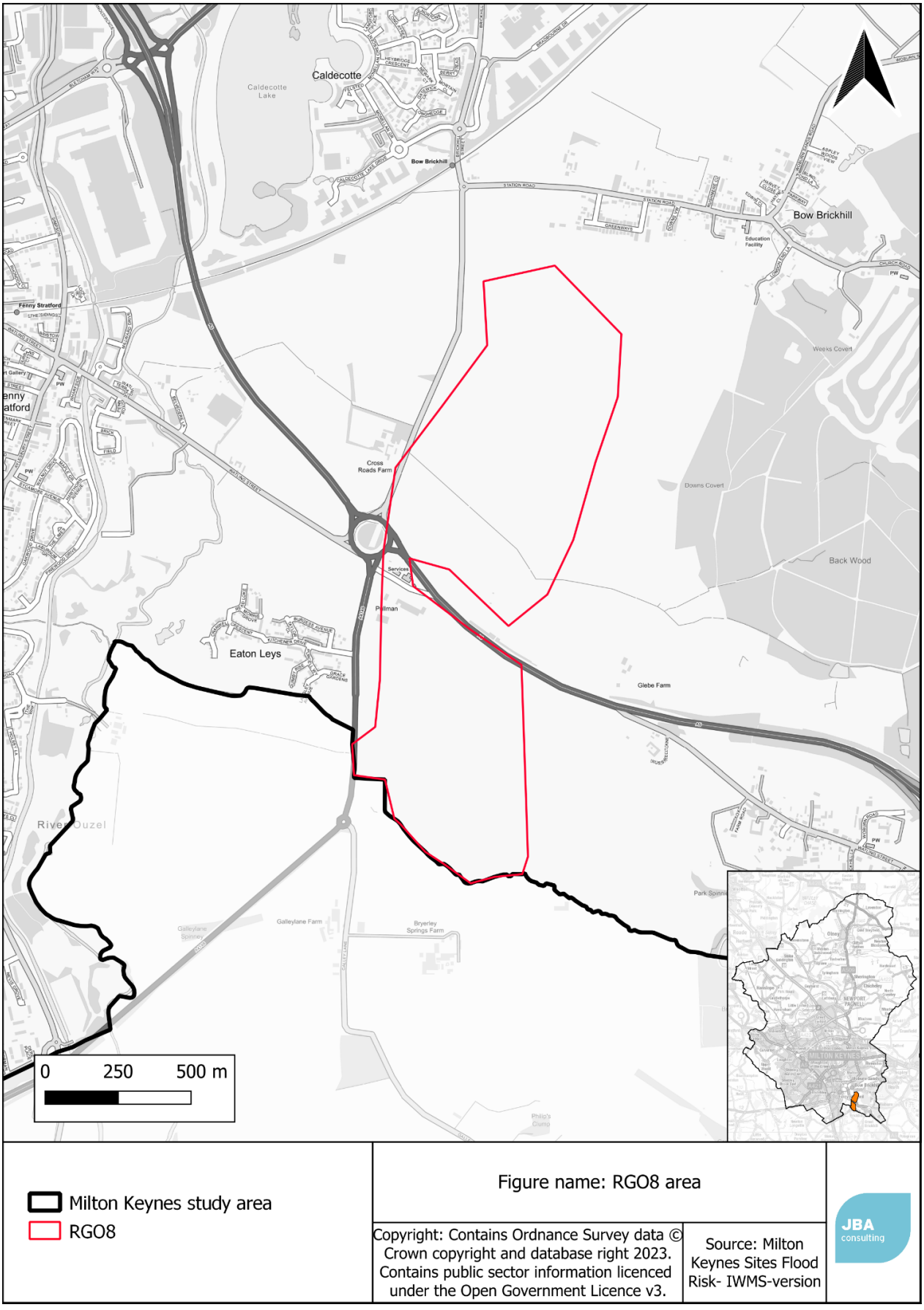


Figure 11.25 Location of RGO8, East of Fenny Stratford.

B.10.3 Flood risk

Fluvial and surface water flood risk have been considered. A more detailed assessment of these, and other sources of flood risk will be included as part of the SFRA. None of RGO8 falls into modelled fluvial extents.

A tributary of the River Ouzel runs through the centre of RGO8 and is represented in the Risk of Flooding from Surface Water mapping. The surface water flood risk is shown in Figure 11.26.

