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Braintree District Council Water Cycle Study

Braintree District Council

December 2016

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Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
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List of Acronyms

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

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Non-Technical Summary

Braintree District is expected to experience significant growth, particularly in relation to domestic redevelopment over the period 2018 to 2033. 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.

This Braintree District Council Water Cycle Study (WCS) update forms an important part of the evidence base that will help Braintree District Council determine the most appropriate options for development within the district (with respect to water infrastructure and the water environment) to be identified in the Council's New Local Plan (2018 to 2033).

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

Wastewater Strategy

Wastewater Treatment

The WCS identifies that in total, 14 Water Recycling Centres (WRCs) will serve the proposed future development across the District. Table 1 below provides an indication of the WRCs which have available capacity and those that are likely to require changes to permits that control discharge and potentially infrastructure upgrades.

Table 1. WRC summary

WRC	Phasing of Development
Bocking	Anticipated development will require revised quality conditions (permits). Upgrades may be required to the WRC and careful development phasing is recommended.
Braintree	Anticipated development will require revised quality conditions (permits). Upgrades may be required to the WRC and careful development phasing is recommended.
Bures	Capacity for growth under assessed growth scenario with some spare capacity for further growth
Coggeshall	Anticipated development will require revised quality conditions (permits). Upgrades may be required to the WRC and careful development phasing is recommended.
Colchester	Capacity for growth under assessed growth scenario with some spare capacity for further growth
Earls Colne	Capacity for growth under assessed growth scenario with some spare capacity for further growth
Gosfield	Capacity for growth under assessed growth scenario with some spare capacity for further growth
Haverhill	Capacity for growth under assessed growth scenario with some spare capacity for further growth
Halstead	Capacity for growth under assessed growth scenario with some spare capacity for further growth
Ridgewell	Capacity for growth under assessed growth scenario with some spare capacity for further growth
Sible Hedingham	Capacity for growth under assessed growth scenario with some spare capacity for further growth
Steeple Bumpstead	Capacity for growth under assessed growth scenario with some spare capacity for further growth
White Notley	WRC currently exceeding flow condition on existing permit. Anticipated development will require revised quality and flow conditions (permits). Upgrades may be required to the WRC and careful development phasing is recommended.

WRC	Phasing of Development
Witham	Capacity for growth under assessed growth scenario with some spare capacity for further growth

Four WRCs (Bocking, Braintree, Coggeshall and White Notley) do not currently have sufficient capacity to accept all future development proposed within the plan period. Therefore solutions are required in order to accommodate the growth to ensure that the increased wastewater flow discharged does not impact on the current quality of the receiving watercourses, their associated ecological sites and also to ensure that the watercourses can still meet with legislative requirements.

The detailed assessments have shown that improvements to Bocking, Braintree, Coggeshall and White Notley WRCs are possible using wastewater treatment technologies currently available, demonstrating that an engineering solution is feasible and hence treatment capacity should not be seen as a barrier to growth. The development currently being planned for within Braintree District Council's Local Plan will require revised quality conditions (permits) to be set for these WRC's, to cope with additional growth which may require upgrades to current treatment processes. Revised flow permits which are currently being exceeded will also need to be set for White Notley WRC.

The WCS has concluded feasible solutions are possible to ensure environmental conditions and legislative objectives are met. However, this WCS recommends that Braintree District Council, the Environment Agency, and AWS should work together to determine when solutions will implemented and hence conclude when and how much development can be accommodated across the study area in the early phases of the Local Plan delivery period.

To ensure that the planned level of development within the plan period does not result in a negative impact upon wildlife both inside and outside of designated sites, it is recommended that policy is included within the Local Plans to ensure that these matters are addressed at a strategic level.

Water Supply Strategy

Based on the growth assessed, the WCS has concluded that, allowing for the planned resource management of Anglian Water's and Essex & Suffolk Water's supply areas in the District, the water supply companies would have adequate water supply to cater for growth over the plan period.

However, the WCS has identified that there significant water stress in the District and limitations on water available in local water resources. Hence there are key drivers requiring that water demand is managed in the District for all new development in order to achieve long term sustainability in terms of water resources.

In order to reduce reliance on raw water supplies from rivers and aquifers, the WCS has set out ways in which demand for water as a result of development can be minimised without incurring excessive costs or resulting in unacceptable increases in energy use. In addition, the assessment has considered how far development in the 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 across the plan period has taken place. A pathway for achieving neutrality as far as practicable has been set out, including advice on:

- what measures need to be taken technologically to deliver more water efficient development;
- what local policies need to be developed 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.

Five water neutrality scenarios have been proposed and assessed to demonstrate what is required to achieve different levels of neutrality in the District. 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:

- Ensure all housing is water efficient, with new housing development meets the mandatory national standard as set out in the Building Regulations;
- Carry out a programme of retrofitting and water audits of existing dwellings and non-domestic buildings. Aim to move towards delivery of 15% of the existing housing stock, with easy fit water saving devices; and,
- Establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use.

Overall Impact of Development

The site assessments have highlighted some localised constraints with the water supply and wastewater network which need to be resolved and agreed between the relevant developer and water company (either Anglian Water or Essex and Suffolk Water).

Overall, the water cycle study concludes there are no constraints with respect to water service infrastructure and the water environment to deliver the Local Plan development, on the basis that strategic water resource options and wastewater solutions are developed in advance of development coming forward.

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1. Introduction

1.1 Background

The District of Braintree is located in the County of Essex. The District has experienced significant growth in the past decade, and is expected to experience a significant increase in housing requirement and economic growth over the period to 2033.

Braintree District Council is currently preparing a new Local Plan which will supersede the current Local Plan and will set out the Council's strategy for future development and growth up to 2033. The Objectively Assessed Housing Needs (OAHN) Study for Braintree identified 14,365 homes would be required in the District from 2016 to 2033 (845 homes per annum). The Council has recently updated its OAHN in based on more up to date subnational projections and a updated East of England Forecasting Model. The Local Plan target for new homes in Braintree is now 862 new homes per year or 14,646 homes over the Plan period, which also takes into account under provision in housing numbers from 2013. These homes will be located primarily in the Towns and Service Villages as well as a number of strategic growth locations.

This Water Cycle Study (WCS) forms an important part of the evidence base that will help to ensure that development does not have a detrimental impact on the water environment within the District. The WCS will also help to guide the development towards the most appropriate locations (with respect to water infrastructure and the water environment) to be identified in the new Local Plan.

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

1.2 WCS History

Braintree District Council commissioned Phase 1 (2010) and Phase 2 (2011) Water Cycle Studies (WCS) to account for the Local Plan period until 2026.

These studies helped provide supporting evidence to inform the Councils Local Development Framework (LDF), by outlining the 2010 capacity of water services infrastructure (phase 1) and completing an environmental capacity assessment to consider planned growth until 2026 (phase 2).

The previous WCS, with reference to wastewater found that:

- Bocking, Coggeshall, Earls Colne and Sible Hedingham Water Recycling Centres (WRCs) had recently had flow permit increases and so any further requests for increases would likely be met by stricter quality permits by the Environment Agency, to protect the receiving water courses under the Water Framework Directive (WFD).
- The likely quality standards required to achieve no deterioration of current river quality would be achievable using conventional treatment technologies and so would be unlikely to constrain development.
- Natural England were satisfied that providing the Environment Agency water quality standards can be met, the impact on Essex Estuaries (Special Area of Conservation and Special Protection Area) would not be significant.
- For Braintree, Halstead, Rayne and Witham WRCs it was predicted increased flows could be accommodated within the existing permitted discharge, and so there was no immediate constraint to development.
- Sufficient capacity was found at the outfall from Witham WRC to the head of the Blackwater Estuary, allowing potentially for greater abstraction upstream.
- Bocking WRC was found to have sufficient capacity to accommodate existing flows, but some upgrades were recommended to accommodate existing planned developments.

- Growth was found to be relatively low in Coggeshall, Earls Colne, Rayne and Sible Hedingham and so extensive upgrades to the WRC were not recommended as development was not completely constrained by capacity.

These conclusions have been reviewed and re-assessed within this WCS.

1.3 Study Governance

This WCS has been carried out with the guidance of the Steering Group established at the project inception meeting held on 5th September 2016 comprising the following organisations:

- Braintree District Council,
- Anglian Water Services (AWS), and
- Environment Agency.

The following organisations are not part of the Steering Group, but are consultees for the WCS:

- Natural England (NE); and
- Essex and Suffolk Water (ESW).

1.4 WCS Scope

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

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

The following sets out the key objectives of the WCS:

- provide a strategy for wastewater treatment across the District which determines if solutions to wastewater treatment are required and if the solutions are viable in terms of balancing environmental capacity with cost;
- describe how the wastewater treatment strategy might impact phasing of development;
- determine whether any Habitats Directive designated ecological sites have the potential to be impacted by the wastewater treatment strategy via a screening process;
- determine whether additional water resources, beyond those already planned by AWL and ESW are required to support growth;
- determine upgrades required to water supply infrastructure relative to potential options for growth through collaboration with AWL and ESW;
- consider whether growth can be delivered and achieve a ‘neutral water use’ condition;
- provide a pathway to achievement of water neutrality;
- determine impact of infrastructure and mitigation provision on housing delivery phasing; and
- provide policy recommendations.

1.5 Key Assumptions and Conditions

1.5.1 Water Company Coverage

Two water companies operate within the District; AWS is the wastewater undertaker for the entire District and supplies the majority of potable water to the District. ESW supplies potable water to an area encompassing the town of Witham.

1.5.2 Water Use

For the water supply assessment, the published measured household consumption for AWS' South Essex Resource Zone of 138l/h/d has been applied, as published in AWS' Water Resources Management Plan (WRMP). This consumption has been assumed across the whole District, including the small area supplied by ESW due to the limited information within the ESW WRMP detailing consumption rates and the relatively small population served by ESW in this area.

It is acknowledged that the 138l/h/d assumption exceeds the current Building Regulations requirement of 125l/h/d for all new homes. However, in their asset planning, AWS will continue to assume this higher water use for new homes. 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. The 125l/h/d requirement is an aspirational target only and AWS are required under their remit to the industry regulator OFWAT, to plan for the expected actual use.

For the wastewater assessments, a different assumption was made on the likely consumption of water per new household going forward in the plan period. A starting assumption of 131l/h/d (litres per head per day) was provided by AWS to calculate wastewater demand per person. In addition, to account for infiltration of surface water, groundwater and misconnections to the sewer network in the future, an additional proportion of 'unaccounted for' flows has been included in the calculations. An additional flow of 45l/h/d[1] has therefore been added to the starting assumption of 131l/h/d, giving a final wastewater demand of 176l/h/d.

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

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

1.5.3 Household Occupancy Rate

The latest Office for National Statistics (ONS) population projections[2] and household projections[3] have been used to determine the occupancy rate of each household coming forward in the plan period, and have been provided in Table 2 below.

Table 2. Calculation of Occupancy Rate

	Projection for 2033
Population	170,356
Number of households	74,766
Calculated Occupancy Rate (people per household)	2.28

Source: ONS

1.5.4 Wastewater Treatment

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

Through application of the best available technologies in terms of wastewater treatment, the reliable limits of conventional treatment (LCT) have been determined for the key parameters of Biochemical Oxygen Demand (BOD)[4], ammonia and phosphate, and are provided in Table 3.

[1] As provided by AWS
[2] 2014-based Subnational Population Projections (ONS) (May 2016). Available at https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2015-10-29
[3] 2014-based Household Projections to 2039 for England (ONS) (July 2016). Available at https://www.gov.uk/government/statistical-data-sets/live-tables-on-household-projections

Table 3. Reliable limits of conventional treatment technology for wastewater

Water Quality Parameter	LCT
Ammonia	1.0 mg/l 95 percentile limit[5]
BOD	5.0 mg/l 95 percentile limit
Phosphate	0.5 mg/l annual average[6]

1.6 Report Structure

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

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

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

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

[4] Amount of oxygen needed for the biochemical oxidation of the organic matter to carbon dioxide in 5 days. BOD is an indicator for the mass concentration of biodegradable organic compounds
[5] Considered within the water industry to be the current LCT using best available techniques
[6] Environment Agency (2015) Updated River Basin Management Plans Supporting Information: Pressure Narrative: Phosphorus and freshwater eutrophication

2. Study Drivers

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

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

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

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

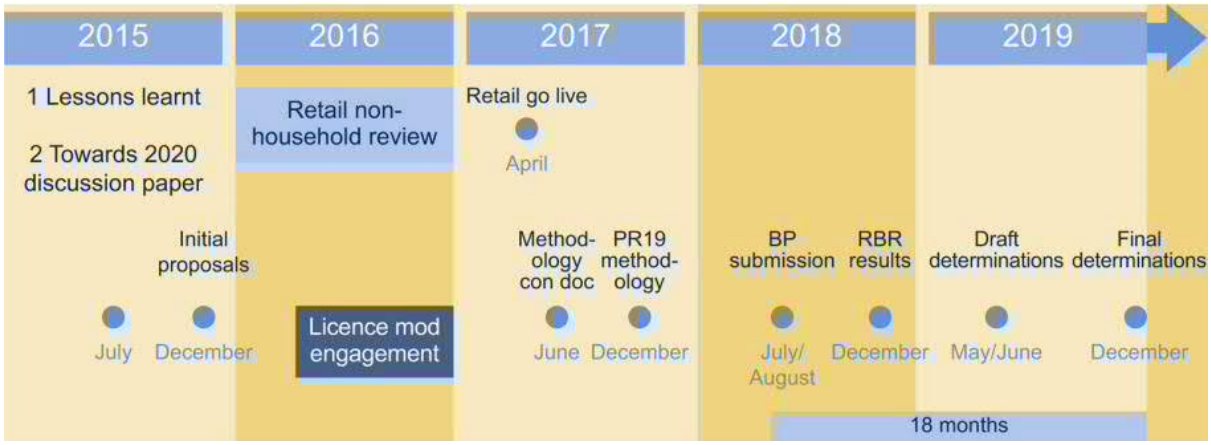
Other relevant studies that have a bearing on the provision of water services infrastructure for development are provided in Appendix B and include, but are not limited to, key documents including the Braintree District Council SFRA Update (AECOM, 2017), AWS' and ESW's WRMP and the Environment Agency's latest Anglian River Basin Management Plan (RBMP) (2015).

2.1 OFWAT Price Review

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

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

Figure 1. Proposed timescales for PR19 (Water 2020) programme[7]



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

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

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

2.2 Water Framework Directive

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

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

These environmental objectives are legally binding, and all public bodies should have regard to these objectives when making decisions that could affect the quality of the water environment. The Environment Agency publish the status and objectives of each surface waterbody on the Catchment Data Explorer[8], and describe the status of each waterbody as detailed in Table 4.

Table 4. Description of status in the WFD

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

Source: Environment Agency RBMPs

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

3. Proposed Growth

3.1 Preferred Growth Strategy

The purpose of the WCS is to assess the potential impact of increased development upon the water environment and WSI across the District, including water resources, wastewater infrastructure, water quality, flood risk, surface water drainage and ecological issues. The increased development is to accommodate the minimum housing requirement for the Council. This level of projected growth has required the Council to revise their spatial approach of future expected development up to 2033. These growth figures therefore form the basis for the WCS.

The administrative area of Braintree District Council covers Braintree town centre in addition to the towns of Witham and Halstead, and the key service villages of Coggeshall, Earls Colne, Hatfield Peverel, Kelverdon, Feering and Sible Hedingham. Figure 2 illustrates Braintree District Councils administrative boundary, main towns, villages and watercourses within the District.

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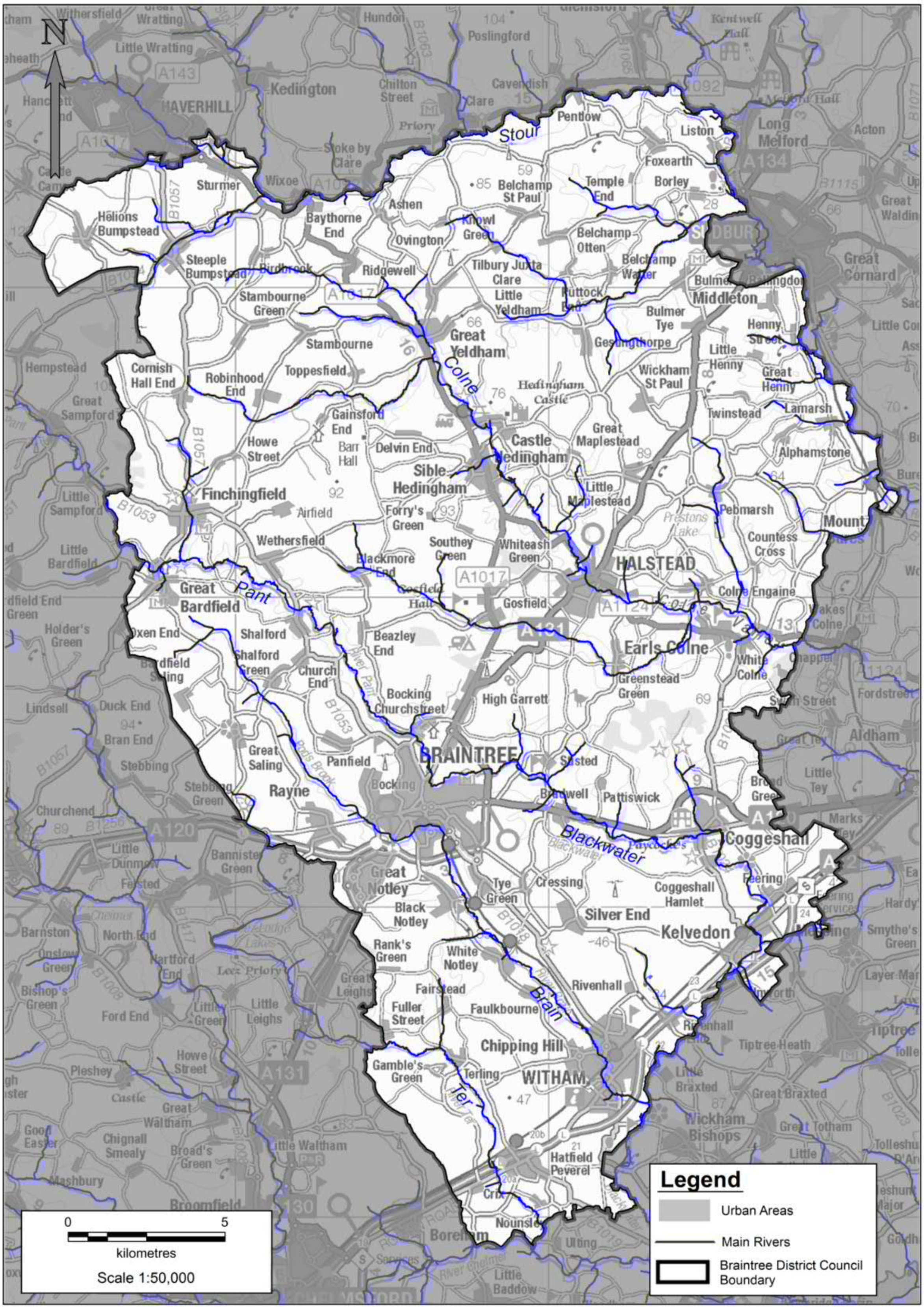
Figure 2. Main rivers and urban areas within Braintree District



Contains Ordnance Survey data © Crown copyright and database right 2016

3.2 Housing

The OAHN Study for Braintree identified 14,365 dwellings would be required in the District from 2016 to 2033 (845 dwellings per annum). This target will be met under the new Local Plan which sets out the strategy for the growth of the District from 2016 to 2033. The Council have also stated that this target is likely to increase by 417 dwellings, thereby bringing the total housing target for the District up to 14,782 new residential dwellings by 2033.

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

- Committed developments (with planning permission, under construction),
- Outstanding commitments (with planning permission, construction not yet started),
- Current allocations (without full planning permission), and
- Proposed allocations (no planning permission).

Table 5 provides an overview of the number of dwellings to be built within the plan period within major development sites (>10 dwellings) and therefore assessed as part of the WCS.

Table 5. Braintree District Council Housing Commitments and Allocations

Type of Site	No. Dwellings
Committed developments	268
Outstanding commitments	236
Current allocations	
Outline planning permission	1,011
Adopted Core Strategy Growth Location Sites (without planning permission)	970
Proposed allocations	7,836
Garden Communities	
West of Braintree	2,500
Marks Tey	1,150
Total potential dwellings to be assessed	**13,971**

Source: Braintree District Council Draft Housing Supply Trajectory

3.3 Employment

The WCS also takes account of the projected increase in employment across the District up to 2033; a total of approximately 8,330 new jobs (490 jobs per year). A percentage of the projected employment growth has been assigned to each of the proposed employment sites, based on the size (hectare) of each site (i.e. the larger the site, the greater the proportion of full time employment jobs allocated).

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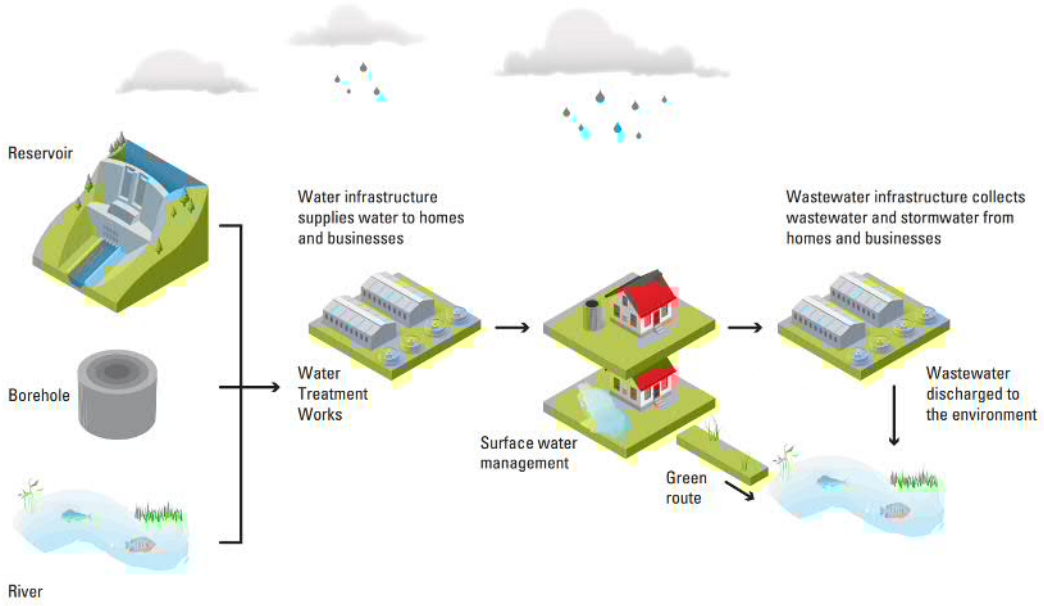
4. Wastewater Treatment

4.1 Wastewater in the District

Figure 3. The water environment and infrastructure components[9]



A broad overview of the water cycle and the role of water and wastewater infrastructure within the cycle is illustrated in Figure 3. Wastewater is generally produced following the use of potable water in homes, businesses, industrial processes and in certain areas can include surface water runoff.

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

Wastewater from the District is treated at 41 WRCs. The following fourteen WRC catchments are expected to receive additional wastewater as a result of growth and their location illustrated in Figure 4:

- Bocking,
- Braintree,
- Bures (outside of District),
- Coggeshall,
- Colchester (outside of District),
- Earls Colne,
- Gosfield (outside of District),
- Haverhill (outside of District),
- Halstead,
- Ridgewell,
- Sible Hedingham,
- Steeple Bumpstead,
- White Notley, and
- Witham.

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

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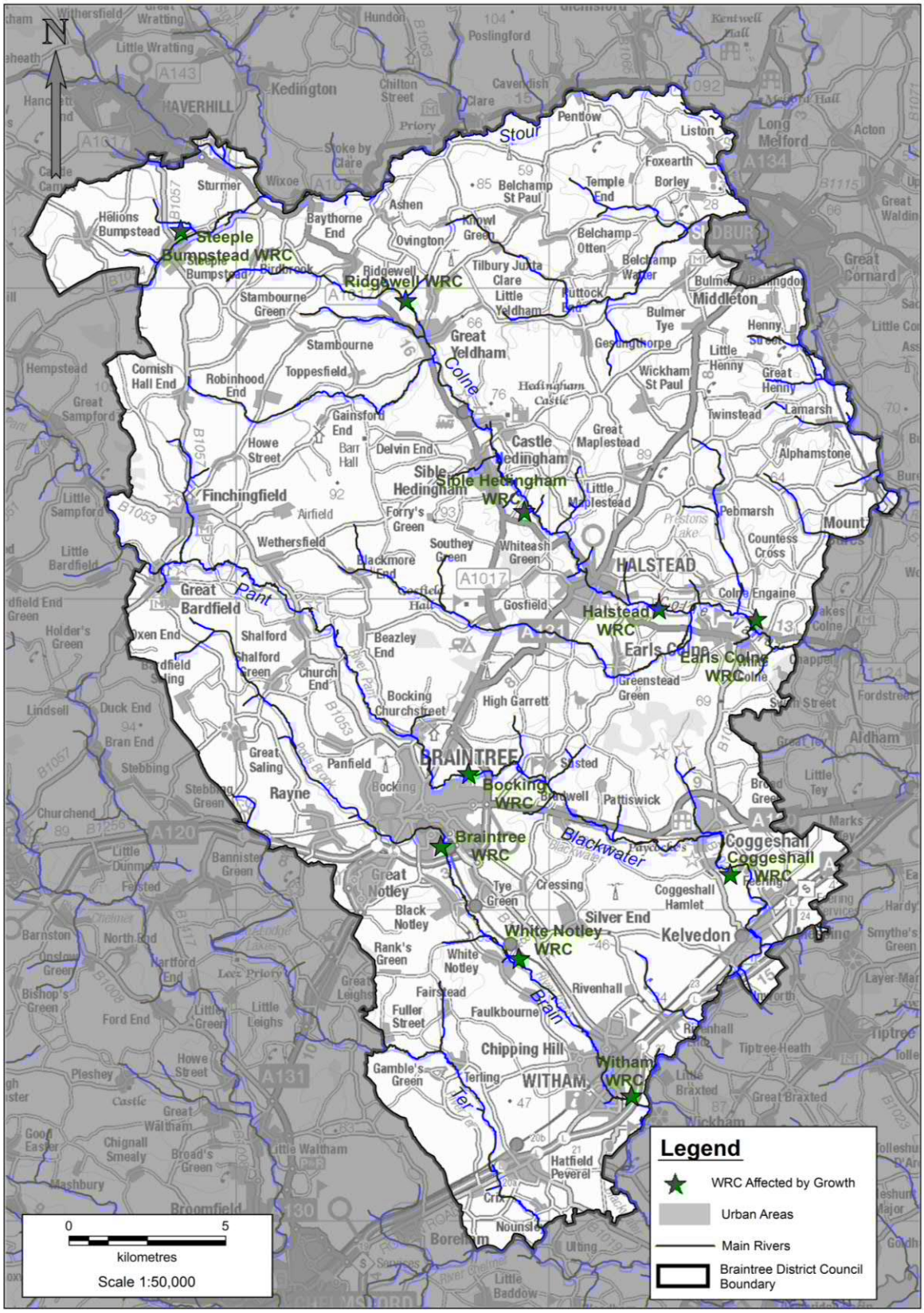
Figure 4. Location of WRC's affected by Local Plan development



4.2 Management of WRC Discharges

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

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

For the purposes of this WCS, the assumption is applied that the permitted headroom is usable[10] and would not affect downstream water quality. This headroom therefore determines how many additional properties can be connected to the WRC catchment before AWS would need to apply for a new or revised discharge permit (and hence how many properties can connect without significant changes to the treatment infrastructure).

