Greater Cambridge Integrated Water Management Study

Outline Water Cycle Study

On behalf of **Greater Cambridge Shared Planning**

Project Ref: 48444/4006 | Rev: C | Date: August 2021

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For and on behalf of Stantec UK Limited

Revision	Date	Description	Prepared	Reviewed	Approved
A	Jan 2021	First draft for client review	Various	CW	EG
B	Mar 2021	Second draft	Various		EG
C	August 2021	Final	Various	EG	SD
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Contents

Figures & information boxes

Tables

Appendices

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1 Introduction

1.1 Greater Cambridge Integrated Water Management Study

1.1.1 Stantec UK Ltd was commissioned by Greater Cambridge Shared Planning Service (GCSPS) to prepare an Integrated Water Management Study to support the development of the Greater Cambridge Local Plan. The Greater Cambridge area represents South Cambridgeshire District Council and Cambridge City Council (Figure 1-1). The Integrated Water Management Study consists of:

- A Level 1 Strategic Flood Risk Assessment, to support a sequential, risk-based approach to the location of development, required as a standalone document under the National Planning Policy Framework.
- An Outline Water Cycle Study, to identify the baseline / as-existing water situation.
- A Detailed Water Cycle Study, to provide advice on the broad strategy options being considered for the location of growth and the sites coming forward for allocation in the draft Local Plan.

1.1.2 This report comprises the Outline Water Cycle Study. Information from this study has been used to inform the Strategic Flood Risk Assessment and vice versa.

1.1.3 A Strategic Spatial Options Assessment was also published in November 2020. That interim report provided a high-level commentary on the opportunities, constraints and uncertainties for water aspects for the strategic (non-site specific) spatial options being tested by the GCSPS. The report was prepared in advance of completing the main Integrated Water Management Study documents, due to timing of receipt of data and ongoing studies by others. The Strategic Spatial Options Assessment was based upon work which was in progress on the Outline Water Cycle Study. That work in progress is reflected in this report. Both reports reach the same conclusions regarding opportunities, constraints and uncertainties.

1.2 What is Integrated Water Management?

1.2.1 Integrated Water Management is “a collaborative approach to managing land and water that delivers co-ordinated management of water storage, supply, demand, wastewater, flood risk, water quality and the wider environment”[1]. Development can have significant detrimental impacts on all aspects of the water environment and existing infrastructure. By adopting a water cycle approach, consideration of water requirements and impacts early in the

[1] “Delivering Better Water Management through the Planning System”, CIRIA C787A, 2019

planning process can provide multiple benefits and efficiencies, contribute to natural capital, and create more liveable and sustainable places (Figure 1-2).

1.2.2 The objectives of the Greater Cambridge Integrated Water Management Study, as defined by Greater Cambridge Shared Planning Service, are to:

- Provide a robust evidence base to support the development of the Greater Cambridge Local Plan as it progresses through different stages of plan making and through examination.
- Consider the levels of growth being proposed and development strategy options for Greater Cambridge and identify constraints and opportunities in relation to the water environment to be considered, taking into account the challenges of climate change.
- Identify measures that would be required to deliver a sustainable development strategy with regards to water.
- Identify water services infrastructure requirements, including their phasing and costs, to support this development strategy.
- Aid in the development of suitable best practice policies in the Greater Cambridge Local Plan relating to water use, water quality, flooding, sustainable drainage, water efficiency and re-use.

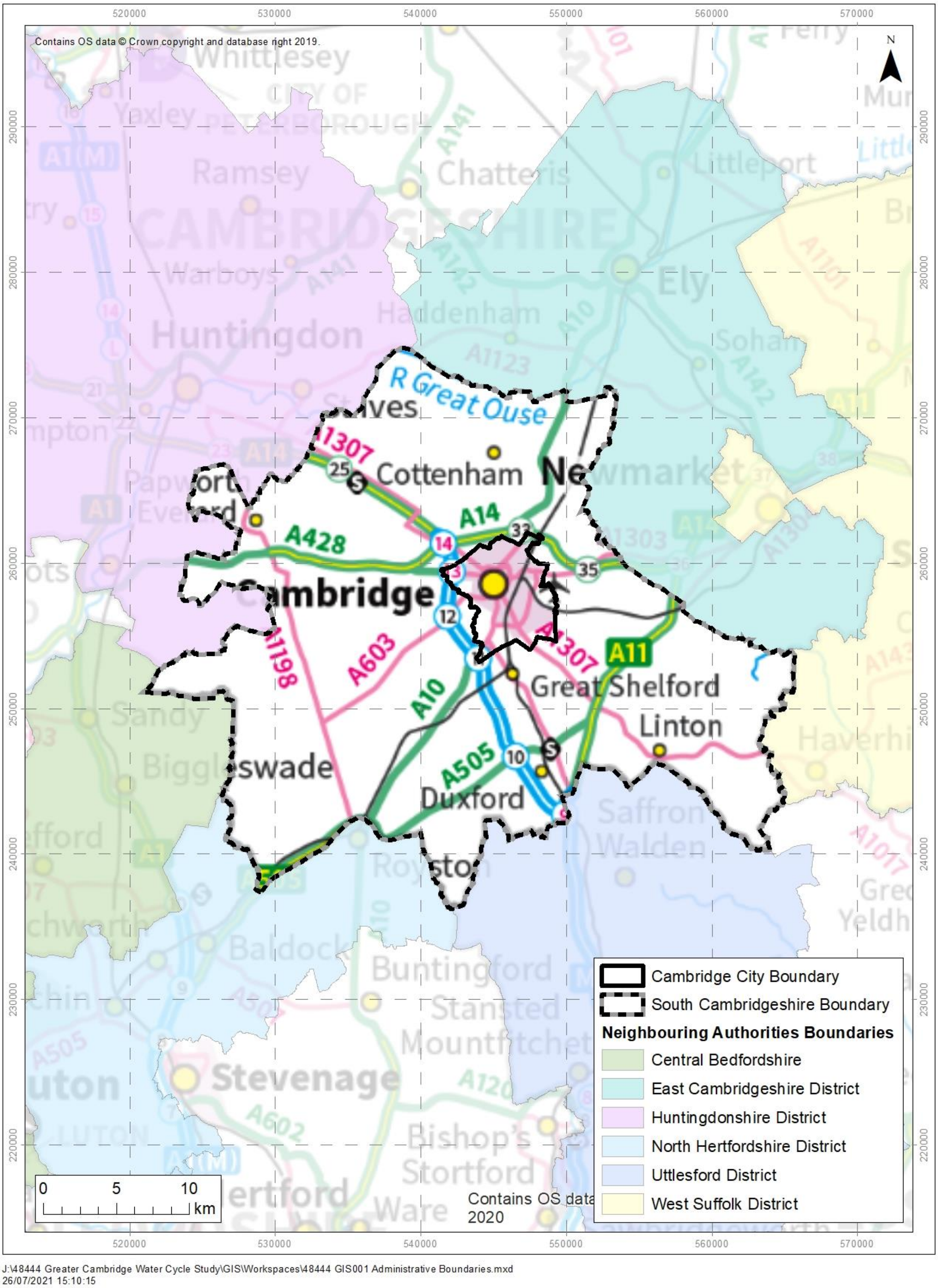

Figure 1-1: The Greater Cambridge study area (South Cambridgeshire and Cambridge City), and Neighbouring Authorities

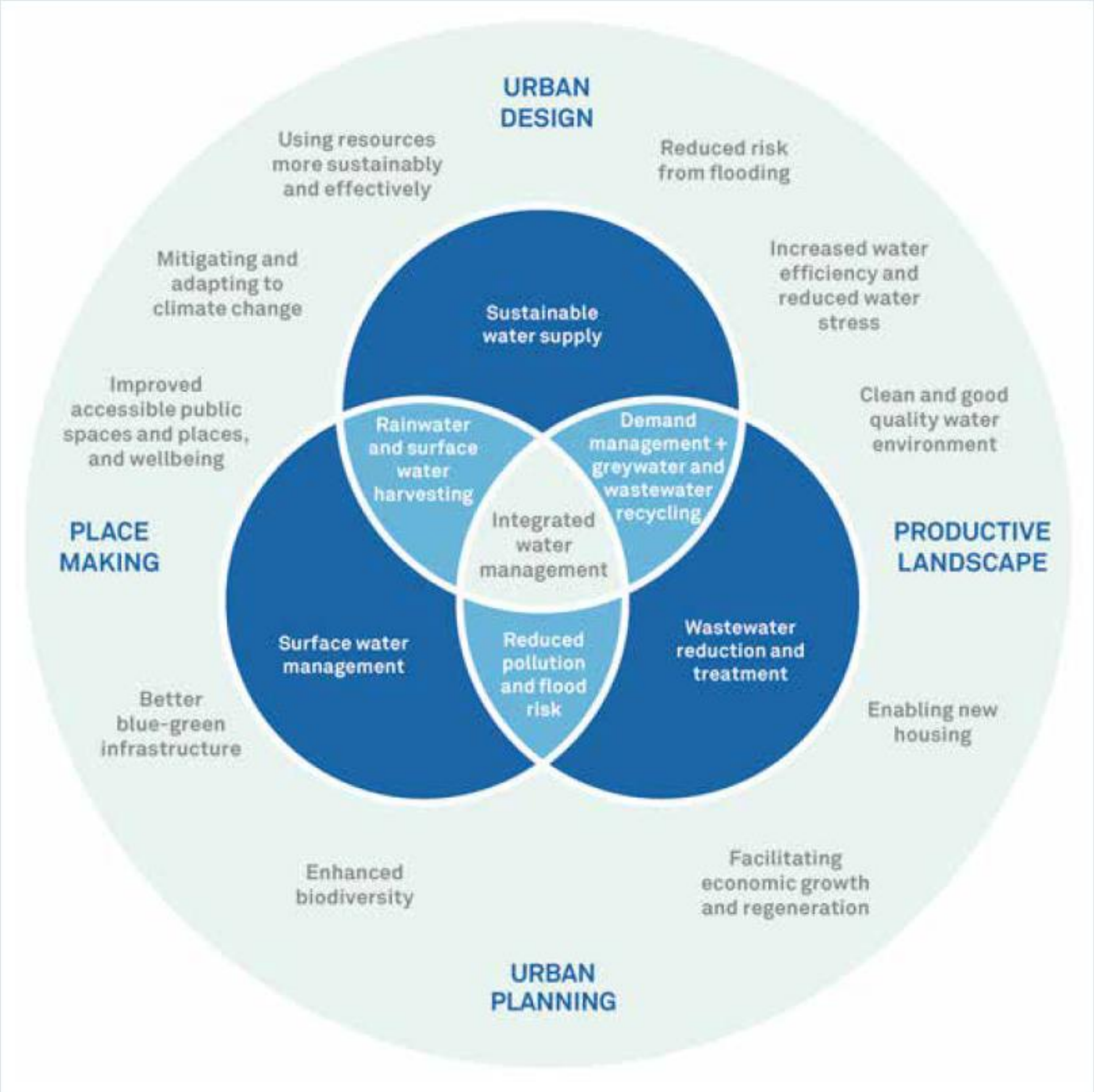

Figure 1-2: The process and benefits of Integrated Water Management, taken from CIRIA C787A (2019)

1.3 Scope of the Outline Water Cycle Study

1.3.1 The scope of this Outline Water Cycle Study is:

- To audit relevant and emerging national planning policy, guidance and other relevant studies and plans.
- To collect and analyse baseline information about the current water system with regards to water resources and supply systems, wastewater and treatment provision and capacity, water quality, and flood risk and surface water management.
- To identify any infrastructure, environmental or geographic constraints on development that should be considered when preparing the draft Local Plan.

1.3.2 This study updates the Phase 1 Outline Water Cycle Strategy prepared for the previous Local Plan in 2008[2].

1.3.3 This outline stage will ultimately be complemented by a detailed stage, that will provide further appraisal of the proposed growth trajectory and specific site allocations. At present, no decision has been made on the scale or location of future development, and therefore this report provides information across Greater Cambridge area.

1.3.4 The structure of the Outline Water Cycle Study is as follows:

- Chapter 2: Study area geographical and hydrological setting.
- Chapter 3: Legislation, policy and guidance context relevant to this study.
- Chapter 4: Water resources and supply baseline conditions, opportunities and constraints for development.
- Chapter 5: Wastewater collection and treatment baseline conditions, opportunities and constraints for development.
- Chapter 6: Water quality baseline conditions, opportunities and constraints for development.
- Chapter 7: Flood risk baseline conditions, opportunities and constraints for development (summary of Level 1 SFRA).
- Chapter 8: Integrated water management opportunities and constraints.
- Chapter 9: Conclusions and recommendations.

[2] "Water Cycle Strategy Phase 1 – Outline Strategy for Major Growth Areas in and around Cambridge", Halcrow Group Limited, 2008

- Chapter 10: An update on the development of detailed Water Cycle Strategy (August 2021)

1.4 Stakeholder Engagement

1.4.1 Water resources in England are managed by a multitude of government departments, independent bodies, local authorities, and private companies, summarised in Table 1-1. In addition, there are numerous other groups and bodies who have an interest in water management and whose activities may influence it.

1.4.2 A stakeholder engagement process was followed to seek information for this study. This engagement process did not constitute a formal consultation process, which will be undertaken as part of the new Local Plan programme. A full list of stakeholders contacted, and responses received, is included in Appendix A.

1.4.3 The bodies ticked in Table 1-1 were considered the primary stakeholder group and were consulted during the preparation of this report to obtain information and guidance for this study and provide comments on the draft report.

1.5 Relationship with other plans

1.5.1 Water management is not static and there are continual updates to guidance and policy, as well as regional and local management plans.

1.5.2 Water Cycle Planning for the Oxford-Cambridge Arc[3] regional growth area is underway and the Greater Cambridge integrated water management study will be a key consideration in its development and vice versa. It is through such regional plans that greatest influence can be had on Government policy regarding matters such as water efficiency.

1.5.3 Timescales for known studies currently being undertaken by others are indicated in Table 1-2. It is recommended that the Outline Water Cycle Study is reviewed by the Local Authorities in consultation with the Environment Agency, private water companies and Water Resources East, every plan making cycle as a minimum, to identify and implement any significant updates necessary as a result of these or other studies, policy or guidance.

[3] Oxford Cambridge Arc

Organisation	Overview of Responsibilities	Key stakeholder
Department of Environment, Food and Rural Affairs (DEFRA)	The government department responsible for policy in the water sector. This includes setting standards, drafting legislation, and creating special permits (e.g. drought orders).	✗
Water Services Regulation Authority (OFWAT)	The economic regulator, responsible for protecting the interests of consumers, and ensuring that water companies properly carry out and finance their functions.	✗
Drinking Water Inspectorate	The public body responsible for regulating drinking water quality, including inspections to confirm water is safe to drink and meets the required standards.	✗
Environment Agency	The non-departmental public body responsible for environmental regulation, and the leading public body responsible for protecting and improving the environment.	✓
Natural England	The non-departmental public body responsible for ensuring that the natural environment, including its land, flora and fauna, freshwater and marine environments, geology and soils, are protected and improved.	✓
Private water companies	Responsible for provision of water supply and sewerage services. In Greater Cambridge, potable water is supplied by Cambridge Water (a subsidiary of South Staffordshire Water), and wastewater services are provided by Anglian Water.	✓
Regional Water Resource Group	Membership group responsible for overseeing strategic regional planning of water resources. Greater Cambridge falls under the Water Resources East group.	✓
Lead Local Flood Authority (LLFA)	Responsible for local flood risk management strategy, flood investigations, consenting and enforcement. In Greater Cambridge, Cambridgeshire County Council are the LLFA.	✓
Internal Drainage Boards (IDBs)	Local public body responsible for flood risk and land drainage in areas of special drainage need	✓

Table 1-1: Overview of key water resource management bodies in Greater Cambridge

Stakeholder	Programme of work	Description	Completion dates
Anglian Water	Drainage and Wastewater Management Plan	Long term strategic plan to maintain and improve wastewater systems and drainage networks	2021: Baseline risk assessment, options development and appraisal Summer 2022: Consultation on draft plan Spring 2023: Final plan published 2024: Determination by Ofwat
Anglian Water	Cambridge Water Recycling Centre Relocation	Development Consent Order (DCO) process for planning application, followed by construction and commissioning	End 2023: DCO granted 2030: Operational
Cambridge Water	Water Resource Management Plan	Long term strategic plan to ensure the balance between water supply and demand is maintained.	Summer 2022: Draft for consultation 2023: Final plan published 2024: Determination by Ofwat
Cambridge Water	Drought Management Plan	Sets out how water resources are managed during dry years to maintain public water supplies and minimise impacts on the environment.	March 2021: Draft for public consultation 2023: Final plan published
Water Resources East	Regional Water Resource Management Plan	Regional long term strategic plan for managing water supply and demand.	Summer 2021: Draft Plan generating a long list of option portfolios that WRE will use in the co-creation Planning Conferences in Autumn 2021 with their members January 2022: Preferred portfolio of options and Draft available for public consultation.
Environment Agency	River Great Ouse Catchment Conveyance and Storage Study	Investigating options for increased flood storage and improved flood conveyance in the River Great Ouse catchment.	2022 – 2024
Environment Agency	Fens Flood Strategy	Investigating options for long term management of water in the Fens	2030

Table 1-2: Timescales for known studies on water resource management in Greater Cambridge being undertaken by others

2 Hydrological Context of Greater Cambridge

2.1 Introduction

2.1.1 This chapter provides an overview of the water environment in the Greater Cambridge area. The area's climate, topography, geology, soils and land use are reviewed. These provide the context for the two main water stores in the area: groundwater and river flows, and the flux of water between these stores.

2.2 Climate

2.2.1 The Greater Cambridge area is one of the driest in the UK, with an average rainfall[4] of only 563 mm per year compared to the UK average of 1154 mm per year. Rainfall is evenly distributed throughout the year (Figure 2-1).

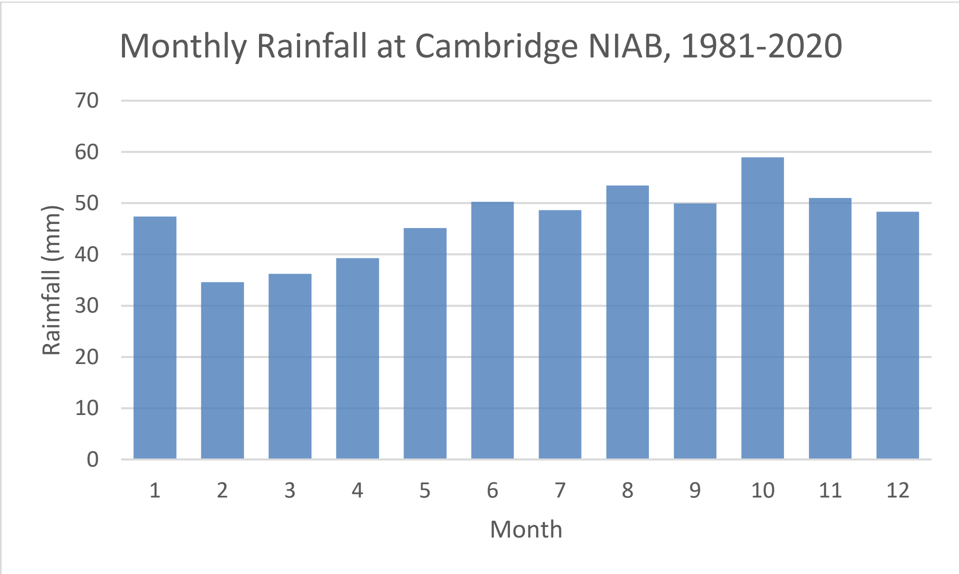

Figure 2-1: Monthly rainfall records at Cambridge NIAB Met Office station, 1981 to 2020

2.2.2 Greater Cambridge also tends to have hot summers (Figure 2-2), and holds the highest temperature record for the UK, 38.7 °C recorded in July 2019 at Cambridge University Botanic Garden. This leads to high rates of potential evapotranspiration (Figure 2-3), which exceed the monthly rainfall from April to September. This means that water stored in soil moisture or standing surface water is rapidly lost to the atmosphere, and the region is vulnerable to drought conditions. Actual evapotranspiration rates are in the order of 430 mm per year, resulting in an average 140 mm of net rainfall per year (approximately 130 million m^3 net rain volume).

2.2.3 The rain that falls in summer months is often in the form of intense convective summer thunderstorms. The high rainfall rate quickly exceeds the absorption

[4] Met Office, Cambridge NIAB station, 1981 – 2020 average.

capacity of soils and can run off over the surface, causing flash flooding. The water rapidly flows out of the catchment and does not replenish the subsurface and groundwater stores that maintain water levels and supplies. This means that Greater Cambridge is dependent on winter rainfall to replenish and maintain subsurface groundwater levels.

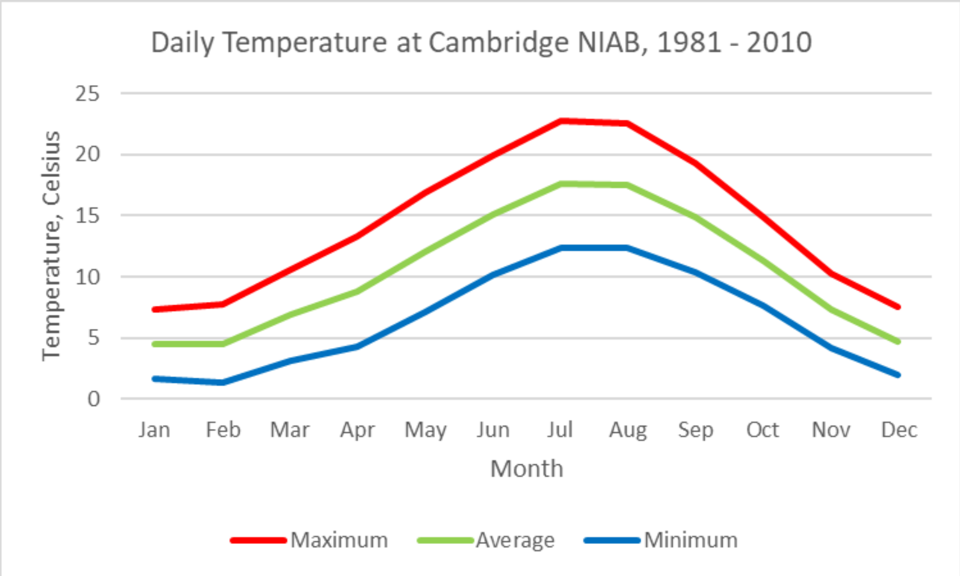

Figure 2-2: Daily temperature records at Cambridge NIAB Met Office station, 1981 to 2010

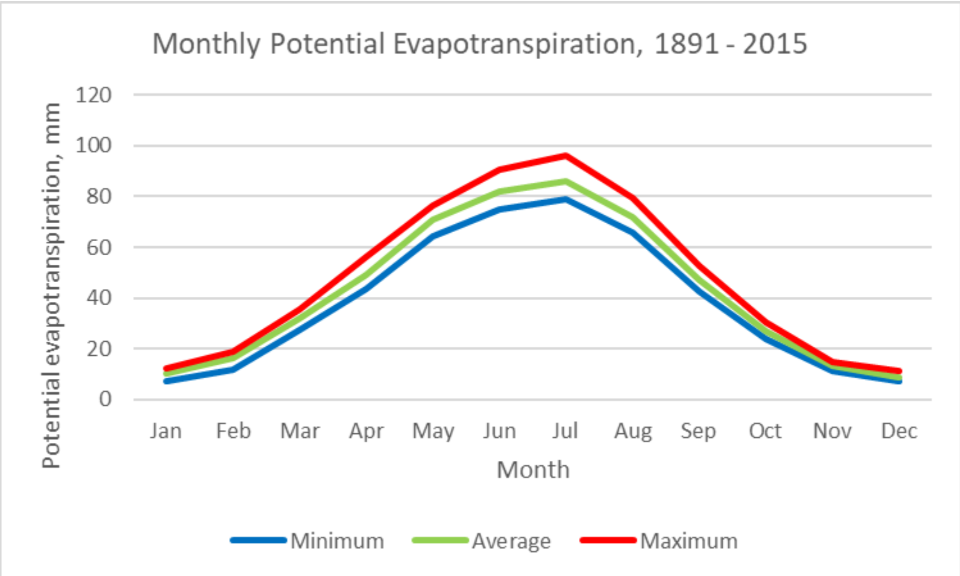

Figure 2-3: Monthly potential evapotranspiration rates (grassland), Cambridge, 1891 - 2015[5]

[5] Robinson, E.L.; Blyth, E.; Clark, D.B.; Comyn-Platt, E.; Finch, J.; Rudd, A.C. (2016). Climate hydrology and ecology research support system potential evapotranspiration

2.3 Geology, Topography, Land Use, and Population

2.3.1 The geology of Greater Cambridge is shown in Figure 2-4 (bedrock) and Figure 2-5 (superficial deposits). The bedrock comprises Grey and White Chalk formations in a band from the south-west of the area to the north-east. These give way to clay formations in the north-west quadrant, interspersed with some smaller areas of sandstone (Lower Greensand). In total, approximately 53% of the area is underlain by the permeable Chalk.

2.3.2 Superficial deposits include Diamicton, sand and gravel river terrace deposits, alluvium and peat. In total, approximately 44% of the Greater Cambridge area has superficial deposits, of which about half are Till.

2.3.3 The topography of Greater Cambridge (Figure 2-6) is strongly influenced by the bedrock geology. Levels vary from highs of +150m AOD in southern and eastern parts where the area overlies the chalk ridge, to lows of less than 0 mAOD (below sea level) in northern parts where the area enters the Fens.

2.3.4 Greater Cambridge is currently mostly agricultural land Grade 2, with some areas categorised Grade 3 (Figure 2-7). Where peat deposits are found, the land is classified as agricultural Grade 1. Approximately 5 percent of the catchment is currently classified as urban land use (Table 2-2).

2.3.5 Although the total percent of urban land use is small, the rate of urbanisation in Greater Cambridge has doubled since the 1950s. The majority of this historic growth has occurred in the rural South Cambridgeshire district (Figure 2-8), partly due to the green belt restrictions around Cambridge itself. The past growth has included new settlements such as Bar Hill (begun late 1950s) and Cambourne (begun late 1990s), as well as infilling and expansion of existing villages. More recently, there has been some release of Green Belt land around Cambridge allowing urban extension developments to the city, for example Eddington and Great Kneighton.

2.3.6 The population in the Greater Cambridgeshire region in mid-2018 is estimated as 294,320 (Cambridgeshire Insights[5]). A further 45,180 homes are planned to be constructed from 2018 in the Greater Cambridge Housing Trajectory and Five Year Housing Land Supply (April 2020), representing known sites based on the 2018 Local Plan and subsequent planning applications. It should be noted that this housing represents total commitments, and some development will take place after 2041 as new towns will still be under construction at that point. Estimated population at 2041 is 365,870 (Cambridgeshire Insights, Figure 2-8), excluding any additional growth that may be allocated in the new Local Plan.

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dataset for Great Britain (1961-2015) [CHESS-PE] . NERC Environmental Information Data Centre. (Dataset). https://doi.org/10.5285/8baf805d-39ce-4dac-b224-c926ada353b7

Layer	Rock type	Area (km^2)	Percentage cover
Bedrock	Gault Clay	223.7	24%
Bedrock	Grey Chalk	235.9	25%
Bedrock	Kellaways Clay	17.0	2%
Bedrock	Lower Greensand	43.4	5%
Bedrock	White Chalk	262.1	28%
Bedrock	West Walton Clay	160.5	17%
Superficial deposits	Alluvium	21.0	2%
Superficial deposits	Glacial sands and gravel	5.0	1%
Superficial deposits	Lacustrine deposits	1.3	0%
Superficial deposits	Peat	31.0	3%
Superficial deposits	River terrace deposits	110.5	12%
Superficial deposits	Sand and gravel (uncertain origin)	9.2	1%
Superficial deposits	Till	240.2	25%

Table 2-1: Geology coverage in Greater Cambridge

Land Classification	Area (km^2)	Percentage cover
Grade 1	17.4	1.8
Grade 2	596.6	63.3
Grade 3	248.5	26.4
Grade 4	15.7	1.7
Non Agricultural	18.7	2.0
Urban	45.5	4.8

Table 2-2: Land classification in Greater Cambridge

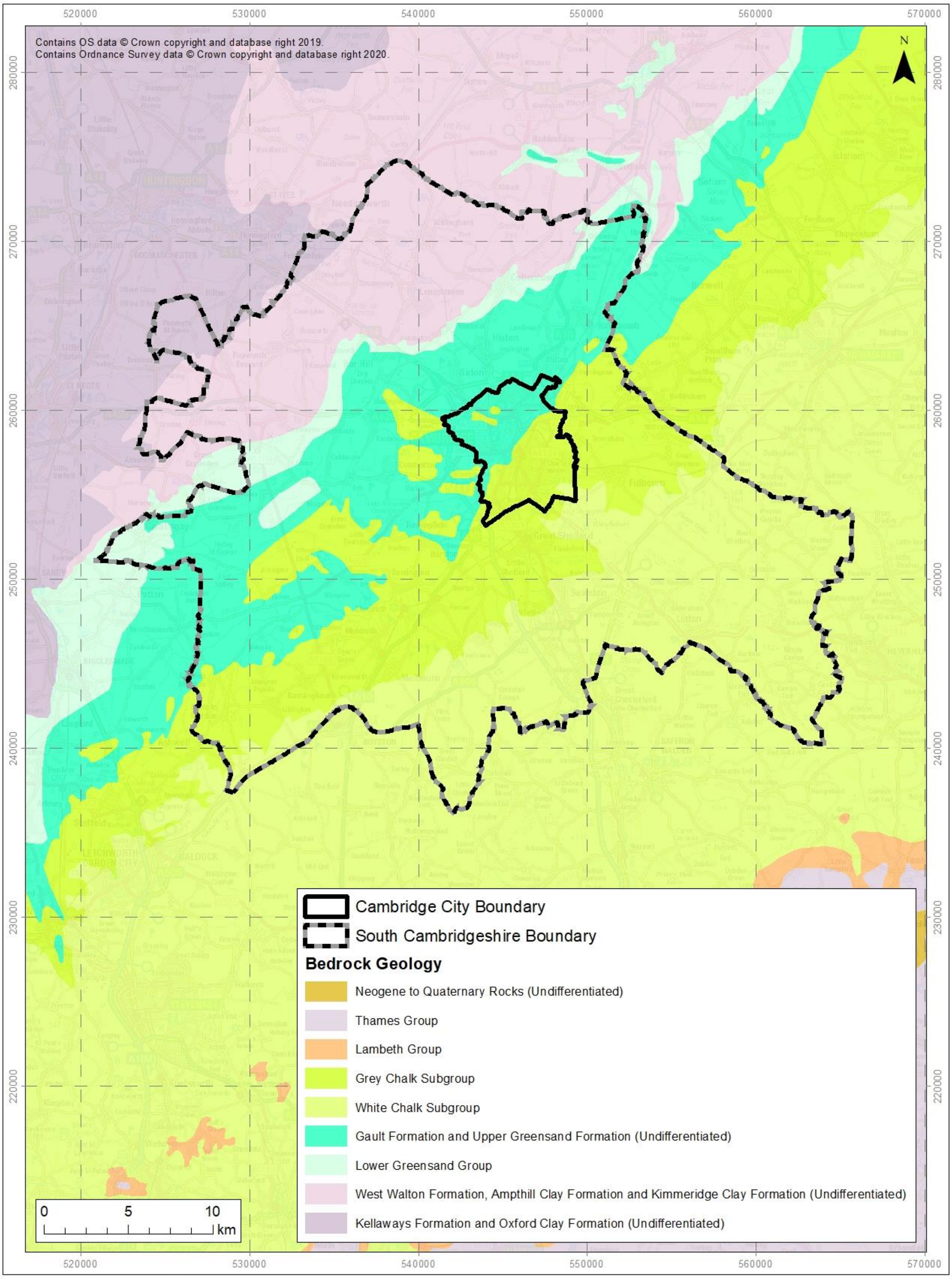

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Figure 2-4: Bedrock geology

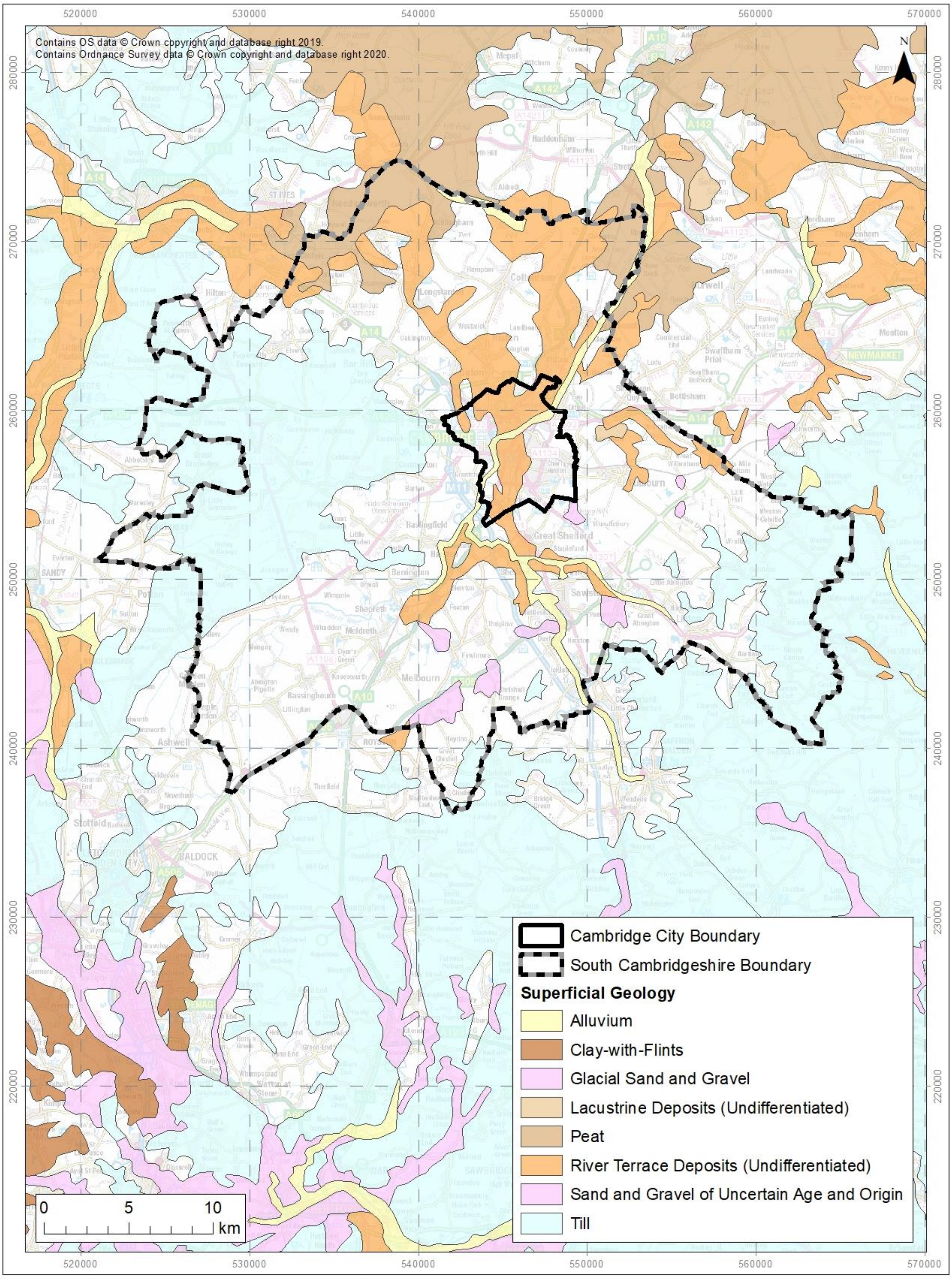

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Figure 2-5: Superficial geology

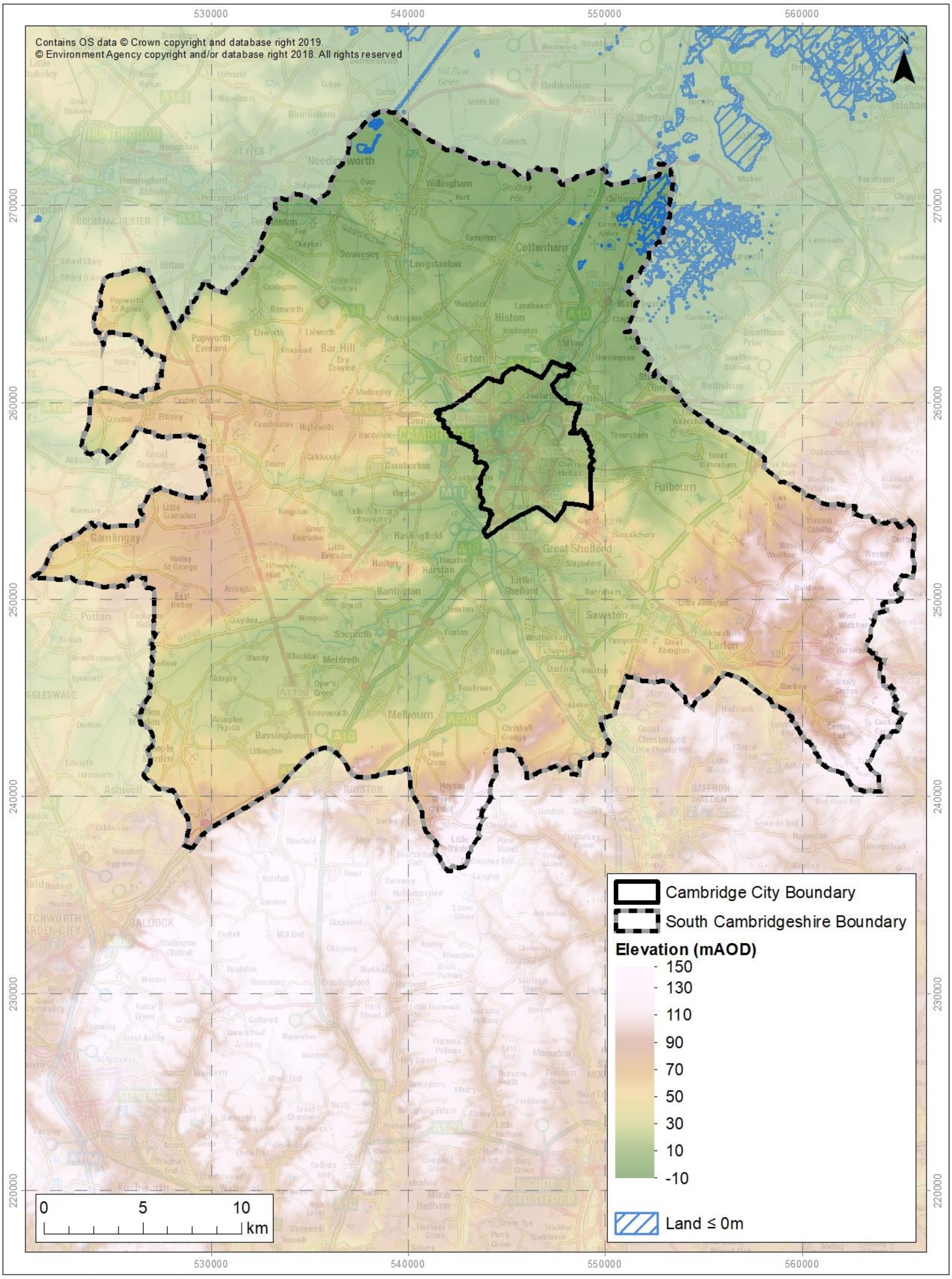

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Figure 2-6: Topography

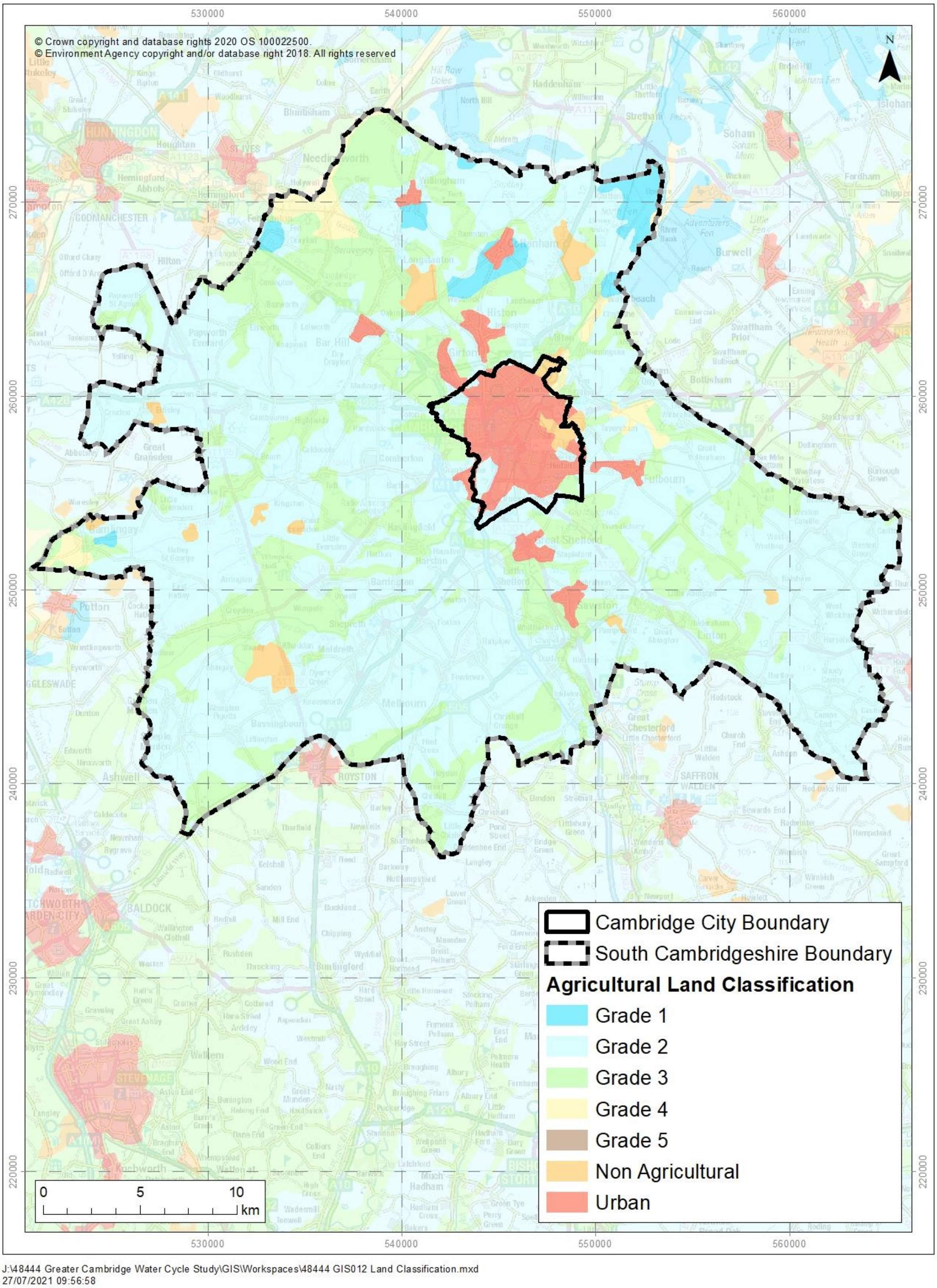

Figure 2-7: Agricultural Land Classification

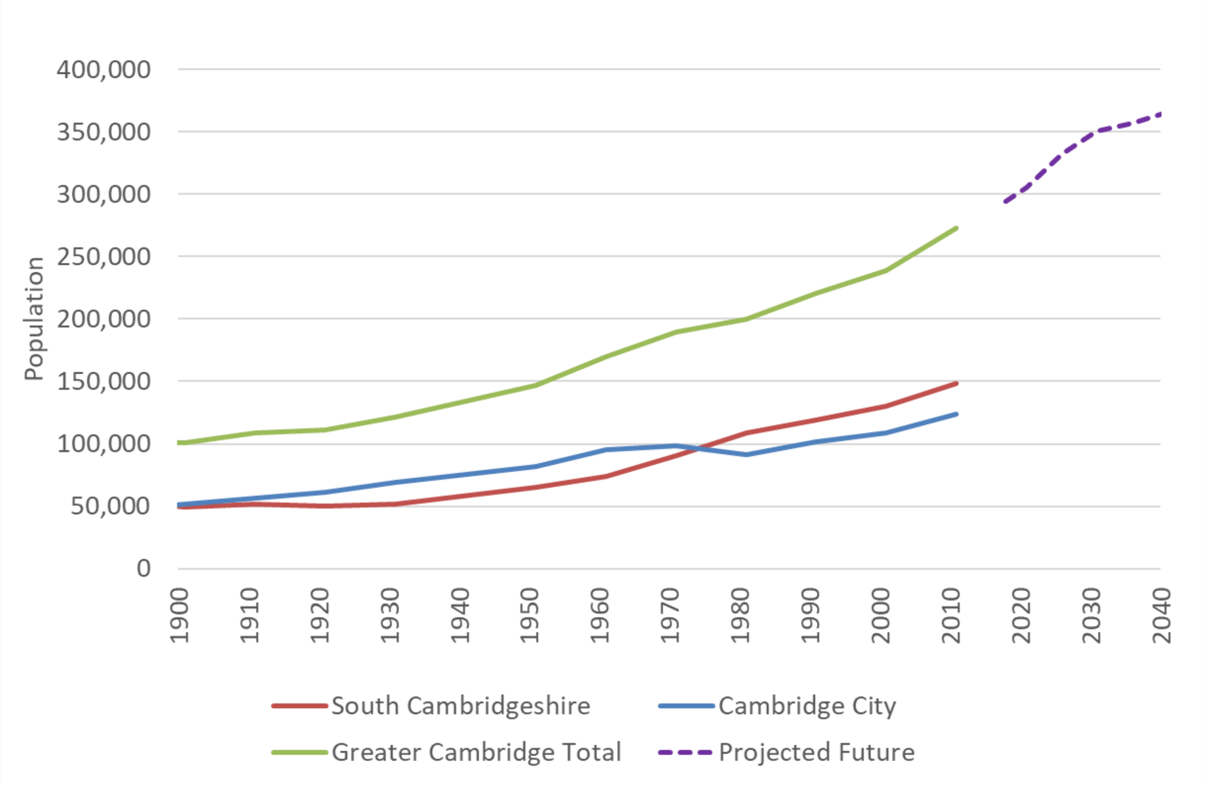

Figure 2-8: Historical population and future projected population, based on currently planned housing allocations (Cambridgeshire Insights), excluding any additional growth that may be allocated in the new Local Plan

2.4 Groundwater

2.4.1 Greater Cambridge contains a number of aquifers (underground layers of water-bearing permeable bedrock or superficial drift deposits from which groundwater can be extracted). Aquifers are classified as follows:

- Principal Aquifers: These are layers with high intergranular and/or fracture permeability, providing a high level of water storage. These may support water supply and/or river base flows on a strategic scale.
- Secondary Aquifers: These are layers with a wide range of water permeability and storage:
  - Secondary A: permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
  - Secondary B: lower permeability layers, which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

2.4.2 In Greater Cambridge, both the Chalk (53% coverage) and Lower Greensand (5% coverage) bedrock areas are classified as Principal Aquifers (Figure 2-9). The Chalk principal aquifer in particular stores considerable quantities of groundwater that sustain river flows and are the principal source of anthropogenic water supply for Greater Cambridge (see Chapter 4). The superficial River Terrace Deposits (12% coverage) are classified Secondary A aquifers, while the Till superficial deposits (25% coverage) are Secondary Undifferentiated (Figure 2-10).

2.4.3 Within the Chalk aquifer, groundwater flow occurs mainly near the top of the saturated zone, with little flow deeper than 50 m below the water table. Although flow rates within the chalk porous matrix itself are low, fractures allow much higher groundwater flow rates of 800 m^2/day (median value), increasing to >2000 m^2/day in some abstraction boreholes[6]. Groundwater levels in the chalk aquifer generally mimic topography, and therefore the groundwater catchment approximately coincides with the surface water catchment. Therefore, groundwater flows are dependent on recharge from rainfall falling within the surface catchment area, although there is hydraulic connectivity at the regional scale.

2.4.4 The Chalk aquifer is overlain by clay-rich till superficial deposits in some upper catchment areas. These deposits reduce recharge rates in these areas, while also providing a protective filtering function to the chemistry and quality of groundwater. Negligible nitrate concentrations indicate that most chalk groundwater beneath the till is a minimum of several hundred years old and

[6] “The Great Ouse Chalk Aquifer, East Anglia”, Groundwater Systems and Water Quality Commissioned Report CR/04/236N, 2004

this older store of water makes only a small contribution to the active circulation in the valleys below.

2.4.5 Active groundwater recharge occurs along the lower edge of the till and in the valley environments with permeable superficial deposits such as sands and gravels. In these areas, the groundwater chemistry is characterised by modern (post-1960s) higher nitrate levels[7], indicating more active circulation (Figure 2-11). The rate of recharge in these active areas is notable by the fact that almost all streams carrying surface runoff from the boulder clay areas lose their flow through recharge to groundwater when they leave the edge of the till. Potential groundwater recharge areas for the Chalk aquifer have been identified in Figure 2-12 (outcropping Chalk bedrock and permeable superficial deposits).

[7] "Recharge to the Chalk Aquifer beneath Thick Till Deposits in East Anglia", Groundwater Systems and Water Quality Programme Internal Report IR/04/007

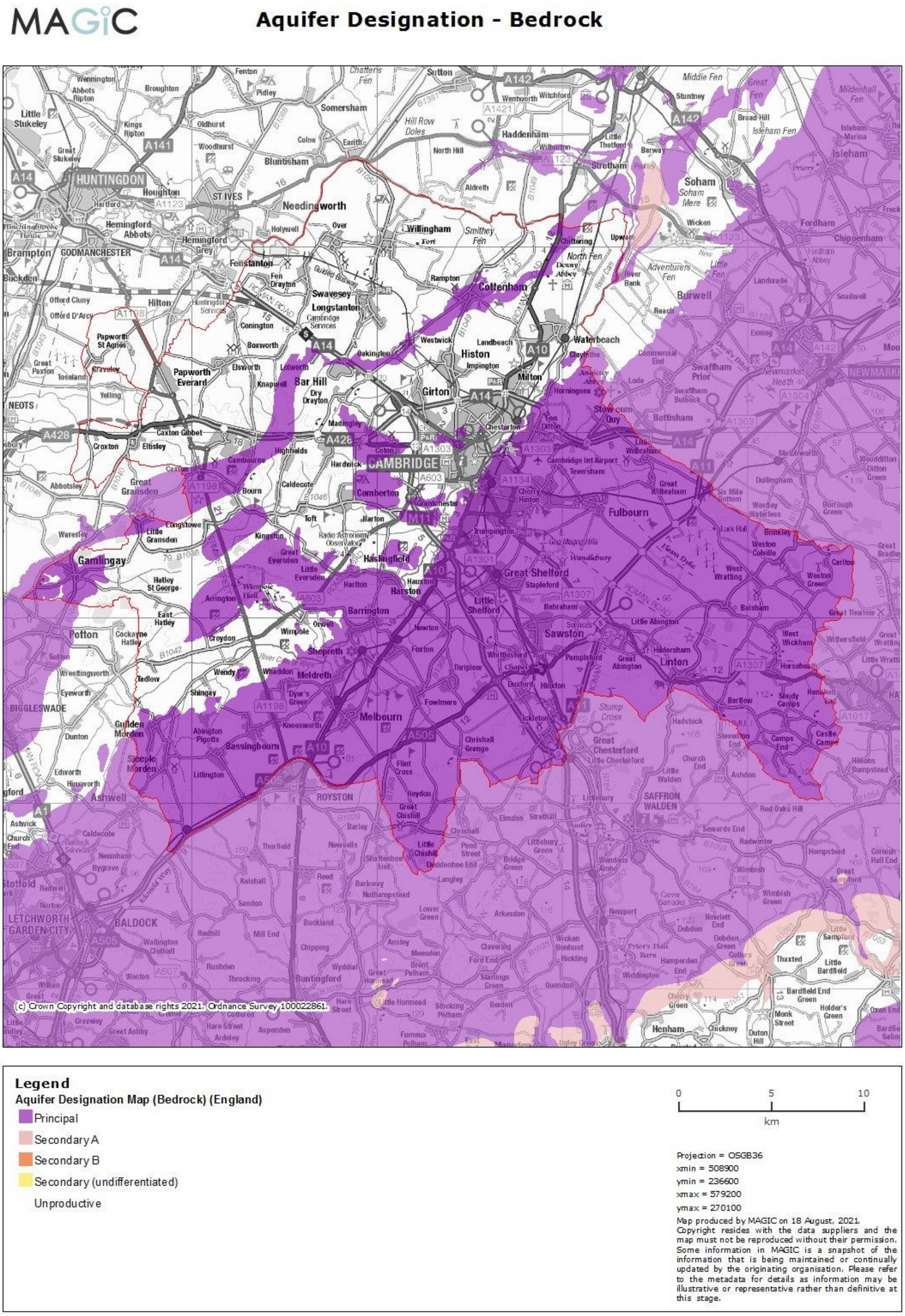

Figure 2-9: Bedrock Aquifer Designation Map (source MAGIC Maps).

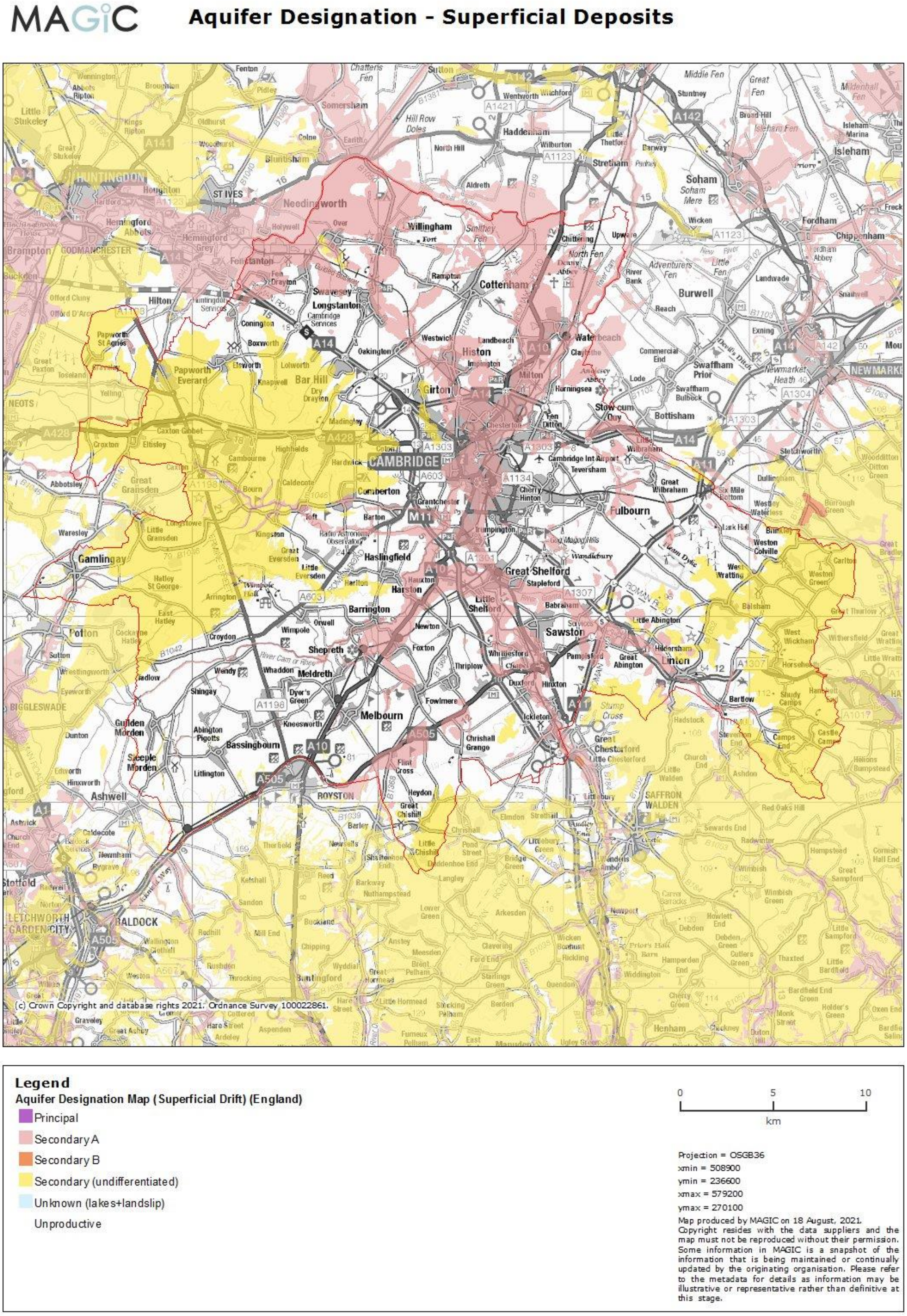

Figure 2-10: Superficial Aquifer Designation Map (source MAGIC Maps).

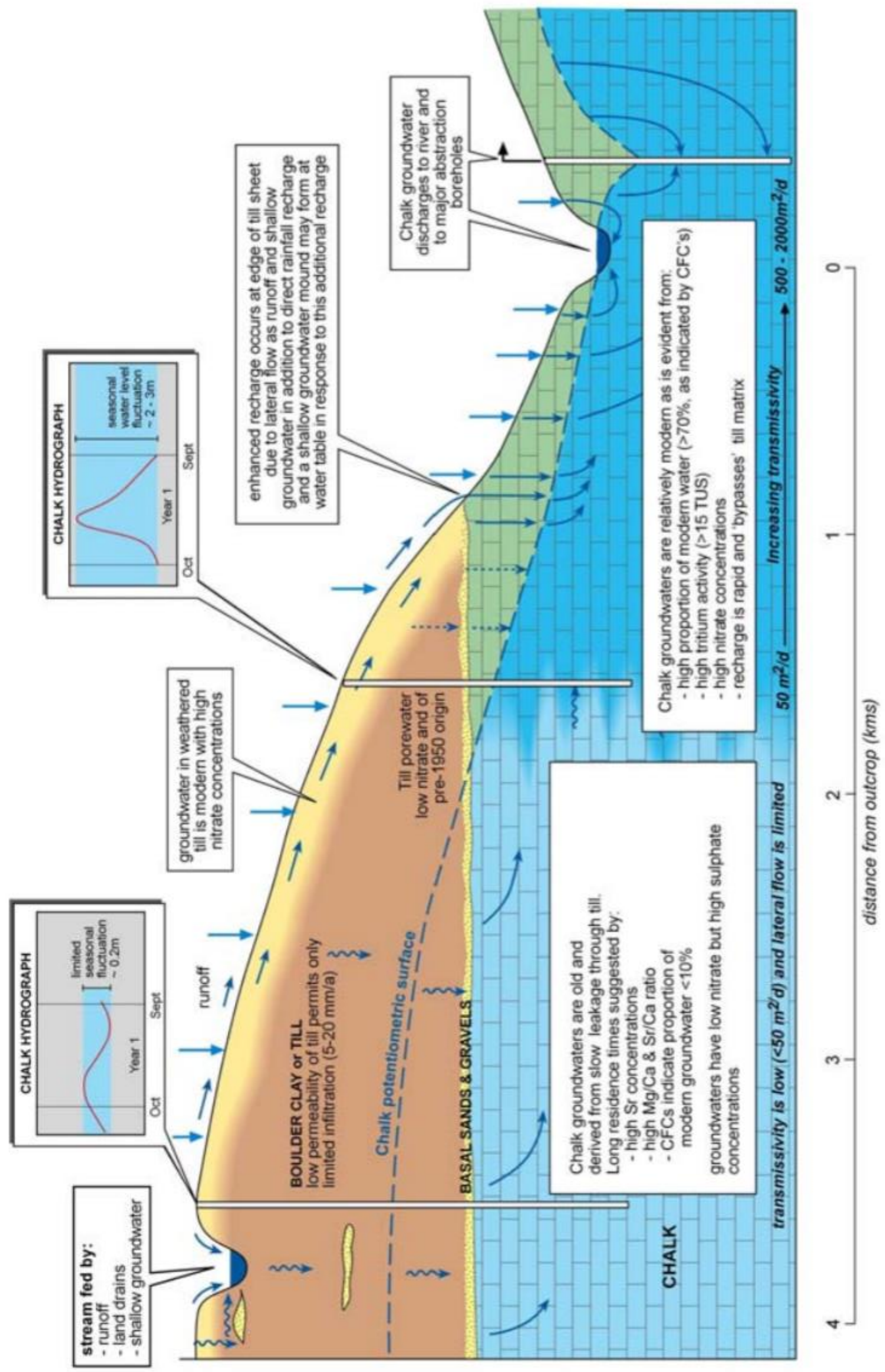

Figure 2-11: Possible groundwater recharge mechanisms and zones for chalk overlain by till, taken from BGS Report IR/04/007

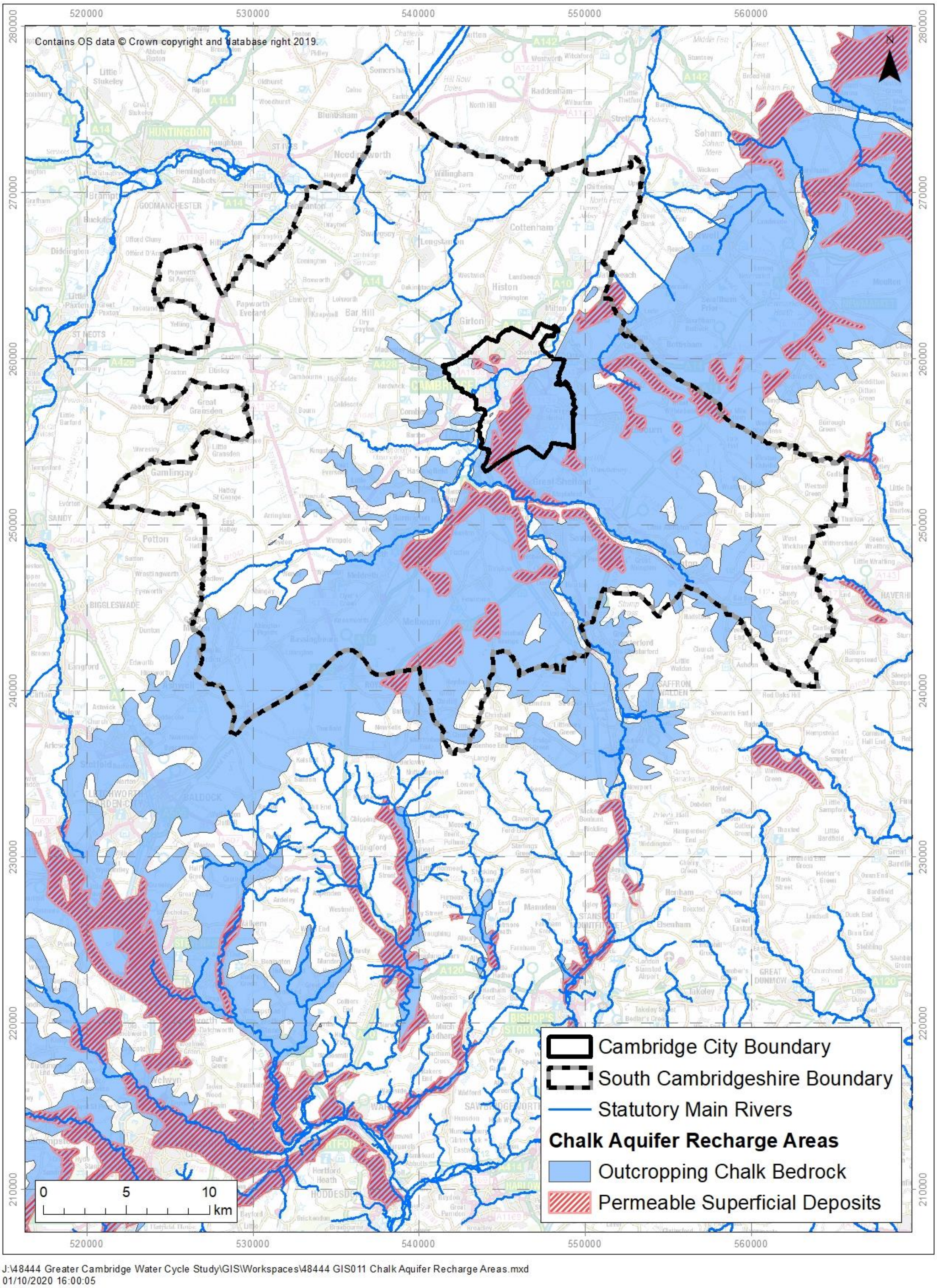

Figure 2-12: Chalk Aquifer recharge areas (outcropping chalk bedrock and permeable superficial deposits)

2.5 Surface Water and River Catchments

2.5.1 The surface water and river flows in Greater Cambridge (Figure 2-13) are determined by the topography and geology of the region. Most of the region is drained by the River Cam catchment, flowing northwards into the River Great Ouse and thence out to sea at the Wash via King's Lynn. Areas in the north-west corner of the region drain northwards directly to the River Great Ouse via a number of smaller watercourses. Some very small areas along the Greater Cambridge boundary drain eastwards or westwards.

