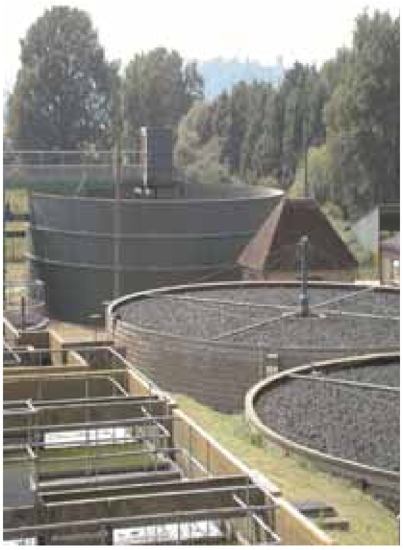
Stage 2: Detailed Water Cycle Study Update

Final Report

December 2014

Prepared for:
Huntingdonshire District Council

UNITED KINGDOM & IRELAND



REVISION SCHEDULE

Rev	Date	Details	Prepared by	Reviewed by	Approved by
1	May 2012	Draft Stage 2 WCS Report	Gemma Hoad Water Scientist	Carl Pelling Principal Consultant	Jon Robinson Technical Director
2	September 2012	Final Draft Stage 2 WCS Report	Gemma Hoad Water Scientist	Carl Pelling Principal Consultant	Jon Robinson Technical Director
3	November 2012	Final Stage 2 WCS Report	Gemma Hoad Water Scientist	Carl Pelling Principal Consultant	Jon Robinson Technical Director
4	December 2013	Draft Stage 2 Update WCS Report	Craig Boorman Graduate Hydrologist Gemma Hoad Water Scientist	Carl Pelling Principal Consultant	Carl Pelling Principal Consultant
5	September 2014	Final Draft Stage 2 Update WCS Report	Craig Boorman Graduate Hydrologist Gemma Hoad Water Scientist	Carl Pelling Associate Director	Carl Pelling Associate Director
6	December 2014	Final Stage 2 Update WCS Report	Craig Boorman Graduate Hydrologist Gemma Hoad Water Scientist	Carl Pelling Associate Director	Carl Pelling Associate Director

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NON-TECHNICAL SUMMARY

The district of Huntingdonshire is expected to experience a significant increase in housing provision over the period to 2036. This growth represents a challenge in ensuring that both the water environment and water services infrastructure has the capacity to sustain this level of growth and development proposed.

A Detailed (Stage 2) Water Cycle Study was initially completed in 2012 based on preferred growth areas identified in the Huntingdonshire District Council's adopted Core Strategy to 2026. An update was undertaken over 2013 to 2014 for additional growth over a longer plan period to 2036 as reported in this WCS document.

Information has been used to determine how the water cycle constraints may relate to potential development sites within the settlements, if and how the constraints can be resolved and how they may impact on phasing of development over the plan period to 2036. Furthermore, it provides a detailed suggested approach to the management and use of water which demonstrates ways to ensure that the sustainability of the water environment in the study area is not compromised by growth.

An updated Detailed Water Cycle Strategy is presented for the District as a whole and for each of the main growth settlements.

The Wastewater Strategy

Wastewater Treatment Capacity

The table below provides an indication of the Wastewater Treatment Works (WwTWs) which are unable to accept any additional growth, and which have available capacity.

SUMMARY OF WWTW AVAILABLE CAPACITY	
WwTW Catchment	**Phasing of Development**
Brampton	Capacity for planned growth with some spare capacity for further growth
Buckden	Capacity for planned growth only
Holme	Capacity for planned growth with some spare capacity for further growth
Huntingdon[1]	WwTW at consent limit after 2021 based on 2013 planned trajectory
Oldhurst	WwTW at consent limit
Kimbolton	Capacity for planned growth with some spare capacity for further growth
Peterborough	Capacity for planned growth – capacity for further growth is dependent on levels of growth outside of the District.
Ramsey	WwTW at consent limit

[1] Including housing and employment growth at Alconbury Airfield site as well as RAF Wyton.

SUMMARY OF WWTW AVAILABLE CAPACITY	
WwTW Catchment	**Phasing of Development**
Sawtry	Capacity for planned growth with some spare capacity for further growth
Stibbington	Capacity for planned growth with some spare capacity for further growth
Somersham	WwTW at consent limit
St Ives	Capacity for planned growth with some spare capacity for further growth
St Neots	WwTW at consent limit

The Detailed study has shown that several WwTWs have capacity to accept wastewater flow from the proposed growth without the need for improvements to treatment infrastructure. This is the case for Brampton, Buckden, Holme, Kimbolton, Peterborough, Sawtry, Stibbington and St Ives. Growth is not constrained by wastewater treatment in these locations.

WwTWs at Oldhurst, Ramsey, Somersham and St Neots are shown to already be at their limit of consent with current housing levels. Huntingdon WwTW only has capacity up to 2021 based on estimated growth trajectories from 2013, or 5,100 dwellings. Therefore solutions are required in order to accommodate growth in these locations to ensure that the increased wastewater flow discharged does not impact on the current quality of the receiving watercourses, their associated ecological sites and also to ensure that the watercourses can still meet with legislative requirements.

In most cases, Anglian Water Services have stated that some degree of headroom is likely to be available at the smaller WwTWs through different measures in the drainage catchment; however this study (through detailed modelling assessments) has looked at the worst case assumption of whether a treatment solution is feasible assuming no further headroom is made available at all WwTWs where there is insufficient capacity.

The detailed assessments have shown that improvements for all WwTW's are possible within the limits of conventionally applied technology, demonstrating that an engineering solution is feasible and hence treatment capacity should not be seen as an absolute barrier to growth. Early phasing of growth in the catchments of Oldhurst, Ramsey, Somersham and St Neots will need to be discussed between the Environment Agency, Huntingdonshire District Council and Anglian Water Services.

The WCS has concluded that the study partners, including Huntingdonshire District Council, the Environment Agency, Anglian Water Services and the Middle Level Commissioners should work together to determine if any of the potential solutions proposed in the study are acceptable and hence conclude when and how much development can be accommodated across the District.

In all cases, the assessments have shown that the ability of watercourses to meet future water quality targets (Good Status) under the Water Framework Directive will not be compromised by growth alone and hence growth should not be seen as a barrier to watercourses in the District meeting 'Good Status' in the future.

Wastewater Treatment and Ecological Impacts

Phosphorus loading is a key concern for the protected sites associated with the Great Ouse. The WCS has concluded that further reductions in phosphorous loadings are likely to be required further upstream in the Great Ouse catchment in order to counter-balance the increase in discharged phosphorus that will occur from WwTW in the Huntingdonshire District as a result of growth. This is because the key WwTW within the District that discharge to the Ouse are already removing as much phosphorus as is theoretically possible with conventionally applied technology. The Environment Agency and Anglian Water Services are undertaking water quality modelling (including looking at growth) of inputs upstream of the district to determine the most efficient way of managing phosphorus loadings into the Great Ouse within its entire catchment. This modelling is informing the next round of business planning for Anglian Water Services and is beyond the scope of this WCS to address given the cross-district issues and timescales involved in catchment based modelling.

Wastewater Discharge – Flood Risk Implications

Flood risk calculations are only available for one WwTW covered by the Detailed WCS where an increase in consented discharges is likely to be required (Somersham), due to an absence of flow and /or cross-sectional data for the other receiving watercourses. For the this WwTW, it is shown that the flood flows would only be likely to increase by less than 1% as a result of the increase in effluent discharges. It is unlikely that such small increase will cause flooding issues.

The Middle Level Commissioners have advised that flood risk as a result of additional discharge from Ramsey WwTW is a concern in the St Germans Pond section of the Middle Level system and any increase in flow above the current consented volume would require assessment of flood risk before permission would be granted to discharge. The hydraulic model required to determine the level of risk was not made available for this study. Calculations undertaken of the additional discharge volumes demonstrate that increases in treated effluent volumes would be small; however, the Middle Level Commissioners' position remains that any increase in flow would raise an objection and hence growth in the Ramsey catchment requires further discussion and agreement between Anglian Water Services and the Middle Level Commissioners.

Sewer Capacity

In order to ensure wastewater from growth can be drained to the WwTWs, an assessment of sewer capacity constraints on potential growth sites was undertaken. This assessment has determined where developers will need to contribute to upgrades to existing sewerage infrastructure (sewer mains or pumping stations) or towards new infrastructure and have highlighted concerns in several places.

The Water Supply Strategy

This WCS has identified that approximately 7,500 more homes are included within the council's growth target than Anglian Water Services have allowed for within their current planned demand calculations in the District to 2035. This would mean that if the proposed housing growth took place as per the current estimated trajectory, there would be insufficient supply to meet demand by 2023 in the Huntingdonshire District (unless additional resources are secured).

There is a further option to provide a new connection from a major water treatment works to serve the District such that additional growth beyond 2023 could be accommodated.

Cambridge Water have confirmed that options for additional treated water transfers into the District are adequate to meet the proposed growth.

There is a drive to ensure the delivery of sustainable development for Cambridgeshire as a whole and hence there are key drivers requiring that water demand is managed in the study area to achieve long term sustainability in terms of water resources (including the high levels of growth not currently planned for by Anglian Water Services). The Anglian region is the driest part of the UK and key sources of water (rivers and aquifers) are considered to be close to their limits of abstraction before ecosystems reliant on them would be adversely affected. It is also predicted that climate change will further reduce available water resources.

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

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

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

- new housing development must go beyond the minimum requirements of Building Regulations;
- carry out a programme of retrofitting and water audits of existing dwellings and non-domestic buildings. Aim to move towards delivery of 20% of the existing housing stock with easy fit water savings devices; and
- establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use.

Surface Water Drainage Management

Conventional surface water drainage systems for new development were designed to convey rainwater and surface water run-off away as quickly as possible. This helps to prevent flooding of the drained area, but may cause flooding of downstream areas. In addition to the increased flood risk, conventional drainage systems can cause pollution of the receiving watercourses as impermeable surfaces accumulate pollutants such as hydrocarbons, tyre fragments and debris, detergents and grit and particulates.

Sustainable Drainage Systems (SuDS) can be used to both hold back and treat surface water run-off thereby reduce downstream flood risk and protect or improve water quality in the water environment.

The vision for sustainable surface water management in the proposed new growth in Huntingdonshire is based on the following key aims:

- linkage to green infrastructure giving multiple benefits to users and ecology;
- linkage to water efficiency measures, including rainwater harvesting; and,
- linkage to the Cambridgeshire wide Surface Water Management Plan (SWMP).

Huntingdonshire is aiming to achieve all SuDS above ground for all future developments, where feasible. In addition, above ground SuDS should include environmental enhancement and should provide amenity, social and recreational value.

Although SuDS are an important tool in managing surface water drainage across the District, at a site specific level, the requirements of any discharge of surface water from a site are dictated by the specifics of the water level management system operated by either the Environment Agency or the Internal Drainage Board receiving that discharge. The Internal Drainage Board may have a preference for surface water to be discharged from a site more quickly, rather than holding it back. Developers or development control officers should seek the advice of the relevant Internal Drainage Board to determine whether retention of surface water is preferable to a faster (but controlled) rate of runoff.

Water Cycle Study Recommendations

In order to support the further development of the Huntingdonshire's Local Plan with respect to water services infrastructure and the water environment, the Detailed WCS reports a site specific assessment of the potential constraints on each of the growth sites where the majority of development within the District is likely to take place.

It is recommended that policies are developed similar to those suggested below to include within the Local Plan documents:

<u>WW1 – Development Phasing Ramsey</u>

It is recommended that a policy should be developed by the council that ensures that all development in Ramsey up to at least 2020, is only given planning permission if the Environment Agency and AWS have indicated that they are satisfied that the development can be accommodated either within the limits of capacity at the WwTW or by sufficient capacity being made available and the requirements of the WFD will not be compromised and the MLC will not object on the basis of flood risk in Middle Level system.

<u>WW2 – Development Phasing in St Neots, Oldhurst and Somersham</u>

It is recommended that a policy is developed in respect of major development in St Neots, Oldhurst, and Somersham that requires development in the catchment up to 2020 to be subject to a pre-application enquiry with HDC. HDC will, following consultation with the EA and AWS, advise on any phasing requirements for the development as a result of process and environment capacity limitations at the WwTW.

WW3 – Development Phasing in Huntingdon

It is recommended that a policy is developed in Huntingdon that requires development in the catchment post 2021, to be subject to a pre-planning enquiry[2] with AWS to determine process capacity at the WwTW before granting permission.

WW4 – Development and Sewerage Network

It is recommended that a policy is developed for development at all sites, that they should be subject to a pre-planning enquiry with AWS to determine upgrades needed to prior to planning permission being granted. Assessments made within this WCS consider each site in isolation and capacity will change depending on when and where sites come forward.

WW5 Further Discharge and Capacity Issues

It is recommended that a policy is developed that requires that: where new discharge consents would be triggered by proposed development, developers should demonstrate in liaison with an OFWAT regulated water services company and the Environment Agency, that the likely water quality and flood risk impacts are reasonably manageable to acceptable water quality standards and within the timescales envisaged in the planning application, or by applying phasing conditions.

WS1 – Water Efficiency in new homes and buildings

In order to move towards a more 'water neutral position' and to enhance sustainability of development coming forward, a policy should be developed that ensures all housing is as water efficient as possible, and that new housing development should meet specific water use standards of 105 l/h/d. Non-domestic building should as a minimum reach 'Good' BREEAM status.

WS2 – Water Efficiency Retrofitting

In order to move towards a more 'water neutral position', a policy could be developed to carry out a programme of retrofitting and water audits of existing dwellings and non-domestic buildings with the aim to move towards delivery of 20% of the existing housing stock with easy fit water savings devices.

WS3 – Water Efficiency Promotion

In order to move towards a more 'water neutral position', it is recommended that a policy could be developed to establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use.

SWM1 – SuDS and Water Efficiency

In order to move towards a more 'water neutral position' and to enhance sustainability of development coming forward, it is recommended that a policy a policy should be developed which encourages developers to seek linkage of SuDS to water efficiency measures, including rainwater harvesting.

[2] For a fee, AWS undertaken an assessment of the capacity within the sewer system to accept new growth and this can be extended to include capacity for treatment at wastewater treatment facilities.

SWM2 – Holistic surface water management and use of SuDS

To ensure appropriate design, adoption and maintenance of SuDS, it is recommended that a policy should be developed that requires developers to ensure that SuDS design supports the findings and recommendations of the Cambridgeshire County SuDS Handbook, Cambridgeshire Surface Water Management Plan (SWMP), the SuDS Manual[3], the proposed Cambridgeshire Flood and Water Management SPD, and Huntingdonshire District Council's SFRA. In addition, for development where surface water would drain to an IDB area, developers must consider the standing advice offered by the appropriate IDB.

SWM3 – Water Quality Improvements

It is recommended that a policy should be developed that requires developers to ensure (where possible) that discharges of surface water are designed to deliver water quality improvements in the receiving watercourse or aquifer where possible to help meet the objectives of the WFD.

ECO1 – Biodiversity enhancement

It is recommended that a policy be developed in the Local Plan which commits to seeking and securing (through planning permissions etc) enhancements to aquatic biodiversity in Huntingdonshire through the use of SuDS and other means as outlined in this WCS (subject to appropriate project-level studies to confirm feasibility including environmental risk and discussion with relevant authorities) in line with the Cambridgeshire Green Infrastructure Strategy.

[3] Published by CIRIA

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Description
AMP	Asset Management Plan
AWS	Anglian Water Services
BAP	Biodiversity Action Plan
BGS	British Geological Society
BOD	Biochemical Oxygen Demand
BREEAM	Building Research Establishment Environmental Assessment Method
CBA	Cost Benefit Analysis
CFMP	Catchment Flood Management Plan
CIL	Community Infrastructure Levy
CIRIA	Construction Industry Research and Information Association
CLG	Communities and Local Government
CRC	Carbon Reduction Commitment
CSH	Code for Sustainable Homes
CSO	Combined Sewer Overflow
CW	Cambridge Water
CWS	County Wildlife Sites
DDC	District Drainage Commissioner
DEFRA	Department for Environment, Food and Rural Affairs
DO	Dissolved Oxygen
DG2	Register of pressure of water mains
DWF	Dry Weather Flow
DWI	Drinking Water Inspectorate
EA	Environment Agency
EIB	European Investment Bank
FEH	Flood Estimation Handbook
FFT	Flow to Full Treatment
FMfSW	Flood Maps for Surface Water
GHG	Greenhouse Gas

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Description
GI	Green Infrastructure
GQA	General Quality Assessment
GWMU	Groundwater Management Unit
GWR	Greywater Recycling
HA	Highways Agency
HMWB	Heavily Modified Water Body (under the Water Framework Directive)
HDC	Huntingdonshire District Council
IDB	Internal Drainage Board
JNCC	Joint Nature Conservation Committee
l/h/d	Litres/head/day (a water consumption measurement)
LCT	Limits of Conventional Treatment
LFE	Low Flow Enterprise (low flow model)
LLFA	Lead Local Flood Authority
LP	Local Plan
LPA	Local Planning Authority
MLC	Middle Level Commissioners
Ml	Mega Litre (a million litres)
NE	Natural England
NH4	Ammonium
NPPF	National Planning Policy Framework
OFWAT	The Water Services Regulation Authority (formerly the Office of Water Services)
OR	Occupancy Rate
P	Phosphorous
PE	Population Equivalent
PR	Periodic Review
PS	Pumping Station
p/d	Persons per dwelling
Q95	The river flow exceeded 95% of the time

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Description
Ramsar	Site designated under the International Convention on Wetlands of International Importance especially as Waterfowl Habitat
RAG	Red/Amber/Green Assessment
RBMP	River Basin Management Plan
RoC	Review of Consents (under the Habitats Directive)
RQP	River Quality Planning
RTPI	Royal Town Planning Institute
RWH	Rainwater Harvesting
SAB	SuDS Approval Body
SAC	Special Area for Conservation
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area
SPD	Supplementary Planning Document
SPZ	Source Protection Zone
SS	Suspended Solids
SSSI	Site of Special Scientific Interest
SUDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
SWMS	Sustainable Water Management Study
UKCIP02	United Kingdom Climate Impacts Programme 2002
UKCP09	United Kingdom Climate Projections 2009
UKTAG	United Kingdom Technical Advisory Group (to the WFD)
UKWIR	United Kingdom Water Industry Research group
UPM	Urban Pollution Management
UWWTD	Urban Wastewater Treatment Directive
WCS	Water Cycle Study
WFD	Water Framework Directive
WN	Water Neutrality
WRMP	Water Resource Management Plan

GLOSSARY OF ACRONYMS AND ABBREVIATIONS	
Abbreviation	**Description**
WRZ	Water Resource Zone (in relation to a water company's WRMP)
WSI	Water Services Infrastructure
WRC	Water Recycling Centre (Anglian Water Services' adopted term for Sewage Treatment Works or Wastetwater Treatment Works)
WwTW	Waste Water Treatment Works

1 INTRODUCTION

1.1 Study Need and Drivers

The district of Huntingdonshire is expected to experience a significant increase in housing and employment provision over the period to 2036. This growth represents a challenge to the district in ensuring that both the water environment and water services infrastructure (WSI) has the capacity to sustain this level of growth and development proposed.

A Water Cycle Study (WCS) has therefore been undertaken to determine what impact this growth might have on the water environment and existing WSI. The objective of the WCS is to identify any constraints on housing and employment growth planned for Huntingdonshire up to 2036 that may be imposed by the water cycle and how these can be resolved i.e. by ensuring that appropriate WSI is provided to support the proposed development. Furthermore, it should provide a strategic approach to the management and use of water which ensures that the sustainability of the water environment in the district is not compromised.

1.2 WCS History

The Huntingdonshire Water Cycle Study (WCS) has initially been reported in a Stage 1 Outline WCS which was completed in April 2009 by Faber Maunsell[4]. However, due to the timescales involved in completing the study a number of the conclusions and key constraints identified, particularly in relation to the wastewater treatment, had become out of date.

Additionally, prior to commencing the Stage 2 study, a number of key planning documents (including the Environment Agency's River Basin Management Plan for the Anglian River Basin District, Anglian Water Service's and Cambridge Water's Water Resource Management Plans, Huntingdonshire District Updated Level 1 SFRA, United Kingdom Climate Projections 2009 (UKCP09) etc.) had been published, and as such, the evidence upon which the Stage 1 Outline WCS conclusions and recommendations were founded had changed. The Environment Agency has also revised a number of the wastewater flow consents in 2010 and the methodology for calculating Dry Weather Flow (DWF) and headroom for Wastewater Treatment Works (WwTW) changed, altering the wastewater treatment assessments undertaken as part of the Stage 1 Outline WCS.

An initial Stage 2 Detailed WCS was commissioned in 2012 to update the Stage 1 baseline and identify the WSI solutions required to assist delivery of the planned growth to 2026. However, since the 2012 WCS was published, Huntingdonshire District Council are proposing a larger growth target within the district and over a longer planning horizon to 2036. Therefore an update to the Stage 2 report was required in 2013. The Stage 2 WCS Update is reported in this document and supersedes the initial Stage 2 WCS produced in 2012

1.3 Stage 2 – Study Governance

This Stage 2 Detailed Study Update has been carried out with the guidance of the Steering Group established during the Stage 1 and Stage 2 Studies and continued for this study, comprising the following organisations:

- Huntingdonshire District Council;
- Anglian Water Services (AWS) Ltd;

[4] Faber Maunsell (2009) – Huntingdonshire Outline Water Cycle Strategy

- Cambridge Water (CW);
- Cambridge County Council (CCC);
- Environment Agency;

With the addition of the following stakeholders:

- Middle Level Commissioners (MLC) and associated drainage boards; and
- Bedford Group IDB – Alconbury & Ellington.

Some members of the Steering Group met at the commencement and toward the end of the study both to guide and feedback on the assessments undertaken in support of the study.

1.4 Stage 2 WCS Scope

A full Stage 2 WCS follows a Stage 1 Outline Study to determine the detailed infrastructure and mitigation solutions required to mitigate any adverse effects or infrastructure capacity shortfalls determined in the Outline Study. It provides this information at a level suitable to ensure that there are solutions to deliver growth for the preferred development allocations, including the policy required to deliver it. The outcome is the development of a Water Cycle Strategy for the District which informs site specific and the Local Plan of the water environment and WSI issues that need to be considered in bringing growth forward at various sites, including guidance for developers in conforming to the requirements of the strategy.

The following sets out the key objectives of the Detailed WCS for Huntingdonshire:

- determine the required solutions to wastewater treatment for each growth town and how this might impact phasing of development within (and around) each town;
- determine whether any Habitats Directive designated ecological sites have the potential to be impacted by the wastewater treatment strategy via a screening process;
- determine whether additional water resources are required to support growth;
- determine upgrades required to water supply infrastructure relative to potential options for growth;
- provide a pathway to achievement of water neutrality;
- provide detail on location specific SuDS requirements and policy recommendations to achieve sustainable drainage;
- provide infrastructure phasing timelines for each growth town to determine impact of infrastructure and mitigation provision on housing delivery;
- undertake a sensitivity analysis of the impacts of climate change on infrastructure provision. and
- provide detailed policy recommendations.

1.5 Study Drivers

There are several key overarching drivers shaping the direction of the study as a whole:

- deliver sustainable water management – ensure that provision of WSI and mitigation is sustainable and contributes to the overall delivery of sustainable growth and development as set out in the Cambridgeshire Quality Charter for Growth;

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

A full list of the key legislative drivers shaping the study is detailed in the Stage 1 Outline WCS[4], and a summary table is included in Appendix 1 of this study for reference.

Other relevant studies that have a bearing on the provision of water services infrastructure for development include, but are not limited to, the following key documents:

- Huntingdonshire Level 1 Strategic Flood Risk Assessment;
- Cambridgeshire Surface Water Management Plan (April 2011);
- The Cambridgeshire Biodiversity Action Plan;
- The Cambridgeshire Green Infrastructure Strategy; and
- Cambridgeshire and Peterborough Minerals and Waste Core Strategy (adopted July 2011).

1.5.1 *Climate Change*

One of the key drivers for delivering sustainable water management is the future uncertainty caused by the effects of climate change on water supplies, flood risk and wastewater management

Nationally, climate change is predicted to have the greatest effect on the East of England. Therefore, Huntingdonshire District Council is likely to experience hotter drier summers and warmer wetter winters. This is likely to have a significant effect on environmental conditions and will increase the impact of human activity on the water environment. It is therefore essential that issues of water management and climate change should be viewed in a more holistic way to reflect the interdependency of services and resources that we receive from the natural environment, and plan for their future use accordingly.

Environmental sustainability and more efficient use of natural resources should be a key aspiration for Huntingdonshire District Council. In order to achieve these objectives, it is essential that development and water services infrastructure built today considers the future potential impacts of climate change and incorporates adaptive measures to improve future resilience. Investing in infrastructure to adapt to the likely impacts of climate change now could provide long-term cost savings and avoid having to deal with expected climate change impacts in the future, e.g. by providing more climate-resilient infrastructure and 'space for water' now, it is possible to protect societies and economies (to some extent) from its potential impacts such as surface water flooding[5].

[5] The Stern Review on the Economics of Climate Change reported that the benefits of strong and early action outweigh the economic costs of not acting. *"Adaptation to climate change – that is, taking steps to build resilience and minimise costs – is essential. It is no longer possible to prevent the climate change that will take place over the next two to three decades, but it is still possible to protect our societies and economies from its impacts to some extent – for example, by providing better information, improved planning and more climate-resilient crops and infrastructure."*

1.6 Water Use – Key Assumption

For all wastewater and water supply assessments, an assumption was made on the likely use per new household going forward in the plan period. It was agreed with AWS and CW that a starting assumption of 131l/h/d would be used to calculate wastewater generation and water use per person.

It is acknowledged that this figure exceeds the current Building Regulations requirement of 125l/h/d for all new homes. However, in their asset planning AWS and CW will continue to assume higher water use for new homes as their analysis has shown that even when homes are built to a standard of 125l/h/d, the average household use increases over time due to various factors. AWS and CW are required under their remit to the industry regulator Ofwat, to plan for the expected actual use and hence it is important that conclusions made on infrastructure capacity within this study are consistent with AWS' and CW's planning strategies.

This study has however considered the effect that achieving lower average per person consumption would have on infrastructure capacity and the water environment to assist in developing policy that supports and helps lead to a lower per capita consumption.

1.7 Report Structure

There are several water cycle elements that have been considered in this detailed WCS. However, because some strategic level WSI can often serve a larger geographical area some water cycle elements are common to several of the growth sites in combination. These elements are assessed at a district level and hence are presented within a separate chapter in this report. These elements include:

- Wastewater treatment; and
- Water availability (Water Resources).

The other water cycle elements of the study are specific to each site and hence these elements have been reported at the 'settlement area' level with detail included for each potential growth site. These elements include:

- Wastewater network;
- Water supply network; and
- Flood risk;

This report has therefore been set out in the following way to assist its presentation as a primarily planning based source of evidence.

- the planned growth in relation to the water cycle assessment (Chapter 2);
- the assessment of district wide water cycle elements (Chapters 3 and 4);
- a summary of how the site specific water cycle elements have been assessed (Chapter 5);
- WSI and water environment issues within Settlement Area assessments (Chapters 6 to 10); and,
- Policy and other recommendations (Chapter 11).

2 PROPOSED GROWTH

2.1 Preferred Growth Strategy

Huntingdonshire District Council has identified the future expected developments (per year by development site) in Huntingdonshire up to 2036. These figures form the basis for the updated Stage 2 WCS.

2.2 Housing

The total target to 2036 is 21,057 of which the total to be assessed in the Stage 2 WCS is 19,301 dwellings. This has been calculated from a total of the:

- outstanding commitments; and,
- future allocations.

The total built prior to the commencement of this Stage 2 study (up to the end of March 2011) of 1,756 dwellings have not been included within the total assessed as these properties have already been built and it is therefore assumed that wastewater flows from these properties will already be accounted for in the measured flows at the WwTWs. Table 2-1 provides a summary of the housing figures assessed in the Stage 2 WCS.

TABLE 2-1: SUMMARY OF HOUSING FIGURES TO BE ASSESSED

WwTW Catchment	Total built by 2011/2012	Committed Outstanding	Allocations	TOTAL	% of Housing Supply
Brampton	0	12	400	412	2.13%
Buckden	17	4	0	4	0.02%
Holme	0	8	0	8	0.04%
Huntingdon*	0	101	12,039	12,140	62.90%
Oldhurst	0	3	129	132	0.68%
Peterborough	147	14	75	89	0.46%
Ramsey	0	36	500	536	2.78%
Sawtry	0	200	145	345	1.79%
Stibbington	16	10	0	10	0.05%
Somersham	0	0	150	150	0.78%
St Ives	201	234	550	784	4.06%
St Neots	1375	777	3,894	4,671	24.20%
Kimbolton	0	0	20	20	0.1%
TOTAL	1,756	1,399	17,902	19,301	100%

* this includes the Enterprise Zone employment growth and housing growth at Alconbury and Wyton.

Locations of outstanding commitments and preferred allocation sites for the proposed growth have been provided by Huntingdonshire District Council and these have been used to inform both strategic and site specific infrastructure capacity assessments and requirements.

2.2.1 *Settlement Areas*

In order to present the various water cycle capacity assessments in the most useful way to inform planning decisions, the site locations have been grouped into 'Settlement Areas' taking into account (where possible) shared connections to existing WSI.

- Settlement Area 1 – Huntingdon (encompasses Huntingdon, Brampton, Godmanchester, Alconbury and Buckden)
- Settlement Area 2 – St Ives (encompasses St Ives and Fenstanton)
- Settlement Area 3 – St Neots (encompasses St Neots and Little Paxton)
- Settlement Area 4 – Ramsey (encompasses Ramsey, Warboys, Oldhurst and Somersham)
- Settlement Area 5 – Yaxley (encompasses Holme, Yaxley and Sawtry)
- Settlement Area 6 - Kimbolton

2.3 Alconbury Airfield

Part of the Alconbury Airfield site has received Enterprise Zone status from the government for redevelopment to provide an estimated 8,000 new jobs and this employment growth is being considered as part of Huntingdonshire District Council's Local Plan. It is estimated that the site will provide 1,500 jobs by 2015, up to the total of 8,000 by 2036.

The developers for the site also envisage a mixed use development of up to 5,000 residential dwellings, in addition to the employment. The aspiration for residential dwellings at the site is considered by Huntingdonshire District Council to be included in their Local Plan target and has therefore been assessed as part of the total growth for the updated WCS in relation to the district wide WCS elements (water availability and wastewater treatment).

A separate Water Cycle Study has been produced for the site, focusing on all aspects of WSI that may be required with the driver being to manage the water cycle requirements on site as far as practical. The site specific WCS is therefore the primary source of evidence supporting the deliverability of the site with respect to site specific WSI and protection of the water environment.

3 WASTEWATER TREATMENT ASSESSMENT

3.1 Wastewater Treatment Assessment Approach

Increases in residential and employment growth results in an increase in wastewater flows generated in a district and hence it is essential to consider:

- whether there is sufficient capacity within existing treatment facilities (WwTWs) to treat the additional wastewater;
- what new infrastructure is required to provide for the additional wastewater; and,
- whether waterbodies receiving the treated flow can cope with the additional flow without affecting water quality and increasing flood risk.

There are therefore two elements to the assessment of existing capacity (and any solutions required) with respect to wastewater treatment:

- the capacity of the infrastructure itself to treat the wastewater (infrastructure capacity); and
- the capacity of the environment to sustain additional discharges of treated wastewater (environmental capacity).

3.1.1 *Wastewater Treatment in Huntingdonshire*

Wastewater treatment in the district is provided via several WwTWs operated and maintained by AWS, all of which discharge to surface watercourses. Each of these WwTWs is fed by a network of wastewater pipes (the sewerage system) which drains wastewater generated by property to the treatment works; this is defined as the WwTWs 'catchment'.

Due to the relatively flat nature of the topography of the district (and the costs and energy required to pump wastewater over large distances), each settlement tends to have its own designated WwTW, hence numerous WwTWs are affected by growth in the district.

3.1.2 *Management of WwTW Discharges*

All WwTWs are issued with a consent to discharge by the Environment Agency which sets out conditions on the maximum volume of treated flow that it can discharge and also limits on the quality of the treated flow. These limits are set in order to protect the water quality and ecology of the receiving waterbody and dictate how much flow can be received by each WwTW, as well as the type of treatment processes that the WwTWs consists of.

The volume element of the discharge consent determines the maximum number of properties that can be connected within a WwTW catchment. When discharge consents are issued for the first time they are generally set with a volume 'freeboard' which acknowledges that allowance needs to made for additional connections. This allowance is termed 'consented headroom'. The quality conditions applied to the discharge consent are derived to ensure that the water quality of the receiving waterbody is not adversely affected for all discharge flow volumes up to the maximum consented discharge volume. For the purposes of this WCS, a simplified assumption is applied that the consented headroom is usable[6] and would not affect downstream water quality. This headroom therefore determines how many

[6] In some cases, there is a hydraulic restriction on flow within a WwTWs which would limit full use of the maximum consented headroom,

properties can be connected to the WwTW before a new discharge consent would need to be issued.

When a new discharge consent is required, an assessment needs to be undertaken to determine what new quality conditions would need to be applied to the discharge. If the quality conditions remained unchanged, the increase in flow would result in an increase in total load of the some substances being discharged to the receiving waterbody. This may have the effect of deteriorating water quality and hence in most cases, an increase in consented discharge flow results in more stringent (or tighter) conditions on the quality of the discharge. The requirement to treat to a higher level may result in an increase in the intensity of treatment processes at the WwTWs which may also require improvements or upgrades to be made to the WwTW to allow the new conditions to be met.

In some cases, it may be possible that the quality conditions required to protect water quality and ecology are beyond that which can be achieved with conventional treatment processes and as a result, this WCS assumes that a new solution would be required in this situation to allow growth to proceed.

The primary legislative drivers which determine the quality conditions of any new consent to discharge are the WFD and the Habitats Directive as described in the following subsections

3.1.3 *Water Framework Directive Compliance*

The WFD is the most significant piece of water legislation since the creation of the EU. The overall requirement of the directive is that all waterbodies in the UK must achieve "Good Status". The definition of a waterbody's 'status' is a complex assessment that combines standards for water quality with standards for water availability, hydromorphology (i.e. habitat and flow quality) with ecological requirements.

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

- development must not cause a deterioration in status of a waterbody; and
- development must not prevent future attainment of 'good status', hence it is not acceptable to allow an impact to occur just because other impacts are causing the status of a water body to already be moderate or less.

Where consented headroom at a WwTW would be exceeded by proposed levels of growth, a water quality modelling assessment has been undertaken to determine the quality conditions that would need to be applied to the new consent to ensure the two policy requirements of the WFD are met. The modelling process (assumptions and modelling tools) is described in detail in Appendix 2.

3.1.4 *Habitats Directive*

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

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

Where consented headroom at a WwTW would be exceeded by proposed levels of growth, a HR assessment exercise has been undertaken in this WCS to ensure that Habitats Directive sites which are hydrologically linked to watercourses receiving wastewater flows from growth would not be adversely affected. The scope of this assessment also includes non- Habitats Directive sites designated at a national (SSSI) and local level (LNRs). This assessment is reported in section 3.3 of this chapter (Ecological Appraisal).

3.1.5 *Increased Flood Risk*

As well as the consideration of water quality, increases in discharge of treated flow need to be assessed for impacts on flood risk within the receiving waterbody. Some watercourses which receive treated wastewater have limited hydraulic capacity, and flood levels downstream may be increased as a result of additional flow.

3.1.6 *Assessment Methodology Summary*

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

- determine the amount of growth draining to each WwTW and calculate the additional flow generated;
- calculate available headroom at each WwTW;
- determine whether the growth can be accommodated within existing headroom;
- for those WwTWs where headroom s exceeded, calculate what quality conditions need to be put in place to meet the two key objectives of the WFD to ensure:
- no deterioration in receiving watercourse from its current WFD status;
- future Good Status is not compromised by growth.
- determine whether any quality conditions required to meet WFD objectives would be beyond the limits of conventional treatment;
- where the conditions are achievable, determine any infrastructure upgrades required to meet the new consent conditions and phasing implications of these upgrades;
- where the conditions are not achievable, determine alternative solutions for treatment in that catchment;
- Calculate impact on hydraulic capacity and hence flood risk of the receiving watercourse; and,
- Undertake an ecological site screening assessment to determine if any Habitats Directive (or other nationally or locally) designated sites are likely to be affected.

In order to complete the above steps, the following assessment techniques were developed. Details of the procedures can be found in Appendix 2:

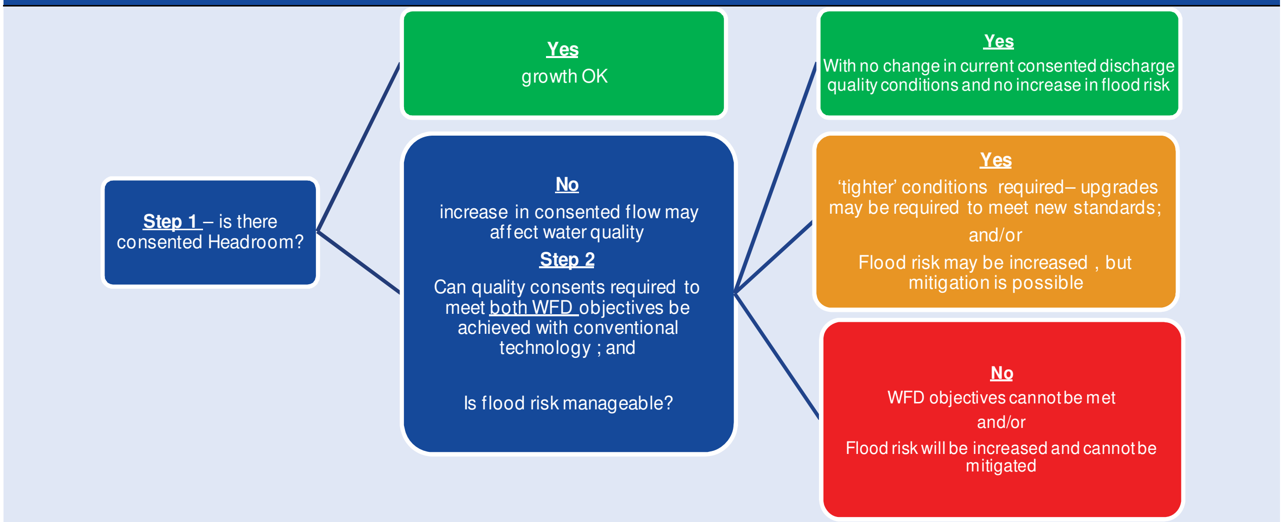
- a headroom calculation spreadsheet was developed with AWS;
- a water quality modelling procedure was agreed with the Environment Agency using Environment Agency software designed for determining discharge consent conditions; and
- a calculation of the increase in flood flows and water levels in receiving watercourses using tools developed by URS.

3.1.7 *RAG Assessment Overview*

The results for each WwTW are presented in a Red/Amber/Green (RAG) Assessment for ease of planning reference. The RAG coded refers broadly to the following categories and the process is set out in Figure 3-1.

- Green – water quality will not be adversely affected and there will be no increase in flood risk. Growth can be accepted with no changes to the WwTW infrastructure or consent required.
- Amber – in order to protect water quality changes to the discharge consent are required, and upgrades may be required to WwTW infrastructure which may have phasing implications; and/or, flood risk may be increased downstream but mitigation is possible.
- Red - in order to protect water quality, changes to the discharge consent are required which are beyond the limits of what can be achieved with conventional treatment; and/or flood risk will be significantly increased downstream and it cannot be mitigated. An alternative solution needs to be sought.

FIGURE 3-1: RAG ASSESSMENT PROCESS DIAGRAM FOR WASTEWATER TREATMENT CAPACITY



3.2 Wastewater Treatment Assessment – Results

The assessment results are presented in this section and have been reported as follows: catchments where growth can be accepted within the current consented headroom have been reported together in a single subsection, whilst those requiring a new consent and hence a water quality or flood risk calculation have been reported in individual subsections of this results section.

3.2.1 *WwTW with Consented Headroom*

The volume of wastewater generated from growth in each WwTW catchment was calculated for the proposed growth locations and compared to the treatment capacity at each WwTW.

Table 3-1 details the WwTW where existing consented headroom is sufficient to accommodate all of the proposed growth sites and hence no infrastructure upgrades are required to deliver the proposed growth levels in these locations.

Growth in these catchments would not deteriorate water quality, or increase flood risk and hence there is no barrier to delivering the proposed growth levels. These catchments are Green in the RAG assessment and have not been assessed any further.

TABLE 3-1: WWTW WITH CONSENTED HEADROOM

Relevant WwTW	Current Consented DWF (m^3/d)	Future 2036 DWF after Growth (m^3/d)	Headroom Assessment		Notes
			2036 Headroom Capacity (m^3/d)	Capacity for additional growth beyond plan period?	
Brampton	1,500	1,374	126	Yes	Sufficient Headroom
Buckden	2,165	2,166	-1	No	Headroom exceeded but growth is minimal and can be accepted within consent
Holme	160	79	81	Yes	Sufficient Headroom
Kimbolton	750	538	212	Yes	Sufficient Headroom
Peterborough	66,190	50,100	16,090	Dependent on growth outside the District	Sufficient Headroom[7]
Sawtry	1,500	937	563	Yes	Sufficient Headroom
Stibbington	290	206	84	Yes	Sufficient Headroom
St Ives	4,200	538	212	Yes	Sufficient Headroom

[7] Peterborough WwTW also serves areas outside of HDC; therefore available headroom depends on growth levels outside of HDC.

3.2.2 *WwTW without Consented Headroom*

The calculations of headroom demonstrated that several WwTW do not have sufficient headroom for all of the proposed growth within their respective catchments, as detailed in Table 3-2.

Huntingdon WwTW has sufficient capacity to treat wastewater from the proposed sites within and around the town; however, when wastewater from residential growth at the proposed Alconbury and Wyton airfield sites is included[8], volumetric capacity is exceeded in the planning year 2021/22 (using current trajectory estimates).

All other WwTWs without future capacity are shown to be already at their limit with current housing levels. This is mainly due to review in 2011 by AWS and the Environment Agency of flow consents where many WwTWs across the AWS area were treating more flow than they were consented to. The Environment Agency therefore re-issued consents to several WwTWs to allow for the additional flow they were treating; but they were issued without any headroom allowance for future growth.

TABLE 3-2: WWTW WITHOUT CONSENTED HEADROOM

Relevant WwTW	Current Consented DWF (m^3/d)	Future 2036 DWF after Growth (m^3/d)	Headroom Assessment	
			2036 Headroom Capacity (m^3/d)	Approximate Residual Housing Capacity after Growth (2036) [9]
Huntingdon (post 2021/22)	10,700	12,735	**-2,035**	**-6,750**
Oldhurst	1,109	1,149	**-40**	**-150**
Ramsey	2,576	2,737	**-161**	**-550**
Somersham	1,558	1,603	**-45**	**-150**
St Neots	10,483	11,890	**-1,407**	**-4,650**

All of theWwTWs included in Table 3-2 required water quality modelling to determine whether the quality consents required to meet WFD objectives would be achievable within the limits of conventionally applied treatment. Detailed results from the modelling are provided in Appendix 2. Several of the receiving watercourses were also assessed for their hydraulic capacity and hence impact on flood risk as a result of additional discharge.

A summary of the results and proposed infrastructure upgrades required are included in the following subsections for each of the WwTWs.

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[8] Treatment capacity at both Alconbury and Wyton airfield sites is limited and hence it has been assumed that development at these major sites will drain to Huntingdon WwTWs for treatment prior to discharge.

[9] Based on an Occupancy rate of 2.3 and consumption rate of 131 l/h/d. Residual housing figures are approximate and subject to change as occupancy rates, new build rates, levels of water use and rainfall vary over time

Huntingdon

Huntingdon WwTW has available flow headroom in its existing discharge consent and can accept the proposed growth up until 2021/22 or 5,100 dwellings based on estimated growth trajectories from 2013), after which the volumetric discharge consent will be exceeded. Unless additional headroom can be made available in the catchment after 2021/22 or 5,100 dwellings, any growth draining to the WwTW would cause the WwTW to exceed its existing volumetric consent conditions, and by a total volume of 2,035m^3/d by the end of the plan period.