When a new or revised discharge permit is required, an assessment needs to be undertaken to determine what new quality conditions would need to be applied to the discharge. If the quality conditions remain unchanged, the increased flow of wastewater received at the WRC would result in an increase in the pollutant load[11] of some substances being discharged to the receiving waterbody. This may have the effect of deteriorating water quality and hence in most cases, an increase in permitted discharge flow results in more stringent (or tighter) conditions on the quality of the discharge.

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

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

4.3 WFD Compliance

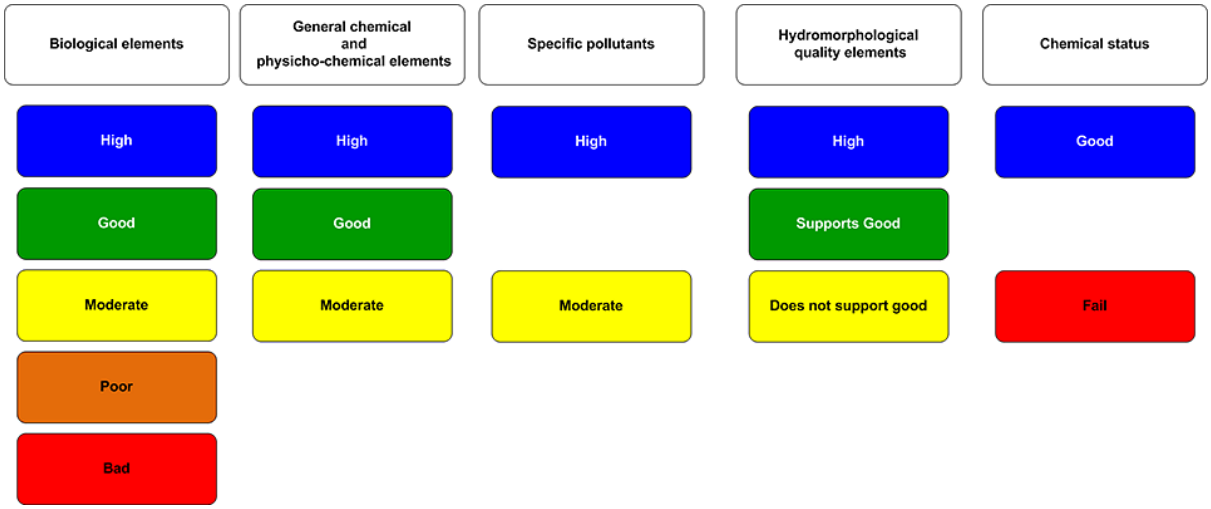
The definition of a waterbody's overall WFD 'status' is a complex assessment that combines standards for chemical quality and hydromorphology (habitat and flow conditions), with the ecological requirements of an individual waterbody catchment. A waterbody's 'overall status' is derived from the classification hierarchy made up of 'elements', and the type of waterbody will dictate what types of elements are assessed within it. The following is an example of the classification hierarchy and Figure 5 illustrates the classifications applied within the hierarchy;

Overall water body status or potential

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

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

Figure 5. WFD status classifications used for surface water elements



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

- Development must not cause a deterioration in WFD status of a waterbody[12]; and
- Development must not prevent a waterbody from achieving its future target status (usually at least Good status).

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

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

4.4 Habitats Directive

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

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

Where permitted headroom at a WRC would be exceeded by proposed levels of growth, a Habitats Regulations assessment exercise has been undertaken in this WCS to ensure that Habitats Directive sites which are hydrologically linked to watercourses receiving wastewater flows from growth would not be adversely affected. The scope of this assessment also includes non-Habitats Directive sites such as nationally designated Sites of

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

Special Scientific Interest (SSSI) and Local Nature Reserves (LNRs). This assessment is reported in Section 4.8 of this chapter (Ecological Appraisal).

4.5 Wastewater Assessment Overview

4.5.1 Approach

An increase in residential and employment growth will have a corresponding increase in the volume and flow of wastewater generated within the District and hence it is essential to consider:

- **Infrastructure Capacity**: defined in this WCS as the ability of the wastewater infrastructure to collect, transfer and treat wastewater from homes and business.
  - What new infrastructure is required to provide for the additional wastewater treatment?
  - Is there sufficient treatment capacity within existing wastewater infrastructure treatment facilities (WRCs)?
- **Environmental Capacity**: defined in this WCS as the water quality needed in receiving waterbodies to protect the aquatic environment and its wildlife. This is ultimately based on water quality targets required to protect wildlife.
  - Can the waterbodies receiving the WRC discharge cope with the additional flow without affecting water quality?

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

4.5.2 Methodology

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

In order to complete the following steps, the following assessment techniques were developed (details of the procedures can be found in Appendix C);

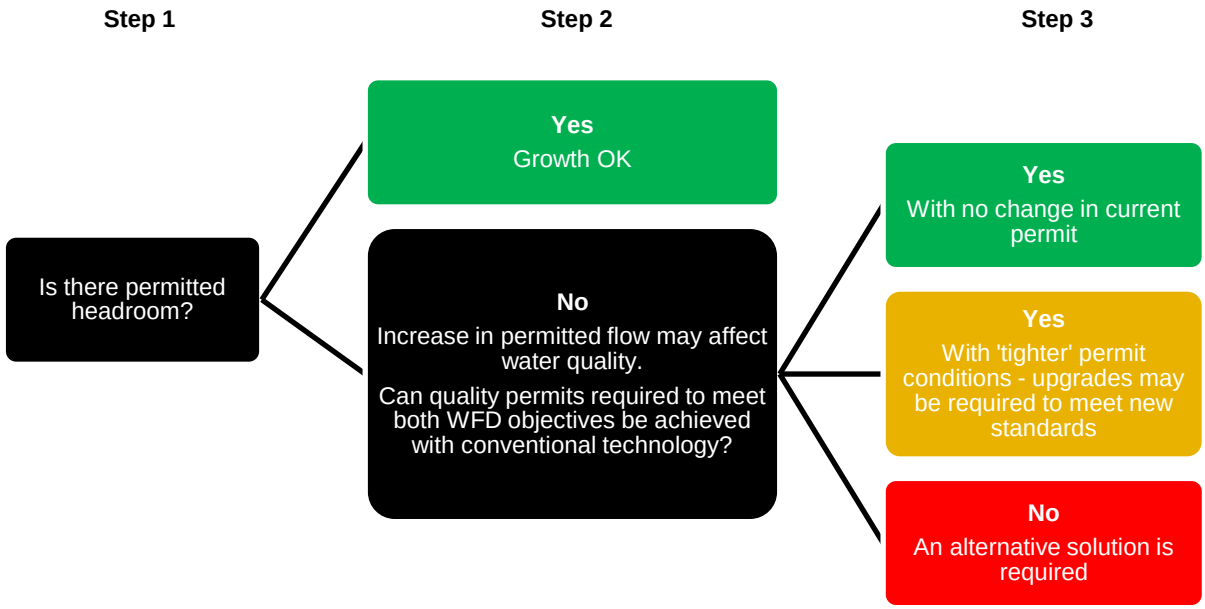
- A flow headroom calculation spreadsheet was developed; and,
- A water quality modelling procedure was agreed with the Environment Agency using Environment Agency software (RQP) designed for determining discharge permit quality conditions.

4.5.3 Assessment Results

The results for each WRC assessment are presented in a Red/Amber/Green (RAG) Assessment for ease of planning reference. The RAG code refers broadly to the following categories and the process is set out in Figure 6.

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

Figure 6. RAG Assessment process diagram for infrastructure capacity



4.6 WRC Headroom Assessment

The assessment results are presented in this section and have been reported in the following order;

- Further detail on WRC catchments where growth can be accepted within the current permitted flow headroom have been reported together in Section 4.6.1;
- Further detail on those WRCs requiring a new discharge permit and hence a water quality assessment have been reported in Section 4.6.2 and 4.7.

4.6.1 WRC with Permitted Headroom

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

Table 6 details the WRC where existing permitted headroom is sufficient to accommodate all of the proposed growth and hence no wastewater treatment infrastructure upgrades are required to deliver the proposed growth in these locations.

Growth in these WRC catchments would not compromise either of the WFD objectives and hence there is no barrier to delivering the proposed growth. These WRCs are assessed as Green in the RAG assessment and therefore do not require any further assessment.

Table 6 also provides an approximation of the number of additional dwellings that could be connected before the flow condition of the discharge permit would be exceeded. However, it should be noted that this WCS and the wastewater assessment for Bures, Colchester, Earls Colne and Haverhill WRC's does not take account of existing populations and growth which are located outside of the District, but are served by these WRCs, and will significantly impact infrastructure capacity at these WRCs. Growth within the District which affects these WRCs is relatively small and in isolation is unlikely to cause infrastructure constraints.

Table 6. WRC with permitted headroom capacity

WRC Catchment	Current DWF Permit (m^3/d)	Current Headroom Capacity		Quantity of proposed dwellings	Future 2033 DWF after growth (m^3/d)	Headroom Assessment after growth (2033)	
		Current DWF (m^3/d)	Calculated Headroom (m^3/d)			Headroom Capacity (m^3/d)	Approx. residual housing capacity
Bures[13]	250	190	**60**	110	230	**20**	**50**
Colchester[14]	29,284	23,378	**5,906**	1150	23,840	**5,450**	**13,580**
Earls Colne[15]	934	791	**143**	190	880	**60**	**140**
Gosfield	290	199	**91**	0	210	**80**	**200**
Haverhill[16]	5,700	4,861	**839**	0	4870	**830**	**2,070**
Halstead	2,900	2,326	**574**	610	2,600	**300**	**760**
Ridgewell	102	57	**45**	10	60	**40**	**100**
Sible Hedingham	1,700	1,517	**183**	280	1,630	**70**	**170**
Steeple Bumpstead	320	262	**58**	30	270	**50**	**120**
Witham	8,100	5,461	**2,639**	2200	6400	**1,700**	**4,240**

[13] Located in the adjacent District of Babergh and serves the village of Bures which straddles the Essex and Suffolk border.
[14] Located in the adjacent Borough of Colchester, and predominantly serves the population of Colchester City and surrounding villages, including the proposed Garden Community at Marks Tey.
[15] Also serves the population of Wakes Colne and Chappel located in the adjacent Borough of Colchester.
[16] Located in the adjacent District of St Edmundsbury and predominantly serves the population of Haverill town.

4.6.2 WRC without Permitted Headroom

The calculations of flow headroom capacity found that four WRCs would not have sufficient headroom once all the growth within the WRC catchment is accounted for as detailed in Table 7. These WRCs would exceed their maximum permitted DWF under their existing discharge permits. Additional headroom can be made available through an application by AWS for a new or revised discharge permit from the Environment Agency.

To ensure that the increase in permitted DWF required to serve the proposed growth would not impact on downstream WFD requirements, water quality modelling has been undertaken for the WRCs listed in Table 7 to determine whether theoretically achievable quality conditions can be applied to a revised discharge permit.

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

Table 7. WRC without permitted headroom capacity

WRC Catchment	Current DWF Permit (m^3/d)	Current Headroom Capacity		Quantity of proposed dwellings	Future 2033 DWF after growth (m^3/d)	Headroom Assessment after growth (2033)	
		Current DWF (m^3/d)	Calculated Headroom (m^3/d)			Headroom Capacity (m^3/d)	Approx. residual housing capacity
Bocking	3,900	2,869	**1,031**	4,300	4,600	**-700**	**-1,730**
Braintree	6,859	6,120	**739**	3,680	7,680	**-820**	**-2,050**
Coggeshall	2,235	2,195	**40**	1,350	2,740	**-510**	**-1,260**
White Notley	660	860	**-200**	70	890	**-230**	**-570**

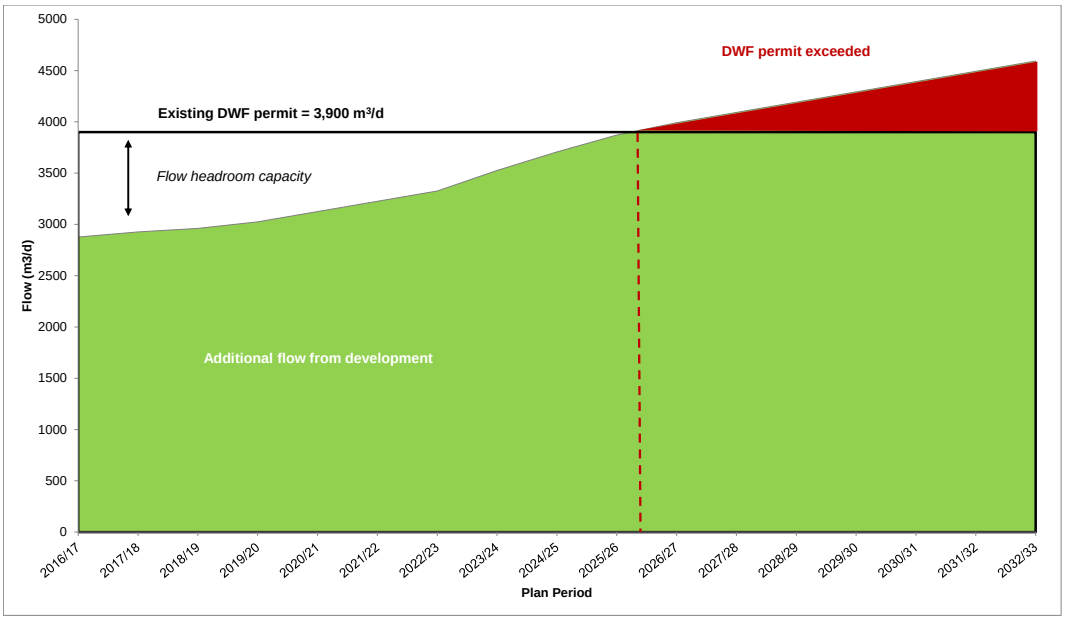
4.6.2.1 Bocking WRC

The headroom assessment has demonstrated that Bocking WRC currently has sufficient flow headroom in its existing discharge permit and can accept development of approximately 2,570 dwellings[17], after which the discharge permit will be exceeded. Based on the latest housing trajectory provided by Braintree District Council, the existing discharge permit will be exceeded in 2026, as shown in Figure 7.

Unless additional flow headroom can be made available at the WRC to accept development beyond 2,570 dwellings, further development connecting to the WRC would result in the existing discharge permit being exceeded, and by a total volume of 700m^3/d (equivalent to approximately 1,730 dwellings) by the end of the plan period as shown in Table 7.

[17] Calculated based on the key assumptions

Figure 7. Bocking WRC DWF across plan period and DWF permit exceedance

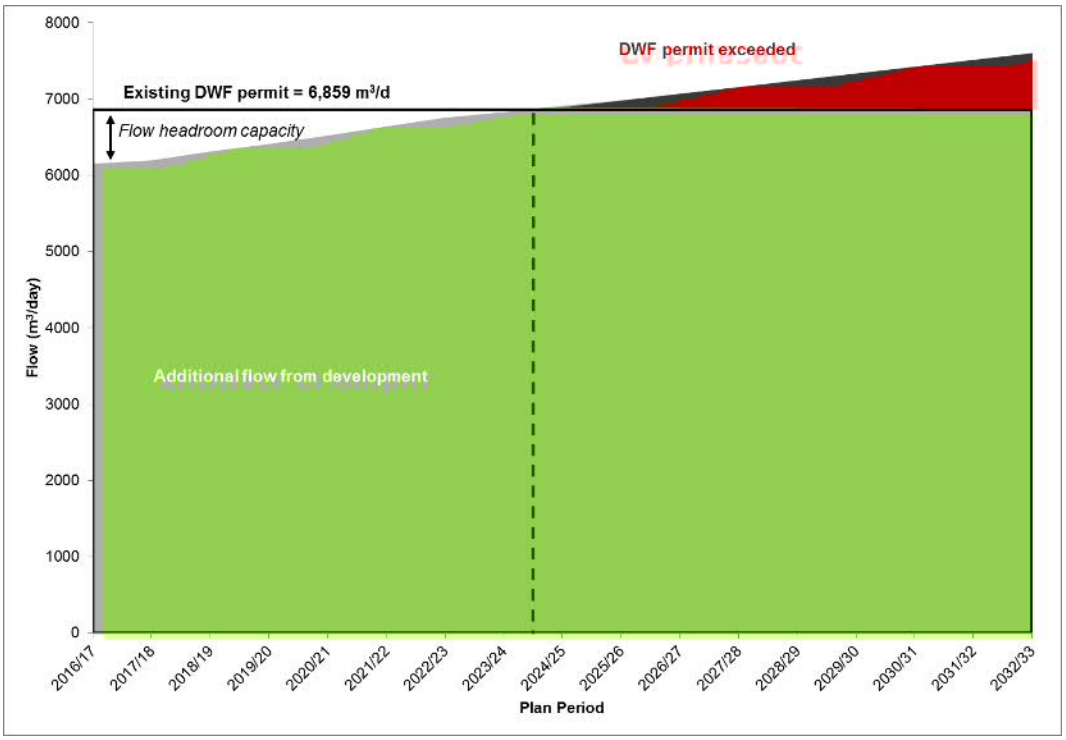


4.6.2.2 Braintree WRC

The headroom assessment has demonstrated that Braintree WRC currently has sufficient flow headroom in its existing discharge permit and can accept development of approximately 1,840 dwellings[17], after which the discharge permit will be exceeded. Based on the latest housing trajectory provided by Braintree District Council, the existing discharge permit will be exceeded in 2024, as shown in Figure 8.

Unless additional flow headroom can be made available at the WRC to accept development beyond 1,840 dwellings, further development connecting to the WRC would result in the existing discharge permit being exceeded, and by a total volume of 820m^3/d (equivalent to approximately 2,050 dwellings) by the end of the plan period as shown in Table 7.

Figure 8. Braintree WRC DWF across plan period and DWF permit exceedance

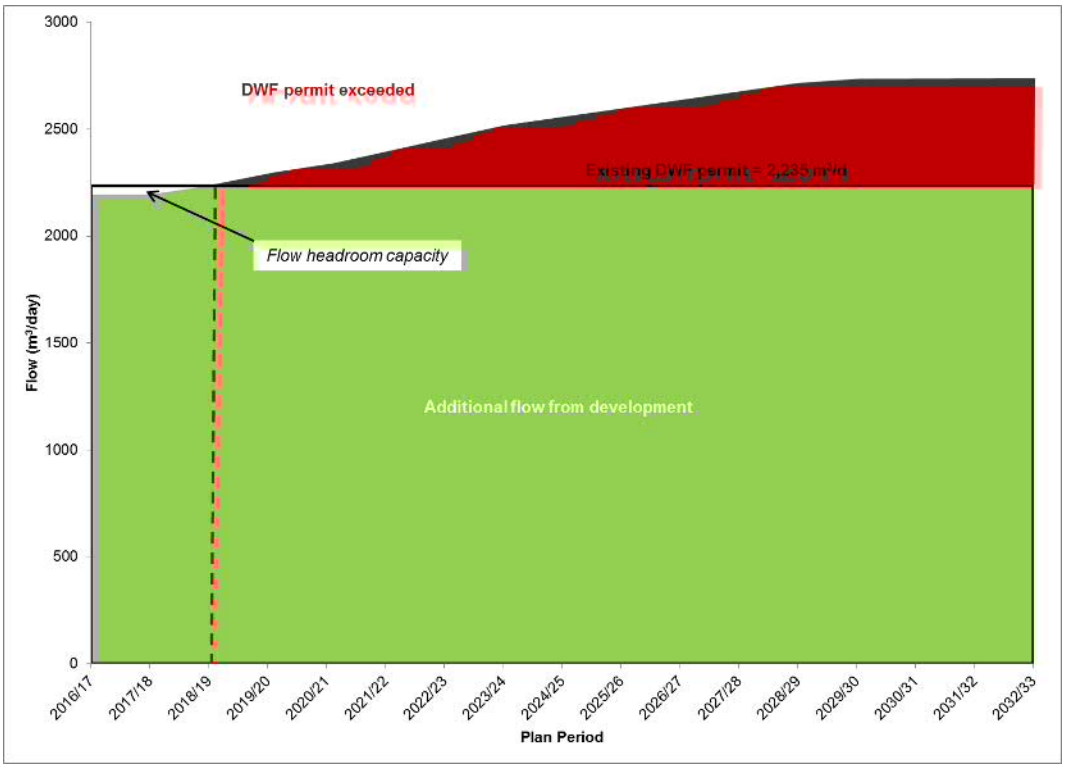


4.6.2.3 Coggeshall WRC

The headroom assessment has demonstrated that Coggeshall WRC currently has sufficient flow headroom in its existing discharge permit and can accept development of approximately 100 dwellings[17], after which the discharge permit will be exceeded. Based on the latest housing trajectory provided by Braintree District Council, the existing discharge permit will be exceeded in 2019, as shown in Figure 9.

Unless additional flow headroom can be made available at the WRC to accept development beyond 100 dwellings, further development connecting to the WRC would result in the existing discharge permit being exceeded, and by a total volume of 510m^3/d (equivalent to approximately 1,260 dwellings) by the end of the plan period as shown in Table 7.

Figure 9. Coggeshall WRC DWF across plan period and DWF permit exceedance



4.6.2.4 White Notley WRC

The headroom assessment has demonstrated that White Notley WRC does not currently have sufficient flow headroom in its existing discharge permit to accept development. In addition, according to data provided by AWS, the WRC is already exceeding its existing DWF permit by approximately 200m^3/d, as shown in Figure 10.

Therefore, until additional flow headroom can be made available at the WRC, any development connecting to the WRC would result in the existing DWF permit being exceeded further, and by a total volume of 230 m^3/d (equivalent to approximately 570 dwellings) by the end of the plan period as shown in Table 7.

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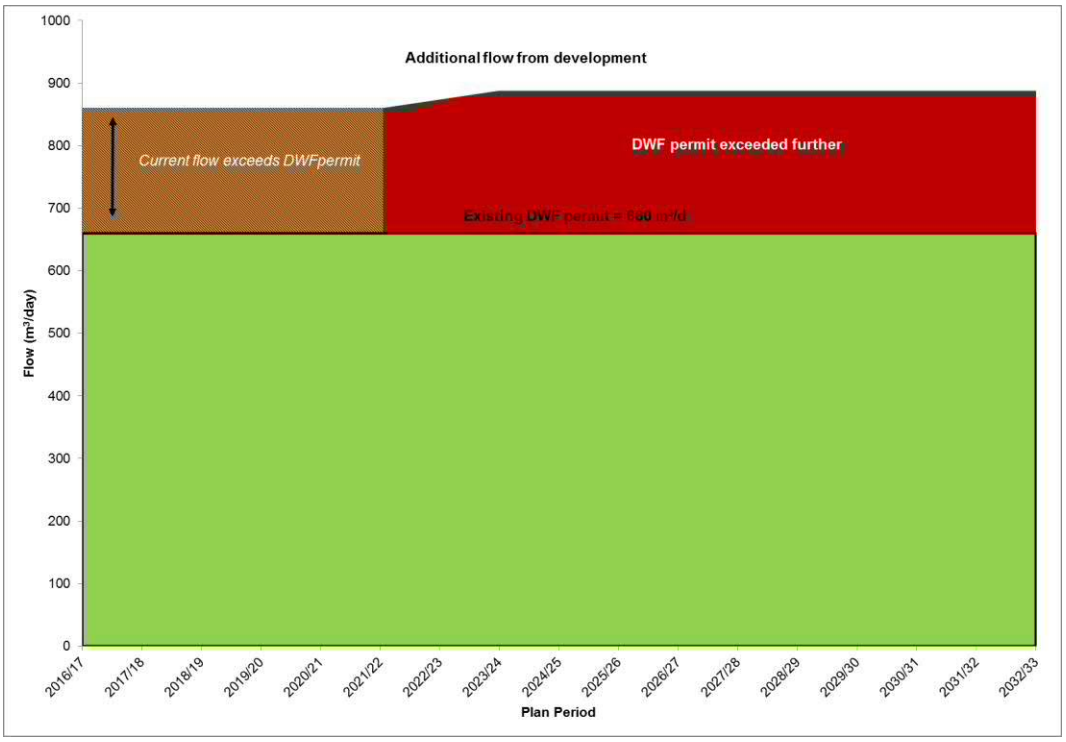
Figure 10. White Notley WRC DWF across plan period and DWF permit exceedance



4.7 Water Quality Assessment

The WRCs which have been identified as having insufficient permitted flow headroom all discharge to freshwater, inland waterbodies. Therefore, statistical based water quality modelling (using RQP software) has been performed to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. Load standstill calculations have been used to determine the future permit conditions for BOD. This approach follows Environment Agency guidelines and best practice.

A summary of the results and proposed infrastructure upgrades required are included in the following subsections for each of the WRCs (listed in Table 7) where:

- Development will use up all available flow headroom capacity in the existing DWF permit and will cause the DWF permit to be exceeded; or
- The existing DWF permit is already being exceeded (i.e. currently no available flow headroom capacity) and development is proposed within the WRC catchment.

Under each WRC, the following detail is provided:

- Environmental baseline for receiving watercourse,
- WFD compliance assessment – No Deterioration,
- WFD compliance assessment– Achieve Future Target Status,
- Infrastructure upgrade requirements,
- Phasing of upgrades, and
- Overall RAG assessment.

4.7.1 Bocking WRC

4.7.1.1 Environmental Baseline

Bocking WRC discharges to the River Blackwater. The River Blackwater currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' status by 2021. Its current overall status is limited to Moderate due to the status of macrophytes & phytobenthos and phosphate. The current status for ammonia and BOD is High.

4.7.1.2 WFD Compliance – No Deterioration

As Bocking WRC discharges to the freshwater River Blackwater, a range of scenarios have been modelled, as agreed with the Environment Agency, (see Appendix C for details) to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

Modelling has been undertaken to take account of the increased wastewater flows from the proposed development, whilst limiting deterioration to no more than 10% of the current downstream quality[18]. The results showed that a revised (tighter) ammonia quality condition and a new phosphate quality condition (currently no phosphate condition) on the discharge permit would be required to ensure the 10% deterioration limit is adhered to. The tighter ammonia and phosphate quality conditions can be achieved with current conventional treatment technologies (within the limits of conventional treatment) and would also ensure no deterioration in ammonia and phosphate status.