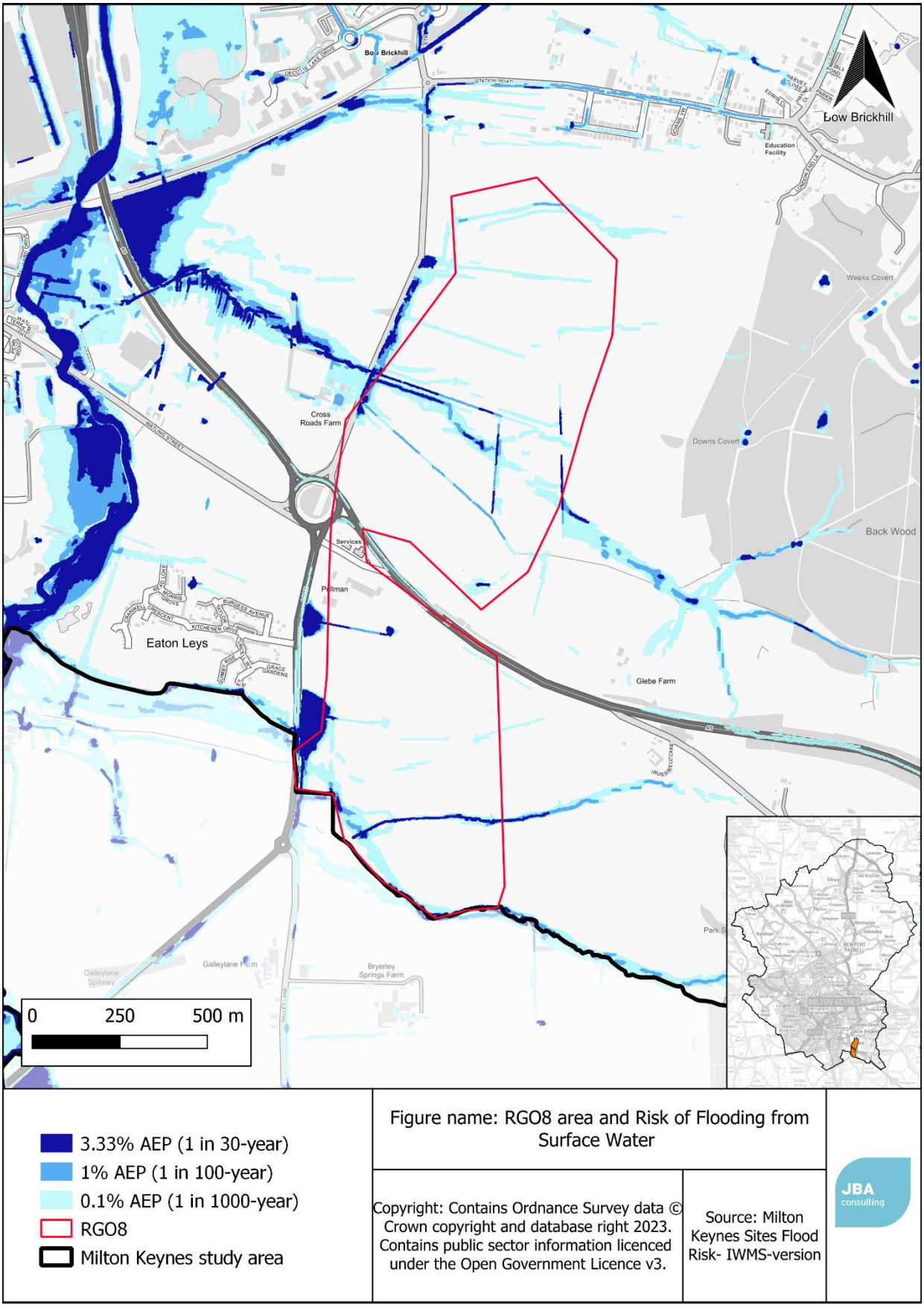


Figure 11.26 Environment Agency at Risk of Flooding from Surface Water mapping in comparison to RGO8.

B.10.4 SuDS

With higher density development (100 DPH) there is less space for above ground SuDS options such as rainwater harvesting (RwH), swales, and rain gardens. Further consideration is therefore required into how surface water may be managed at this housing density. This could mean more permeable paving, soakaways, below-ground storage and rainwater harvesting being implemented. Where flow paths are prominent across the RGO, there is a possibility for SuDS features such as swales to manage surface water. These should be planned in at the master planning stage to maximise their potential.

Where a development density of 35 to 50 DPH, a mixture of above and below ground SuDS could be implemented.

The British Geological Society (BGS) mapping shows that the site lies on a bedrock geology of mudstone, siltstone and sandstone, and soils have slightly impeded draining loamy and clayey soils. This means that infiltration SuDS may not be applicable to this site.

B.10.5 Water resources

RGO8 is covered by Ruthamford Central WRZ which has no internal water resources and relies on imports from neighbouring WRZs (Ruthamford South and Ruthamford North). From a water resources perspective, it is the overall level of growth and consequently water demand that is important, and not the location. It is not therefore possible to assess the site individually. A cumulative assessment is included in section 0.

Water demand on the site could be reduced by making use of Rainwater Harvesting (RwH) to provide non-potable water for use in toilet flushing, washing machines and garden irrigation. With a lower density of dwellings there could be more space for storage of rainwater, and a lower demand. Whereas a higher density would have less storage space, with a higher demand. There may also be a lower ratio of roof space to population providing less opportunities for collection in the high-density scenario. Therefore, RwH would be better suited to a lower density of dwellings when used as a water resource.

B.10.6 Water Recycling

The sewerage undertaker for RGO8 is Anglian Water and it is anticipated that the site would be served by Cotton Valley Water Recycling Centre (WRC). Figure 11.27 shows a comparison of predicted wastewater discharge from Cotton Valley WRC to its permit limit under the three housing density scenarios. There is considerable headroom at this WRC, even after planned growth is factored in, suggesting that Cotton Valley WRC could accommodate several RGOs within its catchment. Section 10 contains a cumulative assessment of the RGOs that would be served by Cotton Valley WRC.

Table 11.24 shows the remaining capacity (number of dwellings) in each scenario.

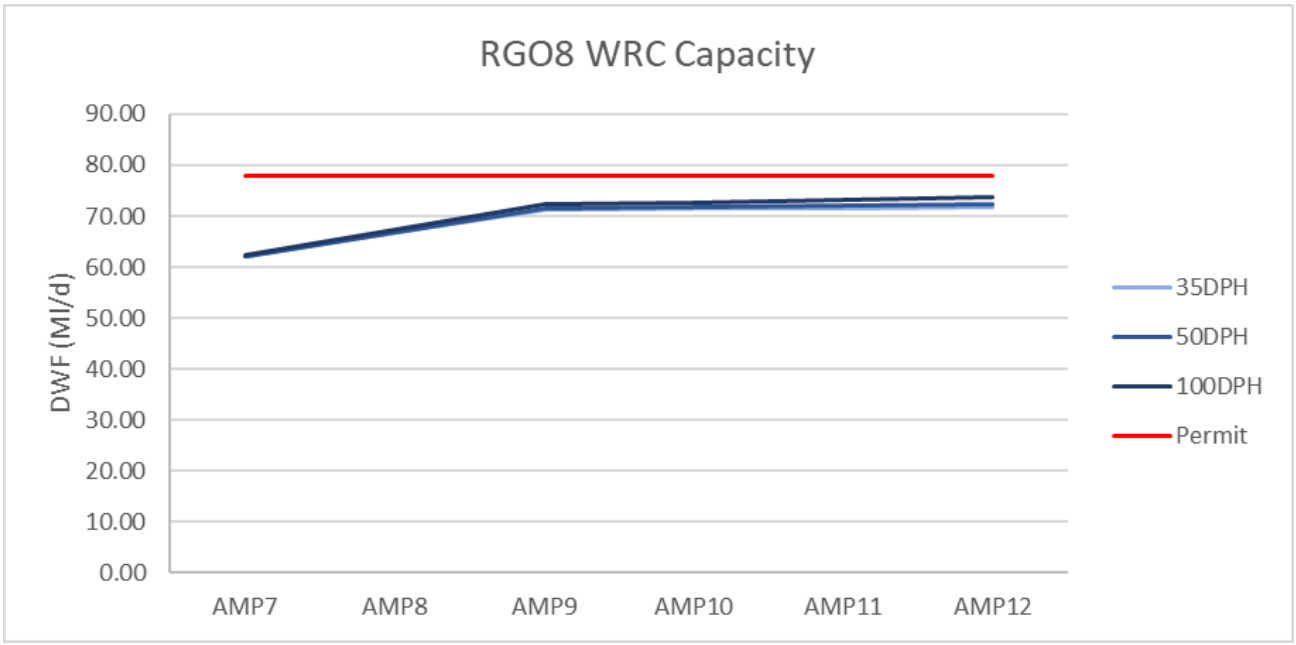


Figure 11.27 Capacity assessment of Cotton Valley WRC

Table 11.24 WRC capacity assessment for RGO8 at all three DPH growth densities.