WFD compliance

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

The modelling has shown that in order to maintain current WFD status downstream in the River Great Ouse, the quality conditions on the revised discharge consent would need to be tighter than the current conditions for Ammonia[10] and that the tighter Ammonia condition would need to be in place by 2025/26 or 6,700 dwellings (based on current trajectories for growth in the catchment). The change that is required for Ammonia is within the limits of conventional treatment.

The modelling has shown that the growth would not prevent Future Good Status being reached in the River Great Ouse for Phosphate as it could not be reached with current discharge levels.

Thus, this WCS has shown that a technically feasible engineering solution can be delivered to accommodate all of the growth proposed for Huntingdon (based on the housing numbers that the council has provided for use in the WCS).

Upgrade Requirements and Phasing

If the volumetric discharge consent is increased, the requirement to change the Ammonia conditions for the new consent may require process upgrades at Huntingdon WwTW by 2025/26 or 6,700 dwellings (depending on actual growth numbers within the catchment).

If upgrades are required as part of the solution, analysis undertaken for this WCS suggests that there is likely to be room for expansion assuming adjacent land can be made available as and when upgrades become a requirement

Flood Risk Implications

Huntingdon WwTW currently discharges to the River Great Ouse and the Environment Agency have confirmed that the River has enough capacity to not be constrained by quantitative flood risk issues.

RAG Assessment

The growth in the Huntingdon WwTW catchment is given a Green status up to and including 2021/22 (or 5,100 dwellings based on estimated growth trajectories from 2013), after which the volumetric discharge consent will be exceeded. Should an increase in volumetric

[10] BOD and Phosphate conditions would not need to change

consent be agreed, Green status will continue up to and including 2024/25 (or 6,700 dwellings (based on current trajectories for growth in the catchment). An Amber status has been given for the planning period extending beyond 2024/25 (or over 6,700 dwellings) on the basis that upgrades within the limit of conventional treatment are likely to be required at the WwTW and a new consent to discharge with a new Ammonia consent will need to be applied for by AWS.

Oldhurst

Oldhurst WwTW currently has no flow headroom in its existing discharge consent; hence unless additional headroom can be made available in the catchment, any growth draining to the WwTW would cause the WwTW to exceed its existing volumetric consent conditions immediately, and by a total volume of $40m^3/d$ by the end of the plan period.

<u>WFD compliance</u>

AWS have indicated that it may be possible for additional headroom to be made available in the catchment, to allow at least some of the early phase development in the plan period to come forward without immediate revisions to the WwTW's discharge consent.

However, as a worst case position (no headroom is available), a revised discharge consent for the WwTW will be required before any new properties are connected into the foul sewer in order to prevent deterioration in the receiving watercourse and in order to comply with the requirements of the WFD.

In consideration of the worst case position (that no headroom is available), water quality modelling has been undertaken to determine whether theoretically achievable quality conditions can be applied to the revised discharge consent that would ensure that the increase in consented flow required to serve all the proposed growth would not impact on downstream WFD requirements.

The modelling has shown that in order to maintain current WFD status downstream in the Bury Brook (via a tributary of the Ripton Brook), the quality conditions on the new discharge consent would need to be tighter than the current conditions for BOD and Ammonia and a Phosphorous limit of 2mg/l would need to be applied. However, these changes are within the limits of conventional treatment.

The modelling has shown that the growth would not prevent future Good Status being reached in the Bury Brook for Phosphate as it could not be reached with current discharge levels. A review of treatment processes required and the resultant energy consumption needed to meet such stringent targets would need to be considered by AWS and the Environment Agency as part of any future upgrade plans at the treatment facility.

Thus, this WCS has shown that, in principle, a technically feasible engineering solution can be delivered to accommodate all of the growth proposed for Oldhurst (based on the housing numbers that the council has provided for use in the WCS).

<u>Upgrade Requirements and Phasing</u>

The requirement for the change of Ammonia, BOD and P conditions required for a new consent may require significant process upgrades at Oldhurst WwTW.

If upgrades are required as part of the solution, analysis undertaken for this WCS suggests that there is likely to be room for expansion assuming adjacent land can be made available; however, funding for these upgrades is not likely to be available until 2015 at the earliest (start of AMP6) as AWS' approach to wastewater treatment asset management requires that sufficient certainty is given that the quantum of development will proceed before improvements to WwTW assets can be justified and funding sought. Once funding has been confirmed, there will be a lead-in time for the necessary upgrades to be completed.

The onus is on AWS to maintain standards set within their environmental permit. As previously referred to, they have suggested a number of measures can be taken to help create 'headroom' in the system (i.e. demand measures or infiltration reduction measures), which should help to reduce the risk from connecting in any properties already coming forward. Depending on their efficacy, these measures may ultimately prove to be a preferable alternative to the WwTW upgrade.

There is currently no evidence to demonstrate the extent to which the above measures can deliver 'headroom', but as that evidence becomes available, the Environment Agency and AWS can make a judgement on the necessity and timing of a major WwTW upgrade.

In the interim, in order to ensure WFD objectives are not compromised by early phasing of growth before any required solution is in place, rigorous monitoring will be required. Additionally, for planning applications coming forward before at least 2015 in this settlement, the Environment Agency will need sufficient evidence that development will not cause the WwTW's flow consent to be exceeded in order to be confident that they do not need to raise objections to planning applications to ensure WFD compliance. Therefore it is recommended that either:

a) permissions are restricted to a per annum completion rate to be mutually agreed between the Environment Agency and AWS; or

b) for each forthcoming application, the developer provides sufficient evidence (via AWS pre-planning enquiry) that demonstrates that there is either sufficient headroom or viable interim treatment solutions (such as tankering) until a permanent treatment solution is put in place.

RAG Assessment

The growth in the Oldhurst catchment is given an Amber status on the basis that upgrades within the limit of conventional treatment are likely to be required at the WwTW and a new consent to discharge will need to be applied for by AWS.

Ramsey

Ramsey WwTW currently has no flow headroom in its existing discharge consent; hence unless additional headroom can be made available in the catchment, any growth draining to the WwTW would cause the WwTW to exceed its existing volumetric consent conditions immediately, and by a total volume of 161m^3/d by the end of the plan period.

WFD compliance

AWS have indicated that it may be possible for additional headroom to be made available in the catchment, to allow at least some of the early phase development in the plan period to come forward without revisions to the WwTW's discharge consent, and hence without the need for potential upgrades being required.

However, as a worst case position (no headroom is available), a revised discharge consent for the WwTW will be required before any new properties are connected into the foul sewer in order to prevent deterioration in the receiving watercourse and in order to comply with the requirements of the WFD.

In consideration of the worst case position (that no headroom is available), water quality modelling has been undertaken to determine whether theoretically achievable quality conditions can be applied to the revised discharge consent that would ensure that the increase in consented flow required to serve all the proposed growth would not impact on downstream WFD requirements.

The modelling has shown that in order to maintain current WFD status downstream in the Ramsey High Lode, the quality conditions on the new discharge consent would need to be tighter than the current conditions for Ammonia[11]. However, these changes are within the limits of conventional treatment and are considered theoretically achievable.

The modelling has also shown that the growth would not prevent future Good Status being reached in the Ramsey High Lode for Phosphate as it could not be reached with current discharge levels.

Thus, this WCS has shown that, in principle, a technically feasible engineering solution can be delivered to accommodate all of the growth proposed for Ramsey (based on the housing numbers that the council has provided for use in the WCS).

Upgrade Requirements and Phasing

The requirement for the change of Ammonia conditions required for a new consent may require process upgrades at Ramsey WwTW.

If upgrades are required as part of the solution, analysis undertaken for this WCS suggests that there is likely to be room for expansion assuming adjacent land can be made available[12]; however, funding for these upgrades is not likely to be available until 2015 at the earliest (start of AMP6) as AWS' approach to wastewater treatment asset management requires that sufficient certainty is given that the quantum of development will proceed before improvements to WwTW assets can be justified and funding sought. Once funding has been confirmed, there will be a lead-in time for the necessary upgrades to be completed.

The onus is on AWS to maintain standards set within their environmental permit. As previous referred to, they have suggested a number of measures can be taken to help create 'headroom' in the system (i.e. demand measures or infiltration reduction measures), which should help to reduce the risk from connecting in any properties already coming forward. Depending on their efficacy, these measures may ultimately prove to be a preferable alternative to the WWTW upgrade.

There is currently no evidence to demonstrate the extent to which the above measures can deliver 'headroom', but as that evidence becomes available, the Environment Agency and AWS can make a judgement on the necessity and timing of a major WWTW upgrade.

In the interim, in order to ensure WFD objectives are not compromised by early phasing of growth before any required solution is in place, rigorous monitoring will be required. Additionally, for planning applications coming forward before at least 2015 in this settlement, the Environment Agency will need sufficient evidence that development will not result in the WwTW's flow consent to be exceeded in order to be confident that they do not need to raise objections to planning applications to ensure WFD compliance. Therefore it is recommended that either:

[11] BOD and Phosphate conditions would not need to change
[12] The WwTW is also located within Environment Agency Flood Zones 2 and 3 and hence AWS will need to demonstrate that it can be expanded and is protected from flooding and does not increase flood risk elsewhere through loss of floodplain storage

a) permissions are restricted to a per annum completion rate to be mutually agreed between the Environment Agency and AWS; or

b) for each forthcoming application, the developer provides sufficient evidence (via AWS pre-planning enquiry) that demonstrates that there is either sufficient headroom or viable interim treatment solutions (such as tankering) until a permanent treatment solution is put in place.

Flood Risk Implications

The Ramsey High Lode drains into the Middle Level catchment (specifically the St Germans Pond section of the catchment) and the MLC have advised that flood risk in the St Germans Pond section of the Middle Level may be increased and have stated that their default position is no increase in flow volume will be accepted from any source.

Therefore, if there is not sufficient headroom made available for all growth and an increase in the flow consent required, further discussion will be needed between AWS and the MLC to determine whether additional flow volumes will result in an increase in flood risk before the additional flow can be discharged.

In order to provide a definitive answer to whether flood risk would be increased, hydraulic modelling of the St Germans Pond section of the Middle Level catchment would be required. Although an existing model has been developed by consultants for the Middle Level catchment, this was not available for use in this WCS. As a worst case, the maximum additional volume discharged to the Middle Level system would be 161m^3/d as a result of all the growth in the plan period.

RAG Assessment

The growth in the Ramsey WwTW catchment is given a Red status on the basis that further work is required to determine flood risk implications in the St Germans section of the Middle Level catchment as a result of any additional discharge. An increase in consented volume will not be agreed by the MLC until this issue has been addressed.

Somersham

Somersham WwTW currently has no flow headroom in its existing discharge consent; hence unless additional headroom can be made available in the catchment, any growth draining to the WwTW would cause the WwTW to exceed its existing volumetric consent conditions immediately, and by a total volume of 45m^3/d by the end of the plan period.

WFD Compliance

AWS have indicated that it is likely that additional headroom will be available in the catchment, to allow the majority of the development in the plan period to come forward without revisions to the WwTW's discharge consent, and hence without the need for potential upgrades being required.

However, as a worst case position (no headroom is available), a revised discharge consent for the WwTW will be required before any new properties are connected into the foul sewer in order to prevent deterioration in the receiving watercourse and in order to comply with the requirements of the WFD.

In consideration of the worst case position (that no headroom is available), water quality modelling has been undertaken to determine whether theoretically achievable quality conditions can be applied to the revised discharge consent that would ensure that the increase in consented flow required to serve all the proposed growth would not impact on downstream WFD requirements.

Since phosphate on the Cranbrook Drain is currently at Bad Status (the lowest WFD Status) and cannot deteriorate further, a modelling assessment has been made based on ensuring no increase in overall Phosphorus load as opposed to ensuring 'no deterioration' in WFD P status.

The modelling has shown that in order to ensure no increase in loading to the Cranbrook Drain, the quality conditions on the new discharge consent would need to be tighter than the current conditions for Phosphorus[13]. However, these changes are within the limits of conventional treatment and are considered theoretically achievable.

The modelling has also shown that the growth would not prevent future Good Status being reached in the Cranbrook Drain for Phosphate as it could not be reached with current discharge levels.

Thus, this WCS has shown that, in principle, a technically feasible engineering solution can be delivered to accommodate all of the growth proposed for Somersham (based on the housing numbers that the council has provided for use in the WCS).

Modelling has shown that the growth would not prevent future Good Status being reached in the Cranbrook Drain for phosphate as Good Status could not be reached with the current discharge quality. However, current discharge quality prevents future Good Status being reached in the Cranbrook Drain for ammonia, unless the ammonia condition is tightened. This is within current limits of conventional treatment and hence this WCS has shown that, in principle, a technically feasible engineering solution can be delivered to accommodate all of the growth proposed for Somersham (based on the housing numbers that the council has provided for use in the WCS).

Upgrade Requirements and Phasing

The requirement to change the Ammonia conditions for a new consent may require process upgrades at Somersham WwTW.

If upgrades are required as part of the solution, analysis undertaken for this WCS suggests that there is likely to be room for expansion assuming adjacent land can be made available[14]; however, funding for these upgrades is not likely to be available until 2015 at the earliest (start of AMP6) as AWS' approach to wastewater treatment asset management requires that sufficient certainty is given that the quantum of development will proceed before improvements to WwTW assets can be justified and funding sought. Once funding has been confirmed, there will be a lead-in time for the necessary upgrades to be completed.

The onus is on AWS to maintain standards set within their environmental permit. As previous referred to, they have suggested a number of measures can be taken to help create 'headroom' in the system (i.e. demand measures or infiltration reduction measures), which should help to reduce the risk from connecting in any properties already coming forward. Depending on their efficacy, these measures may ultimately prove to be a preferable alternative to the WWTW upgrade.

[13] BOD and Ammonia conditions would not need to change in order to maintain downstream conditions for these parameters.
[14] The WwTW is also located within Environment Agency Flood Zones 2 and 3 and hence AWS will need to demonstrate that it can be expanded and is protected from flooding and does not increase flood risk elsewhere through loss of floodplain storage

There is currently no evidence to demonstrate the extent to which the above measures can deliver ‘headroom’, but as that evidence becomes available, the Environment Agency and AWS can make a judgement on the necessity and timing of a major WWTW upgrade.

In the interim, in order to ensure WFD objectives are not compromised by early phasing of growth before any required solution is in place, rigorous monitoring will be required. Additionally, for planning applications coming forward before at least 2015 in this settlement, the Environment Agency will need sufficient evidence that development will not cause the WwTW’s flow consent to be exceeded in order to be confident that they do not need to raise objections to planning applications to ensure WFD compliance. Therefore it is recommended that either:

c) permissions are restricted to a per annum completion rate to be mutually agreed between the Environment Agency and AWS; or

d) for each forthcoming application, the developer provides sufficient evidence (via AWS pre-planning enquiry) that demonstrates that there is either sufficient headroom or viable interim treatment solutions (such as tankering) until a permanent treatment solution is put in place.

Flood Risk Implications

The increase in flow from the WwTW as a result of growth is negligible (0.0041% of the 1 in 5 year flood flow) compared to the flood flow in the Cranbrook Drain. Calculations of the potential increase in water level at key locations on the watercourse show that there would be no significant increase in water level during a flood event (see Appendix 2 for further detail).

RAG Assessment

The growth in the Somersham catchment is given an Amber status on the basis that upgrades within the limit of conventional treatment are likely to be required at the WwTW and a new consent to discharge will need to be applied for by AWS to ensure growth does not compromise the attainment of future Good Status in the Cranbrook Drain..

St Neots

St Neots WwTW currently has no flow headroom in its existing discharge consent; hence unless additional headroom can be made available in the catchment, any growth draining to the WwTW would cause the WwTW to exceed its existing volumetric consent conditions immediately, and by a total volume of 1,407m^3/d by the end of the plan period.

WFD Compliance

AWS have indicated that it may be possible for additional headroom to be made available in the catchment, to allow at least some of the early phase development in the plan period to come forward without revisions to the WwTW’s discharge consent, and hence without the need for potential upgrades being required.

However, as a worst case position (no headroom is available), a revised discharge consent for the WwTW will be required before any new properties are connected into the foul sewer in order to prevent deterioration in the receiving watercourse and in order to comply with the requirements of the WFD.

In consideration of the worst case position (that no headroom is available), water quality modelling has been undertaken to determine whether theoretically achievable quality conditions can be applied to the revised discharge consent that would ensure that the increase in consented flow required to serve all the proposed growth would not impact on downstream WFD requirements.

The modelling has shown that in order to maintain current WFD status downstream in River Great Ouse, a new consent condition would be required for Ammonia[15]. However, this change would be within the limits of conventional treatment.

The modelling has shown that the growth would not prevent future Good Status being reached in the River Great Ouse for Phosphate as no change is required to the quality consent.

Thus, this WCS has shown that, in principle, a technically feasible engineering solution can be delivered to accommodate all of the growth proposed for St Neots WwTW (based on the housing numbers that the council has provided for use in the WCS).

Upgrade Requirements and Phasing

The requirement to limit Ammonia concentrations is likely to require some minor process upgrades at St Neots WwTW.

If upgrades are required as part the solution, analysis undertaken for this WCS suggests that upgrades are unlikely to be significant and unlikely to require expansion of the WwTW; however, funding for these upgrades is not likely to be available until 2015 at the earliest (start of AMP6) as AWS' approach to wastewater treatment asset management requires that sufficient certainty is given that the quantum of development will proceed before improvements to WwTW assets can be justified and funding sought. Once funding has been confirmed, there will be a lead-in time for the necessary upgrades to be completed.

The onus is on AWS to maintain standards set within their environmental permit. As previously referred to, they have suggested a number of measures can be taken to help create 'headroom' in the system (i.e. demand measures or infiltration reduction measures), which should help to reduce the risk from connecting in any properties already coming forward. Depending on their efficacy, these measures may ultimately prove to be a preferable alternative to the WWTW upgrade.

There is currently no evidence to demonstrate the extent to which the above measures can deliver 'headroom', but as that evidence becomes available, the Environment Agency and AWS can make a judgement on the necessity and timing of a major WWTW upgrade.

In the interim, in order to ensure WFD objectives are not compromised by early phasing of growth before any required solution is in place, rigorous monitoring will be required.

Additionally, for planning applications coming forward before at least 2015 in this settlement, the Environment Agency will need sufficient evidence that development will not cause the WwTW's flow consent to be exceeded in order to be confident that they do not need to raise objections to planning applications to ensure WFD compliance. Therefore it is recommended that either:

a) permissions are restricted to a per annum completion rate to be mutually agreed between the Environment Agency and AWS; or

[15] BOD and Phosphate conditions would not need to change

b) for each forthcoming application, the developer provides sufficient evidence (via AWS pre-planning enquiry) that demonstrates that there is either sufficient headroom or viable interim treatment solutions (such as tankering) until a permanent treatment solution is put in place.

Flood Risk Implications

St Neots WwTW currently discharges to the River Great Ouse and the Environment Agency have confirmed that the River has enough capacity to not be constrained by quantitative flood risk issues.

RAG Assessment

The growth in the St Neots WwTW catchment is given an Amber status on the basis that upgrades within the limit of conventional treatment are likely to be required at the WwTW and a new consent to discharge is likely to be required and applied for by AWS.

3.3 Wastewater assessment - Ecological Appraisal

There are five statutory designated sites potentially connected to WwTW discharges in Huntingdonshire – Ouse Washes SAC/SPA/Ramsar site/SSSI, Portholme SAC/SSSI, Nene Washes SAC/SPA/Ramsar site/SSSI, Berry Fen SSSI and Little Paxton Pits SSSI. Although there are numerous other SSSIs in Huntingdonshire they are all remote from watercourses into which WwTWs discharge treated effluent. These designated sites are therefore the focus of this water quality appraisal.

Although the Outline WCS identified a potential connection between Sawtry WwTW and the Great Fen Project, Holme Fen SSSI and Woodwalton Fen SAC the Detailed WCS has identified that this WwTW will not need to exceed it's currently consented discharge volumes in order to accommodate future housing in the district. Any impacts of the existing consented WwTW discharge will have already been covered by the Environment Agency RoC process and the WwTW does not therefore need to be considered in this detailed WCS.

The ecological background to the statutory designated sites included the details of the interest features and relevant condition assessments are provided in Appendix 4.

3.4 Impacts on the Ouse Washes SAC/SPA/Ramsar site/SSSI

The Environment Agency undertook a RoC on all consented discharges that related to the Ouse Washes SAC. For all those WwTWs that will remain within the headroom of their existing consented discharge volumes therefore potential impacts (and the mitigation necessary to address them) will have already been covered in the RoC process and hence no further work is necessary as part of this WCS. For those WwTWs that would need to seek an increase in their consented discharge volumes, the additional discharges will not have been covered by the RoC process and therefore these WwTWs are considered within this WCS.

In April 2005, Defra determined that flooding was the major cause of the habitat decline with regard to SPA birds on the Ouse Washes, rather than water quality. For this reason, the SPA was not taken further in the Environment Agency RoC. As such, it is not specifically taken further in this WCS either. However, improvements made to water quality associated with the SAC will also benefit the SPA, by reducing eutrophication on the Washes and thereby improving habitat quality.

The following Huntingdonshire WwTWs lie within the catchment of either the Bedford Ouse (the River Great Ouse upstream of Earith) or the Counter Drain (which lies within the Ouse Washes SAC) and would exceed their current consented discharge volumes to accommodate the necessary number of dwellings planned for Huntingdonshire:

- Somersham WwTW (within the Counter Drain catchment);
- Huntingdon WwTW (within the Bedford Ouse catchment); and
- St Neots WwTW (within the Bedford Ouse catchment).

The Environment Agency have confirmed that St Neots WwTW, as well as Huntingdon WwTW and Buckden WwTW, all had phosphate removal schemes introduced as part of funded improvements as a result of the Review of Consents process. It is clear from the context of the RoC reports that all the above mentioned WwTWs (except Buckden) will contribute additional phosphorus to the river.

Somersham WwTW within the Counter Drain catchment is specifically mentioned within the RoC as contributing (at the time the RoC was undertaken) an average soluble reactive phosphorus (SRP) level of 8.3 mg/l, giving an average P load of 14.4 kg/day. Somersham WwTW and Manea WWTW (in East Cambridgeshire) accounted for more than 95% of the phosphate load arising from point sources in the Counterdrain catchment. Given that the SRP level in some areas of the Counterdrain/Old Bedford was identified as being above the target for achieving favourable conservation status, it was concluded that those WwTWs that discharge within the Counter Drain catchment may have been having an adverse effect on the integrity of the Ouse Washes SAC, in-combination and amendments to the WwTW consents mentioned above were therefore included within Stage 4 of the RoC.

The discharges that lie on the River Ouse upstream of Earith have historically been the most significant input of phosphate to the Old Bedford Ouse (the stretch of river that lies immediately adjacent to the Ouse Washes, opposite the Counter Drain). Simple assessment of loads reported in the RoC indicates that a range of WwTW consents (including St Neots) collectively contributed (at the time the RoC was undertaken) approximately 60% to the total phosphate load at Earith (immediately upstream of the Ouse Washes).

As a result of this, the RoC for the Ouse Washes proposed phosphorus removal at Somersham WwTW and Manea WwTW to achieve an average effluent quality of 2.5mg/l of P within the Counter Drain. The RoC also proposed phosphorus removal at 15 WwTW's within the Bedford Ouse catchment upstream of Earith; due to commercial sensitivity the list of WwTWs was not made available to us for this study, but information provided by the Environment Agency and AWS demonstrate that this list includes St Neots WwTW within the WCS study area which has a P limit of 1mg/l. These (along with changes in other WwTWs in the catchment) would ensure that no adverse effect on the integrity of the SAC would result from consents within the Environment Agency's jurisdiction.

In order to achieve the Habitats Directive river phosphate target, and given the large number of WwTWs upstream of the Ouse Washes, Anglian Water opted (with the Environment Agency's agreement) to take a catchment approach, using models to assess where best to implement the additional P-removal. This to ensure no adverse effect from AWS discharge consents in totality.

The RoC report only covers internationally important features of the Ouse Washes. The SSSI features on the Ouse Washes most likely to be affected by water quality issues are the ditch feature and the vascular plant assemblage feature (some of which is found within the ditches) and which includes nationally scarce species. JNCC Common Standards Monitoring guidance for ditch features indicates a target phosphate concentration of 0.1

mg/l. However, while the RoC does not directly consider SSSI features, any controls on treated effluent discharge upstream to benefit the SAC will also have a positive effect on the SSSI.

If a WwTW discharges a greater volume of treated effluent without an associated tightening of the permitted phosphorus concentration within that effluent the total amount of phosphorus entering the river will increase. Due to limitations in the data and models available, it is not possible to calculate the specific change in phosphorus loading at a given point downstream that would result from an increase in the consented discharge volumes of Somersham WwTW (within the Bedford Ouse catchment) and St Neots WwTW without an associated tightening of consented phosphorus concentrations within the effluent.

Organic pollution from effluent discharges can result in increased bacterial activity as they breakdown the organic matter, which will in turn deplete the oxygen concentrations in the water column and sediment. If the oxygen levels in the water column or sediment are depleted then fish and invertebrate abundance will decline. A decline in key prey will in turn lead to a decline in bird populations.

The early life stages of fish are particularly sensitive to reduced oxygen concentrations. The Environment Agency Water Quality Technical Advice Group issued guidance for estuarine dissolved oxygen standards[16] for use in determining if existing discharges are likely to be having a significant effect on a European site. The agreed standard is an annual 5 percentile dissolved oxygen concentration of between 5 and 6 mg/l. This standard is based on the protection of sensitive fish which have high dissolved oxygen requirements. The Ouse Washes SAC RoC identified that there were marginal failures of the required DO standards throughout the SAC but that these would be addressed through tackling eutrophication, which (with regard to WwTW discharges) would be focussed on phosphate inputs.

The proposed growth at WwTWs within the Huntingdonshire DC boundary that would need to exceed their consented discharge volumes to accommodate development in the district will lead to an increase in phosphate load to the river (and hence to the Ouse Washes) due to the fact that these WwTWs are already treating at the level of conventional treatment and cannot (theoretically) remove any more phosphate from discharges.

It will be necessary, therefore, to remodel the impact of the increased Dry Weather Flows throughout the catchment (i.e. not just in Huntingdonshire) and take remedial action throughout the catchment as a whole to redress the balance.

Ideally, for the purposes of the Huntingdonshire WCS this modelling and remediation should be carried out specifically for the WwTWs within the district. There are however three problems with this approach:

- Most of the affected WwTWs within Huntingdonshire are already operating at the recognised limit of conventional treatment and as such further P-removal is not, in theory, possible. That means AWS will need to look to implement schemes further up the catchment in order to compensate for growth within Huntingdonshire;
- Much growth is already being planned within other districts and towns upstream in the Great Ouse catchment. This growth will also lead to an increased phosphate load that is beyond the scope of the Huntingdonshire WCS to assess; and

[16] Environment Agency and English Nature (2004) Dissolved Oxygen Limits for Estuaries: Determining Likely Significant Effect. WQTAG088e.

- The Habitats Directive requires an assessment of permits at their maximum consented load. The AMP5 'flow' schemes have also resulted in an increase in phosphate load from WwTWs throughout the whole Great Ouse catchment. Again, the assessment of this impact is beyond the scope of the Huntingdonshire WCS.

The only means to properly assess the in-combination effect of all these changes and to allow Anglian Water to decide where, and to what extent, additional P-removal is required to protect the Ouse Washes, is to model the whole catchment, for all the above changes, separately from the WCS process. This work is already underway for the purposes of AMP6 planning and will be done by AWS and the Environment Agency working together to establish the most effective solution.

3.5 Impacts on Portholme SAC/SSSI

Portholme SAC is a large area of flood meadow, lying between Huntingdon to the north and Godmanchester to the south-east. The meadow is designated as a SSSI and a SAC, though the SSSI area is larger than the SAC. The River Great Ouse flows around the South and East of the site, Alconbury Brook along the North, and a small ditch along the western boundary, parallel to the railway line. The site floods regularly from the Great Ouse and Alconbury Brook, during the winter and spring period, and parts of the site can remain underwater for long periods of time following a flood or even a spell of heavy rain. It is thought that the groundwater within the SAC flows from the River Great Ouse in the south towards the lower-level Alconbury Brook in the North. The sluices and locks of the surrounding watercourses have a significant impact on the flows of these watercourses, for example, Godmanchester sluice, to the south of Portholme SAC, on the River Great Ouse. However, the influence of rainfall and evapo-transpiration is thought to be more important for much of the meadow than the river stage level (except in times of flood).

The SAC feature at risk is Lowland Hay Meadow (MG4: meadow foxtail (*Alopecurus pratensis*) – great burnet (*Sanguisorba officinalis*) grassland). Flooding of the site and associated loading with particulate phosphorus could be critical in determining the status of the MG4 grassland. An excess of nutrients could cause an increasing abundance of curled dock (*Rumex crispus*), which has been associated with elevated soil nutrient concentrations and wetness (from flooding). There are no specific targets or objectives set for Portholme SAC but there is concern that the MG4 communities could be damaged by excess nutrients, particularly when already subjected to prolonged flooding. Studies carried out by Entec and WRc for the Environment Agency RoC specifically to look at the nutrients nitrogen and phosphorus in the River Great Ouse, found that almost all of the nitrogen came from diffuse sources such as agricultural run-off, whilst the vast majority of phosphorus came from point sources like WwTWs Phosphorus loading within the River Great Ouse and associated watercourses was therefore the main water quality issue considered within the RoC.

St Neots WwTW discharges to tributaries of the Great Ouse (Bedford Ouse) upstream of Portholme SAC and would need to exceed its current consented discharge volume to accommodate the housing planned by Huntingdonshire District Council. The Stage 3 RoC concluded that it was not possible to conclude that there was no adverse effect on the integrity of the SAC from consented discharges upstream as they stood at that time. However, further studies undertaken to inform the Stage 4 RoC confirmed that no WwTW consents were causing an adverse effect on the integrity of the SAC and therefore no amendments to existing consents were proposed, beyond those already identified to protect the Ouse Washes.

The RoC report only covers internationally important features of Portholme SAC. The SSSI features at Portholme SAC most likely to be affected by water quality issues are the vascular plant assemblage feature and which includes nationally scarce species. However, the interest features of the SAC and SSSI are sufficiently similar that the analysis for the RoC should apply equally to the SSSI.

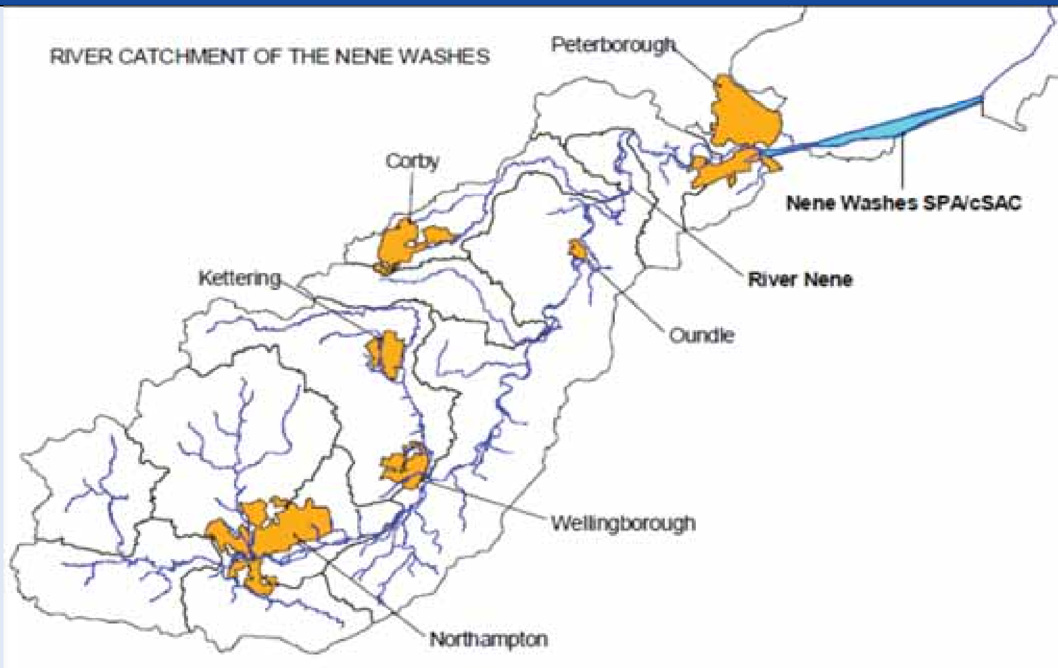
If a WwTW discharges a greater volume of treated effluent without an associated tightening of the permitted phosphorus concentration within that effluent the total amount of phosphorus entering the river will increase. Due to limitations in the data and models available, it is not possible to calculate the specific change in phosphorus loading at a given point downstream that would result from an increase in the consented discharge volumes of St Neots WwTW without an associated tightening of consented phosphorus concentrations within the effluent.

Therefore, the measures identified in the preceding section concerning the Ouse Washes will also be required to protect Portholme SAC.

3.6 Impacts on the Nene Washes SAC/SPA/SSSI/Ramsar site

Figure 3-2 shows the catchment of the Nene Washes.

FIGURE 3-2: NENE WASHES CATCHMENT (SOURCE: ENVIRONMENT AGENCY STAGE 3 REVIEW OF CONSENTS REPORT FOR THE NENE WASHES)



Only a small portion of Huntingdonshire lies within this catchment (the area immediately southwest of Peterborough, from Sutton south to Folksworth). No Wastewater Treatment Works in this area will need to exceed their current consents in order to service the housing planned by Huntingdonshire Council. Therefore, impacts of these WwTWs will have been covered in the Environment Agency's RoC for the Nene Washes and do not need further consideration in this Water Cycle Study.

3.7 Impacts on Berry Fen SSSI

Berry Fen SSSI is an area of washland on the Bedford Ouse (River Great Ouse) immediately upstream of Earith. All those WwTW discharges to the Bedford Ouse that had been identified in the Environment Agency RoC for the Ouse Washes as affecting that site are also very likely to affect Berry Fen SSSI in a similar manner.

As discussed in the section on the Ouse Washes, Huntingdon WwTW and St Neots WwTW lie within the Bedford Ouse catchment and will require an increase in their current consented discharge volumes to accommodate the scale of new housing proposed for their catchments. Therefore, the measures identified in the preceding section concerning the Ouse Washes will also be required to protect Berry Fen SSSI. As discussed, ammonia in the aquatic environment can be toxic at high concentrations and fish are particularly sensitive. However, Berry Fen SSSI is not designated for fish or aquatic invertebrates that would be sensitive to ammonia concentrations.

3.8 Impacts on Little Paxton Pits SSSI

Although this SSSI is immediately adjacent to the River Great Ouse (Bedford Ouse) there is no known pathway for phosphorus loading in the river to affect the SSSI. This site is therefore not considered further.

3.9 Impacts on ecology outside designated sites

In addition to impacts on designated sites, a range of other UK or Cambridgeshire BAP species or otherwise protected/notable species that are found in Cambridgeshire can be affected by wastewater discharge. These include:

- Water vole (protected through Wildlife & Countryside Act 1981 and a UK BAP species)
- Grass snake (partially protected through Wildlife & Countryside Act 1981)
- Common toad (UK BAP species)
- Great crested newt (legally protected through Conservation of Habitats & Species Regulations 2010, Wildlife & Countryside Act 1981 and a UK BAP species)
- Birds such as kingfisher (protected through Wildlife & Countryside Act 1981 and a UK BAP species), reed bunting, sedge warbler and reed warbler
- Invertebrates such as the hairy dragonfly *Brachytron pratense*, the aquatic beetle *Donacia dentata*, the weevil *Bagous subcarinatus* and the diving beetle *Agabus undulatus*
- Rare plant species including grass-wrack pondweed *Potamogeton compressus*, fringed water-lily *Nymphoides peltata* and greater water-parsnip *Sium latifolium*.
- European eel (protected under the Eels (England & Wales) Regulations 2009); and
- Otter (legally protected through Conservation of Habitats & Species Regulations 2010, Wildlife & Countryside Act 1981 and a UK BAP species)

Similarly important habitats (all listed within the separate IDB BAPs) include:

- drainage ditches;
- rivers;
- reedbeds;
- fens;
- grazing marsh;

- open water.

Cambridgeshire BAP habitats present (or possibly present) in Huntingdonshire are Fenland Drainage Ditches, Fens, Rivers & Streams, Floodplain Grazing Marsh and Reed beds, as well as the following BAP species: white-clawed crayfish, otter and water vole.

It is not possible within the scope of this commission to undertake a detailed investigation and evaluation of the impacts of the changes in water quality/flow and infrastructure to be delivered under the water cycle study on wildlife generally, since it would be necessary to undertake detailed species surveys of each watercourse and utilise detailed flow and quality data/modelling which has not been available for this commission for most watercourses. Six WwTWs in Huntingdonshire will require a change to their consents within this planning period in order to comply with the Water Framework Directive requirements for no deterioration downstream.

TABLE 3-3: CONSENT CHANGES FOR NO DETERIORATION

WwTW	Change to volumetric consent	Change to Phosphate consent	Change to Ammonia consent	Change to BOD consent
Huntingdon	Yes (by 2022/23)	No	Yes	No
Ramsey	Yes	No	Yes	No
Somersham	Yes	Yes	No	No
St Neots	Yes	No	Yes	No

3.10 Ecological opportunities associated with WwTWs

This section is intended to describe ecological enhancement opportunities to which the initiatives developed within the WCS could contribute.

There are theoretically considerable opportunities available to enhance the biodiversity of Huntingdonshire through initiatives associated with the WCS. As a first step towards identifying these opportunities the Cambridgeshire Green Infrastructure (GI) Strategy was reviewed in order to determine which, if any, WwTWs are physically close to any of the green corridors initiatives identified on Drawing 050406/31 of the Strategy. Four WwTWs were identified as being located within or immediately adjacent to GI initiatives:

- Brampton WwTW and St Neots WwTW are identified as being within the Ouse Valley Strategic Greenspace Corridor;
- Huntingdon WwTW is close to the Houghton Meadows green infrastructure site (Part of the Ouse Valley Wet Woodland & Wet Meadows Project); and
- Somersham WwTW is identified as being close to the Fen Edge Project area.

These would potentially be the WwTWs that could contribute most directly to initiatives within the GI Strategy and there should be considerable opportunity for the creation of wetland green infrastructure, such as the expansion of WwTW infrastructure could deliver (e.g. the provision of SuDS features, particularly the creation of ponds and reedbeds both of which are UK BAP priority habitats or using treated effluent to supply new water features). However, it is currently considered unlikely that any of the aforementioned WwTW will require physical expansion.

There may be opportunities for treated effluent to be used at a greater distance to supplement wetland habitat creation initiatives such as the Great Fen Project, although this would be subject to confirmation of acceptable water quality standards and non-prohibitive costs of infrastructure delivery.

For all WwTW where the current downstream quality of the receiving watercourse is less than Good Status (under the WFD), a calculation was undertaken to determine if the receiving watercourse could achieve future Good status with the proposed growth within limits of conventional treatment technology and what consent limits would be required to achieve this. Achievement of Good ecological status if achievable would also have significant ecological enhancement benefits; 'Good' ecological status means that human activities have had only slight impacts on the ecological characteristics of aquatic plants and animal communities. A change to ‘Good’ status can therefore be expected to involve an increase in the diversity (both in terms of number and pollution sensitivity of species) for invertebrates, fish, macrophytes and conventional vegetation which will in turn have positive impacts on associated amphibian and bird populations.

It is not possible to evaluate as part of this Detailed WCS whether most of the relevant WwTWs can contribute to achievement of ‘Good’ ecological status but for those where assessment is possible and whose receiving watercourses are not already achieving ‘Good’ status (Somersham WwTW, Huntingdon WwTW and Ramsey WwTW) it is clear that tightening WwTW consents would not achieve ‘Good’ ecological status with regard to phosphate unless novel solutions were devised.

In addition to water quality effects, discharges from WwTWs can also contribute cumulatively to flooding of the Ouse Washes, which could adversely affect the breeding bird interest by leaving nesting habitat unusable. One major contribution WwTW expansion could therefore make is the provision of water supply for the creation of new areas of flooded meadow through the re-routing of discharges away from the Ouse Washes. This new meadow could provide breeding habitat for waders, as reflected in the Ouse Washes Habitat Creation Scheme being supervised by the Environment Agency. On the face of it Somersham WwTW and St Neots WwTW would be the most appropriate WwTWs to contribute since they currently discharge to tributaries of the Ouse Washes and would need to increase their consented discharge volumes immediately. This would also meet the need to conserve and enhance the area of ‘lowland fen’ and ‘grazing marsh’ (both UK BAP habitats) within the study area and improve habitat for Cambridgeshire BAP species such as otter, water vole and great crested newt.

3.11 Climate Change Sensitivity – Water Quality

Climate change has the potential to impact and alter the water environment through increasing river temperatures, reducing flows and increasing diffuse run-off from heavier rainfall and storm events, all of which can alter the quality of the receiving water bodies.

The Environment Agency’s ‘Potential Impacts of Climate Change on River Water Quality’ study[17] reported that relatively little research has been undertaken in assessing the impacts of climate change on water quality. However, the following high-level findings were reported from the literature review undertaken as part of the study:

- water quality will be affected by changes in flow regime;
- lower minimum flows imply less volume for dilution and hence higher concentrations downstream of point discharges;

[17] Potential Impacts of Climate Change on River Water Quality, Science Report SC070043/SR1, Environment Agency 2008

- enhanced growth of algal blooms in rivers and reservoirs could affect levels of dissolved oxygen and the costs of treating water for potable supply;
- increased storm events, especially in summer, could cause more frequent incidence of combined sewer overflows, discharging polluted waters into receiving water bodies. The potential impacts on urban water quality will be largely driven by these changes in short duration rainfall intensity overwhelming drainage systems;
- the most immediate reaction to climate change is expected to be an increase in river and lake water temperatures with subsequent effects on Dissolved Oxygen levels;
- more intense rainfall and flooding could result in increased suspended solids, sediment yields and associated contaminant metal fluxes;
- nutrient loads are expected to increase;
- in shallow lakes, oxygen levels may decline and cyanobacteria blooms may become more extensive; and,
- in the UK, there has been relatively little research on toxins in streams, lakes and sediments, as the problems are thought to be limited. However, climate change may alter this perception.

Higher temperatures will also result in increased evaporation of open waterbodies, possibly leading to changes in water quality which could have an adverse impact on biodiversity. Within the Middle Level Commissioners area, most water does not flow, particularly in the summer months when pumps may not operate for several weeks. During such periods levels of dissolved oxygen levels fall and algal blooms frequently occur.

Climate change studies, especially in relation to water quality and ecology, are at fairly early stages and the outcomes are subject to considerable uncertainty. However, understanding the processes and mechanisms controlling water quality and ecology, and how these combine and interact, is essential for sustaining potable water supplies and conserving river systems[17]. As such, the findings of this study and planned adaptation and mitigation options should be updated when further research and guidance becomes available.

Climate Change, Water Quality and Adaptation

Table 3-4 provides a summary of the potential climate change adaptation and mitigation measures that could be considered in Huntingdonshire with regards to water quality and wastewater services infrastructure. The organisations likely to be responsible for leading these measures have been identified alongside the suggested timescale for these actions to start being taken forward (Immediate, Medium (1 - 10 years) and Long (10+ years)).