Further modelling has also been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status (i.e. irrespective of the 10% deterioration limit). The results showed that a revised ammonia quality condition and a new phosphate quality condition on the discharge permit would be required to ensure no deterioration in status. The revised ammonia and phosphate quality conditions are less stringent than

[18] This is required by the Environment Agency for freshwater discharges to inform their hierarchical approach to the WFD 'no deterioration' targets used to identify indicative permits. This approach helps with consideration of the relative technical feasibility of ensuring 'no deterioration'.

those required to limit deterioration to no more than 10%, and would be considered more achievable with current conventional treatment technologies.

The results of the load standstill calculation for BOD also showed that a revised (tighter) BOD quality condition on the discharge permit would be required and would maintain the current BOD quality downstream. The tighter BOD quality condition can also be achieved with current conventional treatment technology (within limits of conventional treatment).

The revised discharge permit quality conditions are presented in Table 9.

4.7.1.3 WFD Compliance – Achieve Future Target Status

Modelling was not required to assess the impact of growth on preventing the future 'Good' Ecological status being reached in the River Blackwater due to an alternative objective of 'Moderate' Ecological status being set by the Environment Agency in place of an objective to reach 'Good' Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than Good status of phosphate as well as macrophytes and phytobenthos. A detailed explanation for the reason behind the alternative objective has been provided in Appendix F.

The Reasons for Not Achieving Good (RNAG) as outlined in the Anglian RBMP, relevant to the River Blackwater have been provided in Table 8 below.

Table 8. Reasons for not achieving good status on the River Blackwater (GB105037041160)

Category	Activity	Activity Certainty	Classification Element	Objective
Water Industry	Sewage discharge (continuous)	Confirmed	Phosphate	Moderate by 2021
Agriculture and rural land management	Arable field	Suspected	Macrophytes and Phytobenthos Combined	Moderate by 2021
Agriculture and rural land management	Dairy/beef field	Suspected		
Water Industry	Sewage discharge (continuous)	Suspected		

The River Blackwater currently has high phosphorous concentrations attributable to surrounding agricultural land uses and point sources of wastewater discharge. The high nutrient concentration as a result of these activities has also had an impact on the biological quality of the waterbody, specifically on the macrophytes and phytobenthos communities, preventing the waterbody from achieving 'Good' Ecological status.

4.7.1.4 Infrastructure Upgrade Requirements

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WRC are likely to be required before 2026 when based on Local Plan projections, permitted headroom would be exceeded. The exact technical specification of the upgrades required should be determined by AWS for the AMP7 (2020 – 2025) asset planning period, in line with revised quality conditions for ammonia, BOD and phosphate.

By the end of the plan period, the future permit quality conditions detailed in

Table 9, and illustrated in Figure 11 and Figure 12, will be required to ensure deterioration is either limited to 10% of current water quality, or as a minimum, ensure no deterioration in status. To achieve these tighter permit conditions, current conventional treatment technologies would be sufficient (i.e. the quality conditions are within the limits of conventional treatment) but would need to be implemented by AWS at some point in the future. This demonstrates that a technical solution is feasible.

Figure 11. Bocking WRC ammonia permit condition tightening required

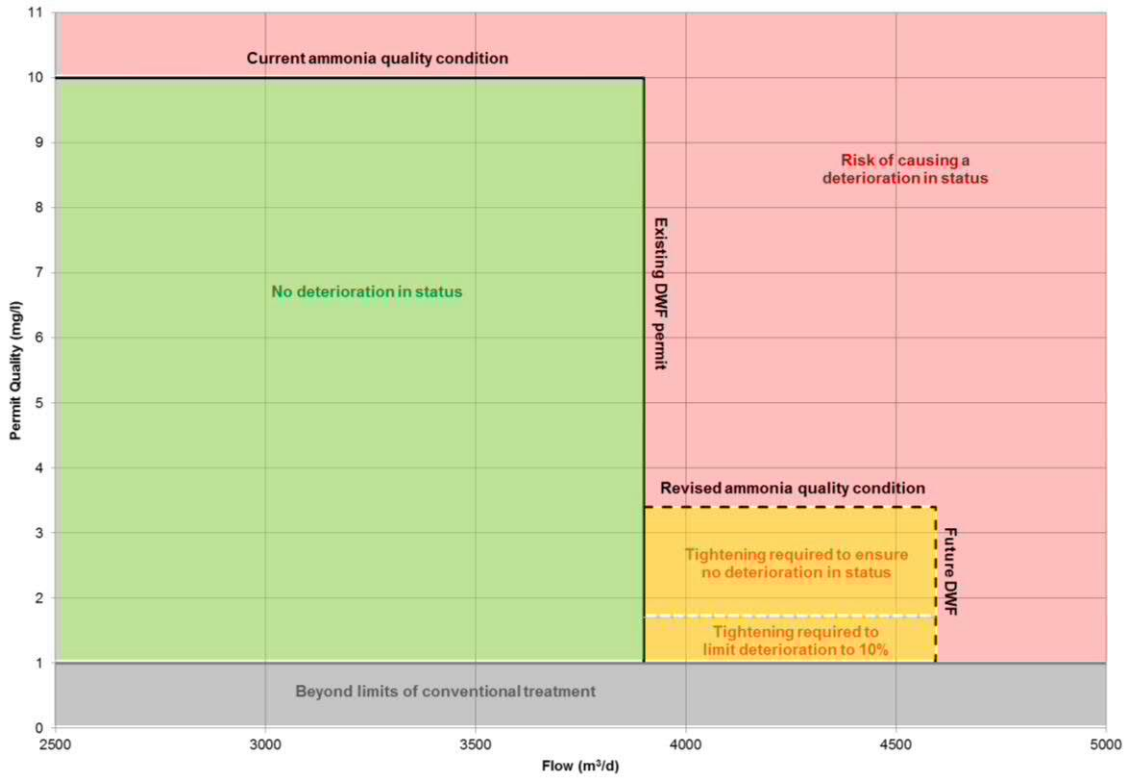


Figure 12. Bocking WRC phosphate permit condition tightening required

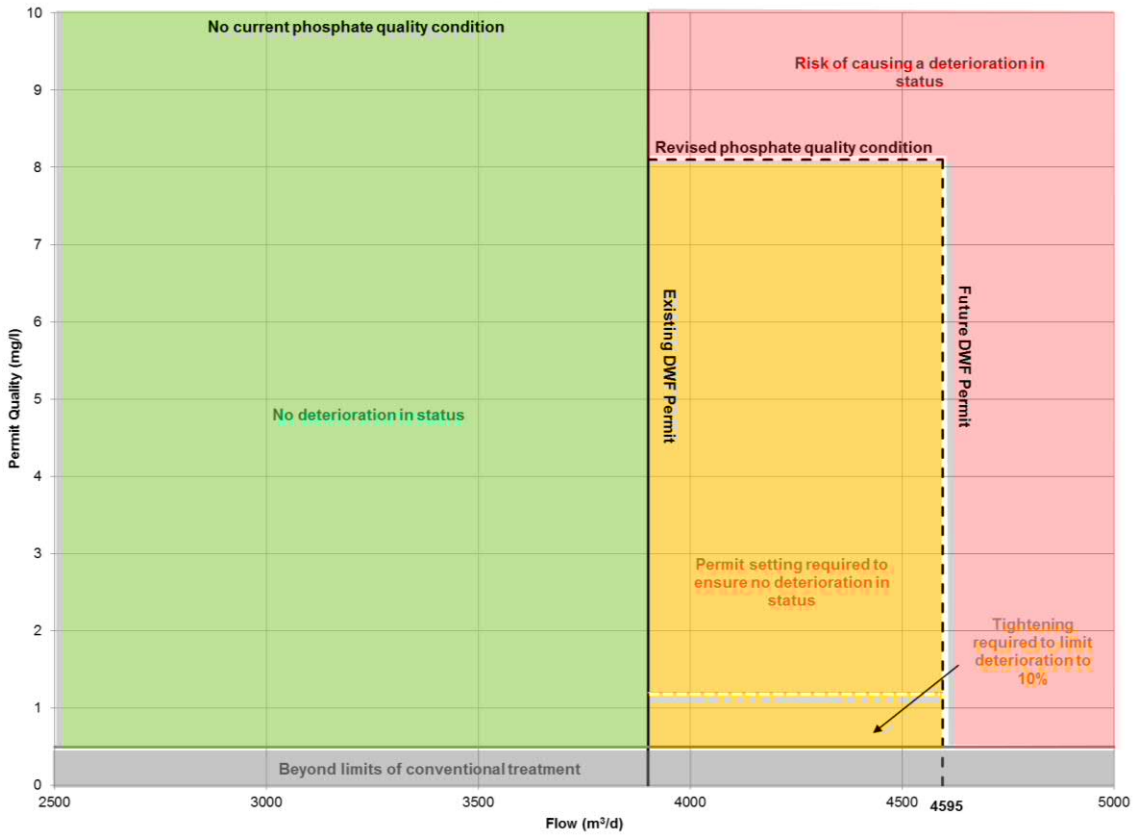


Table 9. Required permit quality conditions for Bocking WRC by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…		
		Limit to 10% deterioration + Ensure no deterioration in status	Ensure no deterioration in status only	Achieve future target status
BOD (mg/l 95%ile)	15	12		N/A
Ammonia (mg/l 95%ile)	10	1.7	3.7	N/A
Phosphate (mg/l annual average)	None	1.2	8.1	N/A

4.7.1.5 Phasing of Upgrades

AWS are currently preparing for Asset Management Plan 7 (AMP7) and their PR19 business plan which will outline their investment programme from April 2020 to 2025. AWS's approach to wastewater treatment asset management requires that sufficient certainty is given that the quantum of development proposed will come forward during the plan period before improvements to WRC assets can be justified and funding sought.

Information provided in this WCS represents the first stage in providing the most up to date information for development coming forward in the plan period, and can be used by AWS to inform their investment programme (AMP7) to ensure the provision of additional capacity is planned and development is not delayed. Once funding has been confirmed, there will be a lead-in time for the necessary upgrades to be completed. It is considered there is sufficient time before development comes forward within the WRC catchment for AWS to plan their investment and to deliver the necessary upgrades.

4.7.1.6 Overall RAG Assessment

Bocking WRC

The development in the Bocking WRC catchment is given an Amber status based on the following requirements:

- revised quality conditions on the new permit for BOD and ammonia,
- a new phosphate quality condition for the new permit, and
- likely process upgrades at the WRC to achieve the revised quality conditions.

If the above requirements are met, it would ensure development does not compromise the WFD objective of no deterioration in status and could be achieved with current conventional treatment technologies. The requirements listed above would be necessary from 2026 to ensure development can be delivered without compromising WFD objectives. Funding for the upgrades is not required immediately and can be planned for by AWS as certainty on the quantum of development increases.

4.7.2 Braintree WRC

4.7.2.1 Environmental Baseline

Braintree WRC discharges to the River Brain. The River Brain currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' status by 2021. Its current overall status is limited to Moderate due to the status of phosphate. The current status for ammonia and BOD is High.

4.7.2.2 WFD Compliance – No Deterioration

As Braintree WRC discharges to the freshwater River Brain, a range of scenarios have been modelled, as agreed with the Environment Agency, (see Appendix C for details) to check for compliance with the WFD objectives in

terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

Modelling has been undertaken to take account of the increased wastewater flows from the proposed development, whilst limiting deterioration to no more than 10% of the current downstream quality[18]. The results showed that the current ammonia quality condition is sufficient, resulting in only a 5% deterioration in current ammonia quality. A new phosphate quality condition (currently no phosphate condition) on the discharge permit would be required to ensure the 10% deterioration limit is adhered to. The new phosphate quality condition can be achieved with current conventional treatment technology (within the limits of conventional treatment) and would also ensure no deterioration in phosphate status.

The results for ammonia therefore indicate that the WRC is treating to a better standard than the permit quality condition (over performing). Information is required from AWS to confirm if the current treatment performance can be maintained, or would growth cause a decline in the WRC ammonia performance and therefore what level of treatment can be provided.

Further modelling has also been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status (i.e. irrespective of the 10% deterioration limit). The results showed that a revised ammonia quality condition and a new phosphate quality condition on the discharge permit would be required to ensure no deterioration in status. The revised quality conditions are less stringent than that required to limit deterioration to no more than 10%, and would be considered more achievable with current conventional treatment technologies.

The results of the load standstill calculation for BOD also showed that a revised (tighter) BOD quality condition on the discharge permit would be required and would maintain the current BOD quality downstream. The tighter BOD quality condition can also be achieved with current conventional treatment technology (within limits of conventional treatment).

The revised discharge permit quality conditions are presented in Table 11.

4.7.2.3 WFD Compliance – Achieve Future Target Status

Modelling was not required to assess the impact of growth on preventing the future ‘Good’ Ecological status being reached in the River Brain due to an alternative objective of ‘Moderate’ Ecological status being set by the Environment Agency in place of an objective to reach ‘Good’ Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than Good status of phosphate. A detailed explanation for the reason behind the alternative objective has been provided in Appendix G.

The RNAG as outlined in the Anglian RBMP, relevant to the River Brain have been provided in Table 10 below.

Table 10. Reasons for not achieving good status on the River Brain (GB105037041140)

Category	Activity	Activity Certainty	Classification Element	Objective
Water Industry	Sewage discharge (continuous)	Probable	Phosphate	Poor by 2021
Agriculture and rural land management	Mixed agricultural	Probable		

The River Brain currently has high phosphorous concentrations attributable to surrounding agricultural land uses and point sources of wastewater discharge.

4.7.2.4 Infrastructure Upgrade Requirements

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WRC are likely to be required before 2024 when based on Local Plan projections, permitted headroom would be exceeded. The exact technical specification of the upgrades required should be determined by AWS for the AMP7 (2020 – 2025) asset planning period, in line with revised quality conditions for BOD and phosphate. A treatment solution may need to be agreed between the Environment Agency and AWS should it not be possible to maintain the current high level of ammonia treatment.

By the end of the plan period, the future permit quality conditions detailed in Table 11, and illustrated in Figure 13 and Figure 14, will be required to ensure deterioration is either limited to 10% of current water quality, or as a minimum ensure no deterioration in status. To achieve these tighter permit conditions, current conventional treatment technologies would be sufficient (i.e. the quality conditions are within the limits of conventional treatment) but would need to be implemented by AWS at some point in the future. This demonstrates that a technical solution is feasible.

Figure 13. Braintree WRC ammonia permit condition tightening required

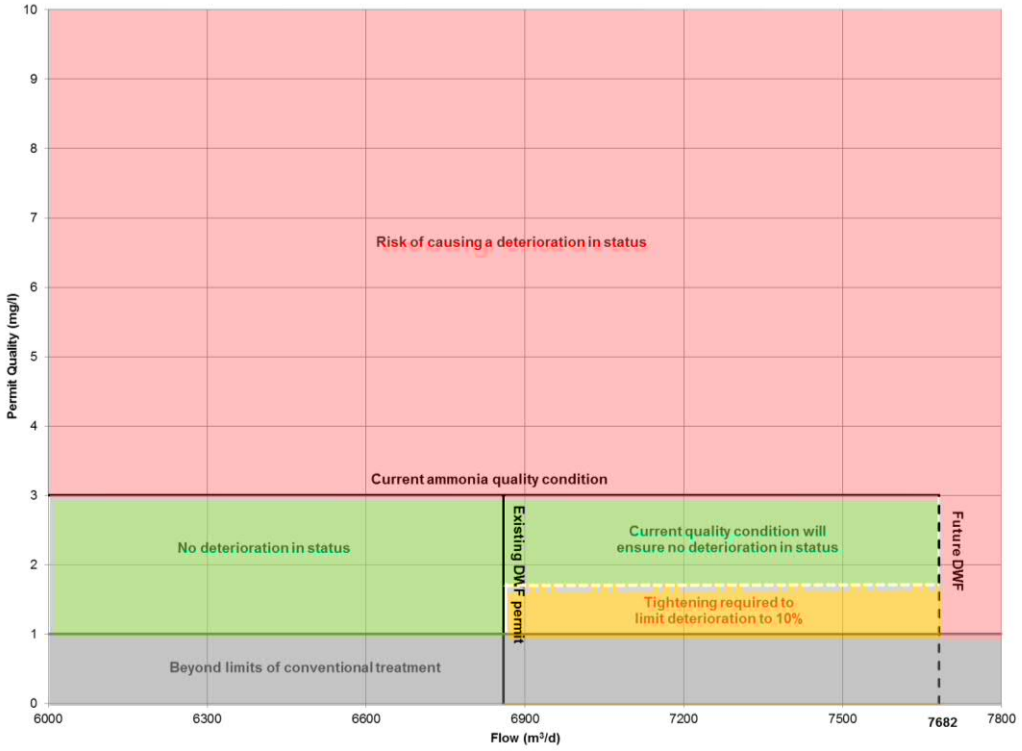


Figure 14. Braintree WRC phosphate permit condition tightening required

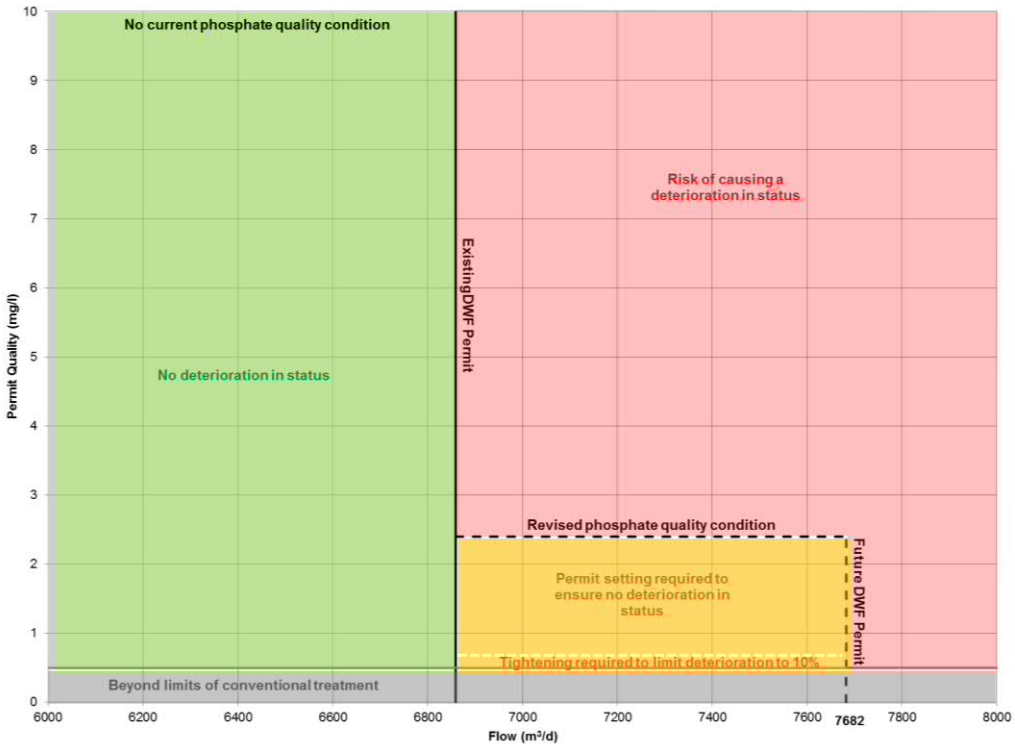


Table 11. Required permit quality conditions for Braintree WRC by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…		
		Limit to 10% deterioration + Ensure no deterioration in status	Ensure no deterioration in status only	Achieve future target status
BOD (mg/l 95%ile)	8	7		N/A
Ammonia (mg/l 95%ile)	3	No change (over performing)	1.7	N/A
Phosphate (mg/l annual average)	None	0.7	2.4	N/A

4.7.2.5 Phasing of Upgrades

Information provided in this WCS represents the first stage in providing the most up to date information for development coming forward in the plan period, and can be used by AWS to inform their investment programme (AMP7) to ensure the provision of additional capacity is planned and development is not delayed. Once funding has been confirmed, there will be a lead-in time for the necessary upgrades to be completed. It is considered there is sufficient time before development comes forward within the WRC catchment for AWS to plan their investment and to deliver the necessary upgrades.

4.7.2.6 Overall RAG Assessment

Braintree WRC

The development in the Braintree WRC catchment is given an Amber status based on the following requirements:

- revised quality conditionconditions on the new permit for BOD,
- a new phosphate quality condition for the new permit,
- more information on the current ammonia treatment, and
- likely process upgrades at the WRC to achieve the revised quality conditions.

If the above requirements are met, it would ensure development does not compromise the WFD objective of no deterioration in status and could be achieved with current conventional treatment technologies. The requirements listed above would be necessary from 2024 to ensure development can be delivered without compromising WFD objectives. Funding for the upgrades is not required immediately and can be planned for by AWS as certainty on the quantum of development improves.

4.7.3 Coggeshall WRC

4.7.3.1 Environmental Baseline

Coggeshall WRC discharges to the River Blackwater. The River Blackwater currently has an overall waterbody status of 'Moderate', with the alternative objective to maintain 'Moderate' status by 2021. Its current overall status is limited to Moderate due to the status of macrophytes & phytobenthos and phosphate. The current status for ammonia and BOD is High.

4.7.3.2 WFD Compliance – No Deterioration

As Coggeshall WRC discharges to the freshwater River Blackwater, a range of scenarios have been modelled, as agreed with the Environment Agency, (see Appendix C for details) to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

Modelling has been undertaken to take account of the increased wastewater flows from the proposed development, whilst limiting deterioration to no more than 10% of the current downstream quality[18]. For phosphate, it is not possible to achieve the limit of 10% without improving upstream water quality, therefore an approach has been taken to apply a 20% deterioration limit. The results showed that a revised (tighter) ammonia quality condition and a new phosphate quality condition (currently no phosphate condition) on the discharge permit would be required to ensure the 10% and 20% deterioration limits are adhered to. The tighter ammonia quality condition can be achieved with current conventional treatment technologies (within the limits of conventional treatment) and would also ensure no deterioration in ammonia status. The new phosphate quality condition cannot be achieved with current conventional treatment technologies (beyond the limits of conventional treatment). It is therefore not technically feasible to limit deterioration to 20% for phosphate.

Further modelling has been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status (i.e. irrespective of the 10% or 20% deterioration limit) The results showed that a revised ammonia quality condition and a new phosphate quality condition on the discharge permit would be required to ensure no deterioration in status. The revised ammonia and phosphate quality conditions are less stringent than those required to limit deterioration to no more than 10% or 20%, and are achievable with current conventional treatment technologies.

The results of the load standstill calculation for BOD also showed that a revised (tighter) BOD quality condition on the discharge permit would be required and would maintain the current BOD quality downstream. The tighter BOD quality condition can also be achieved with current conventional treatment technology (within limits of conventional treatment).

The revised discharge permit quality conditions are presented in Table 12.

4.7.3.3 WFD Compliance – Achieve Future Target Status

Modelling was not required to assess the impact of growth on preventing the future 'Good' Ecological status being reached in the River Blackwater due to an alternative objective of 'Moderate' Ecological status being set by the Environment Agency in place of an objective to reach 'Good' Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than Good status of phosphate as well as macrophytes and phytobenthos. A detailed explanation for the reason behind the alternative objective has been provided in Appendix G.

Coggeshall WRC discharges to the same River Blackwater WFD waterbody as Bocking WRC, therefore, the RNAG provided in Table 8 are also relevant to Coggeshall WRC.

4.7.3.4 Infrastructure Upgrade Requirements

To accept and treat all of the additional wastewater flow expected from development by the end of the plan period, process upgrades at the WRC are likely to be required before 2019 when based on Local Plan projections, permitted headroom would be exceeded. Until such time as the revised quality conditions are agreed with the Environment Agency and process upgrades are delivered by AWS, development may need to be restricted to a rate to be agreed with AWS from 2019 to ensure that additional flow can be treated and discharged without compromising WFD targets in the River Blackwater.

Unless funding has already been allocated to upgrade Coggeshall WRC in the current AMP6 asset planning period (2015 – 2020), the exact technical specification of the upgrades required should be determined by AWS for the AMP7 (2020 – 2025) asset planning period, in line with revised quality conditions for ammonia, BOD and phosphate.

By the end of the plan period, the future permit quality conditions detailed in Table 12, and illustrated in Figure 15 and Figure 16, will be required to ensure deterioration is either limited to 10% of current water quality (20% for phosphate), or as a minimum ensure no deterioration in status. To achieve the tighter permit conditions for ammonia and BOD, current conventional treatment technologies would be sufficient (i.e. the quality conditions are within the limits of conventional treatment) but would need to be implemented by AWS at some point in the future. The exception is tighter permit condition for phosphate, which would require treatment beyond what is currently considered conventional treatment technology.