DPH	Estimated spare hydraulic capacity (number of dwellings)
35	24,762
50	22,978
100	17,030

B.10.7 Water quality

RGO8 falls into the catchment of Ouzel upstream of Caldicote Mill, see WFD status below, Table 11.25.

Table 11.25 WFD status for Chicheley Brook.

Ecological	Physio-chemical quality elements	Chemical
Moderate	Moderate	Does not require assessment

Based on results from the Water Quality sensitivity analysis undertaken as part of the Phase 1 IWMS, there is a moderate deterioration (<10%) in ammonia, BOD and phosphate concentrations at Cotton Valley WRC outfall as a result of a 10% increase in flow at all treatment works within the study area. Within the Ouse (Newport Pagnell to Roxton) catchment, there is deterioration along the entire reach upstream and downstream of Cotton Valley WRC.

At Cotton Valley there is an increase in concentration of each determinand at the outfall from the WRC, however concentrations continue to decrease further downstream of the treatment works. Whilst concentrations decrease downstream, there is moderate deterioration in BOD downstream to Emberton, and in phosphate and ammonia downstream to Olney WRC and beyond as a result of additional flow at WRCs in the study area.

It is proposed to assess the impact of TAL improvements on effluent treatment at WRCs at Stage 2.

B.10.8 Odour

Cotton Valley WRC is 6.4 km to the north of RGO8. Nuisance odour is unlikely to be an issue.

B.10.9 Summary

- RGO8 has a small area at risk of flooding (8.5%).
- An initial desk study of the site geology indicates that infiltration SuDS may not be appropriate on this site.
- There is a large amount of capacity at any of the DPH growth scenarios within the existing permit for Cotton Valley WRC.
- The waterbodies immediately downstream of Cotton Valley WRC have a moderate status for Ecological and physio-chemical quality elements.
- Not at risk of nuisance odour.

B.11 Cumulative Growth

B.11.1 Introduction

It is likely that several RGOs would be needed to serve the housing need in Milton Keynes. Many of these would be served by the same water and wastewater infrastructure and so a cumulative assessment is required. RGO1 and RGO2 are expected to be served by Olney WRC and RGO3 to RGO8 are expected to be served by Cotton Valley WRC. This section contains an assessment of water resources and wastewater treatment capacity should every RGO be built.

B.11.2 Location and description

Figure 11.28 and Figure 11.29 show the location of RGOs served by Olney and Cotton Valley WRCs. The descriptions of individual RGOs can be found in the sections B.3 to 0.