Water Level Management on the River Cam

2.5.2 The River Cam is maintained as a navigable river from its confluence with the River Great Ouse upstream to the Mill Pond (Silver Street) in Cambridge. This is achieved by a series of weirs, sluice gates and locks (at Jesus Green, Baits Bite Lock, and Bottisham Lock) which effectively canalise the watercourse from Mill Pond downstream. Water levels are managed by the Cam Conservators in Cambridge, and the Environment Agency downstream. The structures maintain a constant depth of water in the channel throughout the year to facilitate navigation and recreation, including rowing, punting, canoeing and informal swimming. During summer months, low flow rates can mean these bodies of water are often near-stationary.

Water Level Management in low-lying areas

2.5.3 Gravitational drainage of the low-lying fenland parts of Greater Cambridge is difficult. Peat shrinkage has led to ground levels that are often near to or below sea level. The main river watercourses often have higher water levels than surrounding ground. Permanent inundation of the low-lying adjacent land is prevented by raised embankments. The low-lying land is then drained via sluice gates and pump stations up into the “high-level carrier” main river network. This infrastructure is managed by the Environment Agency and Internal Drainage Boards (IDBs, Figure 2-14).

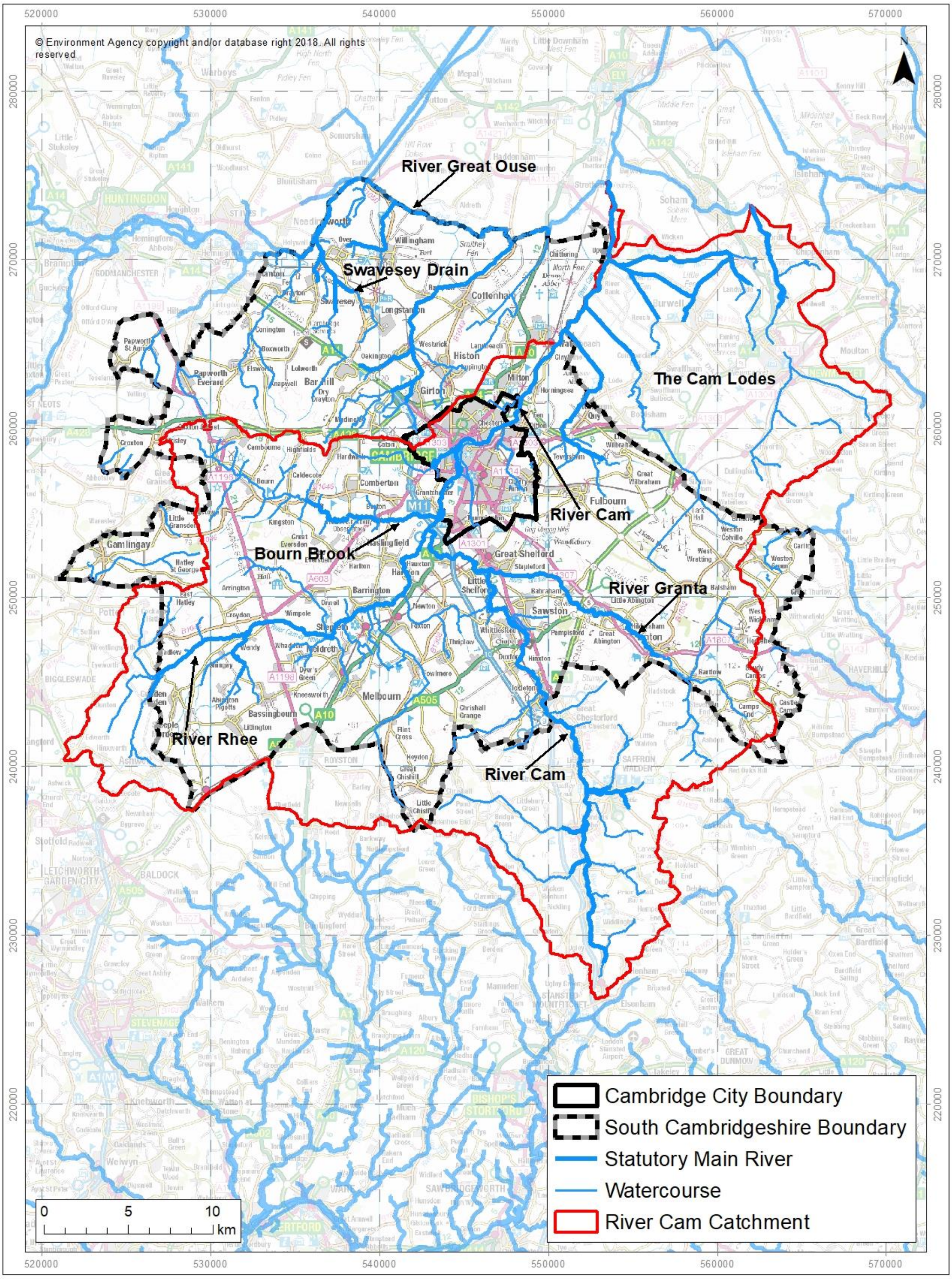

Figure 2-13: Watercourses and River Cam catchment

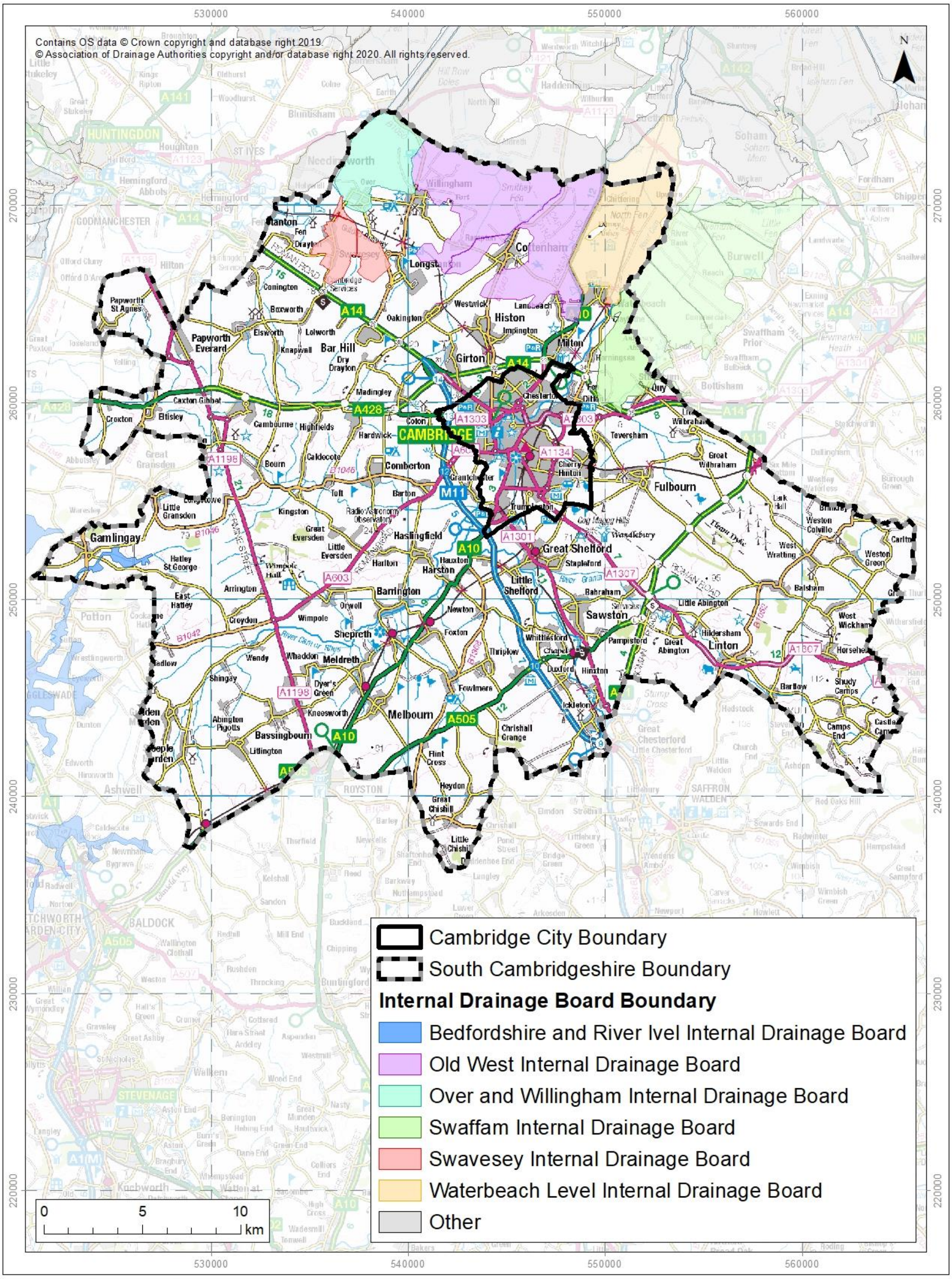

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Figure 2-14: Internal Drainage Board areas

2.6 Historic Floods and Droughts

2.6.1 Historically, the region has been vulnerable to both floods and drought episodes. The last major flood event occurred in October 2001 (estimated return period of 1 in 30 years), affecting many locations in Cambridge. Localised flooding from surface water has occurred frequently since then across the region, with further details provided in the accompanying Strategic Flood Risk Assessment.

2.6.2 The last major drought episode occurred in the summer of 2019. The drought was caused by a low winter and spring rainfall in 2018 – 2019, leading to groundwater levels that were exceptionally low (Figure 2-15). This caused groundwater fed streams and headwaters to dry up, including the Granta at Stapleford, and Little Wilbraham River. The dashed green line in Figure 2-15 represents the maximum monthly data, whereas the blue dashed line represents the minimum monthly data.

2.6.3 Long term groundwater levels and rainfall drought index data are shown in Figure 2-16 (monitoring locations shown in Figure 2-17). The Standardised Precipitation Index (SPI) represents the number of standard deviations by which the observed monthly precipitation deviates from the long term mean. The Standardised Precipitation Evapotranspiration Index (SPEI) takes into account the impact of temperature variations and therefore evapotranspiration on drought. These show that the area suffers notable droughts approximately every five to ten years. More information on specific historic droughts is available at the UKCEH Historic Droughts Inventory[8].

2.6.4 Similar patterns of low flows and drought episodes are observable in river flow timeseries (Figure 2-18), interspersed with some extreme flow and flood episodes. These confirm the natural variability in hydrological conditions between drought and flood conditions, caused by variations in weather and climate. The Environment Agency and Natural England have raised concerns that human impacts on the water cycle in and near Greater Cambridge have made the environment less resilient to the natural variability between drought and flood conditions, causing environmental harm.

[8] Historic Droughts Drought Inventory

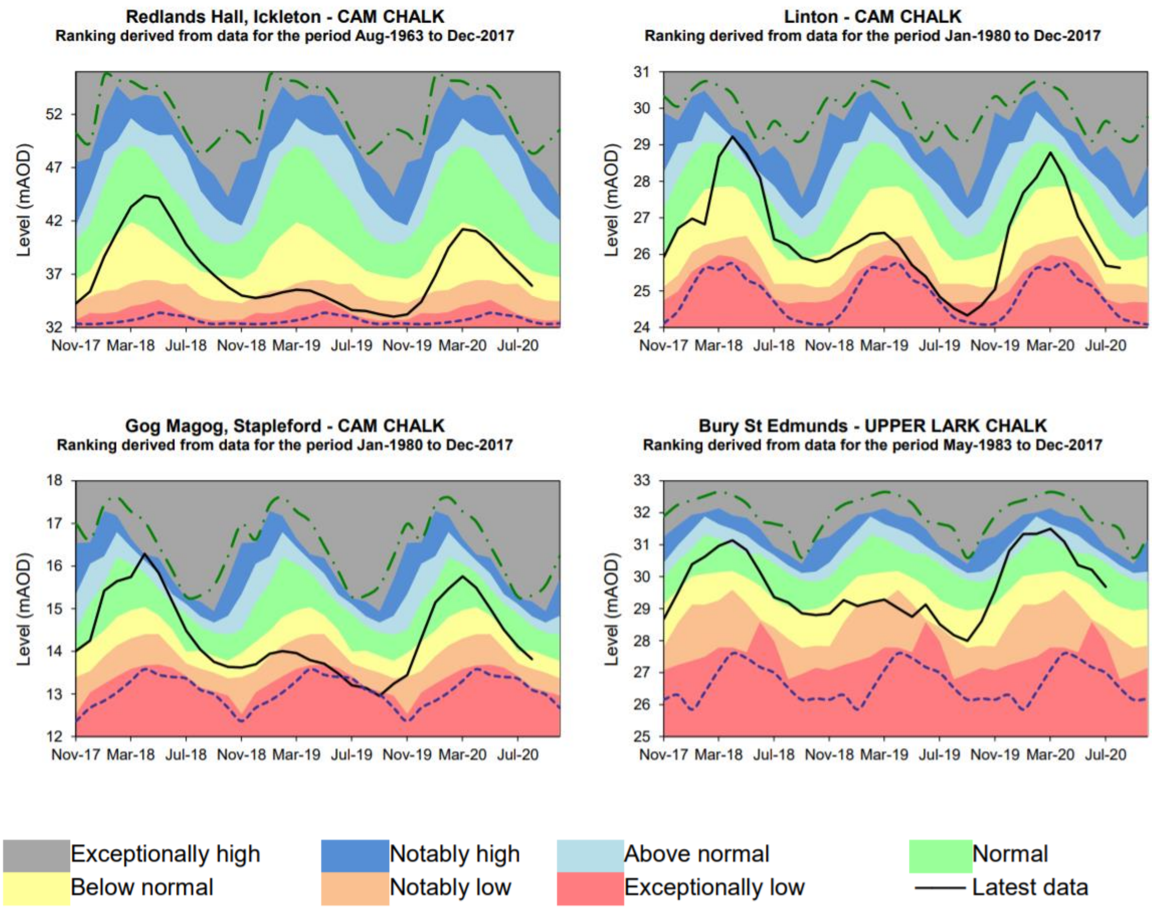


Figure 2-15: Groundwater levels, November 2017 – August 2020, Environment Agency Monthly Water Situation Report (East Anglia, August 2020)

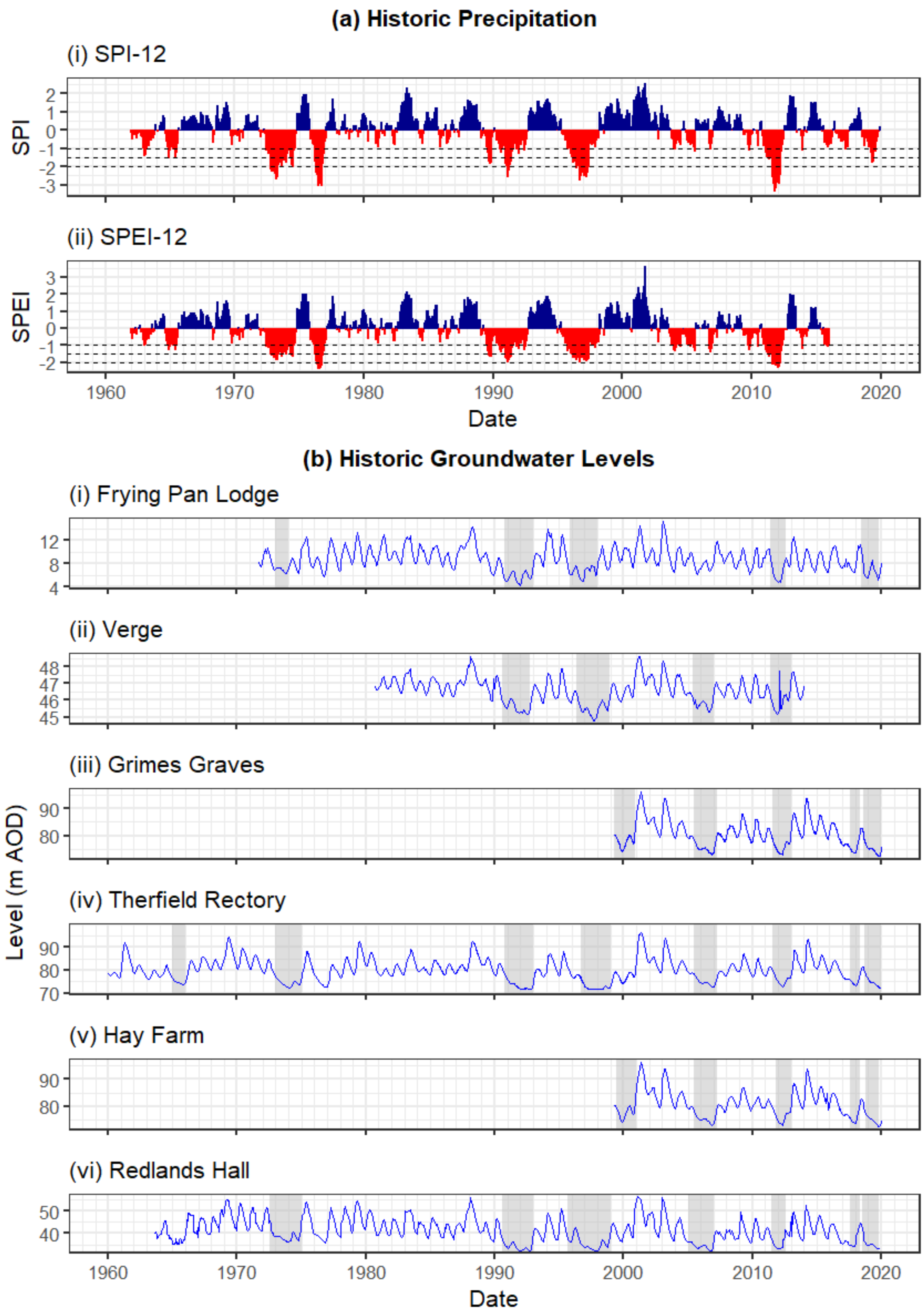
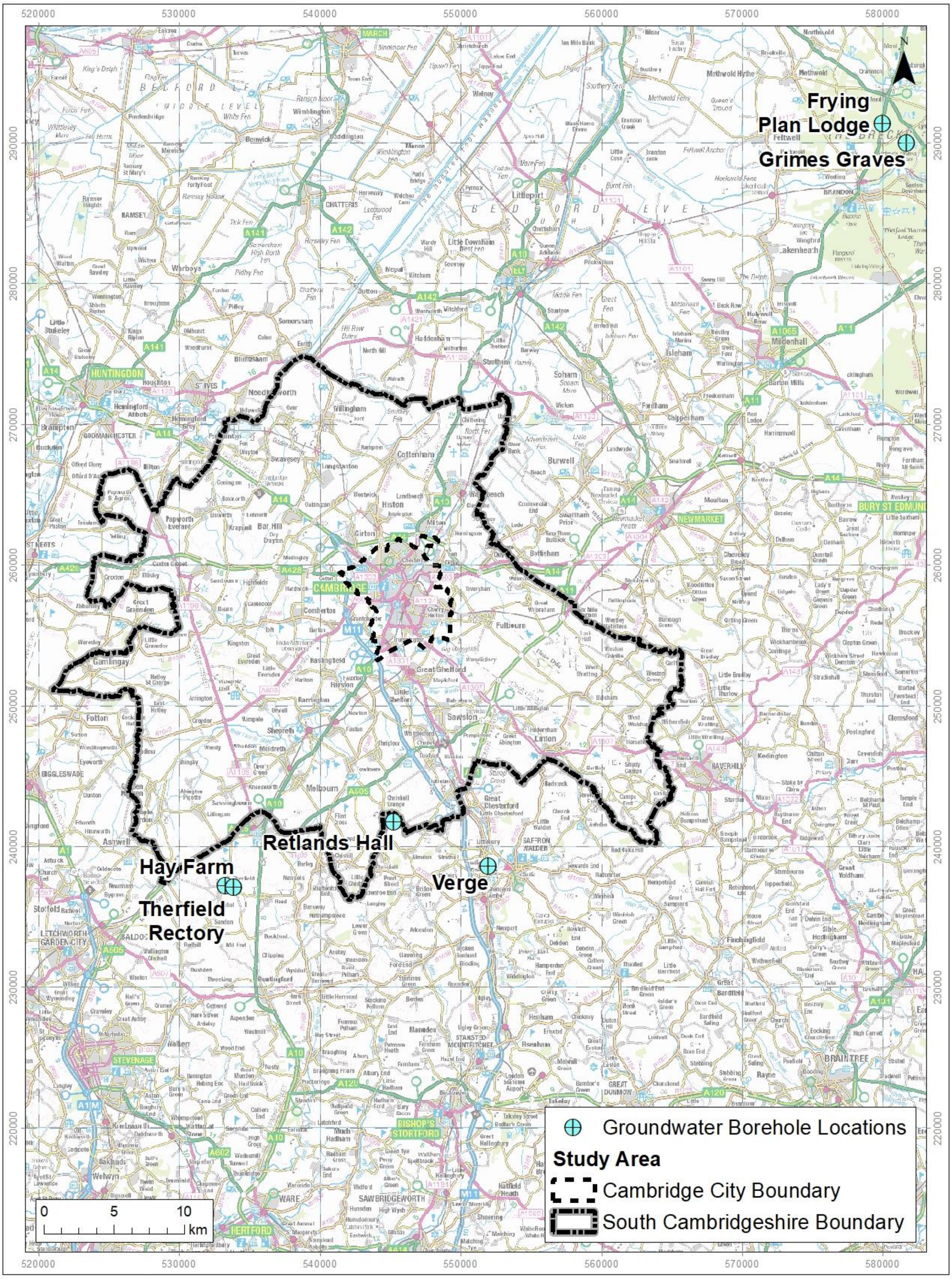


Figure 2-16: Groundwater levels and drought indices, 1960 to 2020. SPI or SPEI less than -1 indicates drought conditions; a value less than -2 indicates an extreme drought.



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24/08/2020 17:14:43

Figure 2-17: Groundwater level monitoring locations

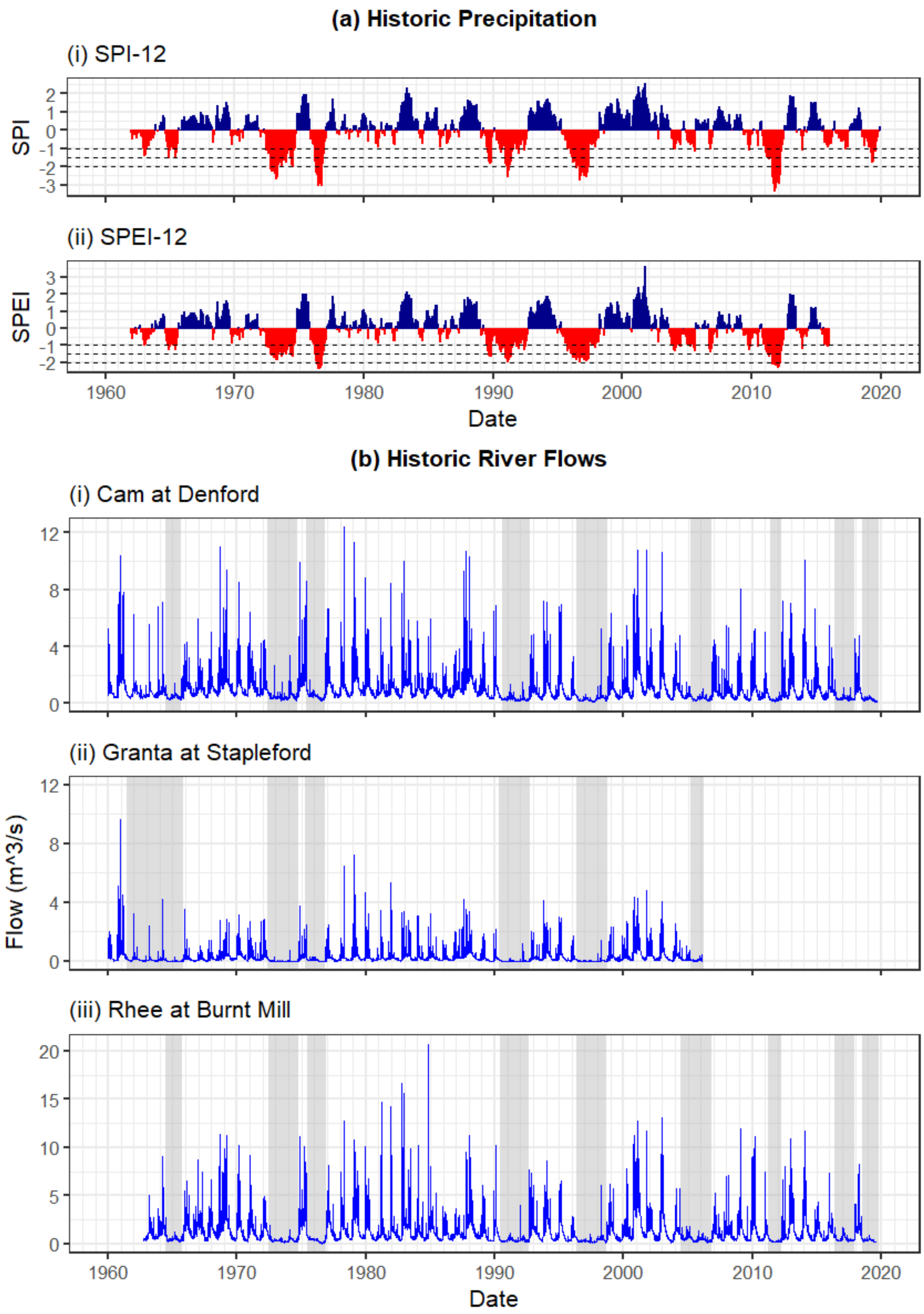

Figure 2-18: River flows and drought indices, 1960 to 2020. SPI or SPEI less than -1 indicates drought conditions; a value less than -2 indicates an extreme drought.

2.7 Future Climate

2.7.1 It is now accepted that human activities are leading to climate change of a scale and pace that could significantly impact our lives and those of future generations. Burning of fossil fuels since the 1800s has led to a 40% increase in the level of carbon dioxide in the atmosphere. Evidence has shown that the high levels of carbon dioxide and other greenhouse gases in the atmosphere is a leading cause of increasing global temperatures. The average global temperature is now approximately 1°C higher than the 1850 – 1900 average[9].

2.7.2 The UK Climate Projections (UKCP) provides the most up-to-date assessment of how the climate of the UK may change in the future. UKCP is a climate analysis tool within the government funded Met Office Hadley Centre Climate Programme. The most recent climate projections were released in 2018 (UKCP18), replacing the previous 2009 release (UKCP09).

2.7.3 The UKCP18 observations of current climate show evidence consistent with the expected effects of a warming climate, alongside considerable natural annual to multi-decadal variability. All of the top ten warmest years for the UK, in a series from 1884, have occurred since 2002. The 21st century so far has been warmer than the previous three centuries. Alongside warmer temperatures, winters and summers have also been wetter, although these patterns are potentially within long-term historic natural variability bounds.

2.7.4 The UKCP18 future climate projections indicate warming across all areas of the UK, especially during summer. The temperature and duration of hot spells during summer months will increase. Rainfall patterns will remain variable, but there will be future increases in the intensity of heavy summer rainfall events despite drier summers overall. All future projections also indicate an increase in winter rainfall, although varying between simulation details.

2.7.5 Therefore, it is anticipated that climate change will lead to an increase in the intensity and frequency of extreme weather events, including both summer and winter floods and droughts. The impact of climate change on flood risk is discussed further in the accompanying SFRA.

2.7.6 The relationship between climate change and groundwater levels is complicated and poorly understood. The Future Flows and Groundwater Levels project[10] was carried out in 2010 – 2012, to assess the impact of climate change on water availability, river flows and groundwater levels, based on UKCP09 climate projections. The outputs included an 11-scenario plausible ensemble projection of monthly groundwater levels at 24 borehole locations. Considering all 11 scenarios together allows an appreciation of the uncertainties in the potential impacts of climate change.

[9] Met Office

[10] CEH Future Flows and Groundwater Levels

2.7.7 The simulations indicated that the groundwater recharge season (typically September to April) could be reduced to 3 – 4 months, during which more recharge could occur over a shorter period, leading to flashy responses in groundwater levels. Higher winter river levels could also increase groundwater levels in adjacent river gravel aquifer systems. Although the potential for higher peaks in groundwater level increases under many of the scenarios, results are not uniform and show a wide range of potential outcomes including both increases and decreases in mean monthly groundwater levels.

3 Legislation, Policy and Guidance Context

3.1 Introduction

3.1.1 This chapter presents a summary of relevant and emerging legislation, policy, guidance, and studies relevant to integrated water management. The review is not exhaustive, but focusses on information of particular relevance to this study.

3.1.2 This chapter focusses on legislation, policy, and guidance relevant to water resources, wastewater and water quality. Aspects relevant to flood risk are reviewed in the accompanying Level 1 Strategic Flood Risk Assessment.

3.2 National and European Legislation

3.2.1 Water resource management is regulated by national and European legislation, with Acts of particular relevance summarised in Table 3-1.

3.2.2 The most significant legislation for this study is the Water Framework Directive (2000). Under this EU directive, management plans must be produced for river basin district, that seek to prevent deterioration, enhance and restore bodies of surface water and groundwater, reduce and prevent pollution and deterioration, and aim to achieve good chemical and ecological status (Table 6-1). The Water Framework Directive (WFD) classifications and objectives for water bodies in the Greater Cambridge region are reviewed in Chapter 7.

3.2.3 The Water Framework Directive has been supplemented by subsequent EU legislation concerning the protection of groundwater against pollution and deterioration (The Groundwater Directive, 2006), the specification of environmental quality standards (The Priority Substances Directive, 2008), and the chemical analysis and monitoring of water status (2009).

3.2.4 The consolidated EU legislation has been transposed into UK law by the Water Environment Regulations (2017) which persist after the United Kingdom left the European Union until and if they are amended or replaced.

Legislation	Summary
The Water Act (1989), the Water Industry Act (1991) and the Water Resources Act (1991)	These acts provided for the privatisation of the former water authorities, and set out the main powers and duties of the water companies, Ofwat, and the National Rivers Authority (now the Environment Agency). Water quality classifications and objectives were introduced.
The Urban Wastewater Treatment Directive (1991)	This EU directive aimed to protect the water environment from being damaged by urban waste water and certain industrial discharges.
The Environment Act (1995)	This act restructured environmental regulation and led to the creation of the Environment Agency. Duties were imposed on water companies to promote the efficient use of water by customers.
The Drinking Water Directive (1998)	This EU directive set quality standards for drinking water, and requires drinking water quality to be monitored and reported.
The Water Industry Act (1999)	This act limited the circumstances in which companies can start charging on a metered basis rather than a rateable value.
The Water Framework Directive (2000)	This EU directive created a single system of water management focussed on natural river basins, and set objectives and deadlines for improving water quality.
The Water Act (2003)	This act amended the framework for abstraction licensing, changed the structure of economic regulation, and extended the scope for competition to large users.
The Bathing Water Directive (2006)	This EU directive set standards for classifying water quality at designated bathing waters.
The Floods and Water Management Act (2010)	This act modernised the list of activities that can be restricted in a drought and made it easier for companies to offer lower tariffs to certain groups.
The Water Act (2014)	This act enabled greater competition for non-household customers and gave Ofwat new powers to make rules about charges and charge schemes.
The Water Environment Regulations (2017)	These regulations set out requirements to prevent the deterioration of aquatic systems; protect, enhance and restore water bodies to ‘good’ status; and achieve compliance with standards and objectives for protected areas. The regulations consolidate and set out the provisions of the Water Framework Directive in more detail.

Table 3-1: Summary of national and European legislation relating to water resource management.

3.3 The National Planning Policy Framework (NPPF, 2021)

3.3.1 The National Planning Policy Framework (NPPF) was first published in 2012 and updated in 2018,2019 and 2021. It sets out the government's planning policies for England and how these are expected to be applied.

3.3.2 Paragraphs of particular relevance for this study are:

- Paragraph 20: Strategic policies should set out an overall strategy for the pattern, scale, and quality of development, and make sufficient provision for:
  - Housing (including affordable housing), employment, retail, leisure and other commercial development.
  - Infrastructure for transport, telecommunications, security, waste management, water supply, wastewater, flood risk and coastal change management, and the provision of minerals and energy (including heat).
  - Community facilities (such as health, education and cultural infrastructure).
  - Conservation and enhancement of the natural, built and historic environment, including landscapes and green infrastructure, and planning measures to address climate change mitigation and adaptation.
- Para 153: 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, biodiversity and landscapes
- Paragraph 174: Planning policies and decisions should contribute to and enhance the natural and local environment by:
  - Protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils.
  - Recognising the intrinsic character and beauty of the countryside and the wider benefits from natural capital and ecosystem services.
  - Maintaining the character of the undeveloped coast, while improving public access where appropriate.
  - Minimising impacts on and providing net gains for biodiversity, including establishing coherent ecological networks that are more resilient to current and future pressures.
  - 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.

  - Remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.

- Paragraph 185: Planning policies and decisions should also ensure new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.

3.4 Planning Guidance for Water Supply, Wastewater and Water Quality (2019)

3.4.1 This guidance, from the Ministry of Housing, Communities & Local Government, was last updated in July 2019. The guidance provides an overview of the water supply, wastewater and water quality concerns that Local Plans may need to address (Table 3-2).

3.5 Planning Policy Guidance for Housing: Optional Technical Standards

3.5.1 This guidance explains how planning authorities can gather evidence to set optional technical standards for new housing. This includes the option for tighter water efficiency requirements for new homes to manage demand. All new homes already have to meet the mandatory national standard set out in the Building Regulations (of 125 litres/person/day). Where there is a clear local need, Local Plan policies can require new dwellings to meet the tighter Building Regulations optional requirement of 110 litres/person/day. A review by the Environment Agency of local planning authorities in September 2017 suggested around 80 authorities had utilised the optional requirement for developers to build to the lower level of 110 l/p/d in their planning conditions[11].

[11] Waterwise – Advice on water efficient homes for England

Plan-making considerations	What may need to be considered?
Water Infrastructure	• Identifying suitable sites for new or enhanced wastewater and water supply infrastructure. • Whether development is appropriate near to sites used for water and wastewater infrastructure. • Phasing of development so that infrastructure is in place when and where needed.
Water Quality	• How to protect and enhance local surface water and groundwater. • Where a WFD assessment of the potential impacts on water bodies and protected areas may be required. • Whether measures to improve water quality can have multiple benefits (e.g. mitigating flood risk).
Wastewater	• The sufficiency and capacity of wastewater infrastructure. • The circumstances where wastewater from new development would not drain to a public sewer. • The capacity of the environment to receive effluent from development without preventing statutory objectives from being met.
Cross-boundary issues	• Using a catchment-based approach to identify water supply and quality issues, the need for new water and wastewater infrastructure, and flood risk. The duty to cooperate across boundaries applies to water supply and quality issues.
Strategic Environmental Appraisal	• Water supply and quality are considerations in strategic environmental assessment and sustainability appraisal.

Table 3-2: Water supply, wastewater and water quality considerations for plan making

3.6 The 25 Year Environment Plan (2018)

3.6.1 This ambitious plan sets out the Government's goals for improving the environment over the next 25 years. It aims to deliver cleaner air and water in cities and rural landscapes, protect threatened species and provide richer wildlife habitats.

3.6.2 The plan aims to achieve clean and plentiful water by improving at least three quarters of waters to be close to their natural stage by:

- Reducing abstraction of water from rivers and groundwater
- Reaching or exceeding objectives for rivers, lakes, coastal and groundwaters that are specially protected
- Supporting OFWAT's ambitions on leakage
- Minimising bacteria in designated bathing waters and improving cleanliness.

3.6.3 The plan also aims to reduce the risks of harm to people, the environment and the economy from natural hazards including flooding, drought and coastal erosion. This will include making decisions on land use that reflect flood risk, ensuring interruptions to water supplies are minimised during dry weather and drought, and boosting the long term resilience of homes and infrastructure.

3.6.4 A draft Environment Bill has been prepared to build on the vision of the 25 Year Environment Plan. Proposals for improving long term planning and regulation of the water industry were consulted on in 2019. Work on the Bill is ongoing, although its progress through parliament has been delayed to Autumn 2021 at the earliest.

3.6.5 One important feature of the Bill is the provision for the Nature Recovery Network[12] (NRN). This is a new integrated approach to nature recovery, bringing together partners, policies and investment to actively restore and enhance the natural world, the benefits it provides and to enable us all to connect with nature in our towns, cities and countryside alike. Targets for 2042 include:

- restoring 75% of protected sites on land (including freshwaters) to favourable condition so nature can thrive
- creating or restoring 500,000 hectares of additional wildlife-rich habitat outside of protected sites
- supporting work to increase woodland cover

[12] Nature Recovery Network

- recovering threatened and iconic animal and plant species by providing more, diverse and better connected habitats
- achieving a range of environmental, economic and social benefits, such as carbon capture, flood management, clean water, pollination and recreation

3.7 The National Framework for Water Resources (2020)

3.7.1 This water resources national framework identifies the strategic long term water needs of England both nationally and within regional water resource zones. The report identified that Water Resource Management Plans (the statutory plans which address future water resources developed by individual water companies for their customers' needs alone) are unlikely to deliver the right strategic solutions for the nation as a whole.

3.7.2 Therefore, the framework establishes five regional groups to oversee strategic regional planning of water resources. Each regional group must produce a single plan that sets out the preferred options to provide best value to customers, society and the environment. The plans will include:

- Increasing resilience to drought – making provisions for up to a 1 in 500 annual exceedance probability drought event.
- Implementing sustainable abstraction regimes to deliver greater environmental improvement.
- Long term reductions in water usage to 110 litres per person per day by 2050, as well as reductions in non-household demand.
- Reduction of leakage of 50% by 2050.
- Reduced use of drought permits and orders.
- Increased water supplies, including reservoirs, water reuse schemes, desalination plants, shared resources with other sectors, and catchment management.
- Opportunities for water transfer, within and between regions, at all scales.
- Establishing an environmental destination clarifying the requirement to reduce current abstractions by 2050 to meet good status.

3.7.3 Funding to explore strategic options has been made available with the support of the Regulators' Alliance for Progressing Infrastructure Development (RAPID).

3.7.4 The regional group for the Greater Cambridge area is Water Resources East.

3.8 The Water Abstraction Plan (2020)

3.8.1 This policy paper sets out how the Government plans to reform water abstraction management, to protect the environment and improve access to water. This will include:

- Making use of existing regulatory powers and approaches to address unsustainable abstraction, moving 90% of surface water bodies and 77% of groundwater bodies to the required standards by 2021. The Water Industry National Environment Programme (WINEP) will allow water companies to take a leading role in addressing unsustainable abstraction through investment.
- Developing a stronger catchment focus to develop local solutions to pressures, changing licences to better reflect water availability and reduce the impact of abstraction, and improve access to water by introducing more flexible conditions that support water storage, water trading and efficient use.
- Modernising the abstraction service to regulate all significant abstraction and bring into line with other environmental permitting regimes.

3.8.2 The Cam and Ely Ouse was identified as a priority catchment in this programme for updating its abstraction licencing strategy.

3.9 The National Policy Statement for Waste Water (2012)

3.9.1 This document sets out the Government policy for the provision of major wastewater infrastructure. The policy statement is the primary basis for deciding development consent applications for wastewater developments that fall within the definition of Nationally Significant Infrastructure Projects as defined in the Planning Act (2008). The proposed relocation of the Cambridge Water Recycling Centre has been determined to be a Nationally Significant Infrastructure Project and will be assessed for planning permission via a development consent order (see Chapter 5).

3.10 DEFRA Policy Framework for a Catchment Based Approach (2013)

3.10.1 This document sets out a framework to facilitate a Catchment Based Approach to support local approaches to managing the water environment and supporting river basin management planning as part of Water Framework Directive activities. The objectives of the Catchment Based Approach are:

- To deliver a better quality water environment, with positive and sustained outcomes, by promoting a better understanding of the environment at a local level.
- To encourage collaborative working to support transparent decision making when planning and delivering activities to improve the water environment.

- To recognise the role of new and existing partnerships involved in collaborative catchment working, with a formal recognition of their status.
- Encouraging long term self-sustaining funding arrangements.

3.10.2 The Greater Cambridge area lies within the Cam and Ely Ouse Catchment Partnership, co-hosted by the Rivers Trust and Anglian Water.

3.11 Building Regulations Approved Document G: Sanitation, Hot Water Safety and Water Efficiency (2016)

3.11.1 These regulations cover the standards required for cold water supply, water efficiency, hot water supply and systems, sanitary conveniences and washing facilities, bathrooms and kitchens and food preparatory areas in new buildings. Approved Document G provides practical guidance on compliance with Requirements G1 to G6 and regulations 7 and 36 of the Building Regulations (2010). Of particular relevance to this study are requirements relating to water efficiency:

- The estimated consumption of water must not exceed the standard of 125 litres per person per day, or 110 litres per person per day where the optional standard is applied (see Chapter 4).

3.11.2 The regulations provide a methodology to calculate water efficiency for new dwellings, known as the 'Water Efficiency Calculator for New Dwellings'.

3.12 Code for Sustainable Homes (2006 – 2015)

3.12.1 The Code for Sustainable Homes was an environmental assessment method for rating and certifying the performance of new homes. Launched in 2006, it was withdrawn in 2015 following the Housing Standards Review which aimed to simplify regulations into one set driven by Building Regulations. Local Plans are no longer able to require levels of the Code for Sustainable Homes, but instead can vary some Building Regulations requirements (e.g. water efficiency, see Chapter 4).

3.12.2 The Code rated water sustainability in the following ways:

- Indoor water use: aiming to reduce the consumption of potable water in the home from all sources through the use of water efficient fittings, appliances and water recycling systems.
- External water use: aiming to promote the recycling of rainwater and reduce the amount of mains potable water used for external water uses.

Up to 6 credits could be obtained (Table 3-3), representing 9% of the total score achievable across all categories.

3.12.3 Although the Code has been withdrawn, information on the water sustainability standards has been included in here for comparison with other schemes now available.

Category	Criteria	Credits	Mandatory Levels
Indoor water use	Water consumption limited to: <120 l/p/d <110 l/p/d <105 l/p/d <90 l/p/d <80 l/p/d	 1 2 3 4 5	 Levels 1 and 2 Levels 3 and 4 Levels 5 and 6
External water use	Correctly specified and sized rainwater collection system provided (e.g. rainwater butts or central collection system)	1	N/A

Table 3-3: Code for Sustainable Homes water sustainability credits criteria

3.13 Buildings Research Establishment Environmental Assessment Method (BREEAM)

3.13.1 BREEAM is a voluntary sustainability assessment method launched in 1990, which sets standards for environmental performance of buildings through the design, specification, construction and operation phases. Local Authorities may require BREEAM certification as part of the Local Plan or as a specific planning condition imposed on developments. The Government's Construction Strategy requires public projects to aim to achieve an Excellent rating or equivalent.

3.13.2 Up to 9 credits can be achieved for sustainable water use (Table 3-4), with further credits available for flood resilience, surface water run-off management, and minimising watercourse pollution.

Category	Criteria	Credits
Water consumption	Percent improvement over baseline building water consumption: 12.5% 25% 40% 50% 55% 66%	 1 2 3 4 5 Exemplary credit
Water monitoring	Water metering installed to meet standard specified.	1
Water leak detection	Leak detection system installed to meet standard specified. Flow control devices installed to regulate water supply.	1 1
Water efficient equipment	Demonstrable reduction in all other water demands not listed in other categories	1

Table 3-4: BREEAM water sustainability credits criteria

3.14 Home Quality Mark (2015)

3.14.1 The Home Quality Mark is a voluntary national standard for new housing, launched by BRE (Buildings Research Establishment) in 2015 as part of the BREEAM family of schemes. The Home Quality Mark is intended to allow builders to demonstrate the high quality of their homes and to differentiate them in the marketplace, while giving buyers confidence in the standard of the homes they are choosing.

3.14.2 The scheme allocates up to 17 credits for water efficiency (Table 3-5). In addition, up to 19 credits can be achieved for flood risk management, and another 19 credits for managing surface water runoff including water quality. Together, these represent approximately 10% of the Home Quality Mark score.

Category	Criteria	Credits
Water efficient fittings	6 water efficient fittings in the Optional fittings standard (<110 l/p/d)	5
	All water fitting categories in the Optional fittings standard (<110 l/p/d)	8
	All water fitting categories in the Advanced fittings standard (<100 l/p/d)	11
Water recycling	>50% of total demand for WC flushing met by rainwater or greywater	3
	100% of total demand for WC flushing met by rainwater or greywater	6

Table 3-5: Home Quality Mark water sustainability credits criteria

4 Water Resources and Supply

4.1 Overview

4.1.1 The purpose of this chapter is to:

- Review current water use, resources and abstraction regimes, using available information.
- Identify potential impacts of the current usage on low flows, water quality and ecology.
- Consider how water resource availability may change due to climate change.
- Identify what water resources are available for growth, taking into account environmental impacts and infrastructure constraints.
- Investigate current levels of uptake in water re-use systems, and explore options for increasing uptake.
- Consider options for managing water demand and efficiency improvements.

4.2 Managing Water Abstraction

4.2.1 The Environment Agency is responsible for managing water resources in England. To ensure there is enough water for people (public water supply, industry and agriculture) and a healthy environment, the Environment Agency controls how much water is taken using an abstraction permitting system. The Environment Agency's approach to managing abstraction is set out in their "Managing Water Abstraction"[13] document.

4.2.2 The management of water resources is covered by a range of strategies and plans, which have been reviewed for this study:

- Environment Agency Abstraction Licensing Strategies (ALS): these set out the Environment Agency's licensing approach for potential and existing abstraction. The Greater Cambridge region lies within the Cam and Ely Ouse Abstraction Licensing Strategy area. This strategy was updated in 2020[14]
- Environment Agency River Basin Management Plans: these set out actions needed to achieve good ecological status or potential, under the Water Framework Directive, of which abstraction licensing is one mechanism. The

[13] Managing water abstraction

[14] Cam and Ely Ouse Abstraction Licensing Strategy

Greater Cambridge region lies in the Anglian River Basin Management Plan area[15].

- Environment Agency Water Industry National Environment Programme (WINEP)[16]: this is a programme of investigations and actions for environmental improvement schemes that allow water companies to meet European Directives, national targets and statutory obligations.

- Environment Agency Drought Plans: these set out how the Environment Agency plans for and manages a drought[17]. These documents can be made available by the Environment Agency on application.

- Water Company Water Resource Management Plans (WRMP): these plans set out how water companies will manage the supply and demand of water over a 25-year period. WRMPs are revised every five years and subject to public consultation.

- Water Company Drought Plans: these plans set out what actions water companies will take to manage water supplies during drought periods. These plans are subject to consultation and are publicly available.

- Water Company Water Resources Business Plans: these business plans must be consistent with the WRMPs and are used to set price limits for the following five year period. The plans are submitted to Ofwat who review pricing through the Periodic Review.

4.3 Water Resource Use

4.3.1 Potential sources of water for human activities include rainwater, surface water (e.g. rivers and lakes), groundwater, treated wastewater, and the sea. These are used in Greater Cambridge as follows:

- Rainwater:
    - Rainwater is often collected and used at the individual property level. For example, water butts typically store 100 to 200 litres and have been installed in many properties for garden uses. A very small proportion of individual properties also have larger rainwater harvesting systems. These systems collect rainwater for non-potable domestic uses such as watering gardens, flushing toilets and washing clothes. This requires a large storage tank (typically underground), and a separate plumbing system for non-potable uses, which is costly to retrofit. Rainwater harvesting systems are now beginning to be trialled at whole-site scales for new developments, for example at Eddington (see Box 5-1).

[15] Anglian river basin district river basin management plan

[16] Water industry national environment programme

[17] Drought management for England

- Rainwater harvesting can also readily be used in agriculture, commercial and industrial sites, depending on the specific site water needs. For example, runoff from agricultural polytunnels can be collected and used to irrigate crops grown in containers.

- The uptake of rainwater harvesting systems in Greater Cambridge is currently unknown as Cambridge Water do not keep records of installations. However it is thought these represent less than 1% of the 1800 to 2000 annual new connections. Further discussion of the potential of rainwater harvesting systems for new developments is included in Section 4.9.

- Surface water: The Greater Cambridge region lies in the upper headwaters of the River Cam catchment. Its chalk-fed rivers have low flows that are unsuitable for large abstractions of surface water. Abstractions of water from surface water bodies are therefore limited to almost entirely agricultural usage (by volume), with the majority of the larger surface water abstractions located on the lower River Cam and River Great Ouse

- Groundwater: Abstraction from the chalk aquifer represents the main source of water in Greater Cambridge, and supplies all potable water after treatment processes have occurred. Other abstraction licences are for environmental support purposes, agricultural irrigation, and industrial, commercial and public services uses.

- Treated wastewater: The Greater Cambridge area does not currently have any specific planned treated wastewater re-use schemes. However there is de-facto re-use of water, because treated effluent is discharged upstream of surface water abstraction points for agriculture

- The sea: The Greater Cambridge region currently does not obtain any water resources from the sea. Desalination plants are being considered as part of the regional approach to water supply by Water Resources East for the East Anglia coast, but are expensive to build and run with high energy demands and the potential for local detrimental environmental impacts if not managed effectively.

4.3.2 Over 90% of the water abstracted in Greater Cambridge is sourced from groundwater (Figure 4-2). Of this, approximately 81% is used for public water supply, 11% for industrial and commercial uses, 6% for environmental schemes (for example, flow replenishment schemes), and 2% for agriculture. Approximately three times as much water is drawn from surface water sources for agricultural purposes than from groundwater sources.

4.3.3 Figure 4-3 shows changes in annual total water abstractions in Greater Cambridge since 2000, with variability of approx. 25% between the maximum and minimum abstraction volumes.

- Potable water use: This varies significantly year-on-year, but not all groundwater boreholes used by Cambridge Water are located in Greater

Cambridge. In years where there have been reductions in abstractions within Greater Cambridge, these may have been offset by increases in abstractions beyond the region.

- Industrial, commercial and public services usage: this has decreased by 40% since 2000.
- Agricultural usage: this has quadrupled since 2000, but 75% of this is drawn from surface water rather than groundwater. Although the volume used has increased, total agricultural use is less than 7% of all abstractions, and only 2% of groundwater abstractions.
- Environmental usage: data indicates that this increased from zero in the period 2000 to 2017 to approximately 2 million m^3 in 2018 relating to Environment Agency abstractions for river support schemes. Prior to 2000, river support schemes were operated extensively in the droughts of 1989-1992 and 1996-1997.

Rainwater Harvesting at Eddington, North-West Cambridge

The Eddington development is a 150 ha site which was led by the University of Cambridge to create a sustainable and high quality urban extension to Cambridge. The site will ultimately include 3,000 homes that are supplied with non-potable water by the largest water recycling system in the UK, which captures up to 45% of rainwater on the site. The new homes are being constructed to Level 5/6 of the Code for Sustainable Homes, requiring water consumption to be no more than 80 l/p/d, as set out in the North West Cambridge Area Action Plan. At full capacity, this will represent a daily saving of 0.6 Ml/d in potable water demand.

A site-wide integrated water management system controls the flow of rainwater through the development from blue and brown roofs, into swales and green corridors, and then into purpose-built lagoons within a wider designed floodplain. Planting in the lagoons begins to treat the water quality. The lagoons have been designed for multi-purpose benefits including public recreation, public art, and ecological enhancement. A pump station filters, treats and returns the rainwater into the development for non-potable domestic use including washing clothes, flushing the toilet and watering the garden. The system is also designed to provide surface water attenuation and flood risk benefits, with outflows from the lagoons into watercourses limited to greenfield rates. The rainwater system is operated and maintained by Cambridge Water, while the site-wide SuDS are managed by the University of Cambridge. Residents receive a discount on their water bills as they are charged different tariffs for their potable and non-potable usage.

Available data for 2018 to 2020 provided by Cambridge Water indicate that total domestic consumption of all water (potable and non-potable) is currently in the order of 91 l/p/d, of which 27% is supplied from the rainwater harvesting system. If rainwater is not available (e.g. due to drought or infrastructure failure), the non-potable uses are supplied by the potable mains water system. The rainwater harvesting system proved robust to the 2019 drought period (Figure 4-1), although not yet fully built out (25% occupation, approx. 700 properties).

A public opinion survey was undertaken for this study, publicised by the Eddington Residents Association, for which there were 20 respondents. 85% were positive about the recycling system, 5% neutral and 5% negative. Respondents commented that they felt good to know they were contributing to water sustainability, and strongly supported its use in other developments. 50% of respondents commented that they now try to use less water, because they are more aware of water resource issues. Some residents would like the system to go further, e.g. using the recycled water in showers. Negative comments related to the noise of rain in guttering, the taste and limescale content of the potable water, concerns regarding filtering of viruses, and concerns about disposal of hazardous chemicals in toilets entering the recycling system. These indicated that more could be done to explain the functioning and separation of the non-potable and potable water supply system and the wastewater system to residents.

Box 4-1: Eddington Rainwater Harvesting System

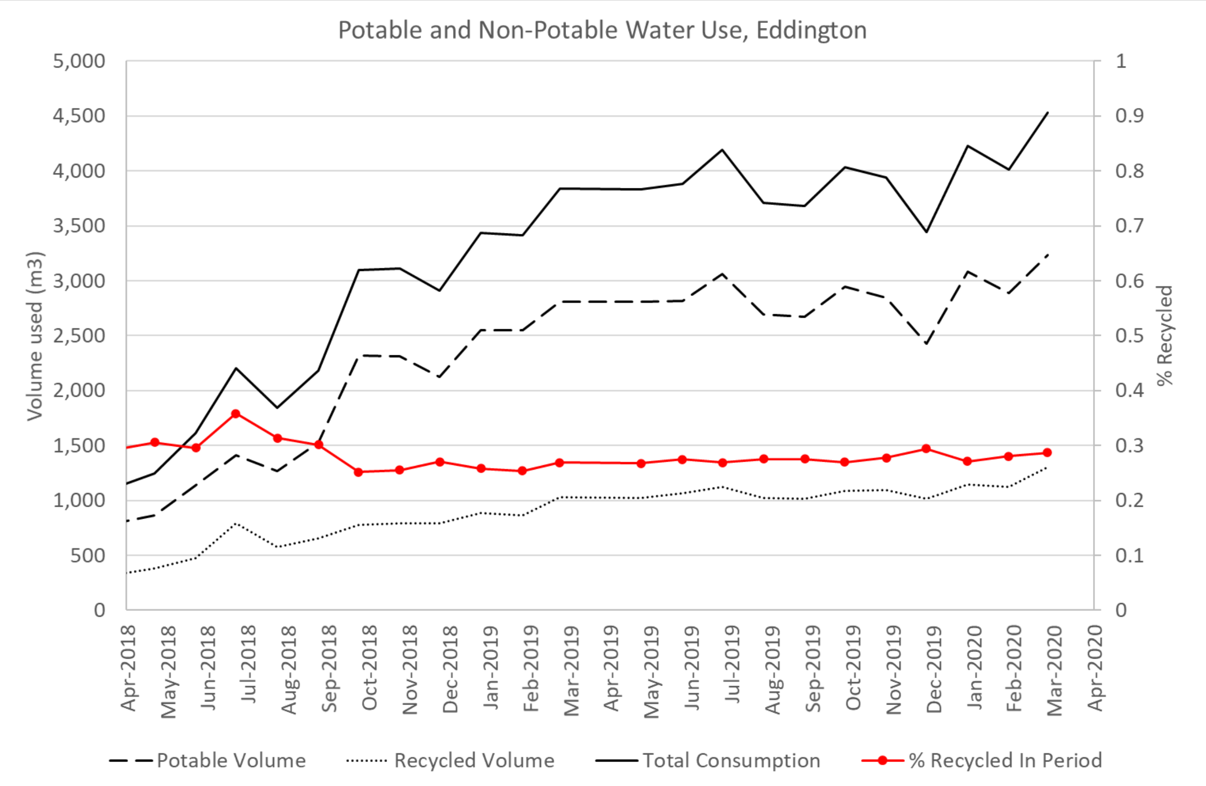

Figure 4-1: Potable and non-potable water use, Eddington. Increases in volume used reflect the built out and occupation of the site, as well as monthly variations in demand due to climate.

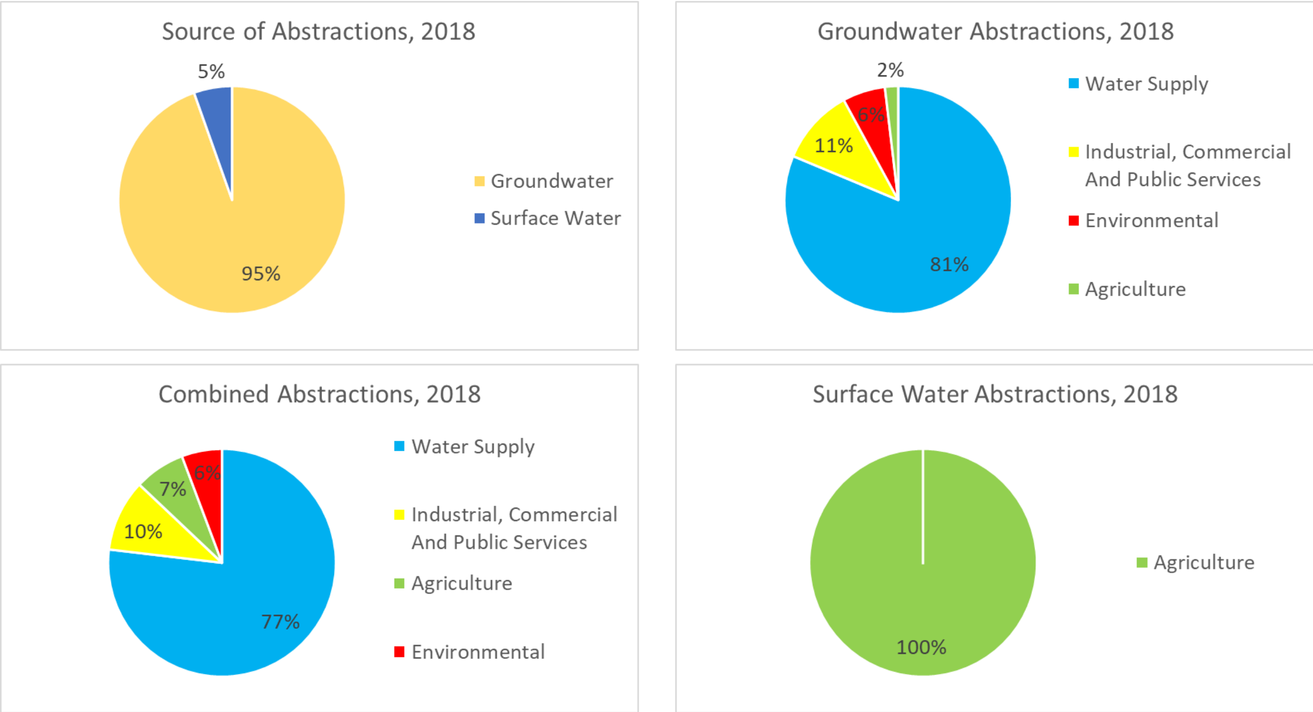

Figure 4-2: Volumetric water abstractions in Greater Cambridge by source and sector (2018)

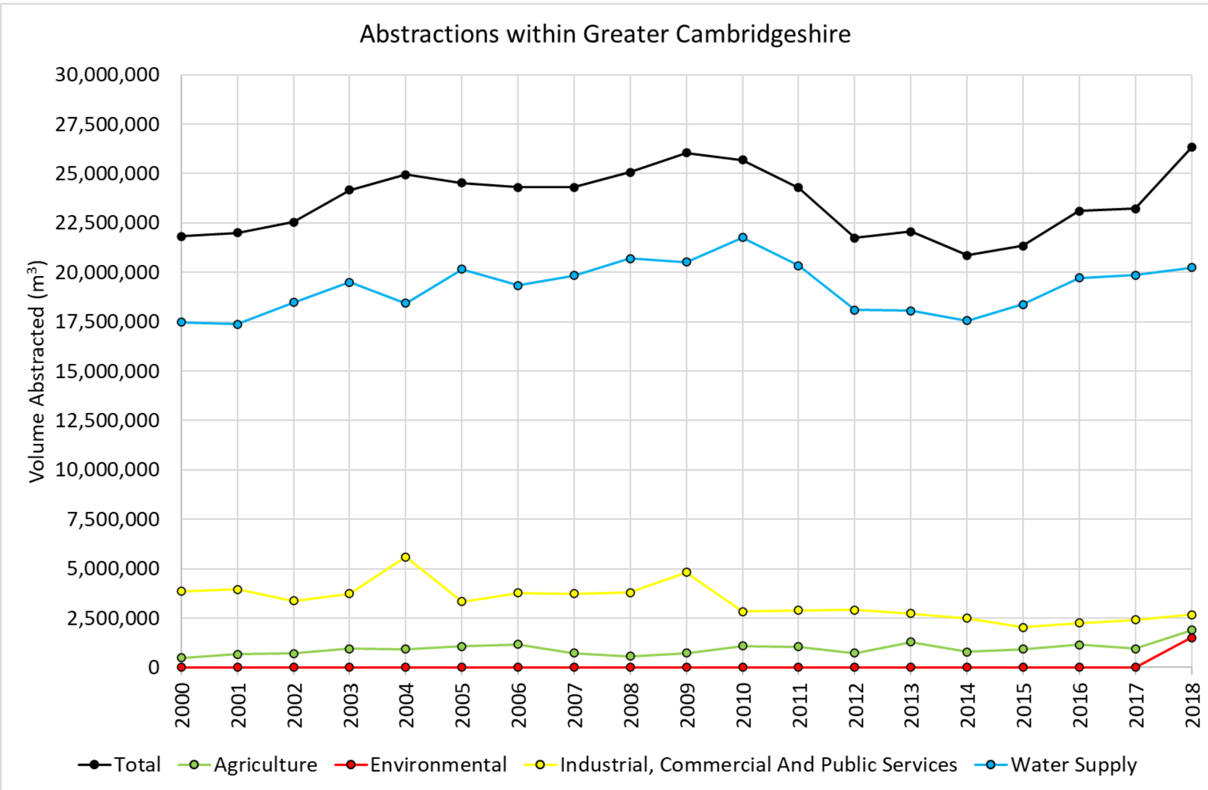

Figure 4-3: Time series of abstractions in Greater Cambridge by sector (2000 to 2018)

4.4 Public Water Demand and Supply

4.4.1 The most significant demand on water resources in the Greater Cambridge area is for public water supply. Greater Cambridge lies within the Cambridge Water statutory supply region. This Water Resource Zone includes all of Greater Cambridge and some wards of Huntingdonshire (Figure 4-4). It is not possible to disaggregate the water demands of Greater Cambridge from the Huntingdonshire wards in the Cambridge Water data.