TABLE 3-4: WATER QUALITY AND WASTEWATER POTENTIAL CLIMATE CHANGE ADAPTION AND MITIGATION[18]

Potential Climate Change	Potential Impact	Adaption and Mitigation Measures	Input Organisation (s): HDC or CC (as LLFA)	EA	AWS/ CW	NE	Timescale for Action
Temperature Rise	• Decrease in Dissolved Oxygen in rivers – impact on river ecology and wildlife • Faster wastewater and surface water asset deterioration • Changes in wastewater process efficiency	Ensure climate change mitigation strategies are in place for species and habitats at risk, e.g. BAPS		✓		✓	Medium
		Monitor long-term Dissolved Oxygen levels in rivers and impacts		✓			Medium
		Ensure resilience where appropriate of wastewater and surface water assets to temperature rise, where new assets are required or upgraded			✓		Medium
Winter rainfall increase	• Increased diffuse pollution • Insufficient infrastructure capacity – storm tanks, CSOs etc. • Increased risk to rivers from combined sewer outflows and surface water drainage systems	Where possible, control diffuse pollution runoff through SuDS	✓	✓	✓	✓	Immediate
		Promoting the creation and preservation of space (e.g. verges, agricultural land, and green urban areas, including roofs) in support of water quality, biodiversity and flood risk goals	✓	✓		✓	Immediate
		Long-term monitoring of CSO and surface water outfall spill volumes and frequency. Ensure Urban Pollution Management (UPM) study is undertaken for major development upstream of CSOs	✓	✓	✓		Medium
Summer rainfall decrease	• Degraded wetlands • More frequent low river flows • Less dilution in rivers for wastewater/surface water discharges and diffuse pollution • Reduced risk to rivers from combined sewer outflows • Tightening of discharge consent • Reduced flexibility – effluent required to maintain river flows	Ensure climate change mitigation strategies are in place for species and habitats at risk, e.g. Biodiversity Action plans		✓		✓	Medium
		Consideration of future climate change impacts on wastewater discharges when renewing consents and on surface water discharges where appropriate.	✓ (surface water)	✓	✓		Medium
Sea level rise	• Saline Intrusion • Asset loss	Monitor water quality for potential impacts from saline intrusion		✓			Medium
		Ensure that key assets, where possible are not susceptible to being lost through sea level rise	✓ (surface water)	✓	✓		Long
Increase in weather extremes	• Increased flooding and risk of service loss • Increased clean-up costs • Inability of infrastructure to cope • Increased subsidence – pipe failure	Promoting the creation and preservation of space (e.g. verges, agricultural land, and green urban areas, including roofs) in support of water quality, biodiversity and flood risk goals	✓	✓		✓	Immediate
		Improve resilience of key wastewater assets to weather extremes where appropriate	✓ (surface water)		✓		Medium

[18] Some inputs edited from AWS Strategic Direction Statement 2010 – 2035

3.12 Wastewater Summary

Table 3-5 provides a summary of the RAG assessment of the WwTWs.

TABLE 3-5: WASTEWATER TREATMENT SUMMARY

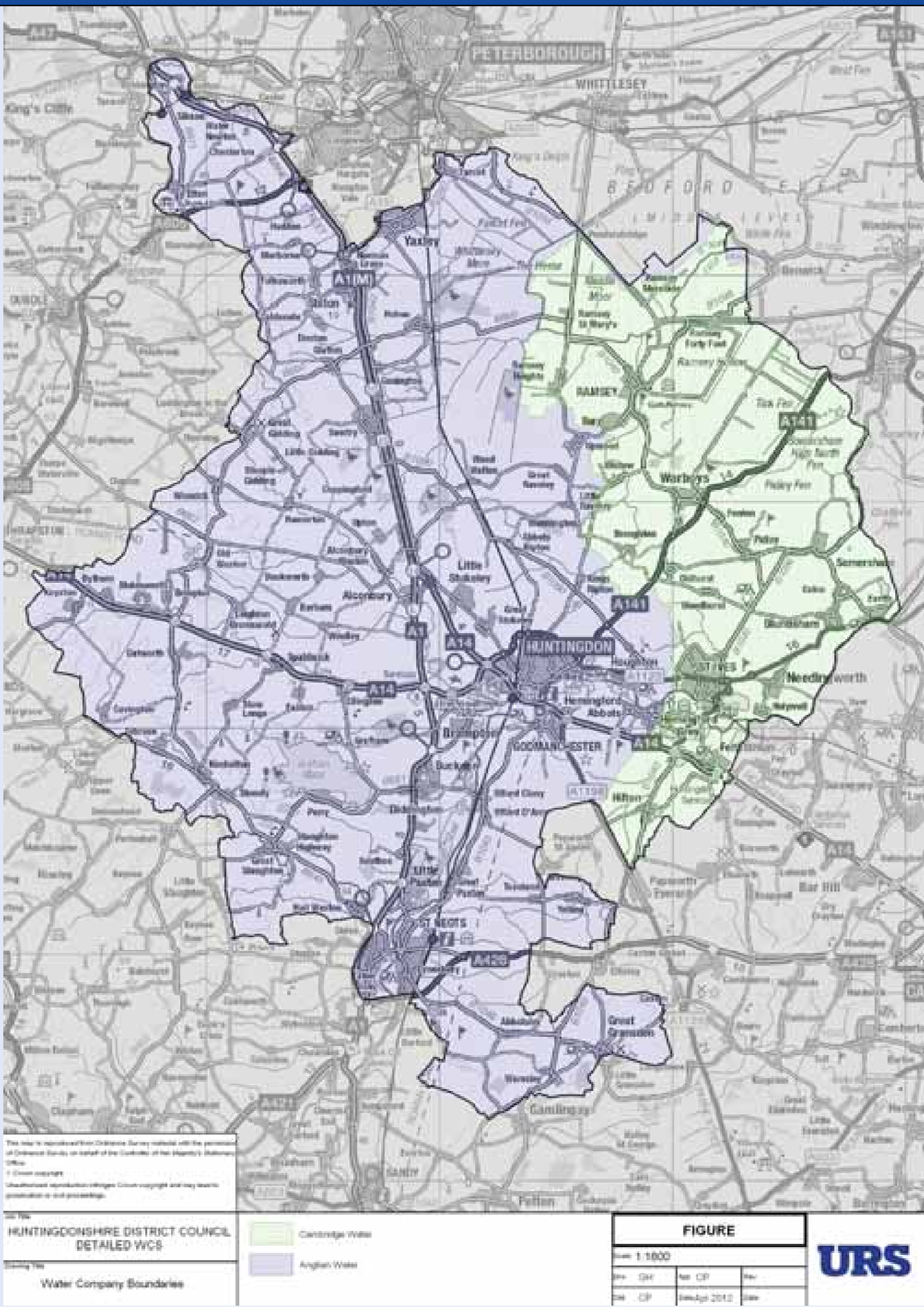
WwTW	Watercourse	IDB receiving watercourse?	Is Headroom available for all planned growth to 2036?	Is there a flood risk concern with additional discharge?	Is a consent update possible – within LCT?	Feasible solution?
Brampton	Brampton Brook	EA & IDB	Yes	No	Yes	Yes
Buckden	Tributary of Diddington Brook	No	No, but minimal growth – Can be accommodated within current consent	No	Yes	
Holme	Holme Brook	MLC IDB	Yes	N/A		
Huntingdon	River Great Ouse	No	No (Headroom only up to and including 2021/22)	No	Yes	Yes
Kimbolton	River Kym	No	Yes	N/A		
Oldhurst	Tributary of Bury Brook	No	Currently no headroom for any growth	No	Yes	Yes
Peterborough	River Nene	No	Yes	N/A		
Ramsey	Ramsey High Lode	MLC IDB	Currently no headroom for any growth	Yes – MLC will not accept additional discharge volume	Yes	To be investigated (flood risk)
Sawtry	Sewer Drain	MLC IDB	Yes	N/A		
Stibbington	River Nene	No	Yes	N/A		
Somersham	Cranbrook Drain	No	Currently no headroom for any growth	No	Yes	Yes
St Ives	Marley Gap Brook	No	Yes	No	Yes	Yes
St Neots	River Great Ouse	No	Currently no headroom for any growth	No	Yes	Yes

4 WATER SUPPLY STRATEGY

4.1 Introduction

Water supply in Huntingdonshire is provided by AWS and CW. The supply area of both companies in the study area is shown in Figure 4-1.

FIGURE 4-1: WATER COMPANY COVERAGE IN HUNTINGDONSHIRE



The Outline Study has already completed an assessment of the existing environmental baseline with respect to locally available resources in the aquifers and the main river systems. The outline assessment was based on the Environment Agency's Catchment Abstraction Management Strategies (CAMS) Huntingdonshire falls within three CAMS[19];

- The Upper Ouse and Bedford Ouse – covers the south of Huntingdonshire, including St Neots, Huntingdon and St Ives.
- The Old Bedford including Middle Level – covers the north of Huntingdonshire, including, Ramsey, Yaxley and Sawtry.
- The Nene – covers a small area in the north-west of Huntingdonshire

The process of describing catchment resources is not repeated in this Detailed WCS. Instead, the Detailed Study has used the final version of AWS' and CW's 2015 Water Resources Management Plans (WRMP)[20][21] to determine available water supply against predicted demand and has considered how water efficiency can be further promoted and delivered for new homes beyond that which is planned for delivery in AWS and CW's WRMPs.

In reviewing the final AWS and CW 2015 WRMP, and through liaison with AWS and CW it has been established that the growth figures assessed for the detailed study are catered for in the 2035 prediction of supply and demand deficits in the relevant Planning Zones under average conditions.

4.2 Water Resource Planning

Water companies have historically undertaken medium to long term planning of water resources in order to demonstrate that there is a long-term plan for delivering sustainable water supply within its operational area to meet existing and future demand.

As of 2007, it became a statutory requirement for water companies to prepare and maintain WRMPs which demonstrate how water companies are managing the balance between available supply and future demand over a 25 year plan. These plans are subject to consultation and approval by secretary of state every five years, but must be updated on a yearly basis.

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

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

[19] http://www.environment-agency.gov.uk/business/topics/water/119931.aspx
[20] Cambridge Water WRMP (2014) http://www.cambridge-water.co.uk/customers/water-resources-management-plan
[21] Anglian Water Services - Water Resources Management Plan, Main Report (2014) http://www.anglianwater.co.uk/environment/water-resources/resource-management/

In formulating the statutory 2015 final WRMPs, AWS and CW used targets as discussed with Local Planning Authorities (as well as other sources).

Prior to use of the findings of the WRMPs of both CW and AWS, it was essential to ensure that the growth being assessed for the district within this WCS was comparable to the growth assumptions used by both companies in formulating their current WRMPs.

4.2.1 *Demand for Water*

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

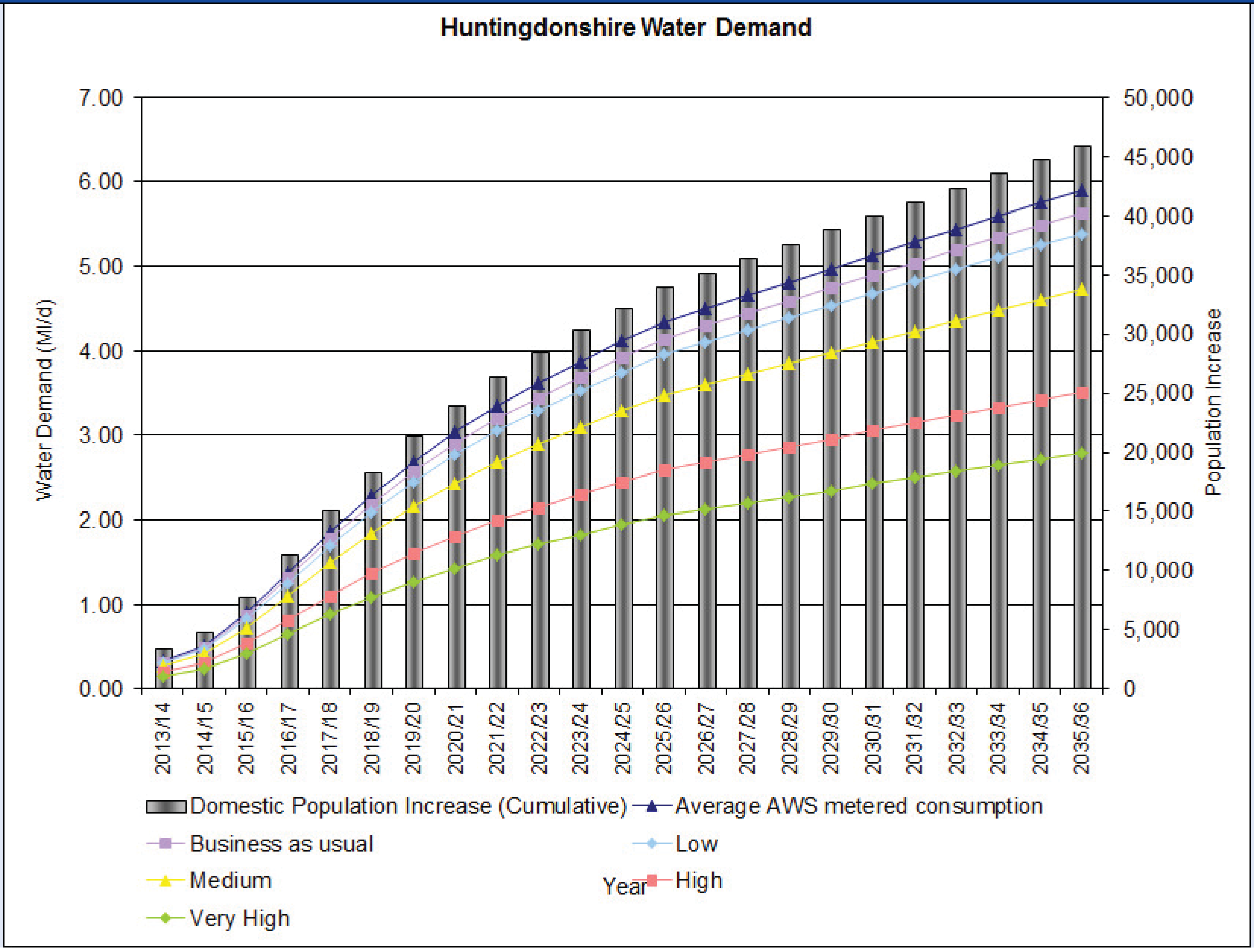
The population projections are based on the housing figures used within this report and assuming an occupancy rate of 2.3. This occupancy rate has been used as a conservative estimate to determine likely water use once all proposed development has been built. This, coupled with projecting to 2035, results in a larger population estimate by the end of plan period than set out in the County's Population, Housing and Employment Forecasts for Huntingdonshire. Using a conservative estimate allows for uncertainty in estimates of water use and population increases into the future.

The projections were derived as follows:

- **Projection 1 – Average AWS Consumption** – New homes would use 131 l/h/d, this reflects the planning consumption used by AWS and CW to maintain security of supply;
- **Projection 2 – Business as Usual** – New homes would conform to (and not use more) Part G of the Building Regulations requirement (in force as of the 6th April 2010) of 125 l/h/d;
- **Projection 3 – Low** – New homes would achieve 120 l/h/d;
- **Projection 4 – Medium** – New homes would achieve 105 l/h/d;
- **Projection 5 – High** – New homes would achieve 80 l/h/d; and,
- **Projection 6 – Very High** – New homes would include both greywater recycling and rainwater harvesting reducing water use to a maximum of 62 l/h/d.

Using these projections, the increase in demand for water could range between 2.79 and 5.90Ml/d by 2036. The projections are shown in Figure 4-2.

FIGURE 4-2: RANGE OF WATER DEMANDS ACROSS PLAN PERIOD IN HUNTINGDONSHIRE DEPENDING ON EFFICIENCY LEVELS OF NEW HOMES



4.3 Planned Water Availability Summary

The 2015 WRMPs for both AWS and CW have been used to summarise water availability to meet the projected demand for the Huntingdonshire District covering the planning period to 2040 and any additional resource capacity that may be required to meet this demand.

Anglian Water

The Huntingdon District is located within two Resource Zones (RZ) called Ruthamford North and Ruthamford South, (formerly the Ruthamford RZ in the 2010 WRMP).

In February 2013, a review of Water Resource Zone integrity was carried out by AWS. One of the recommendations from the review was to split the Ruthamford RZ into two separate WRZs. The Ruthamford North RZ exports to the East Lincolnshire and Central Lincolnshire RZs. Significant volumes of treated water are also exported from this RZ to Severn Trent Water.

The Ruthamford South RZ exports to Affinity Water (formerly Veolia Water) under the terms of the Great Ouse Water Act (GOWA). The review of WRZ integrity showed that areas in the south of the former Ruthamford RZ could not effectively share resources with areas in the north; this includes additional capacity resulting from the AMP4 resource development scheme at Rutland Water. Subsequent separation of the two areas to reflect the lack of integrity revealed a large surplus in the north and a deficit in the south.

Given the projected population increase and therefore the increase in domestic use, demand from these two Ruthamford WRZs is projected to increase notably over the planning period up to 2040.

The towns of Huntingdon and St Neots and fall into Ruthamford South RZ which is forecast to enter deficits under dry year annual average conditions in 2026/27, reaching 28.5 Ml/d in 2039/40.

Proposed supply/demand deficit solutions

AWS have identified their preferred schemes to help maintain the supply demand balance with the Ruthamford South RZ, as detailed in the WRMP. Water efficiency measures and metering activity are to be implemented during AMP6 (2015 to 2020), whilst leakage control and a transfer from Ruthamford North RZ are planned for AMP8 (2025 to 2030), with the commissioning of the Ruthamford South RZ during AMP10 (2035 to 2040). This transfer makes use of the surplus within the north zone and will ensure that the Ruthamford South zone has a surplus of demand by 2040.

This WCS has identified that approximately 7,500 more homes are included within HDC's growth target than AWS have allowed for within their demand calculations in WRZs supplying the District to 2035. This would mean that if the proposed housing growth took place as per the current estimated trajectory, there would be insufficient supply to meet demand by 2023 in the Huntingdonshire District (unless additional resources are secured). Liaison with AWS has highlighted that there is a further option to provide a new connection from Wing WTW to the Ruthamford WRZs that serve the District such that additional growth beyond 2023 could be accommodated. The requirement to develop this option will be assessed and reported within subsequent updates to the current WRMP (the next update being 2019) and will be dependent on the level of growth that occurs within Huntingdonshire and neighbouring authority areas as to whether it is required.

Cambridge Water

The Cambridge Water area forms one single water resource zone, which incorporates the Huntingdonshire towns of Ramsey and St Ives. CW predicts a healthy supply-demand balance which can be maintained across the planning period and growth figures as assessed in this WCS have been accounted for in the CW WRMP. Sufficient resources are therefore available for development within CW's supply area. This surplus has not been allocated specifically to any proposed growth and has only been compared against likely projections. Should additional earlier development be proposed, or trading agreements entered into, the surplus may become reduced.

Whilst the forecasted growth within Huntingdonshire is included within the CW WRMP supply balance, potential future sustainability changes cannot be taken into account which could impact the available surplus in the WRZ.

4.4 Water Efficiency Plan

Through a series of demand management measures and improvement of existing resources, AWS and CW are predicting a supply surplus of available water in 2040 within the RZs located within Huntingdonshire which would provide sufficient water supply to supply the levels of growth within the district through the plan period. Further supply options have been identified and will be implemented if the full level of proposed growth in Huntingdonshire takes place to 2036.

However, there are several key drivers for ensuring that water use in the development plan period is minimised as far as possible. There is a drive to ensure new development meets the sustainable development aspirations within Cambridgeshire County Council and hence sustainable water delivery is a key part of achieving this vision. In addition, the impact of the proposed growth in the District (which is not currently accounted for in Anglian Water's WRMP) can be minimised with more water efficient development, potentially negating the requirement for additional resources to be developed. This WCS therefore includes an assessment of the feasibility of achieving a 'water neutral' position after growth across the district.

As is the case for all sustainable use of resources, the three 'R's of reduce, reuse and recycle are key to maximising the sustainability and reduce is the first and arguably most important element of sustainable water use to consider.

4.5 Drivers and Justification for Water Efficiency

The study area, and East Anglia generally, is an area of serious water stress[22] and is the driest part of the UK. Any growth and increase in population will further exacerbate this issue. In addition, the key sources of raw water (rivers and aquifers) supplying Huntingdonshire are considered to be close to their limit of water they can continue to yield for abstraction, before ecosystems and other users reliant on these sources would be adversely affected.

Based on the baseline assumption of 131l/h/d of water use, demand for water in Huntingdonshire could increase through the plan period by 5.90 Ml/d.

4.6 Policy and Legislation Drivers

Future Water, the Government's water strategy for England[23] was published in February 2008 and lays out the Government's policies for the future management of water in England. Part of its vision is for water efficiency to play a prominent role in achieving a sustainable supply and demand balance.

For relevance to the aspiration of water neutrality, Future Water specifically aims to reduce water consumption in existing homes to 130 or 120 l/h/d by 2030. This will require the retrofitting of water efficient measures in existing homes and business and behavioural change in the use of water and understanding of where it comes from.

The Building a Greener Future Policy Statement[24] published by Communities and Local Government in 2007 gives the target of zero carbon by 2016 (at the time equivalent to CSH Level 6) for all new homes. This will be achieved by a progressive tightening of the Building Regulations.

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[22] As classified by the Environment Agency
[23] Future Water, the Government's water strategy for England, DEFRA, 2008
[24] Building a Greener Future: Policy Statement, CLG, 2007, http://www.communities.gov.uk/publications/planningandbuilding/building-a-greener

Availability of Water

In their 2015WRMP, AWS highlight that over the planning period the key water resources challenges they face are from the impacts of growth, climate change and sustainability reductions. Overall, AWS predict their supply-demand balance could be at risk from adverse changes which may be as large as approximately 50% of their 2011/12 Distribution Input.

Managing Climate Change

It is predicted that climate change will further reduce the available water resources in Huntingdonshire as rainfall patterns change to less frequent, but more extreme, rainfall events in the summer months, and winter rainfall patterns become more frequent and intense. Climate change is thought to be the biggest single risk to water supplies from 2020 and beyond in the WRZs within Huntingdonshire. This could lead to sustainability reductions of abstraction licences.

In their Strategic Direction Statement, AWS state that climate change is the biggest single risk facing their business over the next 25 years. Customers expect AWS to provide a continuous supply of water, but the resilience of the supply systems have the potential to be affected by the impact of climate change with severe weather-related events, such as flooding or an 'outage' incident at a source works supplying one of the major centres of population in the region.

In their draft PR14 submission, AWS made improvements to their assessment of climate change impacts, as directed by the Secretary of State. For their WRMP, AWS applied the recommended approach for assessing climate change impacts and complied with the requirement in the WRMP guideline for developing climate change related target headroom requirements.

In planning for future water resources availability, AWS has accounted for the impacts of climate change within their calculations of available raw water for use and forecast demand. AWS has used assumptions on climate change impacts based on the UKCP09scenarios, the information on sustainability reductions provided at the time by the Environment Agency and the Environment Agency' Water Resources Plan guideline.

AWS reported that the changes most significant for managing water resources in their supply area are:

- the increase in rainfall in the winter;
- reduction in the summer rainfall; and
- an increase in summer temperatures that will reduce the length of the winter recharge season and potentially increase the demand for water.

At a strategic level, AWS highlighted that it will be important to store more run-off from winter rainfall and to enhance the natural groundwater recharge. In the 2015 WRMP, proposed schemes aimed at mitigating changes in the supply-demand baseline and associated risks during the planning period include:

- Ruthamford South RZ: enhanced metering and water efficiency (AMP6), and additional leakage control and transfer from Ruthamford North RZ (post AMP6).

Climate Change and Sustainability Reduction Impacts

AWS have assessed the impacts of climate change and sustainability reductions on both supply and demand. The main findings from these, as included in their 2015 WRMP, are summarised below.

Impact on Supplies

AWS have undertaken analysis of the impacts of climate change on the future availability of their water resources on both their groundwater and surface water sources, and incorporated these results into their assessment of deployable output. The analysis involved processing median, best and worst case scenarios through a number of recognised climate change models, for 25 groundwater and 10 surface water sources considered vulnerable to the potential impacts of climate change on source yield. The results identified a more significant impact on surface water source yield (reservoir and direct intake) than for groundwater. The modelling results also indicated that in some cases potential groundwater yield could increase, as the climate change scenarios not only predict higher temperatures but increased periods of prolonged and heavy rainfall. There are no confirmed or likely sustainability reductions predicted for Ruthamford South RZ.

Impact on Demand

The main impact of climate change on demand is related to periods of extremely hot and dry weather that will increase the peak demand for water. AWS have accounted for the impact on the peak demand and the longer duration effect of a dry year through applying factors to the household and non-household water consumption rate in their supply-demand modelling. The effect of peak demand varies between Water Resource Zones due to factors such as the location of holiday resorts and heavy industry and socio-economic factors reflected in the type and age of housing stock and customers' behaviour.

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

4.7 Water Neutrality

4.7.1 *What is Water Neutrality?*

Water neutrality is a concept whereby the total demand for water within a planning area after development has taken place is the same (or less) than it was before development took place[25]. If this can be achieved, the overall balance for water demand is 'neutral', and there is considered to be no net increase in demand as a result of development. In order to achieve this, new development needs to be subject to planning policy which aims to ensure that where possible, houses and businesses are built to high standards of water efficiency through the use of water efficient fixtures and fittings, and in some cases rainwater harvesting and greywater recycling.

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

[25] Water Neutrality is defined more fully in the Environment Agency report 'Towards water neutrality in the Thames Gateway' (2007)

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

Achieving 'total' water neutrality within a development remains an aspirational concept and is usually only considered for an eco-town or eco-village type development, due to the requirement for specific catchment conditions to supply raw water for treatment and significant capital expenditure. It also requires specialist operational input to maintain the systems such as wastewater re-use on a community scale. Total neutrality for a single development site is yet to be achieved in the UK, although there are exemplar EcoTowns and eco-settlements such as Rackheath in Norfolk where it is an aspiration that is being worked towards.

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

Twin-Track Approach

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

In order to reduce water consumption and manage demand for the limited water resources within the study area, a number of measures and devices are available[26]. Generally, these measures fall into two categories due to cost and space constraints, as those that should be installed in new developments and those which could be retrofitted.

Appendix 5 provides more detail on the different types of device or system along with the range of efficiency savings they could lead to.

Achieving Total Neutrality – is it feasible?

Even when considering neutrality within an existing planning area, it is recognised by the Environment Agency[27] that achievement of total water neutrality (100 per cent) for new development is often not possible, as the levels of water savings required in existing stock may not be possible for the level of growth proposed. A lower percentage of neutrality may therefore be a realistic target, for example 50% neutrality.

This Stage 2 WCS therefore considers four water neutrality targets and sets out a 'pathway' for how the most likely target (or level of neutrality) can be achieved. The pathway concept is discussed in more detail in Appendix 5, and highlights the importance of developing local policy in Huntingdonshire for delivering aspirations like water neutrality as well as understanding the additional steps required beyond 'business as usual' required to achieve it.

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

4.7.2 *Water Neutrality Scenarios*

Four water neutrality targets have been proposed and assessed. Each target moves beyond the Building Regulations scenario which is considered to be:

- 105l/h/d for new affordable homes and 125 l/h/d for all other new homes[28];
- no mandatory efficiency target for non-domestic property; and,
- continued meter installation in existing homes as planned in AWS' WRMP up to 2035.

At 65 per cent, the existing level of metering within the AWS region is already twice the national average. AWS' future target for meter penetration[29] on domestic water meters is 90 per cent by 2035.

During AMP4 from 2005-06 to 2009-10 over 100,000 customers opted to use a water meter, which when combined equates to approximately 20,000 new metered connections each year, resulting in the growth of metered households by 2 per cent per year. The WRMP assumes this rate will continue to the target of 90% of customers metered by 2035.

Therefore, the Water Neutrality scenarios can only assume a further 10% meter penetration within the existing housing stock by the end of the plan period to achieve 100% metering.

The water neutrality scenarios have been developed based on the following generic assumptions. For clarity, Huntingdonshire has been considered as a whole when assessing the scenarios.

Very High Scenario

The key assumptions for this scenario are:

- it assumes water neutrality is achieved, however it is considered as aspirational only as it is unlikely to be feasible based on:
- existing research into financial viability of such high levels of water efficiency measures in new homes; and,
- uptake of retrofitting water efficiency measures considered to be at the maximum achievable (35%) in the county[30].
- It would require:
  - a significant funding pool and a specific joint partnership 'delivery plan' to deliver the extremely high percentage of retrofitting measures required;
  - strong local policy within the Local Plan on restriction of water use in new homes on a district scale which is currently unprecedented in the UK; and,
  - all new development to include water recycling facilities across the district which is currently limited to small scale development in the UK.

The scenario has been developed as a context to demonstrate what is required to achieve the full aspiration of water neutrality.

[28] Building regulations Part G Requirement
[29] proportion of properties within the AWS supply area which have a water meter installed
[30] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2011

High Scenario

The key assumptions for this scenario are:

- A high water neutrality percentage[31] is achieved but requires significant funding and partnership working, and adoption of new local policy which is currently unprecedented in the UK.
- It would require:
  - Uptake of retrofitting water efficiency measures to be very high (25%) in relation to studies undertaken across the UK;
  - a significant funding pool and a specific joint partnership ‘delivery plan’ to deliver the high percentage of retrofitting measures required; and,

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

Medium Scenario

The key assumptions for this scenario are:

- The water neutrality percentage[32] achieved is approximately 50% of the total neutrality target and would require funding and partnership working, and adoption of new local policy which has only been adopted in a minimal number of planning documents in the UK.
- It would require:
  - Uptake of retrofitting water efficiency measures to be reasonably high (20%) in the county[33];
  - a significant funding pool and a specific joint partnership ‘delivery plan’ to deliver the high percentage of retrofitting measures required; and,

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

Low Scenario

The key assumptions for this scenario are:

- The water neutrality percentage[32] achieved is low but would require small scale level of funding and partnership working, and adoption of new local policy which is likely to be easily justified and straightforward for developers to implement; and,
- It would require:
- Uptake of retrofitting water efficiency measures to be fairly low (10%);

[31] WN percentage refers to the percentage of water use savings made by various measures against the total new demand if the business as usual demand were to continue
[32] WN percentage refers to the percentage of water use savings made by various measures against the total new demand if the business as usual demand were to continue
[33] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2011

- a relatively small funding pool and a partnership working not moving too far beyond 'business as usual' for stakeholders; and,

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

4.7.3 *Neutrality Scenario Assessment Results*

For each neutrality scenario, an outline of the required water efficiency specification was developed for new houses, combined with an estimate of the savings that could be achieved through metering and further savings that could be achieved via retrofitting of water efficient fixtures and fittings in existing property. This has been undertaken utilising research undertaken by groups and organisations such as Waterwise East, UKWIR[34], the Environment Agency and Ofwat to determine realistic and feasible efficiency savings as part of developer design of properties, and standards for non-residential properties (see Appendix 5).

To achieve total neutrality, the demand post growth must be the same as, or less than existing demand. Based on estimates of population size, existing demand in Huntingdonshire was calculated to be 20 Ml/d. Demand post growth therefore needs to be below 20Ml/d for water neutrality to be achieved

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

- Stage 1 – total demand post growth without any assumed water efficiency retrofitting for the differing levels of water efficiency in new homes;
- Stage 2 – total demand post growth with effect of metering applied for the differing levels of water efficiency in new homes; and
- Stage 3 – total demand post growth with metering and water efficient retrofitting applied to existing homes for the differing levels of water efficiency in new homes.

The results are shown in Table 4-1. If neutrality is achieved (total demand after metering and water efficient fixtures and fittings is less than 20Ml/d), the result is displayed as green. If it is not, but within 20%, it is displayed as amber, and red if not achieved. The percentage of total neutrality achieved per scenario is also provided.

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

TABLE 4-1: RESULTS OF THE NEUTRALITY SCENARIO ASSESSMENTS

New Homes & Employment Demand Projections	Demand from Growth (Ml/d)	Total demand post growth* (Ml/d)	Total demand after metering effect (Ml/d)	Total demand after metering & WE F&F (Ml/d)	% Neutrality Achieved
Baseline Assumption	5.90	26.10	**25.86**	**25.86**	
Building Regulations	5.63	25.83	**25.00**	**25.00**	14.9%
Low WN Scenario	5.38	25.58	**24.75**	**24.60**	21.9%
Medium WN Scenario	4.73	24.93	**24.09**	**23.19**	47.0%
High WN Scenario	3.51	23.72	**22.88**	**21.02**	85.6%
Very High WN Scenario	2.79	22.99	**22.15**	**19.55**	111.7%

* prior to demand management for existing stock

The results show that total neutrality is achieved by applying the very high scenario only, whilst the high neutrality scenario gives a neutrality percentage of 85.6%; which is close to a neutral water demand position.

4.7.4 *Delivery Requirements – Technological*

The details of what is required technologically from each scenario in terms of new build are included in Table 4-2.

More detail on the specific measures required under each scenario can be found in Appendix 5.

TABLE 4-2: DETAILS OF NEW BUILD SPECIFICATION REQUIRED TO MEET EACH WATER USE TARGET

Component	150 l/h/d Standard Home	Business as usual	Low (120 l/h/d CSH Level 1/2)	Medium (105 l/h/d CSH Level 3/4)	High (80 l/h/d CSH Level 5/6)	Very High
Toilet flushing	28.8	19.2 b	19.2 b	16.8 d	16.8 d	16.8 d
Taps	42.3 a	31.8 a	31.8 a	24.9 a	18 a	18 a
Shower	30	30	24	18	18	18
Bath	28.8 c	25.6 c	25.6 c	25.6 c	22.4 f	22.4 f
Washing Machine	16.7	15.3	15.3	15.3	15.3	15.3
Dishwasher	3.9	3.9	3.6	3.6	3.6	3.6
Recycled water					-16.1 e	-32.2 g
Total per head	150.5	125.8	119.5	104.2	78	61.9
Total per household	325.08	271.728	258.12	225.072	168.48	133.704

- a Combines kitchen sink and wash hand basin
- b 6/3 litre dual-flush toilet (f) recycled water
- c 160 litre bath filled to 40% capacity, frequency of use 0.4/day
- d 4.5/3 litre dual flush toilet
- e Rainwater harvesting
- f 120 litre bath
- g Rainwater/greywater harvesting for toilet and washing machine

4.7.5 *Financial Cost Considerations*

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

It is also important to consider that through using less water, more water efficient homes require less energy to heat water, hence there are energy savings. These elements are broken down in more detail in Appendix 5

The estimated financial cost of delivering the technological requirements of each neutrality scenario has been calculated from available research and published documents. Summary tables below should be reviewed with Appendix 5 for supporting information.

Neutrality scenario costs

Using the information compiled, the financial costs per scenario has been calculated and are included in Table 4-3. It should be noted that these are only estimate costs.

TABLE 4-3: ESTIMATED COST OF NEUTRALITY SCENARIOS

Neutrality Scenario	CSH – Code Level	Outstanding Homes		Existing Properties					Costs Summary		
		Numbers	CSH cost	No. to be metered (10% existing)	Metering cost	Retrofit %	No. to retrofit	Retrofit cost	Developer	Non developer	Total
Low	1 or 2	17,902	-	7,140	£3,569,950	10	7140	£356,995	-	£2,926,945	£3,926,945
Medium	3 or 4	17,902	£2,237,750	7,140	£3,569,950	20	14280	£2,356,167	£2,237,750	£5,926,117	£8,163,867
High	5 or 6 (RWH)	17,902	£47,350,790	7,140	£3,569,950	25	17850	£3,926,945	£47,350,790	£7,496,895	£54,847,685
Very High	5 or 6 (RWH & GWR)	17,902	£71,697,510	7,140	£3,569,950	35	24990	£5,497,723	£71,697,510	£9,067,673	£80,765,183

4.7.6 *Carbon Cost Considerations*

As described in this section, there are sustainability issues to consider when considering a policy for promotion of water efficiency and water neutrality. Reaching the very highest levels of efficiency requires the use of recycling technology (either through rainwater harvesting and treatment or greywater recycling) which requires additional energy both embedded in the physical structures required and also in the treatment process required to make the water usable. More detail is provided in Appendix 5 on the methodology used to calculate carbon equivalents of energy used.

The WRMP Direction 2007[35] and WRP Guideline[36] require details of the greenhouse gas emissions that are likely to arise through the delivery of a water company's proposed WRMP. AWS estimated these from calculation of greenhouse gases as tonnes of carbon dioxide equivalent (tCO2e) for the base year 2011-12 of 180,538 tCO2e for drinking water treatment and distribution. For subsequent years the value of 0.34 tCO2e/Ml has been used with the forecast demand to give the mass of CO2e likely to be emitted on the basis of current technologies. In order to calculate the carbon costs of achieving water efficiency for the proposed growth in Huntingdonshire, the value of 0.34 tCO2e/Ml has been used.

Results

The information was used along with estimates of energy used in recycling technology[37] to provide a carbon cost for each of the WN scenarios for Huntingdonshire. The results are presented in Table 4-4.

The following assumptions have been applied:

- under the 'High' and 'Very high' scenarios, consideration must be taken of carbon use in rainwater harvesting as well as water use;
- A basic assumption that each new home is a $90m^2$ 2-storey house with a small biological system; and,
- insufficient information was available to differentiate between energy used in a building regulations standard home at 125l/h/d and a code level 1 or 2 home on the CSH. Therefore, energy used per home is the same for 'business as usual (i.e. building regulations) and the low WN scenario.

[35] WRMP Regulations Statutory Instrument 2007 No. 727, WRMP Direction 2007, WRMP (No.2) Direction 2007, WRMP (No.2) (Amendment) Direction 2007, WRMP Direction 2008
[36] Water resources planning guideline, Environment Agency, November 2008, http://www.environment-agency.gov.uk/business/sectors/39687.aspx
[37] Environment Agency (2010) Energy and carbon implications of rainwater harvesting and greywater recycling

TABLE 4-4: CARBON COSTS OF WATER NEUTRALITY SCENARIOS							
WN Scenario	**Relevant CSH Target**	**Water Use Reductions from retrofit pre WN Scenario (Ml/d)**	**Carbon reduction per WN scenario (tCO2e/d)**	**Carbon use per New Home (kg/y)**	**Carbon use per New Home (kg/d)**	**Total Carbon use for New Homes in EC (tCO2e/d)**	**Total (tCO2e/d)**
Business as Usual	Building Regs Only	0.0000	0.0000	681	1.8658	17.2060	17.2060
Low	Level 1/2	0.1481	-0.0503	681	1.8658	17.2060	17.1556
Medium	Level 3/4	0.9068	-0.3083	582	1.5945	14.7047	14.3963
High	Level 5/6	1.8622	-0.6332	578	1.5836	14.6036	13.9704
Very High	Level 5/6	2.6071	-0.8864	614.9	1.6847	15.5359	14.6495

The results show that there are significant CO_2 savings to be made by homes being built to a higher water efficiency level and from the effect of existing homes using less energy to heat water through retrofitting of water efficient devices.

The additional energy used per house for RWH in the High scenario is offset by the savings made in using less water in line with Code Level 5/6 on the CSH; however the additional energy required for greywater recycling in the very high scenario makes this scenario higher in CO_2 emissions than both the medium and high WN scenarios. This suggests that in order to meet total neutrality there will be an increase in CO_2 emissions over less intensive WN scenarios and hence there are concerns over the long term sustainability of pursuing such a strategy.

4.7.7 *Preferred Strategy – Delivery Pathway*

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

To achieve any level of neutrality, a series of policies, partnership approaches and funding sources would need to be developed. This WCS has assumed a 'medium' scenario would be favoured and sets out what would be required to support this strategy. The 'medium' WN scenario could allow a WN target of 47% to be reached, but would require funding and partnership working.

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

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

Delivery Requirements – Policy

In order to meet the 'medium' WN scenario, the following measures are suggested to support its delivery.

In order to meet the water neutrality target scenario given above, planning policy should seek to achieve the following:

- Ensure all housing is water efficient, new housing development must go beyond Building Regulations and as a minimum reach water use targets of 105l/h/d.
- Ensure all non-residential development is water efficient and goes beyond Building Regulations and as a minimum reach Good BREEAM status.

Developers should prove that Code Levels 3 or 4 for residential development and Good BREEAM status for non-domestic property water have been met. When considering planning applications for new development (regardless of size), the planning authority and statutory consultees should consider whether the proposed design of the development has incorporated water efficiency measures, including (but not necessarily limited to) garden water butts, low flush toilets, low volume baths, aerated taps, and water efficient appliances sufficient to meet 105l/h/d.

- Carry out a programme of retrofitting and water audits of existing dwellings and non-domestic buildings. Aim to move towards delivery of 20% of the existing housing stock with easy fit water saving devices.
- Establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use.

Undertaking retrofitting and water audits must work in parallel with the promotion and education programme. Further recommendations on how to achieve it are included in Section 4.7.8 below, including recommended funding mechanisms.

4.7.8 *Delivery Requirements – Partnership Approaches*

Housing association partners should be targeted with a programme of retrofitting water efficient devices, to showcase the policy and promote the benefits. This should be a collaborative scheme between the Huntingdonshire District Council, AWS, CW and Waterwise. In addition, RWH/GWR schemes could be implemented into larger council owned and maintained buildings. RWH could be introduced to public toilets, as has been carried out in Cambridge.

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

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

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

- working with AWS and CW to help with its water efficiency initiative, which has seen leaflets distributed directly to customers and at events across the region each year[38];
- a media campaign, with adverts/articles in local papers and features on a local news programme;
- a media campaign could be supplemented by promotional material, ranging from those that directly affect water use e.g. free cistern displacement devices, to products which will raise awareness e.g. fridge magnets with a water saving message;
- encouraging developers to provide new residents with 'welcome packs', explaining the importance of water efficiency and the steps that they can take to reduce water use;
- working with retailers to promote water efficient products, possibly with financial incentives as were undertaken as part of the Preston Water Initiative[39];
- carrying out educational visits to schools and colleges, to raise awareness of water efficiency amongst children and young adults;
- working with neighbourhood trusts, community groups and local interest groups to raise awareness of water efficiency; and,
- carrying out home visits to householders to explain the benefits of saving water, this may not be possible for the general population of Huntingdonshire, but rather should be used to support a targeted scheme aimed at a specific residential group, as was carried out for the Preston Water Initiative[39].

Responsibility

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

It is therefore suggested that responsibility for implementing water efficiency policies be shared as follows:

- responsibility for ensuring planning applications are compliant with the recommended policies lies with Huntingdonshire District Council and Environment Agency (and other statutory consultees as appropriate);
- responsibility for fitting water efficient devices in accordance with the policy lies with the developer, but this should be guided and if necessary enforced by Huntingdonshire District Council through the planning application process (as above);
- responsibility to ensure continuing increases in the level of water meter penetration lies with AWS and CW;
- for privately owned housing stock, responsibility for retrofitting devices lies with home owners, but with guidance and potential financial support from Huntingdonshire District Council for privately owned housing stock;

[38] Anglian Water Services, Water Resource Management Plan, 2010, http://www.anglianwater.co.uk/environment/water-resources/resource-management/
[39] Preston Water Efficiency Report, Waterwise, March 2009, www.waterwise.org.uk

- responsibility for promoting water audits lies with Huntingdonshire District Council. It is suggested that the Council sets targets for the numbers of businesses that have water audits carried out and that a specific individual or team within the Council is responsible for promoting and undertaking water audits and ensuring the targets are met. The same team or individual could also act as a community liaison for households (council and privately owned) and businesses where water efficient devices are to be retrofitted, to ensure the occupants of the affected properties understand the need and mechanisms for water efficiency; and
- responsibility for education and awareness of water efficiency should be shared between Huntingdonshire District Council, AWS, CW and energy companies, as a partnership managed by the Council.

However it should be noted that a major aim of the education and awareness programme, as outlined by Policy Recommendation 2, is to change peoples' attitude to water use and water saving and to make the general population understand that it is everybody's responsibility to reduce water use. Studies have shown that the water efficiencies in existing housing stock achieved by behavioural changes, such as turning off the tap while brushing teeth or reducing shower time, can be as important as the installation of water efficient devices.

Retrofitting funding options

In addition to possible resistance from existing householders, the biggest obstacle to retrofitting is the funding mechanism.

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

Huntingdonshire District Council could consider developer contributions from other sources as set out in the following paragraphs.

Part 11 of the Planning Act 2008[40] (c. 29) ("the Act") provides for the imposition of a charge to be known as Community Infrastructure Levy (CIL). This is a new local levy that authorities can choose to introduce to help fund infrastructure in their area. CIL will help pay for the infrastructure required to serve new development, and although CIL should not be used to remedy pre-existing deficiencies, if the new development makes the deficiency more severe (as is the case with water resources in the Huntingdonshire area) then the use of CIL is appropriate.

Section 106 (S106) of the Town and Country Planning Act 1990[41] allows a local planning authority (LPA) to enter into a legally-binding agreement or planning obligation with a landowner in association with the granting of planning permission, known as a Section 106 Agreement. These agreements are a way of delivering or addressing matters that are necessary to make a development acceptable in planning terms. They are increasingly used to support the provision of services and infrastructure, such as highways, recreational facilities, education, health and affordable housing.