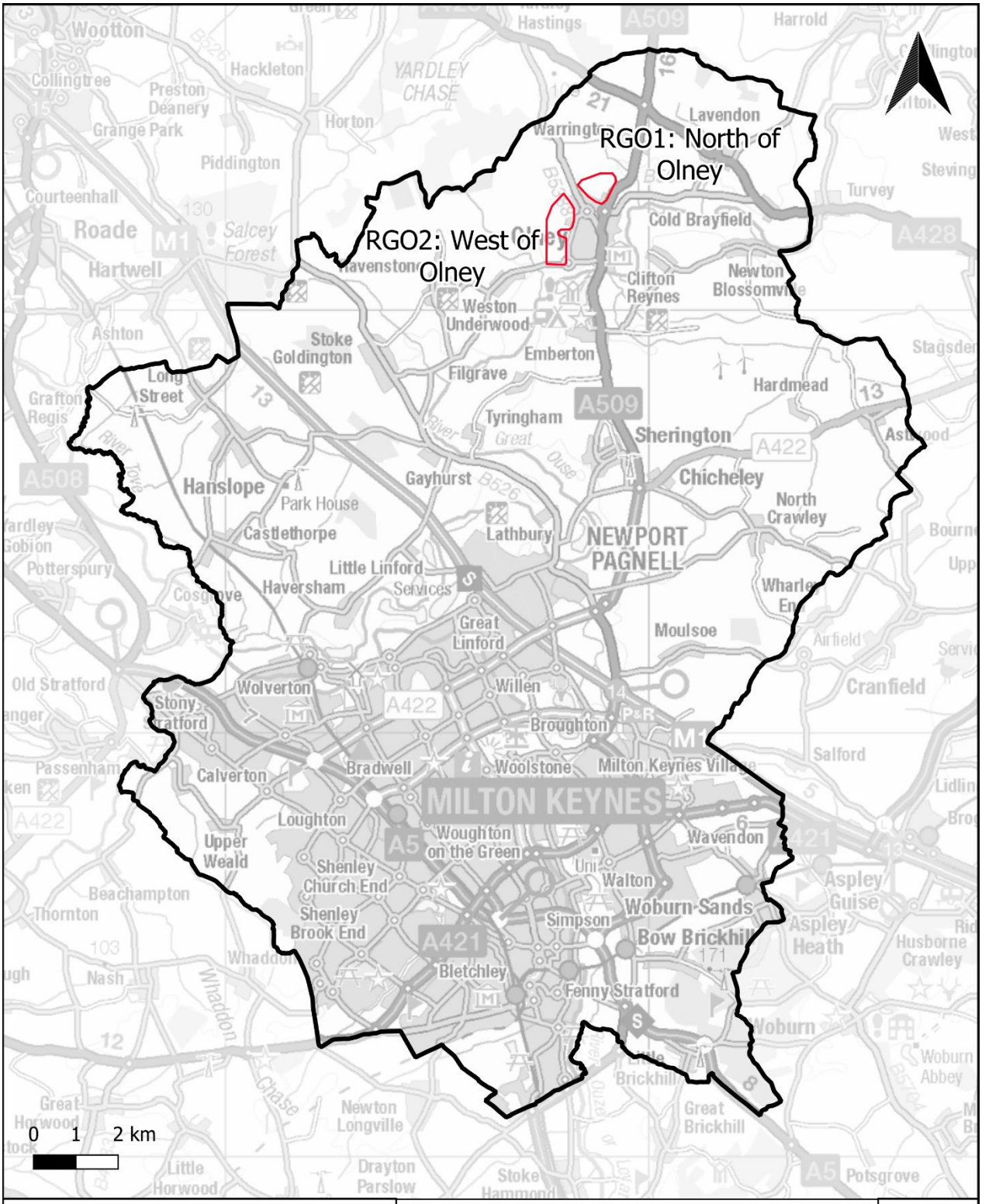


Figure 11.28 RGOs served by Olney WRC

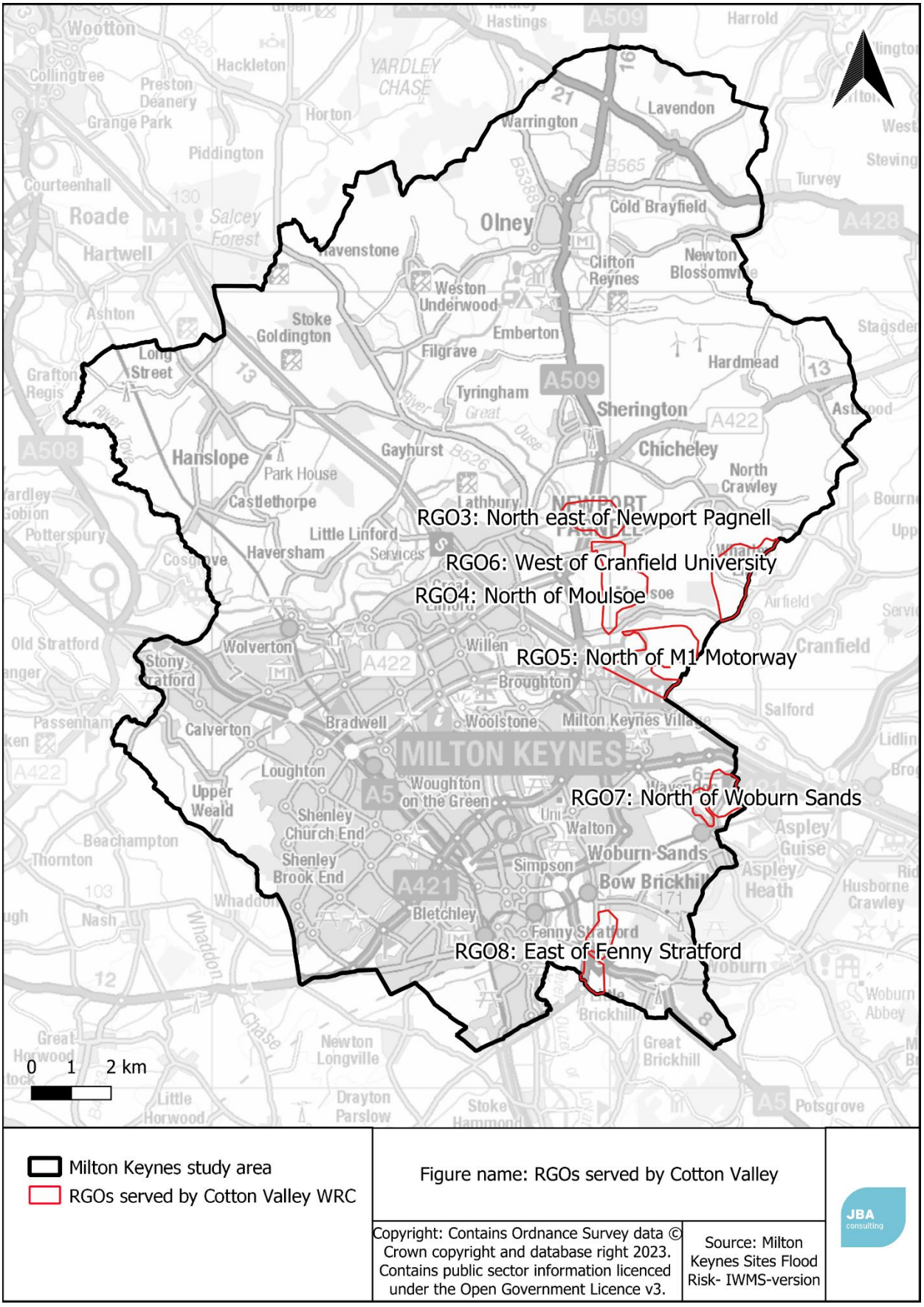


Figure 11.29 RGOs served by Cotton Valley WRC

B.11.3 Dwelling density

The resulting estimated housing capacity across all RGOs once the developable area is taken into account is shown in Table 11.26.

Table 11.26 Housing capacity of cumulative RGOs

WRC	No. dwellings at 35 DPH	No. dwellings at 50 DPH	No. dwellings at 100 DPH
Olney WRC	4,060	5,800	11,600
Cotton Valley WRC	25,410	36,300	72,600
Total	29,470	42,100	84,200

B.11.4 Water resources

All RGOs are covered by Ruthamford Central WRZ which has no internal water resources and relies on imports from neighbouring WRZs (Ruthamford South and Ruthamford North).

Anglian Water have included a growth estimate of 26,244 dwellings in Milton Keynes between 2022 and 2035 in their current water resource planning. Before RGOs are taken into account, existing commitments and allocations within the current Milton Keynes Local Plan (up to 2031) would result in an additional 28,402 dwellings. This is broadly in line with the growth that AW have accounted for. Growth from any of the RGOs would therefore above that which has been included in AW's water resources planning should they be delivered before 2035. The WRMP24 planning tables forecast growth of approximately 58,800 dwellings up to 2050 (based on 80% of demand from Ruthamford Central WRZ coming from Milton Keynes). This is broadly in-line with the growth that would result from the 35DPH scenario if all RGOs were developed. The 50DPH and 100DPH scenarios would result in growth above that which has been factored into the WRMP24.

Table 11.27 Water resources growth forecasts

Forecast	Growth up to 2035 (dwellings)	2050 (dwellings)	Notes
Anglian Water	26,244	58,800	2050 figure is based on 80% of Ruthamford Central demand being from MK
MK	28,402	57,872 (35DPH) 70,502 (50DPH) 112,602 (100DPH)	Growth within Ruthamford Central WRZ

B.11.5 Water Recycling

Figure 11.30 shows the impact of both RGO1 and RGO2 on capacity at Olney WRC. It can be seen that there is minimal capacity at this WRC to accommodate even part of one of the

RGOs without an increase to its permit limit early. Taking into account existing commitments, it is estimated that a further 1,069 dwellings could be built before the permit limit was met (based on 80th exceedance percentile).