4.4.2 There are two small areas within Greater Cambridge where other companies provide water supply services through the New Appointments and Variations (NAVs) process:

- Northstowe Phase 1, where Anglian Water has been appointed (2015).
- Newmarket Road, where Independent Water Networks Limited has been appointed (2019).

4.4.3 The new appointees have the same duties and responsibilities as the previous statutory water company. Although Cambridge Water is not responsible for delivering water to customers in these areas, it provides the bulk supply for these sites which is then delivered by the appointed company who bill the residents for this service. Therefore, the resource demands for these areas must also be considered by Cambridge Water in their supply planning.

4.4.4 The Cambridge Water supply region is bordered by Affinity Water to the south, and Anglian Water to the north, east and west (Figure 4-4). Affinity Water and Anglian Water also abstract water from the underlying Chalk aquifer. A regional approach to water resource management planning is now being led by Water Resources East, to take into account all demands on the regional groundwater resource.

4.4.5 All potable water in the Cambridge Water supply region is sourced from groundwater: 97% from the Chalk aquifers and 3% from greensand aquifers. Water is abstracted via boreholes, of which there are 30 licensed locations within and beyond Greater Cambridge. Not all of these licensed locations are currently used: water was abstracted at 22 locations in 2018. Five of these are located outside of the Greater Cambridge footprint: three within 5 km of the region, but two further afield at Thetford. These out-of-area abstractions are all sourced from the Chalk aquifer and contribute approximately 30% of the public water abstractions for Cambridge Water. This indicates that Greater Cambridge is not a water neutral region and is dependent on imports of water from beyond its administrative boundary. These out-of-area abstractions also mean that any increase in water demand within Greater Cambridge could have detrimental impacts on the wider regional environment which is not permissible.

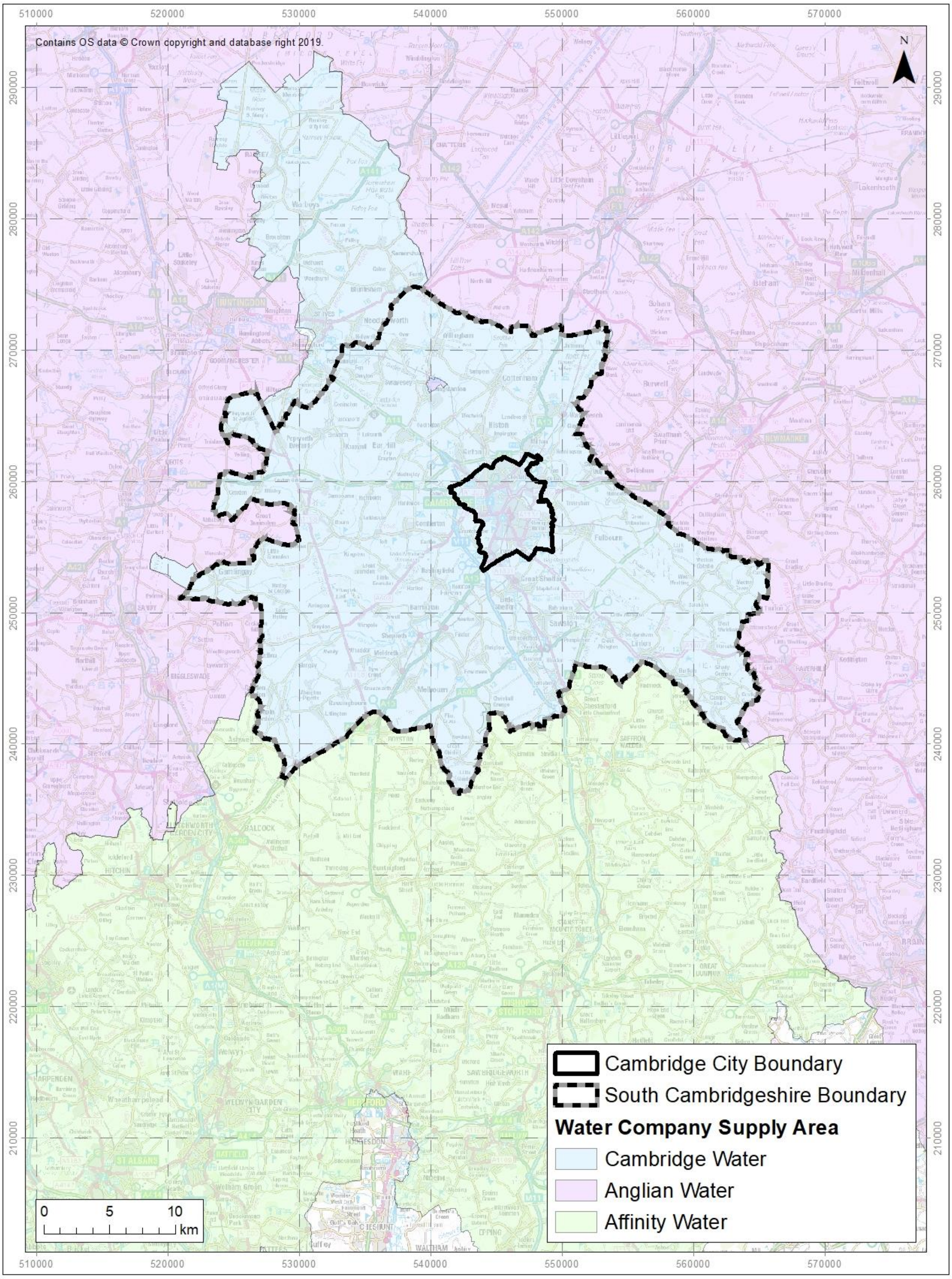

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Figure 4-4: Water Company Supply Areas

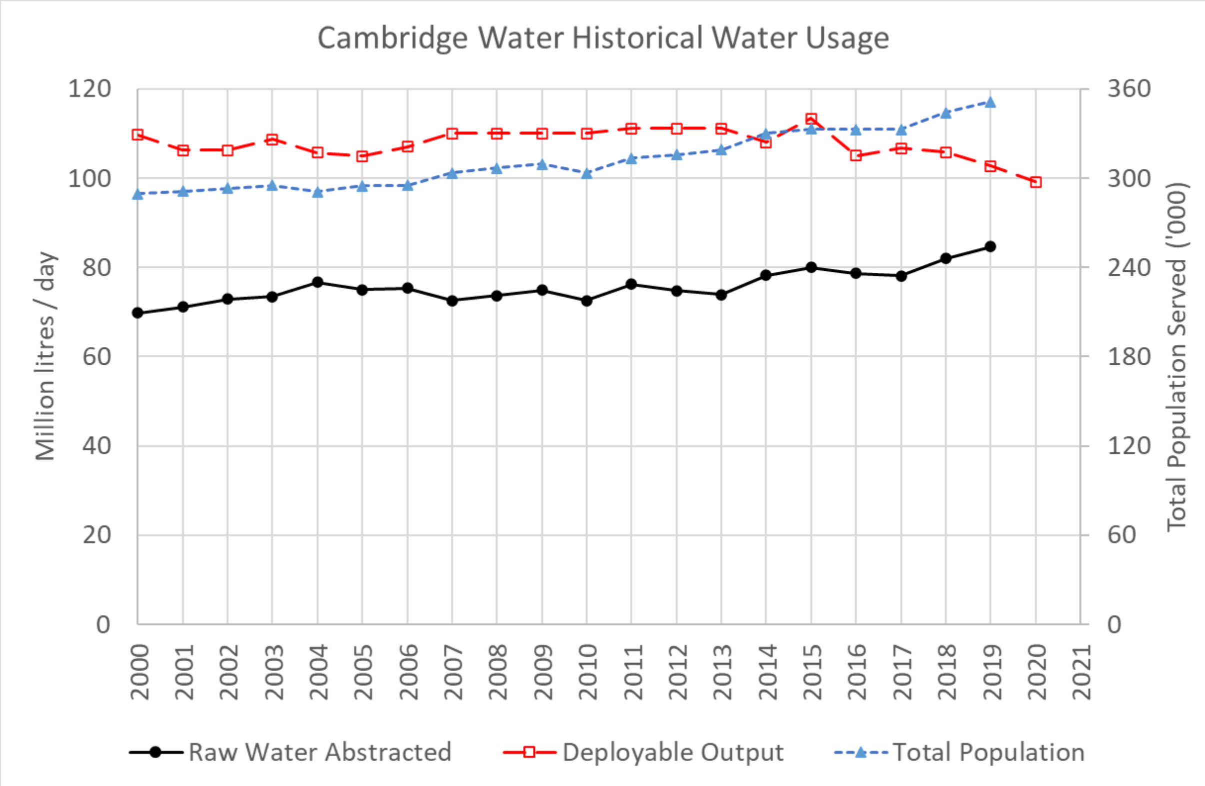

Figure 4-5: Raw water abstracted, deployable output and total population served (Cambridge Water annual review data, 1999 – 2019)

4.4.6 Historic raw water abstraction rates were obtained from water company annual review return data (Figure 4-5). These indicate a 20% increase in both total population served (289,000 to 351,000) and raw water abstracted (70 Ml/d to 85 Ml/d) from 2000 to 2019. Although not all these abstractions will have been within the Greater Cambridge area itself, they will all have been from the shared underlying aquifers. Not all abstracted water is public supply as some is used for operational purposes.

4.4.7 Deployable Output (DO) is the estimated volume of output for specified conditions from the water resources system as constrained by natural, regulatory (permit) and infrastructure considerations. This represents the maximum potential amount of water that could be abstracted to supply water in Greater Cambridge. This has decreased from approximately 110 Ml/d to less than 100 Ml/d due to reductions in abstraction licences for environmental and water quality reasons (Figure 4-5).

4.4.8 Figure 4-6 shows historic trends in water consumption by household and non-household properties. Household consumption is approximately twice non-household consumption. Household water metering has increased from 40% to over 70% since 2000 (Figure 4-7). Water metering generally results in customers using water more efficiently. This has led to an increasing disparity between metered and non-metered per capita consumption, as the remaining non-metered households tend to be higher demand water users. The average per capita consumption is approximately 140 l/h/d, which is similar to the national average.

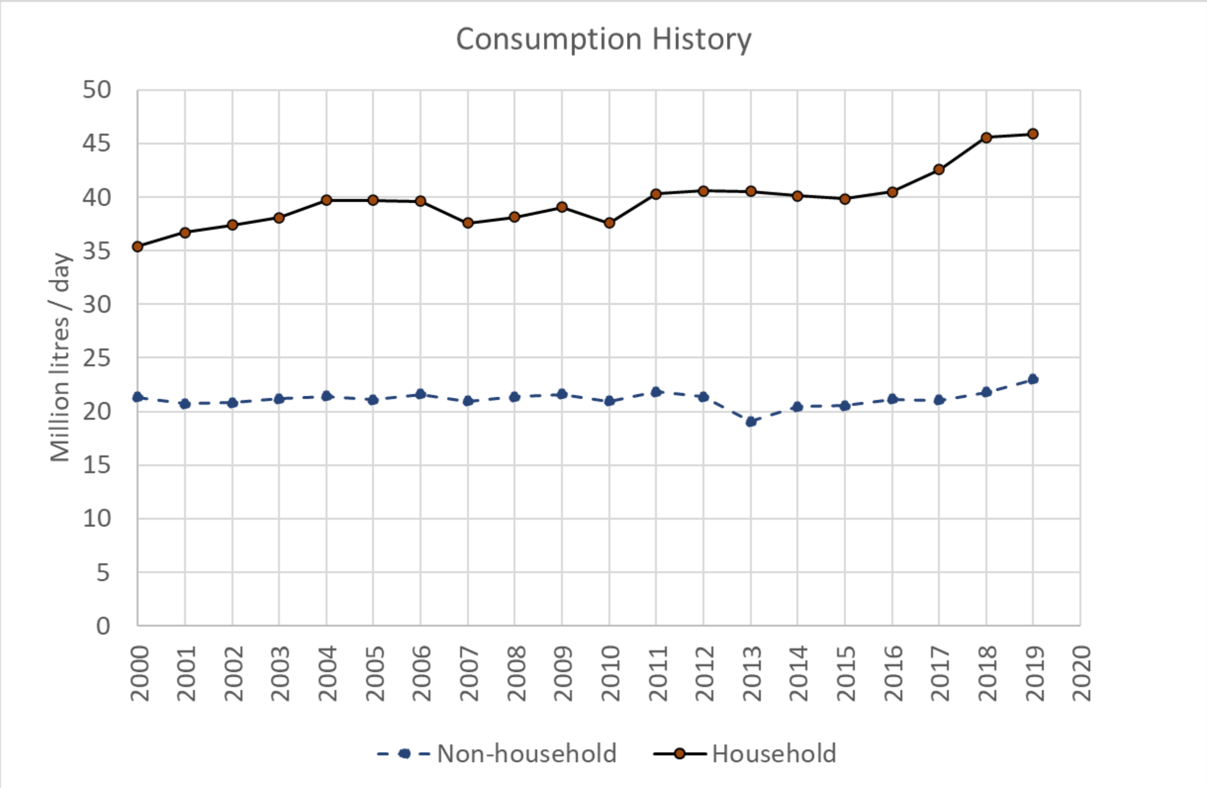

Figure 4-6: Household and non-household water consumption (Cambridge Water annual review data, 1999 – 2019)

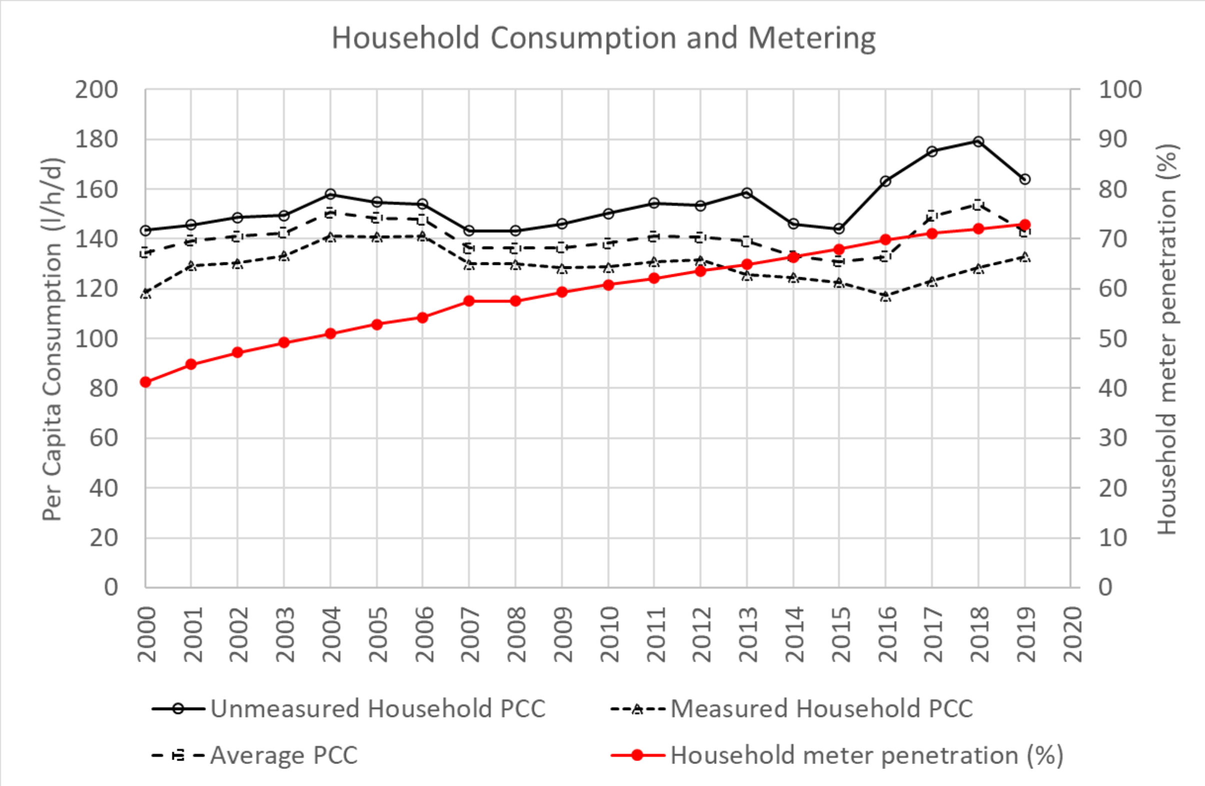

Figure 4-7: Household consumption and water metering rates (Cambridge Water annual review data, 1999 – 2019)

4.5 Resource Availability

4.5.1 The availability of resources for existing and new abstractions is set out in the Environment Agency's Abstraction Licensing Strategy. The Greater Cambridge region lies within the Cam and Ely Ouse Abstraction Licensing Strategy area. This strategy was updated in 2017[18].

Surface Water Abstractions

4.5.2 The Abstraction Licensing Strategy (2017 and 2020) classifies surface water resource availability as described in Table 4-1. There is no water available for licensing for new surface water abstraction for the majority of flow scenarios in Greater Cambridge (Figure 4-8), particularly in areas upstream of Cambridge.

4.5.3 The availability of surface water resources is calculated at Assessment Points for subcatchments, which are marked as red circles in Figure 4-8. "Hands Off Flow" (HOF) conditions have been calculated by the Environment Agency, to

[18] An update was subsequently published in December 2020 Cam and Ely Ouse Abstraction licensing strategy. Compared to the Abstraction licensing strategy surface water resource availability maps (shown in Figure 4-8 and published in 2017), the main difference is that there are more areas mainly at the south and also at the northern region within the Cam and Ely Ouse, where water is not available for licensing during the Q30 and Q50 flows scenarios.

indicate the river flow at which abstraction must cease in order to protect the environment. In dry years, restrictions are more likely to be applied more often, which affects the reliability of supply. Table 4-2 shows that HOF conditions have typically been set at about the Q20 flow (the flow that is exceeded 20% of the time). This means that abstraction may be available for about 20% of the time in a typical year.

4.5.4 Some low-lying areas of Greater Cambridge have been classified as Level Dependent Management Units (LDMU) in the abstraction licensing strategy. Environmental conditions in these areas are dependent on the control of water levels rather than flows. The license restrictions in these areas are:

- The Lodes LDMU (including Swaffham Internal Drainage Board and additional land including Wicken Fen): No water available at low flows. Water may be available at high flows subject to a Hands Off Flow condition at the Lower River Cam and Chalk Assessment Point 6. A local level based cessation condition to protect IDB drain levels may also be included. Trading of recent actual quantities within IDB areas may be possible.

- The Old West LDMU (including Waterbeach Level Internal Drainage Board and Old West Internal Drainage Board): No water available at low flows. Water may be available at high flows subject to a Hands Off Flow condition at Denver Sluice. A local level based cessation condition to protect IDB drain levels may also be included. Trading of recent actual quantities within IDB areas may be possible.

Water Resource Availability Colour	Implication for licensing
Blue - High hydrological regime	There is more water than required to meet the needs of the environment. However, 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. New licences can be considered depending on local and downstream impacts. Some time-limited licence renewals may require changes to reflect historic annual usage in order to manage the risk of deterioration to the environment. Abstractions for non-consumptive uses can still be permissible in catchments where there are sustainability issues.
Yellow - Restricted water available for licensing	Full licensed flows fall below the Environment Flow Indicators (EFIs). If all licensed water is abstracted there will not be enough water left for the needs of the environment. No new consumptive licences would be granted. Some time-limited licence renewals may require changes to reflect historic annual usage in order to manage the risk of deterioration to the environment. It may also be appropriate to investigate the possibilities for reducing fully licensed risks. Water may be available if you can ‘buy’ (known as licence trading) the entitlement to abstract water from an existing licence holder. Abstractions for non-consumptive uses can still be permissible in catchments where there are sustainability issues.
Red - Water not available for licensing	Recent actual flows are below the EFI. This scenario highlights water bodies where flows are below the indicative flow requirement to help support Good Ecological Status/Potential (GES/P) (as required by the Water Framework Directive). Note: we are currently taking action in water bodies that are not supporting GES / GEP). No further consumptive licences will be granted. Some time-limited licence renewals may require changes to reflect historic annual usage in order to manage the risk of deterioration to the environment. Water may be available if you can buy (known as licence trading) the amount equivalent to recently abstracted from an existing licence holder. Abstractions for non-consumptive uses can still be permissible in catchments where there are sustainability issues.

Table 4-1: Surface water resource availability colours and their implications for licensing (Environment Agency).

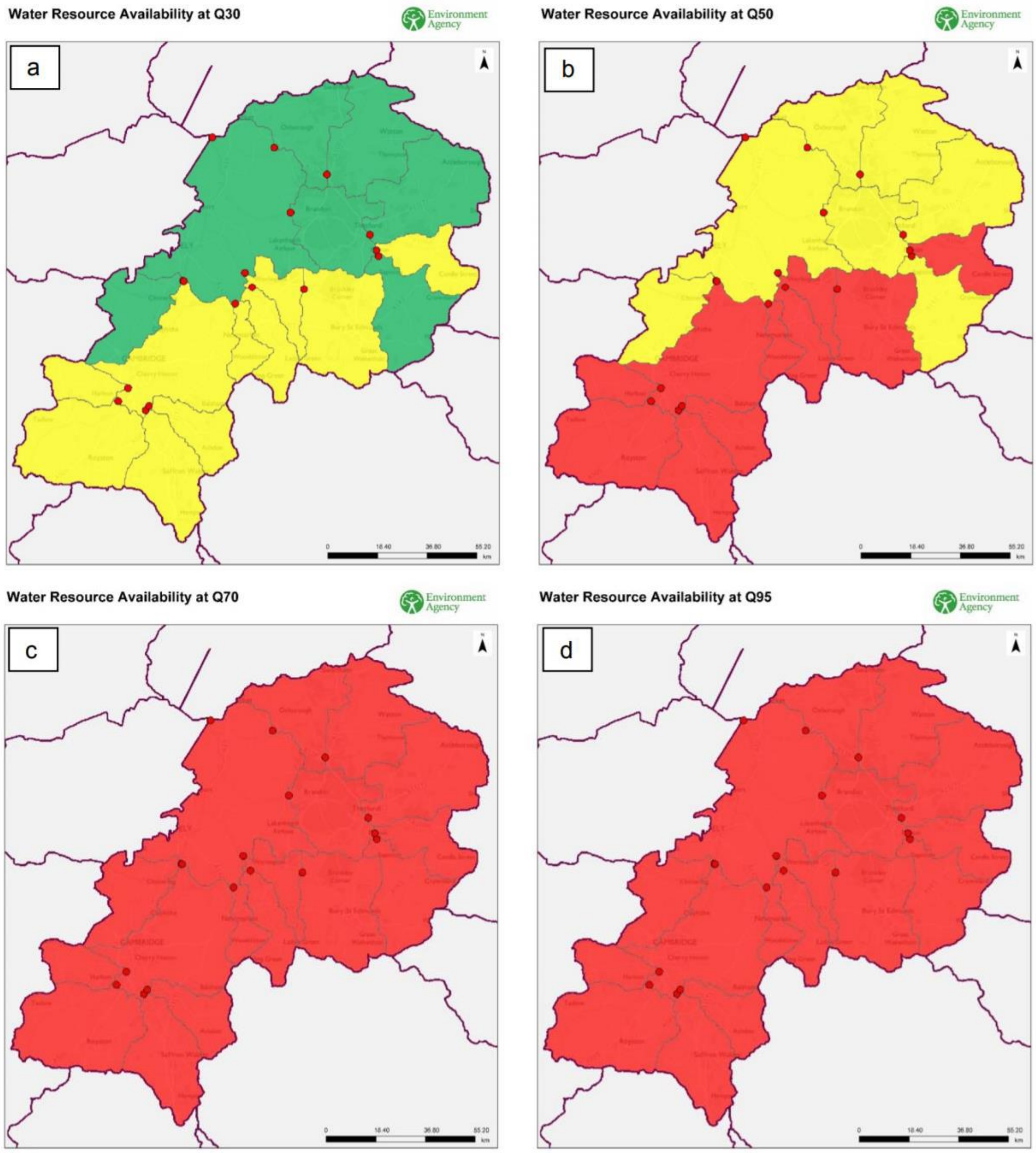

Figure 4-8: Surface water resource availability colours at Q30, Q50, Q70 and Q95 in the Cam and Ely Ouse Abstraction Licensing Strategy (Environment Agency, 2017). Red dots indicate assessment points. Q30, Q50, Q70 and Q95 flows refer to the flows that are exceeded 30%, 50%, 70% and 95% of the time. This means that abstraction may be available for about 30%, 50%, 70% and 95% of the time in a typical year.

Assess-ment Point	Catchment Name	HOF restriction (Ml/d)	No of days per annum abstraction may be available	Approximate volume available at restriction (Ml/d)	Additional restrictions
1	Old West	35 (Q33)	120	36.4	Old West LDMU level based restrictions may apply. Downstream conditions at Denver Sluice override this resource availability.
2	River Granta	23 (Q19)	69	2.8	-
3	Upper River Cam	78.5 (Q22)	80	17.5	HoF may be gauged at Dernford or Chesterford.
4	River Rhee	96.2 (Q22)	80	21.2	-
5	Bourn Brook	24.2 (Q22)	80	43.5	Level based cessation set at Fox's Bridge
6	Lower River Cam	329.9 (Q22)	80	127.6	Lodes LDMU level based restrictions may apply.

Table 4-2: Summary of licensing approach for the assessment points in the Greater Cambridge area of the Cam and Ely Ouse abstraction licensing strategy.

Groundwater Abstractions

4.5.6 The Abstraction Licensing Strategy (2017) classifies groundwater water resource availability as described in Table 4-3. There is no water available for new consumptive abstraction licences from groundwater in Greater Cambridge (Figure 4-9)[19].

4.5.7 Where groundwater abstractions directly impact on surface water flows, the impact is measured at the surface water assessment point and sometimes Hands Off Flow (HOF) or Hands Off Level (HOL) conditions applied. Two of the 26 abstraction licences currently used by Cambridge Water are affected by HOF conditions. Some other sites are currently under investigation to identify whether abstraction should be reduced and/or HOF conditions applied.

Groundwater Resource Availability Colour	Implication for licensing
Green - Water available for licensing	Groundwater unit balance shows groundwater available for licensing. New licences can be considered depending on impacts on other abstractors and on surface water. Some time-limited licence renewals may require changes to reflect historic annual usage in order to manage the risk of deterioration to the environment.
Yellow - Restricted water available for licensing	Groundwater unit balance shows more water is licensed than the amount available, but that recent actual abstractions are lower than the amount available OR that there are known local impacts likely to occur on dependent wetlands, groundwater levels or cause saline intrusions but with management options in place. In restricted groundwater units no new consumptive licences will be granted. Some time-limited licence renewals may require changes to reflect historic annual usage in order to manage the risk of deterioration to the environment. It may also be appropriate to investigate the possibilities for reducing fully licensed risks. Water may be available if you can ‘buy’ (known as licence trading) the entitlement to abstract water from an existing licence holder. In other units there may be restrictions in some areas e.g. in relation to saline intrusion.
Red - Water not available for licensing	Groundwater unit balance shows more water has been abstracted based on recent amounts than the amount available. No further consumptive licences will be granted. Some time-limited licence

[19] An update was subsequently published in December 2020 Cam and Ely Ouse Abstraction licensing strategy. Compared to the Abstraction licensing strategy groundwater resource availability map (shown in Figure 4-9 and published in 2017), there are no obvious differences.

	renewals may require changes to reflect historic annual usage in order to manage the risk of deterioration to the environment.

Table 4-3: Groundwater resource availability colours and their implications for licensing (Environment Agency).

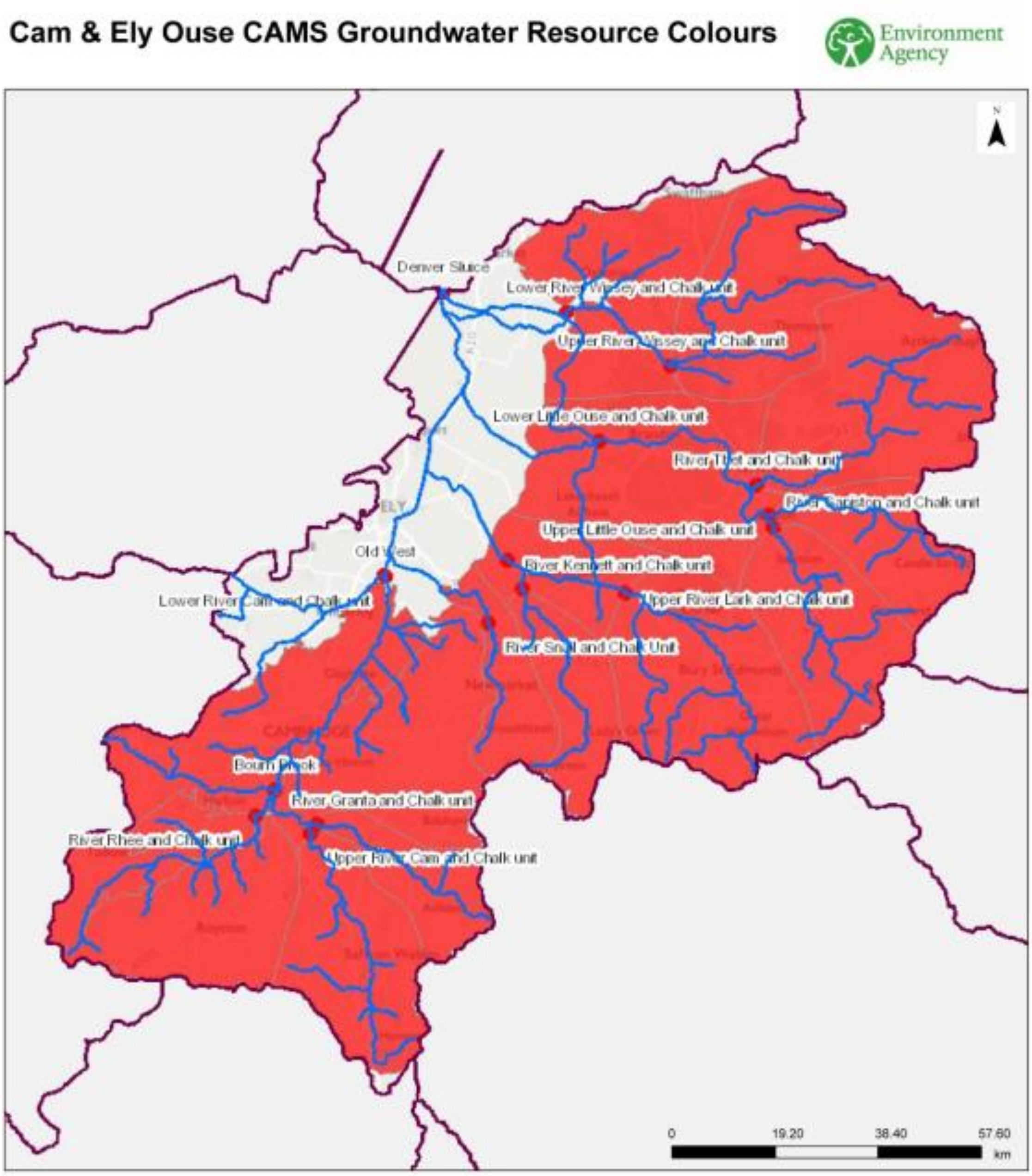

Figure 4-9: Groundwater resource availability colours in the Cam and Ely Ouse Abstraction Licensing Strategy (Environment Agency, 2017)

4.6 Impacts of Abstraction on Groundwater Levels and River Flows

4.6.1 Groundwater levels and river flows are primarily determined by weather and climate trends, as indicated in Chapter 2. Although historic data indicates that notable droughts and resulting low river levels and flows occur approximately every five to ten years, the Environment Agency and Natural England have raised concerns that human impacts on the water cycle in and near Greater Cambridge have made the environment less resilient to the natural variability between drought and flood conditions, causing environmental harm.

4.6.2 Figure 4-10 shows the Water Framework Directive surface water catchments where the hydrological regime status has been assessed to “not support good status”. These include the upper River Cam, River Granta, Hobson’s Brook and Wilbraham River. In these catchments, the reasons for not achieving “good” status include groundwater and surface water abstraction causing changes to natural flow and levels of water. These classifications confirm the detrimental impacts of abstraction on the water environment.

4.6.3 Low flows potentially cause a deterioration in water quality, due to reduced dilution of pollutants. The interaction between low flows and water quality is considered further in Chapters 5 and 6.

4.6.4 Within Greater Cambridge there are 43 Sites of Special Scientific Interest and 1 Special Area of Conservation. Natural England have provided information on sites within and near Greater Cambridge where they have particular concerns about the impacts of low water levels (Appendix B). Although some sites are located outside the Greater Cambridge area, there are nevertheless potential impacts due to the location of public water supply boreholes and other cross-boundary downstream impacts. Natural England have commented that in general groundwater flows are unable to supply adequate water quantity and quality to maintain SSSI favourable condition, and measures implemented to mitigate the impacts of abstraction have had only limited beneficial effect. Although not yet agreed or implemented, Natural England have identified that current abstraction may need to be reduced by up to 60% to achieve minimum river levels considered sustainable.

4.6.5 A number of initiatives have previously been implemented or are currently being investigated by stakeholders to reduce the impacts of abstraction on groundwater levels, river flows, water quality and ecology. These are outlined in the following sections.

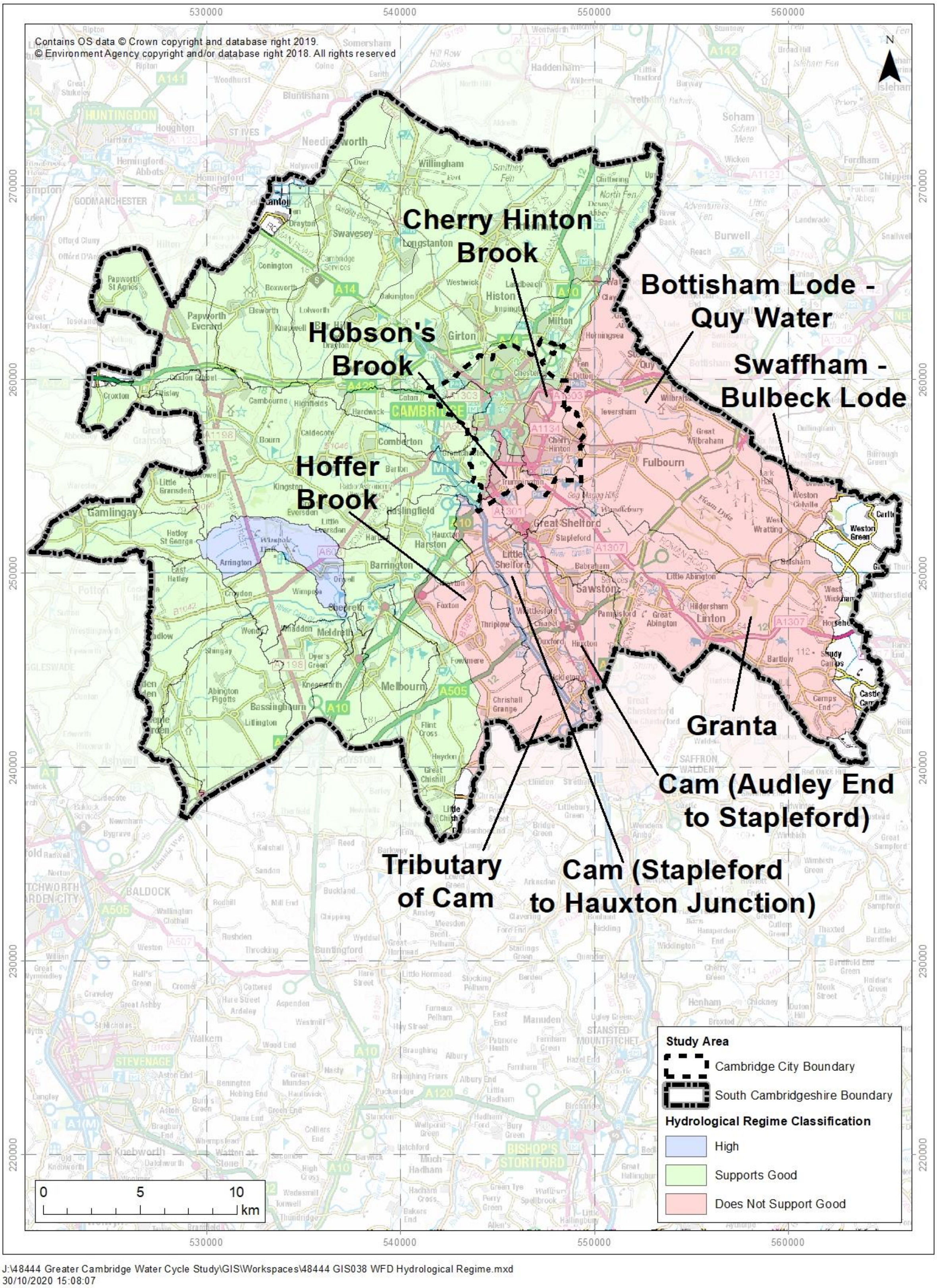

Figure 4-10: WFD Surface Water Hydrological Regime Classifications (2020). Catchments where the regime “does not support good” are labelled.

Supported Rivers

4.6.6 River support schemes have been implemented to mitigate the effects of groundwater abstraction, for public water supply, on catchment flows during dry periods. These schemes involve pumping additional water from groundwater boreholes and discharging into watercourses, to supplement river flows when groundwater levels fall too low to support them.

4.6.7 The river support schemes currently in operation are:

- The River Granta: This scheme was implemented in the 1990s, and is designed to mitigate against drought when these watercourses would naturally dry up. The support scheme involved constructing a borehole and pipeline to pump additional flows into the watercourse upstream of Linton when low levels fall below a critical threshold.

- The Cam Lodes: The scheme was constructed in the 1990s and involves five boreholes for river support, that supply water to 13 springheads via 44 km of pipeline. Maintenance of flows in these watercourses was considered important due to the high abstraction rates from the rivers for spray irrigation of Grade 1 agricultural land produce, the need to dilute wastewater treatment works discharges, to support aquatic flora and fauna and for conservation and aesthetic reasons[20]. Although the maximum output from the scheme was estimated to be 21 Ml/day, the long term average is 2.0 ML/day. The Environment Agency note that the scheme is designed to mitigate the effects of abstraction during dry periods, rather than to prevent impacts of normal drought episodes when these watercourses would naturally dry up.

- The River Rhee: eight boreholes support eight tributaries of the River Rhee including three SSSIs: Ashwell Springs, Fowlmere Watercress Beds & Thriplow Meadows. Some of the tributaries require pumping to support them every year, others only in times of drought.

- River Cam and Ashwell Springs Scheme: Affinity Water support flows in these watercourses in consultation with the Environment Agency (but also dependent on Drought Orders).

- Hobson’s Conduit / Nine Well Springs: A further low flow support scheme is currently being designed and delivered for the Vicar’s Brook and Hobson’s Conduit catchment. The conduit is a watercourse constructed in the 1600s by diverting flows from Vicar’s Brook, to bring freshwater into Cambridge from springs at Nine Wells near Great Shelford. The Nine Wells support scheme was implemented in 2020 and is operated by Cambridge Water on instruction from the Environment Agency. The scheme supports spring flows in Hobsons Brook. The 1970s drought event is regarded to be the

[20] “Groundwater support of stream flows in the Cambridge area, UK”, Rushton & Fathrop, IAHS Publication no 202, 1991

reason for loss of crenobia alpina flatworms, the biological designation of SSSI. The current status of the scheme is that it is operated as per license conditions and was so for the summer and autumn of 2020. Hobsons Conduit Trust have agreed to the scheme, via consultation with the Environment Agency and Cambridge Water in the Options Appraisal and Design.

4.6.8 While these flow support schemes may mitigate some of the impacts of over-abstraction on the watercourses, they do not address the underlying cause of over-abstraction of groundwater. Natural England do not consider artificial augmentation of surface water to be a sustainable emergency measure to limit or prevent damage to designated sites.

Environment Agency Programme: Taking Action on Unsustainable Abstraction

4.6.9 The Environment Agency launched its Restoring Sustainable Abstraction (RSA) programme in 1999 to investigate and change permanent abstraction licences that have caused environmental damage, reduced biodiversity and reduced ecosystem resilience. By May 2019, over two thirds of the original programme had been completed (282 licences amended or revoked across England), with the remainder aiming to be completed by March 2020[21]. Throughout the RSA programme up to 2019/20, Cambridge Water have voluntarily given up abstraction license of approximately 25 ML/day, around 25% of the available supplies secured in the 1990s to meet the growth in demand predicted at that time.

4.6.10 The Environment Agency is also taking action to reduce unsustainable abstraction through its licence renewal process[21], as follows:

- Surface Water abstraction:
    - All licences will need a Hands off Flow (HoF) condition to protect the ecological needs of a river at low flows. In some level controlled areas, a Hands Off Level (HoL) condition may be applied.
    - Abstraction quantities must be adequately justified and the applicant demonstrated that the water is being used efficiently.
    - Renewed licences will be time-limited.
- Groundwater abstraction:
    - Licences will only be renewed at previous quantities where the aquifer, overlying rivers and associated wetland habitats have environmentally sustainable rates of water abstraction.

[21] Abstraction reform report

- If there is a risk that ecology could be adversely affected at fully licenced rates, the licence will be capped at the historic maximum uptake rate to reduce the risk of deterioration from the 2015 RBMP baseline. The historic maximum rate will be assessed over 2005 to 2015 (except spray irrigation, which will be 2000 to 2015 to reflect climate and crop variability).
- Licences will be renewed with measures to help restore waterbodies to a sustainable level of abstraction. These measures could be licence reductions or HOF/HOL conditions.
- Renewed licences will be time-limited.

4.6.11 In addition, certain abstractions that are currently lawfully exempt from licence control are proposed to be brought into the licensing system to balance the needs of all abstractors and the environment. This will include abstraction of water into Internal Drainage Districts, dewatering of mines, quarries and engineering works, all forms of irrigation, and transfer of water into managed wetland systems.

4.6.12 The Cam and Ely Ouse was identified as a Priority Catchment for developing and testing innovative solutions to address unsustainable abstraction, promoting a catchment-based approach working collaboratively with various stakeholders to deliver solutions with multiple benefits. The measures will focus on what scope there is to redistribute existing abstraction between parties whilst ensuring there isn't an overall increase in abstraction. These innovative solutions addressing unsustainable abstraction, the promotion of catchment-based approaches bringing together all the stakeholders, as well as the measures clarifying the scope of the existing abstraction redistribution between parties are illustrated in the Cam and Ely Ouse Abstraction Licensing Strategy[14] (updated in 2020).

4.6.13 In the Cam and Ely Ouse area, the Environment Agency has stated that water rights trades will only be allowed based on recent actual abstraction, with no increase in abstraction permitted even where the licence allows greater abstraction than recent actual usage. A water rights trade is where a person or organisation sells all or part of their water right, as defined by their abstraction licence(s), to another person on a permanent or temporary basis. In the majority of cases a trade will involve a change in abstraction location and/or use which requires approval through the issue or variation of abstraction licences. The difference between the recent actual usage and the licenced rate will be recovered for environmental betterment. Cambridge Water investigated the use of such trades in its 2019 WRMP, but these were not found to be part of the optimal solution for water supply. As indicated earlier, the low volume of existing agricultural and industrial groundwater abstraction limits opportunities for public water supply trade-offs, although this should not discourage this option from being fully explored for any minor benefits it may offer.

Anglian River Basin Management Plan Actions

4.6.14 River Basin Management Plans are required under the Water Framework Directive and set out how organisations, stakeholders and communities will work together to improve the water environment. The most recent plans were published in 2015 and are due to be updated in 2021. Actions in Greater Cambridge are led by the Cam and Ely Ouse (CamEO) Catchment Partnership. The River Basin Management Plan identifies the priority management issues in this catchment to be:

- Diffuse pollution in rural areas
- Biological impacts of low flow rates and over-abstraction
- Nutrient loading.

4.6.15 The CamEO Partnership work programme for water resources[22] seeks to ensure there is enough water of sufficient quality to support the needs of the environment and wider society. They encourage and promote the adoption of best practice for water resource management throughout society including water efficiency, capture and storage, and provide mechanisms for partners to engage with and influence water resource management. No particular work programmes in Greater Cambridge have been highlighted by stakeholders for reference in this study.

Water Industry National Environment Programme (WINEP)

4.6.16 WINEP represents a set of actions that the Environment Agency has requested all 20 water companies operating in England to complete between 2020 and 2025, in order to contribute towards meeting their environmental obligations. Table 4-4 lists the actions assigned to Cambridge Water with regards to water resource usage.

4.6.17 Cambridge Water has recently commissioned an analysis of the chalk streams in Greater Cambridge, in partnership with Cambridge City Council. The study will assess the health of these chalk streams, and provide a programme of actions for local groups and stakeholders to fund and implement in partnership. Cambridge Water will use the list of projects to help inform where WINEP interventions can be directed and delivered. The project was completed in January 2021[23] and identifies a number of initial projects that could be undertaken in each catchment to improve river habitats over the short term, while acknowledging that reducing abstractions will be essential too over the long term.

[22] CamEO – Water resources

[23] Cambridge City Council – Chalk streams

Measure Type	Location	Description
Sustainability Change	Granta at Horseheath	Agreed reduction in abstraction relating to a new Hands Off Flow condition from 2025.
Sustainability Change	Granta at Linton (Alder Carr SSSI)	Measures to avoid detrimental impacts on integrity of SSSI.
Investigation and Options Appraisal	Water company scale	Survey for and develop actions / projects to protect, restore and enhance and NERC section 41 species and habitats present on any land owned or managed by the water company.
Investigation and Options Appraisal	Water company scale	Identify river restoration projects on chalk streams to improve habitats and maximise flow for Brown Trout.
Investigation and Options Appraisal	Cam (Audley End to Stapleford), Granta, Shep, Rhee, Hoffer Brook, Bourn Brook, Mel, Mill River	Investigation to determine whether increased use of groundwater abstraction will cause deterioration in the ecological status of the surface water body. If shown to cause deterioration, the investigation will look at costs of options to provide alternative sources of public water supply. It is the opinion of the EA that increased use of licences beyond maximum peak use between 2005 and 2015 may cause deterioration.
Investigation and Options Appraisal	Cam and Ely Ouse Chalk, Cam and Ely Ouse Woburn Sands	Investigation to determine whether increased use of groundwater abstraction will cause deterioration in the status of the groundwater body. If shown to cause deterioration, the investigation will look at costs of options to provide alternative sources of public water supply. It is the opinion of the EA that increased use of licences beyond maximum peak use between 2005 and 2015 may cause deterioration.

Table 4-4: WINEP statutory obligations and regulatory actions for Cambridge Water relating to water resource usage.

Water Resources East Sustainable Abstraction Study

4.6.18 Water Resources East is currently undertaking work to agree the environmental destination for the region (i.e. the volume of water which will need to be retained in the environment and not abstracted), and the environmental ambitions for the sustainable abstraction of water, the timescales over which changes need to occur, and the regional supply of water including growth.

4.6.19 As part of the Environment Agency's National Framework[24], estimates are made about the potential reductions in abstraction necessary to protect water bodies including chalk streams. The value for East of England (under the 2050 enhanced scenario) for public water supply reductions is 484 M/d.

4.7 Impacts of Climate Change

4.7.1 The potential impacts of climate change on water resources include:

- Changes to water resource availability due to annual and seasonal changes in precipitation and evapotranspiration rates and variability. Many climate change models show an increased likelihood for hotter, drier summers which could increase the likelihood of droughts.

- Changes to water demand due to behavioural changes. On average, people use 20% more water although some areas up to 40% more during hot weather periods, mainly due to watering gardens[25].

4.7.2 The Cambridge Water 2019 WRMP[26] includes an assessment of climate change on supply. Individual sources that are potentially vulnerable to climate change were identified and the potential for loss of supply across the planning period was assessed.

4.7.3 The analysis indicated less than 1% reduction in available supply by 2045. This small impact reflects the fact that many of the groundwater abstraction sources in the Cambridge Water area are licence-constrained rather than resource-constrained (i.e. constrained by Environment Agency limitations for sustainability objectives, rather than the absolute maximum quantity of water it would be possible to abstract).

4.7.4 The analysis did not take into account the potential impact of climate change on environmental resilience. Increased frequency of drought periods may lead to increased vulnerability of surface water bodies to low flow conditions. This

[24] Appendix 4 Longer term environmental water needs
[25] Water UK – Hot weather infographic 310520
[26] Cambridge climate change impacts on supply

may require reductions in groundwater abstractions to avoid deterioration in water body ecological status.

4.7.5 The Cambridge Water WRMP includes an estimate of the effects of climate change on household demand considering that the final forecast year is 2044/45[27]. Climate change impacts were estimated following the UKWIR 13/CL/04/12 "Impacts of Climate Change on Demand" methodology. An increase in demand was estimated at +0.75% in annual average conditions and +2.05% during the "critical period" (a summer peak period of a week). This increase is included in the household demand forecast in the WRMP, and the uncertainty associated with this estimate is included in the headroom allowance.

4.7.6 It is anticipated that the analysis will be updated to reflect the latest UKCP18 climate projections in the next WRMP, due in 2024.

4.8 Future Water Resource Planning

4.8.1 Water resource planning for public water supply is undertaken by:

- Cambridge Water, through their Water Resource Management Plan (WRMP), in compliance with the Water Industry Act (1991) which requires that water companies develop and maintain an efficient and economical system of water supply within their area, and the Water Resources Management Plan Regulations (2007), which sets out the formal process for completing a WRMP including consultation and publication. The most recent WRMP was published in 2019, and the next update is due in 2024.

- Water Resources East, who are now responsible for regional water resource planning for Eastern England. WRE is preparing their first regional water resource management plan, which will be ready in summer 2021, and it will generate a long list of option portfolios which will then be used in the co-creation Planning Conferences in Autumn 2021 with WRE's members. This will generate a preferred portfolio of options which will be published in January 2022 for public consultation. The regional plan will consider options for resolving deficits from across sectors (e.g. Canals and Rivers Trust, Internal Drainage Boards and National Grid) and will consider options from beyond individual company zones such as the regional strategic options and transfers set out in the Ofwat final determination[28]. The regional plan will form the basis for the next 2024 Cambridge Water WRMP.

4.8.2 The Cambridge Water 2019 WRMP sets out the company forecasts for supply and demand for the period 2020 to 2045, and assesses options to meet any future deficit where demand is forecast to exceed supply. The WRMP has been revised following public consultation (including consultation with the Environment Agency and Natural England) and is agreed with Ofwat as the

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[27] Cambridge Water WRMP19 Household consumption forecast: Baseline forecast

[28] Ofwat PR19 final determinations strategic regional water resource solutions appendix

basis for Cambridge Water's Water Resource Business Plan and pricing agreement. This plan has been reviewed below to identify what capacity is currently available for further growth in the region.

Baseline Supply-Demand Balance

4.8.3 The "baseline" scenario considers the continuation of existing supply and demand patterns without any mitigating options to meet future deficit. Under this scenario (Figure 4-11):

- The total water available for use decreases from 94 Ml/d in 2017, to 87 Ml/d from 2020 onwards due to restoration of sustainable abstraction caps and changes in deployable output due to climate change.
- The total water demand (household consumption, non-household consumption and leakage) is forecast to increase from 82 Ml/d in 2017, to 84 Ml/d from 2020 and up to 91 Ml/d by 2045. The total water demand exceeds the available water supply from 2025. By 2045, there is a 4 Ml/d deficit between supply and demand.
- The target headroom, including an allowance for climate change, increases from 2 Ml/d in 2020 to 3 Ml/d by 2045. When the target headroom is included, there is a deficit in water supply from 2022 onwards. By 2045 there is a 7 Ml/d deficit between supply and demand including target headroom.

4.8.4 The increase in water demand from 2020 to 2045 reflects an assumed population increase of 73,000 or 20%, across the Cambridge Water resource zone (Greater Cambridge plus Huntingdon wards). This population increase is in keeping with the population growth forecast by Cambridgeshire Insights based on the previous 2018 Local Plan (Figure 4-12). The baseline forecast assumes that average household consumption reduces slightly from 140 l/p/d in 2020 to 133 l/p/d by 2045, due to changes in demographics and housing stock, and assuming metering increases from 75% of properties to 88% of properties over the period.

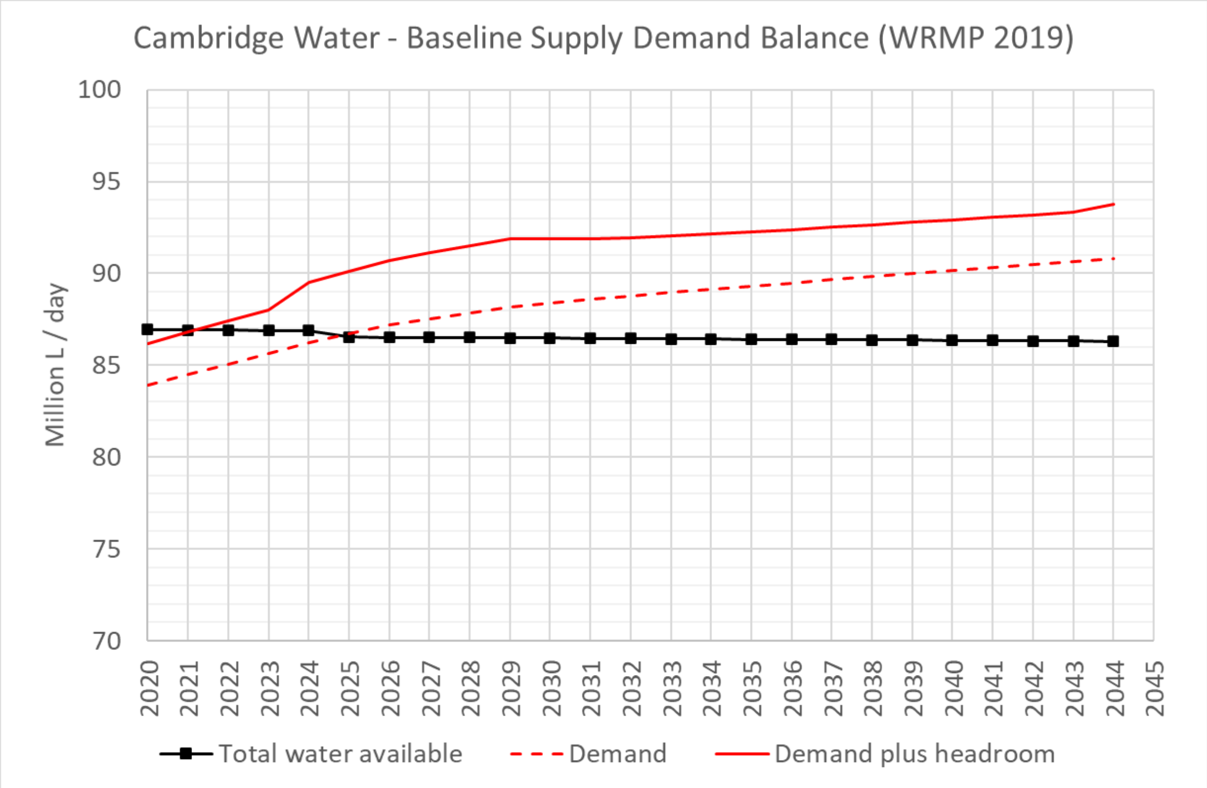


Figure 4-11: Cambridge Water Baseline Supply Demand Balance (WRMP 2019)

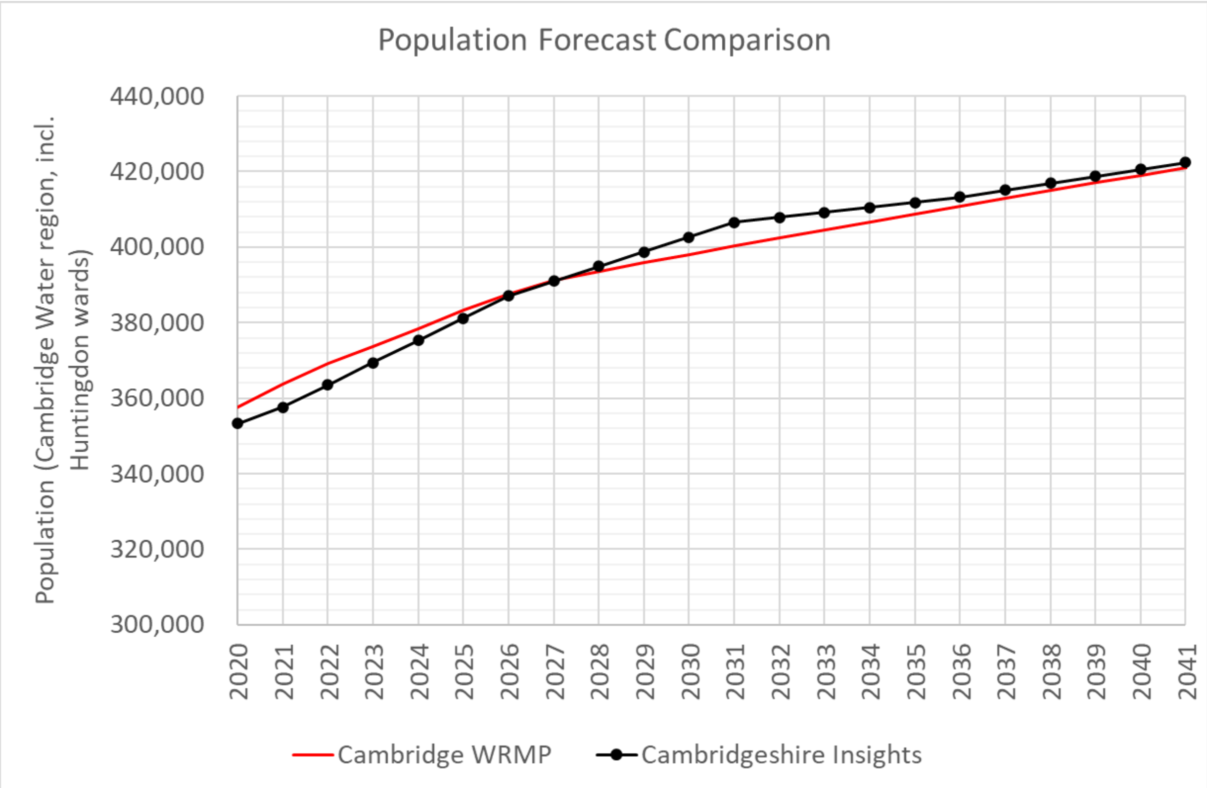


Figure 4-12: Cambridge Water region population forecast comparisons

Options Appraisal

4.8.5 To meet the deficit in the baseline supply-demand balance, the 2019 WRMP considered feasible options to both increase supply and reduce demand, including:

a. Options to increase raw water abstractions, including:
   - New abstractions from the Ouse gravels aquifer
   - Recommissioning previously closed boreholes from the Chalk aquifer
   - Constructing new surface water storage reservoirs (Upper Stour, Ely Ouse or Great Ouse catchments)
   - Creating a string of high flow winter reservoirs at a variety of sites
   - Licence trading
   - Bulk imports of raw or potable water from neighbouring water companies (Anglian Water and Affinity Water)
   - Transfer / trade with the Ely Ouse Essex Transfer scheme

b. Options to reduce distribution losses, including:
   - Active leakage management to various capacities
   - Pressure management

c. Options to reduce customer demand, including:
   - Water efficiency commitments of various capacities
   - Increased water metering, including compulsory metering

4.8.6 The options appraisal process involved iterative screening of the initial Long (Unconstrained) List of options to develop a Short (Constrained) List of options for detailed review in a Decision Making Framework investment model. This approach enabled scheme development to be integrated with the Strategic Environmental Appraisal, the Habitats Regulations Assessment, and the Water Framework Directive Compliance Assessment (all supporting documents to the WRMP), and including consultation with key stakeholders. Screening criteria included scale and location of the scheme benefits, future proofing, environmental and planning constraints, customer service needs, stakeholder acceptability, and robustness of option (flexibility, viability, known technologies and licensing). The detailed review of the Short (Constrained) List considered technical feasibility, delivery risks, environmental constraints and costs (whole life capital and operational costs). Further details on the appraisal are provided in Appendix S of the 2019 WRMP.