[40] http://www.legislation.gov.uk/ukpga/2008/29/contents
[41] http://www.legislation.gov.uk/ukpga/1990/8/contents

However, there are considerable existing demands on developer contributions and it is unlikely that all of the retrofitting required in Huntingdonshire could be funded through these mechanisms; Huntingdonshire District Council therefore needs to look beyond developer contributions, possibly to the water companies, for further funding sources. Some councils offer council tax rebates to residents who install energy efficient measures (rebates jointly funded by the Council and Energy Company)[42]. Huntingdonshire District Council should consider a similar scheme, although this would require the agreement of AWS and CW.

There are two possible European funding mechanisms available for the promotion of water efficiencies:

- European Investment Bank; and,
- European Regional Development Funds.

The European Investment Bank's lending policy[43] sets out how they will support water efficiency measures by water service providers and grant loans to promote water efficiency in buildings. This could be a possible funding route for a widespread retrofitting programme.

European Regional Development Funds are more limited, as funds are often preferentially directed towards energy efficiency projects, with the aim of reducing carbon emissions to achieve European targets. Allocated funding for the current programming period (2007 to 2013 are mainly allocated to such projects[44], although the possibility for funding water efficiency project post-2013 should be investigated.

Retrofitting monitoring

During delivery stage, it will be important to ensure sufficient monitoring is in place to track the effects of retrofitting on reducing demand from existing housing stock. The latest research shows that retrofitting can have a significant beneficial effect and can be a cost effective way of managing the water supply-demand balance[45]. However, it is acknowledged that savings from retrofitting measures do diminish with time. This means that a long-term communication strategy is also needed to accompany any retrofit programme taken forward and this needs to be supported by monitoring so that messages can be targeted and water savings maintained in the longer-term. The communication and monitoring message also applies to new builds to maintain continued use of water efficient fixtures and fittings.

4.8 Water Supply and Climate Change Adaption

Table 4-5 provides a summary of the potential climate change adaptation and mitigation measures that could be considered in the Huntingdonshire District with regards to water resources and water supply infrastructure. The organisations likely to be responsible for leading these measures have been identified alongside the suggested timescale for these actions to start being taken forward (Immediate, Medium (1 - 10 years) and Long (10+ years).

[42] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010
[43] http://www.eib.org/attachments/strategies/water_sector_lending_policy_2008_en.pdf
[44] Ensuring Water for All, Scoping Study Final Report, Environment Agency, 2010

[45] Waterwise (2011): Evidence base for large-scale water efficiency, Phase II Final report

TABLE 4-5: WATER RESOURCES POTENTIAL CLIMATE CHANGE ADAPTION AND MITIGATION MEASURES[46]

Potential Climate Change	Potential Impact	Adaption and Mitigation Measures	Lead Organisation (s)				Timescale for Action
			HDC	EA	AWS	NE	
Temperature Rise	• Increase in demand for water in summer • Increased evapotranspiration • Increased peak demand • Faster water supply asset deterioration • Changes in process efficiency	Ensure regional drought plans take into account the impacts of climate change		✓	✓		Medium
		Adapt to seasonal changes in climate by appropriately managing summer peaks in demand for water	✓		✓		Medium
		Contribute to managing water demand through increased water efficiency in homes, businesses, industry and agriculture and promotion of water efficiency measures	✓	✓	✓		Immediate
Winter rainfall increase	• Opportunity for more water storage • Inadequate pump capacity for raw water • Increased diffuse pollution	Adapt to seasonal changes in climate by providing appropriate winter storage capacity			✓		Medium
		Ensure adequate pump capacity for winter storage requirements where appropriate			✓		Medium
		Where possible, control diffuse pollution runoff through SuDS, particularly for new / redevelopment close to river and water bodies	✓	✓	✓	✓	Immediate
Summer rainfall decrease	• More frequent low river flows • Increased competition for water • Increased peak demand • Changing customer expectations	Adapt to seasonal changes in climate by appropriately managing summer peaks in demand for water	✓		✓		Medium
		Contribute to managing water demand through increased water efficiency in homes, businesses, industry and agriculture and promotion of water efficiency measures	✓	✓	✓		Immediate
		Ensure that water abstraction is sustainable through monitoring		✓	✓		Medium
Sea level rise	• Saline intrusion • Asset loss	Monitor water quality and adapt abstraction and water treatment as appropriate		✓	✓		Medium
		Ensure that key assets where appropriate, are resilient to the impacts of sea level rise		✓	✓		Long
Increase in weather extremes (heatwaves, intense rainfall, storms)	• Increased run-off reduces recharge of aquifers • Decrease in raw water quality – increased treatment cost • Increased flooding and risk of service loss • Increased flooding and risk of service loss • Increased subsidence – pipe failure • Increased contamination • Peak demand delivery during heat waves	Improve resilience, where appropriate of key water supply assets such as pumps, including new industry design standards for water assets			✓		Medium
		Where possible, control diffuse pollution runoff through SuDS, particularly for new / redevelopment close to river and water bodies	✓	✓	✓	✓	Immediate
		Improve RBMP Programme of Measures to ensure WFD objectives are met and include climate change allowance		✓			Medium

[46] Some inputs edited from AWS Strategic Direction Statement 2010 – 2035 http://www.anglianwater.co.uk/about-us/statutory-reports/strategic-direction/

5 SETTLEMENT AREA ASSESSMENTS

5.1 Introduction

Following the assessment of wastewater treatment capacity and water resources at the district level, this section of the WCS addresses infrastructure capacity issues related to site specific locations.

The assessment of capacity has been undertaken on a site by site basis, as it has not been possible for the stakeholders to model and assess the impact of the many different permutations of how development sites will eventually come forward. Therefore, the statements on capacity should only be taken as an indicative assessment of constraints at the time of Local Plan making, made to inform the allocation of sites. Each developer for each development site will still need to request pre-planning enquiries from the infrastructure provider to confirm capacity and any specific solutions required before proceeding with site plans and designs, and any subsequent planning application.

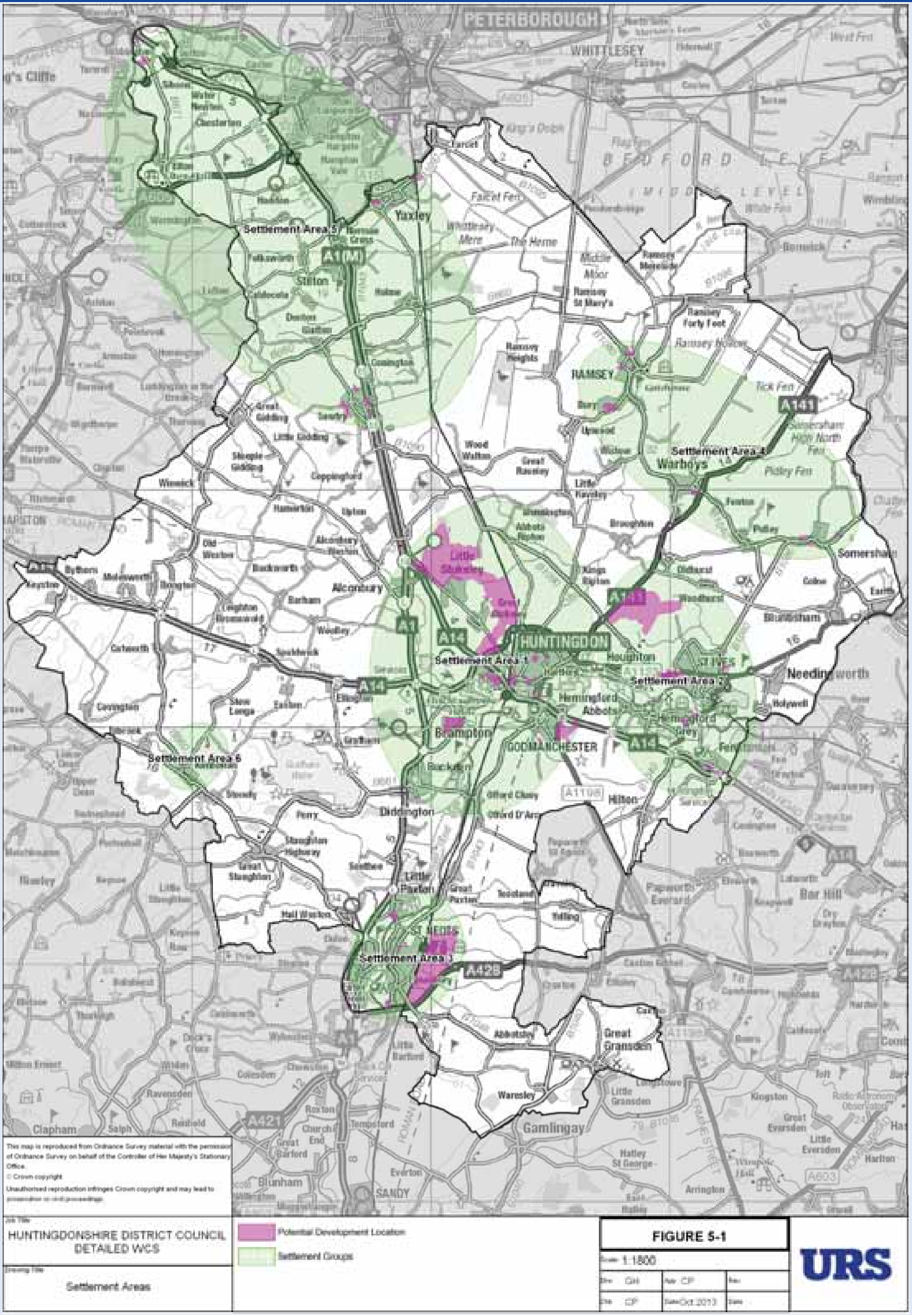
5.2 Settlement Areas in Huntingdonshire

In order to assess the potential development sites across Huntingdonshire District Council, the sites have been grouped together into 'Settlement Areas' based on their geographical location. Each site has then been individually assessed, within each of these settlement areas.

Five settlement areas have been defined as shown in Figure 5-1.

- Settlement Area 1 – Huntingdon (encompasses Huntingdon, Brampton, Godmanchester, Alconbury and Buckden)
- Settlement Area 2 – St Ives (encompasses St Ives and Fenstanton)
- Settlement Area 2 – St Neots (encompasses St Neots and Little Paxton)
- Settlement Area 4 – Ramsey (encompasses Ramsey, Warboys, Oldhurst and Somersham)
- Settlement Area 5 – Yaxley (encompasses Holme, Yaxley and Sawtry)
- Settlement Area 6 - Kimbolton

FIGURE 5-1: SETTLEMENT AREAS IN HUNTINGDONSHIRE



5.3 Site Specific Assessment Methodologies

5.3.1 *Wastewater Network*

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

An assumption has been applied that it is preferential from a cost and phasing perspective to use capacity within the existing sewer network first, before new sewers are built and commissioned.

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

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

The results are presented for each of the Settlement Areas in the following sections. A RAG assessment has been undertaken; a key indicating the coding applied to each assessment is provided in Table 5-1.

TABLE 5-1: KEY FOR WASTEWATER NETWORK RAG ASSESSMENT	
When all growth in the catchment comes on line, there may be a capacity issue in the network; a pre-planning enquiry is recommended before planning permission is granted	**There is limited capacity in network, and solution is not yet identified.**

5.3.2 *Water Supply*

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

AWS and CW have undertaken an internal assessment of the capacity of the water supply system using local operational knowledge. A RAG assessment has been undertaken; a key indicating the coding applied to each assessment is provided in Table 5-2.

TABLE 5-2: KEY FOR WATER SUPPLY NETWORK RAG ASSESSMENT		
Capacity available to serve the proposed growth	**Infrastructure and/or treatment upgrades required to serve proposed growth or diversion of assets may be required**	**Major consents to the provision of infrastructure and/or treatment to serve proposed growth**

5.3.3 *Flood Risk*

Fluvial and Tidal

The flood risk to each of the proposed development sites has also been considered using the Environment Agency Flood Maps. The landuse cover information has also been identified to establish what restriction to runoff rates may be required.

Surface Water Flood Risk

A County wide Surface Water Management Plan (SWMP) has been undertaken by Cambridgeshire County Council, as Lead Local Flood Authority (LLFA). Wetspots have been identified across the study area and have then been ranked. Within the 'Top Ten' wetspots identified, six have been identified in Huntingdonshire District Council:

- St Neots,
- Huntingdon;
- St Ives;
- Sawtry;
- Offord Cluny; and,
- Godmanchester.

Cambridgeshire County Council has undertaken a detailed SWMP for St Neots, which was published in June 2012.

Surface water flooding has only been reviewed on a Settlement Area basis to provide an overview, as the Flood Map for Surface Water (FMfSW) cannot be used on an individual site basis.

Information has also been supplied by the Middle Level Commissioners on specific surface water flooding issues within their area of jurisdiction.

5.3.4 *Surface Water Management*

Surface water drainage methods that take account of run-off rates, water quality, pollution control, biodiversity and amenity issues are collectively referred to as Sustainable Drainage Systems (SuDS). Sustainable surface water management takes account of long term environmental and social factors in designing a surface water drainage system that avoids the problems of flooding, pollution or damage to the environment that may occur with conventional surface water management systems.

Local planning policy requires that proposed development does not result in an increase in surface water runoff. The Middle Level Commissioners have also advised that for watercourses under their jurisdiction, there is no additional capacity in the system and run-off post development must be at existing runoff rates (where a site is currently undeveloped) unless the IDB explicitly requires surface water to be released early to avoid peak floods.

In order to ensure this, attenuation of runoff is required to manage surface water runoff generated during the 1% annual probability storm event, inclusive of climate change.

In addition to local policy and IDB requirements, the NPPF sets out that proposed development should ensure runoff rates from the development are no greater than pre-development rates.

Specifically within the Middle Level Commissioners area, the use of SuDS needs to be considered carefully as the preferred option is not always the most suitable. Careful consideration needs to be given to the facility to be used, what is trying to be achieved and the nature of water level management in the area.

Adoption and Maintenance of SuDS

Under the Flood and Water Management Act, responsibility for the adoption and maintenance of SuDS systems has been clarified. Before the implementation of the Act, maintenance and responsibility for SuDS systems in developments was inconsistent with some SuDS systems becoming ineffective some time before their design life was exceeded due to inadequate maintenance.

The Act will confirm the exact arrangement for adoption and maintenance of SuDS systems in 2014, but for the purposes of this Detailed Stage 2 WCS it should be assumed that:

- Cambridgeshire County Council will become responsible for the adoption and maintenance of new build SuDS;
- Cambridgeshire County Council will become the SuDS approving body (SAB) for all new build SuDS which meet the required design standards;
- the requirements for approving new build SuDS will be outlined in forthcoming national standards on the construction and operation of surface water drainage; and,
- the current right to connect new developments to the existing public surface water sewerage network has been revoked and new surface water drainage systems will need to be approved in line with the National Sustainable Drainage Standards before any connection to the public sewerage network is allowed.

In light of the change in SuDS approval and maintenance, this WCS has undertaken a high level review of issues affecting potential SuDS options at specific sites, including:

- infiltration limitations (affecting some infiltration techniques);
- Environment Agency Flood Zone (potentially affecting space for surface attenuation features; and,
- groundwater protection issues (see next sub-section).

SuDS and Groundwater Protection

When considering infiltration SuDS, developers should consider the following with respect to protection of water quality in aquifers in the study area. The water environment is potentially vulnerable (for several of the growth area zones) and there is an increased potential for pollution from inappropriately located and/or designed infiltration SuDS.

The majority of Huntingdonshire District Council is not located within an Environment Agency Source Protection Zone (SPZ). However, there are a small number of potential development sites in St Ives and St Neots which do fall within a SPZ, and which should be taken into account when designing SuDS. Where a site has been indicated to fall within a SPZ, it has been identified in the individual site assessments SuDS constraints column. More information on SuDS is available in the SuDS Manual produced by Cambridgeshire County Council.

- Soakaways and other infiltration SuDS must not be constructed in contaminated ground. The use of infiltration drainage would only be acceptable if a phased site investigation (in line with CLR11, 'Model Procedures for the Management of Land Contamination') showed the presence of no significant contamination. The use of non-infiltration SUDS may be acceptable subject to agreement with the Environment Agency.
- The Environment Agency considers that deep boreholes and other deep soakaways systems are not appropriate in areas where groundwater constitutes a significant resource. Deep soakways increase the risk of groundwater pollution.

5.4 Ecological Opportunities associated with Development Areas

There are a number of potential opportunities which are available to enhance the biodiversity of Huntingdonshire through initiatives associated with the WCS. The ecological opportunities available have been assessed within each of the Settlement Areas identified.

5.5 Settlement Area 1 – Huntingdon (including Buckden, Godmanchester, Brampton, Offord d'Arcy)

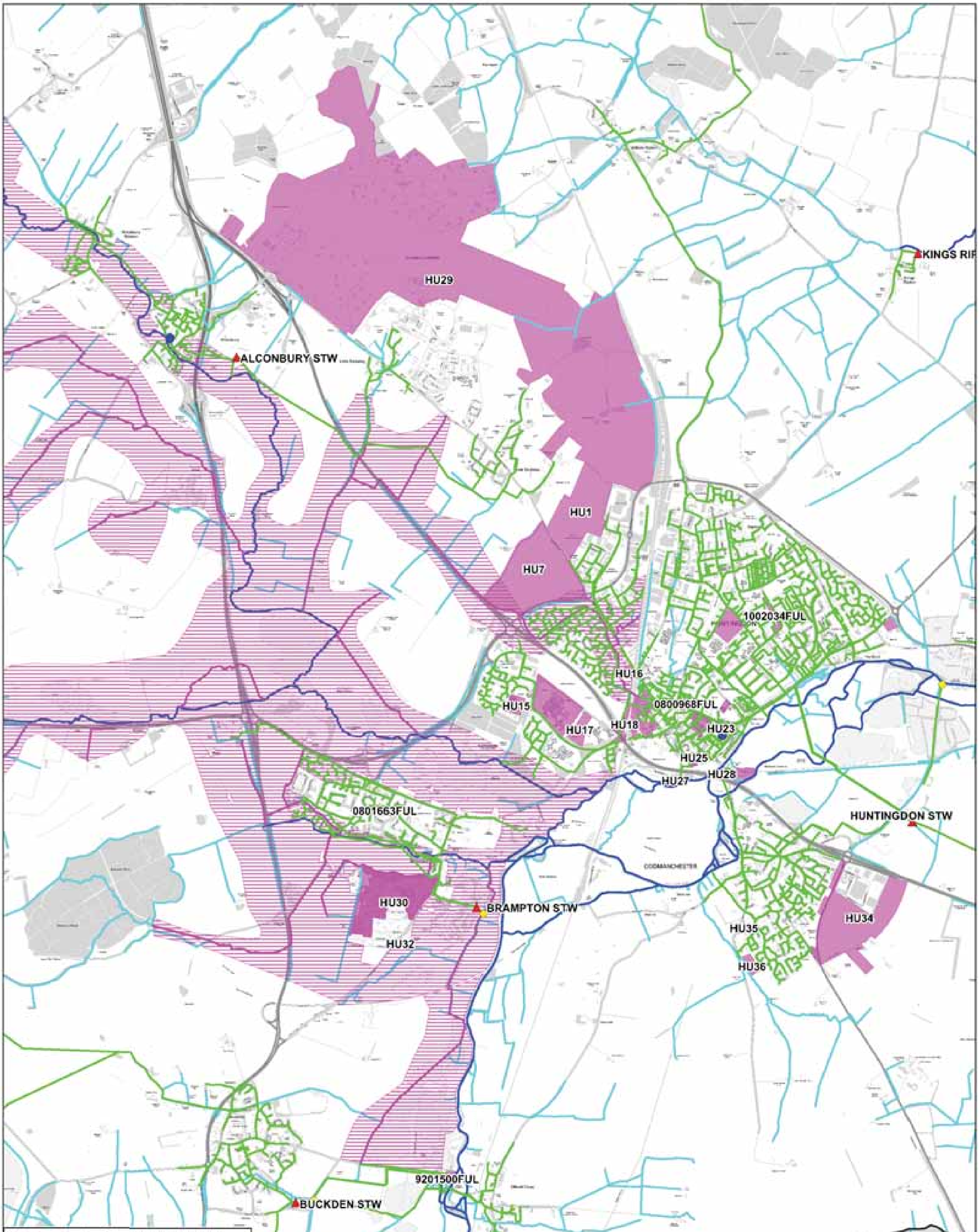
5.5.1 *Water Cycle Constraints*

TABLE 5-3: CONSTRAINTS ASSESSMENT – AREA 1

Water Cycle Topic	**Summary**	**Overall Assessment**
Water Resources and Water Supply	Huntingdon falls within the Ruthamford South RZ which is forecast to have a deficit of 35Ml/d by the end of the Water Company planning period in 2040, although schemes have been identified to help maintain the supply-demand balance within the WRZ. Water efficiency should be considered for development in this settlement area.	
Wastewater Treatment and Water Quality	Huntingdon WwTW has capacity to accommodate the predicted growth up to and including 2021/22. A change in discharge consent is required beyond this date to allow for the projected growth but changes required to meet water quality standards under the WFD are achiveable.	
	Brampton WwTW has capacity to accommodate the predicted growth. A change in discharge consent is not required for the projected growth.	
	Buckden WwTW has capacity to accommodate the small amount of predicted growth. A change in discharge consent is not required for the projected growth.	
Surface Water Flood Risk	The FMfSW identifies some areas in Huntingdon more susceptible to surface water flooding. The Cambridgeshire SWMP has ranked Huntingdon and Godmanchester in the top ten wetspots identified. The FMfSW highlights significant flooding within Buckden associated with the numerous surface water drainage ditches in the area. No sites are within a SPZ.	
Ecology and Biodiversity	The development areas around Buckden/Huntingdon/Brampton are not identified as being directly linked to any corridors or strategic greenspace identified within the Cambridgeshire Green Infrastructure Strategy, but the sites have potential for the enhancement of ecological value through new SuDS opportunities linked to the new development which could provide habitat for Cambridgeshire BAP species and habitats such as grazing marsh, great crested newt or water vole.	

5.5.2 *Potential Development Sites*

The location of potential development sites in Settlement Area 1 are shown in Figure 5-2



Potential Development Location	Main River
Alconbury & Ellington IDB	Drain
Alconbury & Ellington IDB Drain	Sewer Pipe
DG5 Sewer Flooding	WwTW Discharge Locat
	WwTW Location

Job Title
HUNTINGDONSHIRE DISTRICT COUNCIL
DETAILED WCS

Drawing Title
Settlement Area 1
Huntingdon

FIGURE 5-2

Scale 1:350			
Drw GH	App CP	Rev	
Chk CP	Date Oct 2013	Date	

URS

5.5.3 ***Settlement Area 1: Individual Site Assessments***

TABLE 5-4: SETTLEMENT AREA 1 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis (water supply and foul drainage)		Flood Risk and Surface Water Management					
Site Name / Ref	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
0801663FUL, 115 High Street, Brampton	12	0.23	AWS	Brampton	This site may require a local reinforcement main and this scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to deliver this scheme is in the order of 6 months.	Existing connections with moderate increase in foul flows. Pre-planning enquiry required to confirm capacity taking into account other growth in catchment	Unknown	FZ 1	Current runoff rate must not be exceeded	Alconbury Brook	River Terrace Deposits	
0800968FUL, Brookside, Huntingdon	43	0.69	AWS	Huntingdon		Significant increase in flows - This site may require a local reinforcement main and this scheme would only go ahead once a requisition or firm commitment has been received from the developer. Pre-planning enquiry required to confirm capacity and timescales for solution		FZ 3	No increase in flows above previously agreed restricted discharge	Long Moor Baulk / Barracks Brook	Clay	Space for surface attenuation SuDS may be limited due to location within FZ 3. Infiltration SuDS may not be possible due to geology.
9201500FUL, Mill Road Buckden	4	1.44	AWS	Buckden		Existing connection with no significant increase in foul flows. However, Pre-planning enquiry required to confirm capacity taking into account other growth in catchment	Controlled connection to Watercourse	FZ3	Current runoff rate	River Great Ouse	Alluvium	
101193FUL, Primrose Lane, Huntingdon	36	0.72	AWS	Huntingdon	This site will require a reinforcement main approximately 340m in length. This scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to deliver this scheme is in the order of 3 to 6 months.	Existing connection with no significant increase in foul flows. However, Pre-planning enquiry required to confirm capacity taking into account other growth in catchment	Development would not be able to utilise existing surface water network without increasing flood risk.	FZ 1	Current runoff rate	River Great Ouse	River Terrace Deposits	

TABLE 5-4: SETTLEMENT AREA 1 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis (water supply and foul drainage)		Flood Risk and Surface Water Management					
Site Name / Ref	No. of Dwellings (residual)	Total Site Area (Ha)	Water Supply Company	WwTW	Water Supply Network RAG Assessment & Description of potential connection	Foul Sewerage Network Capacity	Surface Water Network Capacity	EA Flood Zone	Restriction of Runoff Rate	Potential receiving watercourse/ IDB Drain	Geology	SuDS Constraints
1002034FUL, Buttsgrove Way, Huntingdon	22	1.70	AWS	Huntingdon	Some local reinforcements maybe required but this scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to deliver this scheme is in the order of 3 months.	Assumes development was envisaged in existing sewerage design. However, Pre-planning enquiry required to confirm capacity taking into account other growth in catchment		FZ 1	Current runoff rate	River Great Ouse	Till	
Washingley Farm, Huntingdon (HU1)	400	32.81	AWS	Huntingdon	Contribution towards the Wing Strategic main scheme required.	Will require increase in FW network capacity and this scheme would only go ahead once a requisition or firm commitment has been received from the developer. Pre-planning enquiry required to confirm capacity and timescales for solution.		FZ1	Current runoff rate	River Great Ouse	Clay	Infiltration SuDS may not be possible due to geology.
South of Ermine Street, Huntingdon (HU7)	1050	51.82	AWS	Huntingdon	This development will require a new pumping station and 850m of off-site main from Saply WT to the development. The estimated timescale to deliver these schemes upon receipt of requisition is up to 12 months. Contribution towards the Wing Strategic main scheme required.	May require increase in FW network capacity. Local reinforcements may be required - However, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ 1	No increase in flow	River Great Ouse	Clay	Infiltration SuDS may not be possible due to geology.
California Road, Huntingdon (HU11)	210	5.54	AWS	Huntingdon	Contribution towards the Wing Strategic main scheme required.	No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ 1	Current runoff rate	River Great Ouse	Clay	Infiltration SuDS may not be possible due to geology.
Former Forensic Science Laboratory, Huntingdon (HU15)	55	2.70	AWS	Huntingdon	Contribution towards the Wing Strategic main scheme required.	No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment	Development would not be able to utilise existing surface water network without increasing flood risk.	FZ 1	Current runoff rate	Alconbury Brook	Till	

TABLE 5-4: SETTLEMENT AREA 1 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis (water supply and foul drainage)		Flood Risk and Surface Water Management						
Site Name / Ref	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
South of Fern Court, Huntingdon (HU16)	70	0.82	AWS	Huntingdon	Contribution towards the Wing Strategic main scheme required.	No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ 1	No increase in flow	Long Moor Baulk / Barracks Brook	Clay	Infiltration SuDS may not be possible due to geology.
Constabulary land, Hinchingbrooke Park Road, Huntingdon (HU17)	45	3.87	AWS	Huntingdon	Contribution towards the Wing Strategic main scheme required.			FZ 1	No increase in flow	Long Moor Baulk / Barracks Brook	Till	
George Street/ Ermine Street, Huntingdon (HU19)	200	7.80	AWS	Huntingdon	Contribution towards the Wing Strategic main scheme required.			FZ 1,2	No increase in flow	Long Moor Baulk / Barracks Brook	Till	
Fire Station, Huntingdon (HU23)	20	0.47	AWS	Huntingdon			Development would not be able to utilise existing surface water network without increasing flood risk.	FZ 3	No increase in flow	Long Moor Baulk / Barracks Brook	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 3.
St Mary's Street, Huntingdon (HU25)	14	0.08	AWS	Huntingdon				FZ 1	Current runoff rate	River Great Ouse	River Terrace Deposits	
Red Cross Site and Spiritualist Church, Huntingdon (HU26)	10	0.26	AWS	Huntingdon				FZ 1	Current runoff rate	River Great Ouse	River Terrace Deposits	
Gas Depot, Mill Common, Huntingdon (HU27)	20	0.63	AWS	Huntingdon	This site will require a reinforcement main approximately 150m in length (would involve crossing the A14). This scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to delivery is unknown		Development would not be able to utilise existing surface water network without increasing flood risk.	FZ 2,3	Current runoff rate	Alconbury Brook	Clay	Space for surface attenuation SuDS may be limited within FZ 2 and 3.Infiltration SuDS may not be possible due to geology.

TABLE 5-4: SETTLEMENT AREA 1 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis (water supply and foul drainage)		Flood Risk and Surface Water Management					
Site Name / Ref	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
Tyrell's Marina, Godmanchester (HU28)	15	0.30	AWS	Huntingdon		Limited local network capacity – local reinforcement may be required This scheme would only go ahead once a requisition or firm commitment has been received from the developer. Pre-planning enquiry required to confirm capacity and timescales for solution.	Development would not be able to utilise existing surface water network without increasing flood risk.	FZ 3	Current runoff rate	River Great Ouse	Alluvium	Space for surface attenuation SuDS may be limited within FZ 3.
Alconbury Weald (HU29)	5000	578	AWS	Huntingdon	The first phases of this development will need a new local water booster station constructed. Then to supply the whole site will require 3.5km of off-site main from Sapley WR to the development, 10km of off-site main from Buckden village to Sapley WR	Pre-planning enquiry required to confirm capacity and timescales for solution.	N/A	FZ1	Current runoff rate	River Great Ouse	Clay	Infiltration SuDS may not be possible due to geology.
RAF Brampton (HU 30)	400	34.31	AWS	Brampton	Contribution towards the Wing Strategic main scheme required.	May require increase in network capacity or new sewerage direct to WWTW. This scheme would only go ahead once a requisition or firm commitment has been received from the developer. Pre-planning enquiry required to confirm capacity and timescales for solution.	Development would not be able to utilise existing surface water network without increasing flood risk.	FZ1,2,3	Current runoff rate	River Great Ouse	Clay	Infiltration SuDS may not be possible due to geology.
Bearscroft Farm, Godmanchester (HU34)	750	45.36	AWS	Huntingdon	This will require a new pumping station and 100m of off-site main The estimated timescale to deliver this scheme upon receipt of requisition is up to 12 months. Contribution towards the Wing Strategic main scheme required.	May require increase in FW network capacity - Pre-planning enquiry required to confirm capacity and timescales for solution.	Development would not be able to utilise existing surface water network without increasing flood risk.	FZ1	Current runoff rate	Stoneyhill Brook (Great Ouse)	Clay	Infiltration SuDS may not be possible due to geology.

TABLE 5-4: SETTLEMENT AREA 1 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis (water supply and foul drainage)		Flood Risk and Surface Water Management					
Site Name / Ref	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
Wigmore Farm Buildings, Godmanchester (HU35)	15	0.73	AWS	Huntingdon		No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment	Development would not be able to utilise existing surface water network without increasing flood risk.	FZ1	Current runoff rate	Stoneyhill Brook (Great Ouse)	River Terrace Deposits	
North of Clyde Farm, Godmanchester (HU36)	35	2.14	AWS	Huntingdon	Some local reinforcements maybe required but this scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to deliver this scheme is in the order of 6 months. Contribution towards the Wing Strategic main scheme required.		Development would not be able to utilise existing surface water network without increasing flood risk.	FZ2	Current runoff rate	Stoneyhill Brook (Great Ouse)	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 2.
RGE Engineering, Godmanchester	70	2.56	AWS	Huntingdon	This development will require 300m of off-site reinforcement main along Causeway. This scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to deliver this scheme is known		Development would not be able to utilise existing surface water network without increasing flood risk.	FZ2,3	Current runoff rate	River Great Ouse	Alluvium	Space for surface attenuation SuDS may be limited within FZ 2 and 3.

5.6 Settlement Area 2 – St Ives (including Fenstanton)

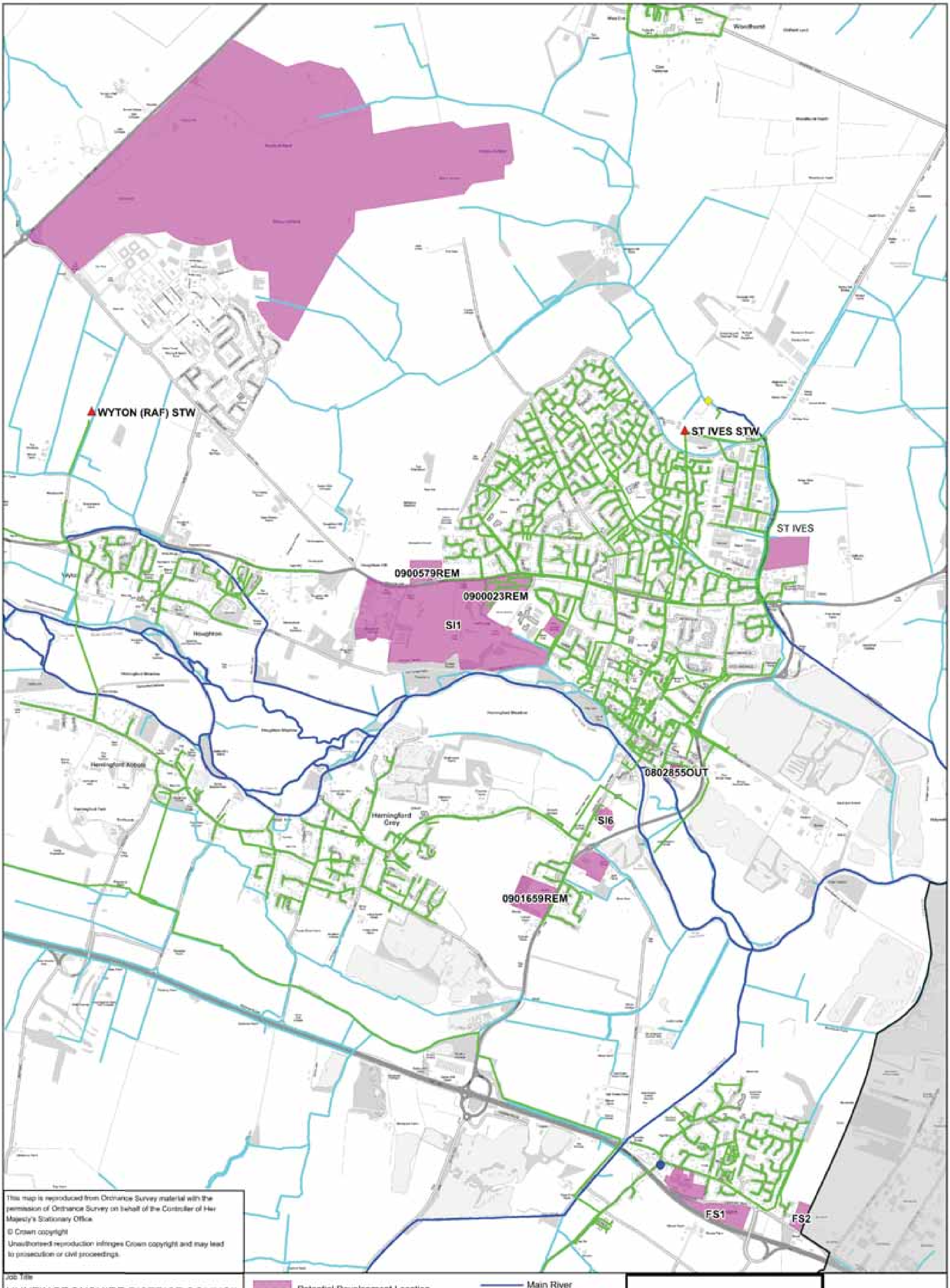
5.6.1 *Water Cycle Constraints*

TABLE 5-5: CONSTRAINTS ASSESSMENT – AREA 2

Water Cycle Topic	Summary	Overall Assessment
Water Resources and Water Supply	St Ives falls within CW's WRMP which predicts supply-demand balance surplus for the Water Company planning period. Further analysis would be required of the water supply network when detailed development plans received. Possible reinforcement of local mains, mains diversion and wider network maybe required along with upgrading or new boosters, increased or new storage capacity.	
Wastewater Treatment and Water Quality	Huntingdon WwTW has capacity to accommodate the predicted growth up to and including 2021/22. A change in discharge consent is required beyond this date to allow for the projected growth which includes the proposed Wyton site; however, changes required are within the achievable limits and hence a potential solution is available.	
	St Ives WwTW has capacity to accommodate the predicted growth. A change in discharge consent is not required for the projected growth.	
Surface Water Flood Risk	The FMfSW identifies some areas in St Ives more susceptible to surface water flooding. The Cambridgeshire SWMP has ranked St Ives in the top ten wetspots identified. The FMfSW highlights the most significant flooding south and east of St Ives, associated with the numerous surface water drainage ditches in the area. There are sites in SPZ 1, 2 and 3.	
Ecology and Biodiversity	Site SI1 is immediately adjacent to the Ouse Valley Strategic Greenspace Corridor. This site therefore has potential for the enhancement of ecological value through new SuDS opportunities linked to the new development which could provide habitat for Cambridgeshire BAP species and habitats such as grazing marsh, great crested newt or water vole and enhancements to the river itself such as wet woodland, reedbed, flood meadow and backwaters to the main river.	

5.6.2 *Potential Development Sites*

The location of potential development sites in Settlement Area 2 are shown in Figure 5-3



Job Title
HUNTINGDONSHIRE DISTRICT COUNCIL
DETAILED WCS

Drawing Title
Settlement Area 2
St Ives

Legend	
Potential Development Location	Main River
Alconbury & Ellington IDB	Drain
Alconbury & Ellington IDB Drain	Sewer Pipe
DG5 Sewer Flooding	WwTW Discharge Loca
	WwTW Location

FIGURE 5-3

Scale 1:200		
Drw GH	App CP	Rev
Chk CP	Date Oct 2013	Date

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5.6.3 ***Settlement Area 2: Individual Site Assessments***

TABLE 5-6: SETTLEMENT AREA 2 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis – AWS		Flood Risk and Surface Water Management					
Site	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
0900579REM, Slepe Meadow, St Ives	86	2.86	CW	St Ives	This development is currently under construction and commitments have been made to the developer (Taylor Wimpey) for 102 properties.	Assumes foul flows pumped to network, with significant increase in foul flows; local reinforcement may be required. This scheme would only go ahead once a requisition or firm commitment has been received from the developer. Pre-planning enquiry required to confirm capacity and timescales for solution.	Unknown	FZ1	Current runoff rate	River Great Ouse	Clay	Infiltration SuDS may not be possible due to geology.
0900023REM, St Ives Golf Course, St Ives	128	4.72	CW	St Ives	Whilst there is no spare capacity for new properties in this zone on a peak day, this does not mean that new development cannot be supplied. Each development would be considered on a first come first served basis, significant reinforcement of our existing network, storage sites, pumping stations or booster stations may be required to enable the development to be served and ensure that our existing customers continue to receive the same level of service.	No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ1	Current runoff rate	River Great Ouse	Clay	Infiltration SuDS may not be possible due to geology.
0901659REM, Former Jewsons, London Road, St Ives	185	5.22	AWS	St Ives	This site may require an off-site reinforcement main approximately 750m in length. This scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to deliver this scheme is in the order of 3 to 6 months.	Substantial increase in foul flows. Offsite reinforcement required to ensure no deterioration. This scheme would only go ahead once a requisition or firm commitment has been received from the developer. Pre-planning enquiry required to confirm capacity and timescales for solution	Development would not be able to utilise existing surface water network without increasing flood risk.	FZ3 (Benefits from defences)	Current runoff rate	River Great Ouse	River Terrace Deposits	The site lies within an Outer (Zone 2) SPZ. Space for surface attenuation SuDS may be limited within FZ 3.

TABLE 5-6: SETTLEMENT AREA 2 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis – AWS		Flood Risk and Surface Water Management					
Site	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
1101075FUL, South of New, St Ives	14	0.57	CW	St Ives	Commitment has been made to the developer (Amber Homes) for 15 properties.	Existing connection, with moderate increase in foul flows. Pre-planning enquiry required to confirm capacity taking into account other growth in catchment		FZ3 (Benefits from defences)	Current runoff rate	Old River / River Great Ouse	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 3.
St Ives West, St Ives (SI1)	500	50.3	AWS/CW	St Ives	Development crosses Anglian Water's statutory water supply area. If supplied from Anglian Water network would require 550m of off-site reinforcement main. This scheme would only go ahead once a requisition or firm commitment has been received from the developer.	May require increase in FW network capacity. Pre-planning enquiry required to confirm capacity and timescales for solution		FZ1	Current runoff rate	River Great Ouse	Clay	The south of the site lies within a Total Catchment (Zone 3) SPZ. Infiltration SuDS may not be possible due to geology.
Vindis Car Showroom, St Ives	50	2.76	CW	Huntingdon		No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ3	Current runoff rate	River Great Ouse	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 3.
St Ives Football Club, Westwood Road, St Ives	50	1.38	CW	St Ives				FZ1	Current runoff rate	River Great Ouse	Clay	Infiltration SuDS may not be possible due to geology.
Former Dairy Crest Factory, Fenstanton	90	3.17	CW	Huntingdon				FZ1	Current runoff rate	Hall Green Brook	River Terrace Deposits	
Cambridge Road, Fenstanton (FS1)	65	3.96	CW	Huntingdon	Whilst there is no spare capacity for new properties in this zone on a peak day, this does not mean that new development cannot be supplied. Each development would be considered on a first come first served basis, significant reinforcement of our existing network, storage sites, pumping stations or booster stations may be required to enable the development to be served and ensure that our existing customers continue to receive the same level of service.	Assumes foul flows pumped to network - Pre-planning enquiry required to confirm capacity and timescales for solution.	Unknown	FZ1	Current runoff rate	Hail Green Brook	River Terrace Deposits	The site lies within a Total Catchment (Zone 3) SPZ.

TABLE 5-6: SETTLEMENT AREA 2 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis – AWS		Flood Risk and Surface Water Management					
Site	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
Ivy Nursery, Fenstanton (FS2)	30	1.48	CW	Huntingdon	Whilst there is no spare capacity for new properties in this zone on a peak day, this does not mean that new development cannot be supplied. Each development would be considered on a first come first served basis, significant reinforcement of our existing network, storage sites, pumping stations or booster stations may be required to enable the development to be served and ensure that our existing customers continue to receive the same level of service.	Assumes foul flows pumped to network. Pre-planning enquiry required to confirm capacity taking into account other growth in catchment	Development would not be able to utilise existing surface water network without increasing flood risk.	FZ1	Current runoff rate	Moore Brook	River Terrace Deposits	The site lies within a Total Catchment (Zone 3) SPZ.
Wyton Airfield, Wyton on the Hill (WT1)	3750	266	AWS	Huntingdon	The first phases of the development can be supplied from the existing network. However, to supply the whole of the site will require approximately 5.5km of off-site reinforcement main. The estimated timescale to deliver this scheme will be determined once a requisition or firm commitment has been received from the developer.	Capacity upgrade required to connect to Huntingdon WwTW. This scheme would only go ahead once a requisition or firm commitment has been received from the developer. Pre-planning enquiry required to confirm capacity and timescales for solution		FZ1	Current runoff rate	Back Brook	Clay	Infiltration SuDS may not be possible due to geology.