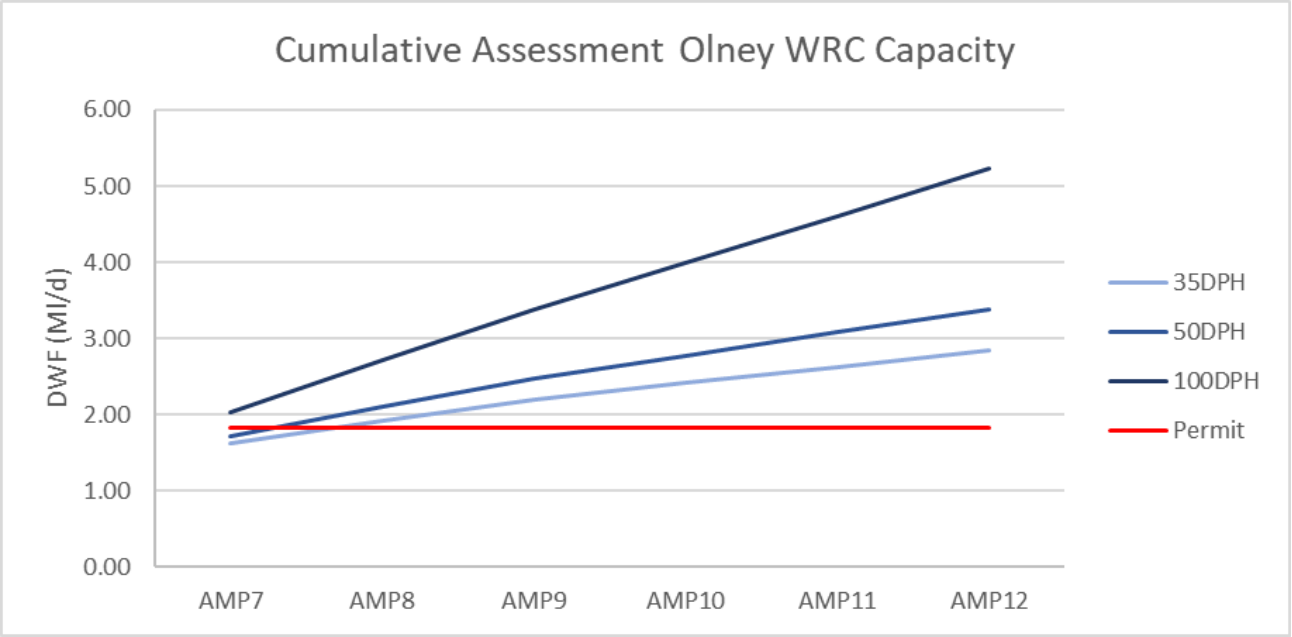


Figure 11.30 Cumulative impact of RGOs at Olney WRC

Figure 11.31 shows the cumulative impact of RGO3 to RGO8 on Cotton Valley WRC. Cotton Valley has substantial head room, approximately 29,000 dwellings once existing commitments and neighbouring authority growth is taken into account. This would allow multiple RGOs to be built before the permit limit was reached in the 35DPH and 50DPH scenarios.

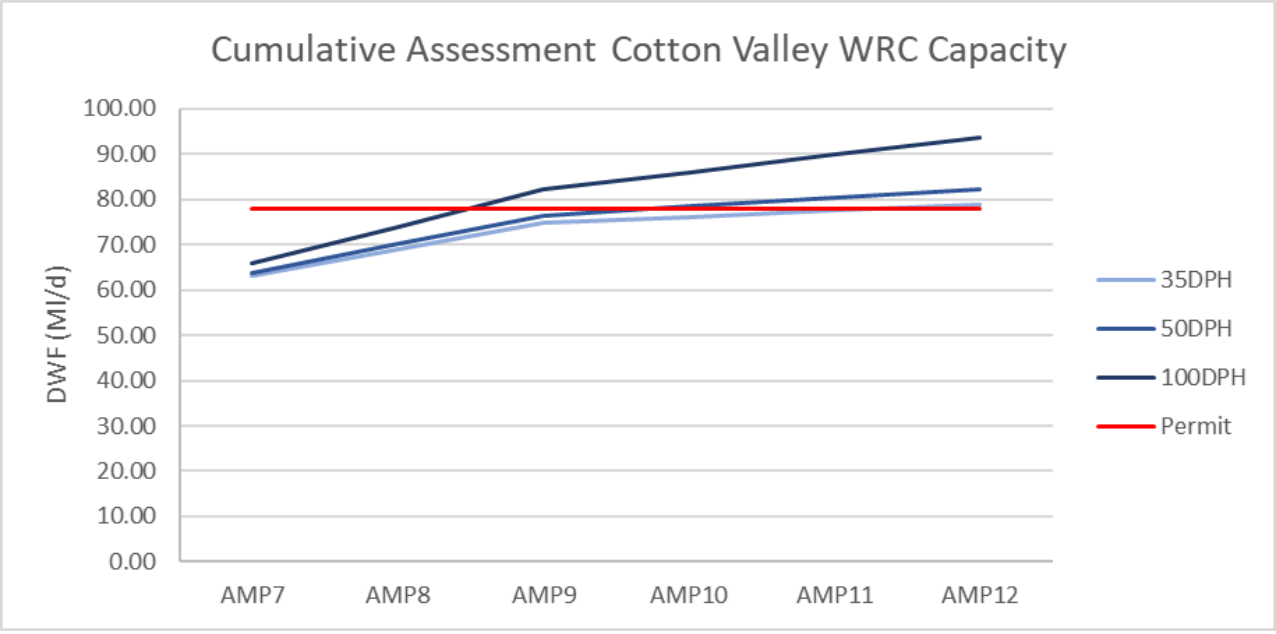


Figure 11.31 Cumulative impact of RGOs at Cotton Valley WRC

B.12 Conclusion

An analysis of the eight RGOs was carried out both individually, and as a cumulative impact on water and wastewater infrastructure. RGOs around Olney (RGO1 and RGO2) would require an increase in the permit limit at Olney WRC in order for either of them to be built to capacity. RGO3 to RGO8 are expected to be served by Cotton Valley WRC. There is considerable headroom at this WRC, which would allow several RGOs to be developed before an increase in the flow permit was required.

While producing their latest Water Resource Management Plan (WRMP24) Anglian Water have accounted for 26,244 dwellings up to 2035, and approximately 58,800 up to 2050. Up to 2035 this is broadly in line with the growth planned by Milton Keynes based on existing commitments and the current Local Plan covering the period up to 2031. Beyond 2035, RGOs developed using the 35DPH scenario would result in a level of growth in line with AW's WRMP24.

Some of the RGOs have areas of flood risk which should be investigated in a Level 2 SFRA should they be taken forward. Sites should be planed sequentially and opportunities should be taken to incorporate SuDS at the master planning stage to maximise the potential benefits and help manage surface water across the site.