Final Supply-Demand Balance

4.8.7 The selected options for the final plan involved:

- Increasing raw water abstraction: Raw water abstractions increased by up to 4 Ml/d from 2024, following the recommissioning of three previously closed boreholes from the Chalk aquifer (with improved treatment facilities to overcome previous issues at these sites). These sites were assessed within the Strategic Environmental Appraisal as having a low risk of impacting Water Framework Directive objectives and watercourse flows.
- Reducing distribution losses: Active leakage management, with reductions starting at <0.5 Ml/d in 2020 and increasing to 3.5 Ml/d by 2045.
- Reduced customer demand: enhanced free metering and water efficiency commitments to reduce customer demand by approx. 0.5 Ml/d in 2020, increasing to 2.5 Ml/d by 2045, and additional customer supply pipe leakage reductions of up to 2 Ml/d by 2045. Average household per capita consumption is assumed to decrease to 127 l/p/d and the percent of metered households increased to 91% over the planning period.

4.8.8 Typically WRMPs adopt a twin track approach of equal supply capacity increases with demand reductions. However, in the Cambridge Water resource zone, the combined distribution side and customer side demand reductions outweigh supply increases, due to the restrictions on water availability in the region (Figure 4-13).

4.8.9 Together, these options increase the total water available and flatten the demand curve across the planning period (Figure 4-14), to maintain approximately 4 Ml/d additional available headroom above the target requirement.

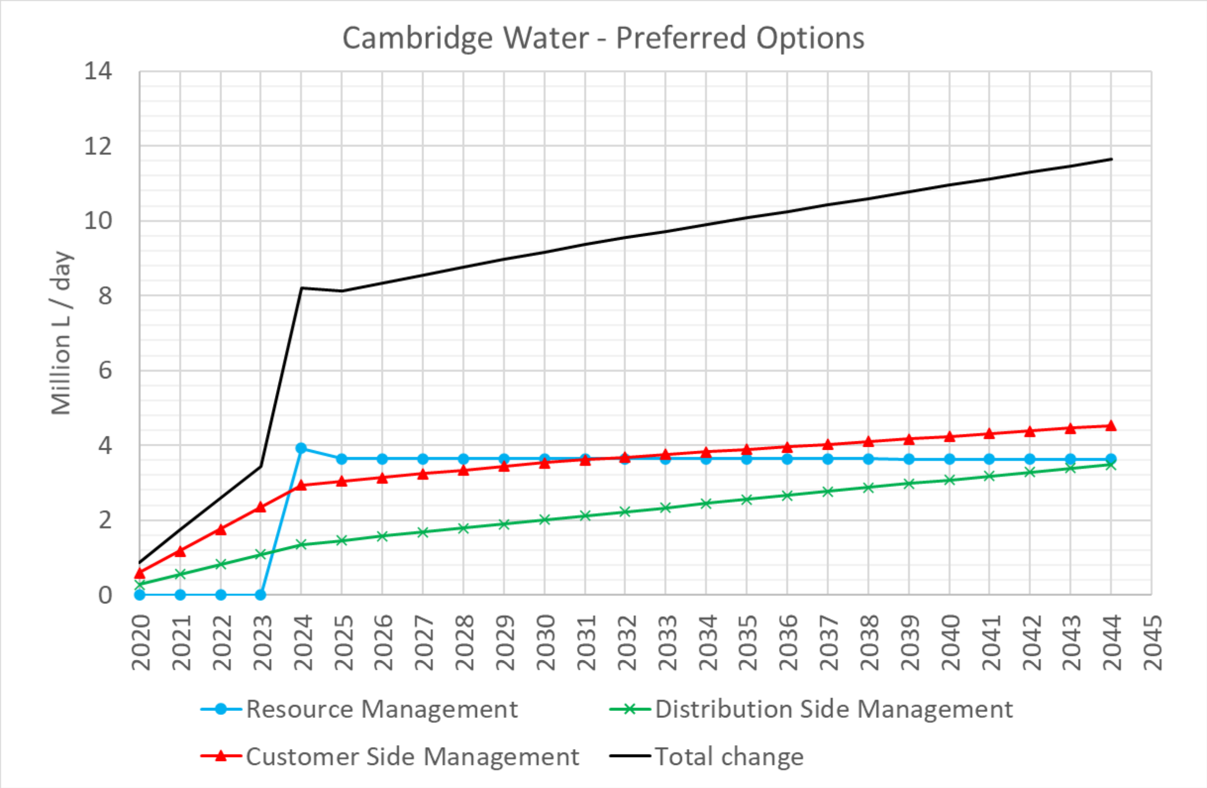


Figure 4-13: Cambridge Water Preferred Options (WRMP 2019)

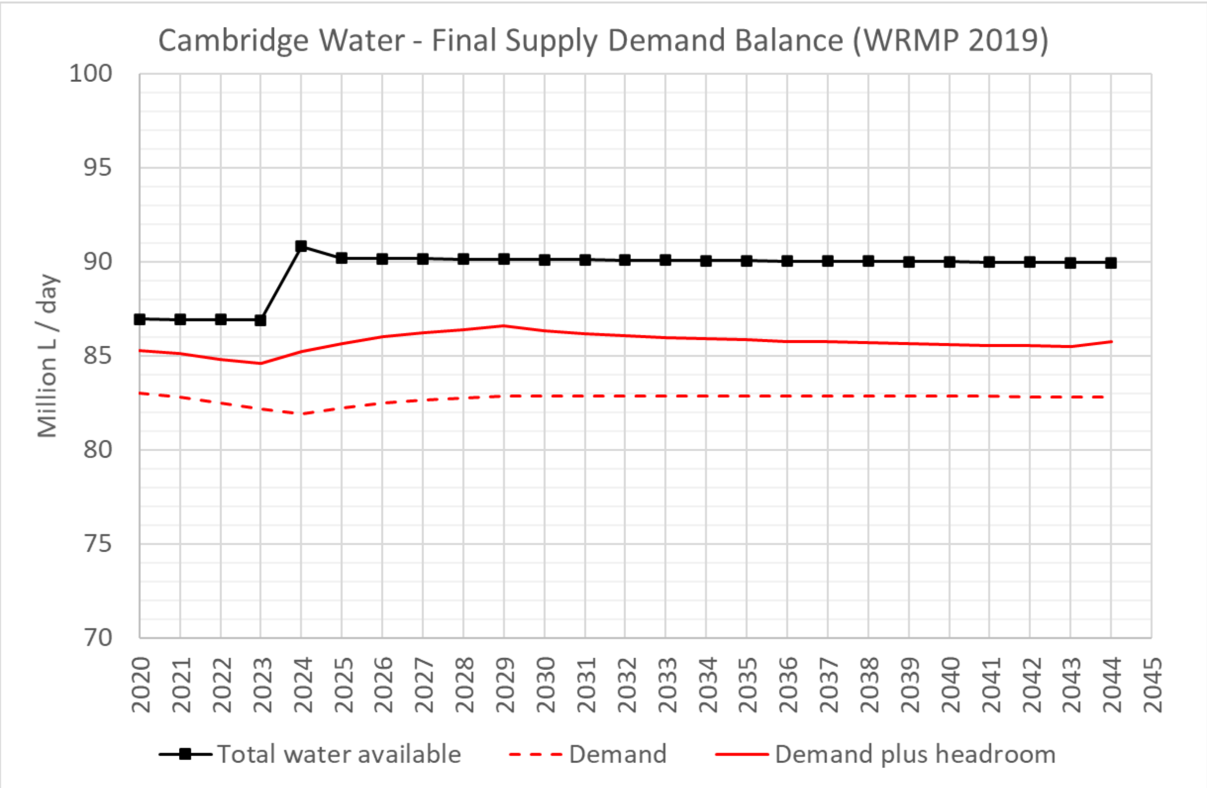


Figure 4-14: Cambridge Water Final Supply Demand Balance (WRMP 2019)

Constraints and Opportunities for Additional Development

4.8.10 There is no environmental capacity for new development (beyond that already allowed for in the WRMP) to be supplied with water by increased abstraction from the chalk aquifer. To meet future demands, potable water supplies will need to be increased in other ways, such as through reduced usage (demand management), reduced leakage, licence trading, and the development of new supply options at the regional scale (e.g. importing water from outside of the Cambridge Water supply area).

4.8.11 There is an available additional headroom (supply-demand balance) of between 2 and 4 mL/d in the current WRMP, taking into account the proposed options to maximise supply and reduce demand. However, the supply-demand balance will be reviewed for the next WRMP (to be published in 2023), and the available headroom may be reduced, particularly where significant non-household or commercial development is proposed and gains planning approval. The Environment Agency would like to see existing headroom prioritised for environmental betterment.

4.8.12 The Environment Agency has not specified what further reductions in abstractions may be required to go beyond the existing cost-benefit tested levels of improvement being actioned through the Water Industry National Environment Programme (WINEP). WRE is currently undertaking work to agree the environmental destination for the region (i.e. the volume of water which will need to be retained in the environment and not abstracted), and the environmental ambitions for the sustainable abstraction of water, the timescales over which changes need to occur, and the regional supply of water including growth. This work will be ready in Summer 2021 and can include allowance for the Greater Cambridge preferred growth trajectory, once known. Significant decreases in licensed groundwater abstraction rates will not be feasible until alternative potable water sources are available. If new sources are not available and growth continues there will be deterioration to water habitats.

4.8.13 It is therefore assumed that the new Local Plan will assume decreasing levels of abstraction with new sources, improved efficiency and less leakage compensating for this and providing for growth. If new sources and other measures are not achieved then there will be deterioration to water habitats. If deterioration is to be avoided, development trajectories may need to be altered until sufficient water is available.

4.8.14 To address uncertainties regarding the effects of abstraction on designated sites (including those sites where remedial measures are in place but their efficacy is still being monitored), Natural England recommend a precautionary approach to be adopted. Adverse impacts should be assumed unless evidence is available to demonstrate otherwise.

4.8.15 Water Resources East is coordinating regional efforts to increase water supply, including construction of major new potable water supply reservoirs. In the longer term (2035 onwards), the new infrastructure could provide water to Greater Cambridge. Cambridge Water are key (founding) members of Water Resources East and will be direct beneficiaries of any new supply options developed through the Water Resources East planning process.

4.8.16 Discussions with Water Resources East have indicated:

- Major new water supply infrastructure is being planned for the Anglian Region, including:
  - A new water supply reservoir in Lincolnshire, which, if funded, would be operational from 2035.
  - A new water supply reservoir in the Fenland / Ouse Washes area (the Fens Reservoir), which, if funded, could be operational from 2040 (or earlier depending on the design), and will be geographically closer to the Greater Cambridge area.

  These new reservoirs can be designed to include allowance for significant reductions in abstraction rates and for increased demand due to additional growth in the Greater Cambridge area. WRE, Cambridge Water and Anglian Water are currently in discussion about new resource schemes and inter-company transfers. The potential demand for water in Greater Cambridge will form part of WRE's regional modelling to inform the strategy being developed.

- Interim measures are being considered by WRE to reduce abstraction and increase supply from other sources before 2035, including:
  - Further water efficiency, demand management and aggressive leakage management measures.
  - Prioritisation of abstraction from the chalk aquifer for public water supply, through licence trading to transfer water between sectors without increasing the actual abstraction rates. Other existing abstractors (e.g. agricultural irrigation) would be supplied instead through new on-farm reservoirs and potentially treated effluent.
  - Reconnection of modified streams to their floodplains, and capture and storage of higher winter flows, leading to improved river flow and increased groundwater recharge through land use management schemes (e.g. ELMS pilot project in Granta / Bourn catchment, see Section 8.3).
  - Considering bulk water transfers within the region. Water quality and chemistry, customer tastes and perceptions mean that it is not always practical to mix transfer water from different sources in the existing network, without further additional treatment (polishing) which has additional costs and carbon impacts. However, it is plausible that discrete settlements near to the Cambridge Water boundary (e.g.

Cambourne area) could be separated from the existing network and supplied by bulk imports. Both Anglian Water and Affinity Water currently have no capacity for bulk water transfers in their current WRMPs, and further work would be needed by WRE to broker transfer agreements for the AMP8 cycle (2025 – 2030). For example, Anglian Water's new Strategic Pipeline and Grid will bring water from North Lincolnshire to Suffolk and beyond, passing near to the Cambridge Water region by 2025.

4.8.17 Table 4-5 summarises the supply options considered but not selected by Cambridge Water in the 2019 WRMP:

- New surface water sources were considered involving the construction of reservoirs in various locations, with capacities of 10 to 40 Ml/d individually. These options were expensive, with net present value costs (construction and whole life operation) of £150,000,000 to £631,000,000, and high p/m^3 costs for the water provided compared to other supply options. In general, larger reservoirs at a single site had greater net present value costs but gave a lower p/m^3 cost of water, indicating economies of scale. The timescale for planning, designing and constructing reservoirs was not specified, but could be in the order of 15 to 20 years, and would not be achievable in less than 10 years.

- Bulk import options were considered, including transfers from Anglian Water and Affinity Water, and amendments to the Ely Ouse Essex Transfer scheme (Box 4-2) to divert flows to Greater Cambridge. These options could supply between 8 and 40 Ml/d individually. The estimated cost of these options was between £50,000,000 and £370,000,000, with moderately high p/m^3 costs compared to other supply options. These options would be reliant on capacity being available in the neighbouring water companies to support the transfers, which is considered unlikely. The timescale for planning, designing and constructing new pipelines was not specified, but could be in the order of 10 to 15 years, and would be unlikely to be achievable in less than 8 years.

- New groundwater sources considered included abstraction from the Ouse gravels and licence trading. These options could supply 0.2 to 5 Ml/d individually. The estimated cost of these options was comparatively low, between £10,000,000 and £38,000,000, with mostly low p/m^3 costs compared to other supply options. The licence trading options would rely on the acceptability of increasing abstraction to permit allowances from currently unused / underused licences, or would require the existing licence holder to find alternative sources (considered unlikely). Increased abstraction from the Ouse gravels could cause deterioration in the WFD status. The timescale for planning, designing and constructing any required infrastructure was not specified, but could be in the order of 5 – 10 years.

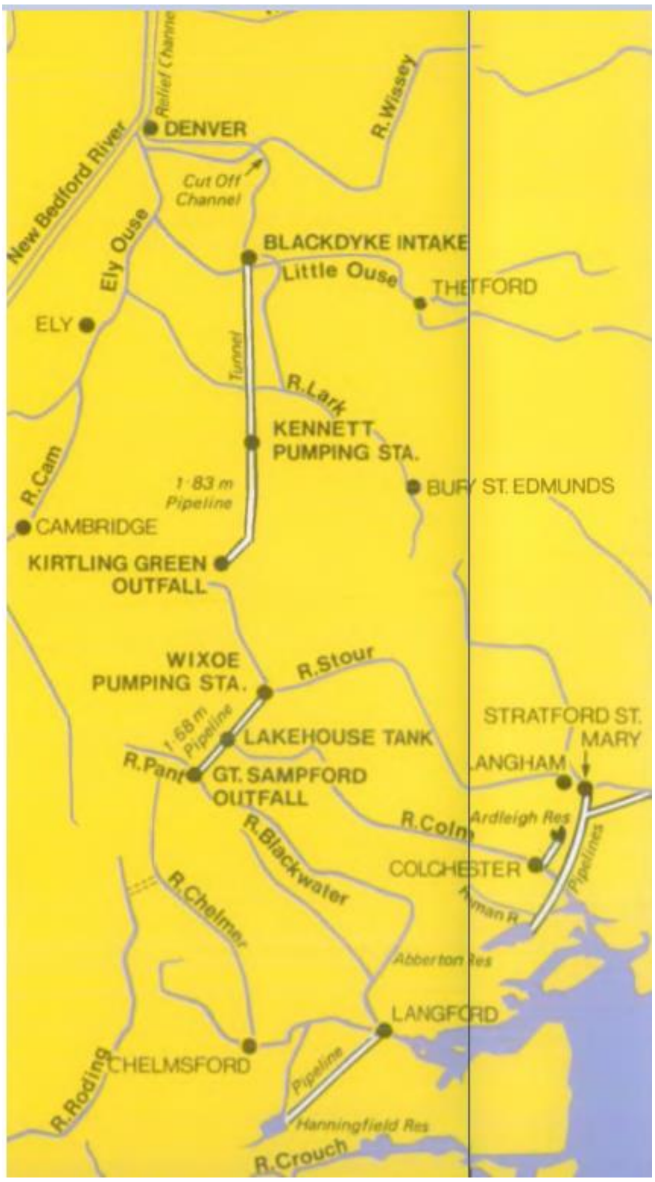
4.8.18 Table 4-6 summarises the distribution side options considered but not selected by Cambridge Water in the 2019 WRMP. The selected package provided an estimated capacity of 3.9 Ml/d through leakage reduction measures and 1.4 Ml/d through live network active leakage management. Potentially, a further 3 Ml/d capacity could be provided by more aggressive leakage management packages (e.g. Leakage Bundles 004 or 005). The costs of these packages is between £16,000,000 and £78,000,000. However, the achievability of these leakage measures is uncertain, and the reductions already adopted by Cambridge Water are considered ambitious.

4.8.19 Table 4-7 summarises the customer side options considered but not selected by Cambridge Water in the 2019 WRMP. The selected package involved water efficiency and metering measures to give in the order of 0.9 Ml/d total reduced demand. Potentially, up to an additional 2 Ml/d reduced demand could be achieved by more aggressive compulsory metering strategies. Compulsory metering can be enforced in areas which are deemed to be in serious water stress by the Secretary of State under the Water Industry Act (1991). These areas were updated in 2013 and did not include the Cambridge Water region[29]. Therefore it was not possible until recently for Cambridge Water to enforce compulsory metering.

4.8.20 However, inJuly 2021 the Environment Agency confirmed that the Cambridge area is within the zone assessed to be under severe water stress[30], allowing Cambridge Water to adopt compulsory metering, if this is also supported by the customers. However, with over 75% of dwellings already metered, the additional savings would be relatively marginal. Nevertheless, Cambridge Water support water supply on a measured basis to help manage demands and promote water efficiency.

[29] The following water company areas were classified as areas of serious water stress by the Environment Agency and Natural Resources Wales (2013 classifications): Affinity Water, Anglian Water, Essex and Suffolk Water, South East Water, Southern Water, Sutton and East Surrey Water, Thames Water.

[30] Water stressed areas 2021 classification



The Ely Ouse Essex Water Transfer Scheme

The Ely Ouse Essex Water Transfer Scheme was developed in the 1960s to transfer surplus water from the Ely Ouse to head waters of Essex rivers, to increase their flows and make available extra water to existing reservoirs in Essex to supply an expanding population in the South Essex area in the 1970s. The scheme was promoted by the former Great Ouse and Essex River Authorities, through the Ely Ouse Essex Water Act 1968.

Under the scheme, surplus water that would otherwise be discharged to the Wash via the tidal River Great Ouse is transferred into the Cut Off Channel at Denver, with reverse flow achieved via an impounding sluice to direct water 25km south-east to Blackdyke, Hockwold. At this point, water is drawn off into a 20 km long tunnel to Kennett. Here, pumps drive the water through a rising main over the watershed and into the River Stour at Kirtling Green. Part of the discharge is drawn off at Wixoe and pumped over further watersheds to the River Pant. The flow is ultimately diverted and stored in the Abberton, Ardleigh and Hanningfield reservoirs for public water supply.

The scheme can transfer up to 48 Ml/d of water. The rate of flow actually transferred is variable, and managed by the EA to take into account the amount of water stored in the Essex reservoirs, the available water in the Essex rivers, and the availability of water from the Ely Ouse catchment to transfer.

Box 4-2: The Ely Ouse Essex Water Transfer Scheme, from NRA Anglian 114 publication

Option	Water Source	Potential Capacity (Ml/d)	Indicative Cost[31] £000	£/m^3
Ouse gravel sources	Groundwater	2	20,000	96
Adopt BRAWS (Anglian Water asset)	Groundwater	5	33,000	65
Licence trading at BARR	Groundwater	0.2	10,000	394
Licence trading – AWS Thetford	Groundwater	5	38,000	75
Upper Stour reservoir	Surface water	40	430,000	148
Upper Stour reservoir	Surface water	24	336,000	193
Abstraction from Ely Ouse with reservoir	Surface water	40	510,000	175
Abstraction from Ely Ouse with reservoir	Surface water	25	464,000	255
Abstraction from Ely Ouse with reservoir	Surface water	20	449,000	309
New raised reservoir on Great Ouse	Surface water	40	341,000	117
New raised reservoir on Great Ouse	Surface water	30	311,000	142
New raised reservoir on Great Ouse	Surface water	24	267,000	153
New raised reservoir on Great Ouse	Surface water	18	234,000	178
String of high flow winter reservoirs – 1 site	Surface water	10	144,000	198
Two high flow winter reservoirs – 2 sites	Surface water	20	296,000	204
Three high flow winter reservoirs – 3 sites	Surface water	30	458,000	210
Four high flow winter reservoirs – 4 sites	Surface water	40	631,000	217
String of high flow winter reservoirs – 4 sub-option with smaller overall capacity	Surface water	24	523,000	300
Bulk supply – KDAWS (Anglian Water)	Bulk import	10	52,000	73
Treated water reservoir in A428 corridor	Bulk import	8	92,000	141
Affinity transfer via LOPW	Bulk import	8	101,000	122
Transfer from west (AWS) to Caxton Gibbet	Bulk import	8	135,000	162
Ely to Waterbeach (AWS)	Bulk import	10	115,000	159
Haverhill to Shudy Camps	Bulk import	10	94,000	130
Transfer from Haverhill to RIPW / LIPW	Bulk import	20	189,146	130
Transfer/ trade with Ely Ouse Essex transfer	Bulk import	10	90,000	125
Ely Ouse Essex transfer reversal from Abberton	Bulk import	40	366,000	125
Ely Ouse Essex transfer reversal from Abberton	Bulk import	24	324,000	186
Ely Ouse Essex transfer with new reservoir	Bulk import	40	368,000	127
Ely Ouse Essex transfer with new reservoir	Bulk import	24	344,000	197

Table 4-5: Resource side options considered but not selected in the 2019 WRMP to increase water supply abstractions, imports, and transfers.

[31] Net present value of capital and operational expenditure, rounded to nearest £1,000,000

Option	Type of Option	Potential Capacity (Ml/d)	Indicative Cost[32] £000	£/m^3
Leakage Bundle 001	Pressure management	2.5	2,000	6
Leakage Bundle 002	Active Leakage Management	3.5	3,000	8
Leakage Bundle 003	Active Leakage Management	5.6	8,000	15
Leakage Bundle 004	Active Leakage Management	7.0	16,000	27
Leakage Bundle 005	Active Leakage Management	7.4	78,000	118
Leakage Bundle 006	Active Leakage Management	1.8	4,000	25
Leakage Bundle 007	Active Leakage Management	3.4	10,000	33
Leakage Bundle 008	Active Leakage Management	4.5	19,000	50
Leakage Bundle 009	Active Leakage Management	4.7	32,000	83
Live network – 500 - CAM	Active Leakage Management	1.4	3,000	24

Table 4-6: Distribution side options considered but not selected in the 2019 WRMP to reduce distribution losses.

[32] Net present value of capital and operational expenditure, rounded to nearest £1,000,000

Option	Type of Option	Potential Capacity (Ml/d)	Indicative Cost[33] £000	£/m^3
CAM Non-metering	Water efficiency	0.9	8,000	292
Water efficiency commitment	Water efficiency	0.6	5,000	86
CAM AMR Compulsory	Compulsory metering	2.5	19,000	103
CAM AMR Enhanced	Metering optants	1.0	11,000	239
CAM AMR Change of occupier	Metering change of occupancy	1.3	14,000	216
CAM Top 5 non-exclusive AIC	Compulsory metering	2.8	16,000	71
CAM Compulsory metering variation (AMR)	Compulsory meeting	1.7	10,000	65
CAM Compulsory metering variation (AMI)	Compulsory meeting	2.3	9,000	41

Table 4-7: Customer side options considered but not selected in the 2019 WRMP to reduce volume delivered to measured and unmeasured households

[33] Net present value of capital and operational expenditure, rounded to nearest £1,000,000

4.8.21 This review indicates no low-cost, straightforward, reliable, and quick measures for significantly increasing water availability before large-scale regional solutions are plausibly operational in the mid-2030s onwards. This means that any additional development allocated in the new Local Plan to be built before then will need to:

- Reduce demand as far as possible using water efficiency measures such as suitable fixtures and fittings or rainwater harvesting systems.
- Be of a suitable scale that the residual demand can be mitigated by interim adaptation measures, implemented in the next WRMP cycle, that do not result in increased abstraction from the Chalk aquifer or reductions to existing headroom.

4.9 Water Re-Use Systems and Water Demand Management

4.9.1 Demand for potable water has increased from an average of 85 litres per person in the 1960s to 140 litres per person today. The Government has recognised that reducing demand will be essential to prevent water resources shortages within the next 20 years.

4.9.2 A 2018 study[34] examining the long term potential for deep reductions in household water demand identified that it could be possible to achieve an average household consumption of between 50 and 70 litres per person per day without a reduction in the level of utility or quality of water use, by a combination of water demand reduction measures:

- Changing consumer choice of water using practices, through smart metering, tariffs, pay-per-use applications, linking energy and water efficiency.
- Delivering greater efficiency with ultra-low flush toilets, recycling showers, waterless washing machines.
- Changing public perceptions about water with incentives, home water reports, smart bills, social norms and feedbacks.
- Affecting customer choice in purchasing decisions with compulsory water labelling, rebates and scrappage schemes.
- Affecting the governance, funding and regulation of water service providers, through water neutrality, supply pipe ownership, natural capital accounting and utility bundling.
- Affecting resource provision with community rainwater harvesting, and reducing the amount of water available for public supply.

[34] "The Long Term Potential for Deep Reductions in Household Water Demand", 2018, Artesia Consulting for OFWAT

- Reducing water waste, focusing on leaky toilets and drop valve toilets, leak detectors, smart taps and smart showers.

4.9.3 The report acknowledges that this level of reductions cannot be delivered by the water industry working in isolation. For example, national planning rules need to be updated to require all new developments to be more water efficient. There needs to be a greater awareness of water scarcity issues in the UK, combined with stronger leadership to ensure that water companies, government, regulators, the supply chain, academia, innovators and others work in a concerted and coordinated way.

4.9.4 The new Local Plan provides the opportunity to reduce water demand in new developments, beyond the Building Regulations standard requirement of 125 l/p/d, making full use of water efficiency and water re-use measures at the individual property and site scale. However, it is currently unclear whether the Local Plan would be able to impose a domestic household per capita consumption that is lower than the Building Regulations optional requirement of 110 l/p/d, as there is currently no precedent.

Changing Behaviour

4.9.5 There have been a number of campaigns aimed at encouraging consumers to take an active role in conservation of water resources. Research[35] indicates that while the public intuitively recognise water as a previous resource, it is simultaneously considered abundant and therefore although individuals are conscious of the issue they are not concerned (e.g. due to the frequency of rainy days, a lack of feedback between water availability and price, and a lack of threat of water restrictions other than hose pipe bans). Households perceive there is little scope for change as they “use only as much as they need”, but are largely unaware of what “normal” is because many water use behaviours are private. There are competing motivations for water use including hygiene, luxury and relaxation, with higher water usage associated with the presence of children and especially teenagers. The research indicated that messaging campaigns should target actions, behaviours and norms at an emotional rather than rational level.

4.9.6 Locally, both Cambridge Water and Anglian Water (Box 4-3) actively encourage their customers to use less water. The Cambridge Water website includes FAQs on why customers should use less water, and tips on how to reduce water consumption at home, outside, and at work. Cambridge Water also offer their customers free water efficiency devices including regulated shower heads, toilet leak detector strips, universal sink plugs, shower timers and cistern bags.

4.9.7 Internationally, both Australia and South Africa have successfully changed public behaviour to reduce water demand in response to severe drought. In

[35] “Understanding Household Water Behaviours and Testing Water Efficiency Measures”, 2013, Icaro Consulting for DEFRA

Australia, the 2000s drought was the worst on record and placed extreme pressure on water supply across much of southern Australia. As well as constructing major new water supply infrastructure including six desalination plants, water efficiency initiatives were successfully used to reduce demand by 30% through customer engagement activities such as the humorous "Nature Knows Best" campaign. In South Africa, severe drought led to significant water restrictions and penalties being imposed on residents in Cape Town to force changes in behaviour (Box 4-4).

4.9.8 These examples show that it is possible to significantly reduce demand to successfully address immediate severe drought shortages, and promote longer term behavioural changes even when normal supply conditions returned. However, the acceptability of these more extreme campaigns in the UK in the absence of severe drought conditions is questionable, and water companies have a statutory obligation to supply water.

The Innovation Shop Window and the Smarter Drop Projects, Newmarket

The Innovation Shop Window is Anglian Water's programme to trial new, creative tools, processes and campaigns for water management in Newmarket. If trials are successful, they will be rolled out into other areas. For example, leakage has been reduced by 23% using pressure monitoring and active leak reduction. The Smarter Drop campaign is being trialled through Innovation Shop Window programme to reduce customer demand for water. It aims to reduce water consumption to 80 l/p/d and make Newmarket one of the most water efficient towns in the UK. The first year of the campaign resulted in a 6% decrease in water demand. The campaign included opening a pop-up shop to invite local customers to find out how to reduce their water usage. Activities at the Smarter Drop Shop include water saving tips and ideas, free tools and devices (e.g. shower times and dual flush converters), a water efficiency challenge competition, kids craft activities, a photo pledge booth, and personal advice from Anglian Water staff including a free water saving home visit.

Box 4-3: The Smarter Drop Project, Anglian Water

The Cape Town Water Crisis

"We can no longer ask people to stop wasting water. We must force them," Cape Town Mayor Patricia de Lille, January 2018

Severe water shortages in South Africa led to a water crisis in Cape Town by early 2018, with mains water supplies potentially being suspended by April. The city authorities responded with water saving initiatives to significantly reduce demand and consumption, including 2 minute showers, reduced toilet flushing, and manual re-use of greywater for gardens and flushing toilets[36]. At its most extreme, residents were restricted to a maximum of 50 l/p/d. Households using high volumes of water were publicly named and fined, water tariffs were significantly increased to punitive levels for highest users, water pressure in the pipes was reduced, and management devices were installed to set daily limits of water supplied to individual properties. The city successfully reduced its daily water usage by more than 50%, which combined with heavy rainfall in June, allowed water restrictions to be eased by September 2018.

Box 4-4: The Cape Town Water Crisis

Water Efficient Fixtures and Fittings

4.9.9 Water efficient fixtures and fittings include dishwashers and clothes washing machines, toilets, showerheads and taps. These can be designed to use less water whilst maintaining comparable performance (e.g. low-flow showerheads). Table 4-8 provides an indication of potential efficiency savings for water-efficient devices.

4.9.10 Building Regulations Approved Document G requires that the design estimate of total water consumption is less than 125 l/p/d. Achieving this standard requires the use of at least some efficient practice components. More measures are necessary to achieve the lower 110 l/p/d optional requirement. The Building Regulations document includes a Water Efficiency Calculator to assist developers in estimating their water consumption to demonstrate compliance with the requirements (https://wrcpartgcalculator.co.uk/).

[36] City of Cape Town Safe Use of Greywater

4.9.11 The cost of using water efficient fixtures and fittings to achieve the lower 110 l/p/d is negligible, estimated at £9 per home. In comparison, reducing consumption from 125 l/p/d to 105 l/p/d was estimated to reduce energy, water and sewerage costs by around £24 per year[37]. Therefore, imposing the lower 110 l/p/d requirement would not be an unreasonable financial burden on development.

4.9.12 User acceptability for water efficient fixtures and fittings is also generally high. A study by United Utilities indicated that aerated showers which reduced flow rates by 28% were accepted and kept by 8 out of 9 participants on average.

4.9.13 There are concerns regarding leakage in newer toilet designs. Waterwise estimates that between 5 and 8% of toilets are leaking due to faulty flush valves, most of which are dual flush toilets, and the majority of which are silent and difficult to detect. Toilet leakage represents 2.3 to 6.5 l/p/d of average per capita consumption, which in the Greater Cambridge region would result in a water demand of 0.8 to 2.3 Ml/d. Cambridge Water provide free detection strips that customers can use to detect leakage. Some water companies are also using smart water meters to identify locations with constant background consumption levels that may be due to leaking toilets, and offering to fix leaking toilets for free during home visits. Waterwise is now coordinating a national campaign to raise awareness of the problem, identify best practices to find and fix leaking toilets, develop new testing standards for products, and improve future designs to eliminate the problem. These leakage problems should not be viewed as a justification for not installing dual flush systems, but should be noted for maintenance purposes and as a potential "easy win" for reducing water demand.

[37] Water Efficiency Strategy for the UK – Advice on Water Efficient New Homes for England, Waterwise, 2018

Fitting / appliance	Baseline practice (meet legal requirements but do not offer appreciable water savings)	Efficient practice (offer reduced water consumption without materially impacting cost or performance)	Highly efficient practice (offer further reduced water consumption but may not be comparable in cost or performance)
Shower (mixer)	12 l/min	<10 l/min (domestic) <8 l/min (non-domestic)	<6 l/min
Shower (electric)	8 l/min	<6 l/min	<6 l/min
Showers	An aeration device or advanced spray pattern may increase user satisfaction while reducing water use.	Government Buying Standard specifies <8 l/min. In domestic properties, some householders want a higher flow rate.	These flow rates may be unacceptable to some householders but acceptable in commercial property. The hot water flow from certain water heating systems may become unstable at these lower flow rates.
WC	6 l/flush	<4.5 l/flush (effective)	<3.5 l/flush (effective)
WC	Appropriate for single flush male public WCs.	Either a 4.5 l single flush, or a 6/4 l dual flush system. A low volume single flush may be appropriate in public buildings.	E.g. a 4.5/2.6 l dual flush. May be inappropriate for plumbing systems requiring higher flow. Single flush system may be more appropriate in public buildings.
Urinal	1.5 l/bowl/use 7.5 l/bowl/hour during building occupancy period, 0 l/hour otherwise	3 l/bowl/hour during building occupancy period with user activated flush. 0 l/hour otherwise	0 l/hour
Urinal		Flush within the hour if one person activates the sensor.	May be inappropriate for high frequency use settings
Tap (basin)	Up to 12 l/min	<6 l/min	<4 l/min
Tap (basin)		Two-stage or click taps help reduce effective flow.	Sensor actuated taps help reduce use in public buildings.
Tap (kitchen)	12 l/min	<8 l/min	<6 l/min
Tap (kitchen)		A higher flow rate is typically required for kitchen use related to volume	User acceptability would need to be considered. Two-stage or click taps help reduce effective flow.
Bath	200 l capacity (excl. body mass within bath)	<180 l capacity (excl. body mass within bath)	<155 l capacity (excl. body mass within bath)
Bath			User acceptability would need to be considered, ergonomically shaped tubs preferable to short or shallow shapes.
Washing machine	10 l/kg dry load	<8.5 l/kg dry load	<7 l/kg dry load
Dishwasher	1.2 l/place setting	<1.0 l/place setting	<0.7 l/place setting
Dishwasher	Older domestic models may use 20 l/cycle	Equivalent to 12 l/cycle domestic dishwasher	

Table 4-8: Indicative practice levels for water efficiency of common fittings and appliances, WRAP Procurement Requirements for Water Efficiency, 2010

Rainwater Harvesting

4.9.14 Rainwater harvesting involves the collection and storage of rainwater for non-potable uses such as watering gardens, flushing toilets and washing clothes. These can achieve up to a 50% reduction in mains water consumption. Systems can be installed at both individual and site-wide scales:

- At the individual property level: water from the rooftop is collected and stored in a tank, subsurface or in the loft space. Water is filtered and treated before being pumped to the point of use. The system maintenance and operation is usually the responsibility of the homeowner.

- At the site-wide scale, such as at Eddington (Box 4-1), water from rooftops is collected and stored in communal facilities which could include subsurface tanks or surface ponds. Water is filtered and treated before being pumped to the point of use in individual properties. The system maintenance and operation is usually the responsibility of a utilities or maintenance company (to the individual property boundary). Generally, these systems only accept clean water from rooftops, and a separate drainage system is necessary for runoff from paved areas and roads, to maintain a high water quality in the recycled water.

4.9.15 Until the development of the mains-water grid in the 19th Century, rainwater harvesting was a standard feature for most new houses, freeing occupants from having to share the village pump. This was particularly common in hard water areas, where groundwater was less suitable for washing. However, modern rainwater harvesting systems have only been introduced to the UK relatively recently. In 2010, only about 400 systems were being installed in the UK per year. In comparison, in Germany, where water is a comparatively expensive commodity, almost all properties are metered, and rainwater harvesting systems are grant aided, 35% of all new buildings are equipped with rainwater collection systems. Cambridge Water do not currently record whether rainwater harvesting systems are installed in new developments, but with the exception of a few developments where site-wide systems have been installed, they estimate rainwater harvesting is installed in very few developments (potentially less than 10 of the 1800 to 2000 new connections annually).

4.9.16 Rainwater harvesting systems are comparatively expensive (Table 4-9). Water efficiency fixtures and fittings discussed in the previous section are cheaper, offer short payback periods, are easier to retrofit and maintain, and should be considered before rainwater harvesting. Generally, the cost effectiveness improves with the scale of the project. At Eddington, a comparison indicated that a site-wide system would cost about half of an individual property recycling system. A study by Ricardo showed that while all system sizes provided a total net benefit, there was also the potential for a private net cost if water demand was low (Table 4-10). Therefore, it was concluded that smaller installations are not privately beneficial for the installer and unlikely to see large scale uptake until promoted by falling prices or government-backed schemes and interventions, or increased price of potable water.

	Apartments	Houses
Code Level 1 and 2	-	-
Code Level 3 and 4 (105 l/p/d)	£6	£9
Code Level 5 and 6 (80 l/p/d)	£900	£2,201 - £2,697
Rainwater only	£887	£2,181 - £2,674

Table 4-9: Water standards costs (extra over usual industry practice), with reference to Code for Sustainable Homes levels (Housing Standards Review Cost Impacts report, DCLG 2014).

Collection area	Example building types	Whole life costs (£000)	Whole life savings (£000)	Private net benefits (£000)	Societal benefits (£000)	Total net benefit (£000)
Small (<500 m^2)	Standalone dwellings, houses, bungalows	£12 to £19	£1 to £19	-£9 to £26	£21 to £77	£10 to £100
Medium (500 – 2000 m^2)	Larger houses or two semi-detached houses	£25 to £38	£8 to £200	-£17 to £150	£50 to £163	£35 to £340
Large (2000 – 5000 m^2)	Row of terraced houses or blocks of flats	£20 to £35	£7 to £150	-£15 to £120	£35 to £335	£20 to £450
Very large (>5000 m^2)	Large scale residential developments	£35 to £60	£70 to £340	-£17 to £280	£30 to £920	£14 to £1,200

Table 4-10: Whole life (20 years) costs and benefits for rainwater harvesting systems based on collection area of a residential building, Ricardo Independent Review of the Costs and Benefits of Rainwater Harvesting and Grey Water Recycling Options in the UK, Waterwise 2020

4.9.17 Rainwater harvesting systems must comply with the Water Supply (Water Fittings) Regulations 1999 and national building regulations, including British Standards EN 16941-1:2018 (which replaced BS 8515 in 2018). Non-compliance can result in public health hazards. For example, cross-connections between rainwater harvesting systems and potable water supply affecting 87 properties at the Upton eco-housing development in Northampton led to E-coli contamination of potable water. Updated guidance was issued by the Drinking Water Inspectorate to water companies to ensure wider knowledge of the risks.

4.9.18 British Standards require that rainwater harvesting systems are installed with a backup supply in the event of equipment failure or unavailability of water. This means that in practice Cambridge Water would still plan to be able to supply the typical full water demand by mains water, and therefore there is no betterment for resource planning, although environmental benefit through reduced actual usage would occur. Rainwater harvesting systems are most likely to suffer from lack of water availability during drought periods, returning the demand to the potable water system. Therefore the potential benefits of rainwater harvesting schemes in these drought episodes could be limited. Rainwater harvesting systems should therefore be designed to meet a minimum drought frequency standard, although there is currently no national guidance on this.

4.9.19 Rainwater harvesting systems have previously been thought to be more carbon intensive than mains water, due to the economies of scale that the mains water system has for embodied carbon (mostly relating the storage tank and pumps) and operational carbon (energy usage for pumping). However, the Ricardo study showed that installations across all building sizes emit less CO_2 when compared to the emissions embedded in mains water over a 20 year lifetime. The emissions are also small compared with other water related energy use, e.g. heating water for domestic uses, which contributes about 5% of the UK's annual greenhouse gas emissions.

4.9.20 Although this section has focussed on domestic rainwater harvesting systems, there is significant scope to use rainwater for activities such as toilet flushing and irrigation of grounds in many commercial buildings, industrial settings and agricultural businesses. The savings that can be achieved are often higher due to larger roof areas and a greater demand for non-potable water.

Grey Water Recycling

4.9.21 Grey Water is defined as wastewater from hand basins, baths and showers. Some definitions also include clothes washing machines in the definition of grey water, however for this study that source has been defined as black water due to the higher degree of pollutant contamination. The British Standard BS8525-1:2010 (Greywater Systems Code of Practice) advises that provided it is treated properly, grey water can be used for toilet flushing, garden use and clothes washing machines. Various treatment process technologies are available to generate clean and odourless non-potable water suitable for re-use. It can be integrated with rainwater harvesting systems.

4.9.22 No data are available on the uptake rates of grey water recycling in Greater Cambridge or the UK in general, however rates are generally reported as low. Public attitudes to grey water recycling are less positive than for rainwater harvesting, primarily with regards to water quality.

4.9.23 Grey water recycling systems are more expensive than rainwater systems due to the additional treatment needed. Therefore these systems are typically not cost-effective at the individual property or small scale development level (Table 4-11).

Yield	Example building types	Costs: CAPEX + OPEX (£000)	Water cost savings (£000)	Private net benefits (£000)	Societal benefits (£000)	Total net benefit (£000)
Low (<500 m^3)	Smaller households, small commercial shops	£45	£5	-£40	£2	-£37
Small (500 – 1,500 m^3)	Larger households	£100	£52	-£48	£18	-£30
Medium (1,500 – 4,000 m^3)	Retail and commercial stores, leisure centres, some offices	£120	£108	-£13	£34	£25
Large (4,000 – 10,000 m^3)	Large commercial settings such as shopping centres, multi-unit offices or flats	£170	£190	£21	£67	£88
Significant (>10,000 m^3)	High rise offices or blocks of flats, hotels, multi-purpose developments	£270	£780	£510	£275	£787

Table 4-11: Whole life (20 years) costs and benefits for grey water recycling systems based on the systems yield (grey water produced), Ricardo

Independent Review of the Costs and Benefits of Rainwater Harvesting and Grey Water Recycling Options in the UK, Waterwise 2020

4.9.24 The energy requirements of grey water recycling systems varies depending on the system, installation arrangements and levels of demand. There is some evidence that supply from carbon efficient systems can involve lower energy demands compared to mains water.

4.9.25 Overall therefore grey water recycling is a suitable option for larger schemes where the yield is large enough to generate economics of scale. However, smaller installations are not beneficial for the installer and therefore large-scale uptake is unlikely until falling prices or government incentives make the systems financially attractive.

Black Water Recycling

4.9.26 Black water is defined as water that may be contaminated with hazardous material and pollutants, e.g. from toilets, kitchen sinks, dishwashers and clothes washing machines. Black water can be recycled and re-used for non-potable uses such as watering gardens (excluding edible crops) and flushing toilets. It is also possible, although expensive, to treat black water sufficiently to be suitable for potable uses, although there are significant perception issues and stigma associated with this.

4.9.27 Black water treatment involves the functions of typical sewage treatment, including settlement, bacterial break down, filtration, aeration and chemical treatment. Due to the complexity of treatment, this process is expensive to undertake at the domestic / small development scale, although not impossible. The treatment could be augmented using reed beds which have added biodiversity benefits and are more feasible for larger developments, although location, land-take, smell, and health and safety may still be limiting factors.

4.9.28 Unplanned indirect black water recycling already occurs to some extent across the UK, in catchments where wastewater treatment works discharge treated effluent into watercourses upstream of surface water abstraction points. For example, in Greater Cambridge, surface water abstraction for irrigation purposes from the Lower Cam will be re-using treated effluent from water recycling centres upstream, diluted with the natural catchment run-off. Some water companies are beginning to investigate options for more targeted black water recycling schemes. For example, Thames Water are developing plans for an effluent recycling scheme at Deephams sewage treatment works in north-east London from 2030, discharging up to 45 Ml/d treated effluent discharge into a water supply reservoir, where it will mix with other water sources before being treated again for potable use.

4.10 Drought Planning

4.10.1 Drought planning is undertaken at the national, regional and local level, by the Environment Agency and the water supply companies, and other stakeholders:

- The Environment Agency has overall responsibility for safeguarding the environment during a drought and overseeing the actions that water companies take to secure public water supplies. The Environment Agency monitors, reports and acts to reduce the impact of drought on the natural environment. Specific actions are taken where low river flows and lake levels have the potential to cause damage to the natural environment and ecology.
- Water companies are responsible for managing water supplies to meet the needs of customers and taking a range of measures to maintain supplies whilst minimising environmental impact.
- Local councils lead local resilience forums which prepare for severe drought impacts in their emergency plans. They may help water companies implement emergency drought measures in an exceptionally severe drought.
- Natural England provides expertise on how drought is affecting protected habitats, species and the natural environment, and provides advice to industries, farmers, local communities and interest groups on how their actions during drought can affect the natural environment. Natural England will carry out drought monitoring at its managed sites, and may manage habitats differently to protect vulnerable species, including restricting access if risk of fire.

4.10.2 The Environment Agency prepare drought plans for their operational areas that are reviewed annually. These plans set out responsibilities, monitoring, and actions to be taken based on specified indicators, including reporting and communications. There is no legislative requirement for the Environment Agency to consult on or publish their drought plans.

4.10.3 Water companies prepare and maintain drought plans under the Water Industry Act 1991 and Water Act 2003, showing how the company will collect, store and transport water to meet demand in a dry year. These plans are publicly consulted on and published. The plans cover drought actions required up to the classification of an emergency (serious threat of restrictions to public water supply using standpipes or rota cuts, or a major environmental or other acute incident requiring multi-agency major incident response arrangements). Arrangements for major drought emergency responses are planned separately and not reported in the drought plans.

4.10.4 The Cambridge Water Draft Drought Plan[38] (published for public consultation in 2021) describes how Cambridge Water will manage the effects of a drought. The Drought Plan complements the WRMP as well as the regional plan produced with other members of Water Resources East. The Cambridge Water Drought Plan sets out the operational steps and management framework that can be applied to maintain customer supplies according to the current levels of service through droughts of different length and severity. The Drought Plan sets out the measures and actions Cambridge Water will take before, during and after a drought, in order to provide a secure water supply to customers, while minimising any environmental impact. Cambridge Water have introduced in the Drought Plan additional environmental indicators that trigger demand saving measures earlier in a drought and moved towards a more consistent language to improve customers' understanding of drought actions. Cambridge Water have tested their Drought Plan against a range of possible drought scenarios to ensure the measures proposed are sufficient to ensure continued water supplies and minimise any environmental impact.

[38] Our Drought Plan | Cambridge Water (cambridge-water.co.uk)

4.11 Opportunities, Constraints and Uncertainties Summary

	Water Supply
Headline findings of baseline conditions	• Stakeholders agree that the Chalk aquifer that supplies the majority of potable water within the Cambridge Water Resource Zone is already under abstraction pressure, which is having a detrimental impact on Chalk stream baseflows and causing environmental damage, particularly during dry years. This may be further exacerbated in the future by the potential impacts of climate change (UKCP18, Met Office). Natural England have highlighted the severity of the issue in potentially affecting a number of nationally and internationally designated sites. Cambridge Water's most recent Water Resource Management Plan[39] includes planned reduction in total abstractions where impacts have been identified, and incorporates restrictions to abstraction licences to reduce the risk of further deterioration in the Chalk aquifer. The Environment Agency will be reviewing and most likely looking to further reduce abstraction licences from groundwater in the future to meet WFD and RBMP targets. • There is no environmental capacity for additional development in the new Local Plan to be supplied with water by increased abstraction from the Chalk aquifer. Even the current level of abstraction is widely believed to be unsustainable, potentially causing environmental damage as described above, and pressure is building to reduce abstraction rates significantly, safeguarding natural river flow. Future water demand and supply will need to be balanced in other ways, such as through reduced usage (demand management), reduced leakage, licence trading, and the development of new supply options at the regional scale (e.g. construction of new water supply reservoirs and importing water from outside of the Cambridge Water supply area). • Water Resources East is coordinating regional efforts to increase water supply, including construction of major new potable water supply reservoirs. In the longer term (2035 onwards), the new infrastructure could provide water to Greater Cambridge. Cambridge water are key (founding) members of Water Resources East and will be direct beneficiaries of any new supply options developed through the Water Resources East planning process. [40].

[39] Cambridge Water: Water Resources Management

[40] Ofwat PR19 Draft determinations Strategic water resources solutions

	Water Supply
	• The development at Eddington of a rainwater recycling system by Cambridge Water and the University of Cambridge has demonstrated that larger sites can successfully use recycling to reduce demand for potable water to the withdrawn Code for Sustainable Homes Level 5 / 6 standard of 80 l/p/d[41]. However, it would be technically difficult and prohibitively expensive to retrofit this type of infrastructure to existing development. Even for sites with demand management, Cambridge Water still plan to be able to supply the average consumption rate, in case of drought or failure, therefore there is no betterment for resource planning, although environmental benefit through reduced actual usage would occur.
Opportunities for development	• Potential for new development to achieve significantly reduced demand, beyond the Building Regulations standard requirement of 125 l/p/d and optional requirement of 110 l/p/d consumption for new developments[42], making full use of water re-use measures on site including surface water and rainwater harvesting, and grey water recycling.
Constraints to development	• There is an additional headroom (supply-demand balance) of between 2 and 4 Ml/d available in the current Water Resource Management Plan taking into account the proposed options to maximise supply and increase demand management. However, the supply-demand balance will be reviewed for the next WRMP (to be published in 2024), and the available headroom will be reduced. The Environment Agency would like to see existing headroom prioritised for environmental betterment and current levels of abstraction reduced significantly. Should development occur without measures to provide more water to Cambridge then further water environment deterioration is inevitable. • To address uncertainties regarding the effects of abstraction on designated sites (including those sites where remedial measures are in place but their efficacy is still being monitored), Natural England recommend a precautionary approach to be adopted. Adverse impacts should be assumed unless evidence is available to demonstrate otherwise.

41 Code for sustainable homes technical guidance

42 Sanitation hot water safety and water efficiency: Approved document G

	Water Supply
Uncertainties	• How water is supplied is not within the Local Plan's remit to impose. To demonstrate sustainability, a commitment will be needed from Cambridge Water that new development will be supplied with water without increasing abstraction or reducing the current available headroom, which could result in further detrimental environmental impacts including designated sites and Priority Habitats. • It is currently unclear what volume of additional water demand could be supplied before new regional infrastructure is completed, through short-term measures such as more aggressive leakage and demand management, licence trading, or import of water from outside the region. Consultation with stakeholders is ongoing. Water Resources East is preparing their first regional water resource management plan, which will be ready in summer 2021, and it will generate a long list of option portfolios which will then be used in the co-creation Planning Conferences in Autumn 2021 with WRE's members, which includes both councils. This will generate a preferred portfolio of options which will be published in January 2022 for public consultation. • The Environment Agency has not specified what further reductions in abstractions may be required to go beyond the existing cost-benefit tested levels of improvement being actioned through the Water Industry National Environment Programme (WINEP). These further reductions will be explored in the regional plan by Water Resources East, which will set out an overall destination for reducing abstraction and the timescales for implementing further actions. It is assumed that significant decreases in licensed groundwater abstraction rates will not be feasible until alternative potable water sources are available. • It is currently unclear whether the Local Plan would be able to successfully impose a domestic household per capita consumption that is lower than the Building Regulations optional requirement of 110 l/p/d consumption for new developments. Nevertheless, all stakeholders support ambitious water efficiency targets below this optional requirement level, targeting 80 l/p/d.

5 Wastewater Collection and Treatment

5.1 Overview

5.1.1 The purpose of this chapter is to:

- Review current wastewater collection and treatment infrastructure, using available information.
- Consider how climate change could impact wastewater treatment requirements in the future.
- Identify existing plans for improvement, including planned allowances for population growth, provision of additional Water Recycling Centre capacities, network and combined sewer overflow upgrades.

5.1.2 There are many links between wastewater treatment and water quality. These are introduced here and explored further in Chapter 6.

5.2 Managing Wastewater Collection and Treatment

5.2.1 The UK's sewerage undertakers are responsible for building, maintaining and improving main sewers, pumping stations and wastewater treatment facilities that service around 96% of the UK's population[43]. This chapter focuses on these strategic facilities, which in Greater Cambridge are owned and operated by Anglian Water.

5.2.2 The remaining 4% of the population, represented by the smallest of communities and individual properties in rural areas remote from main sewers, are generally served by privately owned, small-package treatment plants catering for small groups of houses, or septic tanks, cesspits and other in-situ treatment systems generally serving individual properties. These systems have not been considered further in this chapter. Planning Policy Guidance[44] states that the assumption for new development is that its wastewater is connected directly to the public sewer.

5.2.3 It If allocated development sites are located in areas not served by the main sewer network, it is recommended further assessment is undertaken in a detailed Water Cycle Strategy to consider feasible options for wastewater management.

5.2.4 There are three main types of wastewater collection sewers:

[43] Waste water treatment in the United Kingdom – 2012 Implementation of the European Union Urban Waste Water Treatment Directive 91/271/EEC

[44] Water supply, wastewater and water quality

- Surface water drainage that collects rainwater run-off from roads and urban areas, and discharges to local waterbodies. Surface water flood risk and drainage is discussed in the accompanying SFRA and is not considered further in this Chapter.

- Foul drainage that collects contaminated wastewater from premises (e.g. bathrooms, kitchens and laundry wastewater, excluding rainwater), conveyed to a treatment plant for cleaning before discharging to local waterbodies.

- Combined sewers that collect both rainwater and contaminated wastewater, conveyed to a treatment plant for cleaning before discharging to local waterbodies. These include combined sewer overflows (also referred to as 'storm overflows') to prevent sewage backing up and flooding of properties and roads during heavy rainfall. They also reduce the need for sewer diameter to increase to unmanageable levels as flows aggregate towards treatment facilities. Combined sewer overflows discharge excess untreated (though diluted) wastewater directly to local waterbodies. The circumstances under which discharges are allowed are described in permits issued by the Environment Agency. The impacts of these on water quality is considered further in Chapter 6.

5.2.5 Anglian Water is responsible for the public sewer system in Greater Cambridge, with the exception of some highways drains which may be the responsibility of Local Authorities or the Highways Agency. Property owners are responsible for drains which carry wastewater up until the boundary of their property where they connect to public sewers. Responsibility for maintaining private sewers outside the boundaries of private property was transferred to sewerage companies in 2011.

5.2.6 Anglian Water is also responsible for building, operating and maintaining wastewater treatment facilities (referred to, variously, as water recycling centres (WRC) or sewage treatment works (WRC)). The existing WRC in and near Greater Cambridge are shown in Figure 5-1.

5.2.7 The Environment Agency is responsible for regulating wastewater treatment works, by issuing permits and assessing the quality of treated effluent against compliance limits. In particular, the EU Urban Waste Water Treatment Directive prescribes minimum standards for wastewater collection and treatment in urban areas with a population equivalent[45] of over 2000, with more advanced treatment required in places with a population equivalent over 10,000 in sensitive areas:

[45] "Population equivalent" includes the wastewater generated by both domestic and economic activities, and is calculated from the biochemical oxygen demand (1 population unit is equal to 60 grams of BOD per 24 hours).

- For “less sensitive areas”, a minimum of primary treatment must be provided to settle out larger suspended matter. The UK currently has no “less sensitive area” designations.
- For “normal areas”, secondary treatment is required to breakdown organic matter under controlled conditions in treatment plants.
- For “sensitive areas”, tertiary treatment is required to address specific pollutants using different treatment processes. Sensitive areas include water bodies that are currently or at risk of becoming eutrophic[46], abstraction sources that currently or at risk of having high nitrate levels, and other directives requirements (e.g. the Bathing Water Directive). These areas are mapped in Chapter 6 and show the River Great Ouse, River Cam and River Rhee are designated “sensitive areas” for eutrophication (Figure 6-6).

5.2.8 Anglian Water use long term plans to manage their water recycling infrastructure. Their most recent long term plan was published in 2018, and has been referred to extensively in preparing this report. Anglian Water is currently in the process of updating this plan to meet the requirements for new “Drainage and Wastewater Management Plans” (DWMPs) now required to support business plan submissions for the next Asset Management Period (AMP) cycle price review in 2024. Where available, information from the emerging DWMP has been used in this chapter.

5.3 Impacts of Climate Change

5.3.1 The potential impacts of climate change on wastewater collection and treatment include:

- Increased risk of sewer flooding due to changes in rainfall frequency and intensity.
- Increased risk of pollution to rivers due to changes in rainfall frequency and intensity affecting the operation of storm overflows.

[46] Eutrophication is characterized by excessive plant and algal growth due to the increased availability of one or more limiting growth factors needed for photosynthesis, such as sunlight, carbon dioxide, and nutrient fertilizers. Eutrophication occurs naturally over centuries as lakes age and are filled in with sediments. However, human activities have accelerated the rate and extent of eutrophication through both point-source discharges and non-point loadings of limiting nutrients, such as nitrogen and phosphorus, into aquatic ecosystems (i.e., cultural eutrophication), with dramatic consequences for drinking water sources, fisheries, and recreational water bodies (Eutrophication: Causes, Consequences, and Controls in Aquatic Ecosystems | Learn Science at Scitable (nature.com)).

- Increased risk of pollution during more severe drought episodes, due to reduced dilution of treated wastewater effluent discharges.

5.3.2 The Anglian Water Long Term Plan[47] (2018) notes that climate change scenarios now form part of Anglian Water's hydraulic modelling standards for assessing growth risk to service from their sewerage infrastructure. Anglian Water are also aiming to achieve net zero operational and capital carbon impacts by 2030.

5.4 Existing Wastewater Collection

5.4.1 Anglian Water have detailed hydraulic models of their foul sewer network across the region. These have been updated to a uniform standard to allow assessment of capacity and flood risk, and identify priorities for improvements to address urban creep, climate change and population growth.

5.4.2 An assessment of existing foul sewer capacity and constraints has not been undertaken at this stage, due to the very large number of sewers across the region. This assessment will be undertaken at the detailed Water Cycle Strategy stage when specific site locations are known.

5.4.3 Although all newer developments have separate foul and surface water drainage systems, some older towns have combined systems. These place an additional burden on the wastewater treatment process, and have an increased risk of flooding and pollution. In particular, combined sewer overflows discharge untreated wastewater directly into waterbodies during periods of heavy rainfall, to prevent sewage backing up and flooding streets or homes. These can cause significant pollution problems and be obstacles to achieving good river health and safe river bathing.

5.4.4 Anglian Water monitor the operation of most of their storm overflows using Event Duration Monitors (EDM) which record the frequency and duration of spills to rivers. Results are published[48] by the Environment Agency each year and Table 5-1 reports results for 2020 at 12 locations within the Greater Cambridge region.

5.4.5 Forty spills is considered a trigger for further investigation of the impact the storm overflow has on its receiving river and this may result in improvements to reduce the occurrence of spills. Spills maybe the result of operational issues at the storm overflow or system capacity in heavy rainfall. The impact of spills is dependent on whether the storm overflow is screened, the volume of spill and the dilution the spill receives in the river. The frequency and duration of spills varies year to year because of different rainfall patterns. With climate change and increasing population the frequency and duration of spills may increase slightly because of reduced sewer capacity more frequent heavy

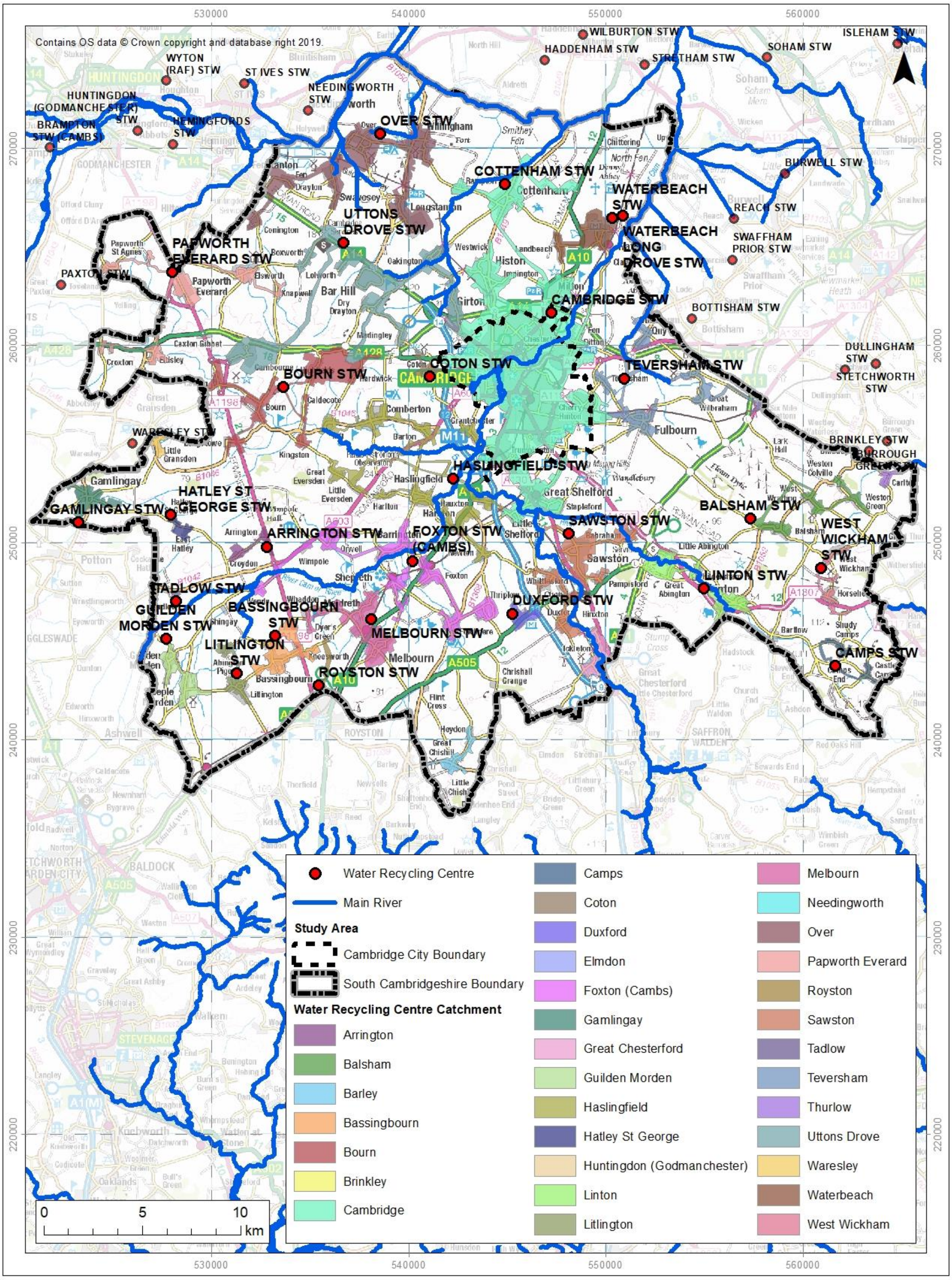
[47] water-recycling-long-term-plan.pdf (anglianwater.co.uk)

[48] Event duration monitoring – Storm overflows -2020

rainfall, but this will vary from overflow to overflow depending on hydraulic conditions.

