Brentwood
Borough Council

Brentwood Scoping and Outline Water Cycle Study

Final Report

January 2011










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Executive Summary

Purpose of this Report

This Water Cycle Study assesses the capacities of water bodies and water related infrastructure to accommodate future development and growth in Brentwood Borough, and is intended to form part of the evidence base for the local development plan. The Study comprises Scoping and Outline phases of a Water Cycle Study, in line with Environment Agency guidance. The Scoping phase sets the context for the study, by agreeing the study area, agreeing objectives with a steering group and collating and reviewing available data. The Outline phase assesses environmental and infrastructure capacity to identify the most suitable locations for growth. Where constraints occur, the Outline phase will recommend further work as part of a Detailed Phase Water Cycle Study.

The study area comprises the administrative area of Brentwood Borough. A Steering Group formed to oversee the study includes representatives from Brentwood Borough Council, Environment Agency, Anglian Water, Thames Water, Essex and Suffolk Water and Veolia Water. Data provided by third party utility organisations has informed the assessment of environmental and infrastructure capacity. Housing numbers have been provided by Brentwood Borough Council.

Development Plans

At the start of this study, growth targets and development plans in England were, in part, driven by the regional planning tier, the Regional Spatial Strategies (RSS). Brentwood's emerging Core Strategy was therefore focused on delivering the minimum requirement of houses set out in the East of England Plan RSS. This required the delivery of at least 3,500 dwellings between 2001 and 2021, i.e., approximately 170 net additional dwellings annually between 2001 and 2021. An RSS review in March 2010 proposed this rate of development should continue to 2031. After subtracting an oversupply in excess of 200 dwellings, this left 3180 dwellings to deliver between 2011 and 2031.

Following the change of Government in May 2010, during the course of this study, the Secretary of State for Communities and Local Government announced he was revoking Regional Spatial Strategies. However, for the purposes of this study, the 3180 dwellings figure has been retained to assess the impacts of growth on the water cycle, with testing carried out under different spatial options and higher and lower growth rates.

Four spatial options were considered to guide the distribution and location of new housing based on Brentwood's Issues and Options consultation (2009). These include locating new housing centrally around the Brentwood urban area; developing along transport corridors; a semi dispersed option; and a dispersed option. All four options have been assessed within this report. Illustrative housing scenarios for these four options per ward are presented in Chapter 2, Table 2.2.

Housing numbers and locations are based on outstanding (i.e. unimplemented) planning permissions, Brentwood Draft Strategic Housing Land Availability Assessment (SHLAA) and spatial options set out in *Pathway to a Sustainable Brentwood* Issues and Options consultation paper (2009). Assumed windfall locations are based on the percentage of outstanding permissions for windfall sites per ward. It is important to note that sites used from the Draft SHLAA are not necessarily preferred or allocated sites, however it may be reasonably assumed for the purposes of this study that over the plan period this level of site provision, in terms of dwelling capacity, may well come forward.

The regional plan also indicated an employment growth target of between 9,000 and 18,000 new jobs in the Borough; however the location of new employment sites has not yet been identified and these are not assessed within this study. Any increase in employment land could potentially add further strain on the capacity of water infrastructure and the water environment.

Water Cycle Context

Brentwood lies in the south west of the County of Essex and is located on the watershed of the River Wid catchment, the Rivers Roding, Beam and Ingrebourne catchment (including the River Roding, Rom and Weald Brook) and the Mar Dyke catchment. Main rivers in the Borough are presented in Chapter 3, Figure 3.1.

Approximately three quarters of the study area is supplied by Essex and Suffolk Water, within their Essex water resource zone. The rest is supplied by Veolia Water Central (formerly known as Three Valleys Water, and subsequently referred to as Veolia Water). This small area of the study includes the settlements of Doddinghurst, Kelvedon Hatch and surrounding rural areas and is in the Veolia Northern water resource zone. Figure 3.4 shows water resource zones relevant to the study area.