Figure 15. Coggeshall WRC ammonia permit condition tightening required

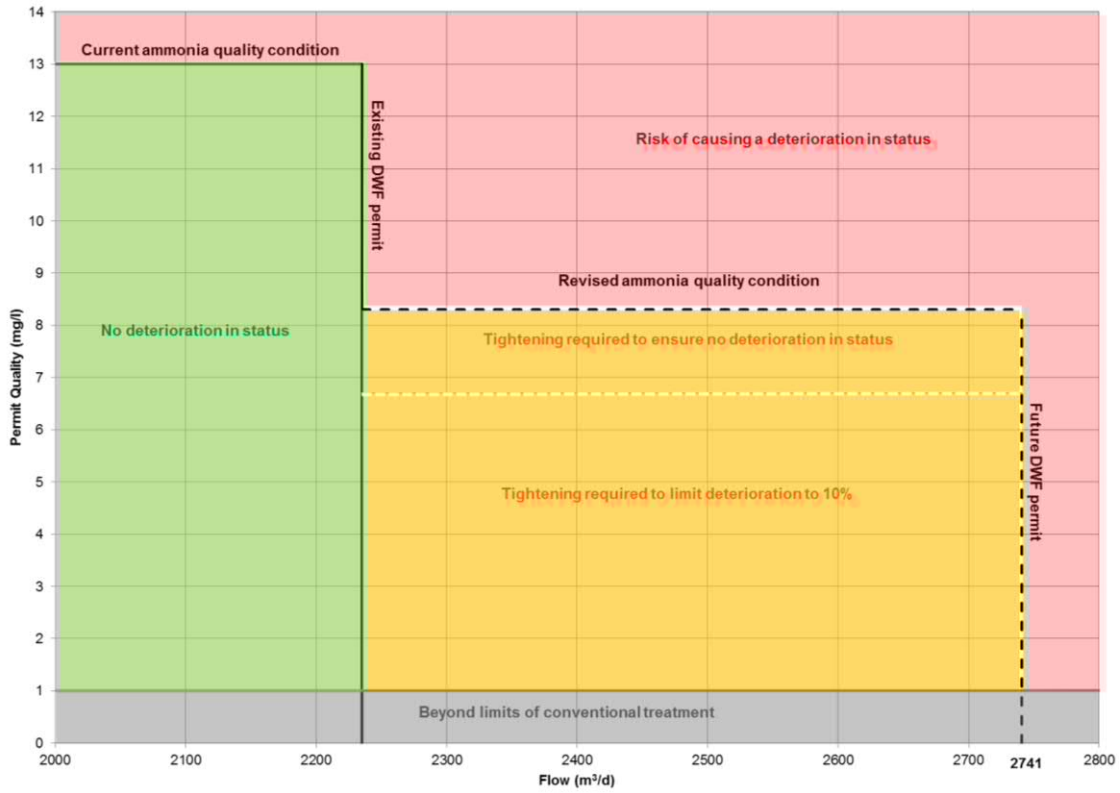


Figure 16. Coggeshall WRC phosphate permit condition tightening required

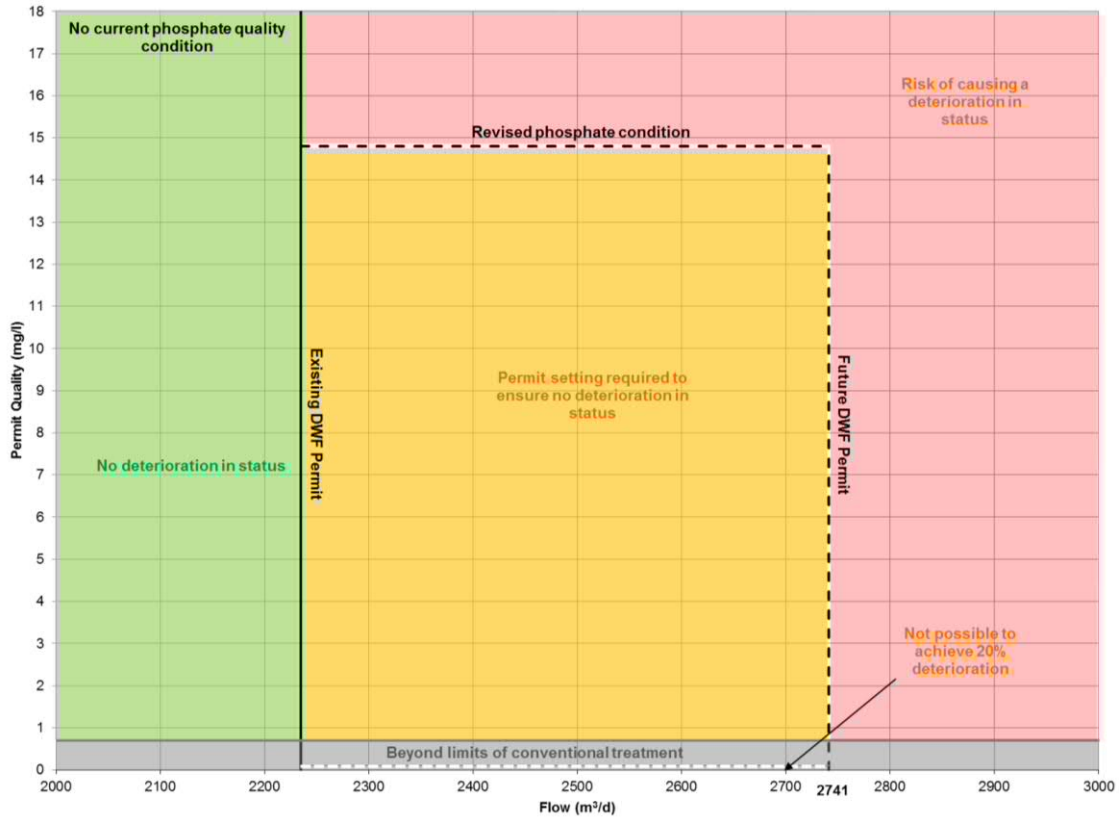


Table 12. Required permit quality conditions for Coggeshall WRC by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…		
		Limit to 10% deterioration + Ensure no deterioration in status	Ensure no deterioration in status only	Achieve future target status
BOD (mg/l 95%ile)	19	15		N/A
Ammonia (mg/l 95%ile)	13	6.7	8.3	N/A
Phosphate (mg/l annual average)	None	0.1*	14.8	N/A

*Limit to 20% deterioration

4.7.3.5 Phasing of Upgrades

Information provided in this WCS represents the first stage in providing the most up to date information for development coming forward in the plan period, and can be used by AWS to inform their investment programme (AMP7) to ensure the provision of additional capacity is planned and development is not delayed. Once funding has been confirmed, there will be a lead-in time for the necessary upgrades to be completed. It is considered there is sufficient time before development comes forward within the WRC catchment for AWS to plan their investment and to deliver the necessary upgrades.

4.7.3.6 Overall RAG Assessment

Coggeshall WRC

The development in the Coggeshall WRC catchment is given an Amber status based on the following requirements:

- revised quality conditions on the new permit for BOD and ammonia,
- a new phosphate quality condition for the new permit, and
- likely process upgrades at the WRC to achieve the revised quality conditions.

If theThe above requirements are met, it would ensure development does not compromise the WFD objective of no deterioration in status and could be achieved with current conventional treatment technologies. The requirements listed above would be necessary from 2019 to ensure development can be delivered without compromising WFD objectives. Funding for the upgrades is required during this AMP period. If no funding has been allocated, development may need to be restricted to a rate to be agreed with AWS from 2019.

4.7.4 White Notley WRC

4.7.4.1 Environmental Baseline

White Notley WRC discharges to the River Brain. The River Brain currently has an overall waterbody status of ‘Moderate’, with the alternative objective to maintain ‘Moderate’ status by 2021. Its current overall status is limited to Moderate due to the status of phosphate. The current status for ammonia and BOD is High.

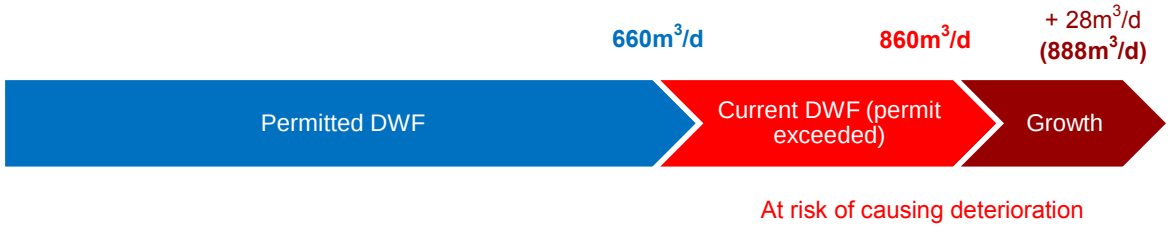
4.7.4.2 WFD Compliance – No Deterioration

As White Notley WRC discharges to the freshwater River Brain, a range of scenarios have been modelled, as agreed with the Environment Agency, (see Appendix C for details) to check for compliance with the WFD objectives in terms of permit conditions for ammonia and phosphate. A load standstill calculation has been used to determine the future BOD permit conditions.

Modelling has been undertaken to determine the quality conditions required now to limit deterioration to no more than 10% of the current downstream quality[18]. For ammonia, a deterioration in current water quality of 10% would

cause a deterioration in status from 'Good' to 'Moderate', therefore it is only necessary to determine what ammonia quality condition is required to ensure no deterioration in status. The results showed that a new phosphate quality condition (currently no phosphate condition) on the discharge permit would be required now to ensure the current discharge (which exceeds the permitted DWF, as illustrated in Figure 17) does not cause more than a 10% deterioration in water quality. The new phosphate quality condition can be achieved with current conventional treatment technologies (within the limits of conventional treatment) and would also ensure no deterioration in phosphate status. When taking into account the increased wastewater flows from the proposed development, a quality condition similar to that required now (pre-growth) would be required.

Figure 17. White Notley WRC DWF permit, DWF permit exceedance and additional DWF from growth



Further modelling has been undertaken, taking into account increased wastewater flows from development, to determine what ammonia and phosphate quality conditions would be required to ensure no deterioration in ammonia and phosphate status (i.e. irrespective of the 10% deterioration limit). The results showed that a revised ammonia quality condition and a new phosphate quality condition on the discharge permit would be required to ensure no deterioration in status. The revised ammonia and phosphate quality conditions are considered to be achievable with current conventional treatment technologies, and for phosphate is less stringent than the quality condition required to limit deterioration to no more than 10%.

For ammonia and phosphate, both of the tighter quality conditions required now and in the future can be achieved with current conventional treatment technologies (within limits of conventional treatment).

The results of the load standstill calculation for BOD also showed that a revised (tighter) BOD quality condition on the discharge permit would be required now to maintain the current BOD quality downstream due to the DWF permit already being exceeded (Figure 17). Further tightening of the BOD quality condition would then be required to maintain the current quality by the end of the plan period (i.e. after growth). Both the tighter BOD quality conditions required now and in the future can be achieved with current conventional treatment technology (within limits of conventional treatment).

The revised discharge permit quality conditions are presented in Table 13.

4.7.4.3 WFD Compliance – Achieve Future Target Status

Modelling was not required to assess the impact of growth on preventing the future 'Good' Ecological status being reached in the River Brain due to an alternative objective of 'Moderate' Ecological status being set by the Environment Agency in place of an objective to reach 'Good' Ecological status. The alternative objective has been set due to the need for a technically infeasible solution to resolve the less than Good status of phosphate. A detailed explanation for the reason behind the alternative objective has been provided in Appendix G.

White Notley WRC discharges to the same River Brain WFD waterbody as Braintree WRC, therefore, the RNAG provided in Table 10 are also relevant to White Notley WRC.

4.7.4.4 Infrastructure Upgrade Requirements

Process upgrades at the WRC are likely to be required immediately to limit deterioration to 10% of current quality or ensure there is no deterioration in the current status.

Until such time as the revised quality conditions are agreed with the Environment Agency and process upgrades are delivered by AWS, development may need to be restricted to a rate to be agreed with AWS to ensure that additional flow can be treated and discharged without compromising WFD targets in the River Brain.

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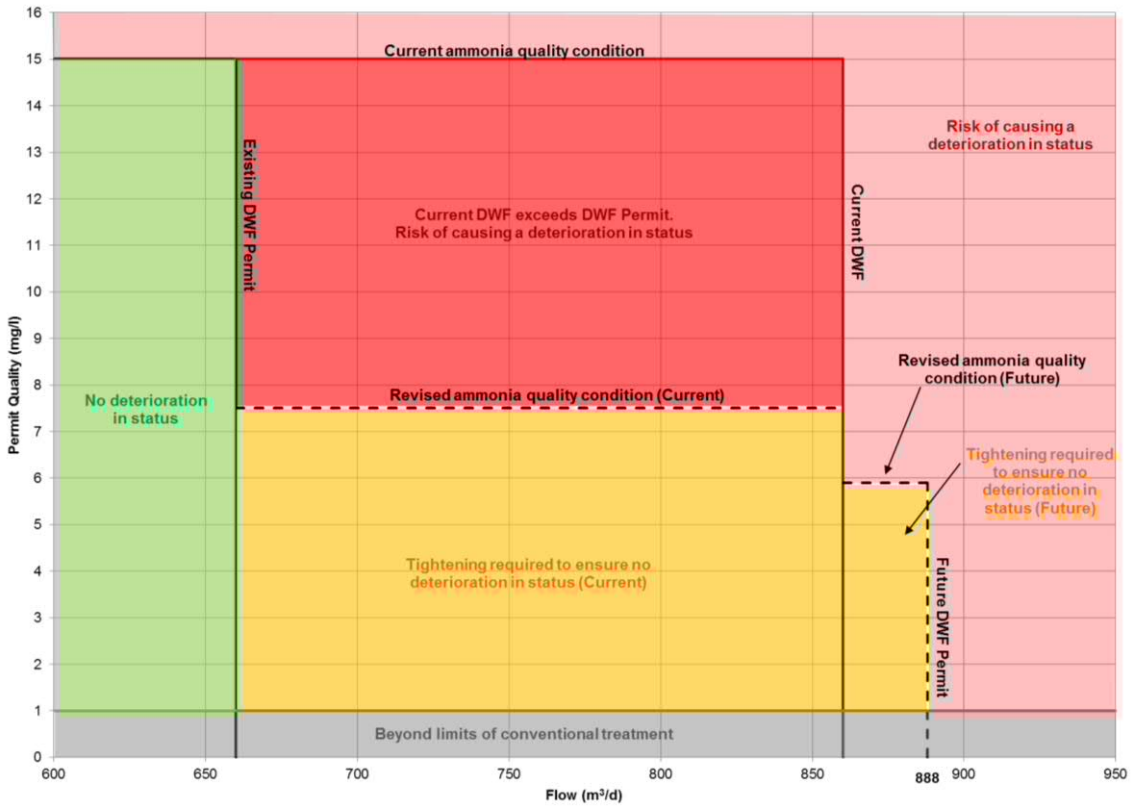
Unless funding has already been allocated to upgrade White Notley WRC in the current AMP6 asset planning period (2015 – 2020), the exact technical specification of the upgrades required should be determined by AWS for the AMP7 (2020 – 2025) asset planning period, in line with revised quality conditions for ammonia, BOD and phosphate.

The permit quality conditions required now[19] (current) and after growth (future) detailed in Table 13, and illustrated in Figure 18 and Figure 19, will be required to ensure deterioration is either limited to 10% of current water quality, or as a minimum ensure no deterioration in status. To achieve these tighter permit conditions, current conventional treatment technologies would be sufficient (i.e. the quality conditions are within the limits of conventional treatment) but would need to be implemented by AWS now or at some point in the future.

Figure 18. White Notley WRC ammonia permit condition tightening required



[19] Based on the current maximum DWF permit of 660m^3/d at the WRC

Figure 19. White Notley WRC phosphate permit condition tightening required

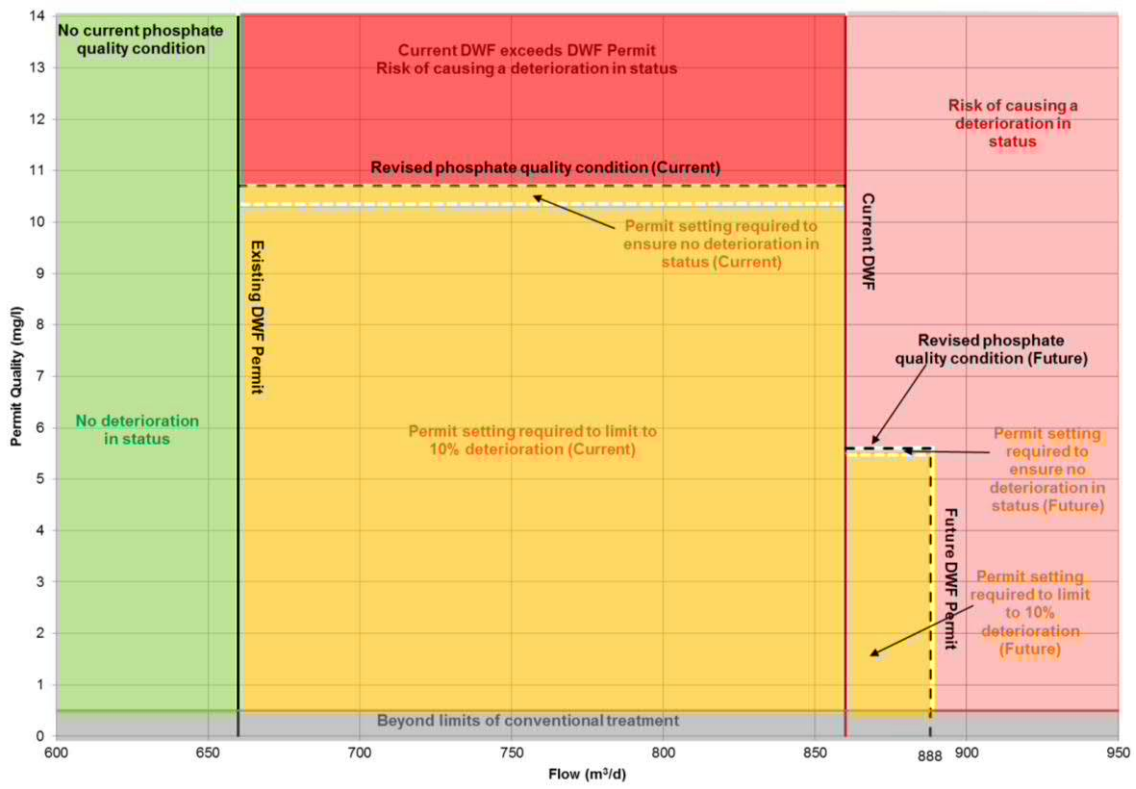


Table 13. Required permit quality conditions for White Notley WRC by the end of the plan period

Water Quality Parameter	Current permit quality condition	Future permit quality condition required to…		
		Limit to 10% deterioration + Ensure no deterioration in status	Ensure no deterioration in status only	Achieve future target status
BOD (mg/l 95%ile)	15	Current: 11.5 Future: 11.1		N/A
Ammonia (mg/l 95%ile)	15	N/A	Current: 7.5 Future: 5.8	N/A
Phosphate (mg/l annual average)	None	Current: 5.6 Future: 5.5	Current: 10.7 Future: 10.3	N/A

4.7.4.5 Phasing of Upgrades

Information provided by AWS confirms that the WRC currently has limited hydraulic capacity, and calculations as part of the WCS also demonstrate this. The onus is on AWS to maintain standards set within the WRC discharge permit; however until a new discharge permit is applied for and subsequently granted by the Environment Agency, rigorous water quality monitoring will be required in order to ensure WFD objectives are not compromised. Communication from Braintree District Council to AWS will be important to confirm which sites are due to come forward for development and the quantum of development proposed. It is recommended that until committed upgrades are implemented, 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, potential developers contact AWS as early as possible to confirm flow rates and intended connection points (via AWS pre-planning enquiry) to demonstrate that there is

either sufficient headroom or viable interim treatment solutions (such as tankering) until a permanent treatment solution is put in place.

Housing trajectory information provided by Braintree District Council to inform this WCS indicates that no development is planned within the WRC catchment until 2022.

AWS are currently preparing for Asset Management Plan 7 (AMP7) which will outline their investment programme from April 2020 to 2025. AWS's approach to wastewater treatment asset management requires that sufficient certainty is given that the quantum of development proposed will come forward during the plan period before improvements to WRC assets can be justified and funding sought.

Information provided in this WCS represents the first stage in providing the most up to date information for development coming forward in the plan period, and can be used by AWS to inform their investment programme (AMP7) to ensure the provision of additional capacity is planned and development is not delayed. Once funding has been confirmed, there will be a lead-in time for the necessary upgrades to be completed. It is considered there is sufficient time before development comes forward within the WRC catchment for AWS to plan their investment and to deliver the necessary upgrades.

4.7.4.6 Overall RAG Assessment

White Notley WRC

The development in the White Notley WRC catchment is given an Amber status based on the following requirements:

- revised quality conditions on the new permit for BOD and ammonia,
- a new phosphate quality condition for the new permit, and
- likely process upgrades at the WRC to achieve the revised quality conditions.

If theThe above requirements are met, it would ensure the current discharge does not compromise the WFD objective of no deterioration in status and that growth would not exacerbate the current situation. Although the revised quality conditions could be achieved with current conventional treatment technologies, the requirements listed above are needed now. Funding for the upgrades is required now and during this AMP period. If no funding has been confirmed for this AMP period, there is considered to be sufficient time before development in 2022 for the above requirements to be funded and implemented prior to development.

4.8 Ecological Appraisal

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

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

- Joint Nature Conservation Committee (JNCC);
- Natural England (NE); and
- Braintree District Council.

For non-statutory wildlife sites, it is common for them to lack specific citations which can create difficulty in identify the specific interest features. Where no citation is available and only a site name exists, an online search was undertaken to determine the key habitats present. If the online search did not identify habitats present then the precautionary principal has been used. Where it was not possible to determine if a site was hydrologically linked to the watercourse (i.e. merely in close proximity), the site was included in the discussion of the assessment as a precaution.

Following this process, ten statutory and five non-statutory designated sites have been identified as being hydrologically connected to WRCs that are unable to meet expected development needs during the Plan period without a change to their discharge permits. These WRCs are: Bocking, Braintree, Coggeshall, and White Notley. The designated sites connected to these WRCs (even if just located adjacent to the watercourse but not confirmed to be hydrologically dependent upon it) are (listed alphabetically):

- Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone (MCZ),
- Blackwater Estuary (Mid Essex Coast Phase 4) Special Protected Area (SPA)/ Ramsar site,
- Blackwater Estuary Site of Special Scientific Interest (SSSI),
- Blackwater Plantation West Local Wildlife Site (LWS),
- Blackwater Plantation LWS,
- Brockwell Meadows Local Nature Reserve (LNR),
- Bocking Blackwater LNR,
- Coggeshall Hall Farm LWS,
- Essex Estuaries Special Area of Conservation (SAC),
- Orwell Estuary SSSI,
- Outer Thames Estuary SPA (and pSPA Extension),
- Riverview Meadows LWS,
- Whet Mead LNR, and
- Witham Marsh LWS.

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

A large new garden community has been proposed to the west of Braintree during the Plan period, which may require a new WRC within the Braintree district. It is probable that the new WRC will be located at one of the following three broad locations which have been identified as: ‘To the East, Pods Brook (River Brain)’, ‘To the South, River Ter’ and ‘To the West, Stebbing Brook’. However, it is expected that the treated effluent from the new proposed location will be pumped to Bocking WRC where it will be discharged directly into the River Blackwater. This has been accounted for in the water quality analysis for Bocking WRC in the next sections. No further analysis is required of the impacts of these three potential locations for a new WRC as no new discharge location is required at these sites and the potential locations are currently too broad to assess impacts of physical construction work.

4.8.1 Impact on Designated Sites

Table 14 identifies the four WRCs that do not have sufficient headroom to accommodate the proposed increase in development within their catchments. As such, they would exceed their maximum permitted DWF under their existing discharge permits. These WRCs are:

- Bocking WRC,
- Braintree WRC,
- Coggeshall WRC, and

- White Notley WRC.

The location of these is illustrated in Appendix E and Table 14 lists the wildlife sites that contain linking pathways to each relevant WRC.

Table 14: Wildlife Sites that contain linking pathways to each relevant WRC

WRC	Wildlife Site	Comments
Bocking (discharges into the River Blackwater; flows into the River Chelmer)	Bocking Blackwater LNR	Receiving watercourse
	Blackwater Plantation West Local Wildlife Site (LWS)	4.54km downstream of the River Blackwater
	Blackwater Plantation LWS	7.23km downstream of the River Blackwater
	Coggeshall Hall Farm LWS	12.60 km downstream of the River Blackwater
	Brockwell Meadows LNR	17.30km downstream of the River Blackwater
	Whet Mead LNR	24.46km downstream of the River Blackwater
	Blackwater, Crouch, Roach and Colne Estuaries MCZ	32.36km on the River Chalmer
	Blackwater Estuary (Mid Essex Coast Phase 4) SPA/ Ramsar, Essex Estuaries SAC, and Blackwater Estuary SSSI	35.04km on the River Chalmer
Braintree (discharges into the River Brain; flows into River Blackwater and River Chelmer)	Witham Marsh LWS	9.24km downstream of the River Brain
	Riverview Meadows LWS	12.12km downstream of the River Brain
	Whet Mead LNR	13.21km downstream of the River Brain
	Blackwater, Crouch, Roach and Colne Estuaries MCZ	21.11km on the River Chalmer
	Blackwater Estuary (Mid Essex Coast Phase 4) SPA/ Ramsar, Essex Estuaries SAC, and Blackwater Estuary SSSI	23.79km on the River Chalmer
Coggeshall (discharges into River Blackwater and the River Chelmer)	Coggeshall Hall Farm LWS	Adjacent to Coggeshall WRC on the River Blackwater
	Brockwell Meadows LNR	4.7km downstream of the River Blackwater
	Whet Mead LNR	11.86km downstream of the River Blackwater
	Blackwater, Crouch, Roach and Colne Estuaries MCZ	19.76km on the River Chalmer
	Blackwater Estuary (Mid Essex Coast Phase 4) SPA/ Ramsar, Essex Estuaries SAC, and Blackwater Estuary SSSI	22.44km on the River Chalmer
White Notley (discharges into River Brain ;flows into the River Blackwater and River Chelmer)	Witham Marsh LWS	3.49km downstream of the River Brain
	Riverview Meadows LWS	6.37km downstream of the River Brain
	Whet Mead LNR	7.46km downstream of the River Brain
	Blackwater, Crouch, Roach and Colne Estuaries MCZ	15.36km on the River Chalmer
	Blackwater Estuary (Mid Essex Coast Phase 4) SPA/ Ramsar, Essex Estuaries SAC, and Blackwater Estuary SSSI	18.04km on the River Chalmer

The internationally important wildlife sites that are geographically close to this part of the District include; Blackwater, Crouch, Roach and Colne Estuaries MCZ, the Blackwater Estuary (Mid Essex Coast Phase 4) SPA/

Ramsar, and Essex Estuaries SAC. Each of these internationally designated sites receives surface water from all the watercourses detailed in Table 1. Subsequently, these WRCs could provide effects upon wildlife sites hydrologically connected to watercourses downstream of discharge locations.

Each relevant WRC is discussed further below.

4.8.1.1 Bocking WRC

This WRC discharges into the River Blackwater and Bocking Blackwater Local Nature Reserve (LNR). After 4.5 km the River Blackwater flows past Blackwater Plantation West Local Wildlife Site (LWS), and after 7.2 km past Blackwater Plantation LWS. As LWS citations are not available for these sites, it is unclear if these plantations are flooded by the River Blackwater. However, it is unlikely that plantations are hydrologically dependant on the river. Between 10 km and 20 km downstream from the discharge point the River Blackwater flows past Coggeshall Hall Farm LWS and Brockwell Meadows LNR. The LWS contains marshy willow plantations that supports scarce flora, whilst the LNR is partially designated for water meadows. In freshwater environments phosphates are a growth-limiting nutrient. Nitrogen (from nitrification of ammonia) is also a growth-limiting nutrient. However, due to the considerable distances involved, the nutrients in waste water discharge are likely to have been substantially diluted. After 24 km the River Blackwater flows past Whet Mead LNR partially designated for wet grassland and lagoons. Beyond this the River Blackwater flows into the River Chelmer. More than 30 km downstream from the discharge point the discharged water flows into the estuarine Blackwater, Crouch, Roach and Colne Estuaries MCZ, and Blackwater Estuary (Mid Essex Coast Phase 4) SPA/ Ramsar, Essex Estuaries SAC, and Blackwater Estuary SSSI.

Due to the estuarine conditions and tidal processes, water conditions are essentially cold and relatively turbid with high levels of water movement and wave action. As such, inflows into the estuarine sites are constantly changing and water is flushed away from the area dispersing any waste water and associated sedimentation, phosphates, ammonia and Biochemical Oxygen Demand (BOD). In addition, the conditions described above tend to result in the various Essex estuaries being less susceptible to excessive macro-algal summer growth and winter persistence (and thus smothering of underlying sediments) than the estuaries in the warner, clearer, calmer waters of the south coast such as the Solent estuaries, notwithstanding their generally hyper-nutrified status. This is supported by the analyses contained in several of the Environment Agency's Stage 3 Review of Consents reports for these estuaries. As such, the features for which these sites are designated (see Appendix E) are likely to be affected by wastewater discharge to a much smaller extent than other estuarine sites, particularly at distances of more than 30km, with consequent extensive dilution. However, evidence suggests[20] that the River Blackwater has history of failing its inorganic dissolved nitrogen limits. The increase in inorganic dissolved nitrogen has potential to affect the oyster populations for which the MCZ is designated, and as such the Blackwater has been set an improvement target to help address this issue. It is noted that the MCZ is located more than 30 km distant from the discharge point, so nitrogen associated with waste water discharge is likely to have been significantly diluted. However, cumulative effects from multiple sources could affect the ability of the MCZ to achieve its target for inorganic nitrogen.