Site Name	Total Duration (hours) of all spills	Counted spills
ARRINGTON STW	60	23
BALSHAM STW	120	16
CAMBRIDGE - RIVERSIDE 187 SSO	10	4
CAMBRIDGE STW - STORM SEWAGE AND SETTLED STORM	0	0
HASLINGFIELD-STW	428	49
HATLEY ST GEORGE STW	1572	70
LINTON STW	27	7
MELBOURN STW	93	62
PAPWORTH EVERARD STW	0	0
ROYSTON STW	28	3
SAWSTON STW	150	11
WATERBEACH STW	241	16

Table 5-1: Monitored storm overflows in Greater Cambridge in 2020



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01/10/2020 16:59:54

Figure 5-1: Existing Water Recycling Centres and their catchments in Greater Cambridge

5.5 Existing Wastewater Treatment

5.5.1 Wastewater treatment is currently undertaken at 26 treatment works located within the Greater Cambridge region, as shown in Figure 5-1. There are four cross-boundary treatment works that are also included in this review for completeness:

- The Royston treatment works lies within the Greater Cambridge area, but treats wastewater generated in the Royston area of North Hertfordshire.
- The Waresley treatment works lies outside the Greater Cambridge area (in Huntingdonshire), but treats wastewater generated in the Little Gransden area of Greater Cambridge.
- The Barley and Great Chesterford treatment works also lie outside the Greater Cambridge area (in North Hertfordshire) but treat wastewater generated in the Chishill and Ickleton areas of Greater Cambridge respectively.

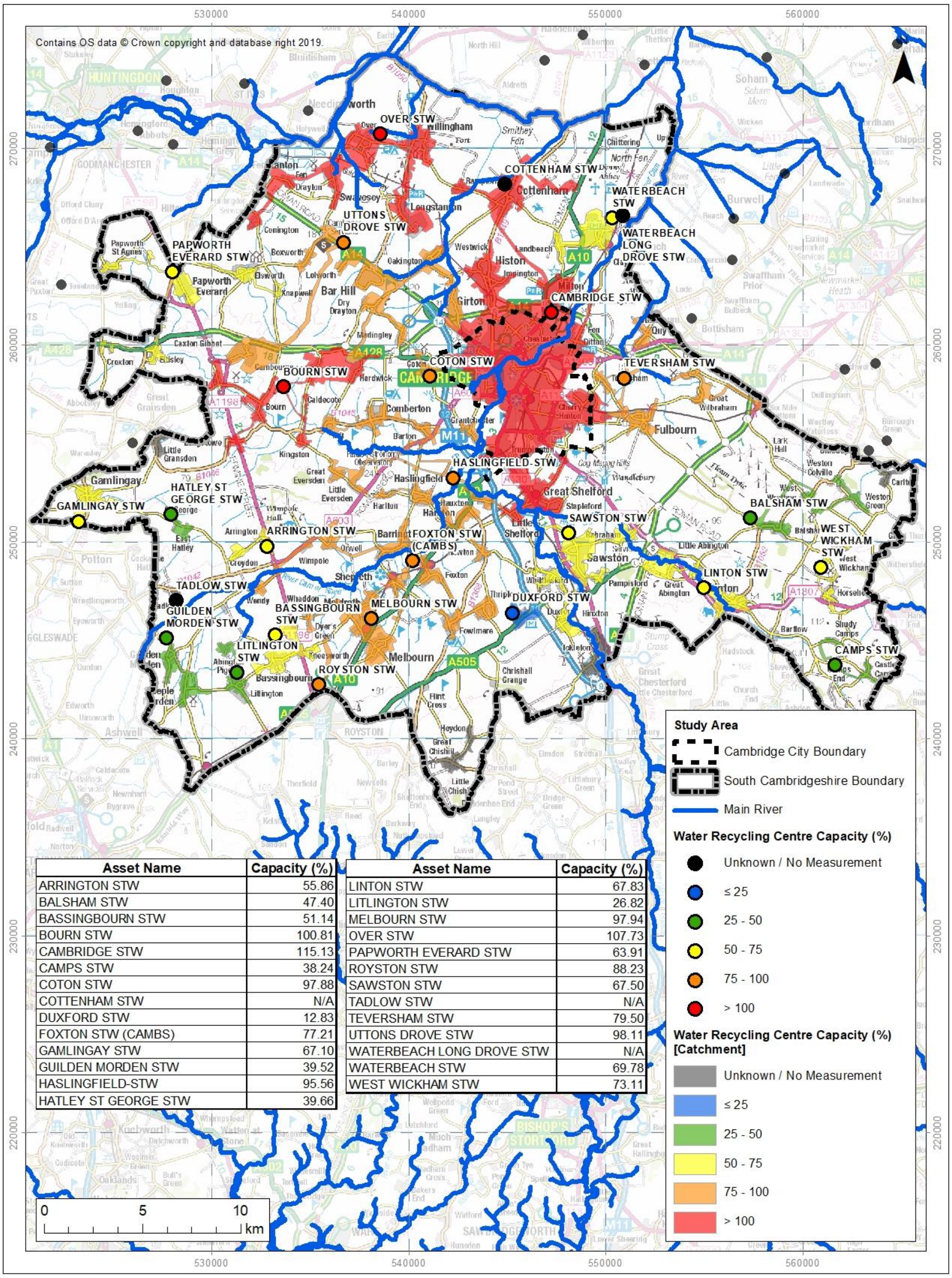
5.5.2 The Environment Agency has provided permitted discharges information for the treatment works. Permitted discharges are based on the Dry Weather Flow (DWF). This is the average daily flow during a period without rain. Compliance against the permitted DWF is assessed by comparing it to the measured 90% percentile flow (980, the flow that is exceeded 90% of the time). These data are listed in Table 5-2 and shown in Figure 5-2.

5.5.3 The data indicate that three treatment works are currently at or exceeding their DWF permits: Cambridge, Bourn and Over. New permits are currently being negotiated that ensure there is no river impact as a consequence of growth which has occurred. A further seven treatment works are nearing their DWF permits (>75% capacity): Coton, Foxton, Haslingfield, Melbourn, Royston, Teversham and Uttons Drove.

5.5.4 There are also permit conditions for suspended solids (SS), biochemical oxygen demand (BOD), Ammonia, and Phosphorus (P). These are listed in Table 5-3. Some new, more stringent Phosphorus constraints are proposed for AMP7 (by 2024), to prevent deterioration or improve status under the Water Framework Directive (see Chapter 6 for further details).

5.6 Future Wastewater Treatment Capacity

5.6.1 The comparison of permitted DWF to measured flows allows an indication of potential capacity for additional “within permit” growth, as listed in Table 5-4. For this calculation it is assumed that water consumption is 0.14m3/p/d and that occupancy is 2.3. These are stated as equivalent dwellings as a reference, but the actual capacity for growth would depend on the mix of residential, commercial and industrial development proposed, and ongoing completions and commitments. It should be emphasised that these are not absolute constraints to growth. In almost all sites, upgrades to physical capacity are possible and treatment improvements could be made in a number of different ways such that water quality impact is the same or better than currently achieved or planned for. In almost all of the treatment works identified as near permit, planned upgrades have already been identified in the Anglian Water Long Term Plan (2018). These are listed in Table 5-4, although specific details of upgrade capacity are not currently available. Anglian Water is currently preparing its Drainage and Wastewater Management Plan which will address questions of capacity for growth in networks and at WRC in detail.



Asset Name	Capacity (%)
ARRINGTON STW	55.86
BALSHAM STW	47.40
BASSINGBOURN STW	51.14
BOURN STW	100.81
CAMBRIDGE STW	115.13
CAMPS STW	38.24
COTON STW	97.88
COTTENHAM STW	N/A
DUXFORD STW	12.83
FOXTON STW (CAMBS)	77.21
GAMLINGAY STW	67.10
GUILDEN MORDEN STW	39.52
HASLINGFIELD-STW	95.56
HATLEY ST GEORGE STW	39.66

Asset Name	Capacity (%)
LINTON STW	67.83
LITLINGTON STW	26.82
MELBOURN STW	97.94
OVER STW	107.73
PAPWORTH EVERARD STW	63.91
ROYSTON STW	88.23
SAWSTON STW	67.50
TADLOW STW	N/A
TEVERSHAM STW	79.50
UTTONS DROVE STW	98.11
WATERBEACH LONG DROVE STW	N/A
WATERBEACH STW	69.78
WEST WICKHAM STW	73.11

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Figure 5-2: Percent of permitted DWF used at each WRC in Greater Cambridge

WRC	Current Permitted DWF (2019) m^3/day	2019 Measured DWF m^3/day	% Permit Capacity Used	Permit Capacity Used Colour coding
Arrington	145	81	56%	Yellow
Balsham	500	237	47%	Green
Barley	No data	No data	No data	-
Bassingbourn	1230	629	51%	Yellow
Bourn	868	875	≥100%	Red
Cambridge	37330	42977	≥100%	Red
Shudy Camps	238	91	38%	Green
Coton	189	185	98%	Amber
Duxford	600	77	13%	Blue
Foxton (Cambs)	1211	935	77%	Amber
Gamlingay	690	463	67%	Yellow
Guilden Morden	420	166	40%	Green
Haslingfield	2250	2150	96%	Amber
Hatley St. George	58	23	40%	Green
Linton	1800	1221	68%	Yellow
Litlington	440	118	27%	Green
Melbourn	1800	1763	98%	Amber
Over	3210	3458	≥100%	Red
Papworth Everard	1607	1027	64%	Yellow
Great Chesterford	1284	826	64%	Yellow
Royston	2600	2294	88%	Amber
Sawston	2800	1890	68%	Yellow
Tadlow	Descriptive permit only	Descriptive permit only	Descriptive permit only	-
Teversham	1400	1113	80%	Amber
Uttons Drove (Bar Hill)	4288	4207	98%	Amber
Waresley	No data	No data	No data	-
Waterbeach	1350	942	70%	Yellow
West Wickham	212	155	73%	Yellow

Key

0 – 25% (Blue)
25 – 50% (Green)
50 – 75% (Yellow)
75 – 100% (Amber)
>100% (Red)

Table 5-2: WRC existing permitted DWF and permit capacity used

Water Recycling Centre	SS permit mg/l	BOD permit mg/l	Ammonia permit mg/l	P permit mg/l	AMP7 (2020 – 2025) P permit mg/l
Arrington	40	20	15	-	-
Balsham	30	17	10	-	-
Barley	30	20	-	-	-
Bassingbourn	30	20	10	-	0.5
Bourn	20	10	3	-	0.5
Cambridge	20	15	5	1	-
Shudy Camps	30	15	3	-	1.0
Coton	30	15	15	-	0.8
Duxford	40	25	15	-	-
Foxton (Cambs)	50	25	10	-	-
Gamlingay	35	20	15	1	-
Great Chesterford	19	9	5	-	-
Guilden Morden	50	25	8	1	-
Haslingfield	60	30	10	2	-
Hatley St. George	-	-	-	-	-
Linton	20	10	4	-	0.5
Litlington	35	20	8	-	0.5
Melbourn	25	13	4	-	-
Over	25	50	4 (3 AMP7)	2	-
Papworth Everard	24	12	5	2.5	0.5
Royston	30	15	10	2	-
Sawston	40	20	10	2	-
Tadlow	Descriptive	Descriptive	Descriptive	Descriptive	-
Teversham	20	15	5	-	-
Uttons Drove (Bar Hill)	20	14	7	1.6	0.4
Waresley	40	35	20	-	1.5
Waterbeach	40	20	15	-	2.0
West Wickham	30	20	4	-	-

Table 5-3: WRC existing permitted chemical and water quality indicators

WRC	Estimated existing capacity for 'within permit' growth (dwellings)	Planned Upgrades Identified in LTP
Arrington	199	No
Balsham	817	No
Barley	No data	No data
Bassingbourn	1866	No
Bourn	0	AMPs 7&8 - increase drainage capacity AMP11 - increase WRC flow capacity
Cambridge	0	AMP7 - increase WRC flow capacity AMPs 7,8, 9,10&11 - increase drainage capacity AMP7 - CSO investigations AMP8 - CSO improvements
Shudy Camps	457	No
Coton	12	AMP9 - increase WRC process capacity
Duxford	1624	No
Foxton (Cambs)	857	AMPs 7&11 - increase WRC flow capacity
Gamlingay	705	No
Great Chesterford	1422	No
Guilden Morden	789	No
Haslingfield	311	No
Hatley St. George	109	No
Linton	1798	No
Litlington	1000	No
Melbourn	115	AMPs 8&11 - increase WRC flow capacity
Over	0	AMP9 - increase WRC flow capacity
Papworth Everard	1801	No
Royston	950	AMP9 - increase WRC flow capacity
Sawston	2826	No
Tadlow	No data	No
Teversham	891	No
Uttons Drove (Bar Hill)	252	AMPs 7&8 - increase drainage capacity
Waresley	No data	No data
Waterbeach	1267	AMP7 - additional WRC flow capacity
West Wickham	177	No

Table 5-4: WRC existing capacity for "within permit" growth (based on permitted DWF) and proposed future upgrades (2018 LTP).
For reference, the Asset Management Period AMP cycles are as follows: AMP 7: 2020 – 2025, AMP 8: 2025 – 2030, AMP 9: 2030 – 2035, AMP 10: 2035 – 2040, AMP 11: 2040 – 2045. The AMP7 investments for confirmed and are funded for delivery.

Cambridge WRC

5.6.2 The most significant future wastewater treatment upgrade for Greater Cambridge will be the relocation of the existing Cambridge WRC. This relocation will enable the regeneration of North East Cambridge. The relocation will be funded by the Government's Housing Infrastructure Fund (HIF).

5.6.3 The relocation project is a Nationally Significant Infrastructure Project and will require a Development Consent Order for planning purposes. The project is currently (January 2021) in the pre-application phase for the Development Consent Order. The application will be considered by the Planning Inspectorate and the Secretary of State for DEFRA. It is anticipated that an approval decision will be taken in late 2023.

5.6.4 The timescales for the new Cambridge WRC are aligned to milestone dates that are fixed in the Housing Infrastructure Fund allocation for the site redevelopment. The current programme is for the new WRC to be operational by March 2028, however this will be dependent on when the Development Consent order is granted, and construction can begin.

5.6.5 The proposed works will increase the capacity of the Cambridge WRC from its existing population equivalent of 213,649 to a proposed population equivalent of 300,000. This is expected to provide headroom for further growth to 2050 and beyond.

5.6.6 It is currently unclear whether there are any technically feasible solutions to upgrading the existing Cambridge WRC in the interim before the new works is operational. The existing Cambridge WRC is currently exceeding its DWF permit, and Anglian Water are negotiating a variation with the Environment Agency. Pending agreement, this could constrain the timings of additional development in its catchment.

5.6.7 The new plant will aim to minimise carbon emissions during construction and operation, using renewable energy sources. To meet planning requirements, the new WRC will be required to have no detrimental impact on water quality in the receiving River Cam. The Development Consent Order for the new WRC will demonstrate any potential impact on downstream water quality and habitats.

Uttons Drove and Papworth Everard WRC

5.6.8 There has recently been significant development pressure in the catchment of Uttons Drove WRC, including the new settlements of Bar Hill, Cambourne and Northstowe. The Uttons Drove WRC discharges into the Swavesey Drain system, which is one of the last downstream tributaries of the River Great Ouse that is not pumped. During periods of high levels on the River Great Ouse, a sluice gate at Webbs Hole closes to prevent water backing up into the Swavesey Drain. This also has the effect of preventing any outflows from the drain. Due to the hydrological regime of the River Great Ouse, the gate can be closed for periods of up to 3 weeks. During this time, all discharges from the WRC must be stored in the Swavesey Drain channel capacities.

5.6.9 Recently, a small pump was installed at Webbs Hole sluice to allow discharge of some flows from the catchment when the gate is closed. However, there is minimal headroom for additional flows above those planned for in the full development of the Northstowe development.

5.6.10 Therefore, Uttons Drove WRC should be considered to be limited in capacity for accepting any further significant increases in runoff due to additional development in the local plan, without further significant investment to increase pumping at Webbs Hole. The current arrangements are governed through a Memorandum of Understanding between the drainage board, Environment Agency and Anglian Water.

5.6.11 A new settlement was allocated at Bourn Airfield in the previous local plan. This settlement cannot drain to Uttons Drove WRC for the reasons stated above. The nearby Bourn WRC is also not appropriate due to lack of capacity and the sensitivity of the very small receiving watercourse headwaters. Therefore, this site is proposed to drain to Papworth Everard WRC, where there is existing capacity and upgrade works are more feasible. New pipelines will be constructed to connect the development. The current status of these works is unknown at the time of writing, however this diversion could support further new development in this area of Greater Cambridge.

5.7 Load Standstill

5.7.1 It is inevitable that new development will result in an increase in wastewater created and a resulting increase in treated effluent discharges. Where the DWF is anticipated to increase above the permitted value, the Environment Agency will reassess the site and its DWF permit, along with the other permit consents relating to pollutant concentrations in the treated effluent. The Environment Agency review and amend water company permit conditions on a five-year cycle to identify environmental improvements to be delivered in the next company Asset Management Plan.

5.7.2 Load standstill is a useful concept to be considered when reviewing wastewater discharge consents for planning purposes. A load standstill approach ensures that as effluent volumes increase, the total pollutant load discharged does not increase. This is achieved by decreasing the concentration of pollutants in the effluent discharge in proportion to the increase in flow. There are technically achievable limits (TAL) below which it is not possible to reduce concentrations using currently available technologies. These are 1 mg/l for Ammonia (95 percentile), 5 mg/l for BOD (95 percentile) and 0.25 for Total Phosphorous (annual average). Actual discharge permits are calculated using catchment water quality modelling methods which may result in tighter conditions than those indicated by a load standstill assumption. Furthermore, within permit growth may be unsustainable because this may cause a deterioration of reported river status, necessitating still tighter permit levels.

5.7.3 Pollutant consents may also need to be revised to reflect the potential impacts of climate change on low flows in rivers. Current climate projections indicate a decrease in summer rainfall that may result in a decrease in typical low river flows during these months. Recent modelling[49] has indicated that low flows in the East Anglian region could reduce by in the order of 10%. The reduction in dilution of effluent discharges due to lower river flows may trigger additional reductions in discharge concentration consents.

5.7.4 Making allowance for the potential impacts of climate change (a 10% reduction in permitted concentrations), and with reference to technical limits for minimum concentration, it is possible to approximate the maximum number of dwellings that could be treated by each works within current technology without deterioration in receiving water quality (achieving load standstill), for BOD as this is the limiting determinand of BOD and Ammonia (Table 5-5).

5.7.5 Phosphorus constraints were not assessed since these are likely to require the tightest feasible permits at treatment plants designed together with catchment based interventions to manage other sources of phosphorous in the environment (e.g.from agriculture).

5.7.6 These estimates only relate to the technical limits of pollutant discharge concentration, and do not consider the feasibility of upgrades, site constraints, or capacity constraints. Nevertheless, they provide an indication of potential technical constraints to development. Detailed water quality modelling would be necessary to confirm impacts.

5.7.7 The current contribution of wastewater treatment works discharges to low flows in the River Granta, Rhee and Cam has been assessed. Cumulative dry weather discharges from upstream wastewater treatment works have been compared to a similar river low flow statistic (Q90, the flow exceeded 90% of the time) approximately estimated for gauging stations on the watercourses. An adjustment for a 10% reduction in river flows has been included to account for the potential impacts of climate change.

5.7.8 This calculation is approximate only. However, Table 5-6 indicates that there may be limited dilution of treated effluent and other pollutants in lower parts of the Granta, which is highly permeable and can become ephemeral in drought periods. Therefore, any proposals for increased wastewater discharges in this catchment will require detailed assessment of impacts on low flow regimes and water quality. Conversely, there may be opportunities to improve water

[49] Kay AL, Watts G, Wells SC, Allen S. The impact of climate change on U. K. river flows: A preliminary comparison of two generations of probabilistic climate projections. *Hydrological Processes*. 2020;34:1081–1088. https://doi.org/10.1002/hyp.13644

quality and river levels by increasing the volume of higher quality treated effluent discharges.

WRC	Current Permitted DWF (m^3/d)	Maximum DWF for technical limits to load standstill (m^3/d)	Estimated capacity for 'load standstill' growth (Additional dwellings from 2019 baseline)
Arrington	145	522	1,171
Balsham	500	1,530	3,199
Barley	No data	No data	No data
Bassingbourn	1,230	4,428	9,932
Bourn	868	1,562	2,157
Cambridge	37,330	100,791	197,084
Shudy Camps	238	642	1,257
Coton	189	510	998
Duxford	600	2,700	6,522
Foxton (Cambs)	1,211	5,449	13,163
Gamlingay	690	2,484	5,571
Great Chesterford	No data	No data	No data
Guilden Morden	420	1,890	4,565
Haslingfield	2,250	12,150	30,745
Hatley St. George	No data	No data	No data
Linton	1,800	3,240	4,472
Litlington	440	1,584	3,553
Melbourn	1,800	4,212	7,491
Over	3,210	5,778	7,975
Papworth Everard	1,607	3471	5,789
Royston	No data	No data	No data
Sawston	2,800	10,080	22,609
Tadlow	No data	No data	No data
Teversham	1,400	3,780	7,391
Uttons Drove (Bar Hill)	4,288	10,805	20,241
Waresley	No data	No data	No data
Waterbeach	1,350	4,860	10,901
West Wickham	212	763	1,712

Table 5-5: WRC estimated maximum capacity for growth while achieving load standstill to current technical limits, based on current permitted levels of BOD, including a 10% allowance for climate change and assuming a sewer flow of 0.14 $m^3/h/d$ and a dwelling occupancy of 2.3.

Location (river gauging station)	Upstream wastewater treatment works	Current measured treated discharge (90th percentile) as a percentage of river low flow (Q90)
Granta at Linton	Shudy Camps, West Wickham	23%
Granta at Babraham	As above, plus Linton	88%
Granta at Stapleford	As above	115%
Rhee at Wimpole	Tadlow, Guilden Morden, Litlington, Bassingbourn, Arrington	12%
Rhee at Burnt Mill	As above, plus Royston, Melbourn, Foxton, Duxford, Haslingfield	33%
Cam at Dernford	Sawston (data unavailable for others upstream on Upper Cam)	7% minimum
Cam at Bottisham	Sawston (data unavailable for others upstream on Upper Cam), Bourn, Coton, Cambridge, Waterbeach, Teversham, Balsham, all Granta, all Rhee.	56% minimum

Table 5-6: Treated effluent as a percentage of low river flows.

5.8 New Wastewater Treatment Infrastructure

5.8.1 Where existing wastewater treatment works do not have sufficient capacity for additional development, or where connection to treatment works is not feasible, it may be possible to construct new treatment works to support new development. These could be constructed by the sewerage undertaker (Anglian Water) on the mains sewer system, or by private operators for properties not connected to the mains sewer (e.g. septic tanks, cesspits and small sewage treatment plants).

5.8.2 New treatment works must be approved by the local planning authority, building regulations, and the Environment Agency (depending on size, location and discharge point). The risk of flooding and odour impacts must also be taken into account when planning new treatment works. The Environment Agency would be responsible for setting environmental permits on discharge volume and quality to prevent any detrimental impacts on receiving watercourses.

5.8.3 New treatment works could utilise new green / natural treatment options such as constructed wetlands, with additional biodiversity, low energy and low carbon benefits. The feasibility of these will be dependent on location and site constraints. An example of such a site is at Ingoldisthorpe[50] in West Norfolk.

5.8.4 There may also be opportunities for new treatment works to re-use treated effluent for other purposes, such as irrigation. Treated effluent could be used for potable supplies, subject to quality standards and infrastructure. This is considered further in Chapter 4.

5.8.5 Wastewater infrastructure can also be linked to energy generation, through biogas, and the residual heat in the treated effluent can also be re-used. For example, in Norwich and Bury St Edmunds, heat from wastewater treatment plants run by Anglian Water has been used to heat innovative greenhouse developments for hydroponics vertical growing systems.

[50] Norfolk wetland hailed a success as Anglian Water outlines plans for 800million of environmental investment

5.9 Opportunities, Constraints and Uncertainties Summary

	Wastewater
Headline findings of baseline conditions	• Cambridge Water Recycling Centre (WRC) is currently exceeding its discharge quantity permit, reflecting that the current population it serves (213,679) is greater than that planned for. Anglian Water are negotiating a variation in the permit pending construction of a new Cambridge WRC by 2030. • The new Cambridge WRC will be designed to accommodate a total future population of 300,000 (existing population and future growth) without deteriorating water quality in the receiving River Cam. The Development Consent Order for the new WRC will quantify its impact on downstream water quality and habitats. • Elsewhere in Greater Cambridge, there are 23 further WRC treating effluent from smaller towns and villages. Some of these have capacity within their permit to receive additional flows. Others may require investment to improve treatment so that they can treat more flows without detriment to the water environment.
Opportunities for development	• Anglian Water is currently preparing a Drainage and Wastewater Management Plan, to be published in 2022, which will set out long term plans for the management of wastewater treatment from 2025 to 2050. The timings of the study should allow the new Local Plan proposals to be included and appropriately planned for. • Expansion of capacity at Cambridge WRC will support continued development in the Cambridge urban area or on the urban fringe. The capacity of interconnecting sewers may become an issue but can be remedied through targeted investment in larger sewers or secondary sewers connecting directly to the WRC. This is within the normal planning and investment responsibility of Anglian Water. • New development could be supported by new green / natural treatment options such as constructed wetlands, at existing or new WRCs, with additional low energy and low carbon benefits. The feasibility of these will be dependent on location and site constraints. • Treated effluent could be used for irrigation, allowing potable water to be prioritised in abstractions. Treated effluent could also be used for potable supplies subject to quality standards and infrastructure. However, re-use of effluent would require assessment to ensure that

	Wastewater
	watercourses currently receiving treated flow are not detrimentally impacted by reduced river flows below sustainable levels, and public health is not impacted (in the context of using treated effluent in the food chain). A regional scale solution could involve re-use of WRC discharges via a downstream Fenland reservoir. Water Resources East are actively investigating these options.
Constraints to development	• Dependent on specific site location, timing of development may need to take into account any necessary WRC or sewerage upgrade works. • Depending on specific WRC impacted by growth, there may be feasibility constraints to increased capacity (e.g. at Uttons Drove and Bourn WRC) associated with the impacts of treated effluent on the receiving water body.
Uncertainties	• It is currently unknown if and when the Environment Agency will impose lower permit restrictions on WRC outflows, to improve water quality and meet WFD targets. • It is unclear what the capacity and permit situation is at the existing Cambridge WRC prior to completion of the new facility in 2030. Depending on how the current plant permit is amended, there may be capacity issues over the next 10 years. • The current timescale for the new Cambridge WRC is aligned to milestone dates that are fixed in the Housing Infrastructure Fund allocation for the site redevelopment. The current programme is for the new WRC to be operational by March 2028, however this will be dependent on when the Development Consent Order is granted, and construction can begin. This could constrain the timings of additional development in its catchment. It is currently unclear whether there are any technically feasible solutions to upgrading the existing Cambridge WRC in the interim. • As specific development locations are currently unknown, it is not possible to assess particular opportunities and constraints relating to individual WRC at this stage. • Planned growth in the west of the region (Cambourne West and Bourn Airfield) could be drained to the expanded Papworth WRC via new pipelines, to avoid known constraints at Uttons Drove and Bourn WRCs. This diversion was agreed in principle for the previous Local Plan, but the current status of these potential works is unknown at the time of writing.

6 Water Quality

6.1 Overview

6.1.1 The purpose of this chapter is to:

- Review current water quality and Water Framework Directive status, using available information.
- Identify existing point and diffuse sources of pollution that may affect water quality, including land use, land management activities, soil erodibility and point discharges.
- Explore the linkage between low flows and water quality (dilution), in the context of other pressures.
- Consider opportunities to improve water quality through the Local Plan.

6.1.2 The quality of potable (drinking) water is managed by the Drinking Water Inspectorate, under legislation including the Drinking Water Directive (1998). This chapter is concerned solely with environmental water quality i.e. the water quality of rivers, lakes, groundwater and other naturally occurring water bodies.

6.1.3 The scope of this work is focussed on water quality and does not include wider considerations of ecology and the environment, such as biodiversity and protected sites, that are covered in other studies. However, there is a clear link between water quality and ecosystem health. Natural England has identified that poor water quality is having a detrimental effect on ecology at designated sites and Priority Habitats in and downstream of the region (Appendix B).

6.2 Managing Water Quality

6.2.1 The Environment Agency is responsible for monitoring and managing water quality in England. To prevent detrimental impacts and maintain environmental standards, the Environment Agency control point discharges to water bodies through its Environmental Permitting system.

6.2.2 The management of water quality is covered by a range of strategies and plans, which have been reviewed for this study:

- Environment Agency River Basin Management Plans: these set out actions needed to achieve good ecological status or potential, under the Water Framework Directive. The Greater Cambridge region lies in the Anglian River Basin Management Plan area[51].

[51] Anglian river basin district river basin management plan

- Environment Agency Water Industry National Environment Programme (WINEP) [52]: this is a water company programme of investigations and actions for environmental improvement schemes within an asset management plan that allow water companies to meet European Directives, national targets and statutory obligations.

6.2.3 Geographical designations are used to identify sensitive areas where certain activities are prohibited, in order to protect water quality. These include:

- Drinking Water Protected Areas and Drinking Water Safeguard Zones. These areas are designated under the Water Framework Directive to prevent pollution that could lead to additional purification treatment needs. Figure 6-1 to Figure 6-3 show the designated areas in Greater Cambridge. All groundwater bodies have been designated as drinking water protected areas.

- Source Protection Zones. These areas are defined around large and public potable groundwater abstraction sites, to provide additional protection to safeguard drinking water. Three zones are defined, based on the travel time of water to the abstraction site, with reference to decay criteria for toxic chemicals, water-borne disease and pollutants. Figure 6-4 shows the designated areas in Greater Cambridge.

- Nitrate Vulnerable Zones. These areas aim to limit nitrate pollution from agriculture to protect drinking water supplies and prevent eutrophication of surface waters. These areas cover over 58% of England. There is a legal requirement to comply with standards in these zones. Figure 6-5 shows the designated areas in Greater Cambridge (all areas in the region are classified as surface water nitrate vulnerable zones).

- Urban Waste Water Treatment Directive (UWWTD) sensitive areas. These areas aim to identify water bodies affected by eutrophication or elevated nitrate concentrations, due to the adverse effects of urban waste water discharges and waste water discharges from certain industrial sectors. Figure 6-6 shows the designated areas in Greater Cambridge.

[52] Water industry national environment programme

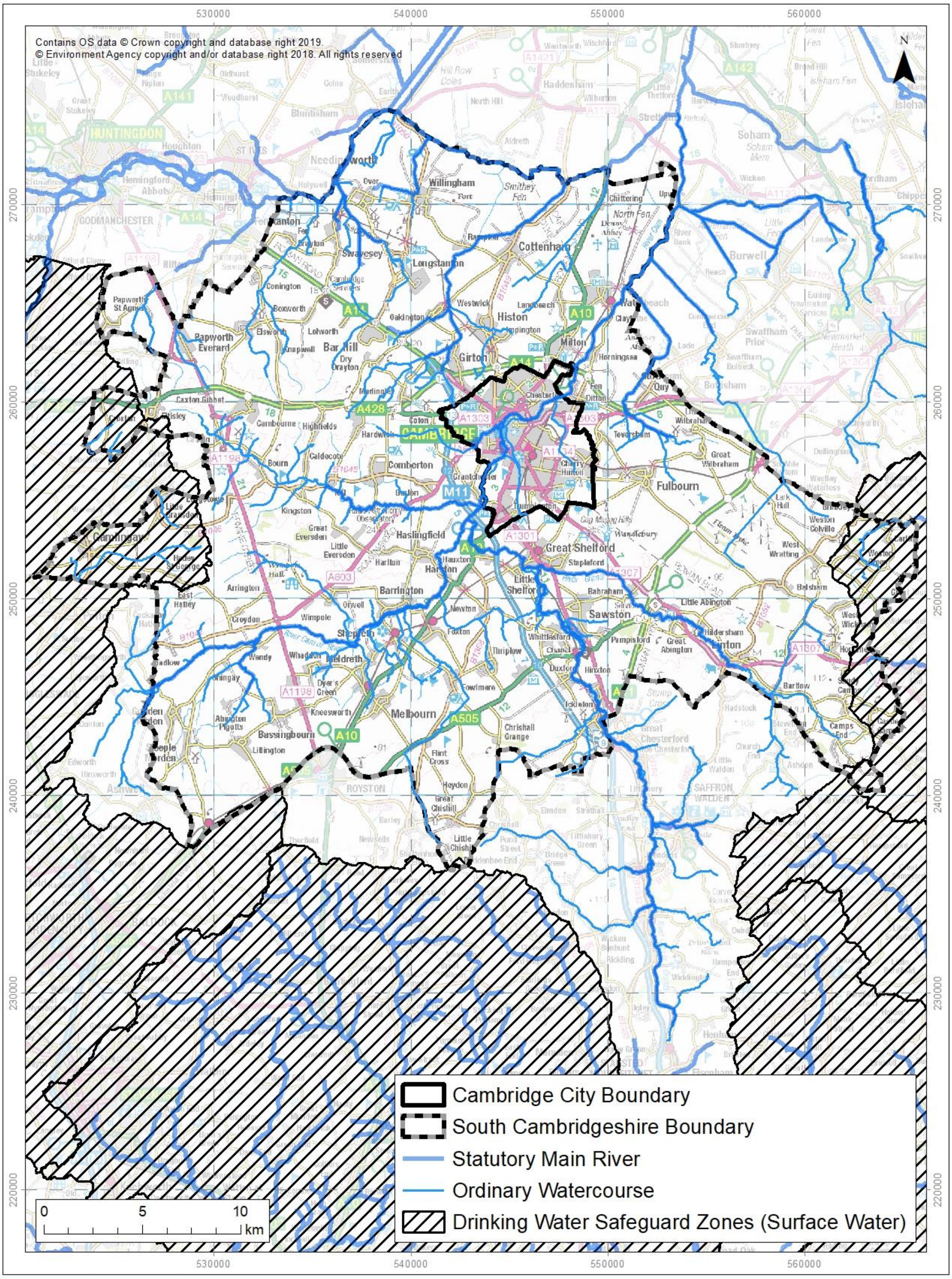

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Figure 6-1: Drinking Water Safeguard Zones (Surface Water)

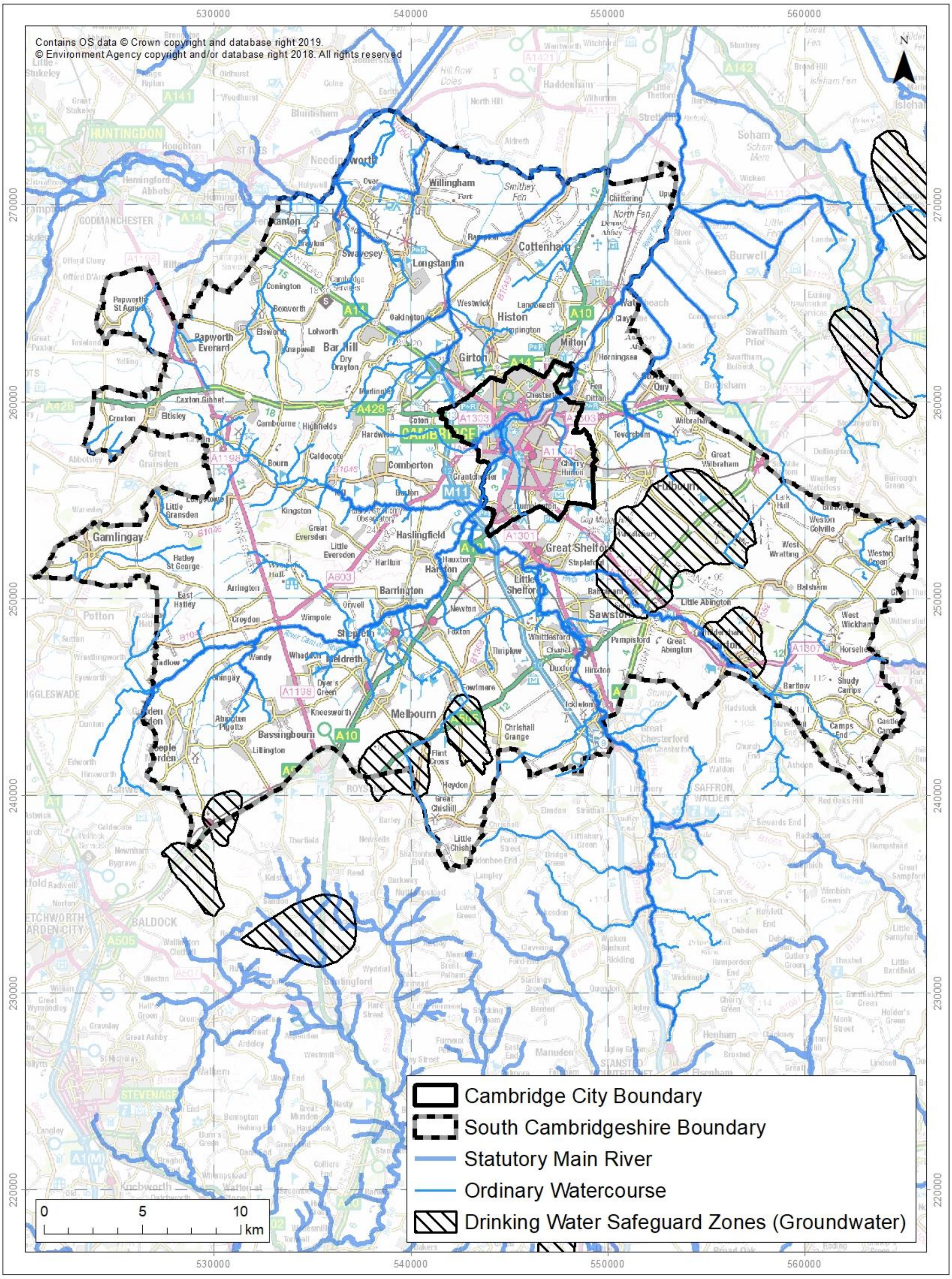

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Figure 6-2: Drinking Water Safeguard Zones (Groundwater)

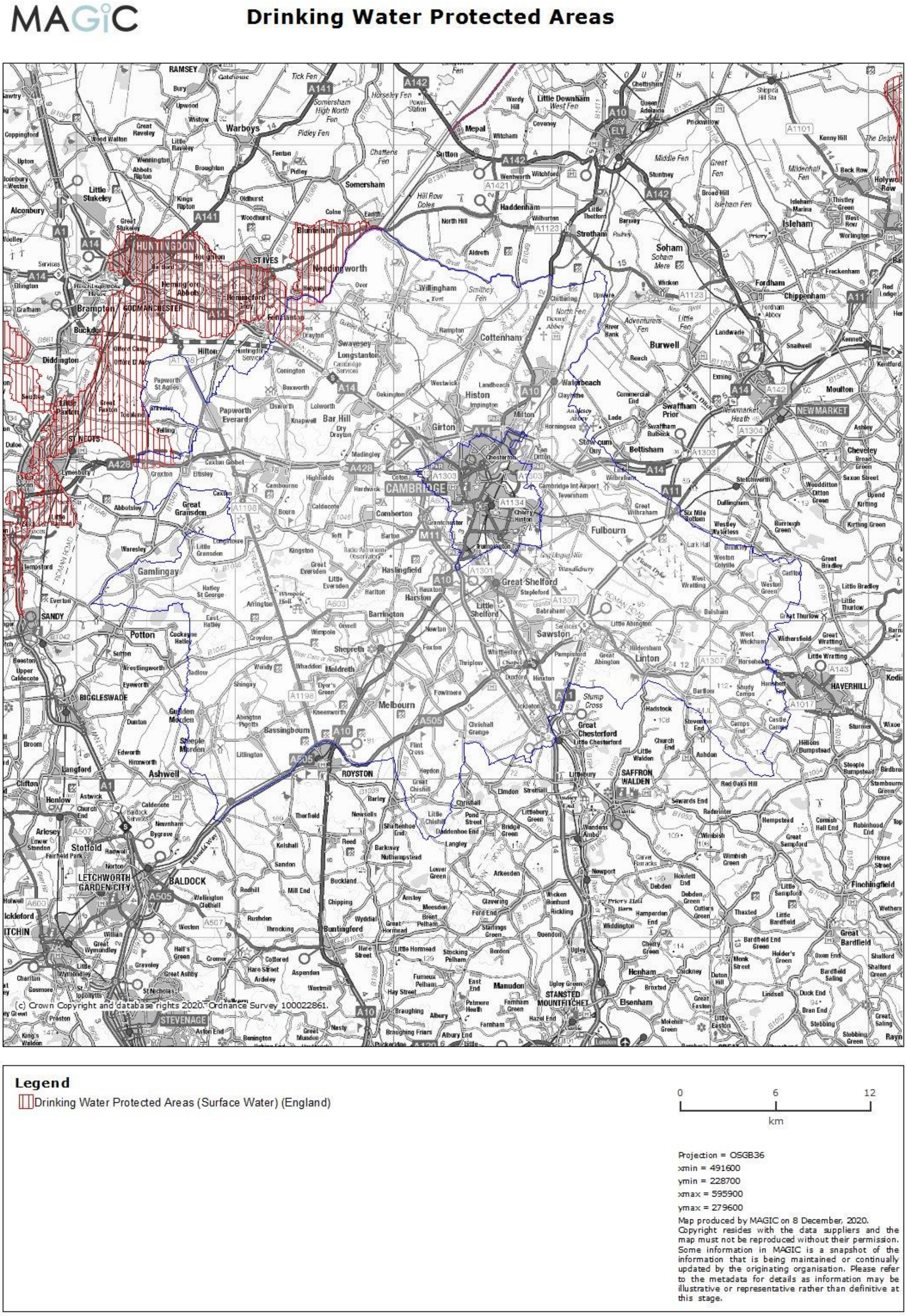

Figure 6-3: Drinking Water Protected Areas (Surface Water) (Magic Maps source only)

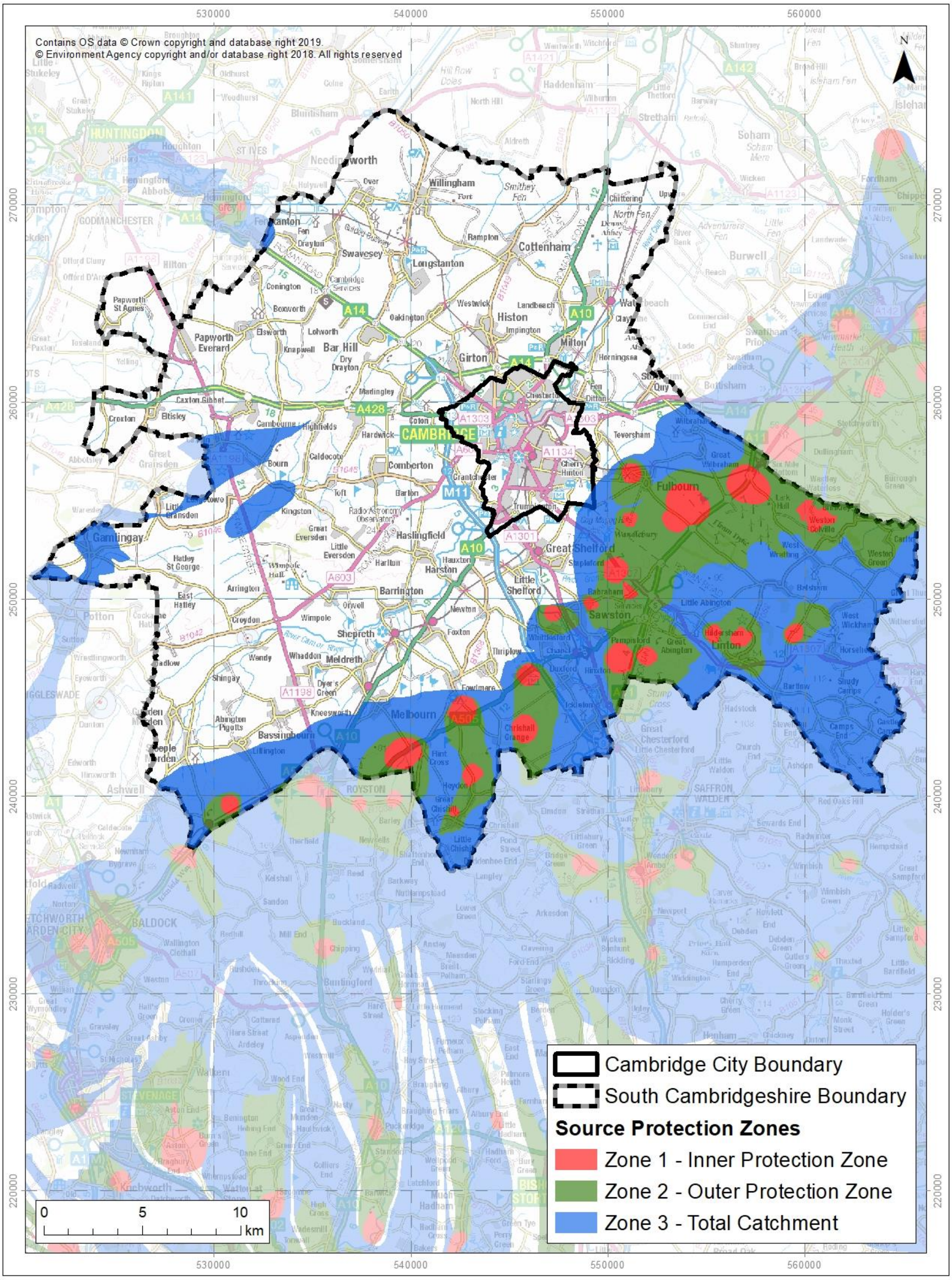

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Figure 6-4: Source Protection Zones

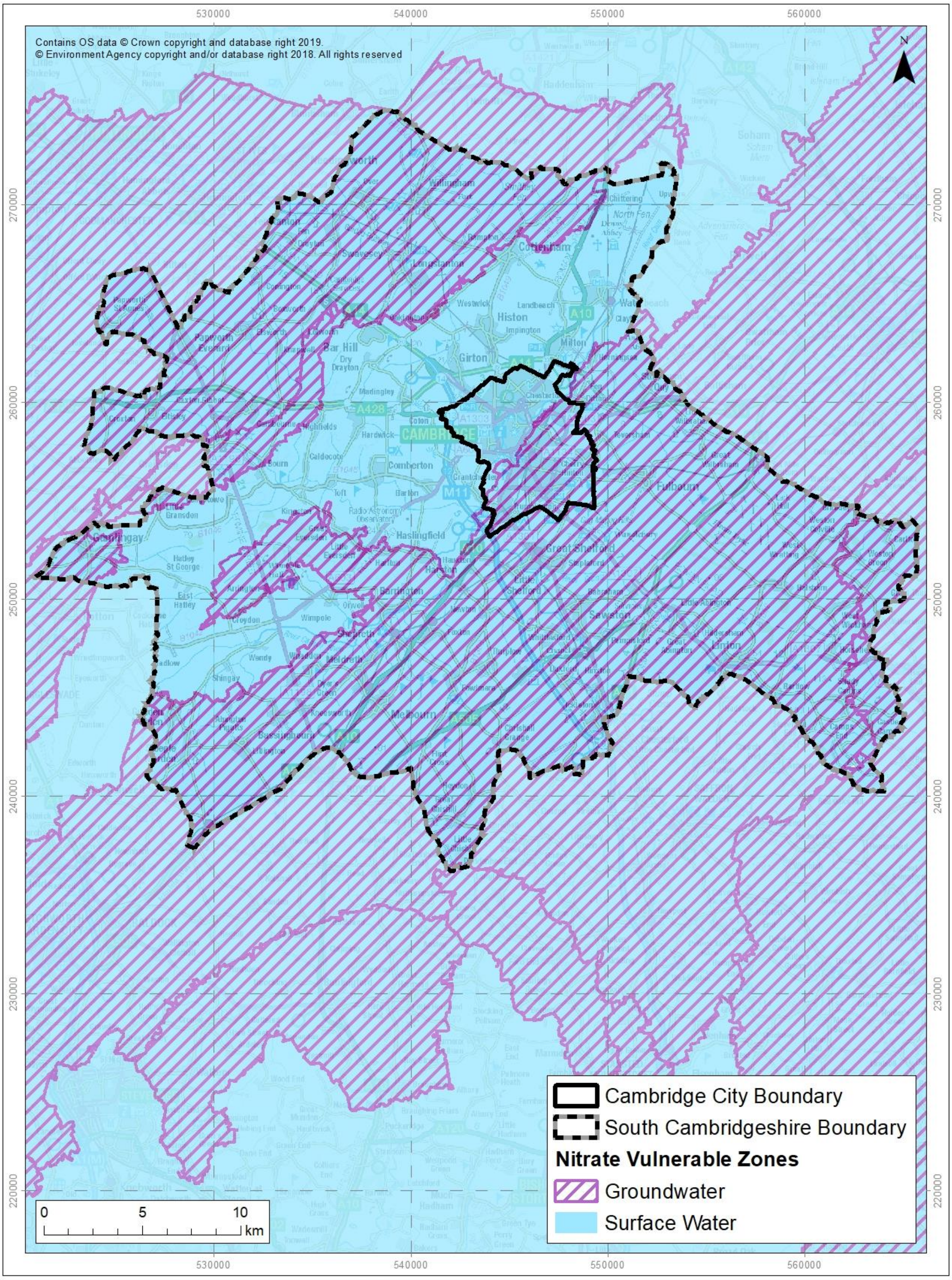

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Figure 6-5: Nitrate Vulnerable Zones

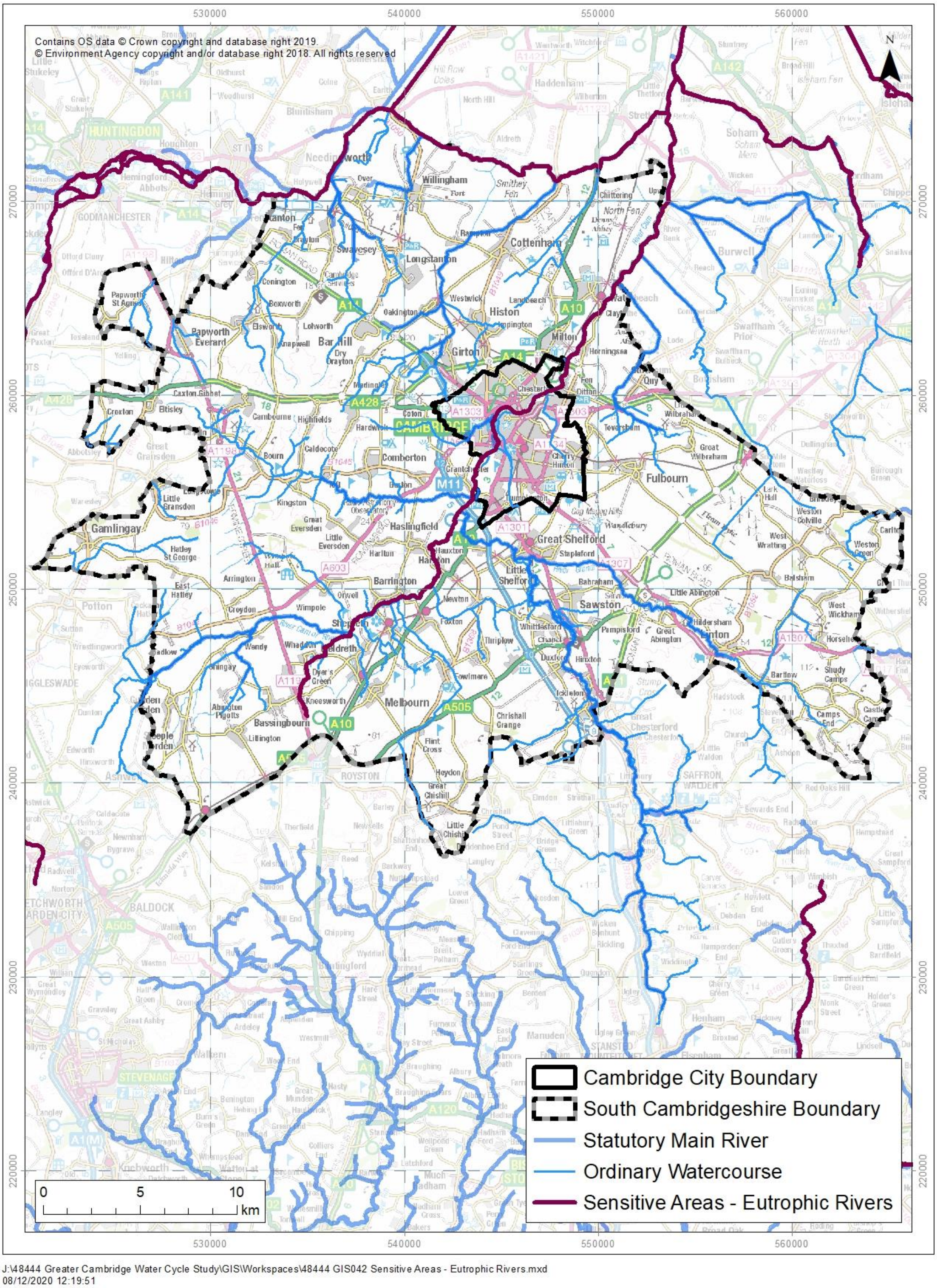

Figure 6-6: Urban Waste Water Treatment Directive Sensitive Areas – Eutrophic Rivers

6.3 Existing Water Quality

Water Framework Directive Status

6.3.1 The WFD status of a water body is determined from a range of quality elements:

- For surface water bodies, biological and chemical elements are assessed.
- For groundwater bodies, quantitative (the amount of groundwater)[53] and chemical elements are assessed.

6.3.2 To achieve good status or potential, every element assessed must be at good status or better. Table 6-1 lists the status classes for ecological elements for surface water bodies. Chemical elements are classified as "fail" or "good". Groundwater status is classified as "poor" or "good".

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

Table 6-1: Definition of status for surface water bodies in the Water Framework Directive

[53] Groundwater levels have been used as one of the measures of quantitative status, using a weight of evidence approach.

6.3.3 The status for groundwater bodies in the Greater Cambridge area is shown in Table 6-2, for 2016 and 2019. The majority of the groundwater bodies have remained at poor quantitative and chemical status. The exceptions are the Cam & Ely Ouse Woburn Sands, which has improved to good quantitative status, and the Upper Bedford Ouse Woburn Sands, which has improved to good chemical status.

6.3.4 The groundwater bodies locations, status and reasons for not achieving good status are summarised in Figure 6-7. The reasons for not achieving good status are diffuse source pollution (highways drainage and poor rural land nutrient management), point source pollution (sewage discharge), and flows (groundwater abstraction).

		Quantitative status	**Quantitative status**	**Chemical status**	**Chemical status**
Water Body	**Year**	**Poor (Red)**	**Good (Green)**	**Poor (Red)**	**Good (Green)**
Cam & Ely Ouse Chalk	2016	✓		✓	
Cam & Ely Ouse Chalk	2019	✓		✓	
North Essex Chalk	2016	✓		✓	
North Essex Chalk	2019	✓		✓	
Upper Bedford Ouse Chalk	2016	✓		✓	
Upper Bedford Ouse Chalk	2019	✓		✓	
Upper Bedford Ouse Woburn Sands	2016	✓		✓	
Upper Bedford Ouse Woburn Sands	2019	✓			✓
Cam & Ely Ouse Woburn Sands	2016	✓			✓
Cam & Ely Ouse Woburn Sands	2019		✓		✓
Total	2016	5	0	4	1
Total	2019	4	1	3	2

Table 6-2: Quantitative and chemical status for groundwaters in Greater Cambridge

6.3.5 The status for surface water bodies in the Greater Cambridge area is shown in Table 6-3, Figure 6-8 and Figure 6-9. All water bodies have changed chemical status from good (2016) to fail (2019). This failure is because of the inclusion of new tests and standards for priority substances, in particular, for two persistent organic pollutants: polybrominated diphenylether (PBDE; used as flame retardants) and perfluorooctane sulphonic acid (PFOS; used as a textile stain repellent and fire-fighting chemical). These chemicals are ubiquitous, difficult to control at source, and highly persistent in the environment. Although these substances are now banned or restricted in the UK, they break down very slowly and can remain in the environment for decades. The chemical status failure of water bodies does not reflect any increase in the presence of these chemicals, but the use of new tests with greater sensitivity to detect them.

6.3.6 As these chemicals have only recently been included in water quality assessments, there are no objectives and measures for improving their status in the 2015 River Basin Management Plans. Updated River Basin Management Plans are currently being prepared for release in 2021, and will include a nationally co-ordinated approach with actions for chemicals of widespread concern.

6.3.7 There are no specific local actions or opportunities that are currently known that could be promoted through the new Local Plan to improve the current chemical status of the waterbodies in Greater Cambridge.

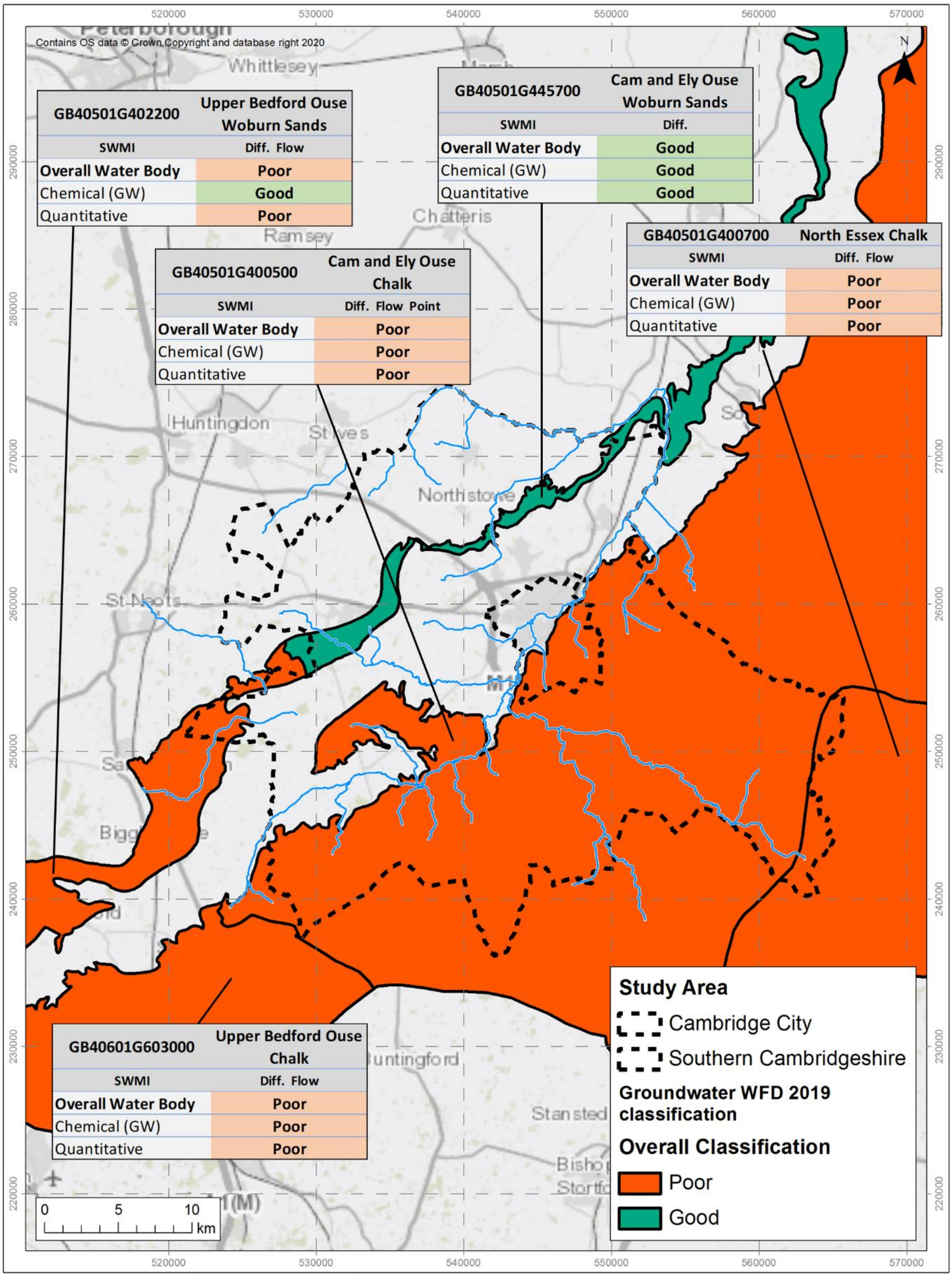

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Figure 6-7: Groundwater WFD 2019 classification and reasons for not achieving “good” status. Significant water management issues (SWMI): diff. (diffuse source pollution), point source pollution, flow.