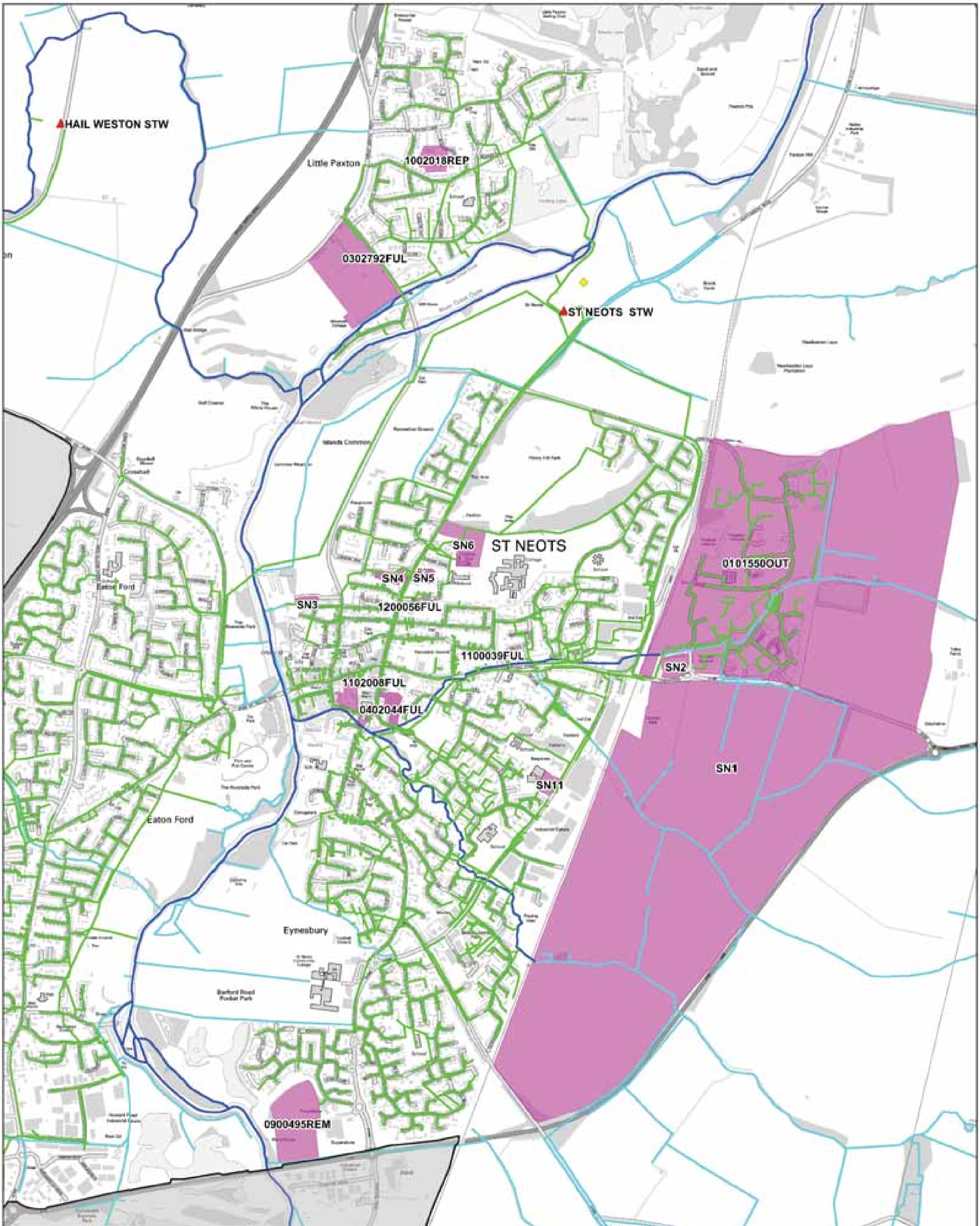
5.7 Settlement Area 3 – St Neots (including Little Paxton)

5.7.1 *Water Cycle Constraints*

TABLE 5-7: CONSTRAINTS ASSESSMENT – AREA 3		
Water Cycle Topic	**Summary**	**Overall Assessment**
Water Resources and Water Supply	St Neots falls within the Ruthamford South RZ which is forecast to have a deficit of 35Ml/d by the end of the Water Company planning period in 2040, although schemes have been identified to help maintain the supply-demand balance within the WRZ. Water efficiency should be considered for development in this settlement area.	
Wastewater Treatment and Water Quality	St Neots WwTW does not have capacity to accommodate all of the predicted growth. A change in discharge consent would be required for the projected growth, but this would be achievable within the limits of conventional treatment and hence would not impact on attainment of WFD water quality objectives.	
Surface Water Flood Risk	The FMfSW identifies some areas in St Neots more susceptible to surface water flooding. The Cambridgeshire SWMP has ranked St Neots in the top ten wetspots identified. A detailed SWMP has been undertaken for St Neots and should be consulted when undertaking work in the area. The FMfSW highlights the most significant flooding to be located close to the River Great Ouse and areas to the east associated with the numerous surface water drainage ditches in the area. One site is partially situated within SPZ1.	
Ecology and Biodiversity	The development areas around St Neots (not excluding those which already have full planning permission) are not identified as being directly linked to any corridors or strategic greenspace identified within the Cambridgeshire Green Infrastructure Strategy, but the sites have potential for the enhancement of ecological value through new SuDS opportunities linked to the new development which could provide habitat for Cambridgeshire BAP species and habitats such as grazing marsh, great crested newt or water vole.	

5.7.2 *Potential Development Sites*

The location of potential development sites in Settlement Area 3 are shown in Figure 5-4.



Job Title

HUNTINGDONSHIRE DISTRICT COUNCIL
DETAILED WCS

Drawing Title

Settlement Area 3
St Neots

Potential Development Location	Main River
Alconbury & Ellington IDB	Drain
Alconbury & Ellington IDB Drain	Sewer Pipe
DG5 Sewer Flooding	WwTW Discharge Loca
	WwTW Location

FIGURE 5-4

Scale 1:150		
Drw GH	App CP	Rev
Chk CP	Date Oct 2013	Date

URS

5.7.3 ***Settlement Area 3: Individual Site Assessments***

TABLE 5-8: SETTLEMENT AREA 3 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis – AWS		Flood Risk and Surface Water Management					
Site	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
0402044FUL, Church View, St Neots	16	0.80	AWS	St Neots	Phase 1 of this site has no issues but phase 2 may require some off-site work that would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to deliver this scheme is in the order of 3 months.	Local reinforcements may be required. Pre-planning enquiry required to confirm capacity and timescales for solution.	Controlled connection to Watercourse	FZ 2	Current runoff rate	Fox Brook	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 2.
0900495REM, Barford Road, St Neots	164	5.95	AWS	St Neots		local reinforcements may be required - Pre-planning enquiry required to confirm capacity and timescales for solution.	Controlled connection to Watercourse	FZ 1	Current runoff rate	River Great Ouse	River Terrace Deposits	
0101550OUT, Loves Farm, St Neots	278	62.87	AWS	St Neots	This development is completed and is being supplied by AWS.	No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ 1,2,3	Current runoff rate	Fox Brook	Till	
1200056FUL, Abbey Gardens, St Neots	11	0.21	AWS	St Neots		Existing connections with moderate increase in foul flows- likely to be acceptable within existing capacity. however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment	Development would not be able to utilise existing surface water network without increasing flood risk.	FZ 2	Current runoff rate	River Great Ouse	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 2.
0302792FUL, Riverside Mill, Little Paxton	223	9.19	AWS	St Neots	Off-site works for this area of growth should have already been completed.	Existing connections with substantial increase in foul flows. Local reinforcements may be required - Pre-planning enquiry required to confirm capacity and timescales for solution.	Development would not be able to utilise existing surface water network without increasing flood risk.	FZ 1,2	Current runoff rate	River Great Ouse	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 2. The site lies within an Inner (Zone 1) SPZ.

TABLE 5-8: SETTLEMENT AREA 3 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis – AWS		Flood Risk and Surface Water Management					
Site	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
1100039REP, Kings Lane Garage, St Neots	12	0.09	AWS	St Neots		Existing connections with no significant additional foul flows. Likely to be acceptable within existing capacity. however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ2	Current runoff rate	Fox Brook	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 2.
1002018REP, Bydand Lane, Little Paxton	49	1.3	AWS	St Neots	This site may require an off-site reinforcement main approximately 400m in length. This scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to deliver this scheme is in the order of 6 to 12 months.	Existing connections with moderate increase in foul flows. Local reinforcements may be required - Pre-planning enquiry required to confirm capacity and timescales for solution.		FZ1	Current runoff rate	River Great Ouse	River Terrace Deposits	
1100326FUL, Brook Street St Neots	14	0.11	AWS	St Neots	Contribution towards the Wing Strategic main scheme required.	No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ3	Current runoff rate	Fox Brook	Alluvium	
1102008FUL, Church Street, St Neots	10	0.15	AWS	St Neots	Contribution towards the Wing Strategic main scheme required.	No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ2	Current runoff rate	Fox Brook	River Terrace Deposits	
St Neots Eastern Expansion (SN1)	3700	226.1	AWS	St Neots	Upgrade one of the Priory Hill water booster stations, and lay 2km of off-site main from priory Hill WR to the development. The estimated timescale to deliver these schemes upon receipt of requisition is up to 12 months. Contribution towards the Wing Strategic main scheme required.	FW requires substantial increase in network capacity or new sewerage direct to WWTW. This scheme would only go ahead once a requisition or firm commitment has been received from the developer. Pre-planning enquiry required to confirm capacity and timescales for solution.	N/A	FZ1,2,3	Current runoff rate	Hen Brook & Tributary of Fox Brook	Till	Space for surface attenuation SuDS may be limited within FZ 2 and 3.

TABLE 5-8: SETTLEMENT AREA 3 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis – AWS		Flood Risk and Surface Water Management					
Site	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
Loves Farm Reserved Site, St Neots (SN2)	41	1.07	AWS	St Neots	Contribution towards the Wing Strategic main scheme required.	No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ2,3	Current runoff rate	Fox Brook	Till	Space for surface attenuation SuDS may be limited within FZ 2 and 3.
Former Youth Centre, Priory Road, St Neots (SN 3)	14	0.45	AWS	St Neots		No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment	Development would not be able to utilise existing surface water network without increasing flood risk.	FZ3	Current runoff rate	River Great Ouse	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 2.
Huntingdon Street, St Neots (SN4)	15	0.59	AWS	St Neots		Limited local network capacity. Local reinforcements may be required. Pre-planning enquiry required to confirm capacity and timescales for solution.		FZ2	Current runoff rate	River Great Ouse	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 2.
Fire Station and Vacant Land, St Neots (SN5)	14	0.40	AWS	St Neots		No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ2	Current runoff rate	River Great Ouse	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 2.
Former Regional College and Adjoining Land, St Neots (SN6)	50	2.26	AWS	St Neots	Contribution towards the Wing Strategic main scheme required.			FZ1,2	Current runoff rate	River Great Ouse	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 2.
St Mary's Urban Village, St Neots (SN 7)	40	0.89	AWS	St Neots	Contribution towards the Wing Strategic main scheme required.			FZ2,3	Current runoff rate	Fox Brook	River Terrace Deposits	Space for surface attenuation SuDS may be limited within FZ 2 and 3.
Cromwell Road Car Park, St Neots (SN 11)	20	0.59	AWS	St Neots	Contribution towards the Wing Strategic main scheme required.	Limited local network capacity. Local reinforcements may be required. Pre-planning enquiry required to confirm capacity and timescales for solution.		FZ1	Current runoff rate	Tributary of Fox Brook	Till	

5.8 Settlement Area 4 – Ramsey (including Somersham, Warboys)

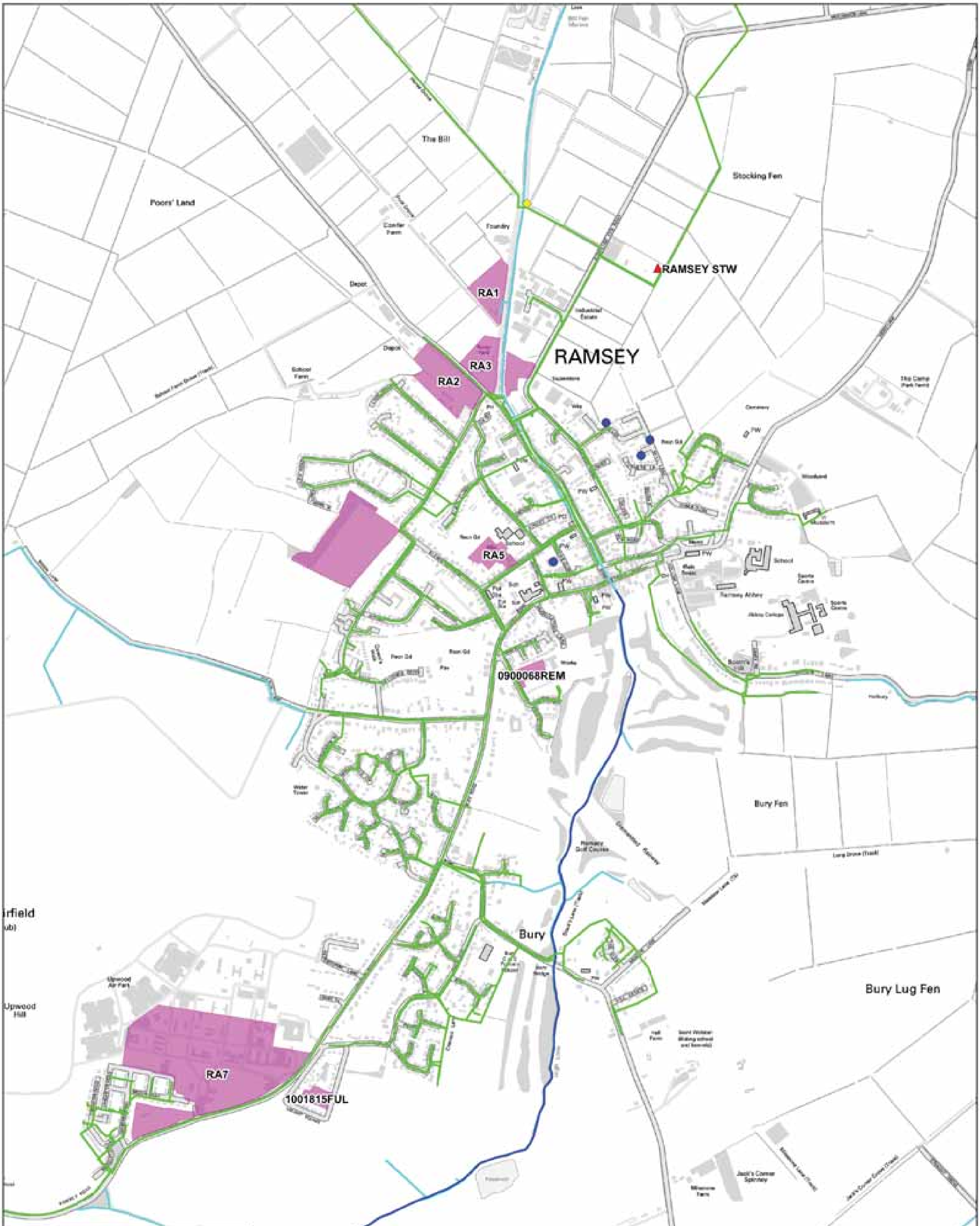
Water Cycle Constraints

TABLE 5-9: CONSTRAINTS ASSESSMENT – AREA 4

Water Cycle Topic	Summary	Overall Assessment
Water Resources and Water Supply	Ramsey, Somersham and Warboys fall within CW's WRMP which predicts a surplus in supply-demand balance for the planning period.	
Wastewater Treatment and Water Quality	Ramsey WwTW does not have capacity to accommodate all of the predicted growth. A change in discharge consent for Ammonia and Phosphate would be required for the projected growth. However, hydraulic capacity and hence flood risk within the Middle Level catchment is a concern and further work is required to determine whether specific mitigation is required.	
	Somersham WwTW does not have capacity to accommodate all of the predicted growth. A change in discharge consent for is required for the projected growth; but this would be achievable within the limits of conventional treatment and hence would not impact on attainment of future WFD water quality objectives.	
	Oldhurst WwTW does not have capacity to accommodate all of the predicted growth. A change in discharge consent for is required for the projected growth; but this would be achievable within the limits of conventional treatment and hence would not impact on attainment of future WFD water quality objectives.	
Surface Water Flood Risk	Surface water discharged into the Ramsey IDB and Ramsey Upwood and Great Raveley IDB New Fen pumped system may allow for increased flows and volumes. Elsewhere, no increased volumes or flows will be consented by the relevant IDB. Parts of Somersham discharge into the High Fen pumped catchment, maintained by Warboys, Somersham and Pidley IDB. The discharge of increased flows and volumes maybe possible. The FMfSW identifies some areas in Ramsey and Somersham more susceptible to surface water flooding, whilst Warboys will be largely unaffected by surface water flooding. No sites are located within a SPZ.	
Ecology and Biodiversity	The development areas around Ramsey are not identified as being directly linked to any corridors or strategic greenspace identified within the Cambridgeshire Green Infrastructure Strategy, but the sites have potential for the enhancement of ecological value through new SuDS opportunities linked to the new development which could provide habitat for Cambridgeshire BAP species and habitats such as grazing marsh, great crested newt or water vole.	

5.8.1 *Potential Development Sites*

The location of potential development sites in Settlement Area 4 are shown in Figure 5-5., Figure 5-6 and Figure 5-7.



Job Title
HUNTINGDONSHIRE DISTRICT COUNCIL DETAILED WCS

Drawing Title
Settlement Area 4

- Potential Development Location
- Alconbury & Ellington IDB
- Alconbury & Ellington IDB Drain
- DG5 Sewer Flooding
- Main River
- Drain
- Sewer Pipe
- WwTW Discharge Loca
- WwTW Location

FIGURE 5-5

Scale 1:150			
Drw GH	App CP	Rev	
Chk CP	Date Oct 2013	Date	

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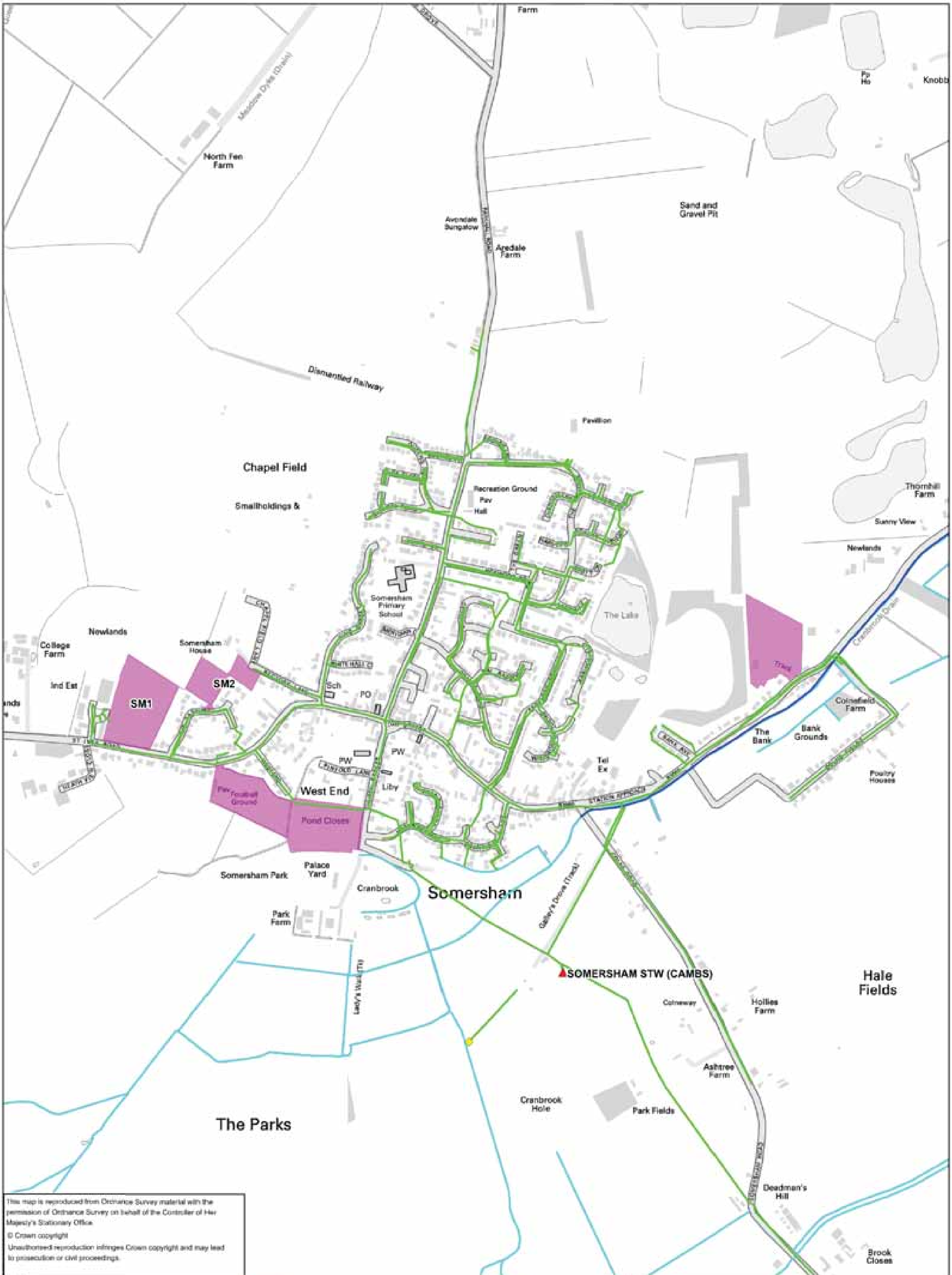


Job Title: HUNTINGDONSHIRE DISTRICT COUNCIL DETAILED WCS

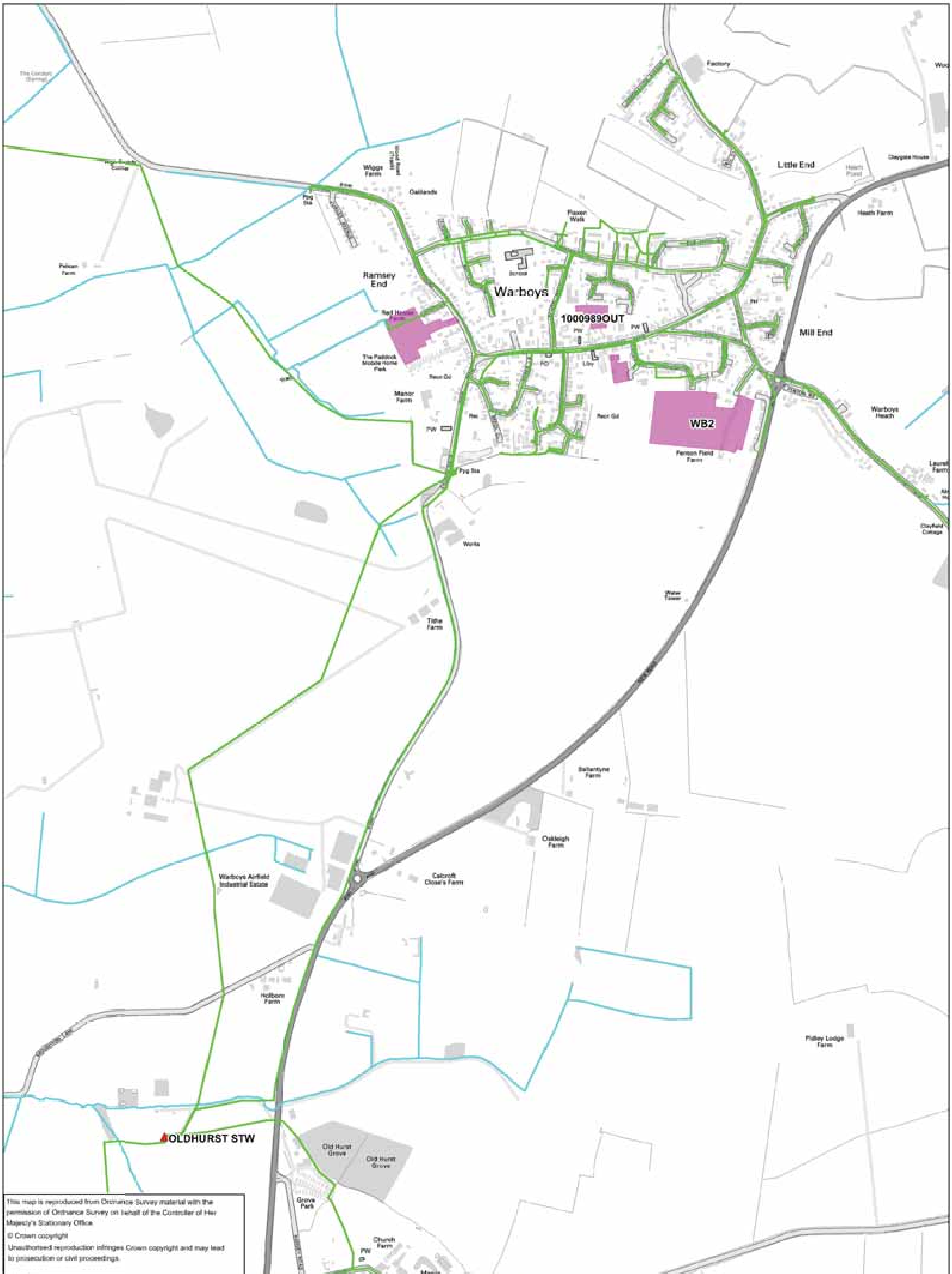
Drawing Title: Settlement Area 4

- Potential Development Location
- Alconbury & Ellington IDB
- Alconbury & Ellington IDB Drain
- DG5 Sewer Flooding
- Main River
- Drain
- Sewer Pipe
- WwTW Discharge Loca
- WwTW Location

FIGURE 5-6

Scale 1:150		
Drw GH	App CP	Rev
Chk CP	Date Oct 2013	Date

URS



Job Title			
HUNTINGDONSHIRE DISTRICT COUNCIL DETAILED WCS	Potential Development Location	Main River	FIGURE 5-7
	Alconbury & Ellington IDB	Drain	Scale 1:150
Drawing Title	Alconbury & Ellington IDB Drain	Sewer Pipe	Drw GH · App CP · Rev
Settlement Area 4	DG5 Sewer Flooding	WwTW Discharge Loca	
		WwTW Location	Chk CP · Date Oct 2013 · Date

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5.8.2 ***Settlement Area 4: Individual Site Assessments***

TABLE 5-10: SETTLEMENT AREA 4 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis– AWS		Flood Risk and Surface Water Management					
Site	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
1001815FUL, Valiant Square, Bury	14	0.48	AWS	Ramsey		No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ1	Current runoff rate	High Lode	Clay	Infiltration SuDS may not be possible due to geology.
1000989OUT, Rear of 41 High Street, Warboys	3	0.52	CW	Oldhurst	This development could be supported by the local network. However some minor local reinforcement of the network in Warboys may be required to prevent existing customers in the area receiving pressure below the company's DG2 levels of service.	Existing connections (via private sewer), with no significant increase in foul flows. However, Pre-planning enquiry required to confirm capacity taking into account other growth in catchment		FZ 1	Current runoff rate	Bury Brook	Clay	Infiltration SuDS may not be possible due to geology.
0900068REM, Bury Road, Ramsey	22	0.48	CW	Ramsey	This development could be supported by the local network. However some minor local reinforcement of the network may be required to prevent existing customers being affected by the development.	Known foul flooding in the Millfields area. Local reinforcements may be required. Pre-planning enquiry required to confirm capacity and timescales for solution		FZ 1	Current runoff rate	Bury Brook	Till	
Newlands, St Ives Road, Somersham (SM1)	30	2.45	CW	Somersham	The local network is capable of supporting this development.	Local reinforcements may be required. Pre-planning enquiry required to confirm capacity and timescales for solution.	Controlled connection to Watercourse	FZ 1	Current runoff rate	Cranbrook Drain	Clay	Infiltration SuDS may not be possible due to geology.
The Pasture, Somersham (SM2)	20	0.97	CW	Somersham		No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment.		FZ1	Current runoff rate	Cranbrook Drain	Clay	Infiltration SuDS may not be possible due to geology.

TABLE 5-10: SETTLEMENT AREA 4 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis– AWS		Flood Risk and Surface Water Management					
Site	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
RAF Upwood and Upwood Hill House, Ramsey (RA7)	160	15.3	CW	Ramsey	Bury booster station would have to be upgrade to support this development. It may also require some reinforcement of local mains.	Existing connections with significant increase in foul flows. Known foul flooding in the Millfields area. Scheme would only go ahead once a requisition or firm commitment has been received from the developer. Pre-planning enquiry required to confirm capacity and timescales for solution.	Development would not be able to utilise existing surface water network without increasing flood risk.	FZ 1	Current runoff rate	Bury Brook	Till	
Ramsey Gateway (RA2)	90	2.80	CW	Ramsey	This development could be supported by the local network. However, significant reinforcement of the network may be required to prevent existing customers being affected by the development.	Existing connections with significant increase in foul flows. Known foul flooding in the Millfields area. Offsite reinforcement required to ensure no deterioration. Scheme would only go ahead once a requisition or firm commitment has been received from the developer. Pre-planning enquiry required to confirm capacity and timescales for solution.	Direct to Watercourse – although capacity limited	FZ 1	Current runoff rate	High Lode	Till	
Ramsey Gateway (High Lode) (RA3)	125	2.37	CW	Ramsey	This development could be supported by the local network. However, significant reinforcement of the network may be required to prevent existing customers being affected by the development.	Assumes gravity connection. Known foul flooding in the Millfields area. Scheme would only go ahead once a requisition or firm commitment has been received from the developer. Pre-planning enquiry required to confirm capacity and timescales for solution.	Controlled connection to Watercourse	FZ 1,2,3	Current runoff rate	High Lode	Till	Space for surface attenuation SuDS may be limited within FZ 2 and 3.

TABLE 5-10: SETTLEMENT AREA 4 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis– AWS		Flood Risk and Surface Water Management					
Site	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
Whytefield Road, Ramsey (RA5)	35	0.91	CW	Ramsey	This development could be supported by the local network. However, reinforcement of the local network may be required to prevent existing customers being affected by the development.	Existing connections with moderate increase in foul flows. Known foul flooding in the Millfields area. Scheme would only go ahead once a requisition or firm commitment has been received from the developer. Pre-planning enquiry required to confirm capacity and timescales for solution.		FZ 1	Current runoff rate	Great Whyte Tunnel or High Lode	Till	
Field Road, Ramsey	90	5.18	CW	Ramsey		No significant cacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ1	Current runoff rate	Bury Brook	Clay	Infiltration SuDS may not be possible due to geology.
Somersham Town Football Club, Somersham	50	3.86	CW	Somersham				FZ1	Current runoff rate	Bury Brook	Alluvium	
North of the Bank, Somersham	50	2.14	CW	Somersham				FZ1	Current runoff rate	Cranbrook Drain or Warboys/ Somersham & Pidley IDB drain	Alluvium	
South of Farrier's Way, Warboys (WB2)	70	4.73	CW	Oldhurst				FZ1	Current runoff rate	Fenton Lode Drain	Clay	Infiltration SuDS may not be possible due to geology.
West of Ramsey Road, Warboys	45	1.70	CW	Oldhurst				FZ1	Current runoff rate	Bury Brook	Clay	Infiltration SuDS may not be possible due to geology.
Rear of 64 High Street, Warboys	14	0.36	CW	Oldhurst				FZ1	Current runoff rate	Fenton Lode Drain	Clay	Infiltration SuDS may not be possible due to geology.

5.9 Settlement Area 5 – Yaxley (including Stibbington, Holme, Sawtry)

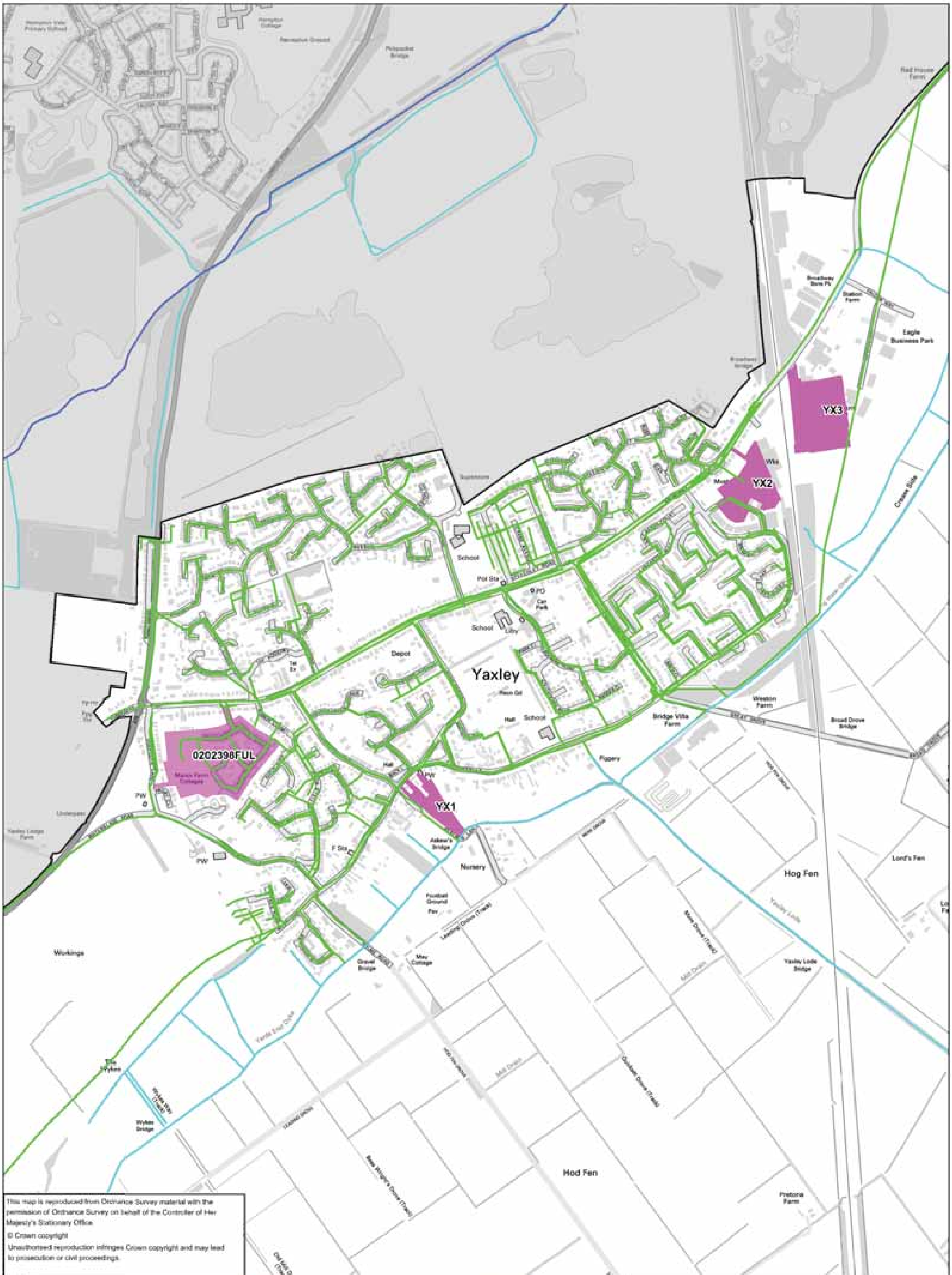
5.9.1 *Water Cycle Constraints*

TABLE 5-11: CONSTRAINTS ASSESSMENT – AREA 5

Water Cycle Topic	Summary	Overall Assessment
Water Resources and Water Supply	Yaxley, Holme, Sawtry and Stibbington fall within the Ruthamford North RZ which is forecast to have a surplus by the end of the Water Company planning period in 2040.	
Wastewater Treatment and Water Quality	Holme, Sawtry and Stibbington WwTWs have the capacity to accommodate all of the predicted growth. A change in discharge consent is not required for the projected growth.	
	Wastewater from Yaxley discharges to Flag Fen WwTW which has been covered by the Peterborough WCS in more detail; however AWS consider there to be sufficient capacity to accept flows from the small growth volumes in the Huntingdonshire District.	
Surface Water Flood Risk	Yaxley is served by Yards End Dyke and Pigwater MLC watercourses, which ultimately discharge into Yaxley Lode/Black Ham which form the northern boundary of the Great Fen area. No increased volumes will be consented by the MLC and any current rates of flow must be retained. Yaxley, Holme and Stibbington will be largely unaffected by surface water flooding as highlighted in the FMfSW.	
	Sawtry village has historically and still remains subject to flooding during high rainfall events. No increased volumes will be consented by the IDB and any current rates of flow must be maintained. Sawtry WwTW discharges into the Sewer Drain (a Sawtry IDB drain), which discharges by gravity into the Commissioners' Catchwater Drain, upstream of the Control Sluice. There is limited hydraulic capacity in the watercourse. The FMfSW identifies some areas in Sawtry more susceptible to surface water flooding, with the most significant flooding located to the south of Sawtry. The Cambridgeshire SWMP has ranked Sawtry in the top ten wetspots identified. No sites are located within a SPZ.	
Ecology and Biodiversity	The Middle Level Commissioners Catchwater Drain passes through the Great Fen area.	

5.9.2 *Potential Development Sites*

The location of potential development sites in Settlement Area 5 are shown in Figure 5-8, Figure 5-9., Figure 5-10 and Figure 5-11.



Job Title

HUNTINGDONSHIRE DISTRICT COUNCIL
DETAILED WCS

Drawing Title

Settlement Area 5a
Sawtry

Potential Development Location

Alconbury & Ellington IDB

Alconbury & Ellington IDB Drain

DG5 Sewer Flooding

Main River

Drain

Sewer Pipe

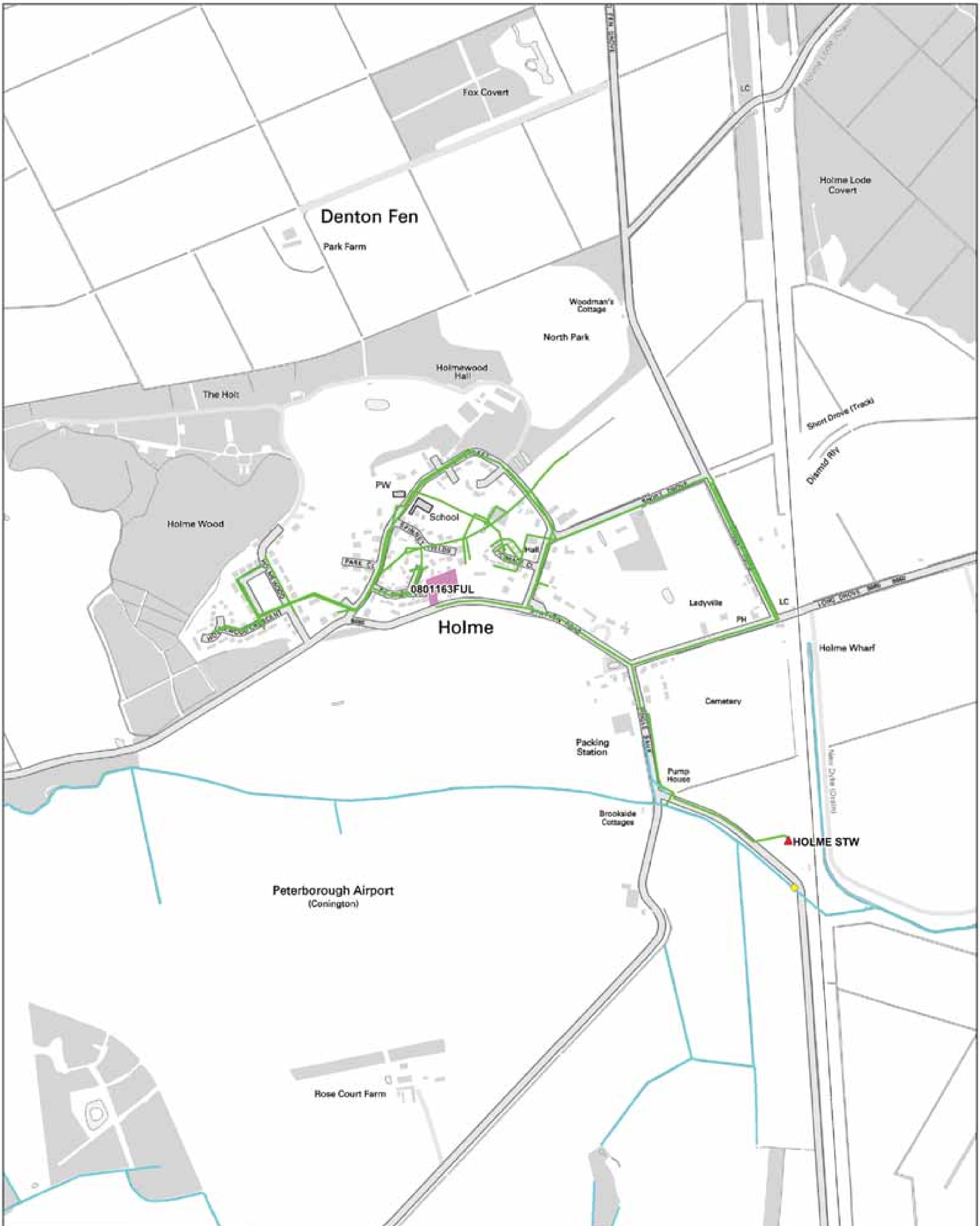
WwTW Discharge Loca

WwTW Location

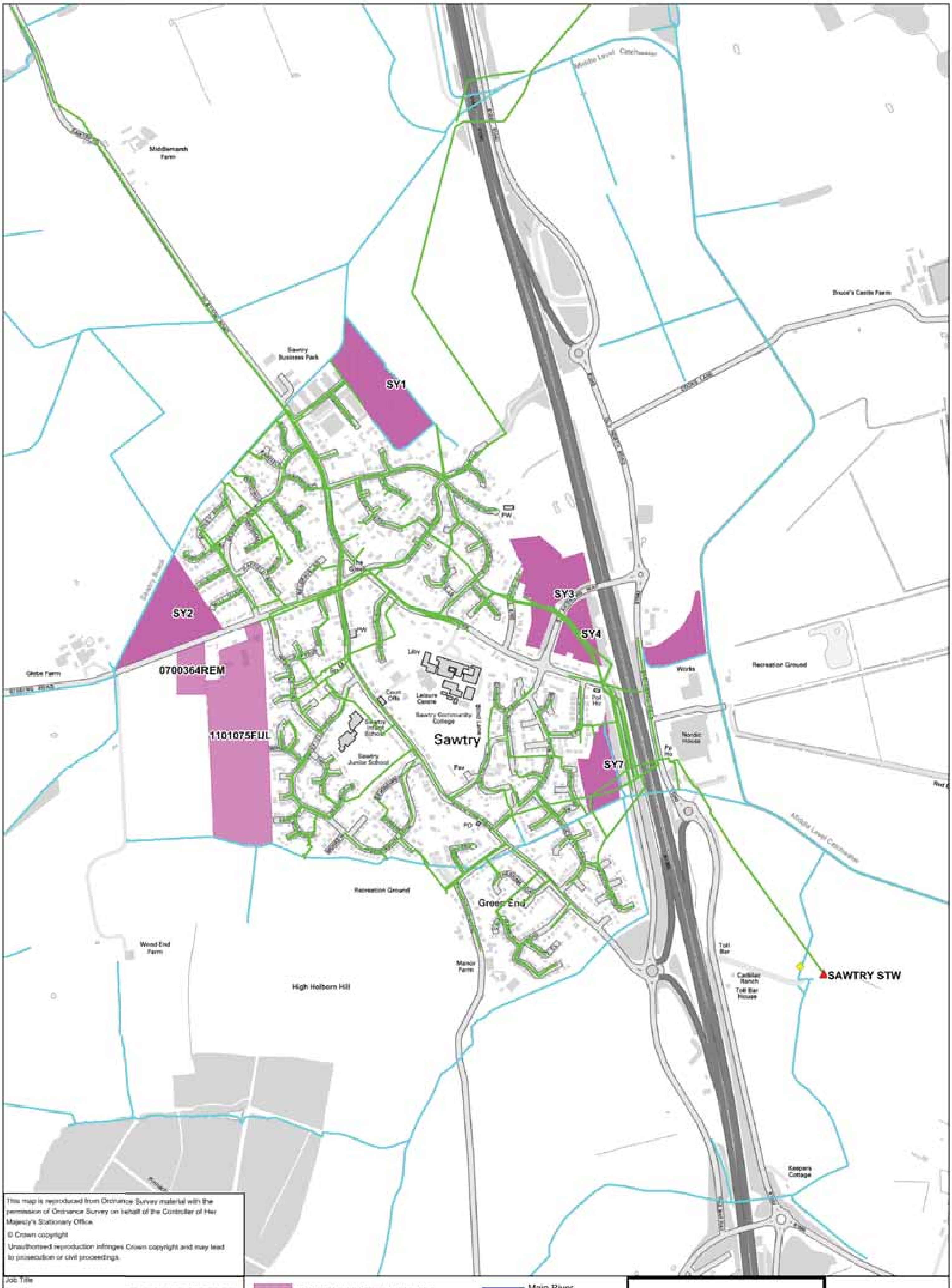
FIGURE 5-8

Scale 1:100			
Drw GH	App CP	Rev	
Chk CP	Date Oct 2013	Date	

URS



Job Title: HUNTINGDONSHIRE DISTRICT COUNCIL DETAILED WCS	Potential Development Location	Main River	**FIGURE 5-9**
	Alconbury & Ellington IDB	Drain	Scale: 1:100
Drawing Title: Settlement Area 5a Sawtry	Alconbury & Ellington IDB Drain	Sewer Pipe	Drw: GH / App: CP / Rev
	DG5 Sewer Flooding	WwTW Discharge Loca	Chk: CP / Date: Oct 2013 / Date
		WwTW Location	URS