C Appendix C Groundwater Dependent Terrestrial Ecosystems

GWDTE name	Groundwater name	SWMI Y/N
Badby Wood (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Baynhall Meadow (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Bittell Reservoirs (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Bosworth Mill Meadow (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Brandon Marsh (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Bugbrooke Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Calcutt Locks Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Cave's Inn Pits (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Cooksholme Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Dagnell End Meadow (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Dean Brook Valley Pastures (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Dormston Church Meadow (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Draycote Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Drybank Meadow, Cherington (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Foster's Green Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Grafton Wood (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Great Blaythorn Meadow (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Herald Way Marsh (SSSI)	Avon Warwickshire - Secondary Mudrocks	No

GWDTE name	Groundwater name	SWMI Y/N
Hewell Park Lake (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Ipsley Alders Marsh (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Lobbington Hall Farm Meadow (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Long Meadow, Thorn (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Lower Saleway Farm Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Loxley Church Meadow (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Merriman's Hill Farm Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Midsummer Meadow (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Misterton Marshes (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Naunton Court Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Oak Tree Farm Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Portway Farm Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Racecourse Meadow (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Railway Meadow, Langley (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Rectory Farm Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
River Itchen (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Rookery Cottage Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Salt Meadow, Earl's Common (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Sherbourne Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Stock Wood Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Tiddesley Wood (SSSI)	Avon Warwickshire - Secondary	No

GWDTE name	Groundwater name	SWMI Y/N
	Mudrocks	
Trickses Hole (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Ullenhall Meadows (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Welford Field (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Whichford Wood (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Wylde Moor, Feckenham (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Yellow House Meadow (SSSI)	Avon Warwickshire - Secondary Mudrocks	No
Bestmoor (SSSI)	Banbury Jurassic	No
Cam Washes (SSSI)	Cam and Ely Ouse Woburn Sands	Yes
Delph Bridge Drain (SSSI)	Cam and Ely Ouse Woburn Sands	Yes
Wicken Fen (SSSI)	Cam and Ely Ouse Woburn Sands	Yes
Chinnor Hill (SSSI)	Chiltern Chalk Scarp	No
Tring Reservoirs (SSSI)	Chiltern Chalk Scarp	No
Weston Turville Reservoir (SSSI)	Chiltern Chalk Scarp	No
Brasenose Wood & Shotover Hill (SSSI)	Headington Corallian	No
Lye Valley (SSSI)	Headington Corallian	No
Rushbeds Wood & Railway Cutting (SSSI)	Headington Corallian	No
Shabbington Woods Complex (SSSI)	Headington Corallian	No
Sidlings Copse & College Pond (SSSI)	Headington Corallian	No
Alder Wood & Meadow (SSSI)	Nene Mid Lower Jurassic Unit	No
Aldwincle Marsh (SSSI)	Nene Mid Lower Jurassic Unit	No
Badby Wood (SSSI)	Nene Mid Lower Jurassic Unit	No
Birch Spinney & Mawsley Marsh (SSSI)	Nene Mid Lower Jurassic Unit	No
Bozeat Meadow (SSSI)	Nene Mid Lower Jurassic Unit	No
Bulwick Meadows (SSSI)	Nene Mid Lower Jurassic Unit	No
Castor Flood Meadows (SSSI)	Nene Mid Lower Jurassic Unit	No

GWDTE name	Groundwater name	SWMI Y/N
Castor Hanglands (SSSI)	Nene Mid Lower Jurassic Unit	No
Hardwick Lodge Meadow (SSSI)	Nene Mid Lower Jurassic Unit	No
River Ise & Meadows (SSSI)	Nene Mid Lower Jurassic Unit	No
Southfield Farm Marsh (SSSI)	Nene Mid Lower Jurassic Unit	No
Southorpe Paddock (SSSI)	Nene Mid Lower Jurassic Unit	No
Sutton Heath & Bog (SSSI)	Nene Mid Lower Jurassic Unit	No
Upper Nene Valley Gravel Pits (SSSI)	Nene Mid Lower Jurassic Unit	No
Wadenhoe Marsh & Achurch Meadow (SSSI)	Nene Mid Lower Jurassic Unit	No
Wansford Pasture (SSSI)	Nene Mid Lower Jurassic Unit	No
Wollaston Meadows (SSSI)	Nene Mid Lower Jurassic Unit	No
Alder Wood & Meadow (SSSI)	Nene Northampton Sands	No
Aldwincle Marsh (SSSI)	Nene Northampton Sands	No
Sudborough Green Lodge Meadow (SSSI)	Nene Northampton Sands	No
Upper Nene Valley Gravel Pits (SSSI)	Nene Northampton Sands	No
Wadenhoe Marsh & Achurch Meadow (SSSI)	Nene Northampton Sands	No
Castor Flood Meadows (SSSI)	Northampton Sands	No
Castor Hanglands (SSSI)	Northampton Sands	No
Dungee Corner Meadow (SSSI)	Northampton Sands	No
Sutton Heath & Bog (SSSI)	Northampton Sands	No
Titchmarsh Meadow (SSSI)	Northampton Sands	No
Upper Nene Valley Gravel Pits (SSSI)	Northampton Sands	No
Wadenhoe Marsh & Achurch Meadow (SSSI)	Northampton Sands	No
Yardley Chase (SSSI)	Northampton Sands	No
Blagrove Common (SSSI)	Ouse Upper Bedford Chalk	No
Blow's Down (SSSI)	Ouse Upper Bedford Chalk	No
Fancott Woods & Meadows (SSSI)	Ouse Upper Bedford Chalk	No
Galley & Warden Hills (SSSI)	Ouse Upper Bedford Chalk	No
Houghton Regis Marl Lakes (SSSI)	Ouse Upper Bedford Chalk	No
Smithcombe, Sharpenhoe & Sundon Hills (SSSI)	Ouse Upper Bedford Chalk	No
Sundon Chalk Quarry (SSSI)	Ouse Upper Bedford Chalk	No
Bucknell Wood Meadows (SSSI)	Ouse Upper Bedford Principal Oolite 1	No