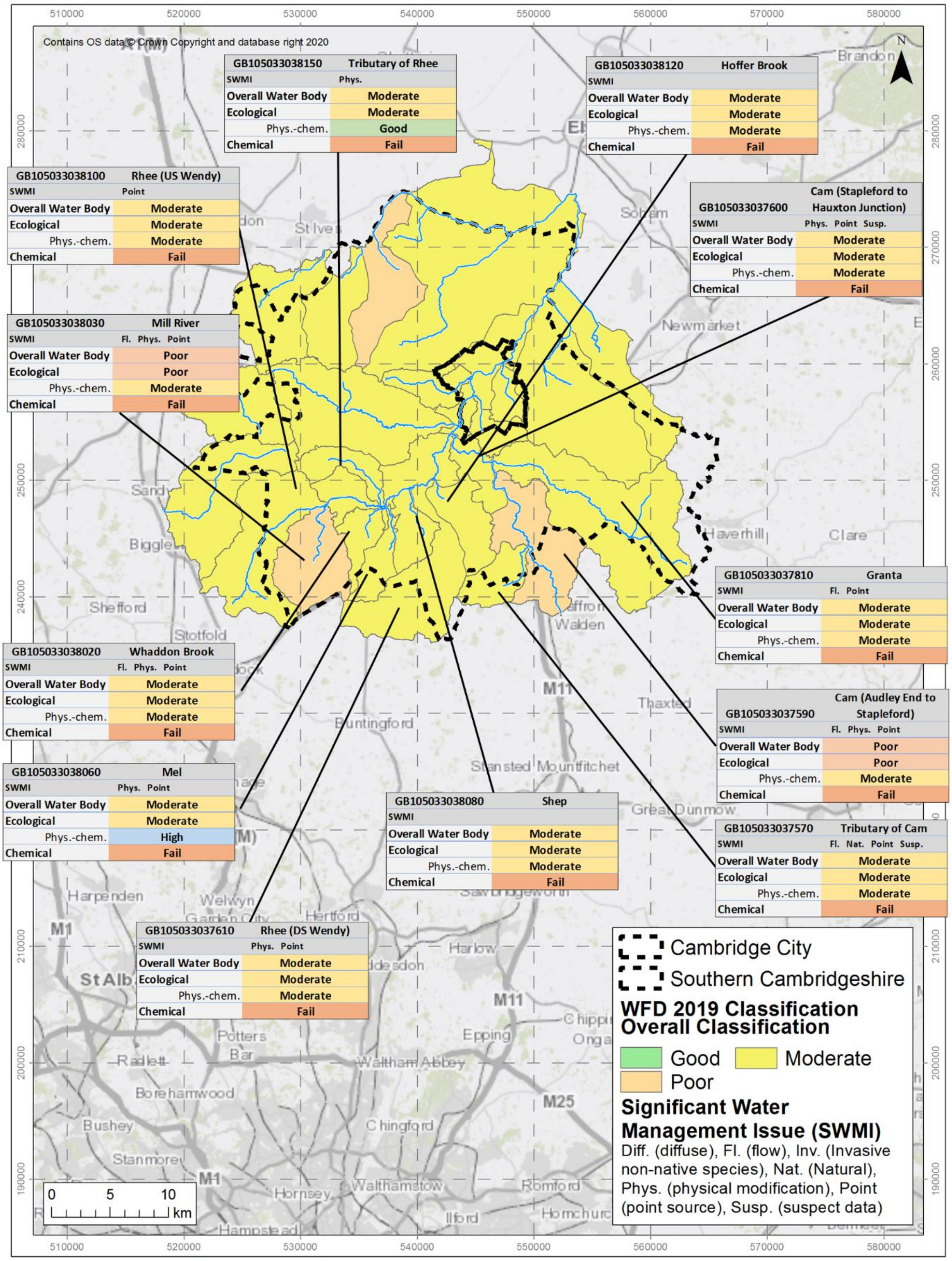

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Figure 6-8:Surface water body WFD 2019 classification and reasons for not achieving “good” status: southern catchments

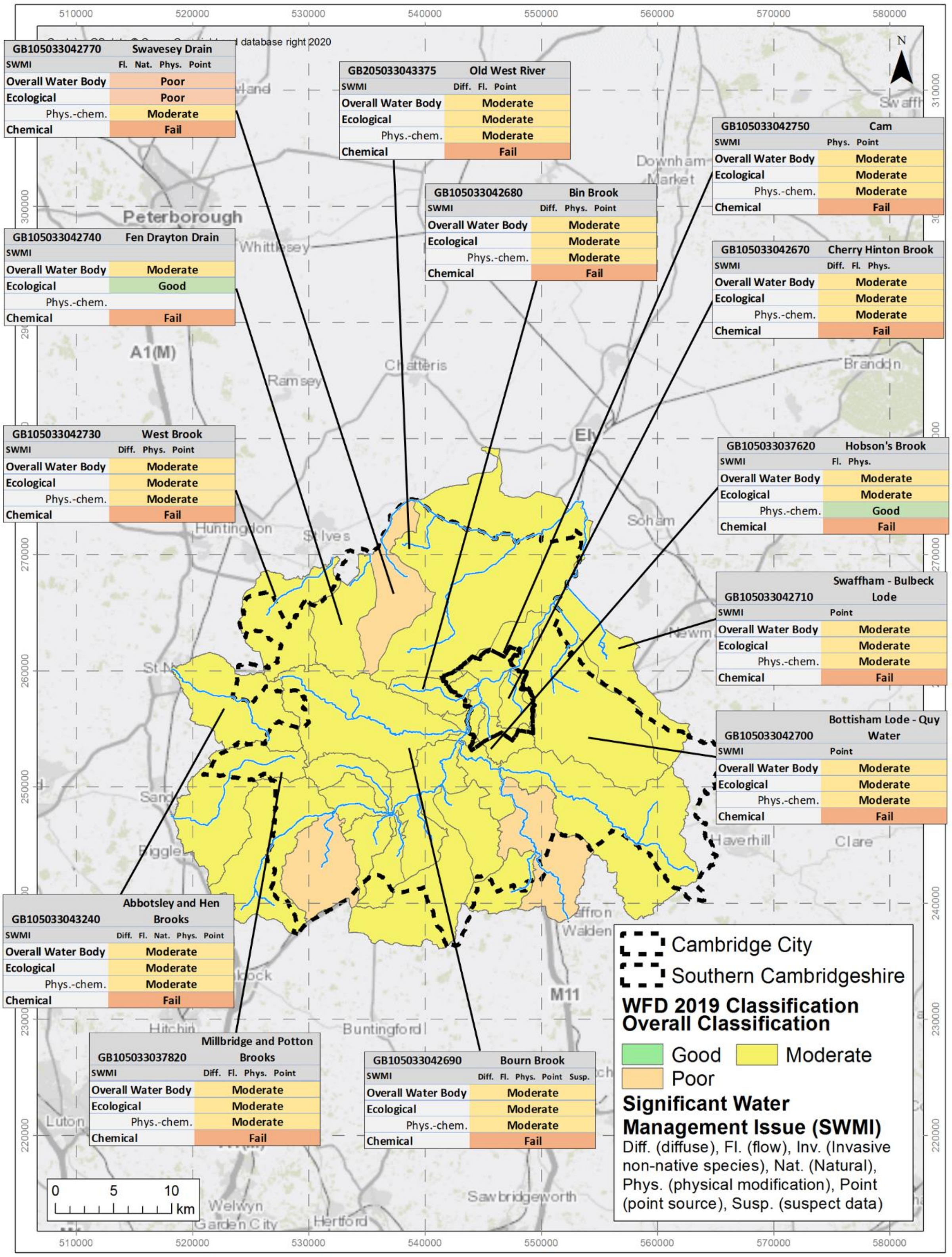

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Figure 6-9: Surface water body WFD 2019 classification and reasons for not achieving “good” status: northern catchments

		Ecological status or potential					**Chemical status**	
Water Body	Year	Bad	Poor	Mod	Good	High	Fail	Good
Abbotsley & Hen Brooks	2016			✓				✓
Abbotsley & Hen Brooks	2019			✓			✓	
Bin Brook	2016			✓				✓
Bin Brook	2019			✓			✓	
Bottisham Lode & Quy Water	2016			✓				✓
Bottisham Lode & Quy Water	2019			✓			✓	
Bourn Brook	2016			✓				✓
Bourn Brook	2019			✓			✓	
Cam	2016			✓				✓
Cam	2019			✓			✓	
Cam (Audley End to Stapleford)	2016		✓					✓
Cam (Audley End to Stapleford)	2019		✓				✓	
Cam (Stapleford to Hauxton)	2016			✓				✓
Cam (Stapleford to Hauxton)	2019			✓			✓	
Cherry Hinton Brook	2016			✓				✓
Cherry Hinton Brook	2019			✓			✓	
Fen Drayton Drain	2016			✓				✓
Fen Drayton Drain	2019				✓		✓	
Granta	2016			✓				✓
Granta	2019			✓			✓	
Hobson’s Brook	2016			✓				✓
Hobson’s Brook	2019			✓			✓	
Hoffer Brook	2016				✓			✓
Hoffer Brook	2019			✓			✓	
Mel	2016			✓				✓
Mel	2019			✓			✓	
Mill River	2016		✓					✓
Mill River	2019		✓				✓	
Millbridge and Potton Brooks	2016				✓			✓
Millbridge and Potton Brooks	2019			✓			✓	
Old West River	2016			✓				✓
Old West River	2019			✓			✓	
Rhee (DS Wendy)	2016			✓				✓
Rhee (DS Wendy)	2019			✓			✓	
Rhee (US Wendy)	2016			✓				✓
Rhee (US Wendy)	2019			✓			✓	
Shep	2016				✓			✓
Shep	2019			✓			✓	
Swaffham – Bulbeck Lode	2016			✓				✓
Swaffham – Bulbeck Lode	2019			✓			✓	
Swavesey Drain	2016		✓					✓
Swavesey Drain	2019		✓				✓	
Tributary of Cam	2016			✓				✓
Tributary of Cam	2019			✓			✓	
Tributary of Rhee	2016			✓				✓
Tributary of Rhee	2019			✓			✓	
West Brook	2016			✓				✓
West Brook	2019			✓			✓	
Whaddon Brook	2016			✓				✓
Whaddon Brook	2019			✓			✓	
Total	2016	0	3	19	3	0	0	25
Total	2019	0	3	21	1	0	25	0

Table 6-3: Ecological and chemical status for surface waters in Greater Cambridge

6.3.8 Three surface water bodies are classified with “poor” ecological status:

- The Cam (Audley End to Stapleford), due to poor biological quality elements (Macrophytes and Phytobenthos). Reasons for not achieving good status include point source pollution (sewage and industrial discharges), low flows (abstraction), and physical modification (agriculture and rural land management).
- Mill River, due to poor biological quality elements (Macrophytes and Phytobenthos). Reasons for not achieving good status include point source pollution (sewage discharge), low flows (abstraction), and physical modification (land drainage).
- The Swavesey Drain, due to poor biological quality elements (Macrophytes and Phytobenthos). Reasons for not achieving good status include point source pollution (sewage discharge), physical modification (land drainage and flood protection), flows (land drainage) and natural (drought).

6.3.9 Only one surface water body is classified as having “good” ecological status (Fen Drayton Drain). All other surface water bodies are classified as having “moderate” ecological status. Three surface water bodies declined in ecological status from good (2016) to moderate (2019). Preliminary indications are that the apparent deterioration is due to changes in sampling regime rather than an actual worsening of water quality.

- Hoffer Brook, due to moderate biological quality elements (dissolved oxygen). Reasons for not achieving good status have not yet been assessed.
- Shep, due to moderate biological quality elements (phosphate). Reasons for not achieving good status have not yet been assessed.
- Millbridge and Potton Brooks, due to moderate biological quality elements (dissolved oxygen) and moderate supporting elements (surface water). Invertebrates were also classified as “poor”. Reasons for not achieving good status have not yet been assessed.

6.3.10 The ecological classification items failing WFD standards (not “High” / “Good”) are listed in Table 6-4. The failure classification for chemical elements limits the overall classification of all the water bodies to “moderate”, even when the ecological classification is “good”. We note that three water bodies, the Rhee (DS Wendy), the Rhee (US Wendy) and Millbridge & Potton Brooks, are classified as “moderate” overall despite having “poor” biological classification. This is because they are classified as heavily modified waterbodies, for which the sensitive elements are excluded from influencing the waterbody classification of “moderate” ecological potential.

Waterbody		Overall Water Body	Ecological Classification Items											
			Supporting elements (Surface Water)		Biological quality elements				Hydro-morphological supporting elements	Physico-chemical quality elements				
ID	Name		Overall classification	Mitigation measures assess-ment	Overall classification	Fish	Inverte-brates	Macro-phytes and Phyto-benthos		Overall classification	Ammonia (Phys-Chem)	Dissolved oxygen	Phosphate	Tempe-rature
GB105033037570	Tributary of Cam	Moderate							Does Not Support Good	Moderate		Poor	Moderate	
GB105033037590	Cam (Audley End to Stapleford)	Poor	Moderate	Moderate or less	Poor			Poor	Does Not Support Good	Moderate			Poor	
GB105033037600	Cam (Stapleford to Hauxton Junction)	Moderate	Moderate	Moderate or less					Does Not Support Good	Moderate			Poor	Moderate
GB105033037610	Rhee (DS Wendy)	Moderate	Moderate	Moderate or less	Poor	Poor				Moderate			Poor	
GB105033037620	Hobson's Brook	Moderate	Moderate	Moderate or less					Does Not Support Good					
GB105033037810	Granta	Moderate			Moderate			Moderate	Does Not Support Good	Moderate			Poor	
GB105033037820	Millbridge and Potton Brooks	Moderate	Moderate	Moderate or less	Poor		Poor			Moderate		Moderate	Moderate	
GB105033038020	Whaddon Brook	Moderate			Moderate		Moderate			Moderate			Poor	
GB105033038030	Mill River	Poor	Moderate	Moderate or less	Poor			Poor		Moderate			Poor	
GB105033038060	Mel	Moderate	Moderate	Moderate or less										
GB105033038080	Shep	Moderate								Moderate			Moderate	
GB105033038100	Rhee (US Wendy)	Moderate	Moderate	Moderate or less	Poor	Poor				Moderate			Poor	
GB105033038120	Hoffer Brook	Moderate								Moderate		Moderate		
GB105033038150	Tributary of Rhee	Moderate	Moderate	Moderate or less										
GB105033042670	Cherry Hinton Brook	Moderate	Moderate	Moderate or less	Moderate		Moderate		Does Not Support Good	Moderate	Moderate	Poor	Moderate	
GB105033042680	Bin Brook	Moderate	Moderate	Moderate or less	Moderate		Moderate			Moderate			Poor	

GB10503 3042690	Bourn Brook	Moderate	Moderate	Moderate or less	Moderate	Mode rate				Moderate			Poor	
GB10503 3042700	Bottisham Lode - Quy Water	Moderate								Moderate			Poor	
GB10503 3042710	Swaffham - Bulbeck Lode	Moderate	Moderate	Moderate or less						Moderate			Poor	
GB10503 3042730	West Brook	Moderate								Moderate			Poor	
GB10503 3042740	Fen Drayton Drain[54]	Moderate												
GB10503 3042750	Cam	Moderate	Moderate	Moderate or less						Moderate			Poor	
GB10503 3042770	Swavesey Drain	Poor	Moderate	Moderate or less	Poor	Mode rate	Moderate	Poor		Moderate	Poor	Moderate	Poor	
GB10503 3043240	Abbotsley and Hen Brooks	Moderate	Moderate	Moderate or less	Moderate		Moderate			Moderate		Poor	Poor	
GB20503 3043375	Old West River	Moderate	Moderate	Moderate or less						Moderate		Moderate	Moderate	

Table 6-4: Surface water bodies 2019 WFD classifications and ecological sub-classifications. Note – for clarity, only those items assessed as failing WFD standards are shown (not High / Good).

Water Quality Monitoring

6.3.11 The Environment Agency monitor water quality through a regular programme of sampling. The data are open source and available online through the Water Quality Archive[54]. Sampled data for key locations in the Greater Cambridge (Figure 6-10) has been downloaded for 2017 – 2019, for ammonia, biological oxygen demand (BOD) and orthophosphate water quality indicators. These are compared to the “good” status threshold in Table 6-5[55]. Ammonia and BOD are generally meet the “good” status threshold, while phosphorus levels are frequently significantly worse than the “good” environmental quality standard (i.e. fail to meet the standard).

Modelled Water Quality: Source Apportionment

6.3.12 Many of the surface water bodies in the study area are at less than “good” status for phosphate. Environment Agency modelled data (SAGIS-SIMCAT) has been used to indicate the contribution of different sector sources (both point and diffuse) to phosphate levels. The Source Apportionment Geographical Information System (SAGIS), a modelling framework shared between the Water Industry and the Environment Agency, forms the basis of source apportionment assessments across England, and also “Fair Share” calculations. As a result, SAGIS underpins both River Basin Management Plans and the Water Industry National Environment Program, and thus is a key component of the evidence base justifying the level of the WRC permits set out to improve WFD status based on “Fair Share” principles.

6.3.13 The SAGIS modelling framework collates the best available data (both measured and modelled outputs) to derive loads and export coefficients for point and diffuse inputs from different sector sources. These are then fed forward, in the form of summary statistics, into the Environment Agency National SIMCAT water quality model. The calibration methodology adopted by the EA fixes known point source inputs, since these are considered more certain as inputs are based on measured data, and adjusts, less certain, diffuse inputs to best match instream water quality at the catchment scale. Flow estimates are based on LowFlow Enterprise (hydrosolutions.co.uk).

6.3.14 The national SAGIS models are undergoing updates and recalibration in order to account for WRC treatment upgrades. The data currently available, in SAGIS Optimiser workbook format, represent conditions at the beginning of AMP7 calibrated against 2010-12 riverine water quality. Despite these limitations, the SAGIS-SIMCAT represent the best available consistent evidence to describe the relative contribution from different sector sources. However, it is important to note that like any model, and particularly those that operate across large regional scales, it is underpinned by modelling

[54] Environment Agency: Water quality data archive

[55] There were no BOD data available for the following sampling point locations: AN-29M04 and AN-19M19.

assumptions and default data that maybe less applicable and lead to performance issues at smaller scales (e.g., individual waterbodies).

6.3.15 Figure 6-11 shows how the total load is apportioned and compares it to the loading considered necessary for “good” status. In many water bodies, the total loading is more than triple the loading necessary for “good” status. This is why there are (and will continue to be) programmes of work to improve wastewater treatment for phosphorous removal in the catchment including new AMP7 permits for Bassingbourne, Bourn, Shudy Camps, Coton, Linton, Litlington, Papworth Everard, Uttons Drove, Warelsey, and Waterbeach WRCs.

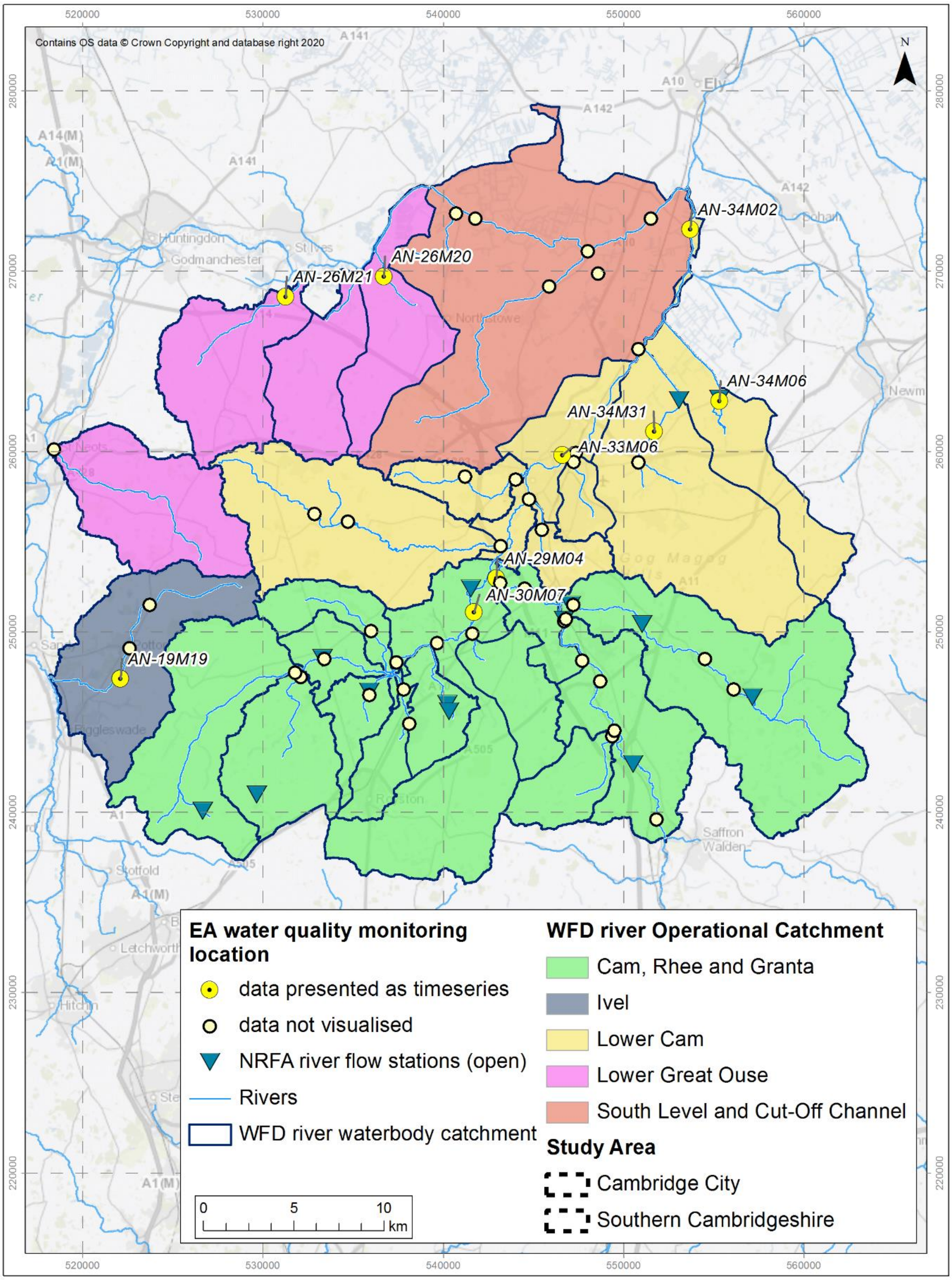

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Figure 6-10: Water quality sampling locations

<table>
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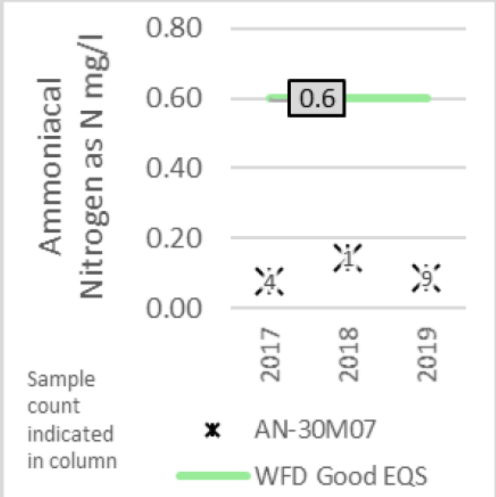
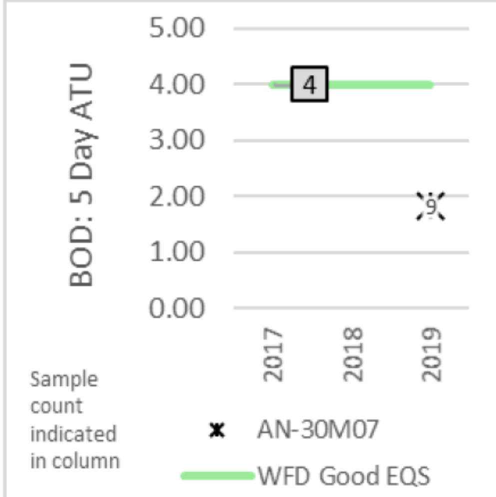
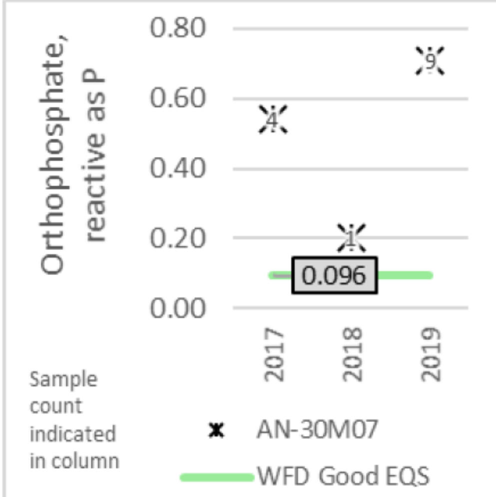
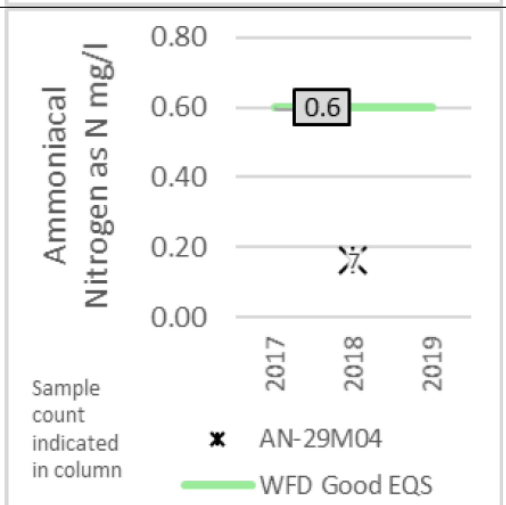
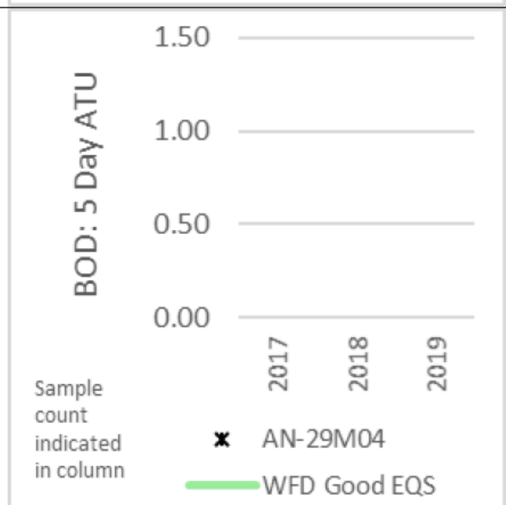
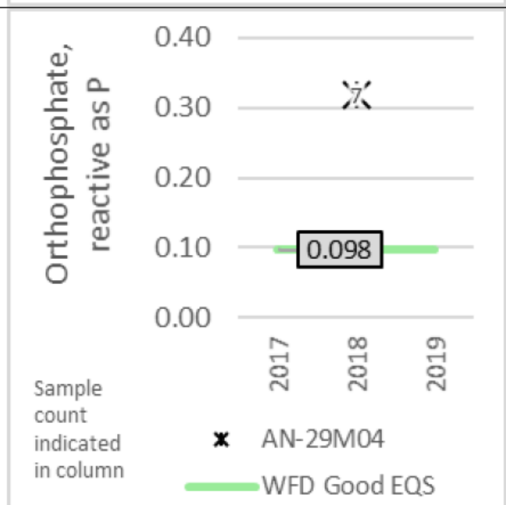
<tr><td>River Rhee (DS Wendy) AN-30M07</td>
<td></td>
<td></td>
<td></td></tr>
<tr><td>River Cam (Stapleford to Hauxton) AN-29M04</td>
<td></td>
<td></td>
<td></td></tr>
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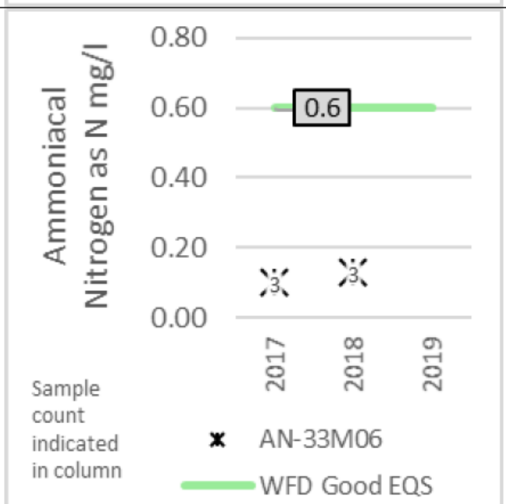
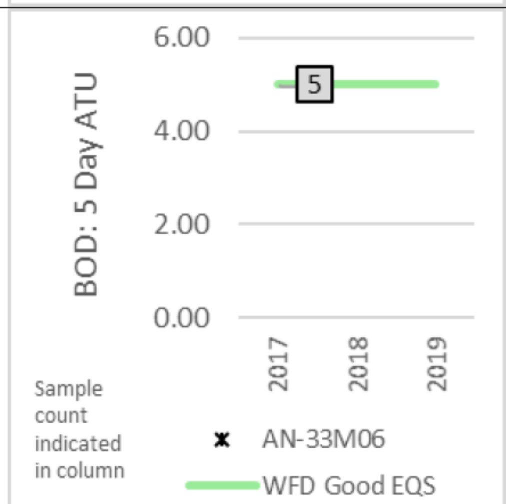
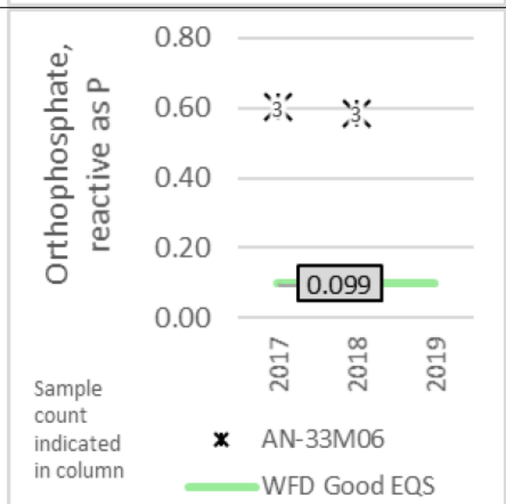
<td></td>
<td></td>
<td></td></tr>
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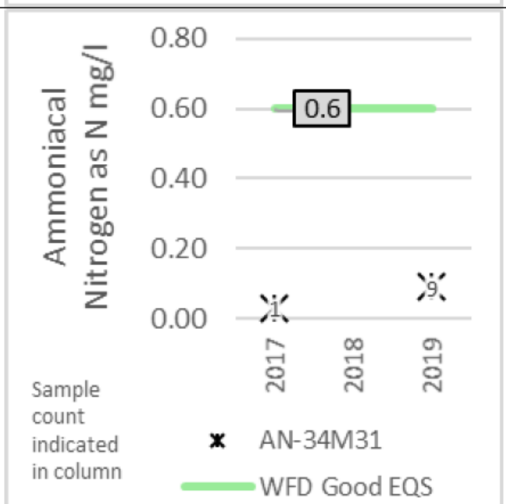
<td></td>
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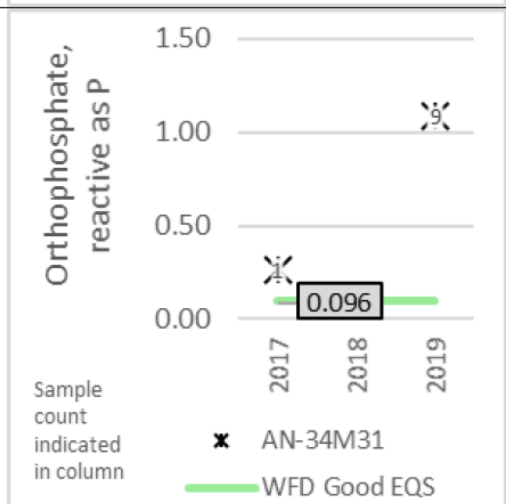
<td></td></tr>
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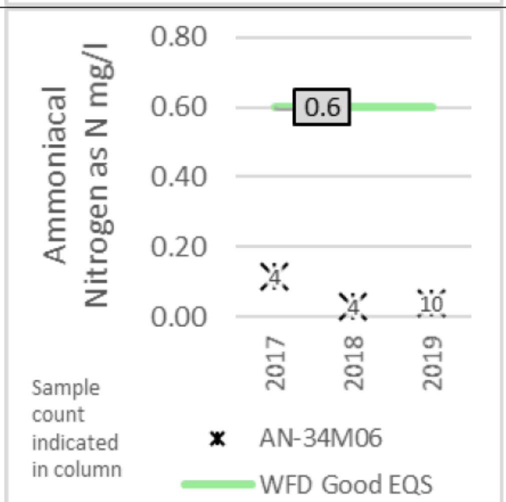
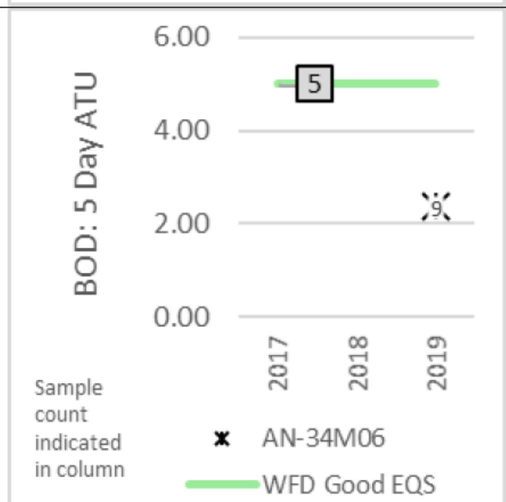
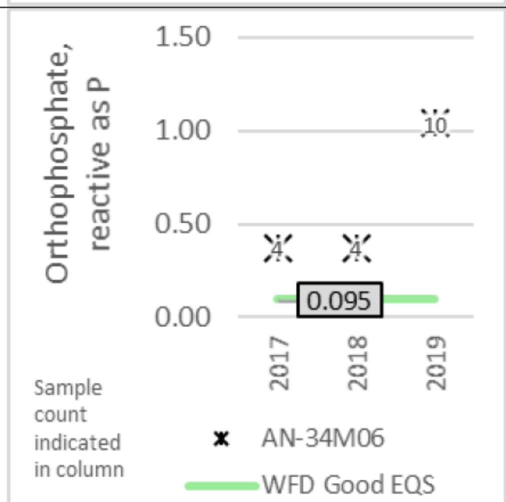
<td></td>
<td></td>
<td></td></tr>
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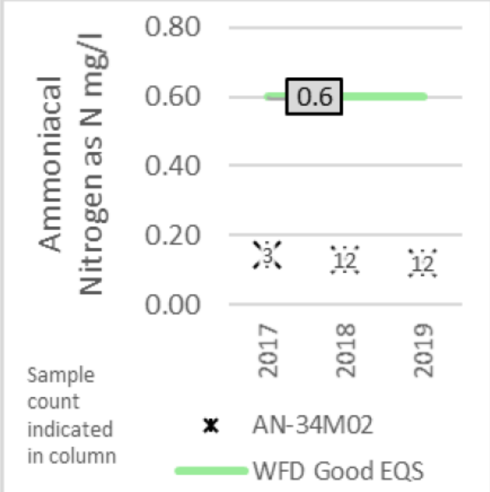
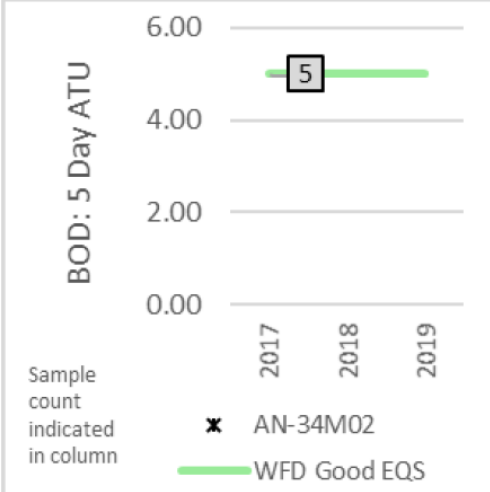
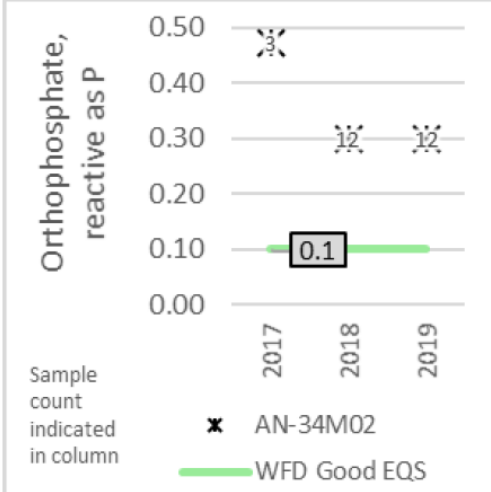
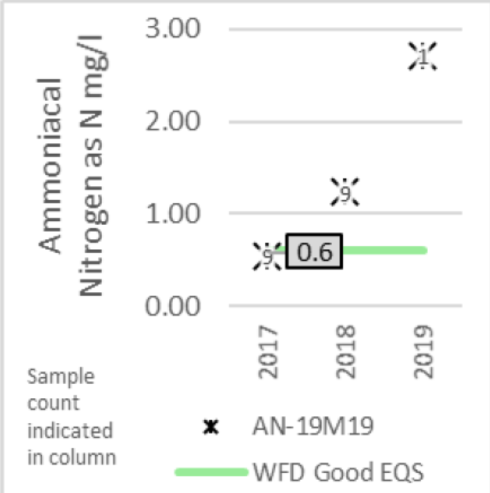
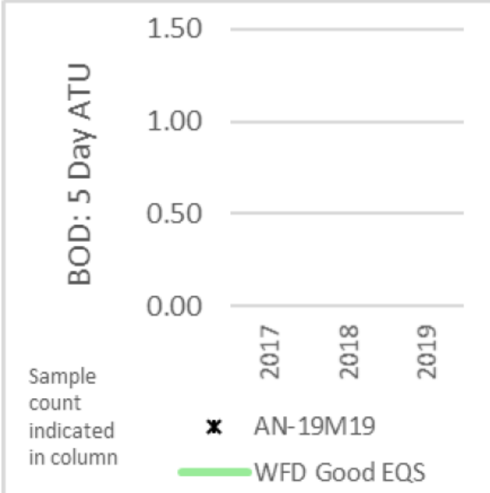
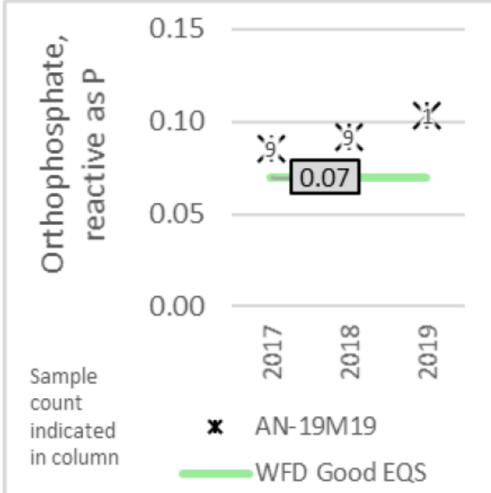
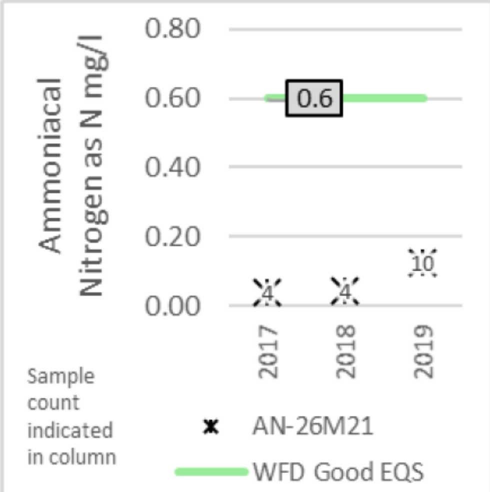
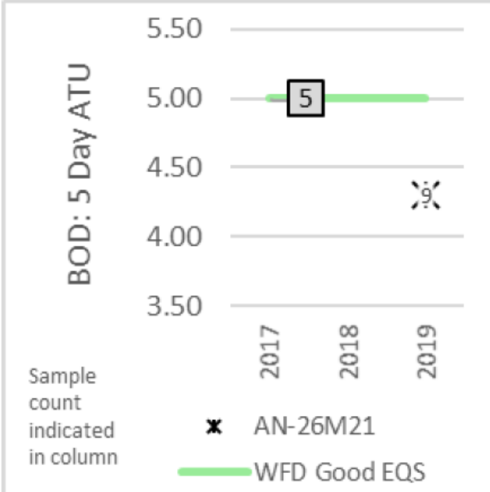
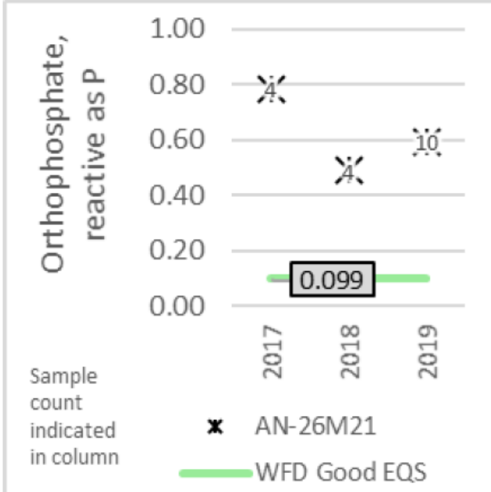
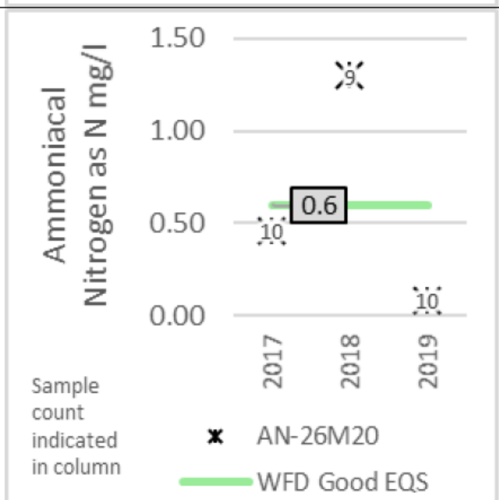
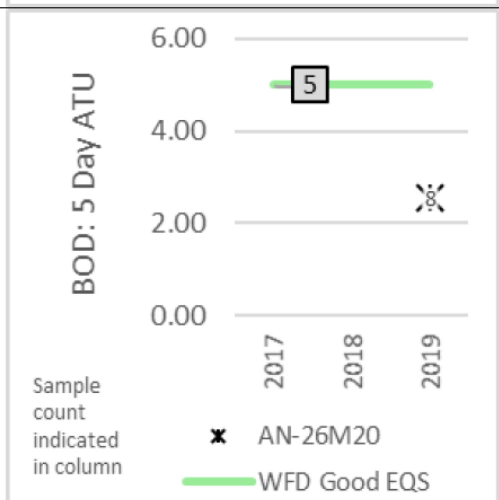
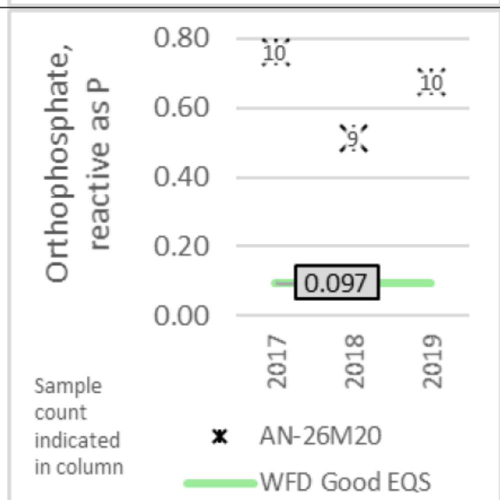
Location	Ammonia	BOD	Phosphate
Lower River Cam (AN-34M02)			
Potton Brook (AN-19M19)			
West Brook (AN-26M21)			
Swavesey Drain (AN-26M20)			

Table 6-5: Water quality monitoring samples for 2017 – 2019 for selected locations and indicators, obtained from WIMS database.

Waterbody		Sample Point		Current in-river SAGIS apportionment								SAGIS predicted in-river concentration (mg/l) – colour coding added	In-river Load (kg/d)		
ID	Name	ID	Name	Sewage effluent	Inter-mittents	Industry	Livestock	Arable	Highways	Urban	On-site WwTW [57]		WRC sources	Non-WRC sources	Total
GB105033037570	Tributary of Cam	AN-27M29	ICKLETON BK.RD.BR.ICKLETON	85.0%	0.5%	0.0%	1.4%	7.4%	0.8%	4.0%	0.9%	0.109 (Yellow)	0.74	0.13	0.87
GB105033037590	Cam (Audley End to Stapleford)	AN-27M10	R.CAM DERNFORD LOCK GAUGING STATION	61.7%	8.3%	1.6%	1.5%	8.5%	1.0%	16.3%	1.1%	0.413 (Amber)	16.31	10.11	26.41
GB105033037600	Cam (Stapleford to Hauxton Junction)	AN-29M04	R.CAM 300M D/S SCHERING AGROCHEMICAL LTD	64.1%	6.9%	3.5%	1.4%	7.4%	1.0%	14.6%	1.1%	0.362 (Amber)	20.62	11.54	32.16
GB105033037610	Rhee (DS Wendy)	AN-30M07	R.RHEE HASLINGFIELD RD.BR.	66.6%	5.0%	0.9%	4.3%	10.3%	0.0%	10.9%	2.0%	0.541 (Amber)	28.52	14.30	42.82
GB105033037620	Hobson's Brook	AN-33M24	HOBSONS BK.TRIB.CAM RD.BR. LONG ROAD	0.0%	0.0%	0.0%	4.0%	0.9%	0.1%	94.1%	1.0%	0.036 (Blue)	0.00	0.25	0.25
GB105033037810	Granta	AN-28M07	R.GRANTA STAPLEFORD BRIDGE	87.5%	0.7%	5.7%	0.5%	2.8%	0.1%	2.4%	0.3%	0.454 (Amber)	6.15	0.88	7.03
GB105033037820	Millbridge and Potton Brooks	AN-19M19	MILLBRIDGE BK.TRIB.IVEL SUTTON FORD	72.2%	6.3%	0.0%	2.1%	5.5%	0.1%	11.5%	2.3%	0.095 (Yellow)	0.74	0.29	1.03
GB105033038020	Whaddon Brook	AN-30M19	WHADDON BK.RD.BR.WHADDON	96.8%	0.0%	0.0%	0.0%	0.3%	0.0%	2.7%	0.2%	0.549 (Amber)	2.89	0.10	2.98
GB105033038030	Mill River	AN-30M15	MILL RIVER RD.BR.SHINGAY-WENDY RD.	90.2%	1.7%	0.0%	0.1%	2.0%	0.0%	5.5%	0.5%	0.365 (Amber)	2.81	0.30	3.11
GB105033038060	Mel	AN-30M21	MELBOURN BK.RD.CULVERT MELDRETH	92.7%	2.4%	0.0%	0.0%	0.0%	0.0%	4.8%	0.0%	2.211 (Red)	9.04	0.71	9.75
GB105033038080	Shep	AN-30M22	R.SHEP FT.BR.AT BOOT LANE	0.0%	0.0%	0.0%	4.9%	5.3%	0.0%	69.7%	20.2%	0.057 (Green)	0.00	0.55	0.55
GB105033038100	Rhee (US Wendy)	AN-30M24	R.RHEE WENDY RD.BR.	44.7%	5.2%	0.0%	7.5%	28.4%	0.1%	11.2%	2.9%	0.311 (Amber)	4.94	6.11	11.05
GB105033038120	Hoffer Brook	AN-30M36	HOFFER BK.A10 RD.BR.HOFFER BRIDGE	79.4%	1.1%	0.0%	1.2%	1.5%	0.4%	15.9%	0.5%	0.696 (Amber)	0.94	0.24	1.18
GB105033038150	Tributary of Rhee	AN-30M45	TRIB.R.RHEE ORWELL RD.BR.	0.0%	0.0%	0.0%	28.3%	43.0%	0.0%	19.2%	9.5%	0.191(Yellow)	0.00	0.20	0.20
GB105033042680	Bin Brook	AN-33M23	BIN BK. RD.BR. GRANGE ROAD	42.5%	0.6%	0.0%	12.5%	14.5%	1.8%	26.2%	1.8%	0.427 (Amber)	0.94	1.27	2.20

GB10503 3042690	Bourn Brook	AN-32M02	BOURN BK.TRIB.CAM CANTELUPE FM.BR.	38.6%	4.7%	0.0%	7.2%	33.4%	0.6%	11.8%	3.8%	0.418 (Amber)	4.93	7.85	12.78
GB10503 3042700	Bottisham Lode - Quy Water	AN-34M31	QUY WATER RD.BR. STATION ROAD	88.8%	2.7%	0.0%	1.1%	1.3%	0.4%	5.4%	0.4%	1.143 (Red)	6.92	0.87	7.79
GB10503 3042710	Swaffham - Bulbeck Lode	AN-34M06	SWAFFHAM BULBECK LODE S.BULBECK RD.BR.	96.6%	0.7%	0.0%	0.5%	1.4%	0.2%	0.4%	0.3%	0.550 (Amber)	5.41	0.19	5.60
GB10503 3042730	West Brook	AN-26M21	WEST BK.A604 RD.BR.FENSTANTON	45.5%	3.9%	0.0%	10.5%	26.3%	1.0%	11.7%	1.0%	0.142(Yellow)	1.45	1.74	3.19
GB10503 3042750	Cam	AN-34M02	R.CAM DIMMOCKS COTE RD.BR.	71.0%	6.5%	0.7%	2.5%	6.5%	0.3%	11.4%	1.0%	0.388 (Amber)	110.54	45.05	155.59
GB10503 3042770	Swavesey Drain	AN-26M20	LONGSTANTON BK.HIGH CAUSEWAY BR.SWAVESEY	83.0%	3.0%	0.0%	3.5%	4.7%	0.2%	4.8%	0.7%	0.567 (Amber)	3.70	0.76	4.46
GB10503 3043240	Abbotsley and Hen Brooks	AN-20M15	HEN BK.TRIB.OUSE BK.STN.RD.BR.ST.NEOTS	56.4%	4.7%	0.0%	5.0%	19.0%	0.8%	12.4%	1.7%	0.262 (Amber)	2.52	1.94	4.46
GB20503 3043375	Old West River	AN-35M24	OLD WEST R. OLD STREATHAM P.S. BRIDGE	15.8%	12.9%	0.0%	20.8%	16.2%	0.6%	30.2%	3.4%	0.256 (Amber)	5.34	28.34	33.68

Table 6-6: Phosphate source apportionment, predicted in-river concentrations and loads (with colour indicating WFD status: blue = high, green = good, yellow = moderate, Amber = poor, red = bad) extracted from SAGIS Optimiser (2010 – 2012 calibration period) for water quality assessment points that are located at the most downstream available point within the surface water bodies of the study area. This assessment precedes planned AMP7 improvements being delivering before 2025

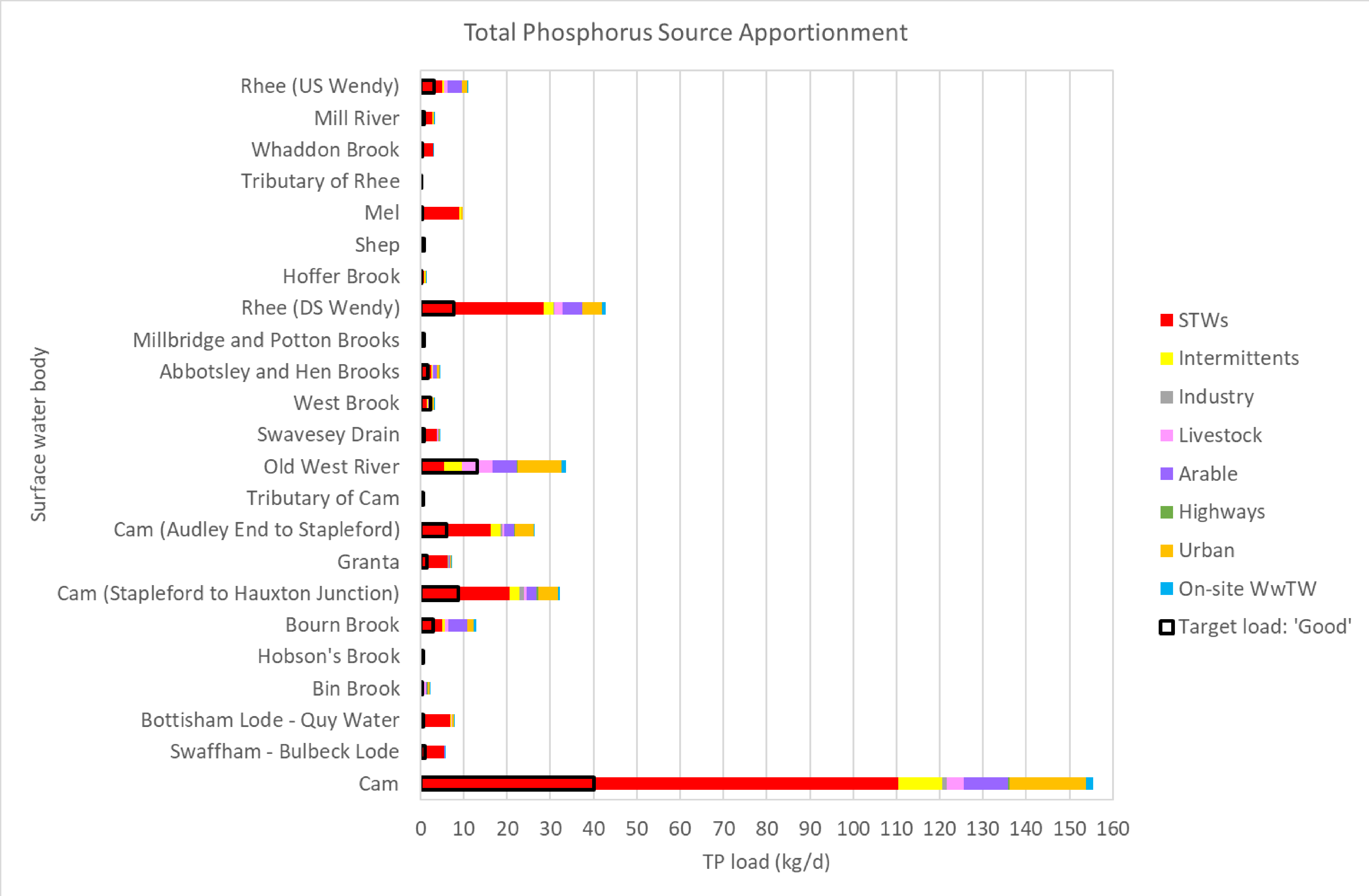


Figure 6-11: Total phosphorus source apportionment for AMP7 planning (pre 2020)

6.4 Water Quality Management Objectives and Measures

6.4.1 Objectives and measures for managing water quality in the Greater Cambridge area are set out in the Anglian River Basin Management Plan (2015). Updates to these are available via the EA's Catchment Data Explorer and updated River Basin Management Plans (2021) will be referenced in the detailed WCS where changes are relevant.

6.4.2 The environmental objectives of the WFD are:

- To prevent deterioration of the status of surface waters and groundwater.
- To achieve the objectives and standards for protected areas.
- To aim to achieve good status for all water bodies, or, for heavily modified water bodies and artificial water bodies, good ecological potential and good surface water chemical status.
- To reverse any significant and sustained upward trends in pollutant concentrations in groundwater.
- To cease discharges, emissions and losses of priority hazardous substances into surface waters.
- To progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants.

6.4.3 Environmental objectives were set for each water body in the 2015 River Basin Management Plan. These objectives are legally binding and all public bodies must have regard to these objectives when making decisions that could affect the quality of the water environment. In certain specific circumstances, exemptions from some of the objectives may be applied.

6.4.4 The objectives (i.e. the planned status of each waterbody that must be achieved or maintained) for the water bodies in the Greater Cambridge area were updated following the Cycle 2 2019 classifications and are listed in Table 6-7 and Table 6-8. Almost all of the water bodies are not required to meet "good" standards by 2021, due to disproportionate costs, technical infeasibility, and/or background conditions. Three surface water bodies should be classified "good" by 2021, and a further six surface water bodies should meet this standard by 2027. All other surface water bodies, and all ground water bodies, are expected to remain at "poor" or "moderate" status, due to disproportionate costs, technical infeasibility, and/or background conditions.

Water Body	Year	Objective[56]	Reasons for alternative Objectives
Tributary of Cam	2015	Moderate (Yellow)	[Unfavourable balance of costs and benefits/Disproportionately expensive]][Background condition/Natural conditions]
Cam (Audley End to Stapleford)	2027	Moderate (Yellow)	[Disproportionate burdens/Disproportionately expensive]][Unfavourable balance of costs and benefits/Disproportionately expensive]
Cam (Stapleford to Hauxton Junction)	2015	Moderate (Yellow)	[Disproportionate burdens/Disproportionately expensive]][No known technical solution is available/Technically infeasible]
Rhee (DS Wendy)	2015	Moderate (Yellow)	[Disproportionate burdens/Disproportionately expensive]][Unfavourable balance of costs and benefits/Disproportionately expensive]
Hobson's Brook	2027	Good (Green)	[Disproportionate burdens/Disproportionately expensive]
Granta	2015	Moderate (Yellow)	[No known technical solution is available/Technically infeasible]
Millbridge and Potton Brooks	2015	Moderate (Yellow)	[Unfavourable balance of costs and benefits/Disproportionately expensive]
Whaddon Brook	2015	Moderate (Yellow)	[Disproportionate burdens/Disproportionately expensive]][Unfavourable balance of costs and benefits/Disproportionately expensive]][Action to get biological element to good would have significant adverse impact on use/Good status prevented by A/HMWB designated use]][No known technical solution is available/Technically infeasible]
Mill River	2015	Poor	[Unfavourable balance of costs and benefits/Disproportionately expensive]
Mel	2027	Good (Green)	[Disproportionate burdens/Disproportionately expensive]][Ecological recovery time/Natural conditions]
Shep	2015	Good (Green)	NO DATA
Rhee (US Wendy)	2027	Good (Green)	[Disproportionate burdens/Disproportionately expensive]][Ecological recovery time/Natural conditions]
Hoffer Brook	2015	Good (Green)	NO DATA
Tributary of Rhee	2027	Good (Green)	[Disproportionate burdens/Disproportionately expensive]

[56] Objective: The planned status of a water body that must be achieved or maintained. There are three different status objectives for each water body. These are Overall status objective, Ecological status or potential objective; and Chemical status objective. These are always accompanied by a date by when the objective will be achieved. Ecological status (or potential) objectives will be derived from the predicted outcomes for the biological elements and physico-chemical elements, plus any reasons for not achieving good ecological status (or potential) by 2015. Chemical status objectives will be derived from the predicted outcomes for the chemical elements plus any reasons for not achieving good chemical status by 2015. Overall status objectives will be derived from the ecological status and chemical status objectives (Source: https://environment.data.gov.uk/catchment-planning/glossary)

Water Body	Year	Objective[56]	Reasons for alternative Objectives
Cherry Hinton Brook	2027	Good (Green)	[Disproportionate burdens/Disproportionately expensive][Cause of adverse impact unknown/Technically infeasible]
Bin Brook	2027	Good (Green)	[Disproportionate burdens/Disproportionately expensive]
Bourn Brook	2015	Moderate (Yellow)	[Disproportionate burdens/Disproportionately expensive][No known technical solution is available/Technically infeasible]
Bottisham Lode - Quy Water	2015	Moderate (Yellow)	[No known technical solution is available/Technically infeasible]
Swaffham - Bulbeck Lode	2015	Moderate (Yellow)	[No known technical solution is available/Technically infeasible]
West Brook	2015	Moderate (Yellow)	[Unfavourable balance of costs and benefits/Disproportionately expensive][Action to get biological element to good would have significant adverse impact on use/Good status prevented by A/HMWB designated use]
Fen Drayton Drain	2021	Good (Green)	NO DATA
Cam	2015	Moderate (Yellow)	[Disproportionate burdens/Disproportionately expensive][No known technical solution is available/Technically infeasible]
Swavesey Drain	2015	Poor (Amber)	[Unfavourable balance of costs and benefits/Disproportionately expensive]
Abbotsley and Hen Brooks	2015	Moderate (Yellow)	[Disproportionate burdens/Disproportionately expensive][No known technical solution is available/Technically infeasible][Background condition/Natural conditions]
Old West River	2015	Moderate (Yellow)	[Disproportionate burdens/Disproportionately expensive][Unfavourable balance of costs and benefits/Disproportionately expensive]

Table 6-7: Overall waterbody classification objective for surface water bodies in Greater Cambridge area (2021 EA Catchment Data Explorer)

Water Body	Year	Objective	Reasons for alternative Objectives
Cam & Ely Ouse Chalk	2015	Poor (Red)	[Disproportionate burdens/Disproportionately expensive][Unfavourable balance of costs and benefits/Disproportionately expensive]
North Essex Chalk	2015	Poor (Red)	[Unfavourable balance of costs and benefits/Disproportionately expensive]
Upper Bedford Ouse Chalk	2015	Poor (Red)	[Disproportionate burdens/Disproportionately expensive][Unfavourable balance of costs and benefits/Disproportionately expensive]

Upper Bedford Ouse Woburn Sands	2015	Poor (Red)	[Disproportionate burdens/Disproportionately expensive]|[Unfavourable balance of costs and benefits/Disproportionately expensive]
Cam & Ely Ouse Woburn Sands	2015	Poor (Red)	[Unfavourable balance of costs and benefits/Disproportionately expensive]

Table 6-8: Overall waterbody classification objective for groundwater bodies in Greater Cambridge area (2021 EA Catchment Data Explorer)

6.4.5 Measures to implement objectives include a main programme and local initiatives. The main programme includes:

- Water company investment programmes. The Water Industry National Environment Programme (WINEP) [57] is a programme of investigations and actions for environmental improvement schemes that allow water companies to meet European Directives, national targets and statutory obligations. The most recent WINEP programme data for the Greater Cambridge area is listed in Table 6-9, and includes a number of new limits to phosphorus in treated effluent.

- Countryside and Environmental Stewardship[58]. These voluntary schemes provide grants to eligible land managers to enhance the natural environment. Figure 6-13 and Figure 6-14 indicate that large areas of the Greater Cambridge region are already covered by these agreements.

- Highways England environment fund. This fund invests in environmental improvements including reducing pollution from major highways run-off, for example by retrofitting SuDS. No information is currently available on recent or future schemes in the Greater Cambridge area.

- Flood risk management investment programme. The Environment Agency's Flood and Coastal Erosion Risk Management (FCERM) scheme invests in capital works to reduce the risk of flooding and erosion. Some of these schemes may also contribute towards improving the status of water bodies. There are no known recent or future schemes in the Greater Cambridge area.

- Catchment level government funded improvements. Defra's Catchment Partnership Action Fund and the Environment Agency's Environment Programme support catchment partnerships and local projects carried out by voluntary groups. Further details on the projects local to Greater Cambridge are given below.

- Water resources sustainability measures. The Environment Agency is taking action through its Restoring Sustainable Abstraction programme and other means to reduce the detrimental impacts of abstraction on the environment (see Chapter 4 for further details).

6.4.6 Local measures are mostly managed by the Cam and Ely Ouse Catchment Partnership, as well as the Upper and Bedford Ouse Catchment Partnership for the western and northern tributaries of the River Great Ouse.

[57] Water industry national environment programme

[58] Provided by the Rural Payments Agency, Department for Environment, Food & Rural Affairs, Forestry Commission and Natural England.

6.4.7 The Cam and Ely Ouse Catchment Partnership is hosted by the Rivers Trust and Anglian Water. Its priority aims for 2015 to 2021 are:

- Targeting agricultural diffuse pollution, aiming to reduce the impact of flooding and pollutant run-off from fields.
- Working with the Environment Agency to address invasive non-native species, environmental phosphorus from domestic sewage systems, groundwater pollution from nitrate, and artificial modification of water bodies.
- Developing an Integrated Catchment Management approach.