Job Title
HUNTINGDONSHIRE DISTRICT COUNCIL
DETAILED WCS

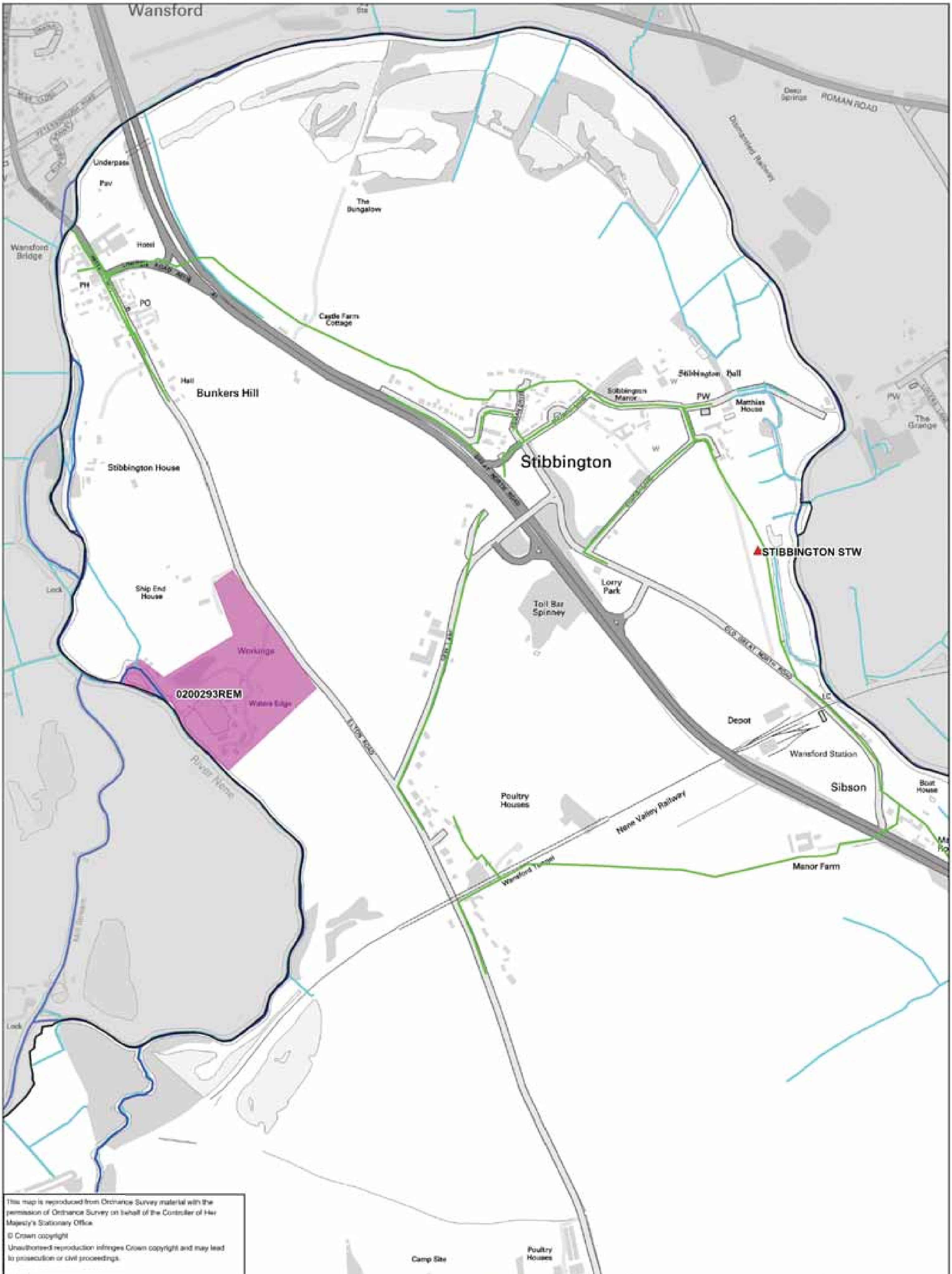
Drawing Title
Settlement Area 5a
Sawtry

Potential Development Location
Alconbury & Ellington IDB
Alconbury & Ellington IDB Drain
DG5 Sewer Flooding
Main River
Drain
Sewer Pipe
WwTW Discharge Loca
WwTW Location

FIGURE 5-10

Scale 1:100		
Drw GH	App CP	Rev
Chk CP	Date Oct 2013	Date

URS



Job Title
HUNTINGDONSHIRE DISTRICT COUNCIL
DETAILED WCS

Drawing Title
Settlement Area 5a
Sawtry

Potential Development Location
Alconbury & Ellington IDB
Alconbury & Ellington IDB Drain
DG5 Sewer Flooding
Main River
Drain
Sewer Pipe
WwTW Discharge Loca
WwTW Location

FIGURE 5-11

Scale 1:100

Drw GH | App CP | Rev
Chk CP | Date Oct 2013 | Date

URS

5.9.3 ***Settlement Area 5: Individual Site Assessments***

TABLE 5-12: SETTLEMENT AREA 5 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis – AWS		Flood Risk and Surface Water Management						
Site	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
0200293REM, Elton Road Wansford	10	8.90	AWS	Stibbington		Assumes foul flows pumped to network. Pre-planning enquiry required to confirm capacity taking into account other growth in catchment	Controlled connection to Watercourse	FZ 1,2	Current runoff rate	River Nene	Limestone Formation	Space for surface attenuation SuDS may be limited within FZ 2.
0202399FUL, Broadway, Yaxley	7	5.24	AWS	Peterborough Flag Fen	This development is complete and is being supplied by AWS.	No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment.		FZ 1	Current runoff rate	Pig Water	Alluvium Deposits	
0202398FUL, North of Manor Farm, Church Street, Yaxley	14	5.91	AWS	Peterborough Flag Fen				FZ 1	Current runoff rate	Yards End Dyke	Alluvium Deposits	
0800444FUL, Chapel Street, Yaxley	14	0.40	AWS	Peterborough Flag Fen		Pre-planning enquiry required to confirm capacity taking into account other growth in catchment		FZ 1	Current runoff rate	Yards End Dyke	Alluvium Deposits	
Askews Lane, Yaxley (YX1)	15	1.19	AWS	Peterborough Flag Fen	Possible reinforcement required.	Limited local network capacity – Pre-planning enquiry required to confirm capacity taking into account other growth in catchment		FZ 1	Current runoff rate	Yards End Dyke	Alluvium Deposits	
Former Snowcap Mushrooms, Yaxley (YX2)	60	2.31	AWS	Peterborough Flag Fen	Possible reinforcement required.	No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment.		FZ 1	Current runoff rate	Pig Water	Alluvium Deposits	

TABLE 5-12: SETTLEMENT AREA 5 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis – AWS		Flood Risk and Surface Water Management					
Site	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
0801163FUL, St Giles Close, Holme	8	0.28	AWS	Holme		Moderate increase in foul flows. Likely to be capacity. However, Pre-planning enquiry required to confirm capacity taking into account other growth in catchment		FZ 1	Current runoff rate	Holme Brook	Clay	Infiltration SuDS may not be possible due to geology.
0700364REM, The Old Granary, Gidding Road, Sawtry	10	1.01	AWS	Sawtry	This site will require approximately 100m of reinforcement water main to be laid. This scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to deliver this scheme is in the order of 3 to 6 months.	Assumes foul flows pumped to network. Local reinforcements may be required - Pre-planning enquiry required to confirm capacity and timescales for solution	Controlled connection to Watercourse	FZ1	Current runoff rate	Sawtry Brook	Clay	Infiltration SuDS may not be possible due to geology.
0802855OUT, South Of Marshall Bros Garage, Gidding Road, Sawtry	190	8.84	AWS	Sawtry	This site will require approximately 1.9km of reinforcement water main to be laid. This scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to deliver this scheme is in the order of 12 months.	Assumes foul flows pumped to network. Significant increase in foul flows. Local reinforcements may be required - Pre-planning enquiry required to confirm capacity and timescales for solution	Controlled connection to Watercourse	FZ1	Current runoff rate	Green End Drain	Clay	Infiltration SuDS may not be possible due to geology.
East of Glebe Farm, Sawtry (SY2)	75	3.86	AWS	Sawtry	This development will require 200m of off-site reinforcement main along Green End Road. This scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to deliver this scheme is determined.	No significan capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment		FZ1	Current runoff rate	Sawtry Brook	Clay	Infiltration SuDS may not be possible due to geology.
West of St Andrew's Way, Sawtry (SY3)	50	3.20	AWS	Sawtry	This development will require 170m of off-site main along St Andrews Road as currently no water main along this road. This scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale is determined			FZ1	Current runoff rate	Sawtry Brook	Clay	Infiltration SuDS may not be possible due to geology.
South of St Andrews Way, Sawtry (SY4)	20	1.41	AWS	Sawtry	This development will require 170m of off-site main along St Andrews Road as currently no water main along this road. This scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale is determined			FZ1	Current runoff rate	Sawtry Brook	Clay	Infiltration SuDS may not be possible due to geology.

5.10 Settlement Area 6 – Kimbolton

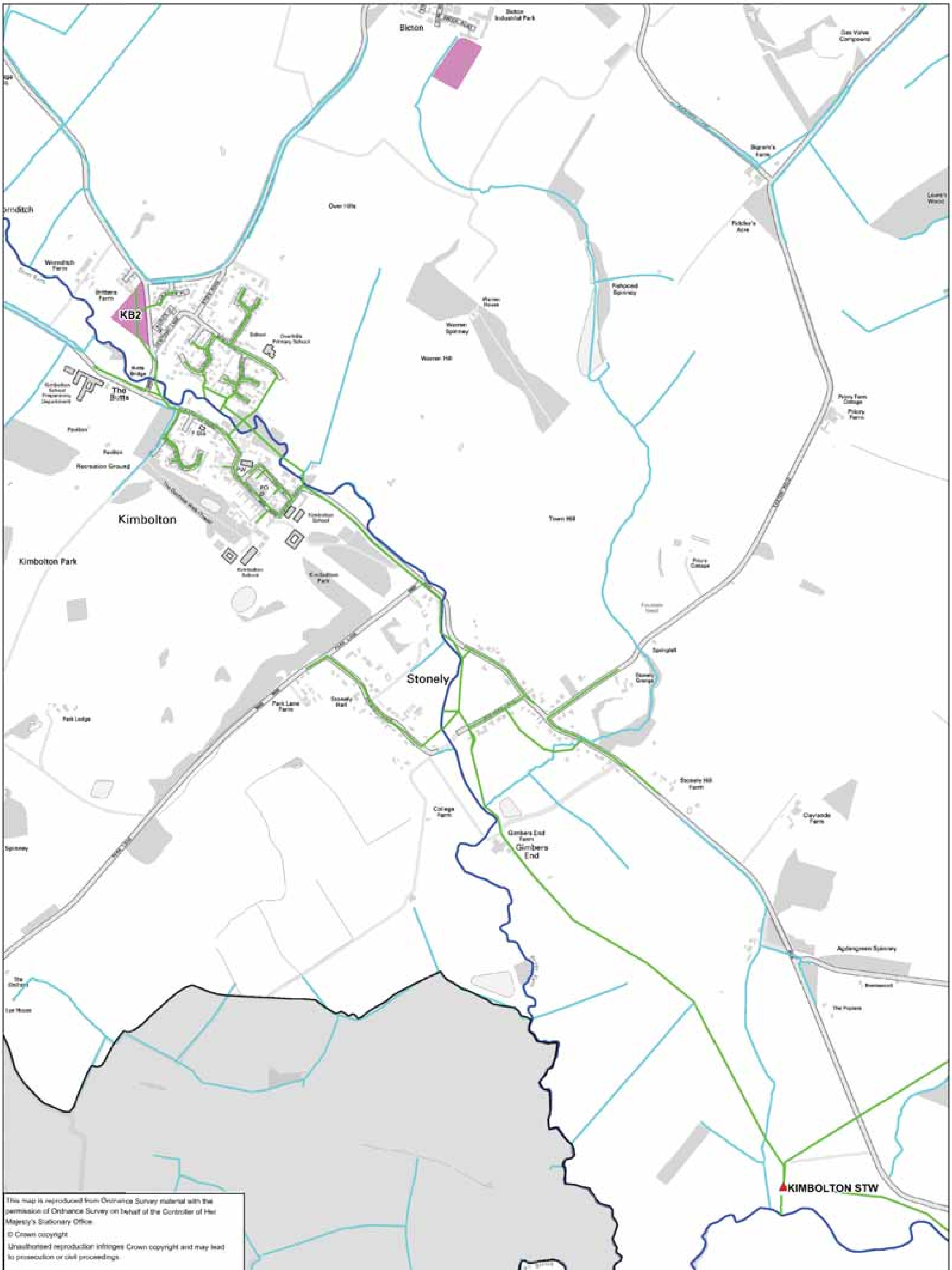
5.11 Water Cycle Constraints

TABLE 5-13: CONSTRAINTS ASSESSMENT – AREA 6

Water Cycle Topic	Summary	Overall Assessment
Water Resources and Water Supply	Kimbolton falls within the Ruthamford South RZ which is forecast to have a deficit of 35Ml/d by the end of the Water Company planning period in 2040, although schemes have been identified to help maintain the supply-demand balance within the WRZ. Water efficiency should be considered for development in this settlement area.	
Wastewater Treatment and Water Quality	Kimbolton WwTW has the capacity to accommodate all of the predicted growth. A change in discharge consent is not required for the projected growth.	
Surface Water Flood Risk	The FMfSW identifies some areas in Kimbolton more susceptible to surface water flooding; particularly those areas close to the River Kym. No sites are located within a SPZ.	

5.11.1 *Potential Development Site*

The location of potential development site in Settlement Area 6 is shown in Figure 5-12.



Job Title
HUNTINGDONSHIRE DISTRICT COUNCIL
DETAILED WCS

Drawing Title
Settlement Area 6
Kimbolton

Potential Development Location
Alconbury & Ellington IDB
Alconbury & Ellington IDB Drain
DG5 Sewer Flooding
Main River
Drain
Sewer Pipe
WwTW Discharge Location
WwTW Location

FIGURE5-12

Scale: 1:150
Drw GH | App CP | Rev
Chk CP | Date Oct 2013 | Date

URS

5.11.2 ***Settlement Area 6: Individual Site Assessments***

TABLE 5-14: SETTLEMENT AREA 6 SITE ASSESSMENTS

Site Information			Water Supply		Network Analysis – AWS		Flood Risk and Surface Water Management					
Site	**No. of Dwellings (residual)**	**Total Site Area (Ha)**	**Water Supply Company**	**WwTW**	**Water Supply Network RAG Assessment & Description of potential connection**	**Foul Sewerage Network Capacity**	**Surface Water Network Capacity**	**EA Flood Zone**	**Restriction of Runoff Rate**	**Potential receiving watercourse/ IDB Drain**	**Geology**	**SuDS Constraints**
West of Station Road, Kimbolton (KB2)	20	1.28	AWS	Kimbolton	This development will require 260m of off-site reinforcement main along Station Road. This scheme would only go ahead once a requisition or firm commitment has been received from the developer, and the anticipated timescale to deliver this scheme is known.	No significant capacity issues when considered in isolation; however, developer should seek Pre-planning enquiry to confirm capacity taking into account other growth in catchment.		FZ1,2	Current Runoff Rate	River Kym	Clay	Infiltration SuDS may not be possible due to geology.

6 RECOMMENDATIONS AND POLICY

6.1 Introduction

It is recommended that a series of policies should be developed by Huntingdonshire District Council to ensure that the Huntingdonshire Local Plan considers potential limitations (and opportunities) presented by the water environment and water infrastructure on growth, and phasing of growth.

6.2 Recommendations for Policy Development

WW1 – Development Phasing Ramsey

It is recommended that a policy should be developed by the council that ensures that all development in Ramsey up to at least 2020, is only given planning permission if the Environment Agency and AWS have indicated that they are satisfied that the development can be accommodated either within the limits of capacity at the WwTW or by sufficient capacity being made available and the requirements of the WFD will not be compromised and the MLC will not object on the basis of flood risk in Middle Level system.

WW2 – Development Phasing in St Neots, Oldhurst and Somersham

It is recommended that a policy is developed in respect of major development in St Neots, Oldhurst, and Somersham that requires development in the catchment up to 2020 to be subject to a pre-application enquiry with HDC. HDC will, following consultation with the EA and AWS, advise on any phasing requirements for the development as a result of process and environment capacity limitations at the WwTW.

WW3 – Development Phasing in Huntingdon

It is recommended that a policy is developed in Huntingdon that requires development in the catchment post 2021, to be subject to a pre-planning enquiry with AWS to determine process capacity at the WwTW before granting permission.

WW4 – Development and Sewerage Network

It is recommended that a policy is developed for development at all sites, that they should be subject to a pre-planning enquiry with AWS to determine upgrades needed to prior to planning permission being granted. Assessments made within this WCS consider each site in isolation and capacity will change depending on when and where sites come forward.

WW5 Further Discharge and Capacity Issues

It is recommended that a policy is developed that requires that: where new discharge consents would be triggered by proposed development, developers should demonstrate in liaison with an OFWAT regulated water services company and the Environment Agency, that the likely water quality and flood risk impacts are reasonably manageable to acceptable water quality standards and within the timescales envisaged in the planning application, or by applying phasing conditions.

WS1 – Water Efficiency in new homes and buildings

In order to move towards a more 'water neutral position' and to enhance sustainability of development coming forward, a policy should be developed that ensures all housing is as water efficient as possible, and that new housing development should meet specific water use standards of 105 l/h/d. Non-domestic building should as a minimum reach 'Good' BREEAM status.

WS2 – Water Efficiency Retrofitting

In order to move towards a more 'water neutral position', a policy could be developed to carry out a programme of retrofitting and water audits of existing dwellings and non-domestic buildings with the aim to move towards delivery of 20% of the existing housing stock with easy fit water savings devices.

WS3 – Water Efficiency Promotion

In order to move towards a more 'water neutral position', it is recommended that a policy could be developed to establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use.

SWM1 – SuDS and Water Efficiency

In order to move towards a more 'water neutral position' and to enhance sustainability of development coming forward, it is recommended that a policy a policy should be developed which encourages developers to seek linkage of SuDS to water efficiency measures, including rainwater harvesting.

SWM2 – Holistic surface water management and use of SuDS

To ensure appropriate design, adoption and maintenance of SuDS, it is recommended that a policy should be developed that requires developers to ensure that SuDS design supports the findings and recommendations of the Cambridgeshire County SuDS Handbook, Cambridgeshire Surface Water Management Plan (SWMP), the SuDS Manual47, the proposed Cambridgeshire Flood and Water Management SPD, and Huntingdonshire District Council's SFRA. In addition, for development where surface water would drain to an IDB area, developers must consider the standing advice offered by the appropriate IDB.

[47] Published by CIRIA

SWM3 – Water Quality Improvements

It is recommended that a policy should be developed that requires developers to ensure (where possible) that discharges of surface water are designed to deliver water quality improvements in the receiving watercourse or aquifer where possible to help meet the objectives of the WFD.

ECO1 – Biodiversity enhancement

It is recommended that a policy be developed in the Local Plan which commits to seeking and securing (through planning permissions etc) enhancements to aquatic biodiversity in Huntingdonshire through the use of SuDS and other means as outlined in this WCS (subject to appropriate project-level studies to confirm feasibility including environmental risk and discussion with relevant authorities) in line with the Cambridgeshire Green Infrastructure Strategy.

6.2.1 *WCS Periodic Review*

The WCS should remain a living document, and (ideally) be reviewed on an annual basis as development progresses and changes are made to the various studies and plans that support it; these include:

- five yearly reviews of AWS' WRMP (next full review in 2019, although interim reviews are undertaken annually);
- second round of RBMP updates due by 2015;
- Price review 14 (AWS' business plan for AMP6 – 2015 to 2019); and,
- Climate change impact assessment milestones (see Table 6-1).

TABLE 6-1: WATER RELATED PLANNING DOCUMENTS AND CLIMATE CHANGE

Document	Produced By	Date for Review
AWS Water Resource Management Plan	AWS	2019 (though plan is reviewed annually)
CW Water Resource Management Plan	CW	2019 (though plan is reviewed annually)
Anglian River Basin Management Plan	Environment Agency	December 2015
Catchment Abstraction Management Strategies	Environment Agency	Yearly updates provided. Date of next full review unknown
UKCP09 Projections and Impacts	UKCIP	On-going – check website for further research and case studies for mitigation / adaption (http://www.ukcip.org.uk/)

6.2.2 *Other Recommendations*

The following are additional recommendations to be considered:

- encourage pre-application discussions on relevant planning applications;
- require the submission of holistic or site specific water cycle studies with every significant planning application (greater than 100 dwellings). This would ensure that

an adequate evidence base has been provided and suitable consideration has been given to water level/flood risk management; and,

- water efficiency (and moving towards water neutrality) should be extended to non-domestic properties.

APPENDIX 1: LEGISLATIVE DRIVERS

Directive/Legislation/Guidance	Description
Birds Directive 2009/147/EC	Provides for the designation of Special Protection Areas.
Eel Regulations 2009	Provides protection to the European eel during certain periods to prevent fishing and other detrimental impacts.
Environment Act 1995	Sets out the role and responsibility of the Environment Agency.
Environmental Protection Act 1990	Integrated Pollution Control (IPC) system for emissions to air, land and water.
Flood & Water Management Act 2010	The Flood and Water Management Act 2010 is the outcome of a thorough review of the responsibilities of regulators, local authorities, water companies and other stakeholders in the management of flood risk and the water industry in the UK. The Pitt Review of the 2007 flood was a major driver in the forming of the legislation. Its key features relevant to this WCS are: • To give the Environment Agency an overview of all flood and coastal erosion risk management and unitary and county councils the lead in managing the risk of all local floods. • To encourage the uptake of sustainable drainage systems by removing the automatic right to connect to sewers and providing for unitary and county councils to adopt SuDS for new developments and redevelopments. • To widen the list of uses of water that water companies can control during periods of water shortage, and enable Government to add to and remove uses from the list. • To enable water and sewerage companies to operate concessionary schemes for community groups on surface water drainage charges. • To make it easier for water and sewerage companies to develop and implement social tariffs where companies consider there is a good cause to do so, and in light of guidance that will be issued by the SoS following a full public consultation.
Future Water, February 2008	Sets the Government's vision for water in England to 2030. The strategy sets out an integrated approach to the sustainable management of all aspects of the water cycle, from rainfall and drainage, through to treatment and discharge, focusing on practical ways to achieve the vision to ensure sustainable use of water. The aim is to ensure sustainable delivery of water supplies, and help improve the water environment for future generations.
Groundwater Directive 80/68/EEC	To protect groundwater against pollution by 'List 1 and 2' Dangerous Substances.

Directive/Legislation/Guidance	Description
Habitats Directive 92/44/EEC and Conservation of Habitats & Species Regulations 2010	To conserve the natural habitats and to conserve wild fauna and flora with the main aim to promote the maintenance of biodiversity taking account of social, economic, cultural and regional requirements. In relation to abstractions and discharges, can require changes to these through the Review of Consents (RoC) process if they are impacting on designated European Sites. Also the legislation that provides for the designation of Special Areas of Conservation provides special protection to certain non-avian species and sets out the requirement for Appropriate Assessment of projects and plans likely to have a significant effect on an internationally designated wildlife site.
Land Drainage Act 1991	Sets out the statutory roles and responsibilities of key organisations such as Internal Drainage Boards, local authorities, the Environment Agency and Riparian owners with jurisdiction over watercourses and land drainage infrastructure.
Making Space for Water, 2004	Outlines the Government's strategy for the next 20 years to implement a more holistic approach to managing flood and coastal erosion risks in England. The policy aims to reduce the threat of flooding to people and property, and to deliver the greatest environmental, social and economic benefit.
National Planning Policy Framework	Planning policy in the UK is set by the National Planning Policy Framework (NPPF). The NPPF revokes most of the previous Planning Policy Statements (PPS) and Planning Policy Guidance. However, NPPF does not revoke the PPS25 Practice Guide. NPPF advises local authorities and others on planning policy and operation of the planning system. A WCS helps to balance the requirements of various planning policy documents, and ensure that land-use planning and water cycle infrastructure provision is sustainable.
Pollution Prevention and Control Act (PPCA) 1999	Implements the IPPC Directive. Replaces IPC with a Pollution Prevention and Control (PPC) system, which is similar but applies to a wider range of installations.
Ramsar Convention	Provides for the designation of wetlands of international importance
Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC	This Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. Its aim is to protect the environment from any adverse effects caused by the discharge of such waters.
Water Act 2003	Implements changes to the water abstraction management system and to regulatory arrangements to make water use more sustainable.

Directive/Legislation/Guidance	Description
Water Framework Directive (WFD) 2000/60/EC	The WFD was passed into UK law in 2003. The overall requirement of the directive is that all river basins must achieve 'good ecological status' by 2015 or by 2027 if there are grounds for derogation. The WFD, for the first time, combines water quantity and water quality issues together. An integrated approach to the management of all freshwater bodies, groundwaters, estuaries and coastal waters at the river basin level has been adopted. It effectively supersedes all water related legislation which drives the existing licensing and consenting framework in the UK. The Environment Agency is the body responsible for the implementation of the WFD in the UK. The Environment Agency have been supported by UKTAG[48], an advisory body which has proposed water quality, ecology, water abstraction and river flow standards to be adopted in order to ensure that water bodies in the UK (including groundwater) meet the required status[49]. These have recently been finalised and issued within the River Basin Management Plans (RBMP).
Natural Environment & Rural Communities Act 2006	Covering Duties of public bodies – recognises that biodiversity is core to sustainable communities and that Public bodies have a statutory duty that states that "every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity
Water Resources Act 1991	Protection of the quantity and quality of water resources and aquatic habitats. Parts have been amended by the Water Act 2003.
Wildlife & Countryside Act 1981 (as amended)	Legislation that provides for the protection and designation of SSSIs and specific protection for certain species of animal and plant among other provisions.

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

APPENDIX 2: WWTW CAPACITY ASSESSMENT RESULTS

Modelling Assumptions and Input Data

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

- the wastewater generation per new household is based on an assumed Occupancy Rate (OR) of 2.3 people per house and an average consumption of 131 l/h/d (as set out in Section 1.6). The 131 l/h/d figure makes an allowance for commercial use and use in schools and hospitals etc considered to represent increases in non-domestic use across the study area;
- WwTW current flows were taken as the current consented dry weather flow (DWF). Future 2031 flows were calculated by adding the volume of additional wastewater generated by new dwellings (using an OR of 2.3, a consumption value of 131l/h/d and allowance for an increase in infiltration) to the current consented DWF value;
- river flow data for the RQP modelling has been provided by the Environment Agency based on outputs from Low Flow Enterprise (LFE) models – data was provided as mean flow and Q95[50];
- Base data for modelling has therefore been provided by Environment Agency water quality planners. The WFD 'no deterioration' targets for each WwTW are the downstream status, for each water quality element, based on river monitoring data collected between 2006 and 2008. Where significant improvement has occurred since 2008, or is planned through confirmed RBMP measures, the 'no deterioration' target' is the planned status. Actual data was used in preference over the published status in the RBMP. Details are provided in Appendix 2 along with the full results and outputs from the water quality modelling.
- For the purposes of this study, the limits of conventionally applied treatment processes are considered to be:
- 5mg/l for BOD;
- 1mg/l for Ammoniacal-N; and
- 1mg/l for Phosphate.

Assessment Techniques

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

The first stage of the modelling exercise was to establish the discharge consent standards that would be required to meet 'No Deterioration'; this would be the discharge consent limit that would need to be imposed on AWS at the time the growth causes the flow consent to be exceeded. No deterioration is an absolute requirement of the WFD and any development must not result in a decrease in quality downstream from the current status.

[50] Defined as the flow value exceeded 95% of the time i.e. a representation of low flows

The second stage was to establish the discharge consent standards that would be required to meet future Good Status under the WFD in the downstream waterbody. This assessment was only carried out for WwTWs discharging to waterbodies where the current status is less than Good (i.e. currently Moderate, Poor or Bad). This would be the discharge consent standard that may need to be applied in the future, subject to the assessments of 'technical feasibility' and 'disproportionate cost. Such assessments would be carried out as part of the formal Periodic Review process overseen by OFWAT in order to confirm that the proposed improvement scheme is acceptable.

Step 1 – 'No Deterioration'

A calculation was undertaken to determine if the receiving watercourse can maintain 'No Deterioration' downstream from the current quality with the proposed growth within limits of conventional treatment technology, and what consent limits would be required. If 'No Deterioration' could be achieved, then a proposed discharge consent standard was calculated which will be needed as soon as the growth causes the WwTW flow consent to be exceeded, see Table A2-1.

Step 2 – Meeting Future 'Good' Status

For all WwTW where the current downstream quality of the receiving watercourse *is less than good*, a calculation was undertaken to determine if the receiving watercourse could achieve future 'Good Status' with the proposed growth within limits of conventional treatment technology and what consent limits would be required to achieve this.

The assessment of attainment of future 'Good Status' assumed that other measures will be put in place to ensure 'Good Status' upstream so the modelling assumed upstream water quality is at the mid-point of the 'Good Status' for each element and set the downstream target as the lower boundary of the 'Good Status' for each element.

If 'Good' could be achieved with growth with consents achievable within the limits of conventional treatment, then a proposed discharge consent standard which may be needed in the future has been given in Table A2-2.

If the modelling showed that the watercourse could not meet future 'Good' status with the proposed growth within limits of conventional treatment technology, a further assessment step three was undertaken.

Step 3 – Is Growth the Factor Causing failure to meet future 'Good Status'?

In order to determine if it is growth that is causing the failure to attain future 'Good Status' downstream, the modelling in step 2 was repeated but without the growth in place (i.e. using current flows) as a comparison.

If the watercourse could not meet 'Good Status' without growth (assuming the treatment standard were improved to the limits of conventional treatment technology), then it is not the growth that would be preventing future 'Good Status' being achieved and the 'No Deterioration' consent standard given in Table A2-1 (Step 1) above would be sufficient to allow the proposed growth to proceed.

If the watercourse could meet 'Good Status' without growth, then it is the growth that would be preventing future 'Good Status' being achieved. Therefore consideration needs to be given to whether there are alternative treatment options that would prevent the future failure to attain 'Good Status'.

The methodology is designed to look at the impact of proposed growth alone, and whether the achievement of 'Good Status' will be compromised. It is important that AWS have an understanding of what consents may be necessary in the future. The RBMP and Periodic Review planning processes will deal with all other issues of disproportionate costs.

TABLE A2-1: 'NO DETERIORATION' ASSESSMENT

	St Neots WwTW			Somersham WwTW			Ramsey WwTW			Huntingdon WwTW			Oldhurst WwTW		
	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate
River Downstream of Discharge															
No Deterioration Target	High	High	Poor	Good	Poor	Bad	Good	Good	Poor	High	High	Moderate	Good	Good	Poor
Designated Salmonid Fishery?	-	-	-	N	N	N	-	-	-	N	-	-	N	-	-
River Quality Target (90%ile or AA)	4.0	0.3	1.0	5.0	2.5	>1	5.0	0.6	1.0	4.0	0.30	0.25	4.0	0.6	1.0
Current Consent															
Current DWF (m^3/day)	10483			1558			2576			8941			1109		
Consent Limits (95%ile or AA)	55	-	1	8	20	7	1	12	-	20	7	1	17	8	-
Discharge Quality Required															
Future DWF (m^3/day)	11890			1603			2737			12735			1149		
Effluent Quality Required (95%ile or AA)	**No Change Required**	**8.81**	**No Change Required**	**No Change Required**	**No Change Required**	**6.22**	**No Change Required**	**2.25**	**2.35**	**No Change Required**	**6.22**	**No Change Required**	**10.28**	**1.94**	**2.11**
Will Growth prevent WFD 'No Deterioration' being achieved?	**No**			**No**			**No**			**No**			**No**		

TABLE A2-2: IMPROVEMENT TO 'GOOD STATUS' ASSESSMENT

	St Neots WwTW			Somersham WwTW			Ramsey WwTW			Huntingdon WwTW			Oldhurst WwTW		
	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate	BOD	Ammonia	Phosphate
River Downstream of Discharge															
Future Status target	High	High	Good	Good	Good	Good	Good	Good	Good	High	High	Good	Good	Good	Good
Designated Salmonid Fishery?	N	-	-	N	-	-	N	-	-	N	-	-	N	-	-
River Quality Target (90%ile or AA)	-	-	0.12	-	0.6	0.12	-	-	0.12	-	-	0.12	-	-	0.12
Current Consent															
Current DWF (m^3/day)	10483			1558			2576			8941			1109		
Consent Limits (95%ile or AA)	-	-	**No Change Required**	-	**1.5**	**0.15**	-	-	**0.23**			**0.90**	-	-	**0.16**
Discharge Quality Required															
Future DWF (m^3/day)	11890			1603			2737			12735			1149		
Effluent Quality Required (95%ile or AA)	-	-	**No Change Required**	-	**1.5**	**0.15**	-	-	**0.23**			**0.78**	-	-	**0.16**
Will Growth prevent WFD 'No Deterioration' being achieved?	**No**			**No**			**No**			**No**			**No**		

Key: Green Value – No change to current consent required, Amber Value – Consent tightening required, but within limits of conventionally applied treatment processes, Red Value – Not achievable within limits of conventionally applied treatment processes

Flood Risk from WwTW

In order to determine whether the increase in wastewater discharged from the WwTWs as a result of growth is likely to impact on flood risk downstream, estimates were made of the percentage increase in flood flows that would occur for a variety of return period events. Flood risk calculations were only possible for one WwTW covered by the Detailed WCS – Somersham, due to an absence of flow and/or cross-sectional data for other receiving watercourses.

The Flood Estimation Handbook (FEH) was used to derive flow estimates of the receiving watercourse of Somersham WwTW – the Cranbrook Drain for a range of flood return periods. (full results are provided below).

The calculated additional flow potentially discharging to the receiving watercourses is:

- Somersham WwTW – 13m^3/day.

This discharge value was calculated as a percentage of the flood flow for different return periods as shown in Table A2-3.

TABLE A2-3: ADDITIONAL FLOW FROM WWTW AS A PERCENTAGE OF ESTIMATED FLOOD FLOWS

Return Period	Cranbrook Drain (Somersham WwTW)	
	m^3/day	% additional flow of flood flow
Q5	311040	0.004
Q10	380160	0.003
Q50	570240	0.002
Q100	682560	0.002
Q200	820800	0.002

Based on these estimates the potential additional discharges to Cranbrook Drain are not significant (less than 1%). It is considered unlikely that these additional flows would result in a significant increase in flood levels; however, this should be considered as part of any proposed upgrade works at the WwTWs.

In order to determine if the increase in flow could impact on flood levels, the increased flows were input into a Manning's spreadsheet to calculate the likely change in water level at a given cross-section on each affected watercourse.

Information was taken from the Environment Agency survey of the Cranbrook Drain and key cross-section data entered into the model.

INPUT MANNINGS CALCULATION SHEET (CRANBROOK DRAIN ONLY)

APPENDIX 3: FEH WORKSHEETS

URS

Hydrological Assessment Cranbrook Drain

UNITED KINGDOM & IRELAND

REVISION SCHEDULE					
Rev	**Date**	**Details**	**Prepared by**	**Reviewed by**	**Approved by**
1	April 2012	Hydrological Assessment	Gemma Hoad Water Scientist	Rob Sweet Principal Flood Risk Specialist	Carl Pelling Principal Consultant

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TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background

Flood estimates have been undertaken for the contributing catchment for Cranbrook Drain, with the downstream boundary at Somersham WwTW discharge point. This These flow estimates will be used within a hydraulic model to estimate peak water levels for a range of return periods. This document presents the methodology used to estimate the flows for a range of return periods for the Cranbrook Drain catchment.

Flow estimates for the Cranbrook Drain have been determined based upon current industry standard flood estimation techniques as set out in the Flood Estimation Handbook (FEH)[1]. This handbook broadly comprises two main methods for hydrological modelling: the statistical method and the rainfall-runoff method. These methods have undergone several revisions but the latest will be used as part of these flow estimates.

1.2 Aim

The aim of this piece of work is to derive design flood hydrographs for the Cranbrook Drain for the following return period events:

- 1 in 2 year;
- 1 in 5 year;
- 1 in 10 year;
- 1 in 20 year;
- 1 in 50 year;
- 1 in 100 year;
- 1 in 100 year including the effects of climate change; and,
- 1 in 200 year.

[1] *Institute of Hydrology (1999) Flood Estimation Handbook. Wallingford, Oxford.*

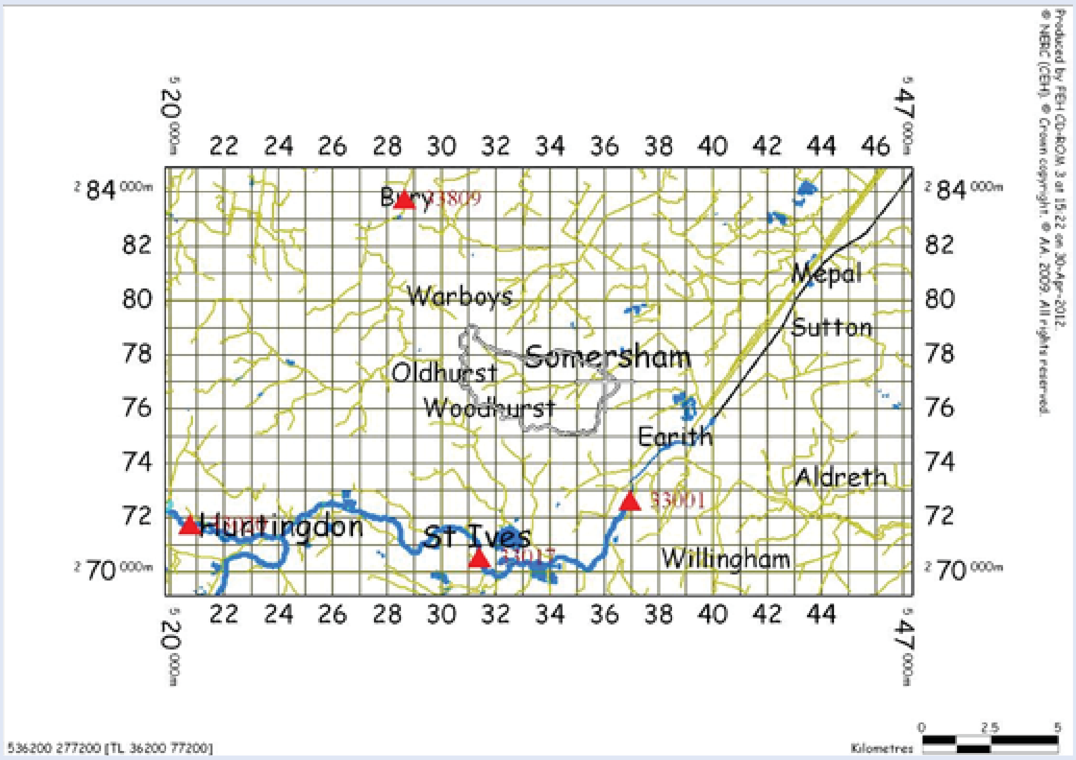
2 CATCHMENT

2.1 Catchment Overview

The Cranbrook Drain is located to the west of the Ouse Washes and flows through the Middle Level Commissioners Internal Drainage Board administrative area. The underlying geology of the Cranbrook Drain is West Walton Formation and Ampthill Clay Formation (Undifferentiated) – Mudstone.

The site is located towards the middle reaches of the Cranbrook Drain. The catchment upstream of the site has been delineated in FEH CD-ROM (Version 3.0, 2009), which is presented in Figure 2-1.

FIGURE 2-1: CRANBROOK DRAIN CATCHMENT BOUNDARY EXPORTED FROM FEH CD-ROM 3 (NERC, 2009)



2.2 Catchment descriptors

The FEH CD-ROM (Version 3.0, 2009) includes catchment data for the whole of the United Kingdom and was interrogated to determine catchment characteristics for the Cranbrook Drain, up to Somersham WwTW discharge point (i.e. the downstream boundary of the site).

The catchment descriptors have been exported from FEH CD ROM 3 (NERC, 2009) and are presented in Table 2-1.

TABLE 2-1: CRANBROOK DRAIN CATCHMENT DESCRIPTORS EXPORTED FROM FEH CD-ROM 3 (NERC, 2009) TL36200 77200

Parameter	Value	Parameter	Value
AREA	12.98	SAAR	544
ALTBAR	24	SAAR4170	553
ASPBAR	56	SPRHOST	52.83
ASPVAR	0.30	URBCONC2000	0.745
BFIHOST	0.364	URBEXT2000	0.0073
DPLBAR	3.69	URBLOC2000	0.948
DPSBAR	19.8	C	-0.027
FARL	1.0	D1	0.320
LDP	7.67	D2	0.259
PROPWET	0.24	D3	0.256
FPEXT	0.1755	E	0.320
FPLOC	0.901	F	2.451
FPDBAR	0.98	C(1 km)	-0.026
RMED 1D	28.5	D1(1 km)	0.311
RMED 1H	11.3	D2(1 km)	0.256
RMED 2D	34.6		

3 FEH STATISTICAL ANALYSIS

3.1 Introduction

The flows were estimated using the FEH statistical method as outlined in the current guidance[2] which supersedes the Flood Estimation Handbook.

3.2 QMED (median annual flood)

3.2.1 *QMED from catchment descriptors (QMEDcds)*

As the subject catchment is ungauged the QMED can be calculated from catchment descriptors using the following equation[2]:

$$QMED = 8.3062AREA^{0.8510}0.1536^{\left(\frac{1000}{SAAR}\right)}FARL^{3.4451}0.0460^{BFIHOST^2}$$

WINFAP-FEH (Version 3.0, 2009) was used to calculate an unadjusted QMED from the catchment descriptors ($QMED_{cds}$).

$QMED_{cds}$ = 1.563m³/sec

3.2.2 *Catchment Descriptors Review*

Some catchments are deemed to be 'problem catchments' where they are significantly different to other catchments. In these cases alternative methods for flow estimation should be reviewed or adjustments can be applied.

To identify whether this catchment is deemed to be problematic the questions listed in Table 3-1 have been answered.

TABLE 3-1: REVIEW OF POTENTIAL PROBLEM CATCHMENTS

Question	Indicator	Yes/No?
Is the catchment small?	AREA <5km^2	No
Is the catchment permeable?	SPRHOST <20	No
Is the catchment urbanised?	URBEXT >0.025	No
Is the catchment flat?	DPSBAR <20	Yes
Is the catchment low lying?	ALTBAR <20	No
Is it subject to attenuation from reservoirs or lakes?	FARL <0.95	No

DPSBAR is only just considered to have a flat drainage path, therefore further investigation was not deemed necessary. All of the other questions imply that the catchment does not need any adjustments made.

3.3 QMED adjustment

The estimate of QMED at an ungauged site from catchment descriptors should be adjusted through data transfer from a gauge on a hydrologically similar catchment.

[2] Defra/Environment Agency (2008) *'Improving the FEH statistical procedures for flood frequency estimation'*, Environment Agency: Bristol.

The revised method for data transfer provided in the Science Report 'SC050050 - Improving the FEH statistical procedures for flood frequency estimation' has been used to adjust QMED.

3.3.1 *Selection of suitable donor(s)*

The 10 closest catchments (i.e. closest based on distance between catchment centroids) to the subject catchment have been reviewed for their hydrological similarity to the subject catchment. These are presented in Table 3-3.

To determine the most appropriate donor catchment the criteria defined in Table 3-2 have been used in a review of the potential data transfer donors. Where the potential catchments do not meet these criteria they have been highlighted in purple in Table 3-3. WinFAP v3 calculates the QMED adjusted value for the subject site using each of the donor stations; this is presented in Column 2 of Table 3-3.