GWDTE name	Groundwater name	SWMI Y/N
Syresham Marshy Meadows (SSSI)	Ouse Upper Bedford Principal Oolite 1	No
Felmersham Gravel Pits (SSSI)	Ouse Upper Bedford Principal Oolite 2	No
Stevington Marsh (SSSI)	Ouse Upper Bedford Principal Oolite 2	No
Yardley Chase (SSSI)	Ouse Upper Bedford Principal Oolite 2	No
Mill Crook (SSSI)	Ouse Upper Bedford Secondary Oolite	No
Plumpton Pasture (SSSI)	Ouse Upper Bedford Secondary Oolite	No
Flitwick Moor (SSSI)	Ouse Upper Bedford Woburn Sands	Yes
King's Wood & Glebe Meadows, Houghton Conquest (SSSI)	Ouse Upper Bedford Woburn Sands	Yes
Maulden Church Meadow (SSSI)	Ouse Upper Bedford Woburn Sands	Yes
Maulden Wood & Pennyfather's Hills (SSSI)	Ouse Upper Bedford Woburn Sands	Yes
Wavendon Heath Ponds (SSSI)	Ouse Upper Bedford Woburn Sands	Yes
Bonemills Hollow (SSSI)	Welland Limestone Unit A	Yes
Bulwick Meadows (SSSI)	Welland Limestone Unit A	Yes
Empingham Marshy Meadows (SSSI)	Welland Limestone Unit A	Yes
Greetham Meadows (SSSI)	Welland Limestone Unit A	Yes
Porter's Lodge Meadows (SSSI)	Welland Limestone Unit A	Yes
Rutland Water (SSSI)	Welland Limestone Unit A	Yes
Shacklewell Hollow (SSSI)	Welland Limestone Unit A	Yes
Southorpe Meadow (SSSI)	Welland Limestone Unit A	Yes
Southorpe Paddock (SSSI)	Welland Limestone Unit A	Yes
Sutton Heath & Bog (SSSI)	Welland Limestone Unit A	Yes
Tickencote Marsh (SSSI)	Welland Limestone Unit A	Yes
Wansford Pasture (SSSI)	Welland Limestone Unit A	Yes
West, Abbot's & Lound Woods (SSSI)	Welland Limestone Unit A	Yes
Whitewater Valley (SSSI)	Welland Limestone Unit A	Yes
Burley & Rushpit Woods (SSSI)	Welland Lower Jurassic Unit	No
Chater Valley (SSSI)	Welland Lower Jurassic Unit	No

GWDTE name	Groundwater name	SWMI Y/N
Empingham Marshy Meadows (SSSI)	Welland Lower Jurassic Unit	No
Great Bowden Borrowpit (SSSI)	Welland Lower Jurassic Unit	No
Owston Woods (SSSI)	Welland Lower Jurassic Unit	No
Rutland Water (SSSI)	Welland Lower Jurassic Unit	No
Saddington Reservoir (SSSI)	Welland Lower Jurassic Unit	No
Seaton Meadows (SSSI)	Welland Lower Jurassic Unit	No
Shacklewell Hollow (SSSI)	Welland Lower Jurassic Unit	No
Tickencote Marsh (SSSI)	Welland Lower Jurassic Unit	No
Grimsthorpe Park (SSSI)	Welland Mid Jurassic Unit	Yes
Porter's Lodge Meadows (SSSI)	Welland Mid Jurassic Unit	Yes

D Appendix D - Protected sites adjacent to rivers within WRZs serving Milton Keynes

SSSI	Waterbody name	SWMI (Y/N)
Portholme	Alconbury and Brampton Brooks	N
Brampton Racecourse	Alconbury and Brampton Brooks	N
Castor Flood Meadows	Billing Brook	N
Monks Wood and The Odd Quarter	Bury Brook	N
Tebworth Marsh	Clipstone Brook	N
Ouse Washes	Counter Drain (Manea and Welney IDB)	N
Ouse Washes	Counter Drain (Sutton and Mepal IDB incl. Cranbrook Drain)	N
Grafham Water	Diddington Brook	N
Little Paxton Pits	Diddington Brook	N
Brampton Meadow	Ellington Brook	N
Fancott Woods and Meadows	Flit	N
Flitwick Moor	Flit and Ivel Navigation d/s of Shefford	N
Flitwick Moor	Flit and Ivel Navigation d/s of Shefford	N
Bozeat Meadow	Grendon Brook	N

SSSI	Waterbody name	SWMI (Y/N)
Southill Lake and Woods	Ickwell Brook	N
Upper Nene Valley Gravel Pits	Knuston Brook	N
Monks Wood and The Odd Quarter	Middle Level	N
Holme Fen	Middle Level	N
Wiggenhall St. Germans	Middle Level	N
Woodwalton Fen	Middle Level	N
Nene Washes	Middle Level	N
Upper Nene Valley Gravel Pits	Nene - conf Brampton Branch to conf Ise	N
Wollaston Meadows	Nene - conf Brampton Branch to conf Ise	N
Felmersham Gravel Pits	Ouse (Newport Pagnell to Roxton)	N
Stevington Marsh	Ouse (Newport Pagnell to Roxton)	N
St. Neot's Common	Ouse (Roxton to Earith)	N
Berry Fen	Ouse (Roxton to Earith)	N
Portholme	Ouse (Roxton to Earith)	N
Houghton Meadows	Ouse (Roxton to Earith)	N
Ouse Washes	Ouse (Roxton to Earith)	N
Little Paxton Pits	Ouse (Roxton to Earith)	N
Godmanchester Eastside Common	Ouse (Roxton to Earith)	N
Nares Gladley Marsh	Ouzel US Caldecote Mill	N
Mill Crook	Tove (DS Greens Norton)	N

E Appendix E SSSIs downstream of WRCs

Table 11.28 SSSIs in and within 5km of the study area

SSSI Name	Grid reference	Potential hydrological link to waterbody (Y/N)	Downstream of WRC? (Y/N)
Bawsey	TF680194	N	N
Biddenham Pit	TL023503	N	N
Blackborough End Pit	TF669145	N	N
Brampton Wood	TL179701	N	Y
Double Arches Pit	SP935291	N	N
St. Neot's Common	TL182612	Y	Y
Hanger Wood	SP997495	N	Y
Hemingford Grey Meadow	TL291692	N	Y
Grimston Warren Pit	TF673222	N	Y
Grafham Water	TL148680	Y	Y
Howe Park Wood	SP832343	N	N
Hunstanton Park Esker	TF695404	N	N
Little Paxton Wood	TL168636	Y	Y
Berry Fen	TL378745	Y	Y
Snettisham Carstone Quarry	TF685348	N	N
Portholme	TL236708	Y	Y
Marston Thrift	SP972416	N	N
Odell Great Wood	SP958589	N	Y
Perry Woods	TL136664	N	N
Nine Acres Pit	SP939276	N	N
Poker's Pond Meadow	SP879280	N	N
Heacham Brick Pit	TF679364	N	N
Ouse Washes	TL490879	Y	Y
Oxley Mead	SP819348	N	N
Roade Cutting	SP749525	N	N
Setchey	TF632131	Y	Y
Ringstead Downs	TF691400	N	N