6.4.8 The Upper and Bedford Ouse Catchment Partnership is hosted by the Bedfordshire Rural Communities Charity. Its priority aims for 2015 to 2021 are:

- Engaging with local communities to identify project opportunities.
- Securing funding towards project work to support a sustainable partnership.
- Delivering its Catchment Partnership Action Fund river restoration project.

Measure Type	Location	Description
Actions to prevent deterioration	Duxford WRC (Hoffer Brook)	Permit limit change for Mercury
Actions to prevent deterioration	Royston WRC (Whaddon Brook)	Permit limit change for Nickel
Actions to prevent deterioration	Uttons Drove WRC (Swavesey Drain)	Permit limit change for Phosphorus
Actions to prevent deterioration	Waresley WRC (Abbotsley & Hen Brooks)	Permit limit change for Phosphorus
Actions to improve classification	Bassingbourn WRC (Mill River)	Permit limit change for Phosphorus
Actions to improve classification	Bottisham WRC (Swaffham – Bulbeck Lode)	Permit limit change for Phosphorus
Actions to improve classification	Bourn WRC (Bourn Brook)	Permit limit change for Phosphorus
Actions to improve classification	Coton WRC (Bin Brook)	Permit limit change for Phosphorus
Actions to improve classification	Elmdon WRC (Cam)	Permit limit change for Phosphorus
Actions to improve classification	Linton WRC (Granta)	Permit limit change for Phosphorus
Actions to improve classification	Litlington WRC (Mill River)	Permit limit change for Phosphorus
Actions to improve classification	Newport WRC (Cam)	Permit limit change for Phosphorus
Actions to improve classification	Papworth Everard WRC (West Brook)	Permit limit change for Phosphorus
Actions to improve classification	Shudy Camps WRC (Granta)	Permit limit change for Phosphorus
Actions to improve classification	Waresley WRC (Abbotsley & Hen Brooks)	Permit limit change for Phosphorus
Actions to improve classification	Waterbeach WRC (Cam)	Permit limit change for Phosphorus
Investigations	Arrington WRC (Rhee)	Flow to full treatment (FFT) monitoring
Investigations	Balsham WRC (Bottisham Lode)	FFT monitoring
Investigations	Barley WRC (Rhee)	FFT monitoring
Investigations	Bottisham WRC (Bottisham Lode)	FFT monitoring
Investigations	Cambridge WRC (Cam)	FFT monitoring
Investigations	Foxton WRC (Rhee)	FFT monitoring
Investigations	Linton WRC (Granta)	FFT monitoring
Investigations	Melbourn WRC (Shep)	FFT monitoring
Investigations	Royston WRC (Mel & Whaddon Brook)	FFT monitoring and diethylhexylphthalate sampling to assess substance reduction
Investigations	Teversham WRC (Bottisham Lode)	FFT monitoring
Investigations	Wrestlingworth WRC (Rhee)	FFT monitoring

Table 6-9: WINEP statutory obligations and regulatory actions for Anglian Water relating to actions and investigations for water quality.

Figure 6-12: Environmental Stewardship Scheme Agreements

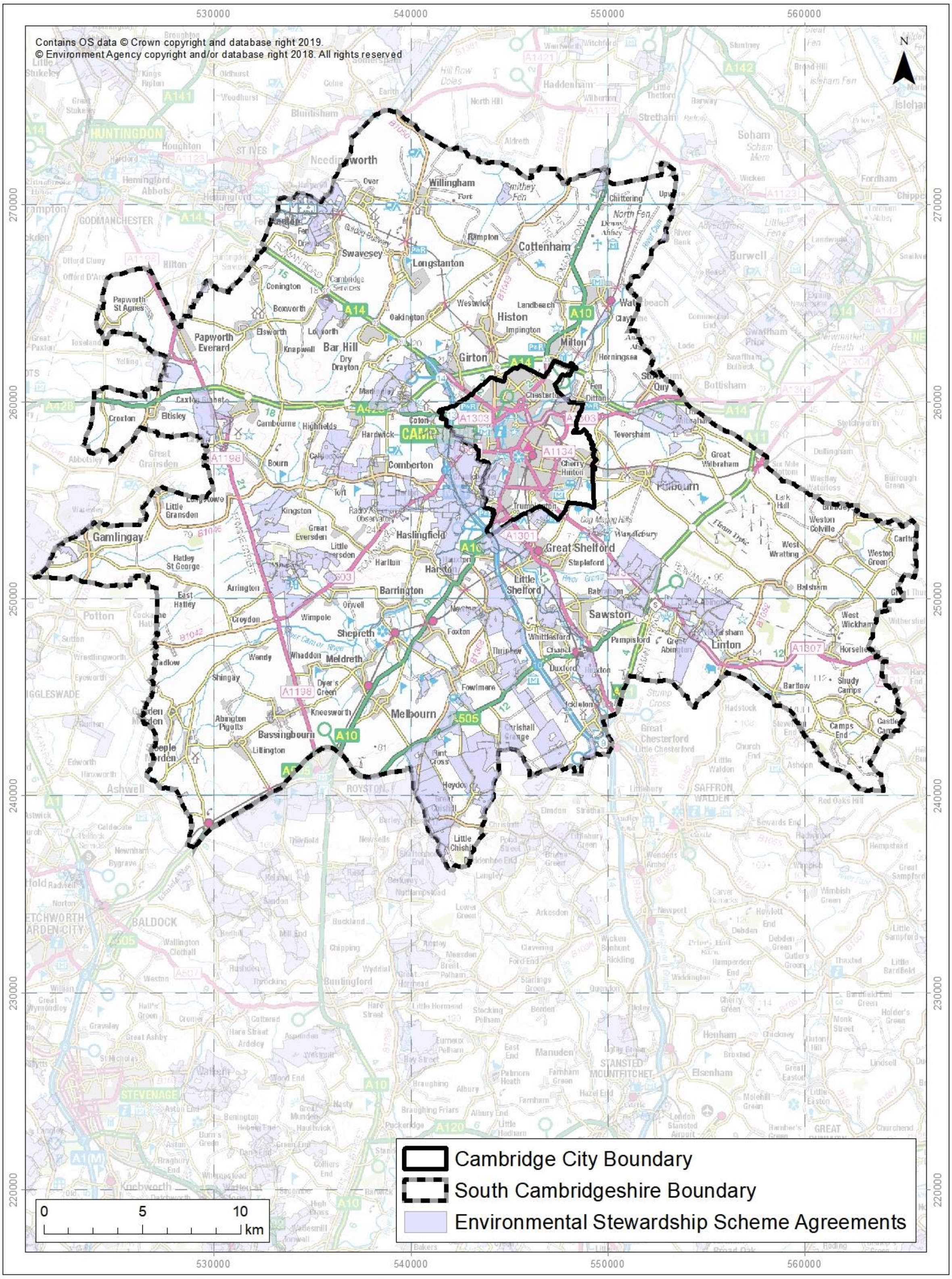


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Figure 6-13: Environmental Stewardship Scheme Agreements

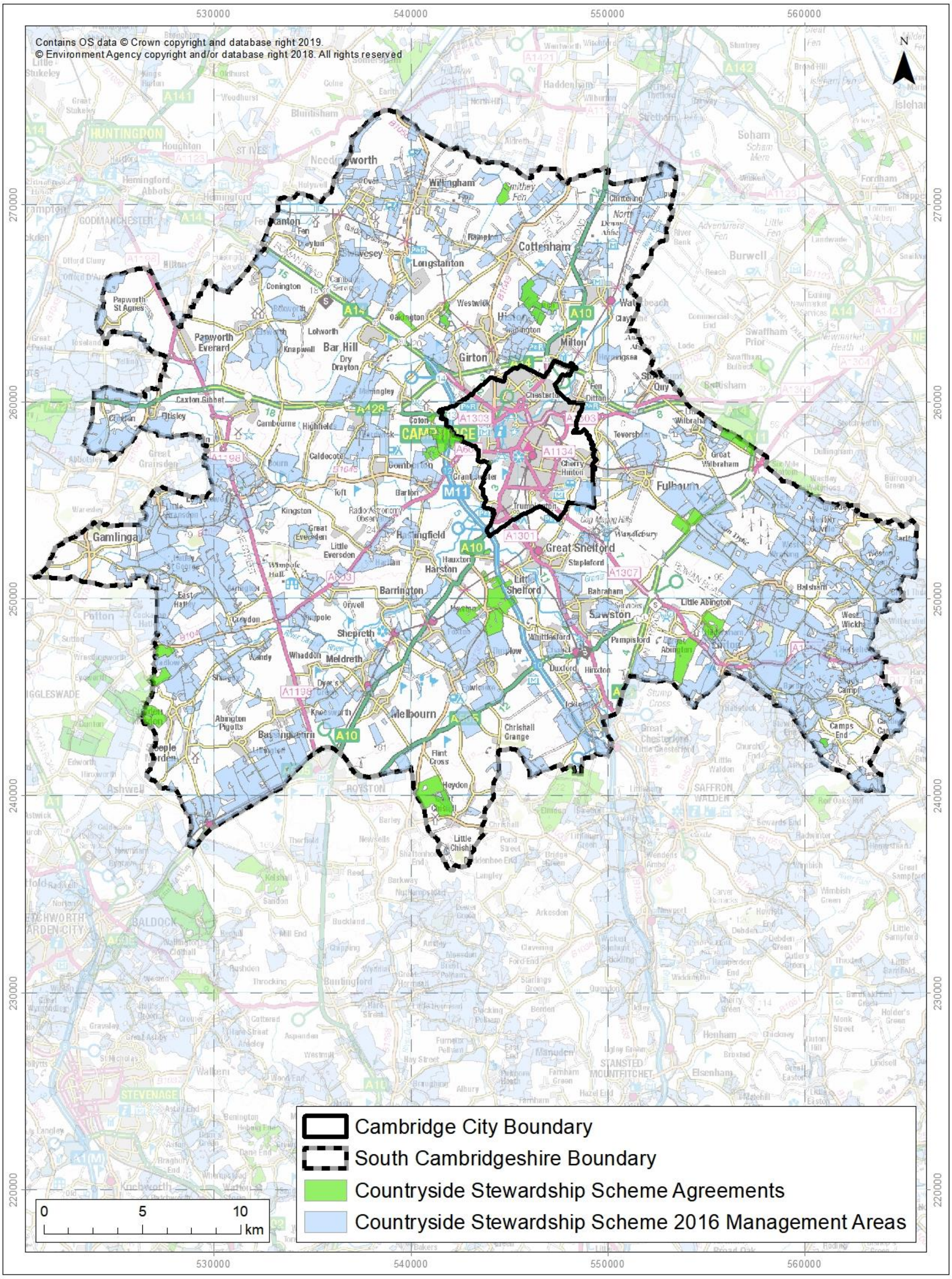

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Figure 6-14: Countryside Stewardship Scheme Agreements

6.5 Impacts of Development on Water Quality

6.5.1 The information reviewed here indicates that the majority of water bodies in Greater Cambridge are currently failing to meet "good" water quality standards and in some cases have deteriorated in recent years. To meet legislative requirements, it will be necessary for the Local Plan to demonstrate that it will not contribute to any deterioration in WFD status, and where possible, that it will support measures to implement objectives for each water body.

6.5.2 Development can detrimentally impact water quality by:

- Increasing the volume of wastewater requiring treatment and discharge to surface waters. This can increase the levels of phosphorus, ammonia and organic matter in receiving watercourses.
- Increasing pollutants in surface water runoff from development surfaces, including roads and pavements. Rainwater draining from development roads and pavements can carry many pollutants, including metals, vehicle emissions, salt, grid, oil, microplastics and household chemicals.
- Decreasing typical flows in watercourses due to increased abstraction for water supply, leading to increased concentration of pollutants.

6.5.3 These impacts and possible mitigation options are considered further below. Well-designed developments can provide opportunities for betterment, by removing land from intensive agricultural usage and providing green-blue infrastructure to control urban sources of pollution.

Increases in volume of wastewater due to additional growth and development

6.5.4 Wastewater can contain nutrients such as phosphorus and nitrates, harmful chemicals including ammonia and metals, and other harmful substances including viruses and bacteria. Increased volumes of wastewater, without mitigation, can lead to increases in both the concentration and total loading of pollutants entering watercourses from treated effluent, and an increased frequency and/or duration of sewer storm overflows.

6.5.5 The concentration and total load of pollutants in treated effluent is managed through permits. For the purposes of this, where there is existing headroom between current discharges and the permitted level, development could lead to a detrimental impact on water quality as there would be no requirement to mitigate the increase in pollutants if it remained below the permitted level. The Environment Agency is responsible for setting and reviewing permitted levels. A load standstill approach can be applied to approximate permit revisions which prevent increases in pollutants due to increased wastewater (see Chapter 5), although water quality modelling may be needed to set permits accurately.

6.5.6 Although theoretically attractive, the practicalities of offsetting nutrient neutrality through land use change become problematic at the larger strategic scale, due to the costs of purchasing land to guarantee particular land use management in perpetuity. Wetlands and WRC upgrades are more plausible to plan and deliver, but may need to be delivered within the AMP funding cycle process. The timings of upgrades will be important to avoid any deterioration in water quality as a result of development.

6.5.7 When wastewater volumes increase there is less capacity to carry stormwater in combined sewers which may result in increased frequency and volume of storm overflows spills. The effect can be heighted if paved areas increase (e.g. paving of gardens) and/or climate change increases the frequency of heavy rainfall. The combined effect of these influences is hard to predict without use of sewer network hydraulic models. Anglian Water is undertaking such analysis as part of its Drainage and Wastewater Management Plan. To mitigate these effects and further reduce the occurrence of storm overflow Anglian Water can make local improvements to sewer network capacity and manage stormwater runoff with retrofit SuDS. Because storm overflows are now monitored it is likely that permits will begin to include spill frequency standards and Anglian Water will need to apply

Increases in Surface Water Runoff Pollutants

6.5.8 Development can lead to a decrease in the quality of surface water run-off, due to the introduction of pollutants from roads, pavements and other surfaces, and due to mis-use of the surface water drainage network (e.g. misconnections and illegal disposal of chemicals). Microplastics are a pollutant of increasing concern which travel to the oceans via surface runoff and rivers.

6.5.9 In new developments, sustainable drainage systems (SuDS) should be used to provide treatment to water quality, as well as reducing flood risk downstream. Where SuDS include blue-green infrastructure (ponds, swales green roofs, buffer strips etc.) they also deliver valuable wider benefits in terms of improved biodiversity and protection from summer temperature extremes. Further details on SuDS can be found in the Greater Cambridge Level 1 Strategic Flood Risk Assessment, and the Cambridgeshire Floods and Water Supplementary Planning Document[59].

6.5.10 In existing developments, reducing pollution can be complex, with the cost of measures often high and ownership of the problem unclear. Regeneration schemes should be used to incorporate blue infrastructure and SuDS that rectify any misconnections, reduce burdens on combined sewer systems, and provide water quality improvements for surface water drainage. Local Plan Policies and the LLFA should support these schemes. Opportunities for retrofitting SuDS are discussed further in Chapter 8.

[59] Cambridgeshire flood and water spd

Increased Concentration in Low Flows

6.5.11 Increased abstraction of water for water supply for new developments could lead to lower typical flows in rivers, which would decrease the dilution of treated effluent and other pollutant sources. As discussed in Chapter 5, there is no environmental capacity for new development (beyond that already allowed for in the WRMP) to be supplied with water from increased abstraction. It will be necessary for increased water demands to be managed by other means, such as demand management and leakage reduction. Longer term solutions include new regional water supply infrastructure that may allow significant decreases in abstraction rates that support improved environmental objectives.

6.5.12 Dilution effects due to increased abstraction could be compounded by the impacts of climate change, which may include[60]:

- A reduction in low flows, leading to higher nutrient concentrations due to reduced dilution effects.
- Longer water residence times, increasing the potential for eutrophication.
- Increased water temperatures and stratification.

6.5.13 River basin management plans consider risk up to 2027. These relatively short timescales do not include consideration of the longer term impacts of climate change. The plans advocate implementing measures that are flexible or increase resilience to extreme events including drought.

6.5.14 For the purposes of this WCS, the principle of load standstill (see Chapter 5) can be applied to wastewater treatment works permits, taking into account the impacts of climate change, to prevent detrimental impacts on pollutant loading in watercourses due to increases in treated effluent discharges.

Development improving water quality

6.5.15 Development can improve water quality by being an investment driver for the latest wastewater treatment improvements or entire new treatment facilities. The proposed new Cambridge WRC is a great example where it is expected that ultra-low phosphorous permits in particular will result in downstream water quality improvements and safeguard capacity issues for years to come. Added benefits are that the facility will be carbon and energy neutral. In this case development funding (through the Government’s Housing Infrastructure Fund) means that this state-of-the-art facility will be delivered without burdening existing wastewater customers in Cambridge.

[60] “The consequences of climate change for the water environment in England: an assessment of the current evidence” Report WT1540, 2014, Defra

6.6 Opportunities, Constraints and Uncertainties Summary

	Water Quality
Headline findings of baseline conditions	• There are 25 Water Framework Directive (WFD) assessed surface water bodies (e.g. rivers, lakes and wetlands) in the Greater Cambridge area, with the most recent WFD status classifications available from September 2019[61]. Water quality in surface bodies is predominantly "moderate" (22 bodies) with three classified as "poor". No waterbodies are classified as "good". There has been a decline in WFD status since the previous assessment in 2016, when three bodies were classified as "good". Reasons for not achieving good status within the study are predominantly associated with abstraction, wastewater treatment (point source discharges) and agricultural diffuse pollution. • The surface water bodies considered poor are: Cam (Audley End to Stapleford, due to point source pollution, abstraction affecting flows, and physical modification), Mill River (due to point source pollution, abstraction affecting flows, and physical modification), and Swavesey Drain (due to drought, low flows, physical modifications, and point source pollution). • All the surface water bodies are now failing on Chemical elements in the latest 2019 classifications. This is because of the new inclusion of PBDE and PFOS tests following the Priority Substances Directive (2018). These chemicals, historically used as flame retardants, stain repellents and fire-fighting chemicals, are ubiquitous and exceed environmental quality standards across the UK. The failure rate for PBDE and PFOS does not reflect an actual deterioration in water quality, but an improved approach to assessing these chemicals in water bodies. Many surface water bodies across England have failed to meet the stricter new chemical standards. • There are 5 groundwater bodies intersecting the Greater Cambridge area, with the most recent WFD status classifications available from September 2019. The overall status in four of the groundwater bodies is currently poor. The two bodies covering the majority of the Greater Cambridge area are: ○ The Cam and Ely Ouse Woburn Sands, which has good quantitative and chemical status.

61 Environment Agency: Catchment Data explorer

	Water Quality
	◦ The Cam and Ely Ouse Chalk, which has poor quantitative and chemical status, due to diffuse pollution (agriculture and transport runoff), point source pollution (sewage discharge), and flow (groundwater abstraction). • Source protection zones (SPZ) occur across much of the Chalk aquifer areas, with requirements for surface water runoff quality, particularly in SPZ1.
Opportunities for development	• The new Cambridge WRC and other WRC upgrades could allow improvements to the quality of water bodies that are currently not meeting “good” standards due to point source pollution from sewage treatment. • Well-designed green / blue infrastructure will contribute to improved water quality and habitat both within sites and downstream, as well as providing wider benefits for people, wildlife, landscape, soils including the remnant peat resource, and mitigating the potential impacts of climate change. • Well-designed developments can also provide an opportunity for betterment to diffuse pollution, by removing land from intensive agricultural usage, if urban sources of pollution such as highways runoff are controlled and mitigated. • Other environmental enhancements linked with development, such as reduced agricultural runoff and tree planting for carbon offsetting, could contribute to improved water quality, by reducing diffuse sources of pollution.
Constraints to development	• Although point source pollution managed through permits should not increase, there is a risk of increase of diffuse and point source pollution from other sources increasing due to development, for example highways runoff. Positive countermeasures will be necessary to offset impacts. • Upgrades to WRC and other mitigation measures (such as additional land use change) will be necessary to maintain an overall load standstill / nutrient neutrality. The timing of upgrades will be important to avoid any deterioration in water quality as a result of development. • Improvements to storm overflows maybe necessary to offset growth driven more frequent operation. The timing of upgrades will be important to avoid any deterioration in water quality as a result of development.

	Water Quality
	• Source protection zones will influence requirements for site drainage infrastructure, and development should be undertaken with due regard to such constraints in these areas.
Uncertainties	• Depending on specific site allocation, more detailed investigations of the impact of development on protected sites may be necessary. • Mitigation measures for achieving nutrient neutrality are an emerging area although this is not a requirement for Cambridge currently. It is unclear whether catchment-based mitigation measures, such as removing land from intensive agricultural farming, to offset nutrient loading would be achievable at larger scales.

7 Flood Risk

7.1 Overview

7.1.1 The purpose of this chapter is to summarise information on flood risk opportunities, constraints and uncertainties, that have been explored in more detail in the separate Level 1 Strategic Flood Risk Assessment.

7.2 Opportunities, Constraints and Uncertainties Summary

	Flood Risk
Headline findings of baseline conditions	• Although fluvial flood risk from Main Rivers is reasonably well understood, there is extensive surface water flood risk and Ordinary Watercourse fluvial flood risk across the district, that is less well understood and affects many existing properties and settlements. Other potential sources of flood risk include groundwater, sewer and reservoir breach flooding. There are some locations where flood risk could represent a significant constraint to further development. These are identified in the Level 1 SFRA, and the Sequential and Exception Tests applied to direct development to areas of lowest flood risk where possible. • To date, studies have not identified any economically justified strategic schemes that will reduce flood risk at the most at-risk hotspots. Property level resilience is likely to be the most cost-effective solution, in line with the Government's national strategy to promote greater resilience towards flooding[62]. • There may be larger strategic flood storage schemes in the catchment in the future, following the Environment Agency's River Great Ouse catchment storage and conveyance study currently being undertaken. Locations and volumes are currently unknown. Some storage capacity may be created at the future Cambridge Sports Lakes[63] location, pending planning permission and detailed design.
Opportunities for development	• Potential for flood management and SuDS schemes to deliver multi-functional benefits including biodiversity enhancements and net gain, green infrastructure, landscape enhancements, and climate change adaption.

[62] National Flood and Coastal Erosion risk management strategy for England

[63] Cambridge sport lakes

	Flood Risk
	• Opportunities for landscape-scale enhancements such as distributed natural flood management techniques to benefit and enhance designated wildlife sites. Potential for channel improvements and additional flood storage to be delivered within riparian corridors in development sites, focussing on natural flood management techniques and reconnecting watercourses to floodplains. • Potential for daylighting of existing culverted watercourses. • Potential for development on brownfield sites to reduce runoff to greenfield rates or lower, reducing existing surface water and sewer flood risk in local area. • Potential for flood resilient buildings redevelopment in existing areas of flood risk. • Potential for site-specific hydraulic modelling to contribute to the improved understanding of local flood risk and impacts of climate change beyond site boundaries. • Potential for retrofitting of SuDS to existing developments, including sustainable retrofitting of wastewater utilities to reduce the risk of combined sewer flooding.
Constraints to development	• Known surface water and fluvial flood zones are constraints to development, depending on specific site location. Known flood extents will be mapped in the SFRA currently being prepared. • Pumped catchment capacities may present a constraint to runoff rates and required storage volumes, requiring additional long-term storage and mitigation measures.
Uncertainties	• Updated hydraulic modelling may be needed to confirm areas of future fluvial and surface water flood risk due to the impacts of climate change, depending on specific site location. • Risk of fluvial flooding following embankment breach may need updated modelling, depending on specific site location (River Great Ouse and lower parts of River Cam).

	Flood Risk
	• Further investigations of groundwater, sewer and reservoir breach flood risk may be necessary depending on specific site location. • It is currently unclear if / how development S106 / CIL contributions could be used to contribute to flood risk management projects in areas not directly impacted by the specific development site.

8 Integrated Water Management

8.1 Overview

8.1.1 The purpose of this chapter is to:

- Review how water can be managed in an integrated way.
- Identify existing examples of integrated water management in the Greater Cambridge area.
- Consider future opportunities and constraints for integrated water management.

8.2 Managing Water in an Integrated Way

8.2.1 All stakeholders consulted in this study are supportive of a more integrated approach to water management. This holistic approach would reference the wider effects of water-related impacts on the natural environment, including biodiversity, landscape, soils and agriculture, access to green infrastructure and associated health and well-being, and mitigating the potential impacts of climate change including working towards carbon neutrality.

8.2.2 Table 1-1 and the previous chapters have identified how different stakeholders are responsible for managing different aspects of the water environment. This historic division of responsibilities presents challenges for integrated water management, which must be delivered by a partnership of stakeholders and the land owner / developer. This includes funding and arrangements for long term maintenance of the infrastructure.

8.2.3 CIRIA produced guidance in 2019 to support planning for water through the delivery of integrated water management[64]. The report identifies the following as critical success factors for achieving good integrated water management outcomes:

- A robust and accessible evidence basis, showing which approaches are appropriate, and identifying possibilities at an early stage.
- Local policy which is clear and understandable, with supportive strategies from the LLFA and water companies.
- Early engagement with the water companies, developers, the LLFA, the local community, the catchment partnership and other stakeholders.
- Working in partnership with stakeholders.

[64] "Delivering better water management through the planning system", CIRIA C787, 2019

- Good whole life project management, including a strong champion, long-term maintenance arrangements, co-ordination of budgets and funding, and enforcement of planning conditions.

8.2.4 Integrated water management is sometimes perceived by planners, developers and engineers to be expensive and difficult to do. The case studies included in the guidance show that, at the development site scale, there is a clear advantage in terms of cost effectiveness and better outcomes over traditional approaches.

8.2.5 The guidance provides examples of good local policy. The 2018 Local Plan for Cambridge City is identified as having good local policy (Policy 31 IWM and the water cycle). The policy seeks to ensure that all new development in Cambridge takes a water sensitive urban design approach to surface water, supported by additional guidance in the Cambridgeshire Flood and Water Supplementary Planning Document. The policy success is based on a high level of technical expertise in the evidence base, good partnerships between the local planning authority, LLFA, water companies, Environment Agency and the local community, and good management by the council’s sustainable drainage engineers working in collaboration with the planning policy team.

8.3 Existing Integrated Water Management Examples

8.3.1 There are few examples of integrated water management currently being undertaken at the larger landscape or whole catchment scale in or near Greater Cambridge. At a smaller scale, examples include farm-scale land management projects, development-scale schemes, and the community-led projects of local voluntary groups and charities.

Farm-scale Land Management Projects

8.3.2 Water Resources East (WRE) are currently undertaking trials to support the proposed Environment Land Management Scheme. This agricultural funding scheme administered by Defra will be rolled out by the end of 2024, to replace environmental management schemes currently available under the EU’s Common Agricultural Policy. Under the scheme, farmers will be paid for work that enhances the environment, such as river management to mitigate flooding, or creating and restoring habitats for wildlife. In their trial, WRE are working with a landowner in the headwaters of the Granta to use land close to watercourses for flood relief and groundwater recharge ponds. This pilot project will focus on water level management, whilst recognising the multifunctional benefits the scheme may have for ecology and water quality. The results of the study will be used to develop a model for natural flood risk management and groundwater recharge projects for the Chalk streams in East Anglia. It should be also noted that WRE have recently entered into a new research partnership with HR Wallingford to look at the impact of land use change on chalk stream catchments.

8.3.3 The charity Cambridge Past Present & Future (CPPF) is a significant landowner in the Bin Brook catchment, at the Coton Countryside Reserve. They are currently undertaking a feasibility study to consider options to improve water quality and reduce flood risk downstream. The proposed works being assessed comprise:

- Creation of a new integrated water treatment wetland, to filter outflow from Coton Water Recycling Centre, reduce diffuse pollution from agriculture, improve downstream water quality, create new wetland habitat and public amenity.
- Targeted natural flood management interventions to reduce the rate of runoff from agriculture drainage systems, at locations where these ditches enter Bin Brook.
- The feasibility study is anticipated to be completed in 2020, after which CPPF will be seeking funding to implement the proposals

8.3.4 Cambridgeshire ACRE are also leading a project, "New Life on the Old West", to implement conservation efforts on and around the Old West (River Great Ouse) river. The project will deliver 88 wildlife habitat enhancements to green spaces and surrounding countryside areas, aiming to increase connectivity and resilience along the ecological corridor between Wicken Fen and the Ouse Washes. The enhancements will include berm creation in drains, new ponds and wetlands, reintroduction of priority and wildflower species, and habitat piles.

8.3.5 The Game & Wildlife Conservation Trust operates the Allerton Project: Water Friendly Farming[65].

8.3.6 The Great Fen project[66] is trialling field-scale wet farming that could deliver benefits.

8.3.7 The Fens Biosphere[67] project is 'looking at how water resources can be managed on a landscape scale'.

Development-scale Projects

8.3.8 Two development sites in Greater Cambridge are highlighted in the CIRIA guidance as case studies for integrated water management: Eddington and Clay Farm.

8.3.9 The Eddington (North West Cambridge) development has a comprehensive integrated water management system that reduces off-site runoff to below

[65] Game and Wildlife Conservation Trust: Water friendly farming

[66] Wet Farming

[67] The Fens Biosphere Vision

greenfield runoff rates (reducing flood risk downstream) and using the captured rainwater for non-potable uses in homes.

8.3.10 The Clay Farm (Great Kneighton) development is located between Trumpington and Addenbrooke's on the southern edge of Cambridge, and comprises 2300 new homes. The development features a site-scale integrated water management scheme including sustainable drainage systems. The surface water drainage strategy includes attenuation ponds with opportunities for biodiversity, ecology and wildlife habitat, and water quality treatment stages to reduce the risk of pollution to the receiving watercourse Hobson's Brook. Rainwater harvesting is encouraged with water butts, and potable water demand has also been reduced with low water use fixtures and fittings. Part of the site has been developed to COSH Level 5 standards and includes communal rainwater harvesting to reduce potable water consumption to below 80 l/p/d.

Community-led Projects

8.3.11 The councils, local voluntary groups and charities have undertaken a number of small scale community-led projects that provide some integrated water management benefits, as listed in Table 8-1. These have often been supported by funding from water companies, and undertaken in collaboration with the Environment Agency. Most examples are focussed on local river restoration and habitat enhancements, and their potential benefits are constrained by the wider water management (abstraction and quality) context.

Project	Lead Group	Description	Benefits
River Mel Enhancement Project	River Mel Restoration Group	Enhancement works were undertaken to the River Mel at Meldreth, to return the watercourse to a more natural width with in-channel variation and improved habitat quality. Over time, the removal of woody debris and silt had led to an over-wide and deep channel that suffered from sluggish flows and poor habitat quality. Supported by the Environment Agency and the River Restoration Centre, the local community group the River Mel Restoration Group undertook works to install willow brashings, channel narrowing using faggot bundles, vegetation clearing to reduce shade and increase natural light, and a v-groyne deflector to create flow variation and encourage scour and deposition. This project is an example of what can be achieved by working with the community with a limited budget, and was awarded winners of the Amateur category at the Wild Trout Trust Awards in 2009.	Channel morphology and habitat improvements
Bourn Free Project	Wildlife Trust for Bedfordshire, Cambridgeshire & Northamptonshire	The Bourn Brook is a valuable habitat for water voles, one of the UK's fastest declining mammals due to loss of habitat and predation by mink. The Wildlife Trust has been leading efforts to improve ecology since 2011, in partnership with the Countryside Restoration Trust and the Environment Agency, and with funding from Anglian Water's Pebble Fund. As well as efforts to control mink populations, volunteers have focussed efforts on reducing invasive species including Giant Hogweed and Himalayan Balsam. Regular ecological surveys have been undertaken to track the impacts of interventions, showing significant improvements since 2011, although some vulnerability of vole and otter populations to drought conditions in 2019. While continuing with existing work, the project has now begun to look at flood flows and water quality, with the aim of producing a map of potential projects to discuss with landowners and seek funding.	Habitat improvements, control of invasive species, water quality and flood risk
Cherry Hinton Brook Improvements	Friends of Cherry Hinton Brook	Cherry Hinton Brook is a chalk stream that provides habitat for many species and acts as a wildlife corridor in the city. The channel has been straightened over time, leaving a slow-flowing stream with reduced habitat diversity. The Friends of Cherry Hinton Brook volunteer group received funding to improve the stream habitat by adding flow deflectors and gravel riffles along a 1.7km stretch of the stream. The group also undertake community engagement and involvement in the stream, producing publicity materials and arranging litter picking days. The work has been supported by the City Council, who have also undertaken scrub clearance and tree maintenance, and local landowners.	Channel morphology and habitat improvements
Wilbraham River Protection	Wilbraham River Protection Society	The society was founded in 1997 by local residents, to work to safeguard the river and its flora and fauna. The society aims to identify the main causes of decline in wildlife, and take action to restore the watercourse and plan co-ordinated maintenance. The society supported a river corridor survey, undertaken in 2015 by the Wildlife Trusts, which identified potential habitat improvements including channel narrowing, coppicing, in-channel vegetation cutting, bank re-profiling and bankside vegetation maintenance. The watercourse is groundwater fed and heavily dependent on flow augmentation schemes to maintain flows during summer or drought periods.	River restoration and habitat improvements
The Rush, Sheep's Green	Cam Valley Forum	This project, championed by the Cam Valley Forum and delivered by Cambridge City Council in partnership with the Environment Agency, sought to restore the Rush watercourse, which flows through Sheep's Green local nature reserve in Cambridge. The channel indicates the original meandering course of the River Cam prior to its canalisation in the 1800s. Over recent years the stream has suffered extreme siltation and consequently had little biodiversity value. The works included replacing the sluice gate to increase year-round flow, regrading of the channel profile, and removal of silt. Ecological surveys have shown rapid colonisation by a variety of species including protected European Eels.	River restoration and habitat improvements
River Shep Restoration, Fowlmere	RSPB	This project involved the restoration of the River Shep at Fowlmere Nature Reserve. Previous dredging had left the channel over-deep and filled with silt. Habitat restoration work was undertaken following recommendations of the River Restoration Centre, to include riffle creation, marginal habitat enhancement, bed raising and channel narrowing. The results led to significant habitat improvements and increased trout populations.	Channel morphology and habitat diversity

Table 8-1: Examples of small scale community led projects to enhance the water environment.

8.4 Future Opportunities and Constraints

8.4.1 There are many opportunities for an integrated approach to water management to be adopted at the landscape and site scale. This section reviews a number of possible initiatives and their potential application in the new Local Plan (this list is not exhaustive):

- Water re-use (rainwater harvesting and wastewater recycling)
- Surface water storage
- Managed aquifer recharge
- Separation of combined sewer systems
- Retrofitting SuDS
- Woodlands planting

Water Re-use

8.4.2 All stakeholders agree that there are significant water supply constraints in the Greater Cambridge region, with over-abstraction already leading to detrimental impacts on the environment. Reducing the demand for new potable water by re-using collected rainwater or treated wastewater for non-potable applications should therefore be a high priority for the new Local Plan. Options for rainwater and wastewater recycling at the site scale are discussed and recommendations made in Section 4.9.

8.4.3 Larger scale re-use of wastewater for potable water applications in the form of unplanned indirect reuse is commonplace throughout the UK. For example, the effluent from upstream areas is treated to required standards, discharged into local watercourses, and then abstracted further downstream and treated to potable standards as part of the water supply to a downstream town. This does not currently occur for potable water sources in Greater Cambridge, as all potable water is sourced from groundwater abstraction. However, it does occur for other uses such as agricultural irrigation, which abstract surface water containing treated effluent from the lower River Cam and other watercourses. The Ely-Ouse Essex Transfer Scheme (Box 4-2) also results in indirect re-use of treated water generated in Greater Cambridge for potable applications in other parts of East Anglia (after suitable treatment).

8.4.4 Larger scale indirect re-use of water for potable applications in Greater Cambridge could be implemented in the future. For example, downstream reservoirs could be constructed in the lower River Great Ouse catchment to provide new sources of surface water (see Section 4.8). These reservoirs, as well as those planned in the Lincolnshire area, could provide sufficient volumes to allow the significant reduction in abstraction rates from groundwater needed for a return to good environmental status in the Greater

Cambridge water bodies. Water Resources East are actively investigating these options.

8.4.5 There are currently no known plans for large scale direct re-use of wastewater for potable applications in the Greater Cambridge area. Although technologies such as reverse osmosis can allow wastewater to be treated to potable standards in a closed loop system, the public acceptability of these schemes is low. If developers or water companies were to pursue this option, public perceptions would need to be changed through education and awareness campaigns to promote the benefits of re-use and the drinking water quality standards.

Surface Water Storage

8.4.6 Reservoirs can provide many integrated water management benefits including water supply (potable, non-potable), flood mitigation, irrigation, recreation, hydropower and ecology. Water Resources East are actively investigating options for large new reservoir infrastructure for water supply across East Anglia (see Section 4.8). Other opportunities for large new storage areas could include:

- The Cam Sports Lake project, which proposes to create a rowing lake and water storage lake to the west of the River Cam between Milton and Waterbeach, set within a country park that will include cycling and other recreation facilities. The site obtained planning permission in 2013 following submission in 2006, however due to subsequent significant changes in planning policy, the reserved matters consultations in 2018 led to the application being withdrawn. An updated planning application is now being prepared. The scheme is likely to involve the construction of a canal to link the lakes to the River Cam upstream of Baits Bite Lock, and the lakes may provide up to 34% increase in floodplain storage volume compared to existing. Detailed modelling is expected to be undertaken to support the updated planning application which will quantify the potential beneficial impacts of this scheme in flood risk upstream and downstream. In addition to the above, Cambridge Sports Lakes have recently joined WRE to investigate how their flood storage system might be used in an integrated manner as a water resource opportunity.

- The Great Ouse Storage and Conveyance project, which is being led by the Environment Agency, to assess how flood risk within the catchment can be managed now and into the future. The inception phase was completed in June 2020, involving data review and methodology scoping. Later phases of the study will include improvements to existing hydraulic models. The outcomes of the study will not be available for several years, but will include a high level evaluation of the costs and benefits of providing very large flood storage volumes in the catchment.

8.4.7 Reservoirs can have unintended impacts on downstream environments, due to changed flow patterns. There are already concerns that high flows through

Denver sluice are not sufficient to counteract tidal influx siltation rates in the lower Great Ouse. Natural England have identified this as a potential detrimental impact on the drainage of the Ouse Washes protected site. Further reductions in downstream flow rates due to diversion into reservoir stores could lead to increased siltation, reduced channel capacity, increased flood risk, and detrimental environmental impacts. These impacts will need to be evaluated and mitigated if any major flood storage reservoirs are to be constructed in the Greater Cambridge area.

Aquifer Storage and Recovery (Managed Aquifer Recharge)

8.4.8 Aquifer storage and recovery, also known as managed aquifer recharge, is the intentional recharge of groundwater levels by the injection of water into the aquifer via a borehole, during wetter periods. The resulting higher groundwater levels can be used for environmental benefits, and/or as a source of water during drier periods. Various techniques are available, such as infiltration ponds, injection wells and underground dams, depending on local hydrogeology.

8.4.9 In the UK, managed aquifer recharge has only been used for public water supply purposes by Thames Water in North London (Box 8-1). Globally, there has been a much greater usage, particularly in Australia where treated recycled water (urban stormwater and wastewater) is used to boost drinking water supplies.

8.4.10 Within East Anglia, small-scale managed aquifer recharge pilot projects are being developed in Felixstowe (FRESH4Cs Felixstowe Hydrocycle project), and in the upper parts of the Granta catchment in Cambridgeshire (Water Resources East agricultural land management trial, discussed above). At the development site scale, infiltration SuDS features in any development sites located above permeable bedrock will also contribute to aquifer recharge. Where groundwater is protected (e.g. Source Protection Zones), risk assessments and additional water quality treatment stages are necessary before infiltration SuDS can be used[68].

8.4.11 Managed aquifer recharge at the small or large scale should be encouraged in Greater Cambridge, with the following constraints:

- The existing groundwater has a high water quality. It would be necessary for any recharge water to be treated to a suitably high level to maintain the groundwater quality. For infiltration-type recharge methods, the Environment Agency’s source protection zones requirements must be followed. For direct injection type methods, we recommend treatment to potable standards. This need for a high level of treatment may make it difficult to implement direct injection aquifer recharge schemes outside of the water industry.

[68] “The SuDS Manual”, CIRIA C753, 2015

The North London Aquifer Recharge Scheme[69]

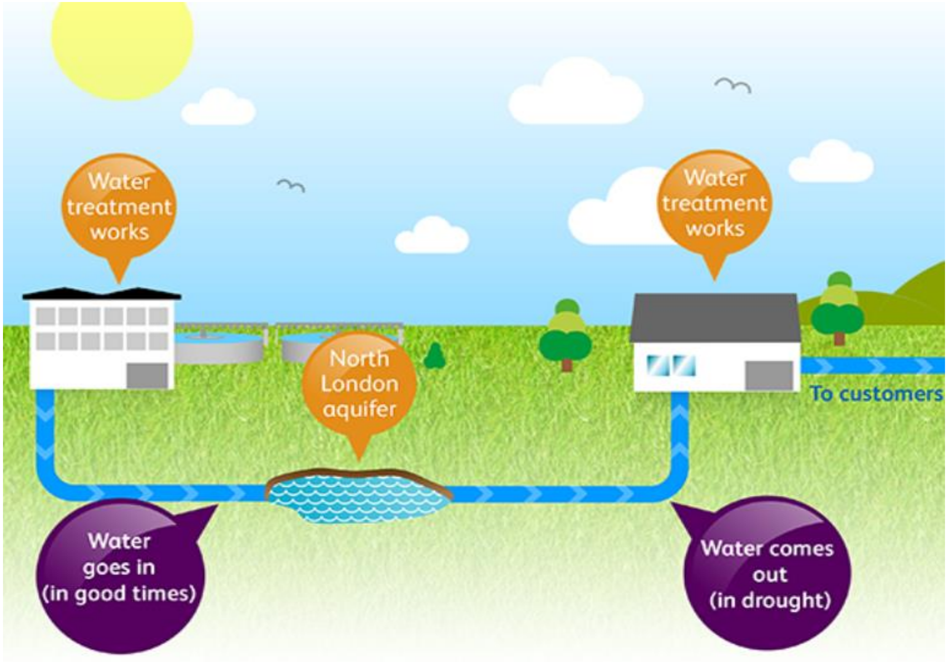


Image source: Thames Water

The North London Artificial Recharge Scheme is the only artificially recharged aquifer used for public water supply in the UK, managed by Thames Water. The chalk aquifer is recharged with fully treated potable water at a rate of up to 65 million litres per day when rainfall is plentiful, to be used as a source to boost supplies during droughts. Thames Water have been operating the scheme since 1995, with upgrade works to increase potential daily output following the 2006 drought. The scheme can now supply 180 million litres of water per day, and has been used during dry spells in 1997, 2003, 2005, 2006, 2018 and 2019.

Box 8-1: The North London Aquifer Artificial Recharge Scheme

[69] NLARS: Evolution of an artificial recharge scheme

- It will be necessary to ensure any source of recharge water does not have a detrimental impact elsewhere. In Cambridgeshire, all potable water is currently sourced from abstraction, and therefore this water should not be used to recharge groundwater, to avoid creating an unnecessary circulation. At the small site scale, rainwater could be captured and used to recharge groundwater through infiltration or direct injection (subject to treatment), but larger scale diversion of rainwater or stream flows could impact low flows in downstream watercourses. The resource availability assessment in Section 4.5 indicates that there could be water available for abstraction in the lower River Cam and River Great Ouse catchments, that could potentially be used to recharge groundwater (subject to treatment) and store water in the aquifers for drier months. However this would require significant investment in infrastructure to pump water up into the Chalk areas.

8.4.12 It is therefore recommended that the Local Plan encourage the use of infiltration SuDS wherever possible within development sites (subject to appropriate treatment), and supports the water industry with planning consent in developing new options for larger scale aquifer recharge schemes that might require new infrastructure across the region, if these are identified as a viable solution by Water Resources East. The infrastructure would need to be costed, funded and delivered through the water industry AMP framework.

Separation of Combined Sewer Systems

8.4.13 Although all newer developments have separate foul and surface water drainage systems, some older towns have combined systems. These place an additional burden on the wastewater treatment process, and have an increased risk of flooding and pollution. In particular, combined sewer overflows discharge untreated wastewater directly into waterbodies during periods of heavy rainfall, to prevent sewage backing up and flooding streets or homes. These can cause significant pollution problems.

8.4.14 Separation of combined sewer systems and removal of sewer overflows can have beneficial impacts on water quality and flood risk, and reduce the treatment demand on water recycling centres. However, in many locations, the costs of the infrastructure works in heavily urbanised areas are disproportionately expensive and not economically justifiable.

8.4.15 It is therefore recommended that the Local Plan supports measures to reduce the quantity of storm water entering combined sewers through working with Anglian Water to mandate the use of SuDS and separate sewerage in new development areas and support retrofit SuDS elsewhere.

Retrofitting SuDS

8.4.16 Diffuse urban pollution is one of the major obstacles to achieving compliance with the Water Framework Directive. Although most recent developments have used SuDS (sustainable drainage systems) to manage and treat urban runoff, older developments discharge runoff directly to surface water sewers or overland into watercourses. The urban runoff increases flood risk and can introduce pollutants from highways, domestic waste water misconnections, illegal disposal of waste, industrial and commercial site contaminants, and leaching of contaminated land. For example, grey water contamination is a recurring problem where domestic appliances have been misconnected to the surface water system, such as washing machines in garages discharging to a gully grate. Often, households are not aware of the problem, although they are legally responsible.

8.4.17 Increasing green spaces and retrofitting SuDS features in urban areas can reduce run-off rates and volumes, and improve water quality. In new developments, the collective benefits of SuDS scheme provide a more cost-effective solution offering numerous benefits compared with traditional schemes. Brownfield developments offer the opportunity to introduce SuDS into existing urban environments. Further guidance on SuDS for new developments is provided in the accompanying SFRA and the Cambridgeshire Floods and Water Supplementary Planning Document.

8.4.18 Retrofitting SuDS to existing developments is not straightforward due to the space required and costs of rebuilding the drainage infrastructure. However, there are many opportunities to use small-scale SuDS measures in existing developments landscaping. For example, in London, rain gardens have been retrofitted in schools, and along roads (Box 8-3). The Mayor of London has developed a Sustainable Drainage Action Plan (2016) that focusses on retrofitting SuDS, and a Transport Strategy (2018) includes policies to protect and enhance green infrastructure in the existing transport estate and alter at least 5 ha of the transport network catchment each year to drain to SuDS.

8.4.19 It is therefore recommended that the Local Plan require the use of SuDS in all brownfield developments. Opportunities could also be investigated by the Councils and the LLFA , for retrofitting SuDS measures in council-owned sites within existing urban areas. The use of small-scale SuDS measures should be incorporated into council property refurbishment and highways projects wherever possible. The council should support the water industry in public education campaigns to reduce domestic waste water misconnections and illegal disposal of waste in the surface water network.

SuDS for Schools

The charity WWT worked with ten schools in North London at risk of surface water flooding, to retrofit SuDS. These aimed to reduce peak flows and pollution to the nearby Pymmes Brook. The SuDS measures provided new opportunities for outdoor play and learning. Work was funded by Thames Water, the Environment Agency, and the schools, with materials and labour also donated by the local community and businesses. The Mayor of London has produced a "Reimagining rainwater in schools"[70] report to help other schools include SuDS in their environments.

Image credit: WWT

Box 8-2: SuDS for Schools

The Alma Road Suds Project[71]

[70] Reimagining rainwater in schools

[71] Alma road suds project

Image credit: London Borough of Enfield

This project in Ponders End, Enfield, was undertaken to reduce the risk of surface water flooding and improve water quality in the downstream watercourses Salmon's Brook and the River Lea. The project led to the creation of rain gardens along Alma Road, linking into an urban regeneration scheme. The gardens cost £50,000 to install and have been adopted and are maintained by the council's Highways Services team. The gardens act as speed-reduction measures after speed bumps were removed. Community engagement was undertaken with local schools, and the project also led to wider take-up of SuDS by the council's transport team in other traffic calming schemes, footway renewals and cycle routes.

Box 8-3: The Alma Road SuDS Project

Woodlands

8.4.20 Woodlands can offer significant benefits to integrated water management, including reducing diffuse pollution and erosion, protecting and enhancing river morphology, regulating water temperatures, mitigating downstream flooding, and increasing infiltration and groundwater recharge. The "Woodlands for Water" project[72] undertaken by the Environment Agency and the Forestry Commission indicates strong evidence to support woodland creation in appropriate locations.

8.4.21 Woodlands need to be carefully planned and managed to avoid unintended impacts on the environment. For example, woodlands can pose a risk of diffuse water pollution, especially linked to harvesting operations and intensive management practices on sensitive soils. Woody debris can wash downstream and block key structures such as bridges and culverts. Good management planning and practices can mitigate these risks.

8.4.22 Trees can have a high water demand compared to other types of vegetation (Figure 8-1). Conifer woodland has a disproportionately larger effect in drier

[72] Woodland for Water: Woodland measures for meeting Water Framework Directive objectives

lowland areas, resulting in a 7 to 10% reduction in water yield for a 10% catchment area land cover change. Individual tree water usage varies considerably throughout the year. Forest Research estimate maximum daily transpiration losses for large individual trees of between 500 l to 2000 l on a hot summer day. This is equivalent to the water usage of 5 to 20 people[73].

8.4.23 Therefore, the "Woodlands for Water" project recommends that catchments with insufficient water to maintain ecological flows may be unsuitable for planting woodlands, although this can be mitigated by appropriate species selection. The lower water use of broadleaved trees pose less of a risk to water supplies, and can even increase water resources. For example, planting native ash has been predicted to increase water yields by 1.5 to 20.2% per 10% catchment area cover, compared to grass.

8.4.24 Stakeholders have raised concerns about the impacts of drought on existing trees in Cambridge. The council have noted increasing losses in newly planted and establishing tree stock, and increased mortality in mature cherry and birch which are known to be intolerant to dry conditions. The impact of pests and disease on trees is increased in drought conditions, and there are also indirect impacts of tree related property subsidence. The council recognise the valuable role that trees play as green infrastructure, and are taking a number of measures to increase the resilience of the urban trees. This includes exploring options for using SuDS measures such as storm-water attenuation tree pits and rainwater harvesting to improve water supplies to trees.

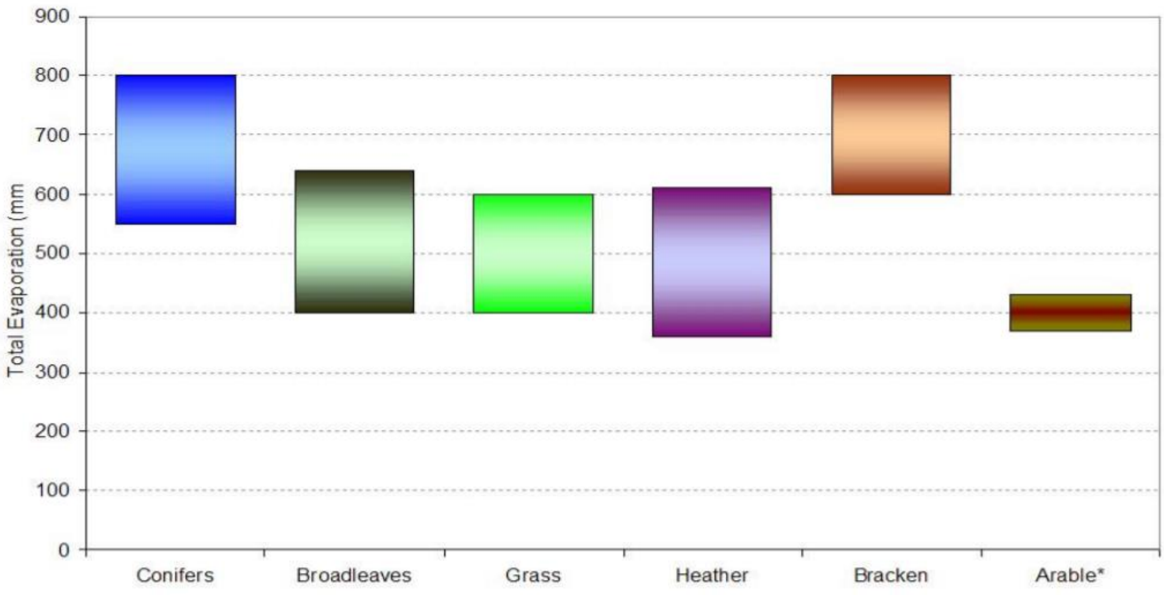


Figure 8-1: Typical annual evaporation losses in mm for different land covers receiving 1000 mm annual rainfall in the UK (* assuming no irrigation). From "Woodland for Water" EA / Forestry Commission report (2011).

[73] How much water do forests use - Forest Research

8.4.25 The scope for widespread woodland planting has been historically limited by constraints on land use and the financial viability of schemes for land managers. However, the potential of woodland for carbon offsetting schemes could lead to significant land use change proposals in the future.

8.4.26 It is therefore recommended that the Local Plan:

- Supports the use of SuDS to benefit existing and new trees in urban environments, including retrofitting SuDS and rainwater harvesting schemes.
- Supports the small-scale use of riparian and floodplain woodland planting to provide multiple benefits to water quality and riparian habitat.
- Supports the use of natural buffer strips between developed (and undeveloped) land and rivers and streams to trap pollutants before they enter the water environment.
- Requires further work to assess the potential water cycle impacts on any proposed woodland planting that would exceed a 5% change in catchment land cover (including cumulative effects of many smaller plantations), compared to today's baseline land cover.
- Requires all woodland planting schemes to consider water impacts when selecting species and defining management processes, including harvesting.

8.5 Opportunities, Constraints and Uncertainties Summary

	Integrated Water Management
Headline findings of baseline conditions	• All stakeholders are supportive of a more integrated approach to water management. This holistic approach would reference the wider effects of water-related impacts on the natural environment, including biodiversity, landscape, soils and agriculture, access to green infrastructure and associated health and well-being, and mitigating the potential impacts of climate change. • There are few examples of this being undertaken at present, in part due to the historic division of responsibilities for water management between the stakeholders (e.g. water supply and drainage divided between separate utility companies). The Eddington site is one example where rainwater and surface water run-off have been captured for re-use, and the open water storage ponds form part of the open space with leisure benefits and public art. • There is insufficient legislation, resource and incentive for partners to collaboratively deliver ICM at scale. The Local

	Integrated Water Management
	Plan is limited in its influence over these matters although it can mandate exacting water efficiency targets in new development and the nature of land drainage within developments (e.g. using SuDS).
Opportunities for development	• There are many opportunities for an integrated approach to water management to be adopted at the new settlement or urban extension scale, for example: o Storage and re-use of site surface water run-off for non-potable domestic uses such as toilet flushing, laundry and garden watering, to reduce potable water use and help manage surface water run-off, and combining water re-use (surface water or rainwater harvesting) with sustainable drainage systems (SuDS). o Re-use of treated WRC effluent to maintain low flows in watercourses, to recharge groundwater aquifers, or to irrigate agricultural land. o Capture and storage of fluvial flood waters that reduce flood risk downstream, and for re-use in domestic applications such as toilet flushing, laundry and garden watering, to recharge groundwater aquifers, or to irrigate agricultural land. o Improvements to riparian corridors, to provide natural flood management, improve water quality and recharge to groundwater. Stream restoration activities can also improve resilience to low flow conditions caused by drought or over-abstraction. o Planting of wet woodlands to offset increases in nutrient loads, improve water quality, slow rates of runoff and increase recharge to groundwater, as well as potentially contributing towards carbon neutrality. This should be carefully planned as a change of land use to more water demanding vegetation can reduce groundwater recharge rates. o Planted SuDS features, such as bioretention systems, integrated across development sites and catchments to treat surface water runoff and manage flows at all scales, and providing multiple benefits to “green” streetscapes. The SuDS features could also be integrated with water re-use systems to provide non-potable water supply. o Linking water management to broader sustainability and open space strategies, to have an integrated

	Integrated Water Management
	approach where water management measures can provide solutions that also support community and environmental objectives. • Many of these opportunities are currently under active consideration by Water Resources East as part of their planning process and could have wider multi-functional benefits for people and wildlife beyond the water cycle.
Constraints to development	• There are cost implications for development sites, and may be feasibility limitations for some schemes in smaller sites / infill locations. Although there are economies of scale available for larger sites, the principles of integrated water management can be applied at smaller sites. Different solutions may be required for different scales of site, and opportunities will need to be considered at an early stage in site planning.
Uncertainties	• To be fully implemented and integrated, projects will need to be supported outside of the realm of the Local Plan,and require a wider re-think of water management at the regional scale. Institutional arrangements are poor in support of this. • There are a number of regulatory, practical and behavioural changes that present significant uncertainty to the implementation of these approaches. • It is currently unclear how aspirations for integrated water management schemes that are not directly linked to specific development sites could be actioned or funded through planning policy or S106 / CIL contributions. The Local Plan is limited in its influence over the uptake of integrated water management measures especially outside of new large development sites. • The effectiveness of some of these measures in addressing adverse environmental impacts will need to be demonstrated and monitored, if to be relied upon as confirmed mitigation measures rather than additional benefits. The measures and associated monitoring will need to be agreed and delivery secured before development proceeds.

9 Conclusions and Recommendations

9.1 Conclusions

9.1.1 This Outline Water Cycle Study provides evidence on existing (baseline) infrastructure and environmental conditions for water aspects relevant to the new Local Plan: flood risk, water supply, wastewater and water quality. Opportunities, constraints and uncertainties for each of these aspects have been identified.

9.1.2 For flood risk, wastewater treatment, and water quality, there are constraints to development due to existing areas of high flood risk, wastewater treatment capacity limitations, and existing diffuse and point source pollution. At minimum, development will need to mitigate any further detrimental impacts on flood risk, wastewater treatment and water quality, to have a neutral impact. However, there are also opportunities for major development to offer betterment to existing conditions, for example by reducing flood risk downstream, reducing point and diffuse pollution, and supporting larger integrated water management schemes including more natural wastewater treatment options.

9.1.3 For water supply, currently permitted abstraction of the Chalk aquifer is having a detrimental impact on environmental conditions, particularly during dry years. Even without any further growth, significant environmental improvements are unlikely to be achievable until major new water supply infrastructure is operational, which is unlikely to occur before the mid-2030s. To prevent any increase in abstraction and its associated detrimental environmental impact before the 2030s, short term mitigation measures will be necessary. All stakeholders agree this should include ambitious targets for water efficiency in new development but there are also options to deliver new water locally which will be set out in the detailed study.

9.1.4 If solutions cannot be identified and delivered to provide more water to Cambridge then continued growth will cause detriment to the water environment. This could be avoided if new development trajectories were made contingent on sufficient water resources becoming available over time.

9.1.5 The report is based on information received to date from stakeholders. Consultation with stakeholders is ongoing and not all questions can be answered at this stage. There are a number of simultaneous projects being undertaken by key stakeholders, that may supersede the data and findings of this study. Therefore it is recommended that this study is reviewed and updated periodically by the stakeholder group.

9.1.6 It should be also reiterated that the Local Plan is one of the influencing mechanisms regarding the water environment and that an integrated approach is required from all the key stakeholders in order to have a positive effect on the potential impacts of growth on the water environment.

9.2 Recommendations for Detailed Water Cycle Strategy

9.2.1 The interim findings of this outline study were used to inform a high level appraisal of strategic spatial options (potential growth trajectories and broad location options), published in November 2020.

9.2.2 Further detailed work will be necessary to support the development of the Local Plan, including assessing growth levels, spatial approach and policy options, and where possible reducing uncertainties and addressing assumptions regarding growth trajectory timelines and non-household demand. The scope of work will be dependent on the growth trajectory and specific site allocations, and will be confirmed with Greater Cambridge Shared Planning Service and the relevant stakeholders at the appropriate stage in the planning process.

9.2.3 Some stakeholders are working on separate infrastructure plans during development of the Local Plan. For example, Water Resources East (Regional Plan), Water Resource Management Plan (Cambridge Water and Anglian Water) and Drainage and Wastewater Management Plan (Anglian Water). The Water Cycle Study should be revisited and updated as these separate infrastructure plans are published over the next 2 years.

9.3 Wider Recommendations for Stakeholders

Protection of and improvements in the water environment are closely linked to parallel Government policies for Environmental Net Gain as set out in the 25 Year Environment Plan, for example through the use of Local Nature Recovery Strategies. There will be benefits in integrating green infrastructure policies and water policies to achieve multiple objectives once the legislative and policy is clearer with the eventual finalisation of the Environment Bill process. For example, through the creation of new habitats managing nutrient loading to water courses and flood management benefits. Such opportunities are being explored in the Local Plan with regards to the evidence in the Green Infrastructure Opportunity Mapping (2021).

10 An update on development of the Detailed Water Cycle Study (August 2021)

10.1 Introduction

10.1.1 This chapter comprises an initial stage of the Detailed Water Cycle study, the full scope of which is still in development in consultation with stakeholders. It was authored in August 2021 with knowledge of the preferred development strategy identified for the First Proposals which describes the preferred location and level of development growth until the end of Local Plan period which is 2041.

10.1.2 This chapter reflects the relatively early stage the local plan has reached in the plan making process, and the on-going nature of planning activities for water resources and drainage and wastewater in the region.

10.1.3 The Greater Cambridge Planning Service continues to engage with the Environment Agency, Anglian Water and Cambridge Water to demonstrate that the Local Plan can be supported by an evidence base which demonstrates that development can occur in parallel with protection and enhancement of the local water environment.

10.1.4 This study will be revised and broadened as stakeholders develop detailed infrastructure plans through processes such as Water Resource Management Plans (WRMP) and Drainage and Wastewater Management Plans (DWMP). There is also regional planning activity for water infrastructure as part of the Oxford-Cambridge Arc.

10.1.5 This chapter is structured to describe the preferred development strategy (10.2) and aspects relevant to water resources (10.3), wastewater and drainage (10.4).

10.2 Preferred development strategy and water management

10.2.1 The level of growth proposed reflects a medium + scenario, which is slightly above the medium growth scenario described in the Integrated Water Management Study - Strategic Spatial Options Assessment, published in November 2020, but which has been considered through the supplementary analysis to this assessment published in August 2021.

10.2.2 Table 10-1 shows the proposed distribution of dwellings within the plan period, with intervals aligned with water company Asset Management Plan (AMP) five year investment periods. It shows the planned number of dwellings by location (or type) to be built by the end of the Local Plan period (2041) and the trajectory towards that.

10.2.3 Table 10-1 includes (in row one) the existing development commitments outside of strategic sites. In addition, there are number of existing major developments which are anticipated to continue development during the plan period. The new proposals are focused on a number of key strategic developments, which are anticipated to begin development in or around the 2030s. The total number of dwellings tabulated is the basis for population forecasts based on assumptions regarding occupancy.