Presently, Bocking WRC is within its DWF discharge permit. Modelling has identified that planned development within the WRC catchment will result in an exceedance of permitted effluent discharge volume and quality. Biochemical Oxygen Demand (BOD), ammonia and phosphate levels are all forecast to be in excess of current permitted levels as a result of new growth by the end of the Plan period. Growth will cause the current permitted DWF to be exceeded by 21%.

At present this WRC has a Water Framework Directive (WFD) No Deterioration Target of 'High' for BOD', 'High' for ammonia and 'Poor' for phosphate. It is technically feasible to achieve no more than 10% deterioration in current ammonia and phosphate concentrations downstream of the discharge point with the proposed future growth. As such, the current targets could still be met and there would be no significant negative effect from the future growth compared to the current situation.

With reference to the general water quality of inorganic dissolved nitrogen in the Blackwater Estuary downstream; the deterioration in ammonia concentrations in upstream waterbodies (between 10% and the status threshold) should be taken into account when a decision is to be made on a revised ammonia quality condition for Bocking WRC.

[20] https://www.gov.uk/government/publications/anglian-district-river-basin-management-plan [accessed 20/12/2016]

For ammonia, BOD and phosphate, permit tightening will be required to ensure that permitted discharge quality thresholds do not deteriorate significantly, but this is considered to be possible within the limits of Best Available Technology.

4.8.1.2 Braintree WRC

The WRC discharges into the River Brain and 9.2 km downstream the discharged water flows into Witham Marsh Local Wildlife Site (LWS). In the absence of a citation for this site it is assumed that the marsh is flooded by the River Brain. In freshwater environments phosphates are a growth-limiting nutrient. Increases in phosphate levels in freshwater environments can result in the death of aquatic plants and animals via the process of eutrophication. In addition nitrogen (from nitrification of ammonia) is another growth-limiting nutrient. Elevated levels of nitrogen can result in increased plant growth of those plant species that can readily take advantage of increased levels of nitrogen, outcompeting less competitive plant species, thus potentially altering the species composition of the site. In addition, ammonia is directly toxic to aquatic organisms.

More than 10 km downstream of the discharge point the River Brain passes the Riverside Meadows LWS. Whilst this site is flooded by the River Brain, due to the distances involved any nutrients associated with waste water discharge are likely to have been sufficiently diluted to not impact upon the designated features of theses wildlife sites. Beyond this the River flows past Whet Mead LNR and then into the River Chelmer where it flows into Blackwater, Crouch, Roach and Colne Estuaries MCZ and Blackwater Estuary (Mid Essex Coast Phase 4) SPA/ Ramsar, Essex Estuaries SAC, and Blackwater Estuary SSSI. Due to the considerable distances involved and the estuarine nature of these sites (as explained with regards to Bocking WRC) their interest features are likely to be affected by wastewater discharge to a much smaller extent than other estuarine sites, particularly at distances of more than 30km, with consequent extensive dilution. However, cumulative effects from multiple sources could affect the ability of the MCZ to achieve its target for inorganic nitrogen, as discussed for Bocking WRC.

Presently Braintree WRC is within its DWF discharge permit. Modelling has identified that planned development within the WRC catchment will result in an exceedance of the effluent discharge volume and quality required. BOD and phosphate levels will be in excess of those permitted. By the end of the Plan period, new growth will cause the permitted DWF to be exceeded by 14%. Planned development within the WRC will not result in levels of ammonia increasing beyond their permitted discharge concentrations and as such are not discussed further, with the exception of with regards to the MCZ.

Currently this WRC has a WFD No Deterioration Target of ‘High’ for BOD, ‘Good’ for ammonia and ‘Poor’ for phosphate. It is technically possible to achieve no more than 10% deterioration in current phosphate concentrations and no more than 5% deterioration in ammonia downstream of the discharge point with the proposed future growth, thus ensuring no deterioration in WFD status. . As such, the current targets could still be met and there would be no significant negative effect from the future growth compared to the current situation.

With reference to the general water quality of inorganic dissolved nitrogen in the Blackwater Estuary downstream; the deterioration in ammonia concentrations in upstream waterbodies (between 10% and the status threshold) should be taken into account when a decision is to be made on a revised ammonia quality condition for Braintree WRC. . Therefore, it is concluded that further restriction of ammonia discharges from this WRC has not been identified as being essential to help the MCZ achieve its target status.

To ensure that the planned level of development within the Plan period does not result in a negative impact upon designated features or riverine habitats as a result if the above discussed changes in water quality, it is recommended that Policy is included within the Plan to ensure that the delivery of housing is kept in step with the delivery of new wastewater treatment infrastructure and processes. For ammonia, BOD and phosphate, permit tightening will be required to ensure that permitted discharge quality thresholds do not deteriorate significantly, but this is considered to be possible within the limits of Best Available Technology.

4.8.1.3 Coggeshall WRC

This WRC discharges into the River Blackwater immediately opposite Coggeshall Hall Farm LWS which contains marshy willow plantations that supports scarce flora including Blue Waterspeedwell (Veronica anagallis-aquatica), Pink Water-speedwell (Veronica catenata), Marsh Marigold (Caltha palustris) and Meadowsweet (Filipendula ulmaria). For the freshwater environments such as those associated with this site, phosphates are a growth-limiting nutrient. Increases in phosphate levels in freshwater environments can result in the death of aquatic plants and animals via the process of eutrophication. In addition nitrogen (from nitrification of ammonia) is another growth-limiting nutrient. Elevated levels of nitrogen can result in increased plant growth of those plant

species that can readily take advantage of increased levels of nitrogen, outcompeting less competitive plant species, thus potentially altering the species composition of the site. 4.7 km downstream of the discharge point the River Blackwater flows past Brockwell Meadows LNR which is partially designated for water meadows. Similar to Coggeshall Hall Farm LWS this site has potential to be vulnerable to changes in both phosphate and nitrogen from nitrification of ammonia. 11.9 km downstream of the discharge point the River Blackwater flows past Whet Mead LNR. Similar to the above two wildlife sites, this site has potential to be vulnerable to changes in phosphate and ammonia levels. However, due to the considerable distance involved nutrients associated with waste water discharge from this WRC are likely to have been substantially diluted.

Beyond this the River Blackwater enters the River Chelmer and ultimately into Blackwater, Crouch, Roach and Colne Estuaries MCZ and Blackwater Estuary (Mid Essex Coast Phase 4) SPA/ Ramsar, Essex Estuaries SAC, and Blackwater Estuary SSSI. Due to the considerable distances involved and the estuarine nature of these sites (as explained with regards to Bocking WRC) their interest features are likely to be affected by wastewater discharge to a much smaller extent than other estuarine sites, particularly at distances of more than 30km, with consequent extensive dilution. However, cumulative effects from multiple sources could affect the ability of the MCZ to achieve its target for inorganic nitrogen, as discussed for Bocking WRC.

Currently Coggeshall WRC is within its DWF discharge permit. Modelling has identified that planned development within the WRC catchment will result in an exceedance of the effluent discharge volume and quality required. BOD, ammonia, and phosphate levels will be in excess of those permitted. By the end of the Plan period, new growth will cause the permitted DWF to be exceeded by 25%.

At present this WRC has a WFD No Deterioration Target of ‘High’ for BOD, ‘Good’ for ammonia and ‘Poor’ for phosphate. For phosphate it is not technically possible using current conventional treatment technology to achieve a 20% no deterioration target. For ammonia it is technically possible to achieve no more than 10% deterioration in current ammonia even with the proposed future growth, thus ensuring no deterioration in WFD status. status As such, the current targets could still be met and there would be no significant negative effect from the future growth compared to the current situation.

With reference to the general water quality of inorganic dissolved nitrogen in the Blackwater Estuary downstream; the deterioration in ammonia concentrations in upstream waterbodies (between 10% and the status threshold) should be taken into account when a decision is to be made on a revised ammonia quality condition for Coggeshall WRC.

For ammonia, BOD and phosphate, permit tightening will be required to ensure that permitted discharge quality thresholds do not deteriorate significantly, but this is considered to be possible within the limits of Best Available Technology. It is concluded that further restriction of ammonia discharges from this WRC has not been identified as being essential to help the MCZ achieve its target status.

4.8.1.4 White Notley WRC

The WRC discharges into the River Brain. 3.5 km downstream the discharged water flows past Witham Marsh LWS. For the freshwater environments such as those associated with this site, phosphates are a growth-limiting nutrient. Increases in phosphate levels in freshwater environments can result in the death of aquatic plants and animals via the process of eutrophication. In addition nitrogen (from nitrification of ammonia) is also a growth-limiting nutrient. Elevated levels of nitrogen can result in increased plant growth of those plant species that can readily take advantage of increased levels of nitrogen, outcompeting less competitive plant species, thus potentially altering the species composition of the site. 6.4 km downstream of the discharge point the River Brain passes Riverside Meadows LWS, and 7.5 km downstream of the discharge point, the River Brain passes Whet Mead LNR. These sites are both likely to receive flood water from the River Brain so are vulnerable to changes in both levels of phosphate and ammonia (nitrogen) as detailed for the Witham Marshes LWS. The River Brain flows into the River Chelmer, which more than 15 km downstream from the discharge point flows into the Blackwater, Crouch, Roach and Colne Estuaries MCZ, Blackwater Estuary (Mid Essex Coast Phase 4) SPA/ Ramsar, Essex Estuaries SAC, and Blackwater Estuary SSSI. Due to the considerable distances involved and the estuarine nature of these sites (as explained with regards to Bocking WRC) their interest features are likely to be affected by wastewater discharge to a much smaller extent than other estuarine sites, particularly at distances of more than 30km, with consequent extensive dilution. However, cumulative effects from multiple sources could affect the ability of the MCZ to achieve its target for inorganic nitrogen, as discussed for Bocking WRC.

At present, White Notley WRC is exceeding its DWF permit (before growth) by 30%. Modelling has identified that planned development within the WRC catchment will result in a further 5% exceedance of the effluent discharge

volume and quality required (i.e. a total exceedance of 35%). As discharge volumes are already in exceedance of those permitted, new growth during the Plan period will not result in the WFD targets being failed as they are already being failed.

At present this WRC has a WFD No Deterioration Target of 'High' for BOD, 'Good' for ammonia and 'Poor' for phosphate. It is technically possible to achieve no more than 10% deterioration in current phosphate quality downstream of the discharge point with the proposed future growth, thus ensuring no deterioration in actual WFD status. However, it is not technically possible to achieve no more than 10% deterioration in current ammonia levels downstream of the discharge point with future proposed growth. Following a Status Deterioration Test it was concluded that whist the 10% no deterioration target will not be met, it is technically possible to ensure no deterioration in ammonia 'status' with the proposed future growth. While it is technically possible to achieve no deterioration in ammonia WFD status, the fact that ammonia concentrations from this WRC will deteriorate by more than 10% may result in some negative effects on the ecology of the receiving watercourse. In addition, with reference to the general improvement target for inorganic dissolve nitrogen in the Blackwater Estuary, the deterioration in ammonia concentrations will not help to achieve this overall target.

To ensure that the level of development within the Plan period does not result in a negative impact upon designated features or riverine habitats it is recommended that Policy is included within the Plan to ensure that the delivery of housing is kept in step with the delivery of new wastewater treatment infrastructure and processes.

For ammonia levels, the predicted deterioration when the new development in the catchment is factored into consideration exceeds 10%, even though the actual current WFD status (Good) can still be maintained with the delivery of improved treatment processes. A view would need to be taken with the Environment Agency as to whether this deterioration is considered acceptable.

4.8.2 Impacts on Ecology outside Designated Sites

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

In addition to impacts on designated sites, a range of other UK or Essex BAP species or otherwise protected/notable species that are found in Essex 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 bittern, kingfisher (protected through Wildlife & Countryside Act 1981 and a UK BAP species), lapwing and snipe, and
- Otter (legally protected through Conservation of Habitats & Species Regulations 2010, Wildlife & Countryside Act 1981 and a UK/ Essex BAP species).

Similarly important habitats (all listed in the Essex BAP) include:

- Floodplain and coastal grazing marsh,
- Reedbeds,
- Coastal saltmarsh, and
- Rivers & streams.

All of these habitats and species are present (or possibly present) in the District.

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 WCS 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.

The assessment in the previous section of designated wildlife sites identified that the majority of wildlife sites assessed that were close enough to the WRC discharge points to be vulnerable to changes in discharge volumes are freshwater and terrestrial features, and thus limited by phosphate and ammonia (nitrogen via nitrification of ammonia) levels. Phosphates are the primary limiting compound in freshwater systems; where levels are high it can lead to the death of aquatic plants and animals via the process of eutrophication. The impacts of ammonia on freshwater systems can result in death of plants and animals. In terrestrial habitats the primary limiting compound is nitrogen (from nitrified ammonia) which can result in less competitive plant species being out competed by plant species that are more able to assimilate nitrogen for growth.

Levels of development identified during the Plan period have potential (albeit probably only cumulatively with the existing exceedances) to have an adverse effect on wildlife of the receiving saline habitats and watercourses downstream and avoidance measures will be required as already outlined.

4.8.3 Ecological Opportunities Associated with Proposed Development Locations

To ensure that the planned level of development within the Plan period does not result in a negative impact upon wildlife both inside and outside of designated sites, it is recommended that policy is included within the Local Plan to ensure that these matters are addressed at a strategic level and water quality at these locations will be improved to suitable WFD levels and permit levels. This may include the requirement for new infrastructure to be in place prior to the delivery of new development or the need for phased infrastructure to ensure that the WRCs can accommodate the increased capacity and not result in a detrimental impact upon wildlife features.

Further to recommended policy, it is also recommended that where ecological risks resulting from proposed water cycle changes have been identified, these are considered within the relevant flood risk and surface water management proposals. These opportunities and the reduction of identified risks can be incorporated into the detailed design of the developments and local green infrastructure plans.

The analysis also indicates that particular caution is required when allocating housing to the White Notley WRC catchment on the basis that it is already in exceedance of permit and has sensitive sites and species close to the discharge, particularly if a change to existing discharge permit parameters would be required.

4.9 Wastewater Summary

WRCs which are shown to exceed their volumetric permits have undergone water quality modelling (Bocking, Braintree, Coggeshall and White Notley). The results demonstrate that there is environmental capacity for the proposed options for growth as long as permit changes and any required process upgrades are undertaken.

Therefore, from a WFD perspective there is capacity to accept growth and comply with current WFD targets based on the limits achievable with current technology. However, environmental capacity should be considered to be ultimately limited on the basis that limitations on current treatment technologies are preventing the optimal target of future good status from being achieved. The capability and performance of treatment technologies are likely to improve over time, and hence capacity for additional wastewater flow would need to be reconsidered in the context of achieving good status up to the end of the plan period and beyond.

Table 15 provides a summary of the RAG assessment of the WRCs within the District which have been assessed as not having sufficient headroom to accommodate growth.

Table 15. Wastewater treatment works assessment summary

WRC	Watercourse	WFD ID	Is Headroom available for anticipated growth?	Is a revised quality condition required?		Technically feasible?	Overall RAG
Bocking	River Blackwater	GB105037041160	Headroom only up to 2,570 dwellings	Ammonia	Yes	Yes	Upgrades and revised quality conditions required by 2026. Permit setting recommended for phosphate.
				BOD	Yes		
				Phosphate	Yes		
Braintree	River Brain	GB105037041140	Headroom only up to 1,840 dwellings	Ammonia	No	N/A	Upgrades and revised quality conditions required by 2024. Permit setting recommended for phosphate.
				BOD	Yes	Yes	
				Phosphate	Yes	Yes	
Coggeshall	River Blackwater	GB105037041160	Headroom only up to 100 dwellings	Ammonia	Yes	Yes	Upgrades and revised quality conditions required by 2019. Permit setting recommended for phosphate.
				BOD	Yes	Yes	
				Phosphate	Yes	Yes (status deterioration only)	
White Notley	River Brain	GB105037041140	No headroom currently available for anticipated growth	Ammonia	Yes	Yes (status deterioration only)	No headroom capacity. Current flow exceeds DWF permit – new DWF permit required. Upgrades and revised quality conditions required now. Permit setting recommended for phosphate.
				BOD	Yes	Yes	
				Phosphate	Yes	Yes	

5. Water Supply Strategy

5.1 Introduction

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

This study has also used AWSs 2015 WRMP[21] and Essex and Suffolk Water (ESW) 2015 WRMP[22] to determine available water supply against predicted demand and has considered how water efficiency can be further promoted and delivered for new homes beyond that which is planned for delivery in AWS's and ESW's WRMP.

5.2 Abstraction Licensing Strategies

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

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

The categories of resource availability status are shown in Table 16. The classification is based on an assessment of a river system's ecological sensitivity to abstraction-related flow reduction. This classification can then be used to assess the potential for additional water resource abstractions.

Table 16. Water resource availability status categories

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

The classification for each of the Water Resource Management Units (WRMU) in the District has been summarised for surface waterbodies in Table 17.

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

[22] Essex and Suffolk Water Final Water Resource Management Plan (2015) https://www.eswater.co.uk/_assets/documents/ESW_Final_Published_PR14_WRMP_Report_-_V3_-_08OCT14.pdf

Table 17. Resource availability classification

River – WRMU	Surface Water (flow exceedance scenarios)			
	Q30	Q50	Q70	Q95
AP1 River Stour at Wixoe				
AP8 River Colne/Bourn Brook				
AP15 River Brain at confluence with Blackwater				

All rivers are defined as having no water available for licencing during periods of average to low flow (Q50-Q95). One site has restricted water available for licencing during periods of higher flow (Q30). This analysis indicates that there is limited potential for local abstraction to support major site development at a local level and therefore, reliance on strategic water resource management and movement of water into the area is required to sustain growth and demand for potable water.

5.3 Water Resource Planning

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

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

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

5.4 Water Resource Planning in the District

In reviewing AWS's Final 2015 WRMP and through liaison with AWS it has been established that the growth figures assessed for this WCS study are catered for in the 2040 prediction of supply and demand deficits in the relevant WRZs under average conditions.

For the small portion of housing projections predicted to be serviced by ESW (approximately 319) and through a review of ESWs WRMP it is considered these have been adequately accounted for within the ESW WRMP. Therefore, conclusions on available water supply from AWS's and ESW's Final 2015 WRMP have been used directly in this study to inform and support the Local Plan.

5.5 Demand for Water

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

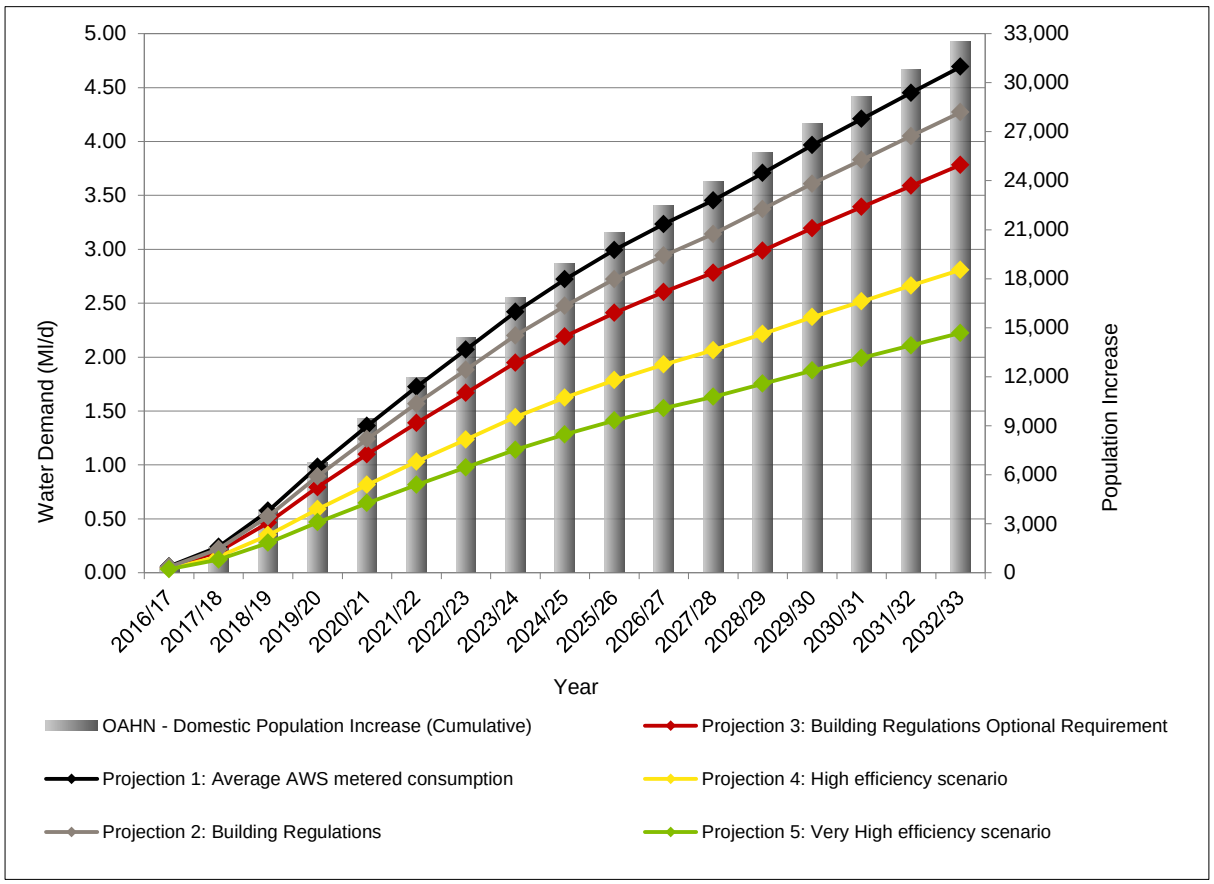
The projections were derived as follows:

- **Projection 1** – Average AWS metered consumption – New homes would use 138 l/h/d, this reflects the planning consumption used by AWS to maintain security of supply;
- **Projection 2** – Low Scenario (Building Regulations) – New homes would conform to (and not use more than) Part G of the Building Regulations requirement of 125 l/h/d;

- **Projection 3** – Medium Scenario (Building Regulations Optional Requirement) - Only applies where a condition that the new home should meet the optional requirement is imposed as part of the process of granting planning permission. Where it applies, new homes would conform to (and not use more than) Part G of the Building Regulations optional requirement of 110 l/h/d;
- **Projection 4** – High Efficiency Scenario – New homes would achieve 80 l/h/d (to reflect the now superseded Code for Sustainable Homes Level of 5 or 6); and,
- **Projection 5** – Very High Efficiency Scenario – New homes would include both greywater recycling and rainwater harvesting reducing water use to a minimum of 62 l/h/d.

Using these projections, the increase in demand for water could range between 2.22 and 4.69 Ml/d by 2033. The projections are shown in Figure 20.

Figure 20. Range of water demands across plan period in Braintree depending on efficiency levels of new homes



5.6 Planned Water Availability Summary

The final 2015 WRMPs for AWS and ESW has have been used to summarise water availability to meet the projected demand for the Braintree study area covering the planning period to 2040.

The Braintree District is located in two different AWS WRZs and one ESW WRZ. These are Central Essex and South Essex (AWS) and Essex (ESW).

5.6.1 South Essex Water Resource Zone (AWS)

The AWS South Essex WRZ is supplied using water obtained from groundwater and surface water from the Chalk Aquifer and River Colne.

The South Essex WRZ is predicted to have a baseline supply-demand surplus of 1.25Ml/d (during the Dry Year Annual Average) by the end of AMP9 (2034/35) and a deficit of 1.02 Ml/d by 2040. A surplus of 10.38 Ml/d exists during peak conditions by 2040 for the South Essex WRZ.

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Supply-Demand Strategy

The WRMP has considered one or more of the following schemes for South Essex WRZ:

- SE1 Colchester water reuse - Effluent from Colchester WRC would be treated to an extremely high (near potable) standard and discharged to the River Colne to supplement river flows and permit increased abstraction. A new pipeline and pumping station would be required to convey the water to the water treatment works which would require additional treatment capacity;
- SE2 East Suffolk WRZ transfer (12Ml/d) - This option provides for the transfer of 12Ml/d of water from Ipswich in the East Suffolk WRZ to Colchester via a new 22km long pipeline;
- SE4 Amendment to Ardleigh agreement - Resources in the Colchester area are shared with Affinity Water. This option would increase the Anglian Water share of the available resource;
- SE6 South Essex WRZ groundwater development - This option provides for the utilisation of an existing licenced borehole in the Colchester area. New treatment facilities would be required;
- SE7 Ardleigh reservoir extension - An extension to an existing reservoir utilising disused mineral abstraction pits to provide additional storage. Additional treatment capacity and transfer pipelines would also be required; and
- SE8 East Suffolk WRZ transfer (2Ml/d) - This option is similar to option SE2 above but requires a smaller pipeline.

SE2 and SE8 utilise the surplus apparent within the East Suffolk WRZ during the beginning of the forecasting period. However, once these resources become depleted, further resources will be required to supply the transfer, as described within Anglian WRMP within the East Suffolk WRZ summary.

AWS have identified their preferred plan for the South Essex WRZ as outlined in Table 18.

Table 18. South Essex WRZ – Preferred Plan

Scheme Type	AMP6 (2015-20)	AMP7 (2020-25)	AMP8 (2025-30)	AMP9 (2030-35)
Resources side	-	-	-	SE4 – Amendment to Ardleigh Agreement
Distribution side	Transfers out of South Essex RZ to support Central Essex RZ and East Suffolk RZ: • CE1 – South Essex RZ transfer to Central Essex RZ • ES10 – South Essex RZ transfer to East Suffolk RZ.	-	-	-
Customer (Demand) side	Water efficiency plan (Section 4.3.2): • Approx. 9,000 water efficiency audits • Estimated 4,000 customers will opt onto metered billing • Leakage reduction	-	-	-

The preferred plan assumes:

- Continuation of the current 70/30 arrangement with Affinity Water to trade the resources of Ardleigh reservoir;
- The availability of an option to trade 80/20 with Affinity Water in AMP9; and
- That the deployable output of the Ardleigh WTW can be maintained at the 36Ml/d currently assumed.

5.6.2 Central Essex Water Resource Zone (AWS)

The water resource for the Central Essex WRZ is entirely dependent on abstraction from the Chalk Aquifer. AWS predict that by the end of AMP 9 (2034/35) there will be a baseline supply-demand deficit of 0.49Ml/d during the Dry Year Annual Average and a deficit of 0.86 Ml/d by 2040. No deficits exist during peak conditions with a surplus of 2.48 Ml/d by 2040.

Supply-Demand Strategy

AWS has identified a number of schemes that will benefit the Central Essex WRZ. The strategy includes:

- CE1 - South Essex RZ transfer - This option provides a transfer from South Essex RZ to Central Essex RZ requiring 12km of new pipeline with 2 new pumping stations, and
- CE2 - West Suffolk RZ transfer - A transfer from West Suffolk RZ to Central Essex RZ via a new 34km long pipeline and 3 new pumping stations.