SSSI Name	Grid reference	Potential hydrological link to waterbody (Y/N)	Downstream of WRC? (Y/N)
Salcey Forest	SP809510	N	N
Nares Gladley Marsh	SP907277	Y	Y
Mill Crook	SP773463	Y	Y
Houghton Meadows	TL293716	Y	Y
Stevington Marsh	SP985551	Y	Y
Bozeat Meadow	SP901590	N	Y
Wavendon Heath Ponds	SP931337	N	N
Wiggenhall St. Germans	TF588138	Y	Y
Whittlewood Forest	SP701432	N	Y
Kings and Bakers Wood and Heaths	SP924296	N	N
Yardley Chase	SP857541	N	N
Hunstanton Cliffs	TF675420	Y	N
North Norfolk Coast	TF891452	Y	N
Little Paxton Pits	TL199637	Y	N
The Wash	TF537402	Y	Y
Roydon Common	TF686224	N	N
Dersingham Bog	TF673288	Y	N
River Nar	TF834169	Y	Y
Godmanchester Eastside Common	TL269713	N	N
Leziate, Sugar and Derby Fens	TF703201	Y	Y

Table 11.29 Ramsar sites within and downstream of the study area

Ramsar Name	Grid reference	Potential hydrological link to waterbody? (Y/N)	Downstream of WRC? (Y/N)
Ouse Washes	TL490879	Y	Y
Upper Nene Valley Gravel Pits	SP971720	Y	N
North Norfolk Coast	TF891452	Y	N
Dersingham Bog	TF673288	Y	N
Roydon Common	TF686224	N	N
The Wash	TF537402	Y	Y

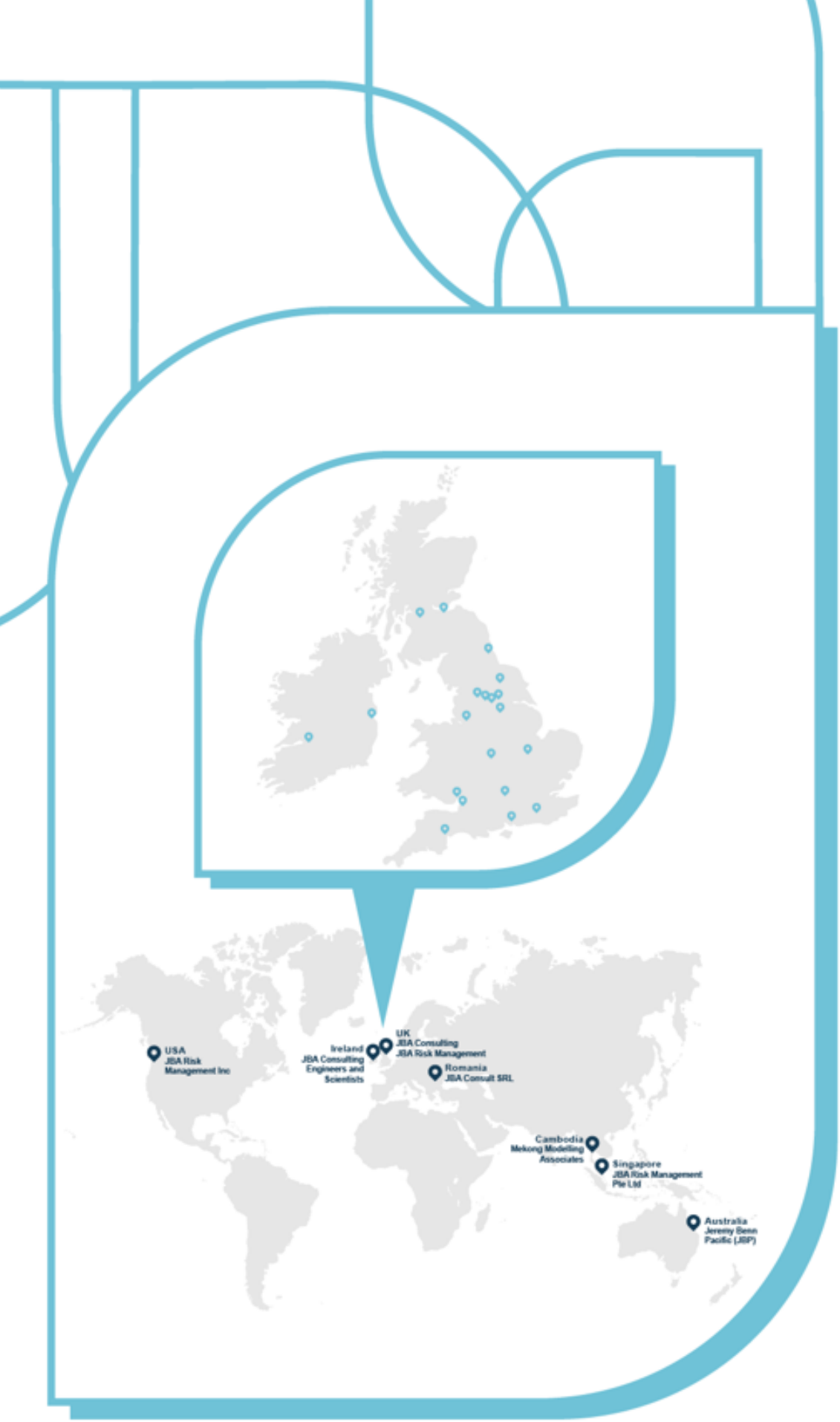
Table 11.30 Special Protection Areas downstream of the study area

SPA Name	Grid reference	Potential hydrological link to waterbody? (Y/N)	Downstream of WRC?
Upper Nene Valley Gravel Pit	UK9020296	Y	N
Greater Wash	UK9020329	Y	Y
Gibraltar Point	UK9008022	Y	N
N Norfolk Coast	UK9009031	Y	N
The Wash	UK9008021	Y	Y
Nene Washes	UK9008031	Y	N
Ouse Washes	UK9008041	Y	Y

Table 11.31 Special Areas of Conservation downstream of the study area

SAC Name	Grid reference	Potential hydrological link to waterbody? (Y/N)	Downstream of WRC? (Y/N)
Baston Fen	UK0030085	Y	N
North Norfolk Coast	UK0019838	Y	N
Portholme	UK0030054	N	Y
Fenland	UK0014782	N	N
Orton Pit	UK0030053	N	N
Barnack Hills & Holes	UK0030031	Y	N
Nene Washes	UK0030222	N	N
Roydon Common & Dersingham Bog	UK0012801	Y	Y
The Wash & North Norfolk Coast	UK0017075	Y	Y
Ouse Washes	UK0013011	Y	Y

F Appendix F Water quality results



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