Development location / type	Cumulative total of new dwellings at the end of each AMP period			
	2020-2025 AMP7	2020-2030 AMP8	2020-2035 AMP9	2020-2041[74] AMP10
Development Commitments (excluding strategic sites)	5,357	6,666	6,967	6,967
Adjustments to anticipated delivery from existing adopted allocations (Cambridge)	93	144	140	161
North West Cambridge (Eddington)	538	1,766	2,142	2,142
North West Cambridge (additional sites)	0	0	750	1,000
Darwin Green	383	1,383	2,383	2,478
Cambridge East	632	1,802	2,500	2,500
Cambridge East (additional sites)	0	0	750	2,850
Cambourne West	680	1,480	2,230	2,590
Cambourne (additional sites)	0	0	300	1,950
Cambridge Southern Fringe	453	453	453	453
Northstowe	1,533	3,045	4,545	6,345
Waterbeach New Town	580	2,030	3,530	5,330
Bourn Airfield New Village	110	810	1,560	2,460
Wellcome Genome Campus	350	1,350	1,500	1,500
Windfall Allowance (Cambridge)	0	740	1,665	2,775
Windfall Allowance (South Cambs)	0	120	1,130	2,570
North East Cambridge (additional sites)	0	650	1,800	3,900
Southern Cluster villages (additional sites)	0	80	160	160
Elsewhere villages (additional sites)	40	144	224	224
Students and communal accommodation (Cambridge urban area) – equivalent dwellings	343	352	352	352
Students and communal accommodation (South Cambridgeshire rural area) – equivalent dwellings	40	75	75	75
Cambridge (additional sites)	0	12	12	12
Cumulative Total	**11,132**	**23,102**	**35,168**	**48,794**

Table 10-1: First Proposals preferred development strategy – number and location of new dwellings

10.2.4 Figure 10-1 shows the consequential population increase in the Greater Cambridge area with an assumed average occupancy of 2.13, and the

[74] AMP10 ends in 2040 – this column of data shows the estimated number of dwellings by the end of the plan period in 2041.

assumption that the population in 2020 was 301,253. On this basis population in 2041 increases to an estimated 405,184, an increase of 34% over 2020.

10.2.5 The level of growth (and hence population) needs to be considered with regards to the future position for water resources in Greater Cambridge, including the security of supply and environmental impact connected to the level of abstraction from the chalk aquifer and its influence on river flow and levels.

10.2.6 It also informs the future position for wastewater services in Greater Cambridge, with consequences for the capacity of existing sewers and water recycling centres (WRC) and the environmental impact connected to their discharges into rivers. These issues are explored in the next sections (10.3 and 10.4).

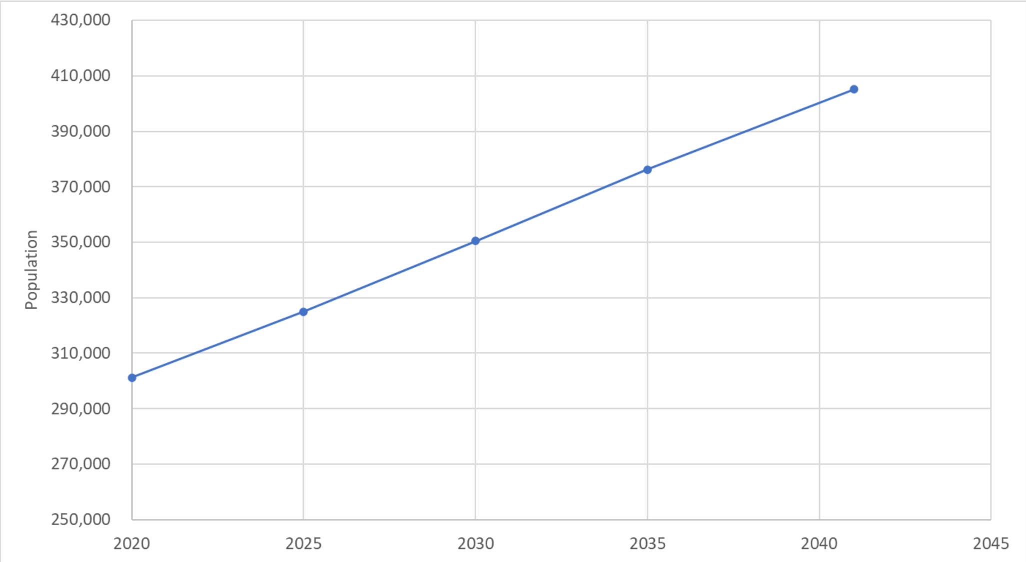


Figure 10-1: Greater Cambridge population forecast to 2041

10.3 Water Resources

Introduction

10.3.1 The distribution of new homes and population within Greater Cambridge is not so relevant for the purpose of strategically planning water supply to the area. It is assumed at this strategic level that any dwelling can be supplied through existing or new pipework within the Cambridge Water supply zone as part of Cambridge Water's obligations as water service providers.

10.3.2 The Cambridge Water supply zone contains the whole of Greater Cambridge plus part of Huntingdonshire. For the purposes of the Water Cycle Study the Huntingdon population (including an assumption for growth) is included in the assessment.

10.3.3 Cambridge Water, working with Water Resources East (WRE) (and Anglian Water as appropriate) are planning the strategic investments necessary to supply drinking water to Cambridge whilst protecting and improving the local environment. This Water Cycle Study will be updated as these plans are agreed over the next 18 months.

10.3.4 Appendix C contains a Joint Statement from these stakeholders setting out their planning timetable and current proposals to address the particular water resource pressures of Cambridge.

Background

10.3.5 Abstraction from the chalk aquifer represents the principal source of water in Greater Cambridge. As detailed in Chapter 4 of this outline Water Cycle Strategy, the current level of abstraction from the chalk aquifer supplying water to Cambridge is acknowledged by all stakeholders to be too high and results in poor groundwater and river health and is detrimental to an internationally important chalk stream environment.

10.3.6 In the mid-2030s it is planned that new strategic water resource options will come on-line to enable abstraction to be significantly reduced to levels which are sustainable, benefiting the river environment, providing resilience for climate change and meeting the demands of a growing population.

10.3.7 The appraisal of strategic growth options in November 2020 considered that the highest level (maximum) development option for Greater Cambridge (57,000 dwellings) was a potential 'deal breaker' due to water resource limitations. It indicated that a 'medium' growth strategy (42,000 dwellings) could plausibly be addressed provided that the mid-2030s strategic water solutions were augmented with other solutions in the short term to 'bridge the gap'.

10.3.8 The preferred development strategy level of growth has been defined as 'medium+' and is equivalent to 48,794 dwellings. If this level of development is to be planned for appropriately, it places a greater emphasis on the importance of securing short term solutions.

10.3.9 In 2019 Cambridge Water published their current Water Resource Management Plan (WRMP19) with the approval of regulators and the Secretary of State. It set out the water resource supply-demand balance until 2045. It included assumptions about growth in Greater Cambridge (and wards of Huntingdonshire) and was informed by the adopted 2018 Local Plans. It also took account of reductions in available water because of sustainable abstraction measures and climate change allowances. Measures included in the plan to meet demand were:

a. Increasing raw water abstraction (providing an additional 4 Ml/d)

b. Reducing distribution losses (leakage) (providing an additional 3.5 Ml/d)

c. Reducing customer side leakage (providing an additional 2 Ml/d)

d. Reducing domestic demand (from an average of 140 l/head/day to 128 l/head/day) (providing an additional 2.5 Ml/d)

10.3.10 Figure 10-2 illustrates how for WRMP19 Cambridge Water demonstrated that supply and demand were balanced. Supply here is shown with headroom allowances removed; these are the buffer between supply and demand which the water company maintains to ensure a reliable service.

10.3.11 Figure 10-3 contrasts forecasts of population growth in the Cambridge water supply zone between WRMP19 and that which would be generated by the preferred development strategy (medium +) option. The water supply zone includes population outside of Greater Cambridge (in Huntingdonshire) which increases from 51,392 to 56,530 over this period. The new planned population for the supply zone exceeds the 2019 WRMP assumption by 39,349 (9.3%).

10.3.12 Figure 10-2 also illustrates the revised trajectory of demand that would occur if the preferred option described in the First Proposals is taken forward in the Local Plan. This is shown as WCS Demand, and uses the same assumptions for occupancy, non-household use (for example businesses, schools and hospitals) and per person water consumption in metered and non-metered households. By this analysis demand would exceed supply in early 2030s without further interventions.

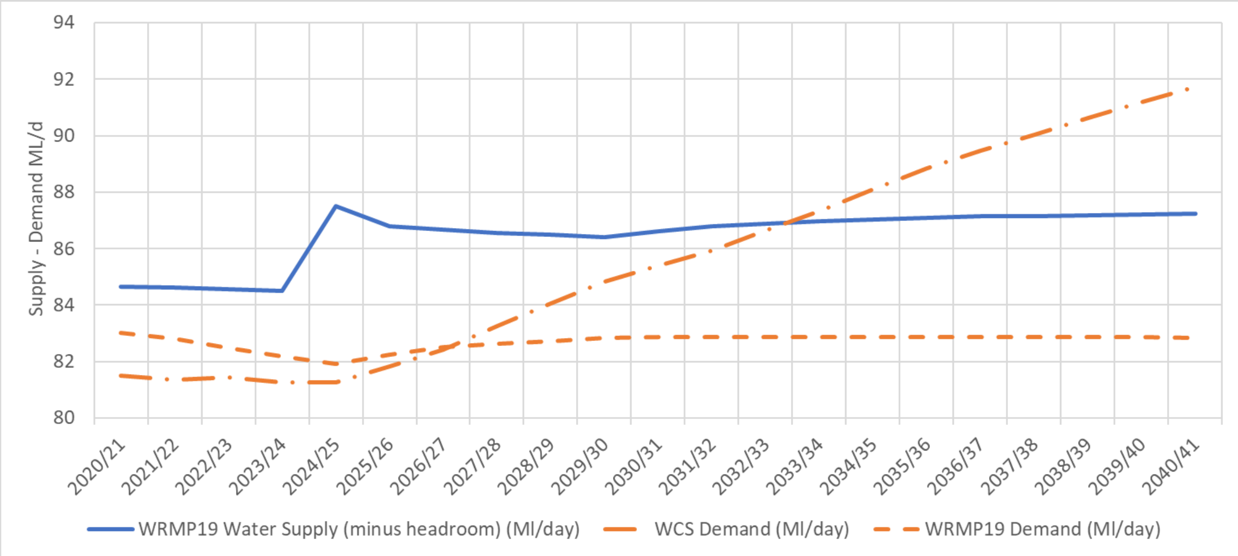


Figure 10-2 Supply and Demand balance in Cambridge water supply zone (Greater Cambridge plus wards of Huntingdonshire) for WRMP19 and with estimated new demand profile arising from preferred option spatial strategy

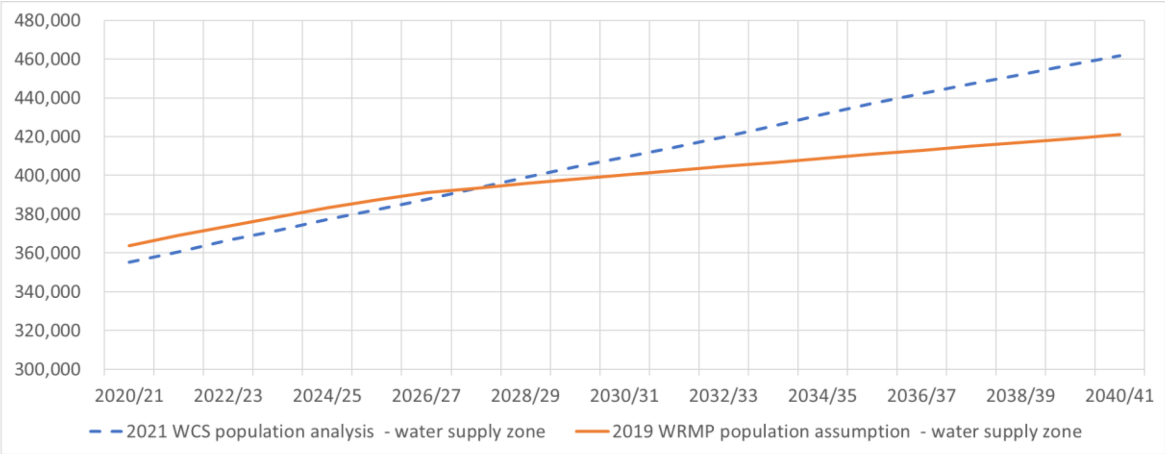


Figure 10-3: Population growth in the Cambridge water supply zone

10.3.13 The next round of water resource planning (WRMP24) will take account of revised levels of planned growth. It will also need to consider the impact that further licence reductions could have on abstraction (see information in the Outline Water Cycle Strategy). WRMP24 will plan for the reduction of abstraction permits to more sustainable levels to protect and enhance the area's chalk streams and rivers and other dependent ecosystems. Changes in how headroom is calculated will also increase pressures.

10.3.14 In parallel, planning led by Water Resources East is identifying a long-term sustainable level of abstraction (the Environmental Destination) and regional strategies to align supply and demand for public water supply and other requirements.

Next Steps for the Integrated Water Management Strategy and the Local Plan

10.3.15 Anglian Water, Cambridge Water and Water Resources East are currently working on water resource plans to address the challenges described above.

10.3.16 At the Oxford Cambridge Arc Level, the Creating a Vision[75] consultation acknowledges that sustainable abstraction and water resilience is key to future planning. It proposes, 'Promoting a combined approach to managing water across the Arc, through protecting water resources, improving water quality and reducing the risk of flooding. For example, treating wastewater, improving water storage, and reusing surface runoff.'

10.3.17 Water Resources East (WRE) is preparing a Regional Plan. Working under the National Framework for Water Resources, the regional plan will outline multi-sector, collaborative solutions which will meet the needs of all water users, enabling economic development and the restoration and enhancement of the natural environment. Both strategic region-wide and more

[75] Creating a Vision for the Oxford Cambridge Arc

local solutions to meet public water supply needs and the water requirements of other sectors will be identified through the regional plan and these solutions will flow through into individual water company Water Resources Management plans as well as into the plans of other organisations and sectors. The regional plan will also specifically consider the role of nature based solutions and land use change initiatives in enhancing our region's chalk streams.

10.3.18 The draft regional plan will be published in August 2022, and finalised by September 2023. An informal consultation on the draft regional plan will take place in January 2022, with the formal consultation period being held between October and November 2022.

10.3.19 Cambridge Water and Anglian Water are developing their 25 year statutory water resources management plans (WRMP). The previous plans were published in 2019 and the ones under development with be published in 2024. These plans will incorporate the outputs from the WRE regional plan and will set out in detail how each company will maintain their supply demand balance whilst accommodating growth in their supply area and factoring in the impact of climate change and the needs of the environment. They set plans for demand management including leakage reduction, metering and domestic water efficiency initiatives as well as identifying the new supply side infrastructure (such as new reservoirs and pipelines) that will be needed.

10.3.20 Pre-consultation on the company WRMPs will start in January 2022, with the formal consultation period being held between October and November 2022 (in line with the regional plan).

10.3.21 The water companies and WRE are working closely with the Environment Agency and other organisations through the regional planning process to develop the environmental destination and ambition for the region, as set out in the Water resources national framework.

10.3.22 Cambridge Water, Anglian Water and Water Resources East have provided a joint statement providing information on the work they are undertaking which is included in full as Appendix C. These organisations are collaborating to identify Cambridge's future supply options through the processes described above. Key points from the statement are summarised here:

- Long term strategic options include the proposed Fens Reservoir which could support up to 100 Ml/d of new supplies to the region supporting growth in Cambridge as well as meeting the needs of the agricultural sector and the environment. The earliest delivery for this option is the mid-2030s.

- There are a number of options currently being considered to satisfy demands and environmental needs before this time (see Figure 2 in Appendix C). These include supply from Anglian Water's new strategic grid (construction completes in 2025) or the existing Grafham Water or

Rutland Water reservoirs. All options avoid additional abstraction pressure on groundwater fed systems and are made possible through Anglian Water's investment in a strategic water grid which is completing in 2025, enabling inter regional transfers of water.

- Short-term options will be considered as part of Anglian Water and Cambridge Water's WRMP24 planning process with delivery in the mid to late 2020s.

- Anglian Water and Cambridge Water will work in close partnership with the Environment Agency and Greater Cambridge Shared Planning Service in the coming months to demonstrate the soundness of the Local Plan and underpinning evidence base (including this Water Cycle Study)

10.3.23 Further elements being considered as part of the ongoing planning process are to further reduce leakage and, through wider use of metering, reduce the demand across the whole area. Greater and compulsory meter use is now feasible as Cambridge has been designated an area of serious water stress by the Environment Agency. Cambridge Water has identified a further 2 Ml/d of demand reductions from compulsory metering which could be achieved in AMP8 (by 2030).

10.3.24 Strategies considered but rejected in the current WRMP identified a further 3 Ml/d of savings through leakage strategies costing up to £78 million. Fifty percent of this saving (1.5 Ml/d) could be implemented by 2035, although the current plan to reduce leakage by 3.9 Ml/d is considered ambitious, so there remains uncertainty over whether these improvements can be achieved.

10.3.25 The outcome of these wide ranging water planning processes are key issues for this Integrated Water Management Study and for the Local Plan process. As these processes are still at an early stage it is not yet possible for this study to confirm the water supply position with regards to the First Proposals for the new Local Plan.

10.3.26 The Councils' Local Development Scheme sets out the programme for the Local Plan. It is anticipated that water resource planning in the region will have progressed significantly by the next stage, which is consultation on the draft local plan itself, currently anticipated for autumn 2022. This Detailed Water Cycle Study (part of an Integrated Water Management study) will be updated to inform the Draft Plan stage, and explore whether the water supply issues identified in this report have been addressed, to inform decisions regarding development proposals at future stages of the Local Plan process.

Water efficiency policy proposals in the First Proposals

10.3.27 In recognition of the acute pressure on water resources in Greater Cambridge the Greater Cambridge Local Plan First Proposals is also proposing a policy targeting water efficiency in new developments. This will reduce the demand imposed by planned growth to the minimum, although it is acknowledged that demand overall will still increase.

10.3.28 The adopted 2018 Local Plans specified that new development should have a water consumption of 110 litres/person/day, which is the lower optional requirement allowed by Building Regulations. For the new Local Plan it is proposed that the standard becomes 80 litres/person/day in all new housing development. This is equivalent to the standard required in the (now withdrawn) Code for Sustainable Homes Level 5/6 which was the design standard for the development at Eddington[76] in North West Cambridge which has demonstrated the feasibility of achieving this level of consumption through water efficient fixtures and development scale rainwater harvesting. Building with this level of water efficiency improves the resilience of water supply systems although because of uncertainties over long term maintenance and performance, these efficiencies are not relied upon in the water resource management plan process.

10.3.29 Whilst acknowledging these uncertainties, Figure 10-4 shows the effect on water demand of applying such efficiency standards to new homes. The sum of new properties from 2025 (to 2041) at certain strategic development sites[77] is 28,182, with an implied population of 60,027. Figure 10-4 explains the total efficiency in water demand which would result from moving to 80 litres/person/day from 110 litres/person/day across these developments, assuming that non household consumption is 42% of household consumption and consumption and leakage losses are 10%. The savings are not insignificant (2.8 Ml/d in 2031) and similar in scale to extending metering of the current customer base.

10.3.30 Furthermore, an equivalent water efficiency policy for non-residential property is also proposed to require full credits for category Wat 01[78] of BREEAM. This insures that new non-residential buildings include the most water efficient fixtures and measures such as rainwater or greywater reuse. Building with this level of water efficiency improves the resilience of water supply systems although because of uncertainties over long term maintenance and performance, these efficiencies are not relied upon in the water resource management plan process. With reference to Figure 10-4, this measure would potentially reduce non household consumption to a degree dependent on the mix of buildings at each site.

[76] See Outline Water Cycle Study for description of Eddington water management approach

[77] Northstowe, Waterbeach, Cambourne, Wellcome Genome Campus, Cambridge East, Bourn Airfield New Village, North West Cambridge excluding Eddington and North East Cambridge

[78] A description of the BREEAM Wat 01 category for water efficiency in new non-residential buildings

10.3.31 The justification for requiring water efficiency targets in new development is strengthened by the Environment Agency's recent classification of Cambridge as an area of severe water stress.

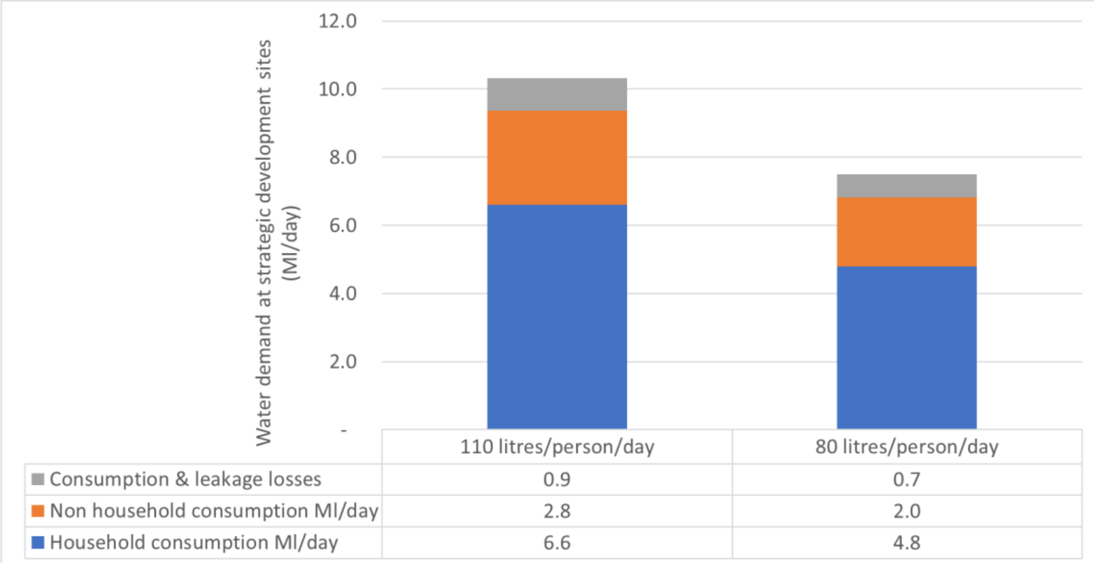


Figure 10-4 Water demand at strategic development sites in 2041 comparing water consumption standard of 110 and 80 litres/person/day

10.4 Wastewater and drainage

Introduction

10.4.1 Wastewater services (sewers and wastewater treatment) are vital to enable development in Greater Cambridge and protect and enhance the water environment. Through effective sewerage they protect homes and business from flooding and watercourses from pollution. Pollutant loads of ammonia, organic material and nutrients are controlled through water recycling centres (WRC) which return treated wastewater to the environment. The discharges are subject to permits which specify their quantity and quality to ensure downstream river meeting environmental targets where this is possible.

10.4.2 The nature of development-site storm drainage is also of importance. When achieved through sustainable drainage systems (SuDS) this protects water courses from contaminated stormwater, provides local and downstream flood risk protection and safeguards capacity in foul or combined sewers reducing sewer flooding and the operation of combined sewer overflows.

10.4.3 Anglian Water, working with the Environment Agency and local planning authorities, are currently working on a Drainage and Wastewater Management Plan (DWMP) for the whole of the Greater Cambridge area (and across their region) which will set out their strategy and investments required to meet new demands from growth whilst protecting and enhancing the environment and adapting systems to be resilient for climate change. This Water Cycle Study will be updated as these plans are agreed over the next 18 months. The Anglian Water DWMP will be published as a Draft in mid-2022 and finalised in December 2022 in time to inform a business plan submission for the 2025 to 2030 period (AMP8) in mid-2023.

10.4.4 The level and distribution of growth across Greater Cambridge are of significance for wastewater and drainage because the capacity of existing WRC differ as do pressures and constraints on water courses across the area. Wastewater is not so easily transferred across large distances and the opportunities to successfully seek planning permission and environmental permits for new WRC are limited.

10.4.5 Policies influencing the nature of storm drainage from new developments are important as the highest standards can limit risks from flooding, limit the impact on downstream sewer capacity, remove contamination from polluted runoff and improve local amenity and green space.

Background

10.4.6 The context for future wastewater capacity in Greater Cambridge is dominated by the proposed development of a new 300,000 population WRC. Whilst the preferred site of Honeyhill has been identified (north of the A14 between Fen Ditton and Horningsea) this is subject to further consultation and a development consent order (DCO) process, the application for which will include comprehensive assessments of its impact in the immediate vicinity and in the River Cam downstream.

10.4.7 The DCO application will be considered by the Planning Inspectorate and the Secretary of State for DEFRA. It is anticipated that a decision will be taken in late 2023. Without prejudging this outcome and for the purpose of this Water Cycle Study it is assumed that a new facility will be constructed and commissioned before 2030. Proposals outlined in the North East Cambridge AAP are dependent on the relocation of the existing WRC.

10.4.8 The population served by the current Cambridge WRC in Milton is 213,679 and the proposed capacity is that the new WRC can treat for a population of 300,000. The increase in Greater Cambridge population (from 2020 to 2041) is estimated to be approximately 104,000. The additional capacity being constructed at Cambridge WRC is equivalent to approximately 86,300, or approximately 83% of the Greater Cambridge future requirement. Whilst the new WRC will be able to meet most growth needs, this is not possible from all growth locations where local treatment options are also viable.

10.4.9 The current flows arriving at Cambridge WRC are above levels defined in its environmental permit (see Section 5 of the Outline Water Cycle Study) and therefore Anglian Water is in discussions with the Environment Agency to agree a revision to the permit which allows more flow to be treated with corresponding adjustments to the quality of what is discharged.

10.4.10 For the purposes of the Water Cycle Study, at this stage in its development, it is assumed that a suitable permit will be applied which provides capacity and protects downstream watercourses until the new WRC is constructed and all flows are transferred there.

10.4.11 The comprehensive way to assess the environmental permit requirements of WRCs to meet water quality objectives at points downstream and throughout the catchment is to undertake catchment water quality modelling. This is normally a function undertaken by the Environment Agency in partnership with the water company. The degree to which this is necessary as an independent exercise to support the Water Cycle Study has not been agreed or commenced at this time. In a similar manner to the water supply issues, detailed processes such as the DCO and DWMP are underway, and the outcome will inform further work on this Integrated Water Management study which will accompany the next steps of the local plan

Next Steps for the Integrated Water Management Strategy and the Local Plan

10.4.12 Anglian Water is already planning for growth (to 2050) as part its DWMP and has made estimates for population growth at each of its WRC in Greater Cambridge. In its Long Term Plan for Wastewater, it has identified flow and process capacity improvements considered necessary for this anticipated level of growth. This assessment can now be informed and refined by the preferred development approach described in the First Proposals.

10.4.13 The level of treatment currently planned for (see Table 10-2) plus the provision of new treatment capacity at the new Cambridge WRC notionally provides ample wastewater treatment capacity for Greater Cambridge overall. The population served by the new Cambridge WRC plus that planned for in the other WRCs (by 2041) is 449,147, compared to a potential population at that time of 405,184.

	Population in 2019	**2025**	**2030**	**2035**	**2041**
New Cambridge			300,000	300,000	300,000
Cambridge	213,679	230,000	-	-	-
Uttons Drove (Bar Hill)	21,893	23,028	24,032	24,872	25,308
Over	13,358	16,092	15,874	15,872	16,119
Sawston	11,600	11,999	12,135	12,160	12,408
Haslingfield	10,452	10,586	10,418	10,449	10,681
Melbourn	7,700	8,120	7,996	8,013	8,171
Linton	6,958	7,155	7,046	7,064	7,210
Waterbeach	6,942	9,225	12,132	14,865	21,928
Teversham	6,921	7,072	6,959	6,979	7,132
Foxton (Cambs)	6,292	6,412	6,711	6,722	6,857
Bassingbourn	4,781	4,850	4,771	4,785	4,895
Papworth Everard	4,483	4,549	4,475	4,488	4,590
Great Chesterford	3,707	3,454	3,659	3,953	4,069
Gamlingay	3,624	3,796	3,735	3,744	3,824
Bourn	3,371	4,613	5,914	6,694	6,703
Balsham	2,380	2,468	2,428	2,434	2,488
Guilden Morden	1,930	1,937	1,905	1,911	1,955

	Population in 2019	2025	2030	2035	2041
Litlington	968	995	979	981	1,003
Coton	944	932	917	921	943
West Wickham	810	800	788	790	809
Shudy Camps	748	757	745	747	764
Duxford	605	598	588	590	604
Arrington	401	396	390	391	401
Tadlow	142	141	138	139	142
Hatley St.George	113	112	110	110	113
Total (exl. New Cambridge)	**334,800**	**360,086**	**N/A**	**N/A**	**N/A**
Total (with New Cambridge)	**N/A**	**N/A**	**434,848**	**439,674**	**449,117**

Table 10-2: Current planned wastewater treatment capacity (population) in Greater Cambridge

10.4.14 Table 10-3 indicates the cumulative development (population) at each site and the potential wastewater treatment location where this is possible to ascertain without detailed site allocations or further information. This data will support Anglian Water’s detailed catchment scale planning through the DWMP. Population estimates are based on a dwelling occupancy average of 2.13 persons.

Development location / type	2020-2025 AMP7	2020-2030 AMP8	2020-2035 AMP9	2020-2041[79] AMP10	WRC for wastewater
Development Commitments (excluding strategic sites)	11,410	14,199	14,840	14,840	N/A
Adjustments to anticipated delivery from existing adopted allocations (Cambridge)	198	307	298	343	N/A
North West Cambridge (Eddington)	1,146	3,762	4,562	4,562	Cambridge
North West Cambridge (additional sites)	-	-	1,598	2,130	Cambridge
Darwin Green	816	2,946	5,076	5,278	Cambridge
Cambridge East	1,346	3,838	5,325	5,325	Cambridge
Cambridge East (additional sites)	-	-	1,598	6,071	Cambridge
Cambourne West	1,448	3,152	4,750	5,517	Papworth Everard
Cambourne (additional sites)	-	-	639	4,154	Cambridge
Cambridge Southern Fringe	965	965	965	965	Cambridge
Northstowe	3,265	6,486	9,681	13,515	Uttons Drove
Waterbeach New Town	1,235	4,324	7,519	11,353	Cambridge
Bourn Airfield New Village	234	1,725	3,323	5,240	Papworth Everard
Wellcome Genome Campus	746	2,876	3,195	3,195	Great Chesterford then Sawston
Windfall Allowance (Cambridge)	-	1,576	3,546	5,911	Cambridge
Windfall Allowance (South Cambs)	-	256	2,407	5,474	N/A

Development location / type	2020-2025 AMP7	2020-2030 AMP8	2020-2035 AMP9	2020-2041[79] AMP10	WRC for wastewater
North East Cambridge (additional sites)	-	1,385	3,834	8,307	Cambridge
Southern Cluster villages (additional sites)	-	170	341	341	N/A
Elsewhere villages (additional sites)	85	307	477	477	N/A
Students and communal accommodation (Cambridge urban area) – equivalent dwellings	731	750	750	750	Cambridge
Students and communal accommodation (South Cambridgeshire rural area) – equivalent dwellings	85	160	160	160	N/A
Cambridge (additional sites)	-	26	26	26	Cambridge
Total	**23,711**	**49,207**	**74,908**	**103,931**	

Table 10-3: Cumulative new development population by AMP period and indicative WRC

10.4.15 Assessment of the preferred development strategy indicates that much of the new development in strategic sites will/could be accommodated by the new Cambridge WRC. For example, development at Waterbeach, Cambridge East, North East Cambridge, Cambridge West and Darwin Green.

10.4.16 An exception is development at Cambourne and Bourn Airfield where conveyance to, and treatment at, Papworth Everard has previously been considered necessary because of known capacity constraints related to the receiving water bodies at Bourn and Uttons Drove. Receiving water and treatment constraints at Papworth Everard require further assessment through the DWMP and Detailed Water Cycle study. Wastewater from the

[79] AMP10 ends in 2040 – this column of data shows the estimated additional population at these sites by the end of the plan period in 2041.

development at the Wellcome Genome Campus is planned for treatment at Great Chesterford and Sawston.

10.4.17 The continued use of Uttons Drove WRC to treat wastewater from Northstowe (as development continues) will be reviewed in light of treatment capacity and receiving water hydraulic capacity.

10.4.18 The outcome of the DWMP planning process is a key issue for this Integrated Water Management Study and for the Local Plan process. Because the DWMP is at an incomplete stage it is not yet possible for this study to confirm, in any detail, the wastewater and drainage position with regard to the First Proposals for the new Local Plan.

10.4.19 The Councils' Local Development Scheme sets out the programme for the Local Plan. It is anticipated that wastewater and drainage (and by implication catchment water quality) planning in the region will have progressed significantly by the next stage, which is consultation on the draft local plan itself, currently anticipated for autumn 2022. This Detailed Water Cycle Study (part of an Integrated Water Management study) will be updated to inform the Draft Plan stage, and explore how wastewater and drainage issues have been addressed.

10.4.20 In the meanwhile, there will be continuing dialogue between the Environment Agency, Anglian Water and Greater Cambridge Shared Planning Service to agree a scope of work for furthering the Detailed Water Cycle Study in parallel to, and in consultation with, the DWMP process.

Sustainable drainage policy proposals in the First Proposals

10.4.21 The Level 1 SFRA has described localised issues of sewer and surface water flooding within Greater Cambridge. The Outline Water Cycle Study also reporting on a number of combined sewer overflows which discharge an untreated mixture of wastewater and rainwater into rivers during heavy rainfall. Anglian Water is developing strategies which improve their infrastructure to accommodate increased risks arising from population growth and climate change and also address current capacity issues. Part of this strategy will be to work in partnership with the Lead Local Flood Authority (Cambridgeshire County Council) and the planning authorities (GCSPS) to enable retrofit SuDS which limit stormwater entering sewers. This approach can be aligned with Green Space strategies to enhance the urban environment.

10.4.22 In the Local Plan First Proposals there is a policy recommendation to implement integrated water management principles on all new development sites including the comprehensive use of SuDS and blue-green infrastructure to manage the quality and quantity of runoff, minimising its downstream impact. As part of an integrated approach, stored rainwater will also be utilised to reduce the consumption of drinking water and hence achieve the highest levels of water efficiency. The process of designing successful SuDS in developments which mimic natural drainage, and their approval, adoption and maintenance is set out in detail in the Cambridgeshire Flood and Water Supplementary Planning Document[80] and the policy will refer to this document or its successor.

[80] [Cambridgeshire Flood and Water Supplementary Planning Document]

Appendix A Stakeholder Consultation

A.1.1 The table below summarises information obtained directly from key stakeholders, and responses received to an initial communication sent out by the Greater Cambridge Shared Planning Team on behalf of this project to parish councils, residents associations and local groups. Information was sought both for this report and for the wider Integrated Water Management Study.

A.1.2 We recognise that the exceptional circumstances of 2020 may have meant that not all interested stakeholders may have been able to respond or provide information in time for the publication of this report. We recommend that all stakeholders are contacted for updated information when this report is annually reviewed.

Stakeholder	Response	Specific information provided
Abbey People Community Group	Interested and have information to provide	None to date
Affinity Water	Data sharing agreed	WRMP reports (see Chapter 6)
Anglian Water	Data sharing agreed	See Chapter 6
Babraham Road Residents Association	Interested and would like to be kept informed of progress	N/A
Bartlow Parish Council	Interested and have information to provide	None to date
British Geological Society (BGS)	Data sharing agreed	Aquifer baseline conditions and recharge reports and groundwater levels
Cam Ely Ouse Partnership	Interested and have information to provide	Information provided on current work programmes
Cam Valley Forum	Interested and have information to provide	“Let it Flow” Report (now available on the Cam Valley Forum website)
Cambridge ACRE	Interested and have information to provide	Information on Old West River and Fens Biosphere conservation projects
Cambridge PPF	Interested and have information to provide	Information on water issues at their sites of interest

Stakeholder	Response	Specific information provided
Cambridge Sports Lakes Trust & Milton Country Park	Interested and have information to provide	Information on sports lake proposals and Milton Country Park hydrology
Cambridgeshire County Council (LLFA)	Data sharing agreed	See Chapter 6
Caxton Parish Council	Interested and have information to provide	None to date
Cottenham Parish Council & Cottenham Flood Risk Forum	Interested and have information to provide	Comments on sensitivity of Cottenham Parish to water management in the wider area including upstream catchment development
Countryside Restoration Trust	Interested and have information to provide	None to date
Croydon Parish Council	Interested and would like to be kept informed of progress	N/A
Eddington	Have information to provide	Climate change adaptation strategy and potable water strategy reports
Environment Agency	Data sharing agreed	See Chapter 6
FeCRA	Interested and have information to provide	None to date
Friends of Cherry Hinton Brook	Interested and have information to provide	Comments on vulnerability to drought and further information on website
Friends of Histon Road Cemetery	Interested and would like to be kept informed of progress	N/A
Friends of Jesus Green Association	Interested and have information to provide	None to date
Friends of Jesus Green Lido	Interested and would like to be kept informed of progress	N/A
Fulbourn Forum and Fulbourn Parish Council	Interested and have information to provide	Information of the impact of abstraction on water levels

Stakeholder	Response	Specific information provided
Gamlingay Parish Council	Interested and have information to provide	None to date
Gough Way Residents Association	Interested and have information to provide	Detailed information on flooding in 1978 and 2001 and links to further documentation
Grantchester Parish Council	Interested and have information to provide	Information on flooding issue on Mill Way
Harston Parish Council	Interested and would like to be kept informed of progress	N/A
Haslingfield Parish Council	Interested and would like to be kept informed of progress	N/A
Hobson's Conduit Trust	Interested and have information to provide	Information on low flow concerns and proposed groundwater pumping mitigation scheme
Ickleton Parish Council	Interested and would like to be kept informed of progress	N/A
Internal Drainage Boards: Middle Level Commissioners, Ely Group of Drainage Boards and Swavesey Internal Drainage Board	Comments and data provided	See Chapter 6
Members of the public (individual responses)	Interested and would like to be kept informed of progress	N/A
Milton Road Residents Association	Interested and would like to be kept informed of progress	N/A
National Farmers Union	Interested and would like to be kept informed of progress	N/A
Natural England	Interested and have information to provide	Comments received primarily relating to abstraction and water quality
Newnham Riverbank Club	Interested and have information to provide	None to date

Stakeholder	Response	Specific information provided
Orwell Parish Council	Interested and have information to provide	None to date
Over Parish Council	Interested and have information to provide	None to date
Oxford Road Residents Association	Interested and would like to be kept informed of progress	N/A
Residents Association for Old Newnham	Interested and would like to be kept informed of progress	N/A
South Cambridgeshire and Cambridge City Councils	Data sharing agreed	See Chapter 6
South Staffordshire Water	Data sharing agreed	See Chapter 6
Southacre, Latham and Chaucer Road Residents' Association	Interested and would like to be kept informed of progress	N/A
Swavesey Parish Council	Interested and have information to provide	Flood risk update document provided
Trumpington Residents Association	Interested and would like to be kept informed of progress	N/A
Wilbraham River Protection Society	Interested and have information to provide	Information regarding low flows and impacts of abstraction
Wildlife Trust	Interested and have information to provide	None to date
Willingham Parish Council	Interested and have information to provide	None to date
Windsor Road Residents Association	Interested and have information to provide	Information on surface water flooding concerns

Appendix B Designated Sites of Concern

B.1.1 Natural England have provided information on designated sites of particular concern, where low water levels may be having a detrimental impact on the natural environment. These are listed below. The potential impacts of the proposed Local Plan on these sites will be explored further at the detailed study stage, and through the separate Habitats regulations Assessment and Sustainability Appraisal studies.

B.1.2 The conditions are categorised as follows:

- Favourable: Habitats and features are in a healthy state and are being conserved by appropriate management.
- Unfavourable Recovering: If current management measures are sustained the site will recover over time.
- Unfavourable No Change or Unfavourable Declining: Special features are not being conserved or are being lost, so without appropriate management the site will never reach a favourable or recovering condition.
- Part Destroyed or Destroyed: There has been fundamental damage where special features have been permanently lost and favourable condition cannot be achieved.

Conditions are assessed by Natural England every 6 to 10 years approximately.

Designated Site	Current Condition	Natural England comments on risks and opportunities
Ouse Washes (SSSI, SAC, SPA, Ramsar)	Unfavourable No Change (mostly - some sub units are favourable or unfavourable recovering)	Whilst there is limited mechanism for abstraction to impact this site, flooding is a significant issue. A major cause of problematic flooding is silt/sediment on the riverbed at Denver slowing the drainage of flood water. The WCS will need to consider the potential for changes in discharge(s) to the Ely Ouse system to exacerbate this problem. The flows along the Ely Ouse are thought to help distribute the silt, but modelling hasn't been carried out. Effects of the reductions of summer and winter flows are likely to be different, but without modelling any reduction of flows should be considered potentially damaging.

Designated Site	Current Condition	Natural England comments on risks and opportunities
Chippenham Fen and Snailwell Poor's Fen (SSSI, SAC Ramsar, NNR)	Favourable / Unfavourable Recovering	Over abstraction of the chalk aquifer, particularly from the borehole close to Newmarket, has been demonstrated to reduce upwellings from springs on and close to the site. Detailed information in the Review of Consents (EA). Mitigation through pumped water from the aquifer into the drainage system in dry years, but this changes the hydraulic functioning of the site (there are thought to be upwellings across the fen, and surface water won't achieve the same effect). Concerns about changes in water chemistry from pumped water deep in the aquifer. Abstraction from the aquifer needs to be reduced to have confidence in no effect on the site in the future. Chippenham Fen, part of the Fenland SAC, has lost at least two 'species of the Caricion davallianae' (calcareous fen qualifying feature of the SAC) in recent decades. While it is difficult to definitively conclude that this is due to a change in hydrology, there are legitimate concerns, given the evidence available (Wheeler et al 2018) that this is the case. Restoring natural hydrology has further significance nationally, because it would provide opportunities for expansion of the Cladium fen (and alkaline fen, which is not currently a Fenland SAC qualifying feature) which is required to achieve Favourable Conservation Status for this priority Annex 1 habitat. We believe that Chippenham Fen should be an absolute priority in line with NE and EA nature recovery objectives; Tall calcareous fens habitat was recently assessed as Endangered at a European level. EA has indicated that the agreed solution of river support has largely been unused so it's hard to say whether or not it would have positive benefits on the site. The EA have asked whether it

Designated Site	Current Condition	Natural England comments on risks and opportunities
		can be trialled for a longer period of time along with increased monitoring. Natural England's view is that it is not 'river support' in this instance. The Chippenham Estate pumps water from the aquifer into their lake, which exits via a stream and enters Chippenham Fen, which makes it less necessary for Chippenham Fen to use their own pump. Monitoring won't really help, because the problem is a lack of upwelling, it's not as simple as the groundwater level achieved. River support certainly has benefits for the site, but some wetland communities require upwellings and won't persist if upwellings are replaced by surface water. And there's also precedent for artificial augmentation not to be considered acceptable mitigation for SACs that needs to be taken seriously. Monitoring of the vegetation communities requiring upwelling demonstrates changes have occurred. Whilst the artificial pumps are clearly vital given the circumstances, to keep the site wet during dry years, this isn't keeping all SAC communities healthy.
Wicken Fen (SSSI, SAC, Ramsar, NNR)	Unfavourable Recovering / Favourable	EA have indicated that groundwater abstraction has the potential to deplete the feeder drains into Wicken Fen but the major influence is thought to be SW management on site and that the National Trust have licences to transfer water on site. However, Natural England's view is that the hydrology at Wicken Fen isn't well understood. With the exception of a few recent years, when the groundwater level has been high, summer water levels have been worryingly low, too low to support the interest features of the SAC, and a wind pump has been installed to take water from Monks Lode (which also originates in a spring near Exning). There are indications that Wicken Fen must be

Designated Site	Current Condition	Natural England comments on risks and opportunities
		groundwater fed, but the mechanism for this isn't known. Wicken Fen probably doesn't lie within the influence of the Cambridge chalk aquifer (known partly because of the location, partly because of the chemistry of the water).
Dernford Fen (SSSI)	Unfavourable Recovering	Ground water fed site with open fen and wet woodland habitats. The site is subject to monitoring by EA through the 'Restoring Sustainable Abstraction' (RSA) programme. Current management under an Agri-environment scheme is excellent, but full recovery is dependent upon the maintenance of consistently suitable water levels.
Fulbourn Fen (SSSI)	Favourable / Unfavourable Recovering	Historically this site was fed by springs which now run only in very wet years. Additionally deep drains surround the site and intercept any groundwater flow. The site is subject to monitoring by EA through the 'Restoring Sustainable Abstraction' (RSA) programme and relies on water supplied via the Lodes Granta Groundwater Support Scheme. Following some modification to the way in which the support scheme water is delivered to the site, the WT are satisfied that the site is sufficiently wet.
Fowlmere Watercress Beds (SSSI)	Favourable / Unfavourable Recovering	Over abstraction of the aquifer means that springs across the site don't flow in dry years. Mitigation in the form of pumping from deeper in the aquifer, but in dry years this is insufficient to keep the site wet, or potentially impossible because the water drops below the accessible level. The large scrape/shallow lake on this site has dried completely in the last 2 years or so causing problems. This has not happened regularly in the past. The EA has advised that it is worth bearing in mind that the Lodes Granta support scheme was not intended to mitigate against drought, only the

Designated Site	Current Condition	Natural England comments on risks and opportunities
		impact of abstraction. There could be years where the springs would be dry even without the impact of abstraction. We understand that the EA have been discussing with the RSPB the potential to revise the WLMP as a way of making better use of the support water on site. Natural England's view is that drought periods and abstraction are inextricably linked hence the WCS needs to consider that the adverse effects of existing abstraction will be exacerbated by climate change.
Sawston Hall Meadows (SSSI)	Unfavourable Recovering	A ground water fed site subject to monitoring by EA through the 'Restoring Sustainable Abstraction' (RSA) programme. During botanical monitoring of the site in Aug 2015 and July 2018 the whole site was drier than expected with no dampness in the ditches. In 2015 Saw sedge (Cladium mariscus) was seen where it had been seen in the past (in the ditch between Middle and Parsley Meadows), but it was not found anywhere on the site in 2018.
Thriplow Peat Holes (SSSI)	Unfavourable Recovering	A SSSI with spring-fed habitats and wet woodland, subject to monitoring by EA through the 'Restoring Sustainable Abstraction' (RSA) programme. Water supply is at risk from fully licenced abstraction during drought summers. The ground water supply is supported as required by water discharged into the Hoffer Brook.
Whittlesford to Thriplow Hummocky Fields (SSSI)	Favourable / Unfavourable Declining	This site in notified for the plant grass-poly (Lythrum hyssopifolia) and the crustacean fairy shrimp (Chirocephalus diaphanus) which are found in pingos (hollows or dips formed by glacial action) found in these arable fields. Grass-poly needs the hollows to be flooded in winter and spring and the shrimp requires occasional flooding in summer. The site is subject to monitoring by EA through the 'Restoring

Designated Site	Current Condition	Natural England comments on risks and opportunities
		Sustainable Abstraction' (RSA) programme. Fully licenced abstraction can risk the hollows not being water-filled at the appropriate time of year. Monitoring for grass-poly in August 2019 showed that only one of the 8 hollows on the site had any grass-poly and even here there were few specimens. The requirement is that the total population of grass-poly should exceed 1000 individuals at least once every 6 years.
Wilbraham Fen (SSSI)	Favourable / Unfavourable Recovering / Unfavourable Declining	Water supply to this site partly from the upward flow of ground water from the chalk and partly from the adjacent Little Wilbraham River. It is subject to monitoring by EA through the 'Restoring Sustainable Abstraction' (RSA) programme. Since 1991 the flow in the Little Wilbraham River has been supported under the Lodes Granta Groundwater Support Scheme upstream of the SSSI. Monitoring in August 2011 showed the site to be very dry with some quite deep ditches completely dry and water seen only approx. 2m below ground level. The EA has indicated that RSA work was completed for this site 2018 and that mitigation agreed was for NE to install a sluice on site to retain groundwater which will hopefully improve the water retention on site.
Alder Carr (SSSI)	Unfavourable No Change	This site is mostly ground water fed with a network of low-lying springs and channels across the site. Some surface water flows onto the site from the adjacent arable field. It is subject to monitoring by EA through the 'Restoring Sustainable Abstraction' (RSA) programme. The site is in an area subject to abstraction for the public water supply and also through a licence held by a local farmer. Monitoring over more than 10 years has noted the

Designated Site	Current Condition	Natural England comments on risks and opportunities
		spread of sycamore and common nettle suggesting that the site is drying out. However dipwell data from the EA suggested that abstraction was not causing damage to the notified flora. It is possible that modification to a ditch on the edge of the site may help to retain water on the site in dry years We understand from the EA that The River Granta solutions, which came into force 1 April 2020, will also help water levels on Alder Carr. This limits and stops abstraction by Cambridge Water on three of their boreholes close to the Granta & Alder Carr when flows in the Granta reach a trigger level. Hopefully positive improvements will be seen in the next few years. Natural England's advice is that the WCS must adopt a precautionary approach to development in view of the timescales for monitoring the effectiveness of RSA measures.
Thriplow Meadows (SSSI)	Favourable	Ground water fed wet meadows subject to monitoring by EA through the 'Restoring Sustainable Abstraction' (RSA) programme and at risk from over abstraction. Supported by water pumped into the adjacent watercourse and dams to hold the water up. Managed under a Agri-environment scheme and plants monitored by the Wildlife Trust.
L-moor Shepreth (SSSI)	Unfavourable Recovering	Ground water fed wet meadows subject to monitoring by EA through the 'Restoring Sustainable Abstraction' (RSA) programme. WT reserve
Cam Washes (SSSI)	Favourable / Unfavourable No Change	We believe this site is only affected by surface water, in which case any reduction of flows along the Cam could have an effect. The EA have indicated that this is a side channel of the Cam and benefits from winter flooding. Limited mechanism for impact from GW abstraction.

Designated Site	Current Condition	Natural England comments on risks and opportunities
Upware North Pit (SSSI)	Unfavourable Recovering	The 1996 WLMP suggests that there is greater reliance on groundwater than surface water, although there is a connection to the Cam, and an indication that the area is considered over abstracted for both ground and surface water. Site important for water germander, but limited info on current status of this. We believe this site was not assessed under RSA.
Stow-cum-Quy Fen (SSSI)	Unfavourable Recovering	The only water dependent features seem to be the drains and pond. Is this linked to the River Cam? Potentially lower risk if GW is not an issue for this site. We believe this site was not assessed under RSA.
Snailwell Meadows (SSSI)	Unfavourable Recovering	The site is part spring-fed (chalk aquifer) damp grassland. We believe that this site is as affected by over abstraction as Chippenham Fen. There’s dipwell data on NE TRIM files dating back to 1987 but nothing more recent. The site is important for having the only other extant population of Selinum carvifolia in addition to Chippenham Fen. It has hugely decreased over the last 20-30 years, but management hasn’t always been ideal.
Soham Wet Horse Fen (SSSI)	Mainly Unfavourable Recovering	Originally groundwater dependent, but water control structures were installed in the ‘80s/’90s to try and restore water levels through holding back surface water. It was part of the AMP4 process in 2005, but unable to find in files. From the obvious changes in hydrology it must be affected by over abstraction of the aquifer – but not necessarily from Anglian Water boreholes, so may not have been taken any further under the AMP4 process. Monitoring investigation proposed through 1999 report. We understand that the GW model showed that the site was not at risk from abstraction, either historic or FL. It was therefore not taken

Designated Site	Current Condition	Natural England comments on risks and opportunities
		any further under AMP4 or RSA. Natural England's view is that in terms of restoring natural hydrology the site used to be groundwater fed and is now reliant on surface water which is sufficient to keep the site wet.
Thetford Golf Course and Marsh (SSSI)	Unfavourable – No Change	With regard to Unit 3 & 8, this site is partly spring-fed, and the water level here may be reducing, possibly due to over-abstraction, to levels which could negatively affect the site and could ultimately lead to a change in the notified vegetation communities. This is currently being investigated between FE, NE and the EA, with a number of dip wells installed in 2017/18 to check on water levels and quality. This is ongoing and the results of this testing will inform discussions of potential solutions to this issue.

Appendix C Joint statement on water resources from Anglian Water, Cambridge Water and Water Resources East

Joint Water Resources East (WRE), Cambridge Water, Anglian Water statement in support of the preparation of the Greater Cambridge Local Plan

August 2021

Introduction

Water Resources East, Anglian Water, and Cambridge Water are committed to working together to address the water resources challenges in the Cambridgeshire area. Whilst the impacts of climate change, drought events and the need to both protect and enhance the environment are significant we are confident that by working collaboratively through the established water resources planning processes, the proposed levels of housing and economic growth in the Greater Cambridge Local Plan can be achieved sustainably.

It is recognised that water resources in the Cambridge area are under pressure; levels of growth are high with the potential for further sustained economic and population growth as proposed through the OxCam Arc. At the same time there is an ever more pressing need to protect and enhance the area's chalk streams and rivers, and other water dependent ecosystems. This joint statement describes the water resources planning processes which will address these challenges and will continue to support and inform the preparation of the Greater Cambridge Local Plan. The strategic options under consideration are described, along with the collaborative working arrangements in place as plans continue to be developed.

How we plan for future water resource needs

Water Resources East Regional Plan Working under the National Framework for Water Resources, the regional plan will outline multi-sector, collaborative solutions which will meet the needs of all water users, enabling economic development and the restoration and enhancement of the natural environment. Both strategic region-wide and more local solutions to meet public water supply needs and the water requirements of other sectors will be identified through the regional plan and these solutions will flow through into individual water company Water Resources Management plans (see below) as well as into the plans of other organisations and sectors. The regional plan will also specifically consider the role of nature based solutions and land use change initiatives in enhancing our region's chalk streams. The draft regional plan will be published in August 2022, and finalised by September 2023. An informal consultation on the draft regional plan will take place in January 2022, with the formal consultation period being held between October and November 2022. Further details can be found on the WRE website www.wre.org.uk.

Water Resources Management Plans Each water company produces a statutory water resources management plan (WRMP) every five years, covering a minimum of a 25 year period. The next round of plans (WRMP24) are now in development and will incorporate the outputs from the WRE regional plan. The plans outline how each company will maintain their supply demand balance whilst accommodating growth in their supply area and factoring in the impact of climate change and the needs of the environment. The plans address, at a strategic level, how supplies would be maintained during drought events, complemented by tactical drought plans also reviewed every five years. They set out each company's plans for demand management including leakage reduction, metering and domestic water efficiency initiatives as well as identifying new supply side infrastructure (such as new reservoirs and pipelines) that will be needed.

The water companies and WRE are working closely with the Environment Agency and other organisations through the regional planning process to develop the environmental destination and ambition for the region, as set out in the Water resources national framework. This will inform the scale of the abstraction reductions required from the chalk groundwater sources in the Cambridge area, and the timing of these where new large scale supply options will be required to support these reductions.

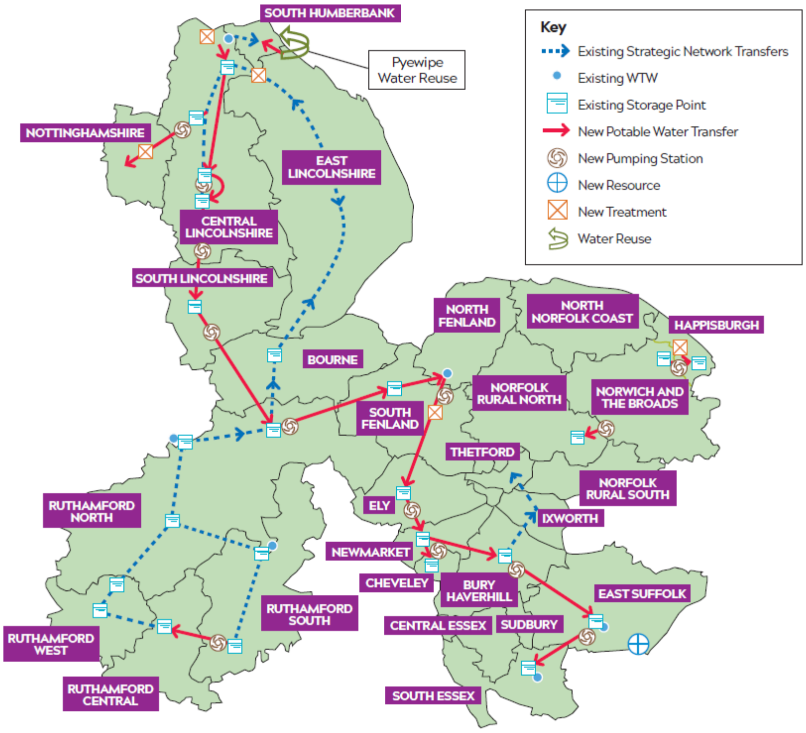
Pre-consultation on the company WRMPs will start in January 2022, with the formal consultation period being held between October and November 2022 (in line with the regional plan).

Current Plans in Delivery

Anglian Water's most recently published Water Resources Management Plan - WRMP19 - set out an ambitious programme of demand management, with smart meters being rolled out across the region by 2030 and a significant programme of leakage reduction.

On the supply side, the plan includes the delivery of c. 500km of new strategic pipelines that transfer water from areas in the north of the Anglian Water region where there is a surplus of water, to areas in the south and East where supplies are under pressure. This network of new pipelines is in delivery now, and will be finalised by 2025. The map below, shows the indicative route of the new pipeline infrastructure.

Figure 1: Anglian Water Strategic Grid in Delivery



Cambridge Water's WRMP19 included a significant reduction in leakage, optimisation of existing supplies, and demand management through metering and water efficiency which allowed for no increases to abstraction from the chalk aquifer despite continued growth, ensuring no deterioration of the environment.

Future Options and Timings

Cambridge Water, Anglian Water and WRE are working together to develop options that will feature in the WRE regional plan and the company's WRMPs. There is a long-term option to develop a new reservoir, referred to as the Fens Reservoir, which could provide up to 100 million litres per day of new supplies to the region. While no specific location has been selected, it is likely any reservoir would be located on the Norfolk / Cambridgeshire border of the Fens. The reservoir would see water abstracted from surface water systems during periods of high flow and stored for use during summer months and drought events. Several sources of water from the Great Ouse, Ely Ouse and the Middle Level drainage system are being assessed to support this reservoir. The reservoir will have the potential to support public water supplies in the Anglian Water and Cambridge Water areas as well as bringing wider benefits to other sectors such as agriculture and the environment. This is a long-term option, with the earliest likely delivery date being in the mid-2030s.

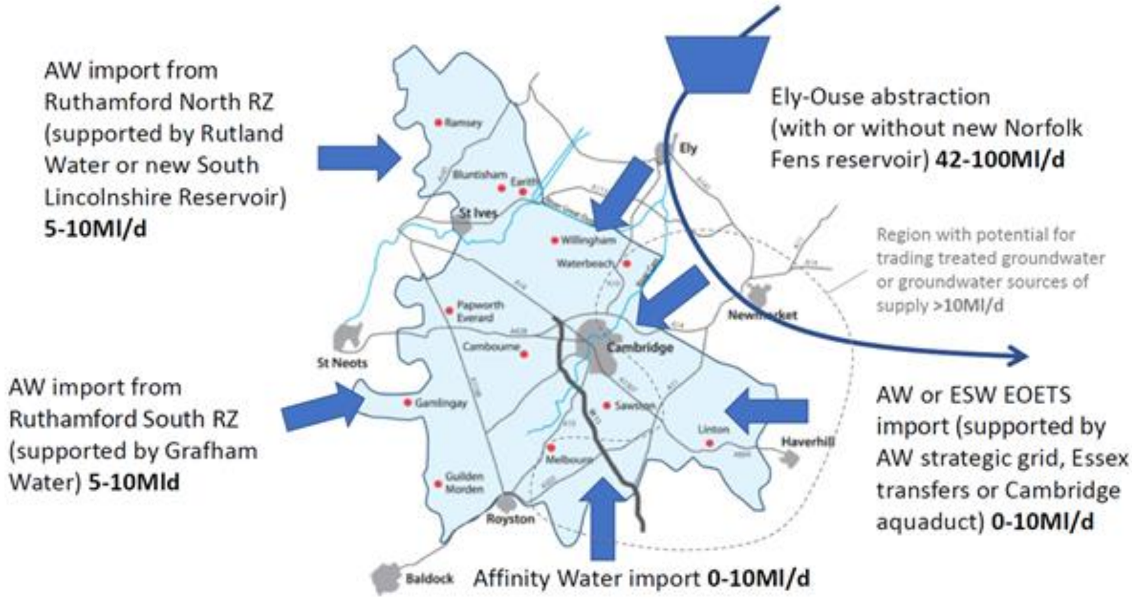
There is collective recognition that the challenges we face cannot wait until the mid-2030s to be addressed. Alongside the development of reservoir schemes there is also a need to deliver options with shorter lead times which support committed growth in the region and facilitate the reductions in abstraction from the chalk aquifer in the Cambridge area which are needed to protect and enhance the area's chalk rivers.

There are a number of options in development which would see supplies in the Cambridge Water network being supported by the Anglian Water network, through the development of new pipeline infrastructure across company borders. The exact location and source of the water for these new pipelines is still under assessment but is likely to either come from Anglian Water's new strategic grid (detailed above) or the existing Grafham Water or Rutland Water reservoirs. All of the options under consideration utilise sustainable sources or water that do not put additional abstraction pressures on sensitive groundwater fed ecosystems. The options are being considered as part of the development of the companies' WRMP24 plans with the view to being delivered in the mid-late 2020s to align with the growth trajectories and sites within the local authorities' development plans. Figure 2 outlines all the options (both shorter and longer term) currently being assessed as part of the development of Cambridge Water's WRMP24. This also includes a potential source form the proposed South Lincolnshire Reservoir which is also being considered as a longer term option. The map in Figure 3 outlines a schematic of the proposed Fens Reservoir option.

Collaborative Working

WRE operates as an independent, not for profit membership organisation, committed to the co-creation of the regional plan for Eastern England. Cambridge City Council and South Cambridgeshire District Council are both members of WRE alongside Anglian Water and Cambridge Water. WRE, Anglian Water and Cambridge Water are committed to working collaboratively with both local authorities, the Environment Agency and other local organisations in the preparation of the emerging Greater Cambridge Local Plan and underpinning evidence base. As statutory consultees both water companies recognise the criticality of water availability and the need to restore and enhance the environment to the soundness of the Local Plan and the delivery of sustainable growth and our three organisations commit to maintaining an open and transparent dialogue as we develop our plans collectively over the coming months.

Figure 2: Strategic transfers into Cambridge Water being assessed



KEY AW: Anglian Water, ESW: Essex and Suffolk Water, EOETS: Ely Ouse Essex Transfer Scheme

Figure 3: Proposed Fens reservoir schematic