AWS have identified their preferred plan for the Central Essex WRZ as outlined in Table 19.

Table 19. Central Essex WRZ – Preferred Plan

Scheme Type	AMP6 (2015-20)	AMP7 (2020-25)	AMP8 (2025-30)	AMP9 (2030-35)
Resources side	-	-	CE1 – South Essex transfer	-
Distribution side	To support CE1 – South Essex Transfer the upstream options selected: • SE4 – Amendment to Ardleigh Agreement	-	-	-
Customer (Demand) side	Water efficiency plan (Section 4.3.2): • Approx. 1,500 water efficiency audits • Estimated 2,000 customers will opt onto metered billing • Leakage reduction	-	-	-

The preferred plan assumes:

- Continuation of the current 70/30 arrangement with Affinity Water to trade the resources of Ardleigh reservoir;
- The availability of an option to trade 80/20 with Affinity Water in AMP9; and
- That the deployable output of the Ardleigh WTW can be maintained at the 36 Ml/d currently assumed.

5.6.3 Essex Water Resource Zone (ESW)

The ESW Essex WRZ is supplied using mainly surface water obtained from the Chelmer, Blackwater, Stour and Roman Rivers which support two pumped storage reservoirs. A small portion of groundwater is supplied via Chalk well and adit sources.

For the ESW Essex WRZ, it is predicted there to be a supply-demand surplus of 63.61Ml/d (during the Dry Year Annual Average) by the end of AMP9 (2034/35) and therefore no further schemes are required.

5.7 Water Efficiency Plan

As well as providing additional supply resource, it is important to ensure that the existing resources are used as efficiently as possible to reduce demand. AWS is planning a series of demand management measures and a number of improvements to existing infrastructure and resources. The majority of these measures will be

undertaken in AMP6 (2019-2020). Lowering water consumption levels is considered to be a priority in offsetting resource development.

Proposed demand management measures across both WRZs include:

- Completing water efficiency audits;
- Water metering (AWS expect 6,000 customers will opt in for metered billing in the South Essex and Central Essex WRZ); and,
- Leakage reduction;

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

5.8 Drivers and Justification for Water Efficiency

In 2013, the AWS and ESW supply areas were classified by the Environment Agency as an 'Area of serious water stress' based on a 'Water Exploitation Index' as derived by the European Environment Agency. Part of this classification is based on climate change effects as well as increases in demand driven by Local Plan growth targets. This creates a very strong driver for new homes in the next 25 years to be made as efficient as economically possible to safeguard the future resources to be made available by AWS and ESW in the District.

5.8.1 Managing Climate Change and Availability of Water

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

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

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

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

5.8.1.1 Impact on Supplies

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

The impact of a worst case climate change scenario on water resources over the plan period within the South Essex RZ and Central Essex RZ is estimated at a decrease of 3.6 Ml/d and 1.11Ml/d (respectively) by 2040.

The impact of a worst case climate change scenario on water resources over the plan period within the ESW Essex WRZ is estimated at an increase 4.16 Ml/d by 2040.

5.8.1.2 Impact on Demand

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

Although AWS and ESW have planned for the anticipated impacts of climate change, the view of AWS, ESW and other water companies is that, in order to manage the effects of climate change effectively, the single most cost effective step in water resources climate change resilience is to manage demand downwards. The reduction in

demand will also help to reduce carbon emissions which aids in reducing impacts of climate change. Planning policy has a significant role to play in helping to achieve this.

5.9 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[23]. 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:

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

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

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

5.9.1 Twin-Track Approach

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

In order to reduce water consumption and manage demand for the limited water resources within the District, a number of measures and devices are available[24]. Generally, these measures fall into two categories due to cost and space constraints, as those that should be installed in new developments and those which could be retrofitted. Appendix D provides more detail on the different types of device or system along with the range of efficiency savings they could lead to.

5.9.2 Achieving Total Neutrality – is it feasible?

When considering neutrality within an existing planning area, it is recognised by the Environment Agency[25] that achievement of total water neutrality (100%) for new development is often not possible, as the levels of water savings required in existing stock may not be possible for the level of growth proposed. A lower percentage of neutrality may therefore be a realistic target, for example 50% neutrality.

This WCS therefore considers four water neutrality targets and sets out a 'pathway' for how the most likely target (or level of neutrality) can be achieved. Appendix D discusses the pathway concept in more detail, and highlights

[23] Water Neutrality is defined more fully in the Environment Agency report 'Towards water neutrality in the Thames Gateway' (2007)
[24] Source: Water Efficiency in the South East of England, Environment Agency, April 2007.
[25] Environment Agency (2009) Water Neutrality, an improved and expanded water management definition

the importance of developing local policy in the study area for delivering aspirations like water neutrality as well as understanding the additional steps required beyond 'business as usual' required to achieve it.

5.9.3 Metering Assumptions

Installing water meters within existing residential properties is an important element of both water companies WRMPs to manage their customers' demand for water. Each of the water companies metering programmes as described in the WRMP has been applied to the four water neutrality scenarios (outlined in Section 4.9.4) and details the level of additional metering that could be undertaken.

The existing level of metering within the AWS WRZs is 82.4%. AWS's future target for meter penetration[26] on domestic water meters is 97.5% by 2040. As no projection has been made within the AWS WRMP for the end of the Local Plan period (2033), a linear projection has been set with a target of 92.7% meter penetration by 2033.

No projected metering data is available beyond 2020 within the ESW WRMP. Due to the small area of the District being serviced by ESW, it has been assumed for calculation purposes that metering penetration values specified by AWS are applied across the whole District.

5.9.4 Water Neutrality Scenarios

5.9.4.1 Very High Scenario

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

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

- Existing research into financial viability of such high levels of water efficiency measures in new homes; and
- Uptake of retrofitting water efficiency measures considered to be at the maximum achievable (24%) in the District.

It would require:

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

5.9.4.2 High Scenario

The key assumptions for this scenario are that a high water neutrality percentage[27] 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:

- Meter installation up to the maximum planned (up to 2040) as per AWS WRMP by 2033 (97.5% meter penetration);
- Uptake of retrofitting water efficiency measures to be very high (20%) in relation to studies undertaken across the UK into feasibility of retrofitting;

[26] proportion of properties within the AWS WRZ which have a water meter installed
[27] 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

- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required; and,
- All new development would need to include rainwater harvesting.

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

5.9.4.3 Medium Scenario

The key assumptions for this scenario are that the water neutrality percentage[27] achieved is at least 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 Local Plans in the UK.

It would require:

- Meter installation estimated as a linear projection between 2016 and 2040 AWS WRMP figures (92.7% meter penetration by 2033);
- New housing development should go beyond mandatory Building Regulations requirements, ideally to 110 l/h/d optional Building Regulations requirements;
- Uptake of retrofitting water efficiency measures to be reasonably high (15%) in the District; and
- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required.

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

5.9.4.4 Low Scenario

The key assumptions for this scenario are that the water neutrality percentage[27] 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.

It would require:

- Meter installation estimated as a linear projection between 2016 and 2040 AWS WRMP figures (92.7% meter penetration by 2033);
- New housing development should go beyond mandatory Building Regulations requirements, ideally to 110 l/h/d optional Building Regulations requirements;
- Uptake of retrofitting water efficiency measures to be fairly low (10%); and
- A relatively small funding pool and a partnership working not moving too far beyond 'business as usual' for stakeholders.

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

5.9.5 Neutrality Scenario Assessment Results

To achieve total water neutrality, the demand post growth must be the same as, or less than existing demand. Based on estimates of population size, current demand in the District was calculated to be 22.25 Ml/d.

For each neutrality option and neutrality scenario, an outline of the required water efficiency specification was developed for new houses, combined with an estimate of the savings that could be achieved through metering and further savings that could be achieved via retrofitting of water efficient fixtures and fittings in existing property. This has been undertaken utilising research undertaken by groups and organisations such as Waterwise,

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UKWIR[28], the Environment Agency and OFWAT to determine realistic and feasible efficiency savings as part of developer design of properties, and standards for non-residential properties (Appendix D).

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

- Stage 1 – total demand post growth without any assumed water efficiency retrofitting 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 provided in Table 20. If neutrality is achieved, the result is displayed as green. If it is not, but is within 5%, it is displayed as amber, and red if neutrality above the 5% threshold is not achieved. The percentage of total neutrality achieved per scenario is also provided.

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

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Table 20. Results of the Neutrality Scenario Assessments

Neutrality Scenario	New Homes demand projections	New homes consumption rate (l/h/d)	% of existing properties to be retrofitted	Demand from Growth (Ml/d)	Total demand post growth* (Ml/d)	Total demand after metering (Ml/d)	Total demand after metering & retrofitting (Ml/d)	% Neutrality Achieved
Baseline	Projection 1: Average metered consumption	138	0	4.69	26.95	**26.62**	**26.62**	7%
Low	Projection 2a: Building Regulations	125	0	4.27	26.52	**26.19**	**26.19**	16%
	Projection 2b:Building Regulations + retrofit	125	10	4.27	26.52	**26.19**	**25.95**	21%
Medium	Projection 3a: Building Regulations optional requirement	110	0	3.78	26.04	**25.71**	**25.71**	26%
	Projection 3b: Optional requirement + retrofit	110	15	3.78	26.04	**25.71**	**24.95**	43%
High	Projection 4: High efficiency + retrofit	80	20	2.81	25.06	**24.58**	**23.14**	81%
Very High	Projection 5: Very High efficiency + retrofit	62	24	2.22	24.48	**23.91**	**22.19**	100%

* prior to demand management for existing housing stock

The results show that total neutrality is only achieved by applying the Very High WN scenario, requiring new homes to use water at a rate of 62 l/h/d. The Medium WN scenario would give a minimum of 26% neutrality which would require only new homes to be designed to use water at a rate of 110 l/h/d (Projection 3a). A further 17% neutrality (up to 43%) could be achieved through retrofitting 15% of the existing housing stock with water efficiency fittings equivalent to the optional requirement standard.

5.9.6 Financial Cost Considerations

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

Using the information compiled, the financial costs per neutrality scenario has been calculated and are included in Table 21. It should be noted that these are only estimated costs based on strategic level research into water efficiency implementation and cost.

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Table 21. Estimated Cost of Neutrality Scenarios

Neutrality Scenario	New Homes		Existing Properties					Costs Summary		
	No.	Efficiency cost	No. to be metered	Metering cost	Population Retrofit %	No. to retrofit	Retrofit cost	Developer	Non developer	Total
Low	13,971	-	4,706	£ 2,352,802	10%	6,418	£ 320,895	-	£ 2,673,697	£ 2,673,697
Medium	13,971	£ 125,739	4,706	£ 2,352,802	15%	9,627	£ 1,829,102	£ 125,739	£ 4,181,904	£ 4,307,643
High	13,971	£ 37,679,787	4,706	£ 2,352,802	20%	12,836	£ 2,823,876	£ 37,679,787	£ 5,176,678	£ 42,856,465
Very High	13,971	£ 57,239,187	4,706	£ 2,352,802	24%	15,403	£ 3,388,651	£ 57,239,187	£ 5,741,453	£ 62,980,640

5.9.7 Preferred Strategy – Delivery Pathway

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

To achieve any level of neutrality, a series of policies, partnership approaches and funding sources would need to be developed. This WCS has assumed a 'medium' scenario would be favoured and sets out what would be required to support this strategy. This 'medium' WN scenario would allow a WN target of between 26% and 43% to be reached if metering were to occur in line with the proposed AWS strategy. The medium scenario is considered to require a significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures, as well as the adoption of new local policy within the Local Plan on restriction of water use in new homes on a District scale which goes beyond that seen generally in the UK. It would require:

- Meter installation estimated as a linear projection between 2016 and 2040 AWS WRMP figures (92.7% meter penetration by 2033);
- New housing development should go beyond mandatory Building Regulations requirements, ideally to 110 l/h/d optional Building Regulations requirements;
- Uptake of retrofitting water efficiency measures to be reasonably high (15%) in the District; and
- A significant funding pool and a specific joint partnership 'delivery plan' to deliver the high percentage of retrofitting measures required.

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

5.9.8 Delivery Requirements – Policy

In order to meet the medium water neutrality target scenario given above, specific planning policy will be required and recommendations are presented in Section 7.

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 to try to limit water use to 110 l/h/d (optional Building Regulations requirements), including (but not necessarily limited to) garden water butts, low flush toilets, low volume baths, aerated taps, and water efficient appliances.

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

5.9.9 Delivery Requirements – Partnership Approaches

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

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

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

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

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

5.9.9.1 Responsibility

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

It is therefore suggested that responsibility for implementing water efficiency policies be shared as detailed in Table 22.

Table 22. Responsibility for implementing water efficiency

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

A major aim of the education and awareness programme, as outlined by Policy Recommendation WS3 is to change peoples' attitude to water use and water saving and to make the general population understand that it is everybody's responsibility to reduce water use. Studies have shown that the water efficiencies in existing housing stock achieved by behavioural changes, such as turning off the tap while brushing teeth or reducing shower time, can be as important as the installation of water efficient devices.

5.9.9.2 Retrofitting funding options

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

Braintree District Council could consider developer contributions to the Community Infrastructure Levy (CIL) or through S106 agreements or even through development of an offset policy. Part 11 of the Planning Act 2008[29] (c. 29) ("the Act") provides for the imposition of a charge to be known CIL. This is a local levy that authorities can choose to introduce to help fund infrastructure in their area. CIL will help pay for the infrastructure required to serve new development, and although CIL should not be used to remedy pre-existing deficiencies, if the new development makes the deficiency more severe than the use of CIL is appropriate.

Section 106 (S106) of the Town and Country Planning Act 1990[30] 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.

However, there are considerable existing demands on developer contributions and it is unlikely that all of the retrofitting required in the District could be funded through these mechanism; they therefore need to look beyond developer contributions, possibly to the water companies, for further funding sources. Some councils offer council tax rebates to residents who install energy efficient measures (rebates jointly funded by the Council and Energy Company)[31]. Braintree District Council should consider a similar scheme, although this would require the agreement of AWS and ESW.

5.9.9.3 Retrofitting monitoring

During delivery stage, it will be important to ensure sufficient monitoring is in place to track the effects of retrofitting on reducing demand form existing housing stock. The latest research shows that retrofitting can have a significant beneficial effect and can be a cost effective way of managing the water supply-demand balance[32]. However, it is acknowledged that savings from retrofitting measures do diminish with time. This means that a long-term communication strategy is also needed to accompany any retrofit programme taken forward. This needs to be supported by monitoring, so that messages can be targeted and water savings maintained in the longer-term. The communication and monitoring message also applies to new builds to maintain continued use of water efficient fixtures and fittings.

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

6. Major Development Site Assessment

6.1 Introduction

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

6.2 Assessment Methodologies

6.2.1 Wastewater Network

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

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

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

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

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

The results are presented for each of the Preferred Sites in Appendix G. A RAG assessment has been undertaken; a key indicating the coding applied to each assessment is provided in Table 23.

Table 23. Key for wastewater network RAG assessment

Development is likely to be possible without upgrades	**Pumping station or pipe size may restrict growth, or non-sewered areas, where there is a lack of infrastructure; a pre-development enquiry is recommended before planning permission is granted**	**There is limited capacity in the network, hence solution required to prevent further CSO discharges or sewer flooding**

6.2.2 Water supply network capacity

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

AWS have undertaken an assessment of the capacity of the water supply system using local operational knowledge. A RAG assessment has been undertaken; a key indicating the coding applied to each assessment is provided in Table 24.

Table 24. Key for water supply network RAG assessment

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

6.2.3 Flood Risk

6.2.3.1 Fluvial

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

6.2.3.2 Surface Water Flood Risk

Surface water flooding has been reviewed for each of the large development sites using the Risk of Flooding from Surface Water (RoFSW)[33] mapping produced by the Environment Agency.

6.2.4 Main Rivers and Ordinary Watercourses

6.2.4.1 Main Rivers

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

6.2.4.2 Ordinary Watercourses

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

ECC will seek to ensure that development is set back by at least 3m on one side of an Ordinary Watercourse for ongoing maintenance purposes. As of 6th April 2012 responsibility for the consenting of works by third parties on Ordinary watercourses under Section 23 of the Land Drainage Act 1991 (as amended by the Flood and Water Management Act 2010) transferred from the Environment Agency to the LLFA, ECC is now responsible for the consenting of works to ordinary watercourses and has powers to enforce un-consented and non-compliant works. This includes any works (including temporary) that will affect the cross sectional area of the channel (such as in channel structures or diversion of watercourses). It is advised that ECC is consulted early of proposed alterations.

6.2.4.3 Policy recommendations

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

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

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

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

6.3 Impact of Garden Communities

The two garden communities proposed, Marks Tey and West of Braintree, represent a significant proportion of Braintree District Council's future growth during the plan period (3,650 dwellings by 2033). It has been agreed with AWS that the assumption to be applied in the WCS assessment is to assume Colchester WRC will serve Marks Tey garden community and Bocking WRC will serve the West of Braintree garden community.

Colchester WRC has sufficient headroom under the current DWF permit to accept the additional wastewater flow from growth in Marks Tey garden community proposed within the plan period (1,150 dwellings by 2033). However, the combined growth (from both Colchester Borough Council and Braintree District Council) has not been assessed within this WCS.

Bocking WRC does not have sufficient headroom under the current DWF permit, and as indicated in Section 4.7.1, would require a revised DWF permit and tightening of the permits quality conditions in order to accept the additional wastewater flow from growth in the West of Braintree garden community proposed within the plan period (2,500 dwellings by 2033).

Table 25. Number of dwellings per Garden Community

Garden Community	Growth up to 2033 (in Colchester's new Local Plan)	Growth up to 2033 (in other local authority Local Plan)	Total dwellings to be delivered	Potential site capacity
West of Braintree	2,500	TBC (Uttlesford District Council)	2,500	10,000
Marks Tey	1,150	1,350 (Colchester Borough Council)	2,500	7,500
Assessed in this WCS?	Yes	No		

In addition to the significant future growth expected at both garden communities as detailed in Table 25, both garden communities also encompass other local WRC catchments which discharge to local watercourses. These WRC discharges form an essential component of the flow in their respective receiving watercourses, which is required to support the ecological habitats and species associated with the watercourses. However, the extent of infrastructure required and the associated cost to connect the garden communities to the WRCs could potentially undermine the viability of maintaining the local WRCs (i.e. it may be more cost effective to close the local WRCs and divert their wastewater flows to Colchester WRC or Bocking WRC via the new infrastructure).

Although these local WRCs have not been modelled as part of this assessment, it is likely that significant investment would be required to upgrade and enable these local WRCs to serve growth within the garden communities and thereby maintaining their viability. This approach may be more expensive in the short term, but could prove to be more sustainable in the longer term in terms of balancing environmental benefits with cost.

The construction of a new package WRC in the next Asset Management Plan (AMP) five year cycle (2020 – 2025) is also considered an option to serve and accept wastewater flows from the Marks Tey garden community (1,150 dwellings within the plan period, with the potential for a further 2,500 dwellings), rather than directing wastewater to Colchester WRC.

The North Essex Garden Communities Concept Feasibility Study[34] identified the opportunities and constraints in terms of waste water for the West of Braintree garden community. The distance between the proposed development site and Bocking WRC is significant (approx. 6km) and poses a constraint due to the high infrastructure and cost of pumping the foul water to the WRC for treatment. The study recommended the construction of a new WRC to treat foul water closer to the proposed development, pumping the treated effluent

[34] https://www.braintree.gov.uk/downloads/file/5788/garden_communities_opportunities_and_constraints

(lower cost of pumping treated effluent) to Bocking WRC to be discharged into the River Blackwater. This is due to the limited environment capacity of nearby watercourses which would be unable to accept the volume of treated effluent without compromising WFD objectives and/or requiring significant treatment upgrades.

Table 26 lists the broad options which could be considered going forward during the Plan period and the benefits and drawbacks of each.

Table 26. Garden community growth wastewater treatment broad options

Option	Benefits	Drawbacks
Marks Tey garden community growth to be served by Colchester WRC. West of Braintree garden community growth to be served by Bocking WRC.	– Lower cost due to economy of scales upgrading existing assets and treating large volume of wastewater. – Colchester WRCs coastal discharge likely to require a less stringent discharge permit.	– Infrastructure cost undermining the viability of local WRCs whose discharge is essential component to flow in local watercourses. – Loss of treated wastewater as a water resource to coastal discharge.
Upgrade existing local WRCs to serve garden community growth	– Long term sustainability, balance between cost and environmental requirements. – Maintain/improve flow conditions in local watercourses.	– High cost due to significant upgrades required to treatment processes and flow capacity at a number of local WRCs. – Fluvial discharges likely to require tight discharge permit conditions due to nature of small watercourses.
Construction of new WRC to serve Marks Tey garden community growth. Construction of new WRC to serve West of Braintree garden community growth.	– Additional headroom made available at Colchester WRC and Bocking WRC. – Potential use of treated wastewater to contribute to local watercourse flow and replenish water resources – Reduced pumping costs	– High cost associated with construction of new WRC. – Suitable location of a new WRC requires detailed investigation.

Further consultation with AWS should be held to determine the necessity, exact requirements and cost associated with each broad option (or a combination of each option) detailed in Table 26 to deal with the additional wastewater flows from the garden communities as the masterplanning and timeline for the communities develops.

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7. Water Cycle Strategy Recommendations and Policy

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

7.1 Policy Recommendations Overview

7.1.1 Wastewater

WW1 – Development Phasing in the Bocking, Braintree and Coggeshall WRC catchments

It is recommended that a policy is developed by Braintree District Council that requires all development proposed to drain to Bocking, Braintree and Coggeshall WRCs to be subject to a developer enquiry with AWS to determine process capacity at the WRC before the Council grants permission.

WW2 – Development Phasing in the White Notley WRC catchment

It is recommended that a policy should be developed by Braintree District Council that ensures all development proposed to drain to White Notley WRC 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 WRC or by sufficient capacity being made available and the requirements of the WFD will not be compromised.

WW3 – Development and Sewerage Network

Development at sites indicated in the WCS to have potentially limited sewer network capacity (shown as Amber) should be subject to a pre-development enquiry with AWS to determine if upgrades are needed prior to planning permission being granted.

WW4 – Development of Garden Communities

Integrated water management studies (IWMS) should be undertaken for both the West of Braintree and Land at Marks Tey garden communities to assess the wastewater and water resource demand that this housing and employment growth will place on existing infrastructure and the environment. The IWMS should consider means by which water can be re-used on site to minimise demand for potable water and increasing the loss of this water as wastewater via discharge to the Colchester WRC coastal outfall. Discussion should be had with AWS about the potential options to serve the garden communities.

7.1.2 Water Supply

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 go beyond mandatory Building Regulations requirements, ideally to 110 l/h/d optional Building Regulations requirements. Non-domestic buildings 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 15% of the existing housing stock with easy fit water savings devices

WS3 – Water Efficiency Promotion

It is recommended that a policy be developed to establish a programme of water efficiency promotion and consumer education, with the aim of behavioural change with regards to water use to move towards the higher water neutrality scenarios.

7.1.3 Surface Water Management and Flood Risk

SWM1 – Sewer Separation

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

- into the ground (infiltration);
- to a surface waterbody;
- to a surface water sewer, highway drain, or another drainage system;
- to a combined sewer.

Where sites which are currently connected to combined sewers are redeveloped, the opportunity to disconnect surface water and highway drainage from combined sewers must be taken.

SWM2 – SuDS and Green Infrastructure

Developers should ensure linkage of SuDS to green infrastructure to provide environmental enhancement and amenity, social and recreational value. SuDS design should maximise opportunities to create amenity, enhance biodiversity, and contribute to a network of green (and blue) open space.

SWM3 – SuDS and Water Efficiency

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

SWM4 – Linkages to SWMP and SFRA

Developers should ensure SuDS design supports the findings and recommendations of the Braintree Surface Water Management Plan (SWMP), the Braintree SFRA and Essex County Council's Sustainable Drainage Systems Design Guide (2014).

SWM5 – Water Quality Improvements

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

7.1.4 Ecology

ECO1 – Biodiversity Enhancement

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

7.2 Further Recommendations

7.2.1 Stakeholder Liaison

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

7.2.2 WCS Periodic Review

The WCS should remain a living document, and (ideally) be reviewed on a bi-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' and ESW's WRMP (the next full review is due in 2019, although interim reviews are undertaken annually);
- Periodic review 2019 (PR19) (AWS' business plan for AMP7 – 2020 to 2025); and
- Updates to the RBMPs (next plan due in 2020).

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Appendix A Policy and Legislative Drivers Shaping the WCS

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

Pollution Prevention and Control Act (PPCA) 1999	Implements the IPPC Directive. Replaces IPC with a Pollution Prevention and Control (PPC) system, which is similar but applies to a wider range of installations.
Ramsar Convention	Provides for the designation of wetlands of international importance
Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC	This Directive concerns the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. Its aim is to protect the environment from any adverse effects caused by the discharge of such waters.
Water Act 2003	Implements changes to the water abstraction management system and to regulatory arrangements to make water use more sustainable.
Water Framework Directive (WFD) 2000/60/EC	The WFD, for the first time, combines water quantity and water quality issues together. An integrated approach to the management of all freshwater bodies, groundwaters, estuaries and coastal waters at the river basin level has been adopted. The overall requirement of the directive is that all river basins must achieve 'good ecological status' by 2015 or by 2027 if there are grounds for derogation. The Environment Agency is the body responsible for the implementation of the WFD in the UK. The Environment Agency have been supported by UKTAG[35], 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[36]. Standards, and water body classifications are published via River Management Plans (RBMP) the latest of which were completed in 2015.
Natural Environment & Rural Communities Act 2006	Covering Duties of public bodies – recognises that biodiversity is core to sustainable communities and that Public bodies have a statutory duty that states that "every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity
Water Resources Act 1991	Protection of the quantity and quality of water resources and aquatic habitats. Parts have been amended by the Water Act 2003.
Wildlife & Countryside Act 1981 (as amended)	Legislation that provides for the protection and designation of SSSIs and specific protection for certain species of animal and plant among other provisions.

[35] 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.
[36] UK Environmental Standards and Conditions (Phase I) Final Report, April 2008, UK Technical Advisory Group on the Water Framework Directive.