TABLE 3-2: CRITERIA USED IN THE REVIEW OF POTENTIAL DONOR CATCHMENTS FOR DATA TRANSFER

Parameter	Criteria a donor catchment should meet
AREA	Within factor of 5, small if <5km^2
SAAR	Within factor of 1.1
BFIHOST	Max difference 0.18
FARL	Problem if <0.95
URBEXT	Urbanised if >0.025 – manual check required
PROPWET	Max different 0.1
DPSBAR	Flat if <20
ALTBAR	Low lying if <20

TABLE 3-3: POTENTIAL DONOR CATCHMENTS FOR DATA TRANSFER

Station	QMED Adjusted	Centroid X	Centroid Y	Centroid Distance (m)	AREA	SAAR	BFIHOST	FARL	URBEXT	Data Years	QMED AM	QMED cds
Cranbrook Drain		533487	276827		12.98	544	0.364	1	0.007			
33052 (Swaffham Lode @ Swaffham Bulbeck)	1.312	555300	262850	25.91	33.25	567	0.841	0.998	0.012	40	0.358	0.677
33012 (Kym @ Meagre Farm)	1.525	506371	265471	29.4	137.99	585	0.309	0.992	0.007	49	14.726	16.215
33021 (Rhee @ Burnt Mill)	1.589	534753	244427	32.42	306.06	559	0.715	0.994	0.021	47	8.242	7.704
33027 (Rhee @ Wimpole)	1.542	528835	243642	33.51	128.42	558	0.613	1	0.013	44	5.341	5.666
33055 (Granta @ Babraham)	1.512	557649	246183	39.02	101.8	579	0.637	0.999	0.012	33	4.076	4.772
33023 (Lea Brook @ Beck Bridge)	1.364	569954	262061	39.34	105.95	579	0.561	0.996	0.007	45	3.373	6.467
36012 (Stour @ Kedington)	1.665	567272	251505	42.22	76.64	599	0.396	0.99	0.01	42	11.991	8.711
32003 (Harpers Brook @ Old Mill Bridge)	1.601	491255	284601	42.94	70.46	622	0.415	1	0.017	69	10.158	8.988
33051 (Cam @ Chesterford)	1.553	551708	236036	44.68	140.09	599	0.576	0.993	0.025	40	8.274	8.581
36008 (Stour @ Westmill)	1.514	569913	247315	46.88	222.82	589	0.413	0.994	0.023	49	16.642	19.91

3.3.2 *QMED adjusted (QMED$_{s,adj}$)*

Following this review the most suitable station to be a donor for data transfer is 33012 (Kym @ Meagre Farm) as it is deemed to be hydrologically similar following a review for QMED adjustment to the subject catchment. Although the catchment area is significantly larger, the underlying geology is more similar to the subject catchment. Whilst 33052 (Swaffham Lode @ Swaffham Bulbeck) is the closest site, the catchment is more permeable (BFIHOST = 0.841), and therefore has not been selected.

The equation below is used to adjust the QMED$_{s,cds}$ through the derivation of the ratio between the observed QMED (QMED$_{g,obs}$) and QMED from the catchment descriptors (QMED$_{g,cds}$)from a donor or gauged site.

$$QMED_{(s,\ adj)} = QMED_{(s,\ cds)} \left(\frac{QMED_{(g,\ obs)}}{QMED_{(g,\ cds)}} \right)^{Asg}$$

$$Asg = 0.4598\exp(-0.0200d_{sg})+(1-0.4598)\exp(-0.4785d_{sg})$$

Where:

- s = site,
- adj = adjusted,
- g = gauged;
- cds = catchment descriptors;
- obs = observed;
- d_{sg} is distance between centroids.

WINFAP-FEH (Version 3.0, 2009) was used to calculate an adjusted QMED, without urban adjustment.

QMED$_{s,adj}$ = 1.525m^3/sec

3.4 Flood Frequency Curve

3.4.1 *Initial Pooling Group*

An initial pooling group was formed using data from the HiFlows UK database (v3.1.2 released December 2011). The initial pooling group was reviewed to identify stations 'not suitable for pooling'. The initial pooling group is presented Appendix A, with those not suitable for pooling highlighted in yellow.

3.4.2 *Pooling Group 1st Revision*

The initial pooling group was heterogeneous (H^2=8.52) and a review was desirable. The initial pooling group contained some stations that were deemed not suitable for pooling; these were therefore removed from the pooling group.

Through the removal of these stations the heterogeneity of the pooling group was improved; this created the '1st Revision Pooling Group'.

A summary of the revisions to the initial pooling group is presented in Table 3-4.

TABLE 3-4: SUMMARY 1ST REVISION OF THE POOLING GROUP

Station	Reason	Status
39017 (Ray @ Grendon Underwood)	Not suitable for pooling	Removed
30014 (Pointon Lode @ Pointon)	Not suitable for pooling	Removed
54060 (Potford Brook @ Sandyford Bridge)	Not suitable for pooling	Removed
27038 (Costa Beck @ Gatehouses)	Not suitable for pooling	Removed
33048 (Larling Brook @ Stonebridge)	Not suitable for pooling	Removed
33052 (Swaffham Lode @ Swaffham Bulbeck)	Not suitable for pooling	Removed
41028 (Chess Stream @ Chess Bridge)	Not suitable for pooling	Removed
68011 (Arley Brook @ Gore Farm)	Not suitable for pooling	Removed
41016 (Cuckmere @ Cowbeech)	Not suitable for pooling	Removed
52016 (Currypool Stream @ Currypool Farm)	Not suitable for pooling	Removed
52015 (Land Yeo @ Wraxall Bridge)	Not suitable for pooling	Removed
33049 (Stanford Water @ Buckenham Tofts)	Not suitable for pooling	Removed
31025 (Gwash South Arm @ Manton)	Not suitable for pooling	Removed
43019 (Shreen Water @ Colesbrook)	Not suitable for pooling	Removed
39036 (Law Brook @ Albury)	Not suitable for pooling	Removed
22801 (Pont @ Stamfordham)	Not suitable for pooling	Removed
30017 (Witham @ Colsterworth)	Not suitable for pooling	Removed
28070 (Burbage Brook @ Burbage)	Not suitable for pooling	Removed

TABLE 3-4: SUMMARY 1ST REVISION OF THE POOLING GROUP		
Station	**Reason**	**Status**
31023 (West Glen @ Easton Wood)	Not suitable for pooling	Removed
26010 (Driffield Canal @ Snakeholme Lock)	Not suitable for pooling	Removed
45013 (Tale @ Fairmile)	Not suitable for pooling	Removed

3.4.3 *Pooling Group 2nd Revision*

Following the 1st revision of the pooling group it was identified that a review of the pooling group is essential. All of the catchment descriptor plots were reviewed with the aim of identifying any obvious outliers in the pooling group. In FEH, hydrological similarity is based on the catchment (AREA), standard average annual rainfall (SAAR), flood attenuation by reservoirs and lakes (FARL) and floodplain extent (FPEXT). These catchment descriptors were reviewed in the first instance.

The stations listed below were removed from the 1st Revision Pooling Group.

TABLE 3-5: SUMMARY 2ND REVISION OF THE POOLING GROUP		
Station	**Reason**	**Status**
73015 (Keer @ High Keer Weir	Discordant – flagged red	Removed
32029 (Flore @ Experimental Catchment)	Short Record (<5 years)	Removed

The SAAR values for the catchments in the pooling group are larger than the Cranbrook Drain catchment. The FPEXT values for the majority of the catchments in the pooling group are reasonably evenly spread around the Cranbrook Drain catchment, although most were lower.

The URBEXT values for the majority of the catchments in the pooling group were reasonably evenly spread around the Cranbrook Drain catchment.

The FARL values for the majority of the catchments in the pooling group were similar to the Cranbrook Drain catchment. The Babingley @ Castle Rising (33054) had an obvious low FARL value but was retained in the pooling group as it is greater than 0.95 which is deemed acceptable.

Due to the small catchment area of the subject site and the relatively low number of small catchments within the HiFlows database (there are only 26 with an area less than 20km^2), the similarity of suitable catchments is limited. Therefore stations with some parameters that are considerably different have to be used.

3.4.4 *Final Pooling Group*

The final pooling group is presented in Table 3-6 and a selection of distribution plots are presented in Figure 3-1, Figure 3-2, Figure 3-3 and Figure 3-4.

An H_2 value of 4.36 indicates that the pooling group is heterogeneous and that a review of the pooling group is essential. It is our opinion that we have tested the group to rigorous criteria, removing stations where necessary.

TABLE 3-6: FINAL POOLING GROUP FOR CRANBROOK DRAIN

Station	Distance (SDM)	Years of Data	QMED AM	L-CV	L-SKEW	Discordancy	Area (km^2)	SAAR	FPEXT	FARL	URBEXT 2000
33045 (Wittle @ Quidenham)	1.086	41	1.147	0.338	0.166	0.39	27.55	608	0.177	0.974	0.01
27073 (Brompton Beck @ Snainton Ings)	1.1	29	0.743	0.205	0.011	0.411	8.06	721	0.237	1	0.008
20002 (West Peffer Burn @ Luffness)	1.147	41	3.299	0.292	0.015	1.733	26.31	616	0.128	0.996	0.002
36009 (Brett @ Cockfield)	1.194	39	3.661	0.26	-0.113	1.858	25.62	598	0.113	1	0.005
29009 (Ancholme @ Toft Newton)	1.222	35	1.851	0.386	0.371	2.121	29.52	616	0.206	0.997	0.004
26802 (Gypsey Race @ Kirby Grindalythe)	1.762	10	0.127	0.233	0.25	0.542	15.85	757	0.03	1	0
36010 (Bumpstead Brook @ Broad Green)	1.808	42	6.795	0.428	0.223	1.825	27.58	588	0.045	0.999	0.007
203046 (Rathmore Burn @ Rathmore Bridge)	1.861	27	10.996	0.126	0.125	1.504	22.51	1043	0.073	1	0
25019 (Leven @ Easby)	1.934	31	6.088	0.355	0.396	1.164	15.07	830	0.019	1	0.004
41020 (Bevern Stream @ Clappers Bridge)	2.021	40	13.429	0.229	0.22	0.339	35.42	886	0.076	0.993	0.013
33054 (Babingley @ Castle Rising)	2.032	33	1.129	0.219	0.081	0.185	48.51	686	0.118	0.944	0.005
27051 (Crimple @ Burn Bridge)	2.111	37	4.514	0.22	0.133	1.152	8.15	855	0.013	1	0.006
72014 (Conder @ Galgate)	2.14	42	17.222	0.192	0.058	1.132	28.99	1183	0.082	0.975	0.006
44009 (Wey @ Broadwey)	2.14	32	1.688	0.34	0.241	0.362	7.95	894	0.015	1	0.022
203049 (Clady @ Clady Bridge)	2.165	27	22.742	0.197	0.123	0.283	29.38	1079	0.06	1	0
TOTAL		506									

TABLE 3-6: FINAL POOLING GROUP FOR CRANBROOK DRAIN

Station	Distance (SDM)	Years of Data	QMED AM	L-CV	L-SKEW	Discordancy	Area (km^2)	SAAR	FPEXT	FARL	URBEXT 2000
WEIGHTED MEANS			0.271	0.149							
H2 = 4.36											

3.4.5 *Final Pooling Group Plots*

FIGURE 3-1: FINAL POOLING GROUP AREA PLOT

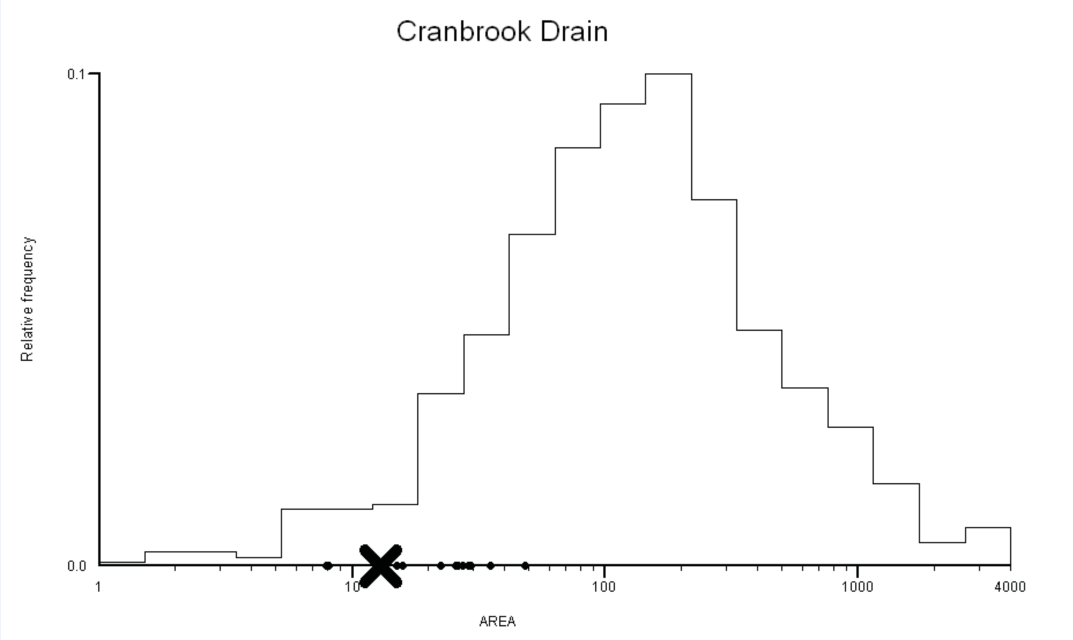


FIGURE 3-2: FINAL POOLING GROUP SAAR PLOT

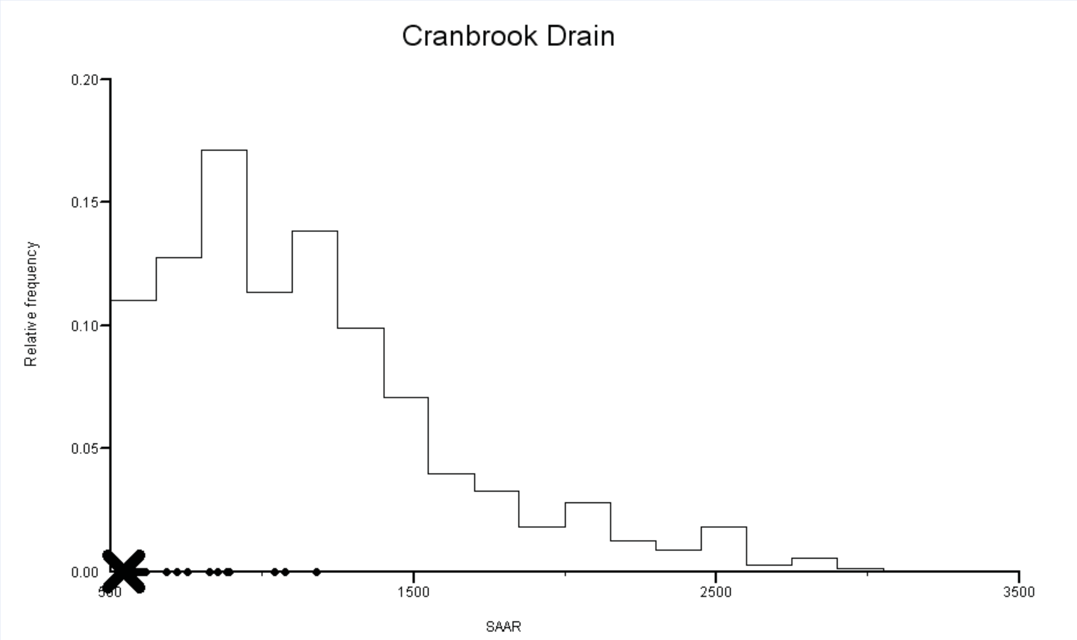


FIGURE 3-3: FINAL POOLING GROUP BFIHOST PLOT

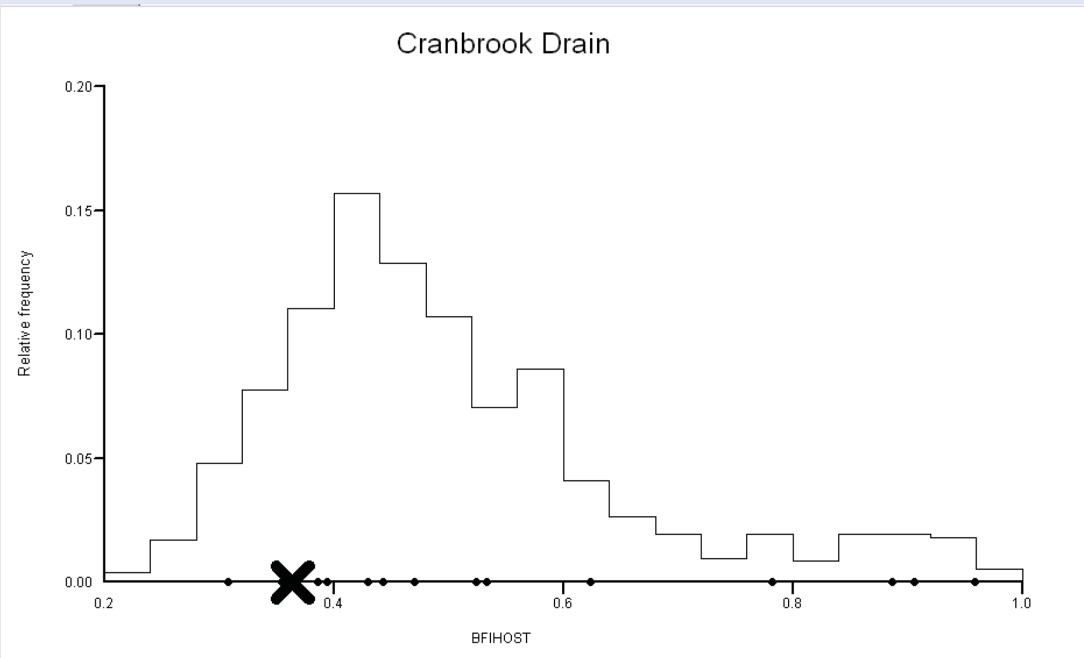
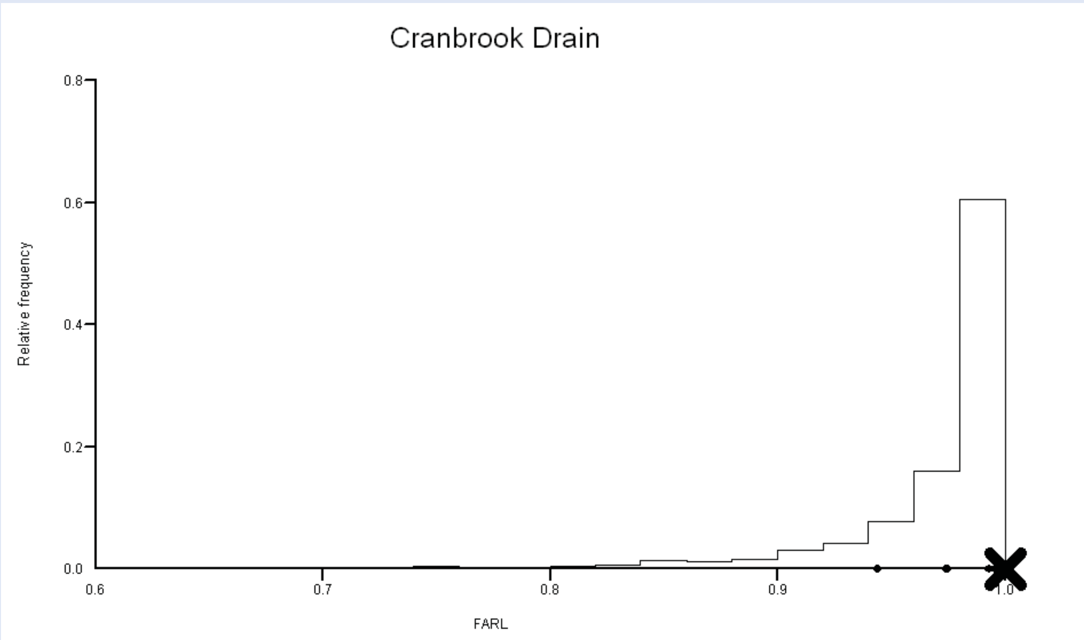


FIGURE 3-4: FINAL POOLING GROUP FARL PLOT



3.4.6 *Distributions of Pooling Group*

Table 3-7 presents the Goodness of Fit ‘z’ values for a range of distributions to derive growth curve fittings from the final pooling group. The distribution with the most acceptable fit is typically selected for the generation of the flood frequency curve.

TABLE 3-7: FINAL POOLING GROUP DISTRIBUTIONS

Station	Status
Generalised Logistic (GL)	0.9551
Generalised Extreme Value (GEV)	-1.3467
Pearson Type III	-1.4335
Generalised Parento	-6.2159

The lowest absolute Z-value indicates the best fit from the Goodness of Fit test statistics within WINFAP-FEP v3. The Generalised Logistic (GL) and Generalised Extreme Value (GEV) distribution produce the most acceptable fit. However, only the GL will be used to derive the growth curve as this is deemed to be the most useful distribution for providing the best overall fit to UK data.

3.5 Estimated FEH Statistical Method Peak Flows

Using the final pooling group and a GL distribution the fittings for the flood frequency curve are presented in Table 3-8.

TABLE 3-8: FLOOD FREQUENCY CURVE ESTIMATES

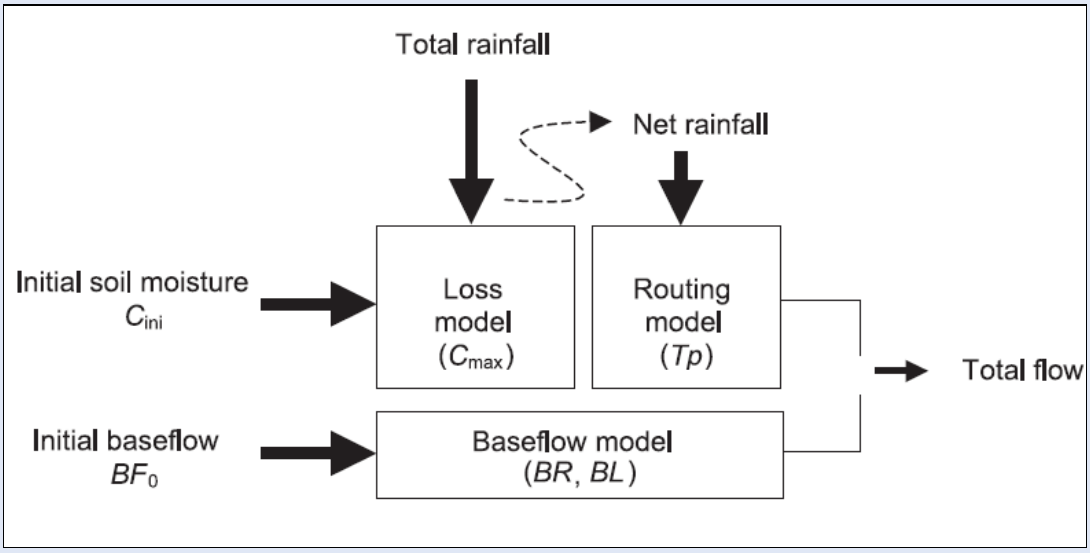
Return Period	GL – Growth Curve Fittings	m^3/sec
2	1.00	1.53
5	1.43	2.18
10	1.73	2.64
20	2.04	3.10
50	2.48	3.78
100	2.85	4.35
200	3.26	4.97
1000	4.39	6.69

4 REVITALISED FLOOD HYDROGRAPH (REFH) RAINFALL-RUNOFF METHOD

4.1 Introduction

The Rainfall-Runoff Method is a lumped conceptual model that coverts rainfall into a flow hydrograph. The most recent rainfall-runoff model is the Revitalised Flood Hydrograph (ReFH) rainfall-runoff model[4]. The schematic in Figure 4-1, represents the main components of the ReFH.

FIGURE 4-1: SCHEMATIC OF REFH MODEL[3]



4.2 Urban expansion adjustment

The ReFH spreadsheet is not compatible with URBEXT2000 values and it is necessary to update the $URBEXT_{1990}$ to the present year. The Urban Expansion Factor (UEF) has been applied as described in the FEH Vol. 5[1], which is:

*UEF = 0.8165+0.2254*ATAN((2012-1967.5)/21.25)*

The UEF has been calculated to be 1.07. The subject catchment $URBEXT_{1990}$ has been updated to 2012 to be 0.042.

4.3 Donor adjustment

4.3.1 *Selection of donor catchment*

The model parameters for an ungauged catchment can be based on the catchment descriptors; a donor catchment; or, a combination of both[4]. Although there are no set rules, the following principles should be considered when choosing a suitable donor catchment:

- The catchment descriptors should be comparable; in particular the catchment area should differ by less than a factor of 5;
- The catchment centroids should normally be separated by a distance of less than 50km;

[3] Centre for Ecology and Hydrology *(2005) 'Revitalised Flood Hydrograph Model'.* Centre of Ecology and Hydrology: Wallingford, Oxford.
[4] Kjeldsen, T. R. (2007) *'The revitalised FSR/FEH rainfall-runoff method',* Centre of Ecology and Hydrology: Wallingford: Oxford.

- The catchments should be substantially rural; and,
- Transfer of information between catchments in the same river basin is preferred, the ideal case being when the gauged site is located just upstream or downstream of the subject site.

The nearest ReFH station to the subject site is 32003 (Harpers Brook @ Old Mill Bridge). In terms of the principles identified above:

- The catchment area (70.46km^2) is outside the factor of 5 of the Cranbrook Drain catchment, However, this is the smallest catchment which is close to the subject catchment;
- The catchment centroids are separated by less than 50km (42.94 km);
- The URBEXT$_{1990}$ is 0.0039 which is essentially rural and almost identical to the ungauged subject site; and,
- The catchment is not in the same river basin.

To review whether the catchment is a suitable donor the catchment descriptors have been compared further in Table 4-1. The same criteria have been applied in this donor selection as in the FEH statistical approach outlined in Table 3-2. This comparison found that the catchment is a suitable donor and has been used to adjust the model parameters.

TABLE 4-1: COMPARISON OF CATCHMENT DESCRIPTORS OF THE SUBJECT AND POTENTIAL DONOR CATCHMENT

Station	AREA	SAAR	BFIHOST	FARL	PROPWET	ALTBAR	DPSBAR	URBEXT$_{1990}$
Cranbrook Drain	12.98	544	0.364	1	0.24	24	19.8	0.0042
32003 (Harpers Brook @ Old Mill Bridge)	70.46	622	0.415	1	0.3	89	37.7	0.0042

4.3.2 *Adjustment to model parameters*

The model parameters used in the donor transfer were extracted from Appendix C of the supplementary report to the FEH[4]. The model parameters were adjusted as presented in Table 4-2.

TABLE 4-2: ADJUSTMENT OF SUBJECT CATCHMENT MODEL PARAMETERS

Model Parameter	Subject Catchment (s,cds)	Donor 32003 Observed (g,obs)	Donor 32003 Catchment Descriptors (g,cds)	Adjustment Factor (g.obs/g.cds)	Subject Catchment Adjusted =s,cds*Adjustment Factor
C max (mm)	321.77	248.80	345.46	0.720	232
T*p*	6.92	7.05	9.27	0.760	5.26
Baseflow Lag (BL)	43.89	62.30	52.87	1.178	51.7
Baseflow Recharge (BR)	0.75	0.84	0.94	0.893	0.67

4.4 Critical Storm Duration

The storm duration for the design storm depends on the response time of the catchment (time to peak, T*p*) and the general wetness of the catchment (measured by *SAAR*). In the case of this catchment T*p* is 6.92 hours for the unadjusted and 5.26 hours when adjusted by the donor station. The storm duration is 9.5 hours.

4.5 Estimated ReFH Method Peak Flows

Using the ReFH method the peak flood flows that have been generated using the unadjusted catchment descriptors and the adjusted catchment descriptors are presented in Table 4-3. The audit reports are presented in Appendix B.

TABLE 4-3: ESTIMATED REFH PEAK FLOWS FOR THE CRANBROOK DRAIN

Return Period	Unadjusted Peak Flow (m^3/sec)	Adjusted Peak Flow (m^3/sec)
2	2.4	2.7
5	3.1	3.6
10	3.8	4.4
20	4.4	5.2
50	5.3	6.6
100	6.3	7.9
200	7.4	9.5

5 RESULTS OF HYDROLOGICAL ASSESSMENT

5.1 Summary of flow estimation methods

A comparison of the flows generated in both methods is presented in Table 5-1. The 'Adjusted ReFH' peak flow values will be taken forward in determining whether there is an increase in flood flows, as a result of an increase in wastewater discharged from a WwTW, as they provide a conservative estimate.

TABLE 5-1: SUMMARY OF FLOWS

Return Period	Statistical Method (m^3/sec)	Adjusted ReFH Peak Flow (m^3/sec)
2	1.53	2.7
5	2.18	3.6
10	2.64	4.4
20	3.10	5.2
50	3.78	6.6
100	4.35	7.9
200	4.97	9.5

APPENDIX A – INITIAL POOLING GROUP

TABLE 0-1: INITIAL POOLING GROUP FOR CRANBROOK DRAIN

Station	Distance (SDM)	Years of Data	QMED AM	L-CV	L-SKEW	Discordancy	Area (km^2)	SAAR	FPEXT	FARL	URBEXT 2000
39017 (Ray @ Grendon Underwood)	0.762	42	5.387	0.353	0.096	0.505	21.15	622	0.158	0.982	0.004
30014 (Pointon Lode @ Pointon)	0.843	37	2.663	0.404	0.328	1.07	10.94	591	0.105	1	0.014
54060 (Potford Brook @ Sandyford Bridge)	0.991	32	1.773	0.447	0.346	0.923	22.37	677	0.133	0.998	0.001
27038 (Costa Beck @ Gatehouses)	1.036	39	1.332	0.379	0.512	1.029	7.98	722	0.125	0.99	0.022
33045 (Wittle @ Quidenham)	1.086	41	1.147	0.338	0.166	0.168	27.55	608	0.177	0.974	0.01
27073 (Brompton Beck @ Snainton Ings)	1.1	29	0.743	0.205	0.011	0.448	8.06	721	0.237	1	0.008
20002 (West Peffer Burn @ Luffness)	1.147	41	3.299	0.292	0.015	0.786	26.31	616	0.128	0.996	0.002
33048 (Larling Brook @ Stonebridge)	1.179	32	0.303	0.412	0.389	1.043	21.99	635	0.233	0.907	0.003
36009 (Brett @ Cockfield)	1.194	39	3.661	0.26	-0.113	1.2	25.62	598	0.113	1	0.005
32029 (Flore @ Experimental Catchment)	1.204	5	2.538	0.374	0.054	1.132	8.34	624	0.086	1	0.002
29009 (Ancholme @ Toft Newton)	1.222	35	1.851	0.386	0.371	1.182	29.52	616	0.206	0.997	0.004
33052 (Swaffham Lode @ Swaffham Bulbeck)	1.349	40	0.358	0.311	0.185	0.061	33.25	567	0.202	0.998	0.012
41028 (Chess Stream @ Chess Bridge)	1.528	45	6.658	0.221	0.178	0.627	24.92	849	0.097	0.983	0.014
26802 (Gypsey Race @ Kirby Grindalythe)	1.762	10	0.127	0.233	0.25	0.441	15.85	757	0.03	1	0
68011 (Arley Brook @ Gore Farm)	1.769	9	6.109	0.132	0.644	5.841	33.76	831	0.25	0.998	0.021
41016 (Cuckmere @ Cowbeech)	1.807	42	13.708	0.325	0.086	1.044	19.09	855	0.043	0.966	0.027

TABLE 0-1: INITIAL POOLING GROUP FOR CRANBROOK DRAIN

Station	Distance (SDM)	Years of Data	QMED AM	L-CV	L-SKEW	Discordancy	Area (km^2)	SAAR	FPEXT	FARL	URBEXT 2000
36010 (Bumpstead Brook @ Broad Green)	1.808	42	6.795	0.428	0.223	0.868	27.58	588	0.045	0.999	0.007
203046 (Rathmore Burn @ Rathmore Bridge)	1.861	27	10.996	0.126	0.125	1.307	22.51	1043	0.073	1	0
52016 (Currypool Stream @ Currypool Farm)	1.876	39	2.673	0.273	0.265	0.766	15.7	934	0.037	1	0
52015 (Land Yeo @ Wraxall Bridge)	1.879	30	3.379	0.295	0.094	0.457	23.33	906	0.058	0.933	0.017
33049 (Stanford Water @ Buckenham Tofts)	1.892	7	0.788	0.51	0.489	1.949	46.42	645	0.165	0.915	0.007
31025 (Gwash South Arm @ Manton)	1.91	31	10.846	0.281	0.099	0.672	23.93	663	0.027	0.995	0.006
25019 (Leven @ Easby)	1.934	31	6.088	0.355	0.396	0.429	15.07	830	0.019	1	0.004
43019 (Shreen Water @ Colesbrook)	1.963	36	13.531	0.196	-0.008	0.539	30.36	884	0.063	0.993	0.015
39036 (Law Brook @ Albury)	1.973	42	0.46	0.253	0.075	1.295	16.05	819	0.017	0.96	0.008
22801 (Pont @ Stamfordham)	1.998	10	11.668	0.47	0.476	1.295	48.11	684	0.116	0.998	0.002
30017 (Witham @ Colsterworth)	2	31	5.844	0.278	0.272	0.096	50.13	641	0.124	0.993	0.026
41020 (Bevern Stream @ Clappers Bridge)	2.021	40	13.429	0.229	0.22	0.277	35.42	886	0.076	0.993	0.013
33054 (Babingley @ Castle Rising)	2.032	33	1.129	0.219	0.081	0.275	48.51	686	0.118	0.944	0.005
28070 (Burbage Brook @ Burbage)	2.086	56	4.302	0.341	0.51	2.2	8.45	1006	0.031	1	0
31023 (West Glen @ Easton Wood)	2.093	37	1.906	0.404	0.306	0.412	4.32	641	0.052	1	0
26010 (Driffield Canal @ Snakeholme Lock)	2.109	21	2.049	0.198	0.227	0.797	49.47	699	0.1	0.987	0.025

TABLE 0-1: INITIAL POOLING GROUP FOR CRANBROOK DRAIN

Station	Distance (SDM)	Years of Data	QMED AM	L-CV	L-SKEW	Discordancy	Area (km^2)	SAAR	FPEXT	FARL	URBEXT 2000
27051 (Crimple @ Burn Bridge)	2.111	37	4.514	0.22	0.133	0.375	8.15	855	0.013	1	0.006
45013 (Tale @ Fairmile)	2.138	24	9.887	0.207	0.197	1.344	31.4	922	0.048	0.998	0.009
72014 (Conder @ Galgate)	2.14	42	17.222	0.192	0.058	0.588	28.99	1183	0.082	0.975	0.006
44009 (Wey @ Broadwey)	2.14	32	1.688	0.34	0.241	0.073	7.95	894	0.015	1	0.022
203049 (Clady @ Clady Bridge)	2.165	27	22.742	0.197	0.123	0.359	29.38	1079	0.06	1	0
73015 (Keer @ High Keer Weir)	2.181	19	9.22	0.076	-0.225	4.126	30.06	1158	0.075	0.976	0.003
TOTAL		1212									
WEIGHTED MEANS			0.297	0.199							
H2 = 8.56											

APPENDIX B – REFH AUDIT REPORTS

APPENDIX 4: STATUTORY DESIGNATED SITES DETAIL

Ouse Washes SAC

The Ouse Washes are located in eastern England on one of the major tributary rivers of The Wash. It is an extensive area of seasonally flooding wet grassland ('washland') lying between the Old and New Bedford Rivers (which are hydraulically connected to the River Great Ouse) and acts as a floodwater storage system during winter months. The cycle of winter storage of floodwaters from the river and traditional summer grazing by cattle, as well as hay production, have given rise to a mosaic of rough grassland and wet pasture, with a diverse and rich ditch fauna and flora. The Ouse Washes were designated as an SAC for their population of Spined Loach. This fish is thought to be largely confined to oxygen rich waters where the substratum consists of fine, organic rich sediment.

The Conservation Objective for the Spined loach population of the site is to maintain the population at Favourable Condition. Specifically, there should be no reduction in densities from existing levels (and in any case no less than $0.1m^{-2}$), no change in extent of Spined Loach habitat (311 ha). Targets for defining favourable conservation status include:

- At least three year-classes should be present at significant densities. At least 50% of the population should consist of 0+ fish
- Maintain the characteristic physical form of the river channel
- Maintain natural substrate character
- Maintain vegetation management to no more than 50% of the channel width (for submerged plants) and 50% of the bank length (for marginal fringing plants)
- No artificial barriers significantly impairing essential fish movement
- No stocking/transfers of fish species at excessively high densities
- Biological water quality equivalent to Class ‘b’ in the Biological module of the General Quality Assessment scheme
- Dissolved oxygen/ammonia/BOD equivalent quality to Chemical GQA Class ‘C’
- Soluble reactive phosphorus of 0.1 mg L-1 annual mean
- Flow regime should be characteristic of the river. As a guideline, at least 90% of the naturalised daily mean flow should remain in the river throughout the year.

Ouse Washes SPA

The washlands support both breeding and wintering waterbirds. In summer, there are important breeding numbers of several wader species, as well as spotted crake *Porzana porzana*. In winter, the site holds very large numbers of swans, ducks and waders. During severe winter weather elsewhere, the Ouse Washes can attract waterbirds from other areas due to its relatively mild climate (compared with continental Europe) and abundant food resources. In winter, some wildfowl, especially swans, feed on agricultural land surrounding the SPA. The site was designated as an SPA for regularly supporting 64,392 waterfowl, including populations of European importance of the following migratory species:

- Ruff
- Spotted Crake
- Bewick's Swan
- Hen Harrier

- Whooper Swan
- Black-tailed Godwit
- Gadwall
- Shoveler
- Pintail
- Pochard
- Wigeon

The detailed targets for determining favourable condition are too extensive to be reproduced here but the overall conservation objective for the SPA bird populations is to maintain the designated species in favourable condition, which is defined in part in relation to their population attributes and in part to habitat attributes (such as maintaining the extent and structure of the lowland neutral grassland habitat on site). On this site favourable condition requires the maintenance of the population of each designated species or assemblage.

Ouse Washes Ramsar site

The Ouse Washes is designated as a Ramsar site for the following reasons:

The site is one of the most extensive areas of seasonally-flooding washland of its type in Britain.

The site supports several nationally scarce plants, including small water pepper *Polygonum minus*, whorled water-milfoil *Myriophyllum verticillatum*, greater water parsnip *Sium latifolium*, river waterdropwort *Oenanthe fluviatilis*, fringed water-lily *Nymphoides peltata*, long-stalked pondweed *Potamogeton praelongus*, hair-like pondweed *Potamogeton trichoides*, grass-wrack pondweed *Potamogeton compressus*, tasteless water-pepper *Polygonum mite* and marsh dock *Rumex palustris*.

Invertebrate records indicate that the site holds relict fenland fauna, including the British Red Data Book species large darter dragonfly *Libellula fulva* and the rifle beetle *Oulimnius major*.

The site also supports a diverse assemblage of nationally rare breeding waterfowl associated with seasonally-flooding wet grassland.

The site supports a wintering waterbird assemblage of international importance

Species occurring at levels of international importance are:

- Tundra swan
- Whooper swan
- Eurasian wigeon
- Gadwall
- Eurasian teal
- Northern pintail
- Northern shoveler
- Mute swan
- Common pochard

- Black-tailed godwit

The detailed targets for determining favourable condition are too extensive to be reproduced here but the overall conservation objectives for the Ramsar site are to maintain the designated habitats and species in favourable condition, which is defined in part in relation to their population attributes and in part to habitat attributes (such as maintaining the extent and structure of the lowland neutral grassland and open water habitat on site). On this site favourable condition requires the maintenance of the population of each designated species or assemblage.

Ouse Washes SSSI

The site is one of the country's few remaining areas of extensive washland habitat. It is of particular note for the large numbers of wildfowl and waders which it supports, for the large area of unimproved neutral grassland communities which it holds and for the richness of the aquatic fauna and flora within the associated watercourse. The capacity of the site to hold wintering and breeding waterfowl and waders is of international significance. Of particular note in the winter are the large numbers of teal *Anas crecca*, pintail *Anas acuta*, wigeon Anas *penelope*, shoveler *Anas clypeata*, pochard *Aythya ferina* and Bewick's swan *Cygnus bewickii*.

The grassland communities of the area are characterised by such grasses as reed and floating sweet-grass *Glyceria maxima* and *G.fluitans*, reed canary-grass *Phalaris arundinacea*, marsh foxtail *Alopecurus geniculatus* together with a variety of sedges and rushes. Typical herbs include amphibious bistort *Polygonum amphibium*, water-pepper *Polygonium hydropiper* and tubular water-dropwort *Oenanthe fistulosa*.

The associated dykes and rivers hold a great variety of aquatic plants, the pondweeds *Potamogeton* spp. are particularly well represented. Other aquatic species include the fringed water-lily *Nymphoides peltata*, greater water-parsnip *Sium latifolium* and the four species of duckweeds *Lemna* spp.

The limnological interest of the Ouse Washes is further diversified by the Old Bedford River and River Delph, both good examples of base-rich, sluggish, lowland rivers. The flora includes the fan-leaved water-crow foot *Ranunculus circinatus*, yellow water-lily *Nuphar lutea*, arrowhead *Sagittaria sagittifolia*, long-stalked pondweed *Potamogeton praelongus*, perfoliate pondweed *Potamogeton perfoliatus*, and river water-dropwort *Oenanthe fluviatilis*. The associated aquatic and semi-aquatic fauna is similarly diverse.

In the most recent condition assessments, 17.32% of the site (by area) was judged to be in either favourable or 'unfavourable recovering' condition, while 82.67% was judged to be 'unfavourable no change'. The reasons for unfavourable condition are primarily given as 'inappropriate water levels' although diffuse agricultural pollution was also identified as a contributory factor.

More than 40% of the UK's aquatic plant species (over 260) are found here including Mousetail, Flowering Rush, Water Starwort, Whorled Water Milfoil, Water Dropwort, Marsh Woundwort, Great Willow herb, Fringed Water-lily and Water Parsnip. In addition to the Washes, the rivers themselves are important habitats, as are the ditches between them.

Large areas of the SSSI, however, are affected by a combination of prolonged summer flooding and a combination of diffuse and point source pollution, resulting in 86% of the SSSI being classified as in unfavourable condition (982 hectares of which is on the RSPB's reserve). In particular, inputs of nutrients have gradually eroded the quality of aquatic plant communities in the rivers and ditches, which were once some of the most diverse in Britain[51]. The high nutrient loadings have considerably increased mat forming duckweed communities in the ditches. The nutrient inputs are also affecting the quality of the wet grassland habitats which are a key feature of the Washes, a Biodiversity Action Plan (BAP) priority habitat, and support important numbers of breeding wading birds such as snipe, lapwing and redshank.

The detailed targets for determining favourable condition are too extensive to be reproduced here but the overall conservation objectives for the SSSI are to maintain the designated habitats and species in favourable condition, which is defined in part in relation to their population attributes and in part to habitat attributes (such as maintaining the extent and structure of the lowland neutral grassland and open water habitat on site). On this site favourable condition requires the maintenance of the population of each designated species or assemblage.

Portholme SAC

Portholme is designated as a SAC for its *Alopecurus pratensis - Sanguisorba officinalis* (MG4) lowland hay meadows. It is the largest surviving traditionally-managed meadow in the UK, with an area of 104 ha of alluvial flood meadow (7% of the total UK resource). There has been a long history of favourable management and very little of the site has suffered from agricultural improvement, and so it demonstrates good conservation of structure and function. It supports a small population of fritillary *Fritillaria meleagris*.