Appendix B Relevant Planning Documents to the WCS

Category	Document Name	Publication Date
Water	Environment Agency Anglian River Basin District. River Basin Management Plan	2015
Environment	Braintree District Council. Adopted Local Plan. Core strategy - Environment	2011
Housing	Objectively Assessed Housing Need Study for Braintree (Peter Brett Associates)	2015
Local Plan	Braintree District Council New Local Plan. Draft for consultation	2016
Employment	Braintree District Employment Needs Assessment. Final Report (AECOM)	2015
Flood Risk	Braintree District Council Strategic Flood Risk Assessment Update (AECOM)	2016
Water	Affinity Water Final Water Resource Management Plan 2015 - 2020	2014
Water	Essex & Suffolk Final Water Resource Management Plan 2015 - 2020	2014
Climate Change	United Kingdom Climate Projections 2009 (UKCP09)	2009
Water	Braintree District Council Water Cycle Study. Stage 2 Final Report (Hyder Consulting)	2011
Flood Risk	Mid Essex Strategic Flood Risk Assessment Main Report (Scott Wilson)	2007

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Appendix C WRC Capacity Assessment results

C.1 Modelling assumptions and input data

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

- the wastewater generation per new household is based on an assumed Occupancy Rate (OR) of 2.29 people per house and an average consumption of 176 l/h/d (as set out in Section 1.5);
- WRC current flows were taken as the current measured dry weather flow (DWF) (Q80) as provided by AWS. Future 2033 flows were calculated by adding the volume of additional wastewater generated by new dwellings (using an OR of 2.29, a consumption value of 131l/h/d and an additional allowance of 45l/h/d for an increase in infiltration) to the current permitted DWF value;
- WRC current discharge quality was taken as the current permitted limits for each water quality element. Figures for the mean and standard deviation of each element were calculated based on these permit levels using RQP 2.5 software (discussed further below),
- River flow data for the RQP modelling has been calculated using outputs from LowFlows Enterprise software – data was provided as mean flow and Q95 ,
- Raw water quality data for modelling was provided by Environment Agency water quality planners. The WFD 'no deterioration' target for each WRC are the downstream status, for each water quality element, based on river monitoring data for the most recent three years of sampling data. The mean value and standard deviation was calculated, using this raw data for BOD, ammonia and phosphate where available for both the upstream (of the WRC) and downstream (the discharge) inputs. Details are provided below along with the full results and outputs from the water quality modelling,
- The Environment Agency provided the most up to date WFD status.
- 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
  - 0.5mg/l for Phosphate.

C.2 Assessment Techniques

Modelling of the quality permits 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 permit standards that would be required to meet 'No Deterioration'. This would be the discharge permit limit that would need to be imposed on AWS at the time the growth causes the flow permit 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. The Environment Agency require two parts to the 'No Deterioration' assessment to inform their hierarchical approach to the WFD 'no deterioration' targets used to identify indicative permits. This approach helps with consideration of the relative technical feasibility of ensuring 'no deterioration'.

The second stage was to establish the discharge permit standards that would be required to meet future Good Status under the WFD in the downstream waterbody. This assessment was only carried out for WRCs discharging to waterbodies where the current status of either the ammonia, BOD or phosphate element is less than Good (i.e. currently Moderate, Poor or Bad). This would be the discharge permit 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.

C.3 Headroom Assessment

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

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

Table C-1. Scoping criteria

Scoped In	Scoped Out
WRCs where flow headroom is exceeded as a result of growth	WRCs where flow headroom is not exceeded as a result of growth
WRCs which already exceed their flow permit and receive any additional flow from growth	WRCs which already exceed their flow permit but do not receive any additional flow from growth[37]

C.4 Water Quality Assessment

For those WRCs which are scoped in (headroom is exceeded), modelling has been undertaken to determine the new quality conditions required for each WRC discharge permit to ensure:

- No deterioration of more than 10% of the current water quality of the receiving waterbody, or if this is not technically feasible,
- No deterioration from the current WFD status of the receiving waterbody, and
- The future target WFD status is not compromised by growth.

Table C-2 provides detail on each of the calculation steps and the sequence in which these are performed.

The Environment Agency require 'no deterioration' calculations C1 and C3 for freshwater discharges to inform their hierarchical approach to the WFD 'no deterioration' targets used to identify indicative permits. This approach helps with consideration of the relative technical feasibility of ensuring 'no deterioration'.

Step 1 – 'No Deterioration' – C1, C2 and C3

Calculations were undertaken to first determine if deterioration can be limited to 10% of the current downstream quality. If this was not achievable within current limits of technology, the second step determines if the receiving watercourse can maintain no deterioration downstream from the current status with the proposed growth within limits of conventional treatment technology, and what permit limits would be required.

Table C-2. Step 1 – 'No Deterioration' – C1, C2 and C3

Ref	Calculation Name	Calculation Detail	Reason for Calculation
C1	Limit deterioration to 10%	No deterioration from current downstream quality + 10% with future effluent flow	To determine if it is technically feasible to limit deterioration to no more than 10% of the current downstream water quality

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

C2	No deterioration (Current)	No deterioration from current status with current effluent flow	To calculate what quality condition is currently needed to avoid deterioration in the current status downstream with the current flow
C3	No deterioration (Future)	No deterioration from current status with future effluent flow	To calculate what quality condition is needed in the future (post-growth) to avoid deterioration in the current status downstream with future flow
C6	Load Standstill	Required future quality permits with future effluent flow for coastal or estuarine waterbodies	To be used where the above calculations are not applicable such as for tidal discharges and calculating BOD quality conditions

If 'No Deterioration' could be achieved, then a proposed discharge permit standard was calculated which will be needed as soon as the growth causes the WRC flow permit to be exceeded, see Table B1.

Step 2 – Meeting Future 'Good' Status – C4 and C5

For all WRC 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 permit 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 that the modelling assumed upstream water quality is at the midpoint 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 permits achievable within the limits of conventional treatment, then a proposed discharge permit standard which may be needed in the future has been given in Table B2.

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.

Table C-3. Step 2 – Meeting Future 'Good' Status – C4 and C5

Ref	Calculation Name	Calculation Detail	Reason for Calculation
C4	Achieve Good status (Current)	Achieving good ecological status with current effluent flow	To test what effluent quality would be needed to achieve good status with the current flow permit
C5	Achieve Good status (Future)	Achieving good ecological status with future effluent flow	To assess whether the future quality permit limits needed to achieve good status will be significantly more onerous and difficult to achieve than those currently needed (calculation 4)

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' permit standard given in Table B1. (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 permits may be necessary in the future. The RBMP and Periodic Review planning processes will deal with all other issues of disproportionate costs.

C.5 Assessment Tables

'NO DETERIORATION' ASSESSMENT - December 2016

	Bocking WRC		Braintree WRC		Coggeshall WRC		White Notley WRC	
	Ammonia	Phosphate	Ammonia	Phosphate	Ammonia	Phosphate	Ammonia	Phosphate
River Downstream of Discharge	River Blackwater		River Brain		River Blackwater		River Brain	
Current permit quality condition (95%ile or AA)	10	None	3	None	13	None	15	None
Limit of Conventional Treatment (LCT) (95%ile or AA)	1	0.5	1	0.5	1	0.5	1	0.5
Deterioration Test Selection								
Current river quality downstream (90%ile or AA)*	0.16	0.32	0.22	0.46	0.46	0.24	0.55	0.72
10% No deterioration target (90%ile or AA)	**0.18**	**0.35**	**0.24**	**0.51**	**0.51**	**0.29**	**0.61**	**0.79**
Status no deterioration target (90%ile or AA)	0.30	1.10	0.30	1.11	0.60	1.10	0.60	1.11
Status or 10% deterioration target?	***10%***	***10%***	***10%***	***10%***	***10%***	***20%***	***Status***	***10%***
Upstream sample point	AN-BL0675 (STRAITS MILL)		BR0221 (U/S BRAINTREE STW)		AN-BL05 (BRADWELL BRIDGE)		AN-BR02 (BULFORD MILL)	
Downstream sample point	AN-BL06 (BLACKWATER SISTEAD MILL)		AN-BR02 (DOWNSTREAM BULFORD MILL)		AN-BL04 (FEERINGBURY OLD MILL)		AN-BR0150 (U/S FAULKBOURNE HALL)	
10% No Deterioration Test								
Future DWF (m3/day)	**4595**		**7682**		**2741**		**888**	
Future river quality (90%ile or AA)	0.21	0.36	0.23	0.69	0.53	0.33		0.80
Level of deterioration	31%	13%	5%	50%	15%	38%		11%
Future development would cause a…	***31% deterioration in current quality***	***13% deterioration in current quality***	***5% deterioration in current quality***	***50% deterioration in current quality***	***15% deterioration in current quality***	***38% deterioration in current quality***		***11% deterioration in current quality***
Future discharge quality required (95%ile or AA)			No change					
If exceeded 10%, what discharge quality required? (95%ile	1.7	1.2		0.7	6.7	0.1		5.5
Status Deterioration Test								
Status deterioration target of d/s sample point	**High**	**Poor**	**Good**	**Poor**	**Good**	**Poor**	**Good**	**Poor**
Origin of status target	Nearest downstream sampling point BL06 not part of WFD monitoring network. BL04 status applied.		Nearest downstream sampling point BR02 not part of WFD monitoring network. BR0150 status applied.		Downstream status of available sampling point		Downstream status of available sampling point	
Downstream sampling point used for status	N/A	BL04	BR0150		BL04		BR0150	
Status no deterioration target (90%ile or AA)	0.30	1.10	0.60	1.11	0.60	1.10	0.60	1.11
Current DWF (m3/day)	**2869**		**6120**		**2195**		**660**	
Current discharge quality required (95%ile or AA)							7.5	10.7
Future DWF (m3/day)	**4595**		**7682**		**2741**		**888**	
Future discharge quality required (95%ile or AA)	3.4	8.1	1.7	2.4	8.3	14.8	5.8	10.3
Will growth prevent WFD objective of 'No Deterioration' from being achieved?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Current permit quality condition (95%ile or AA)	10	None	3	None	13	None	15	None

LOAD STANDSTILL ASSESSMENT - December 2016

	Bocking WRC	Braintree WRC	Coggershall WRC	White Notley WRC
	BOD	BOD	BOD	BOD
Downstream of Discharge	River Blackwater	River Brain	River Blackwater	River Brain
No Deterioration target	**High**	**High**	**High**	**High**
River quality target (90%ile)	**4.0**	**4.0**	**4.0**	**4.0**
Limit of Conventional Treatment (LCT) (95%ile)	5	5	5	5
Current DWF Permit				
Current DWF Permit (m3/day)	**3900**	**6859**	**2235**	**660**
Current permit quality condition (95%ile)	15	8	19	15
(C6) Discharge Permit Required				
Current DWF (m3/day)				**860**
Current permit quality condition required (95%ile)				11.5
Future DWF (m3/day)	**4732**	**7799**	**2784**	**890**
Future permit quality condition required (95%ile)	12.4	7	15.3	11.1

Key to 'Effluent Quality Required'

Green Value – no change to current permit required

Amber Value – Permit tightening required, but within limits of conventionally applied treatment processes

Red Value – not achievable within limits of conventionally applied treatment processes

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Appendix D Water Neutrality

Water Neutrality is defined in Section 4, and the assumptions used outlined in Section 1.6. This appendix provides supplementary information and guidance behind the processes followed..

D.1 Twin-Track Approach

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

In order to reduce water consumption and manage demand for the limited water resources within the study area, a number of measures and devices are available[38], including:

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

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

However, there are a number of the measures listed above that can be easily and cheaply installed into existing properties, particularly if part of a large campaign targeted at a number of properties. Examples of these include the fitting of dual-flush toilets and low flow showers heads to social housing stock, as was successfully carried out in Preston by Reigate and Banstead Council in conjunction with Sutton and East Surrey Water and Waterwise[39].

D.2 The Pathway Concept

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

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

- Local Authorities incorporating environmental standards as part of supplementary planning guidance;
- NHS buildings for new buildings and refurbishments;

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

- Department for Children, Schools and Families for all projects valued at over £500K (primary schools) and £2million (secondary schools);
- The Homes and Communities Agency for all new developments involving their land; and,
- Office of Government Commerce for all new buildings.

Therefore, other than potential local policies delivered through a Local Plan, the only water efficiency requirements for new development are through the Building Regulations[40] where new homes must be built to specification to restrict water use to 125l/h/d or 110l/h/d where the optional requirement applies. However, the key aim of the Localism Act is to decentralise power away from central government towards local authorities and the communities they serve. It therefore creates a stronger driver for local authorities to propose local policy to address specific local concerns.

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

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

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

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

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

D.3 Improving Efficiency in Existing Development

Metering

The installation of water meters in existing housing stock has the potential to generate significant water use reductions because it gives customers a financial incentive to reduce their water consumption. Being on a meter also encourages the installation and use of other water saving products, by introducing a financial incentive and introducing a price signal against which the payback time of new water efficiency measures can be assessed. Metering typically results in a 5-10 per cent reduction from unmetered supply, which equates to water savings of approximately 50l per household per day, assuming an occupancy rate of 2.3[41] for existing properties.

In 2009, DEFRA instructed Anna Walker (the Chair of the Office of Rail Regulation) to carry out an independent review of charging for household water and sewerage services (the Walker view)[42]. The typical savings in water bills of metered and unmetered households were compared by the Walker review, which gives an indication of the levels of water saving that can be expected (see Table D-1).

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

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

Low or Variable Flush Toilets

[40] Part G of the Building Regulations
[41] 2.3 is used for existing properties and new properties. This figure was agreed with AWS prior to the assessment
[42] Independent Walker Review of Charging and Metering for Water and Sewerage services, DEFRA, 2009, http://www.defra.gov.uk/environment/quality/water/industry/walkerreview/

Toilets use about 30 per cent of the total water used in a household[43]. 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[44]per flush. A study carried out in 2000 by Southern Water and the Environment Agency[45] on 33 domestic properties in Sussex showed that the average dual flush saving observed during the trial was 27 per cent, equivalent to a volumetric saving of around 2.6 litres per flush. The study suggested that replacing existing toilets with low or variable flush alternatives could reduce the volume of water used for toilet flushing by approximately 27 per cent on average.

Cistern Displacement Devices

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

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

Low Flow Taps and Showers

Flow reducing aerating taps and shower heads restrict the flow of water without reducing water pressure. Thames Water estimates that an aerating shower head can cut water use by 60 per cent with no loss of performance[46].

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.

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.

[43] http://www.waterwise.org.uk/reducing_water_wastage_in_the_uk/house_and_garden/toilet_flushing.html
[44] http://www.lecico.co.uk/
[45] The Water Efficiency of Retrofit Dual Flush Toilets, Southern Water/Environment Agency, December 2000
[46] http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/9047.htm

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.

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[47] that dishwashers, together with the kitchen tap, account for about 8-14 per cent of water used in the home.

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

Non-Domestic Properties

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

Water Efficiency in New Development

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

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

Component	138 l/h/d Standard Home	Building Regulations 125 l/h/d	Building Regulations Optional Target 110 l/h/d	High 80 l/h/d	62 l/h/d (water recycling)
Toilet flushing	28.2	18.7 b	12.3 d	12.3 d	12.3 d
Taps	24.1 a	22.7 a	20.5 a	15.3 a	15.3 a
Shower	43.7	39.8	31.8	23.9	23.9
Bath	18.5 c	18.5 c	17.0 f	14.5 h	14.5 h
Washing Machine	15.6	15.6	15.6	15.6	15.6
Dishwasher	4.1	4.1	4.1	4.1	4.1
Recycled water				-13.4 e	-26.8 g
External Use	5	5	5	0	0
Total per head	139.3	124.4	106.3	77.3	63.9
Total per household	292.4	261.3	223.3	162.4	134.2

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

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

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

In using the BRE Water Demand Calculator[48], the experience of AECOM BREEAM assessors is that it is theoretically possible to get close to 80l/h/d through the use of fixture and fittings, but that this requires extremely high specification efficiency devices which are unlikely to be acceptable to the user and will either affect the saleability of new homes or result in the immediate replacement of the fixtures and fittings upon habitation. This includes baths at capacity below 120 litres, and shower heads with aeration which reduces the pressure sensation of the user. For this reason, it is not considered practical to suggest that 80l/h/d or lower can be reached without some form of water recycling.

Rainwater Harvesting

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

RWH systems typically consist of a collection area (usually a rooftop), a method of conveying the water to the storage tank (gutters, down spouts and pipes), a filtration and treatment system, a storage tank and a method of conveying the water from the storage container to the taps (pipes with pumped or gravity flow). A treatment system may be included, depending on the rainwater quality desired and the source. Figure D-1 below gives a diagrammatic representation of a typical domestic system[49].

The level to which the rainwater is treated depends on the source of the rainwater and the purpose for which it has been collected. Rainwater is usually first filtered to remove larger debris such as leaves and grit. A second stage may also be incorporated into the holding tank; some systems contain biological treatment within the holding tank, or flow calming devices on the inlet and outlets that will allow heavier particles to sink to the bottom, with lighter debris and oils floating to the surface of the water. A floating extraction system can then allow the clean rainwater to be extracted from between these two layers[50].

[48] http://www.thewatercalculator.org.uk/faq.asp
[49] Source: Aquality Intelligent Water management, www.aqua-lity.co.uk
[50] Aquality Rainwater Harvesting brochure, 2008

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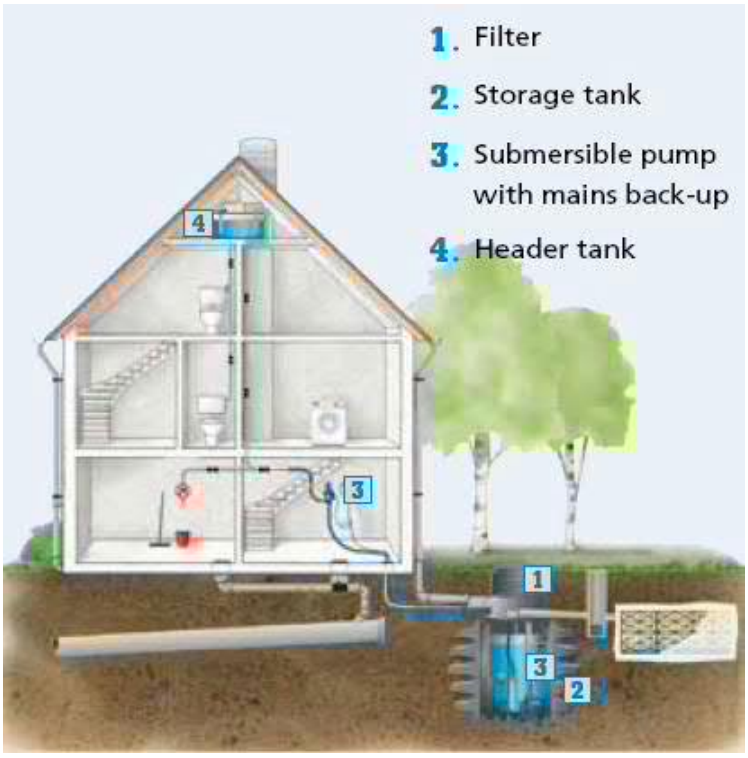
Figure D-1: A typical domestic rainwater harvesting system



A recent sustainable water management strategy carried out for a proposed EcoTown development at Northstowe[51], approximately 10 km to the north west of Cambridge, calculated the size of rainwater storage that may be required for different occupant numbers, as shown below in Table D-3.

Table D-3: Rainwater Harvesting Systems Sizing

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

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

Greywater Recycling

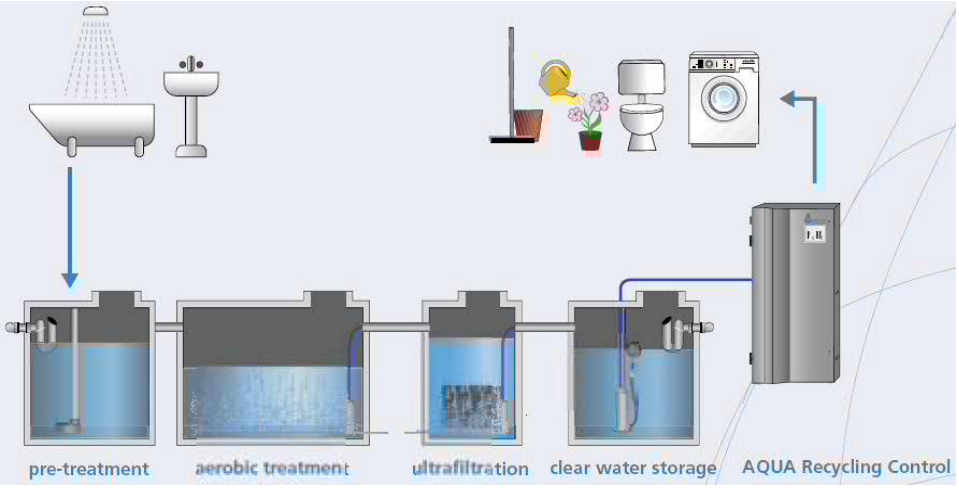
Greywater recycling (GWR) is the treatment and re-use of wastewater from shower, bath and sinks for use again within a property where potable quality water is not essential e.g. toilet flushing. Recycled greywater is not suitable for human consumption or for irrigating plants or crops that are intended for human consumption. The source of greywater should be selected by available volumes and pollution levels, which often rules out the use of

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

kitchen and clothes washing waste water as these tend to be most highly polluted. However, in larger system virtually all non-toilet sources can be used, subject to appropriate treatment.

The storage volumes required for GWR are usually smaller than those required for rainwater harvesting as the supply of greywater is more reliable than rainfall. In domestic situations, greywater production often exceeds demand and a correctly designed system can therefore cope with high demand application and irregular use, such as garden irrigation. Figure D-2 below gives a diagrammatic representation of a typical domestic system[52].

Figure D-2: A typical domestic greywater recycling system



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

The Northstowe sustainable water management strategy calculated the volumes of water that could be made available from the use GWR. These were assessed against water demand calculated using the BRE Water Demand Calculator[53].

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

Table D-4: Potential water savings from greywater recycling

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

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

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

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[54].

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

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

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

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

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

WN Scenario	New development requirement			Retrofitting existing development	
	New development Water use target (l/h/d)	Water Efficient Fixtures and Fittings	Water Recycling technology	Metering Penetration assumption	Water Efficient Fixtures and Fittings
Low (Building Regulations)	125	- WC 6/4 litres dual flush or - 4.5 litres single flush - Shower 10 l/min - Bath 185 litres - Basin taps 6 l/min - Sink taps 8 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	None	97.5%	None
Low (Building Regulations + Retrofit)	125	- WC 6/4 litres dual flush or - 4.5 litres single flush - Shower 10 l/min - Bath 185 litres - Basin taps 6 l/min - Sink taps 8 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	None	97.5%	10% take up across study area: - WC 6/4 litres dual flush or - 4.5 litres single flush - Shower 10 l/min - Basin taps 6 l/min - Sink taps 8 l/min
Medium (Building Regulations Optional Requirement)	110	- WC 4/2.6 litres dual flush - Shower 8 l/min - Bath 170 litres - Basin taps 5 l/min - Sink taps 6 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	None	97.5%	None
Medium (Building Regulations Optional Requirement + Retrofit)	110	- WC 4/2.6 litres dual flush - Shower 8 l/min - Bath 170 litres - Basin taps 5 l/min - Sink taps 6 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	None	97.5%	15% take up across study area: - WC 4/2.6 litres dual flush - Shower 8 l/min - Basin taps 5 l/min - Sink taps 6 l/min
High	80	- WC 4/2.6 litres dual flush;	Rainwater harvesting	100%	20% take up across study area:

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		- Shower 6 l/min - Bath 145 litres - Basin taps 2 l/min - Sink taps 4 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram			- WC 4/2.6 litres dual flush; - Shower 6 l/min - Basin taps 2 l/min - Sink taps 4 l/min
Very High	62	- WC 4/2.6 litres dual flush; - Shower 6 l/min - Bath 145 litres - Basin taps 2 l/min - Sink taps 4 l/min - Dishwasher 1.25 l/place setting - Washing machine 8.17 l/kilogram	Rainwater harvesting and Greywater recycling	100%	24% take up across study area: - WC 4/2.6 litres dual flush; - Shower 6 l/min - Basin taps 2 l/min - Sink taps 4 l/min

D.4 Financial Cost Considerations for Water Neutrality scenarios

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

New Build Costs

The Department for Communities and Local Government (DCLG) published the Housing Standards Review in September 2014. A cost impacts report[55] formed part of this publication, providing the costs of the proposed standards, including the proposed Building Regulations optional requirement water efficiency standard.

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

Table D-6: Building Regulation Specification and costs

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

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

Water Recycling

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

Table D-7: Costs of greywater recycling systems

Cost	Cost	Comments
Installation cost	£1,750	Cost of reaching Code Level 5/6 for water consumption in a 2-bed flat[56]
	£2,000	For a single dwelling[57]
	£800	Cost per house for a communal system[58]
	£2,650	Cost of reaching Code Level 3/4 for water consumption in a 3-bed semi-detached house[59]
Operation of	£30 per annum[60]	

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

[56] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008

[57] http://www.water-efficient-buildings.org.uk/?page_id=1056

[58] http://www.water-efficient-buildings.org.uk/?page_id=1056

[59] Code for Sustainable Homes: A Cost Review, Communities and Local Government, 2008

[60] Environment Agency Publication - Science Report – SC070010, Greenhouse Gas Emissions of Water Supply and Demand Management Options, 2008

Cost	Cost	Comments
GWR		
Replacement costs	£3,000 to replace23	It is assumed a replacement system will be required every 25 years

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

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

Installing a Meter

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

Retrofitting of Water Efficient Devices

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

Table D-8: Water saving methods

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

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

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Appendix E Designated Site Background Detail

E.1 Blackwater, Crouch, Roach and Colne Estuaries MCZ

Blackwater, Crouch, Roach and Colne Estuaries MCZ is located on the Essex coast. It extends from the mean high water mark to where the estuary mouths join the North Sea, and is the largest inshore MCZ covering an area of 284 km2.

The site protects one of the largest estuaries in the East of England and includes the Blackwater, the largest tidal river in Essex. There are already a number of designations within the area including Sites of Special Scientific Interest, the Essex Estuaries Special Area of Conservation and Mid Essex coast Special Protection Area.

These existing sites protect extensive areas of mudflats and saltmarsh, which support a wide range of species including internationally and nationally important numbers of waterfowl such as Brent Goose and Curlew. The MCZ will build upon these existing designations, by offering protection to features such as the native oyster which are not already protected.

The MCZ is designated for:

- Intertidal mixed sediments
- Native oyster (Ostrea edulis) beds
- Native oyster (Ostrea edulis)
- Clacton Cliffs and Foreshore

E.2 Blackwater Estuary Ramsar, SPA and SSSI

The site is one of the largest estuarine complexes in East Anglia. The site consists of intertidal mudflats fringed by saltmarsh, shingle and shell banks as well as offshore islands. Blackwater estuary also contains terrestrial habitats such as sea walls grassland, ancient grazing marsh and associated fleet and ditch systems as well as semi-improved grassland all of which are of high conservation interest. This rich mosaic of habitats supports an outstanding assemblage of nationally scarce plants and a nationally important assemblage of rare invertebrates. Internationally and nationally important numbers of overwintering waterbirds winter at the site including raptors, geese ducks and waders. The site is also important for breeding terns.

The Blackwater Estuary SPA is a moderately-sized, sheltered south-facing estuary, which extends from Youghal New Bridge to the Ferry Point peninsula, close to where the river enters the sea. It comprises a section of the main channel of the River Blackwater to Ballynaclash Quay. At low tide, intertidal flats are exposed on both sides of the channel. On the eastern side the intertidal channel as far as Kinsalebeg and Moord Cross Roads is included, while on the west side the site includes part of the estuary of the Tourig River as far as Kilmagner.