The detailed targets for determining favourable condition are too extensive to be reproduced here but the overall conservation objectives for the SAC are to maintain the MG4 grassland in favourable condition, which is defined in part by maintaining the extent and structure of the lowland neutral grassland on site, particularly through appropriate grazing, and also its frequency *and duration of inundation.*

Portholme SSSI

This SSSI holds grassland communities of the alluvial flood meadow type. Portholme represents one of the largest areas of this grassland type in the country which continues to be managed on traditional lines as a 'lammas' meadow. Watercourses on the periphery of the site have populations of some uncommon invertebrates, including one dragonfly which is of a nationally restricted distribution. The grassland communities are characterised by the presence of such grasses as Yorkshire fog *Holcus lanatus*, yellow oat-grass *Trisetum flavescens*, meadow foxtail *Alopecurus pratensis* and meadow fescue *Festuca pratensis*. The range of herbs present, typical of such meadows, includes lady's bedstraw *Galium verum*, pepper-saxifrage *Silaum silaus* and great burnet *Sanguisorba officinalis*. A number of locally rare and one nationally rare plant are also present. The meadow is surrounded by channels of the River Ouse, and the Alconbury Brook is close by. These water bodies are important for dragonflies (Odonata) in particular the restricted dragonfly *Libellula fulva*. The traditional management of this site, which still continues, is by cutting for hay followed by grazing of the aftermath in later summer until the autumn. In winter and early spring Portholme is inundated by floodwaters. This provides natural fertilising of the soil and it is this seasonal flooding coupled with the traditional management that maintains the diversity of the natural plant communities.

Nene Washes SAC

[51] Reference: Cathcart, R. 2002. Effects of nutrient loading on the ditch flora of the Ouse Washes: current impacts and potential mitigation. RSPB

Nene Washes is designated as a SAC for its population of Spined Loach centred on Morton's Leam, a large drainage channel running along the eastern flank of the Washes, contains the highest recorded density of Spined Loach *Cobitis taenia* in the UK.

The Conservation Objective for the Spined Loach population of the site is to maintain the population at Favourable Condition. Specifically, there should be no reduction in densities from existing levels (and in any case no less than 0.1 $m^{-2'}$), no change in extent of Spined Loach habitat (Morton's Leam). Targets for defining favourable conservation status include:

At least three year-classes should be present at significant densities. At least 50% of the population should consist of 0+ fish

Maintain the characteristic physical form of the river channel

Maintain natural substrate character.

Maintain vegetation management to no more than 50% of the channel width (for submerged plants) and 50% of the bank length (for marginal fringing plants)

No artificial barriers significantly impairing essential fish movement

No stocking/transfers of fish species at excessively high densities

Biological water quality equivalent to Class 'b' in the Biological module of the General Quality Assessment scheme

Dissolved oxygen/ammonia/BOD equivalent quality to Chemical GQA Class 'C'

Soluble reactive phosphorus of 0.1 mg L-1 annual mean

Flow regime should be characteristic of the river. As a guideline, at least 90% of the naturalised daily mean flow should remain in the river throughout the year.

Nene Washes SPA

It is an extensive area of seasonally flooding wet grassland ('washland') lying along the River Nene. The cycle of winter storage of floodwaters from the river and traditional summer grazing by cattle have given rise to a mosaic of rough grassland and wet pasture, with a diverse ditch flora. Areas of arable cropping provide some winter feeding areas for wildfowl. In summer, it is of importance for breeding waders, as well as Spotted Crake *Porzana porzana*, whilst in winter the site holds large numbers of waders and wildfowl. During severe winter weather elsewhere the site can attract waterbirds from other areas due to its relatively mild climate (compared with continental Europe) and abundant food resources. Likewise, the site can act as a refuge for wildfowl displaced by deep flooding of the nearby Ouse Washes SPA. In winter, some wildfowl, especially Bewick's Swan *Cygnus columbianus bewickii*, feed in surrounding areas of agricultural land outside the SPA.

The continued international importance of this site is dependant on the maintenance of a winter flooding regime and a high but controlled summer water table. The establishment of a water level management regime is being addressed through the Nene Washes Management Strategy Group. A Management Plan was agreed in 1992 and a Water Level Management Plan is currently being drafted. English Nature also has management agreements with a number of landowners. Wildfowling occurs on all sections of the Washes but is not considered to cause significant disturbance at current levels. Any proposals for increased wildfowling will be regulated through the Habitat Regulations.

This site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive:

During the breeding season;

- Ruff *Philomachus pugnax*, 1 individuals representing at least 9.1% of the breeding population in Great Britain (Count as at 1993)
- Spotted Crake *Porzana porzana*, 5 individuals representing at least 10.0% of the breeding population in Great Britain (5-11 males = minimum)

Over winter;

- Bewick's Swan *Cygnus columbianus bewickii*, 1,718 individuals representing at least 24.5% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)
- Ruff *Philomachus pugnax*, 91 individuals representing at least 13.0% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)

This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

During the breeding season;

- Black-tailed Godwit *Limosa limosa limosa*, 16 pairs representing <0.1% of the breeding Western Europe/W Africa population (Count, as at 1992)

Over winter;

- Pintail *Anas acuta*, 1,435 individuals representing at least 2.4% of the wintering Northwestern Europe population (5 year peak mean 1991/2 - 1995/6)
- Shoveler *Anas clypeata*, 413 individuals representing at least 1.0% of the wintering Northwestern/Central Europe population

The area qualifies under Article 4.2 of the Directive (79/409/EEC) by regularly supporting at least 20,000 waterfowl. Over winter, the area regularly supports 25,437 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: Black-tailed Godwit *Limosa limosa islandica*, Lapwing *Vanellus vanellus*, Pochard *Aythya ferina*, Teal *Anas crecca*, Gadwall *Anas strepera*, Wigeon *Anas penelope*, Shoveler *Anas clypeata*, Pintail *Anas acuta,* Ruff *Philomachus pugnax*, Bewick's Swan *Cygnus columbianus bewickii*.

The detailed targets for determining favourable condition are too extensive to be reproduced here but the overall conservation objective for the SPA bird populations is to maintain the designated species in favourable condition, which is defined in part in relation to their population attributes and in part to habitat attributes (such as maintaining the extent and structure of the lowland neutral grassland habitat on site). On this site favourable condition requires the maintenance of the population of each designated species or assemblage.

Nene Washes Ramsar site

This site is an extensive area of seasonally-flooding wet grassland (washland) of importance for national and international populations of breeding and wintering waders and wildfowl. During severe winter weather elsewhere, the site can attract waterfowl from other areas due to its relatively mild climate (compared with continental Europe) and abundant food resources available. The site is also notable for the diversity of plant and associated animal life within its network of dykes.

The Nene Washes are designated as a Ramsar site for meeting criteria 2 and 6:

- Ramsar criterion 2 - The site supports an important assemblage of nationally rare breeding birds. In addition, a wide range of raptors occur through the year. The site also supports several nationally scarce plants, and two vulnerable and two rare British Red Data Book invertebrate species have been recorded.
- Ramsar criterion 6 – The site supports species/populations occurring at levels of international importance, namely Bewick's swan *Cygnus columbianus bewickii* and pintail *Anas acuta* in winter and black-tailed godwit *Limosa limosa islandica* in autumn.

The detailed targets for determining favourable condition are too extensive to be reproduced here but the overall conservation objectives for the Ramsar site are to maintain the designated habitats and species in favourable condition, which is defined in part in relation to their population attributes and in part to habitat attributes (such as maintaining the extent and structure of the lowland neutral grassland and open water habitat on site). On this site favourable condition requires the maintenance of the population of each designated species or assemblage.

Nene Washes SSSI

This site represents one of the country's few remaining areas of washland habitat which is essential to the survival nationally and internationally of populations of wildfowl and waders. The site is additionally notable for the diversity of plant and associated animal life within its network of dykes.

The washlands are used for the seasonal uptake of floodwaters and, traditionally, for cattle grazing in the summer months. The mosaic of rough grassland and wet pasture provide a variety of sward structure and herbs of importance respectively for bird nesting habitat and feeding. Additional winter feeding is provided by remains of arable cropping on small areas. These washlands play an additional role in relation to the nearby Ouse Washes in that they accommodate wildfowl populations displaced from the Ouse Washes when deep floodwaters prevent their feeding.

The site is favoured by large numbers of wintering wildfowl and particularly the dabbling ducks wigeon *Anas penelope*, teal *Anas crecca*, pintail *A. acuta* and Bewick's swan *Cygnus bewickii*. Wetland birds such as snipe *Gallinago gallinago* and redshank *Tringa totanus* regularly breed and during passage periods there is often a large movement of waders and raptors through the area. Many of the ditches hold a rich flora which includes such uncommon species as frogbit *Hydrocharis morsus-ranae*, water violet *Hottonia palustris* and flowering rush *Butomus umbellatus*.

In the most recent condition assessment the SSSI was judged to be 80.05% unfavourable recovering and 19.95% favourable condition.

The detailed targets for determining favourable condition are too extensive to be reproduced here but the overall conservation objectives for the Ramsar site are to maintain the designated habitats and species in favourable condition, which is defined in part in relation to their population attributes and in part to habitat attributes (such as maintaining the extent and structure of the lowland neutral grassland and open water habitat on site). On this site favourable condition requires the maintenance of the population of each designated species or assemblage.

Berry Fen SSSI

This site represents a washland habitat of ornithological value and holding neutral grassland communities of a type now scarce in Britain. The site is located close to the internationally important Ouse Washes and this factor influences the use of Berry Fen by wintering wildfowl, especially when the Washes are too deeply flooded. In particular, the Bewick's swan numbers reach nationally significant levels.

The wash grassland is characterised by grasses such as marsh foxtail *Alopecurus geniculatus* and reed canary-grass *Phalaris arundinacea*. This wet grassland grades into stands of reed sweet-grass *Glyceria maxima* towards the wetter parts of the site, together with clumps of slender-tufted sedge *Carex acuta*. Other herbs include the purple loosestrife *Lythrum salicaria* and meadowsweet *Filipendula ulmaria*. The ditches add further diversity, retaining open water into the summer months. Wetland herbs such as the local sneezewort *Achillea ptarmica*, marsh ragwort *Senecio aquaticus* and the uncommon narrow-leaved water-dropwort *Oenanthe silaifolia* occur. Most of the site floods irregularly during winter and wildfowl other than Bewick's swan may reach numbers of county significance.

Little Paxton Pits SSSI

Little Paxton Pits is an extensive area of flooded gravel workings of varied age, with a correspondingly diverse vegetation structure. The pits are of national importance for wintering wildfowl and an important stopping point for migrants. The invertebrate fauna is extremely rich and includes a number of national rarities.

The pits vary in structure from larger, more recently flooded pits having little aquatic vegetation to smaller, older pits with broken fringes of emergent vegetation dominated by plants such as reedmace *Typha latifolia*, common reed *Phragmites australis* and common club-rush *Schoenoplectus lacustris*. Areas of marsh support characteristic species such as meadowsweet *Filipendula ulmaria*, purple loosestrife *Lythrum salicaria* and several species of sedges and rushes. Many of the older pits are surrounded by dense willow Salix carr. Amongst the more local aquatic plant species represented are lesser reedmace *Typha angustifolia* and fringed yellow water-lily *Nymphoides peltata*.

Ornithologically, the pits are noted in particular for their use by wintering gadwall *Anas strepera*. The numbers of the species here regularly exceed 1% of the British wintering population. Of additional interest is the breeding bird community. In particular ringed plover *Charadrius hiaticula*, snipe *Gallinago gallinago*, tufted duck *Aythya fuligula*, kingfisher *Alcedo atthis* and nightingale *Luscinia megarhynchos* have been recorded. In addition there is a small heronry.

The site also supports a particularly rich invertebrate fauna. A number of nationally rare species have been recorded including a number of flies (Diptera) *Spilogona scutulata, Limnophora scrupulosa, Dolichopus andulusiacus* and *Lispocephala falculata* and the leaf-hopper (Homoptera) *Idiocerus herrichi*. The earwig (Dermaptera) *Forficula lesnii* is present at the northern extreme of its British range.

In addition to the aquatic and marsh communities, woodland, scrub, hedges and areas of dry grassland provide further habitat of value to wildlife generally, and support a number of plant species which are local in Cambridgeshire. These include common spotted-orchid *Dactylorhiza fuchsii*, bee orchid *Ophrys apifera,* blue fleabane *Erigeron acer*, hare's-foot clover *Trifolium arvense* and knotted clover *Trifolium striatum*.

APPENDIX 5: WATER NEUTRALITY

Water Neutrality is defined in Chapter 4. This appendix provides supplementary information and guidance behind the processes followed.

Twin-Track Approach

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

In order to reduce water consumption and manage demand for the limited water resources within the study area, a number of measures and devices are available[52], including:

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

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

However, there are a number of the measures listed above that can be easily and cheaply installed into existing properties, particularly if part of a large campaign targeted at a number of properties. Examples of these include the fitting of dual-flush toilets and low flow showers

[52] Source: Water Efficiency in the South East of England, Environment Agency, April 2007.

heads to social housing stock, as was successfully carried out in Preston by Reigate and Banstead Council in conjunction with Sutton and East Surrey Water and Waterwise[53].

The Pathway Concept

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

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

- Local Authorities incorporating environmental standards as part of supplementary planning guidance;
- NHS buildings for new buildings and refurbishments;
- Department for Children, Schools and Families for all projects valued at over £500K (primary schools) and £2million (secondary schools);
- English Partnerships (now incorporated into the Homes and Communities Agency) for all new developments involving their land; and,
- Office of Government Commerce for all new buildings;

Therefore, other than potential local policies delivered through the Local Plan, the only water efficiency requirements for new development are through the Building Regulations[54] where new homes must be built to specification to restrict water use to 125l/h/d. However, the key aim of the Localism Act is to decentralise power away from central government towards local authorities and the communities they serve. It therefore creates a stronger driver for local authorities such as Huntingdonshire to propose local policy to address specific local concerns. New local level policy is therefore key to delivering aspirations such as water neutrality and the Localism Act provides the legislative mechanism to achieve this in Huntingdonshire.

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

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

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

[53] Preston Water Efficiency Report, Waterwise, March 2009, www.waterwise.org.uk
[54] Part G of the Building Regulations

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

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

Improving Efficiency in Existing Development

Metering

The installation of water meters in existing housing stock has the potential to generate significant water use reductions because it gives customers a financial incentive to reduce their water consumption. Being on a meter also encourages the installation and use of other water saving products, by introducing a financial incentive and introducing a price signal against which the payback time of new water efficiency measures can be assessed. Metering typically results in a 5-10 per cent reduction from unmetered supply, which equates to water savings of approximately 14.56l/h/d or 33.5l per household, assuming an occupancy rate of 2.3[55] for existing properties.

In 2009, DEFRA instructed Anna Walker (the Chair of the Office of Rail Regulation) to carry out an independent review of charging for household water and sewerage services (the Walker Review)[56]. The typical savings in water bills of metered and unmetered households were compared by the Walker review, which gives an indication of the levels of water saving that can be expected (see Table A6-1).

TABLE A6-1: CHANGE IN TYPICAL METERED AND UNMETERED HOUSEHOLD BILLS

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

Low or Variable Flush Toilets

Toilets use about 30 per cent of the total water used in a household[57]. An old style single flush toilet can use up to 13 litres of water in one flush. New, more water-efficient dual-flush toilets can use as little as 2.6 litres[58] per flush. A study carried out in 2000 by Southern Water and the Environment Agency[59] on 33 domestic properties in Sussex showed that the average dual flush saving observed during the trial was 27 per cent, equivalent to a volumetric saving of around 2.6 litres per flush. The study suggested that replacing existing toilets with low or variable flush alternatives could reduce the volume of water used for toilet flushing by approximately 27 per cent on average.

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[55] 2.3 is used for existing properties as opposed to 2.1 for new properties – the latter reflects changes in population over time. This figure was discussed and agreed with AWS prior to the assessment.
[56] Independent Walker Review of Charging and Metering for Water and Sewerage services, DEFRA, 2009, http://www.defra.gov.uk/environment/quality/water/industry/walkerreview/
[57] http://www.waterwise.org.uk/reducing_water_wastage_in_the_uk/house_and_garden/toilet_flushing.html
[58] http://www.lecico.co.uk/
[59] The Water Efficiency of Retrofit Dual Flush Toilets, Southern Water/Environment Agency, December 2000

Cistern Displacement Devices

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

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

Low Flow Taps and Showers

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

Pressure Control

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

Variable tariffs

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

The Walker review assessed variable tariffs for water, including:

- rising block tariff;
- a declining block tariff;
- a seasonal tariff; and,
- time of day tariff.

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

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

[60] http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/9047.htm

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

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

AWS' WRMP[61] reviewed variable tariffs and concluded:

'Tariff proposals will only work if customer behaviour and demand is elastic. We carried out research as part of the last Periodic Review to draw together evidence of price elasticity from around the world. The results gave us some clear messages. First, demand tends to be elastic for large industrial customers, but much less elastic for small household customers. Second, demand tends to be elastic in countries such as Australia, where the discretionary use of water is high, but is low in the UK where discretionary use is a relatively small proportion of total water use. This leads us to conclude that increasing the marginal price of water and wastewater services would have some impact on our largest customers, but would tend to have a limited effect on household water consumption either by affecting total demand or by influencing peak profiles. We consider that customer behaviour can be influenced more effectively by promoting 'Waterwise' behaviour rather than by changing the way customer charges are applied.'

Water Efficient Appliances

Washing machines and dishwashers have become much more water efficient over the past twenty years; whereas an old washing machine may use up to 150 litres per cycle, modern efficient machines may use as little as 35 litres per cycle. An old dishwasher could use up to 50 litres per cycle, whereas modern models can use as little as 10 litres. However, this is partially offset by the increased frequency with which these are now used. It has been estimated[62] that dishwashers, together with the kitchen tap, account for about 8-14 per cent of water used in the home.

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

Non-Domestic Properties

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

[61] Anglian Water Services, Water Resource Management Plan, 2010, http://www.anglianwater.co.uk/environment/water-resources/resource-management/

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

There is significant potential for water efficiency in the agricultural sector from rainwater harvesting. The Environment Agency guide for farmers[63] illustrates the potential benefits to both the environment and the farmer from the installation of a RWH system. For example, a farm growing soft fruit in polytunnels could harvest 5,852m^3 of water per year from 120 hectares of tunnels, which could give the following benefits:

- better soil drainage between the tunnels,
- improved humidity levels inside them; and,
- an improvement in plant health through the use of harvested water.

Water Efficiency in New Development

The use of efficient fixtures and fittings as described above also apply to the specification of water use in the building of new homes. The simplest way of demonstrating the reductions that use of efficient fixtures and fitting has in new builds is to consider what is required in terms of installation of the fixtures and fittings at different ranges of specification to ensure attainment of code levels under the CSH water use requirements. The Cambridge WCS[64] gave a summary of water use savings that can be achieved by the use of efficient fixtures and fittings, as shown below in Table A6-2.

[63] Rainwater Harvesting: an on-farm guide, Environment Agency, 2009
[64] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010

TABLE A6-2: SUMMARY OF WATER SAVINGS BORNE BY WATER EFFICIENCY FIXTURES AND FITTINGS

Component	150 l/h/d Standard Home	130 l/h/d	120 l/h/d CSH Level 1/2	115 l/h/d	105 l/h/d CSH Level 3/4	80 l/h/d CSH Level 5/6
Toilet flushing	28.8	19.2b	19.2 b	16.8d	16.8 d	8.4 + 8.4 f
Taps	42.3 a	42.3 a	31.8 a	31.8 a	24.9 a	18 a
Shower	30	24	24	22	18	18
Bath	28.8	25.6c	25.6 c	25.6 c	25.6 c	22.4 e
Washing machine	16.7	15.3	15.3	15.3	15.3	7.65 + 7.65 f
Dishwasher	3.9	3.6	3.6	3.6	3.6	3.6
Recycled water	-	-	-	-	-	-16.1
Total per head	150.5	130	119.5	115.1	104.2	78
Outdoor	11.5	11.5	11.5	11.5	11.5	11.5
TOTAL PER HOUSEHOLD	366.68	319.3	293.52	284.14	257.41	195.58

- a Combines kitchen sink and wash hand basin
- b 6/3 litre dual-flush toilet (f) recycled water
- c 160 litre bath filled to 40% capacity, frequency of use 0.4/day
- d 4.5/3 litre dual flush toilet
- e 120 litre bath
- f rainwater/greywater harvesting
- g Assumed garden use

Table 2 highlights that in order for Code Level 5 and 6 to be achieved for water use under the CSH (80 l/h/d); water re-use technology (rainwater harvesting and/or greywater recycling) needs to be incorporated into the development.

In using the BRE Water Demand Calculator[65], the experience of URS/Scott Wilson BREEAM/CHS assessors is that it is theoretically possible to get close to 80l/h/d through the use of fixture and fittings, but that this requires extremely high specification efficiency devices which are unlikely to be acceptable to the user and will either affect the saleability of new homes or result in the immediate replacement of the fixtures and fittings upon habitation. This includes baths at capacity below 120 litres, and shower heads with aeration which reduces the pressure sensation of the user. For this reason, it is not considered practical to suggest that Code Level 5 and 6 can be reached without some form of water recycling.

Rainwater Harvesting

[65] http://www.thewatercalculator.org.uk/faq.asp

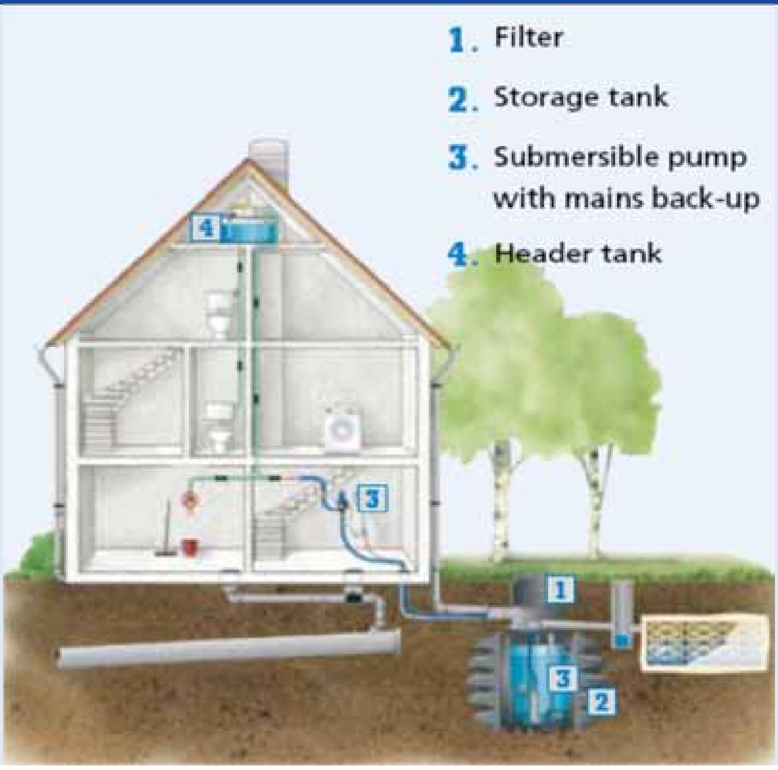
Rainwater harvesting (RWH) is the capture and storage of rain water that lands on the roof of a property. This can have the dual advantage of both reducing the volume of water leaving a site, thereby reducing surface water management requirements and potential flooding issues, and be a direct source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

RWH systems typically consist of a collection area (usually a rooftop), a method of conveying the water to the storage tank (gutters, down spouts and pipes), a filtration and treatment system, a storage tank and a method of conveying the water from the storage container to the taps (pipes with pumped or gravity flow). A treatment system may be included, depending on the rainwater quality desired and the source. Figure A6-1 below gives a diagrammatic representation of a typical domestic system[66].

The level to which the rainwater is treated depends on the source of the rainwater and the purpose for which it has been collected. Rainwater is usually first filtered to remove larger debris such as leaves and grit. A second stage may also be incorporated into the holding tank; some systems contain biological treatment within the holding tank, or flow calming devices on the inlet and outlets will allow heavier particles to sink to the bottom, with lighter debris and oils floating to the surface of the water. A floating extraction system can then allow the clean rainwater to be extracted from between these two layers[67].

[66] Source: Aquality Intelligent Water management, www.aqua-lity.co.uk
[67] Aquality Rainwater Harvesting brochure, 2008

FIGURE A6-1: A TYPICAL DOMESTIC RAINWATER HARVESTING SYSTEM



A recent sustainable water management strategy carried out for a proposed EcoTown development at Northstowe[68], approximately 10 km to the north west of Cambridge, calculated the size of rainwater storage that may be required for different occupant numbers, as shown below in Table A6-3.

[68] Sustainable water management strategy for Northstowe, WSP, December 2007

TABLE A6-3: RWH SYSTEMS SIZING

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

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

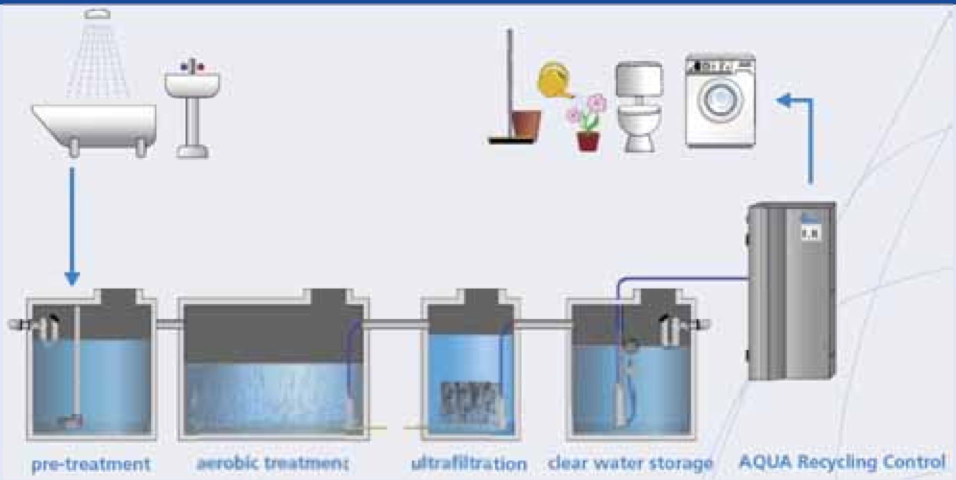
Greywater Recycling

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

The storage volumes required for GWR are usually smaller than those required for rainwater harvesting as the supply of greywater is more reliable than rainfall. In domestic situations, greywater production often exceeds demand and a correctly designed system can therefore cope with high demand application and irregular use, such as garden irrigation. Figure A6-2 below gives a diagrammatic representation of a typical domestic system[69].

[69] Source: Aquality Intelligent Water management, www.aqua-lity.co.uk

FIGURE A6-2: A TYPICAL DOMESTIC GREYWATER RECYCLING SYSTEM



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

The Northstowe sustainable water management strategy calculated the volumes of water that could be made available from the use GWR. These were assessed against water demand calculated using the BRE Water Demand Calculator[70].

Table A6-4 demonstrates the water savings that can be achieved by GWR. If the toilet and washing machine are connected to the GWR system a saving of 37 litres per person per day can be achieved.

TABLE A6-4: POTENTIAL WATER SAVINGS FROM GWR

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

[70] http://www.thewatercalculator.org.uk/faq.asp

The treatment requirements of the GWR system will vary, as water which is to be used for flushing the toilet does not need to be treated to the same standard as that which is to be used for the washing machine. The source of the greywater also greatly affects the type of treatment required. Greywater from a washing machine may contain suspended solids, organic matter, oils and grease, detergents (including nitrates and phosphates) and bleach. Greywater from a dishwasher could have a similar composition, although the proportion of fats, oils and grease is likely to be higher; similarly for wastewater from a kitchen sink. Wastewater from a bath or shower will contain suspended solids, organic matter (hair and skin), soap and detergents. All wastewater will contain bacteria, although the risk of infection from this is considered to be low[71].Treatment systems for GWR are usually of the following four types:

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

Table A6-5 below gives further detail on the measures required in new builds and from retrofitting, including assumptions on the predicted uptake of retrofitting from the existing housing and commercial building use.

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

TABLE A6-5: WATER NEUTRALITY SCENARIOS – SPECIFIC REQUIREMENTS FOR EACH SCENARIO						
WN Scenario	**New development requirement**				**Retrofitting existing development**	
	New development Water use target (l/h/d)	**Relevant CSH target**	**Water Efficient Fixtures and Fittings**	**Water Recycling technology**	**Metering Penetration assumption (a)**	**Water Efficient Fixtures and Fittings (b)**
Business as usual	125	Building Regs only	- 3-6 litre dual flush toilet; - Low aeration taps; - 160 litre capacity bath; - High efficiency washing machine	None	90%	None
Low	120	Level 1/2	- 3-6 litre dual flush toilet; - Low spec aeration taps; - 160 litre capacity bath; - Low spec low flow shower head - High efficiency dishwasher - High efficiency washing machine	None	100%	- 3-6 litre dual flush toilet or cistern device fitted; - 10% take up across district
Medium	105	Level 3/4	- 3-4.5 litre dual flush toilet; - Medium spec aeration taps; - High spec low flow shower head; - 160 litre capacity bath; - High spec low flow shower head - High efficiency dishwasher - High efficiency washing machine	None	100%	- 3-4.5 litre dual flush toilet or cistern device fitted; - medium spec aerated taps fitted - 20% take up across district
High	78	Level 5/6	- 3-4.5litre dual flush toilet;	Rainwater	100%	- 3-4.5 litre dual flush toilet or cistern

TABLE A6-5: WATER NEUTRALITY SCENARIOS – SPECIFIC REQUIREMENTS FOR EACH SCENARIO

WN Scenario	New development requirement				Retrofitting existing development	
	New development Water use target (l/h/d)	Relevant CSH target	Water Efficient Fixtures and Fittings	Water Recycling technology	Metering Penetration assumption (a)	Water Efficient Fixtures and Fittings (b)
			- High spec aeration taps; - High spec low flow shower head; - 120 litre capacity bath; - High spec low flow shower head - High efficiency dishwasher - High efficiency washing machine	harvesting		device fitted; - high spec aerated taps fitted - high spec low flow shower head fitted - 25% take up across district
Very High	62	Level 5/6	- 3-4.5litre dual flush toilet; - High spec aeration taps; - High spec low flow shower head; - 120 litre capacity bath; - High spec low flow shower head - High efficiency dishwasher - High efficiency washing machine	Rainwater harvesting and Greywater recycling	100%	- 3-4.5 litre dual flush toilet or cistern device fitted; - high spec aerated taps fitted - high spec low flow shower head fitted - 35% take up across district

a: only the additional metering beyond business as usual has been accounted for (i.e. 10%)
b: refers to fittings above that are included in a standard home using approximately 131l/h/d

Financial Cost Considerations for Water Neutrality scenarios

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

New Build Costs

Costs for water efficiency in new property have been provided based on homes achieving different code levels under the CSH based on the cost analysis undertaken by CLG[72] and as set out in Table A6-6.

TABLE A6-6: CSH SPECIFICATIONS AND COSTS

Code Level	Estimated water consumption (l/h/d)	Specification	Cost Additional Cost (£)	Cost Cumulative Cost (£)
1 and 2	120	2 x 6/4 litre flush toilets 4 x taps with flow regulators (2.5 l/m) 1 x shower 6 litres/min 1 x standard bath (90 litres per use) 1 x standard washing machine* 1 x standard dishwasher*	£0	£0
3 and 4	105	As Level 1 and 2, except: 2x4/2.5 litre flush toilets 1x smaller shaped bath	£125	£125
5 and 6	80	Houses As Level 3 and 4, except: Rainwater harvesting 2 x 6/4 litre flush toilets	£2,520	£2,645
		Apartments As Level 3 and 4, except: Rainwater harvesting 2 x 6/4 litre flush toilets	£680	£805

Notes: *Additional cost of washing machine and dishwasher is assumed to be zero as these fittings are 'standard' industry performance. Therefore, if they are typically installed by house builder there would be no additional cost over their current specifications.

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

Water Recycling

Research into the financial costs of installing and operating GWR systems gives a range of values, as show in Table A6-7.

[72] CLG (2008) Cost Analysis of the Code for Sustainable Homes

TABLE A6-7: COSTS OF GWR SYSTEMS

Cost	Cost	Comments
Installation cost	£1,750 £2,000 £800 £2,650	Cost of reaching Code Level 5/6 for water consumption in a 2-bed flat[73] For a single dwelling[74] Cost per house for a communal system[75] Cost of reaching Code Level 3/4 for water consumption in a 3-bed semi-detached house[76]
Operation of GWR	£30 per annum[77]	
Replacement costs	£3,000 to replace[23]	It is assumed a replacement system will be required every 25 years

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

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

Installing a Meter

The cost of installing a water meter has been assumed to be £500 per property[78]. It is assumed that the replacement costs will be the same as the installation costs (£500), and that meters would need to be replaced every 15 years[79].

[73] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008
[74] http://www.water-efficient-buildings.org.uk/?page_id=1056
[75] http://www.water-efficient-buildings.org.uk/?page_id=1056
[76] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008
[77] Environment Agency Publication - Science Report – SC070010, Greenhouse Gas Emissions of Water Supply and Demand Management Options, 2008
[78] Cambridge (and surrounding major growth areas) WCS Phase 2, Halcrow, 2010
[79] Environment Agency Publication - Science Report – SC070010: Greenhouse Gas Emissions of Water Supply and Demand Management Options, 2008

Retrofitting of Water Efficient Devices

Findings from the Environment Agency report Water Efficiency in the South East of England[80], costs have been used as a guide to potential costs of retrofitting of water efficient fixtures and fittings and are presented in Table A6-8 below.

TABLE A6-8: WATER SAVING METHODS

Water Saving Method	Approximate Cost per House (£)	Comments/Uncertainty
Variable flush retrofit toilets	£50 - £140	Low cost for 3-6 litre system and high cost for 3-4.5 litre system. Needs incentive to replace old toilets with low flush toilets.
Low flow shower head scheme	£15 - £50	Low cost for low spec shower head; high costs for high spec. Cannot be used with electric, power or low pressure gravity fed systems.
Aerating taps	£10 - £20	Low cost is med spec, high cost is high spec.

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

Neutrality scenario costs

Using the above information, the financial costs per scenario has been calculated and are included in Table A6-9.

[80] Ref – Water Efficiency in the South East of England

TABLE A6-9: ESTIMATED COST OF NEUTRALITY SCENARIOS

CSH – Code Level	Outstanding Homes		Existing Properties					Costs Summary		
	Numbers	CSH cost	No. to be metered (10% existing)	Metering cost	Retrofit %	No. to retrofit	Retrofit cost	Developer	Non developer	Total
1 or 2	17,902	-	7,140	£3,569,950	10	7140	£356,995	-	£2,926,945	£3,926,945
3 or 4	17,902	£2,237,750	7,140	£3,569,950	20	14280	£2,356,167	£2,237,750	£5,926,117	£8,163,867
5 or 6 (RWH)	17,902	£47,350,790	7,140	£3,569,950	25	17850	£3,926,945	£47,350,790	£7,496,895	£54,847,685
5 or 6 (RWH & GWR)	17,902	£71,697,510	7,140	£3,569,950	35	24990	£5,497,723	£71,697,510	£9,067,673	£80,765,183

Carbon Cost Considerations

As described in this section, there are sustainability issues to consider when deciding on a policy for promotion of water neutrality. Reaching the very highest levels of efficiency requires the use of recycling technology (either through rainwater harvesting and treatment or greywater recycling) which requires additional energy both embedded in the physical structures required and also in the treatment process required to make the water usable.

Whilst being water efficient is a key consideration of this study, due to the wider vision for sustainable growth, reaching neutrality should not be at the expense of increasing energy use and potential increasing the carbon footprint of development

It is also important to consider that through using less water, more water efficient homes require less energy to heat water, hence there are energy savings.

In order to give an overview of the likely sustainability of each of the WN scenarios, a 'carbon cost' has been applied to each of the scenarios based on the water efficiency measures proposed for new homes, and the retrofitting of existing.

Methodology

A joint study by the Environment Agency and the Energy Saving Trust[81] assessed the energy and carbon implications of the installation of water saving devices (Table A6-10). The report initially calculated a baseline water consumption figure for existing housing stock, using the following assumptions:

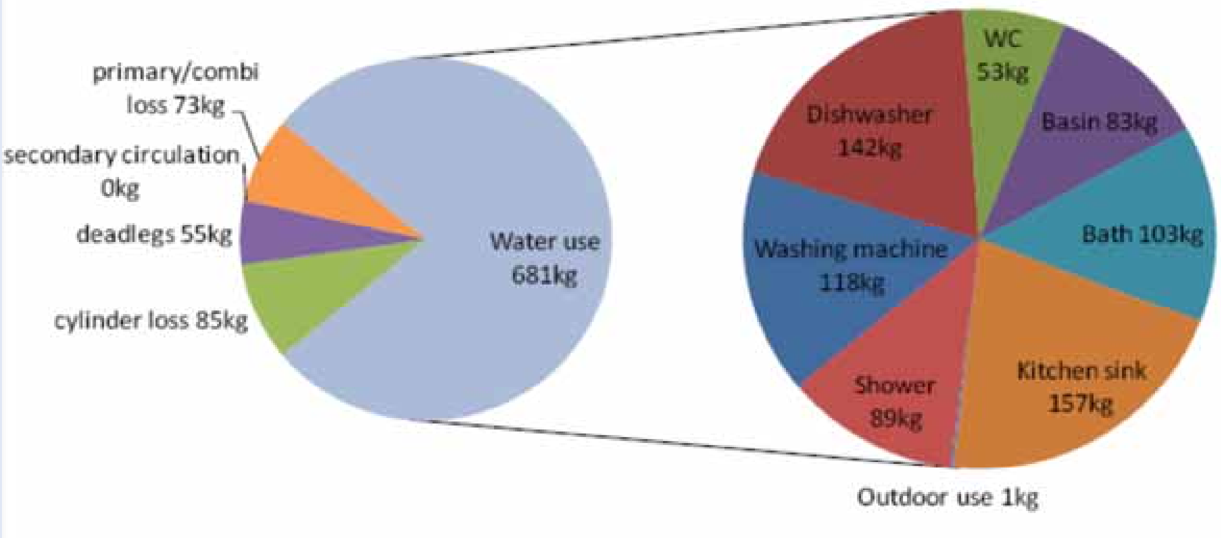
TABLE A6-10: BASELINE ENERGY CONSUMPTION ASSUMPTIONS

Device	Volume of water per use (litres)	Frequency of use (per person per day)
Toilet	9.4	4.66
Kitchen Taps	59	Taps taken as volume/day, 40% cold
Basin taps hot	42	Taps taken as volume/day, 30% cold
Bath	70	0.21
Washing machine	50	0.34
Shower	25.7	0.59
Dishwasher	21.3	0.29

[81] Quantifying the energy and carbon effects of water saving, Full technical report, Environment Agency and the Energy Saving Trust, 2009

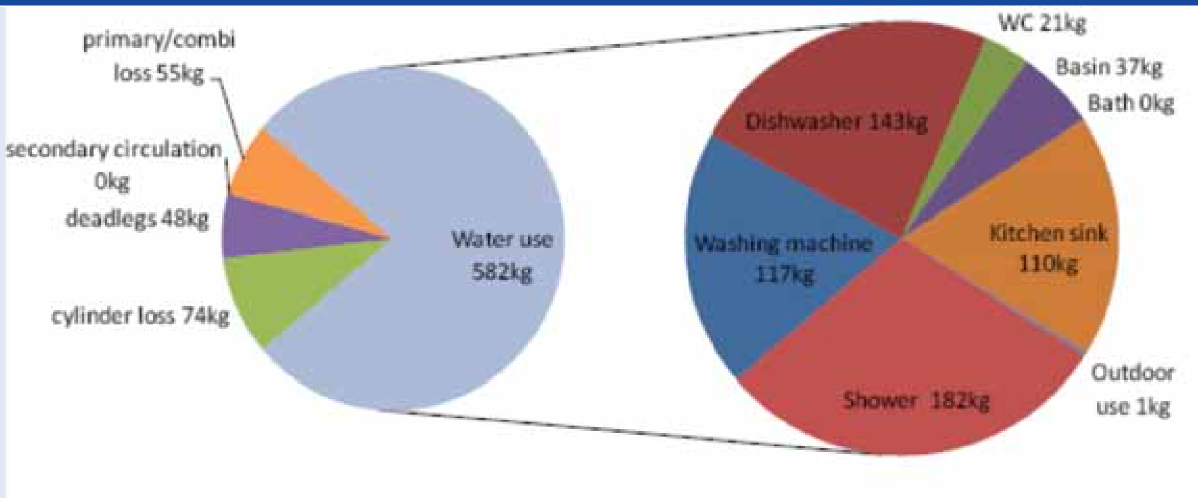
The study then modelled the CO_2 emissions from this 'standard' existing dwelling, as shown below in Figure A6-3. Appliances requiring hot water using appliances dominate, but water use for toilet flushing produces 53kg of CO_2 emissions per year (approximately 50 per cent from water company emissions and 50 per cent due to heat loss as cold mains water in the toilet cistern heats to room temperature).

FIGURE A6-3: CO_2 EMISSIONS FROM A 'STANDARD' EXISTING DWELLING



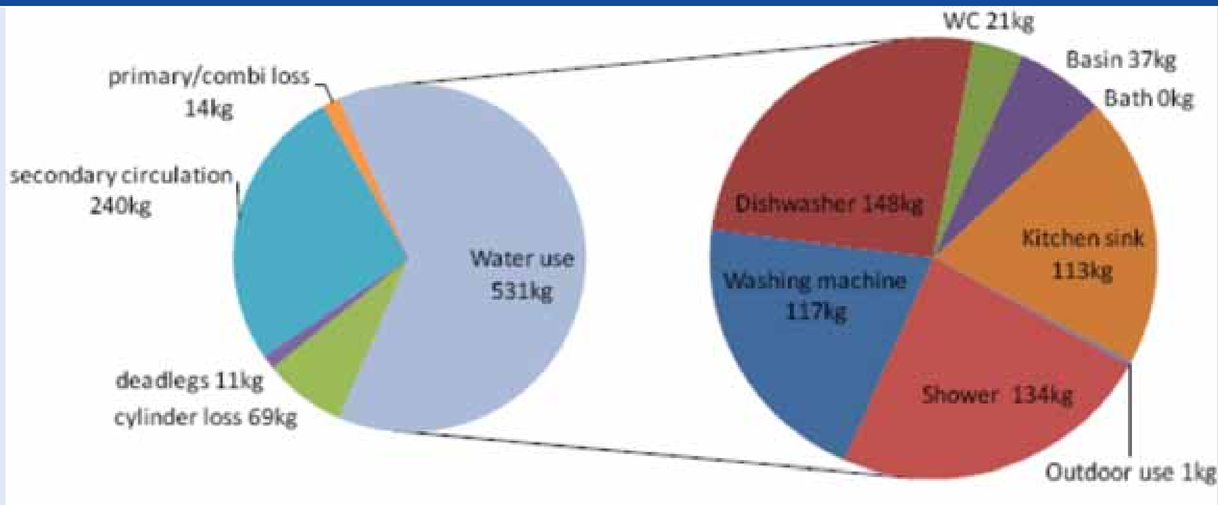
The study then assessed the impacts on this baseline figure of 681 kg CO_2 for water use from a home which has water use compliant with CfSH level 3/4 (Figure A6-4).

FIGURE A6-4: CO_2 EMISSIONS FROM A CFSH LEVEL 3/4 DWELLING



The study then assessed the impacts of a home which has water use compliant with CfSH level 5/6 (Figure A6-5).

FIGURE A6-5: CO_2 EMISSIONS FROM A CFSH LEVEL 5/6 DWELLING



It can therefore be seen that the carbon cost of achieving Levels 3/4 and 5/6 compares favourably to the baseline scenario of current average water use of 681kg/CO_2. CfSH level 3/4 represents a carbon saving of 99 kg/CO_2 and CfSH Level 5/6 represents a carbon saving of 150 kg/CO_2.

The energy savings from water efficiency measures within the home would be offset to a certain degree by increased energy demands of RWH or GWR systems, which have been shown to be required to meet CfSH Level 5/6. Energy savings for AWS from not treating additional water to potable standard, as with the conventional mains water supply, can be thought of to be simply a transfer of energy consumption away from the AWS to the individual householders. While AWS will benefit from this reduction in energy demand, which will assist with meeting its Carbon Reduction Commitment (CRC) (as laid down in 2007's Energy Reduction White Paper[82]), the expense will be passed to householders.

For households with the GWR/RWH required for CfSH Levels 5/6, any financial benefits to householders experienced through a reduction in water bills (for metered properties) will be offset by the increased expense of energy bills for pumping and treating water in GWR and RWH systems.

[82] Meeting the Energy Challenge - A White Paper on Energy, May 2007, Department of Trade and Industry

LIMITATIONS

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The methodology adopted and the sources of information used by URS in providing its services are outlined in this Report. The work described in this Report was undertaken between August 2013 and November 2014 and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances.

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