The intertidal sediments are mostly muds or sandy muds, reflecting the sheltered conditions of the estuary. Green algae (Ulva spp.) are frequent on the mudflats during summer, and Bladder Wrack (Fucus vesiculosus) occurs on the upper more stony shorelines. The sediments have a macrofauna typical of muddy sands, with polychaete worms such as Lugworm (Arenicola marina), Ragworm (Hediste diversicolor) and the marine bristle worm Nephtys hombergii being common. Salt marshes fringe the estuarine channels, especially in the sheltered creeks.

The wetlands within the site are of special conservation interest and supports populations of waterbirds that are of special conservation interest. The site supports an internationally important population of Blacktailed Godwit with a further seven species within nationally important populations: Wigeon, Golden plover, Lapwing, Dunlin, Bar-tailed godwit, curlew and redshank. Little egret, golden plover and bar-tailed godwit are listed on Annex I of the E.U. Birds Directive.

The SPA is designated for:

- Summer: little terns Sterna albifrons.
- Wintering: avocet Recurvirostra avosetta, Golden Plover Pluvialis apricaria, Hen Harrier Circus cyaneus and Ruff Philomachus pugnax.

- Supports internationally and nationally populations of overwintering waterfowl Over supporting 109,815 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: Great Crested Grebe Podiceps cristatus, Golden Plover Pluvialis apricaria, Ruff Philomachus pugnax, Dark-bellied Brent Goose Branta bernicla bernicla, Shelduck Tadorna tadorna, Ringed Plover Charadrius hiaticula, Grey Plover Pluvialis squatarola, Dunlin Calidris alpina alpina, Avocet Recurvirostra avosetta, Redshank Tringa totanus, Curlew Numenius arquata, Cormorant Phalacrocorax carbo, Wigeon Anas penelope, Teal Anas crecca, Pintail Anas acuta, Shoveler Anas clypeata, Goldeneye Bucephala clangula, Red-breasted Merganser Mergus serrator, Lapwing Vanellus vanellus, Black-tailed Godwit Limosa limosa islandica.

The Ramsar is designated for:

- Ramsar criteria 1: contains rare or unique example of natural wetland type of international importance:
  - Qualifies due to the diversity of saltmarsh habitat (3,237 ha)
- Ramsar criteria 2: supports internationally important vulnerable, endangered or critically endangered ecological communities
  - The invertebrate fauna includes 16 Red Data Book species including the endangered water beetle (Paracymus aeneus)
- Ramsar criteria 3: contains internationally important populations of plant or animal species important for maintaining biological diversity
  - Contains saltmarsh plant communities covering a range of variation in Britain.
- Ramsar criterion 6 : species/populations occurring at levels of international importance. Qualifying Species/populations (as identified at designation):
  - Species with peak counts in winter: dark-bellied brent goose Branta bernicla bernicla, black-tailed godwit Limosa limosa islandica, grey plover Pluvialis squatarola, dunlin Calidris alpine alpina

E.3 Brockwell Meadows Local Nature Reserve

The reserve is located on the banks of the River Blackwater and contains 11 acres of diverse habitat including water meadow with hedgerow, woodland and pond habitats. The riverside habitat contains a diverse assemblage of wild plants and invertebrates.

E.4 Essex Estuaries SAC

This is a typical, undeveloped, coastal plain estuarine system with associated open coast mudflats and sandbanks. The site comprises the major estuaries of the Colne, Blackwater, Crouch and Roach rivers. Essex Estuaries contains a very wide range of characteristic marine and estuarine sediment communities and some diverse and unusual marine communities in the lower reaches, including rich sponge communities on mixed, tide-swept substrates. Subtidal areas have a very rich invertebrate fauna, including the reef-building worm Sabellaria spinulosa, the brittlestar Ophiothrix fragilis, crustaceans and ascidians.

There are extensive intertidal mudflats and sandflats in estuaries and at Dengie Flats and Maplin Sands. The area includes a wide range of sediment flat communities, from estuarine muds, sands and muddy sands to fully saline, sandy mudflats with extensive growths of eelgrass Zostera spp. on the open coast. Glasswort Salicornia spp. saltmarsh forms an integral part of the transition from the extensive and varied intertidal mud and sandflats through to upper salt meadows. The area of pioneer marsh includes gradation into extensive cord-grass Spartina spp. swards, including the most extensive remaining stand of the native small cordgrass Spartina maritima in the UK and possibly in Europe at Foulness Point. Other smaller stands are found elsewhere in the estuary complex, notably in the Colne estuary, where it forms a major component of the upper marsh areas.

Extensive upper saltmarshes remain, including Atlantic salt meadows with floristic features typical of this part of the UK. Golden samphire Inula crithmoides is a characteristic species of these marshes, occurring both on the lower marsh and on the drift-line. Mediterranean saltmarsh scrub occurs principally as a strandline community or at the foot of sea-walls. The local variant of this vegetation, which features sea-lavenders Limonium spp. and sea-heath Frankenia laevis, occurs at one location, Colne Point.

The SAC is designated for:

- Atlantic salt meadows (Glauco-Puccinellietalia maritimae),
- Estuaries,
- Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi) (Mediterranean saltmarsh scrub),
- Mudflats and sandflats not covered by seawater at low tide (Intertidal mudflats and sandflats),
- Salicornia and other annuals colonising mud and sand (Glasswort and other annuals colonising mud and sand),
- Sandbanks which are slightly covered by sea water all the time (Subtidal sandbanks), and
- Spartina swards (Spartinion maritimae) (Cord-grass swards).

E.5 Orwell Estuary SSSI

The Orwell Estuary is of national importance for breeding avocet Recurvirostra avosetta, its breeding bird assemblage of open waters and their margins, nine species of wintering waterfowl (including black-tailed godwit Limosa limosa islandica), an assemblage of vascular plants, and intertidal mud habitats.

The Orwell is a long and relatively narrow estuary with extensive mudflats and some saltmarsh. Extensive mudflats border the channel and support large patches of eelgrass Zostera marina, and dwarf eelgrass Z. noltii as well as large numbers of invertebrates that are important for feeding waders. Where it occurs, the saltmarsh tends to be sandy and fairly calcareous with a wide range of communities. Glasswort Salicornia spp. and small cord-grass Spartina maritima are the principal colonisers of the mud, and sea aster Aster tripolium is abundant on the lower marsh. The central areas of marsh are dominated by common saltmarsh-grass Puccinellia maritima, sea purslane Atriplex portulacoides, and common sea-lavender Limonium vulgare. Other species include sea arrowgrass Triglochin maritimum, annual sea-blite Suaeda maritima, seamilkwort Glaux maritima, greater sea-spurrey Spergularia media, and sea plantain Plantago maritima. There are small areas of vegetated shingle on the foreshore of the lower reaches, but most of the saltmarsh is fringed by sea couch Elytrigia atherica or by common reed Phragmites australis and sea club-rush Bolboschoenus maritimus further upstream.

The freshwater grazing marshes which adjoin the estuary at Shotley, and the wet grassland and standing water of Trimley marshes, each form an integral part of the ornithological interest of the site. Shotley marshes are especially important for feeding dark-bellied brent geese Branta bernicla bernicla, wigeon Anas penelope and snipe Gallinago gallinago, and for breeding redshank Tringa totanus and lapwing Vanellus vanellus. Trimley marshes have become an important refuge for wintering and passage birds, as well as a key breeding site.

Breeding birds

The Orwell Estuary supports a nationally important breeding number of avocet. It also supports a nationally important assemblage of breeding birds characteristic of open waters and their margins comprising little grebe Tachybaptus ruficollis, great crested grebe Podiceps cristatus, mute swan Cygnus olor, shelduck Tadorna tadorna, gadwall Anas strepera, garganey Anas querquedula, shoveler Anas clypeata, pochard Aythya ferina, tufted duck Aythya fuligula, avocet, ringed plover Charadrius hiaticula, redshank, and reed bunting Emberiza schoeniclus. The breeding bird assemblage is concentrated in three main areas: Trimley Marshes, Shotley Marshes, and Loompit Lake.

Non-breeding birds

The estuary regularly supports an important assemblage of more than 20,000 nonbreeding waterfowl. It supports considerable numbers of oystercatcher Haematopus ostralegus, ringed plover, knot Calidris canutus islandica, curlew Numenius arquata and turnstone Arenaria interpres, but is particularly important for four other species of wader. These are grey plover Pluvialis squatarola, dunlin Calidris alpina alpina, black-tailed godwit (which regularly occur in numbers of international importance) and redshank. These regularly attain nationally important numbers in winter. The intertidal mud habitats, saltmarsh and adjacent areas used as high tide roosts are important for these wading birds.

Considerable numbers of wigeon and shoveler use the site, whilst cormorant, shelduck, gadwall and pintail Anas acuta regularly occur in numbers of national importance. Also of national importance are the large numbers of dark-bellied brent geese. Numbers often fluctuate because of interchange with neighbouring estuaries. The

intertidal mud habitats, saltmarsh, freshwater marshes and river channel are important to these birds for feeding and roosting.

Vascular plant assemblage

The site supports a nationally important vascular plant assemblage, including at least nine nationally scarce plants. They are characteristic of intertidal mud, saltmarsh, shingle and coastal grazing marsh habitats. These are eelgrass, dwarf eelgrass, slender hare's-ear Bupleurum tenuissimum, golden-samphire Inula crithmoides, lax-flowered sea-lavender Limonium humile, shrubby sea-blite Suaeda vera, small cord-grass, perennial glasswort Sarcocornia perennis, and divided sedge Carex divisa.

Intertidal mud habitats

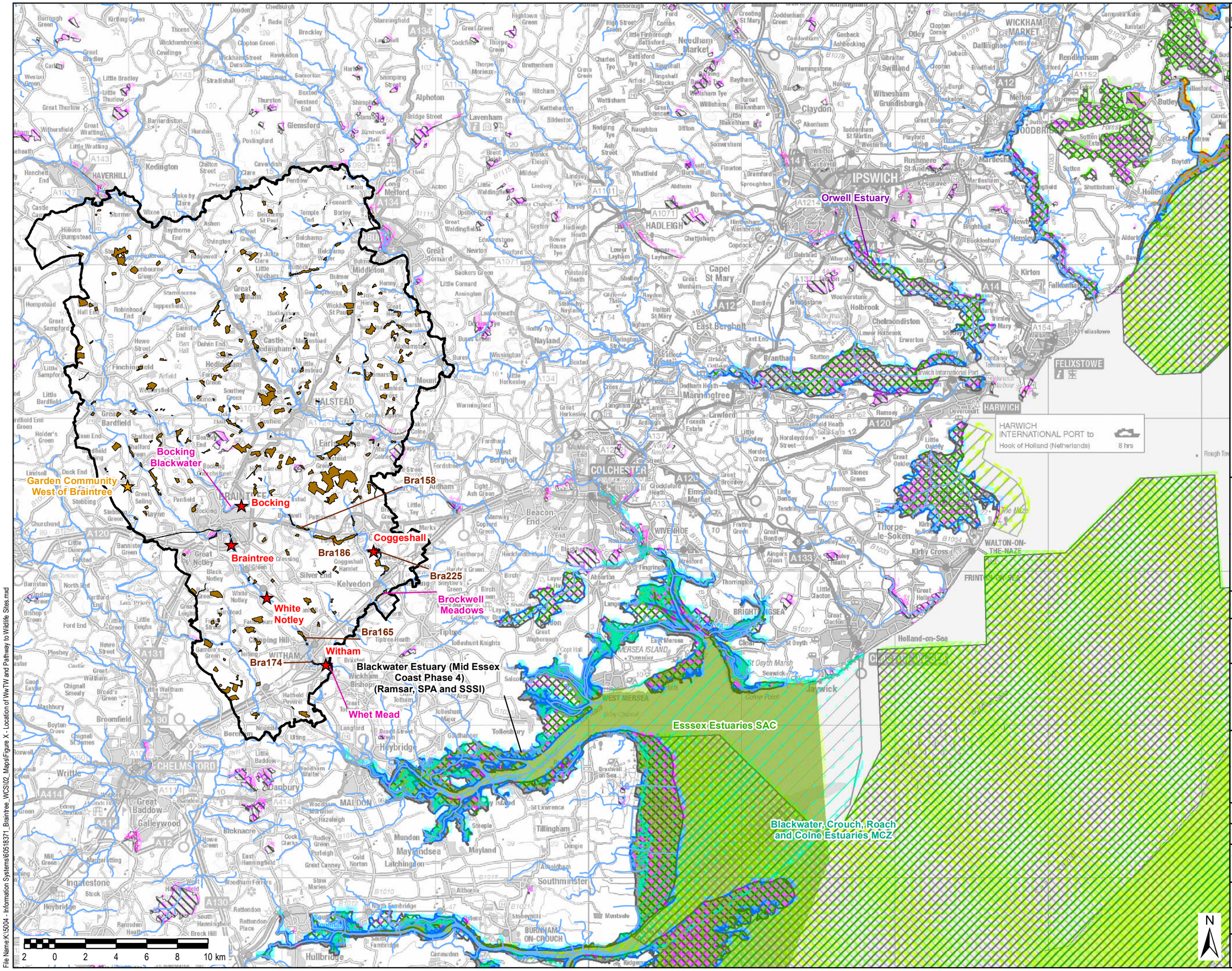
The Orwell Estuary supports a large area of intertidal mud habitat with very rich littoral sediments, particularly sandy muds. There is a high invertebrate species richness within the sediments. The estuary also supports an example of a nationally important tide swept algae community with sponges, ascidians and red algae.

In addition to the reasons for notification, the Orwell Estuary supports an inland nesting colony of cormorants at their only site in Suffolk.

E.6 Whet Mead LNR

The reserve provides valuable wildlife habitat including areas of unimproved grassland and contains three lagoons. The reserved comprises of an old landfill site and is bordered by both the River Brain and the River Blackwater. The rough meadow habitat is home to a range of flowering plants and this supports common butterflies and dragonflies as well as seed-eating birds.

E.7 Locations of WRCs and Pathways to Wildlife Sites



THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

LEGEND

- Braintree District
- WwTw
- Proposed WwTW
- Watercourse
- Local Nature Reserve (LNR)
- Local Wildlfe Sites
- Margate and Long Sands
- Outer Thames Estuary
- Potential Special Protection Areas (Marine)
- Ramsar
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Site of Special Scientific Interest

Marine Conservation Zones © Natural England and JNCC

- Designated
- Recommended

County Wildlife Sites

Bra158	Blackwater Plantation West
Bra165	Witham Marsh
Bra174	Riverview Meadows
Bra186	Blackwater Plantation
Bra225	Coggeshall Hall Farm

Purpose of Issue: DRAFT

Client: BRAINTREE DISTRICT COUNCIL

Project Title: BRAINTREE WATER CYCLE STUDY

Drawing Title: LOCATIONS OF WWTW TO EXCEED CONSENTED VOLUMES AND PATHWAYS TO WILDLIFE SITES

Drawn	Checked	Approved	Date
CN	AK	IHH	20/12/2016

AECOM Internal Project No.: 60518371
Scale @ A3: 1:225,000

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Drawing Number: | Rev: 01

File Name:K:\5004 - Information Systems\60518371_Braintree_WCS\02_Maps\Figure X - Location of WwTW and Pathway to Wildlife Sites.mxd

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Appendix F Reason for Alternative Objective

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

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

F.1 Justification for 'Moderate' Ecological Status Objective for River Blackwater and River Brain

Section 5.4 of the Anglian RBMP Part 2: River basin management planning overview and additional information[61] sets out the specific circumstances for the particular elements and the justification behind the alternative objective. The individual sub-elements 'Macrophytes and Phytobenthos Combined' and 'Phosphate' of the River Blackwater (GB105037041160) waterbody have had alternative objectives of 'Moderate' status to be achieved by 2021 and 2021. This has then been applied to the overall waterbody, which has an objective of 'Moderate' Ecological status by 2021.

The individual sub-element 'Phosphate' of the River Brain (GB105037041140) waterbody has an alternative objective of 'Moderate' status to be achieved by 2021. This has then been applied to the overall waterbody, which has an objective of 'Moderate' Ecological status by 2021.

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

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

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

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

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

Trials are underway involving water and sewerage companies to investigate sewage treatment technologies that could be used to reduce phosphate below 0.5 mg/l. The trials will determine how effective these technologies are and are due to be complete by 2017. The results of the trials will inform the review and update of river basin management plans in 2021.

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

[61] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/500573/Part_2_River_basin_management_planning_process_overview_and_additional_information.pdf

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Appendix G Development Site Assessment

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GIS Reference	Site Reference	Site Location	Site Area (ha)	Planning Status	Dwellings Proposed in Plan Period	Water Supply Network Capacity	WRC	Foul Sewerage Network Capacity	% of Site in FZ1	% of Site in FZ2	% of Site in FZ3a	% of Site in FZ3b	Main River	Ordinary Watercourse
BLAN 115	BLAN 115 BTE/16/0605/FUL	Land at Bakers Lane and London Road	4.0	Without	97		Braintree		100%	0%	0%	0%	NO	YES
BCBG 149	BCBG 149	Braintree Football Club site Clockhouse Way	1.8	Without	75		Braintree		100%	0%	0%	0%	NO	YES
BCBG 150	BCBG 150	Land at Stubbs Lane	0.3	Without	10		Braintree		100%	0%	0%	0%	NO	YES
BCBG 550	BCBG 550	Braintree Tennis Club off Clockhouse Way	4.4	Without	65		Braintree		100%	0%	0%	0%	NO	NO
BCBG 550	BCBG550 (part)	Former playing field Chapel Hill	0.0	Without	65		Braintree		100%	0%	0%	0%	NO	NO
BLAN 114	BLAN 114	Land east of Great Notley, Strategic Growth Location	114.6	Without	2090		Braintree		100%	0%	0%	0%	NO	YES
BOB1H	BOB1H	Phase 2, Tabor House site 5 Coggeshall Road	0.7	Without	19		Bocking		100%	0%	0%	0%	NO	NO
BOB20H	BOB20H BTE/14/1116	Former Garage site at Falkland Court/Land north of Edinburgh Gardens	0.2	Outline	14		Bocking		100%	0%	0%	0%	NO	NO
BOCN 123 & BOCN 127	BOCN123 BOCN127 BOCN132	Land east of Broad Road, Strategic Growth Location	1.5	Without	1000		Bocking		100%	0%	0%	0%	NO	YES
BOCN 137	BOCN137	Towerlands Park	31.3	Without	600		Bocking		100%	0%	0%	0%	NO	YES
BOCS 140	BOCS140 BTE/15/1548	Site at Rayne Lodge Farm, north of Rayne Road	8.3	Without	136		Braintree		84%	5%	6%	5%	YES	YES
BON5H	BON5H BTE/15/1584	Polly's Field, Land at Church Lane Bocking (sheltered housing)	2.1	Without	100		Bocking		100%	0%	0%	0%	NO	YES
BOS16H	BOS16H	Land at Harkilees Way	0.4	Without	10		Bocking		100%	0%	0%	0%	NO	NO
BOS6H	BOS6H BOS8H BTE/15/1319 BTE/15/1320	Land West of Panfield Lane	44.5	Without	600		Braintree		100%	0%	0%	0%	NO	YES
BRAW 153	BRAW153	Broomhills Estate	3.1	Without	70		Braintree		100%	0%	0%	0%	NO	YES
BRC34H	BRC 34H	Land rear of 138-142 (Kwik Fit) South Street	0.2	Without	10		Braintree		100%	0%	0%	0%	NO	NO
BRC77H	BRC 77H	Timber yard east of Crossman House Station Approach	0.1	Without	10		Braintree		100%	0%	0%	0%	NO	NO
BRC1H	BRC1H, BRC31H	Silks Way off South Street	N/A	Without	10		Braintree		100%	0%	0%	0%	NO	NO
BRC6H	BRC6H BTE/16/0211	Cox's Yard, Land north of Rayne Road, south of Bunyan Road	0.6	Without	10		Braintree		100%	0%	0%	0%	NO	NO
BRC76H	BRC76H BTE/15/1596	Crossman House Station Approach	0.1	Without	20		Braintree		100%	0%	0%	0%	NO	NO
BRC7H	BRC7H GNBN264 BTE/15/1193	Land between London Road, Pods Brook and A120	7.6	Without	20		Braintree		100%	0%	0%	0%	NO	NO
BRSO 152	BRSO152	Land adj Braintree Railway Station	0.7	Without	100		Braintree		98%	1%	0%	0%	NO	YES
WITN 426	BTE/15/1273/OUT WITN426	Land north of Conrad Road	6.5	Without	150	Covered by Essex and Suffolk Water	Witham		100%	0%	0%	0%	NO	YES
BURE 165	BURE165	Land south of Cambridge Way	4.9	Without	85		Bures		91%	1%	7%	0%	YES	YES
BURE 166	BURE166	Land south of Cambridge Way	1.2	Without	20		Bures		100%	-7%	7%	0%	NO	YES
COG12	COG12	Cookfield, East Street	1.2	Without	12		Coggeshall		100%	0%	0%	0%	NO	YES
COGG 181	COGG181 (pt) BTE/15/1372	Land between A120 and Tey Road	1.4	Without	10		Coggeshall		100%	0%	0%	0%	NO	YES
COGG506	COGG506	Dutch Nursery West Street	2.5	Without	30		Coggeshall		79%	2%	4%	15%	NO	YES
CRESS 201	CRESS201	Land at Appletree Farm Polecat Road	2.3	Without	70		White Notley		100%	0%	0%	0%	NO	YES
EAR3H	EAR3H BTE/15/0934	Land at Station Road	2.1	Without	56		Earls Colne		100%	0%	0%	0%	NO	NO
EARC 221	EARC221	Monks Road	2.3	Without	50		Earls Colne		100%	0%	0%	0%	NO	YES
EARC 225	EARC225 BTE/15/1580	Land rear of Halstead Road	2.3	Without	80		Earls Colne		100%	0%	0%	0%	NO	YES
FEER 232	FEER230, FEER232, FEER233 BTE/16/569/OUT	Strategic Growth Location, Land south of Feering/west of A12	200.0	Without	1000		Coggeshall		100%	0%	0%	0%	YES	YES
GGHR 307	GGHR307 BTE/14/1580	Land south of Oak Road Halstead	11.8	Without	292		Halstead		100%	0%	0%	0%	NO	YES
GREY 274	GRY3H GREY274 BTE/15/1040	Nuns Walk Field	1.7	Without	29		Sible Hedingham		100%	0%	0%	0%	NO	YES
GREY 275	GRY5X GREY 275 BTE/14/1254	Hunnable Industrial Estate	1.9	Outline	53		Sible Hedingham		100%	0%	0%	0%	NO	YES
HAS26CD	HAS26CD	Land east of the High Street, off St Andrews Road	1.6	Without	50		Halstead		100%	0%	0%	0%	NO	YES
HASA 295	HAS7H	The old wood yard site Fenn Road	2.1	Without	70		Halstead		100%	0%	0%	0%	NO	YES
HASA 286	HASA286	Land at Balls Farm (at Greenways)	0.9	Without	20		Halstead		100%	0%	0%	0%	NO	YES
HASA 289	HASA289 BTE/15/1457	Land East of Cherry Tree Rise	0.8	Without	24		Halstead		100%	0%	0%	0%	NO	YES
HATF 313	HATF313 BTE/15/0463	Sorrells Field	1.8	Without	30		Witham		100%	0%	0%	0%	NO	YES
HATF 315	HATF315 HATF316	Land at Wood End Farm	16.0	Without	450		Witham		100%	0%	0%	0%	NO	YES
KELV 335	KELV335	Monks Farm land SE of Coggeshall Road	10.1	Without	300		Coggeshall		100%	0%	0%	0%	NO	YES
	Land at Marks Tey	Land at Marks Tey	N/A	Without	1150		Colchester		No site boundary provided					
RIDG 359	RIDG359	Land SE side of Ashen Road, at junction with Tilbury Road	0.8	Without	10		Ridgewell		100%	0%	0%	0%	NO	YES
RIVE 360	RIV2H BTE/15/0799	NE Witham Growth Location, East of Forest Road	16.3	Without	370	Covered by Essex and Suffolk Water	Witham		100%	0%	0%	0%	NO	YES
SIB2H	SIB2H (part) BTE/14/0688	Rockways site Station Road	6.3	Outline	113		Sible Hedingham		91%	9%	0%	0%	NO	YES
SIBH 377	SIBH377	Former Tanners Dairy Prayors Hill	2.0	Without	50		Sible Hedingham		100%	0%	0%	0%	NO	YES
SIL6RG	SIL6RG	Crittall Works and adjoining Finishing Company	0.0	Without	80		Witham		100%	0%	0%	0%	NO	YES
SILV 385	SILV385 BTE/15/1004	Land West of Boars Tye Road	1.8	Outline	60	Covered by Essex and Suffolk Water	Witham		100%	0%	0%	0%	NO	YES
STEB 395	STE1	Land at Water Lane	1.3	Without	25		Steeple Bumpstead		100%	0%	0%	0%	NO	YES
WCH14CD	WCH14CD	Land at Newlands Centre Newland Street	1.0	Without	15	Covered by Essex and Suffolk Water	Witham		100%	0%	0%	0%	NO	NO
WCH8H	WCH8H BTE/15/0237	Land adj Coach House Way	N/A	Without	11	Covered by Essex and Suffolk Water	Witham		100%	0%	0%	0%	NO	NO

GIS Reference	Site Reference	Site Location	Site Area (ha)	Planning Status	Dwellings Proposed in Plan Period	Water Supply Network Capacity	WRC	Foul Sewerage Network Capacity	% of Site in FZ1	% of Site in FZ2	% of Site in FZ3a	% of Site in FZ3b	Main River	Ordinary Watercourse
	West of Braintree	West of Braintree	N/A	Without	2500		Bocking		No site boundary provided					
WIN3CD	WIN3CD	Land at Dorothy Sayers Drive/Laburnum Avenue	0.8	Without	13	Covered by Essex and Suffolk Water	Witham		100%	0%	0%	0%	NO	YES
WITC 422	WIS06H BTE/15/0430	South West Witham Growth Location, off Hatfield Road	35.5	Outline	750	Covered by Essex and Suffolk Water	Witham		100%	0%	0%	0%	NO	YES
WITC 423	WIS10X BTE/14/1528	Former Bowls Club And Land At Old Ivy Chimneys Hatfield Road	0.8	Outline	18	Covered by Essex and Suffolk Water	Witham		100%	0%	0%	0%	NO	YES
WIS9H	WIS9H BTE/12/1071	Land south of Maltings Lane	3.6	Outline	78	Covered by Essex and Suffolk Water	Witham		100%	0%	0%	0%	NO	YES
WITC 421	WITC421	Gimsons	2.7	Without	40	Covered by Essex and Suffolk Water	Witham		99%	1%	0%	0%	NO	YES
WITC 425	WITC425	Chipping Hill Industrial Estate	0.4	Without	40	Covered by Essex and Suffolk Water	Witham		100%	0%	0%	0%	NO	YES
WITN 427	WITN427	Land north of Conrad Road	0.3	Without	10	Covered by Essex and Suffolk Water	Witham		100%	0%	0%	0%	NO	YES
WITW 431	WIW431	Land off Teign Drive	1.5	Without	40	Covered by Essex and Suffolk Water	Witham		100%	0%	0%	0%	NO	YES

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