Public sewerage services are provided predominantly by Anglian Water, with the western side of Brentwood town being served by a Thames Water wastewater treatment works. The divide between the two sewerage providers is not clearly delineated. Figure 3.6 shows the indicative catchment areas of the wastewater treatment works serving the Borough.

The Water Framework Directive (WFD) is an important piece of European legislation for matters relating to the protection of the water environment and set within a River Basin District context. The Directive sets out a requirement to prevent deterioration of current water quality and overall status, and to achieve good ecological status in rivers, estuaries and coastal waters, together with good status of groundwater by at least 2027. The River Wid is located within the Anglian River Basin District and the Roding, Beam and Ingrebourne catchment and Mar Dyke lie within the Thames River Basin District. Watercourses in the study area are either of Poor or Moderate Status, and this is presented in Figure 3.4.

Water Supply and Availability

Essex is in an area of Serious Water Stress (*Identifying areas of water stress*, Environment Agency Consultation document, January 2007). Therefore options to develop new resources are limited.

Essex and Suffolk Water's Water Resource Management Plan (WRMP) outlines a strategy to secure public water supplies over the next 25 years. The key element of the strategy is to increase the capacity of Abberton reservoir. Demand management is also a core element of the strategy but this will not remove the deficit in the short term. Planning permission has been granted for the Abberton scheme and Asset Management Plan for the period 2010 to 2015 (and AMP5) funding has been approved. The construction of a raised reservoir began in January 2010 and is due to be completed by December 2012.

Veolia Water's resources are dominated by groundwater and options to secure public water supplies are, therefore, different. The Company's preferred strategy is constrained to securing supplies through demand management rather than developing new resources. Demand management will be led throughout the planning period to 2035 although there is a significant uncertainty over whether demand reductions will be sustained in the longer term. Key aims of the WRMP are to continue enhancing existing resources, compulsory metering, reduce leakage, further water efficiency advice for customers and research resource development with other water companies.

Based on water company plans, water supply is not seen as a constraint to potential growth in Brentwood Borough. By assessing various water efficiency levels in new homes, it has been shown that a saving of approximately 3.5Ml/d could be achieved by making it compulsory for all new homes to meet the water consumption level from the Code for Sustainable Homes Level 3 /4

Water Quality and Wastewater Treatment

The water quality of rivers in the study area is generally Moderate Status, with Poor Status present on the Rivers Ingrebourne, MarDyke and Wid. There is potential for growth to increase pressure on meeting the WFD target of Good Status if growth levels exceed existing wastewater discharge consents. Detailed modelling is required to assess the impacts of growth on effluent and on receiving water quality, which lies outside the scope of this study. However, a high level assessment of quality constraints and future flow capacity has been undertaken.

There are currently no constraints with regard to the wastewater treatment process in terms of discharge quality. The Environment Agency's no deterioration policy in water quality is expected to apply to all future wastewater discharges (quality permits) in the area. The WFD however is not only about maintaining existing water quality standards but is also about striving for improvements. Tightening of permits (for quality) may be considered for the next River Basin Management Plan or the next Price Review in order to achieve 'Good'. This could potentially constrain works, even without any need to increase the flow consent.

The flow volume capacity at wastewater treatment works must also be considered. Capacity for future growth has been assessed by comparing the consented flow volume from the environmental permit with the estimated total

increase in flow at the end of the growth period, apportioning housing numbers per works according to the four spatial options described above. This assessment, together with advice provided by the Environment Agency and Anglian Water, identifies that treatment works at Doddinghurst and Ingatestone are currently at capacity and unable to receive any additional flow without breaching the permitted flow volume.

This lack of capacity affects potential growth in Tipps Cross, Ingatestone Fryerning and Mountnessing Wards and the eastern half of Brizes and Doddinghurst Ward (including Kelvedon Hatch and Doddinghurst). It is recommended that growth in these areas be avoided and instead, alternative locations identified to accommodate necessary growth elsewhere in the Borough. A more detailed assessment and modelling would be required to determine whether any minor growth can be accommodated in these areas.

Flood Risk and Sustainable Drainage

A Level 1 Strategic Flood Risk Assessment prepared alongside the Scoping and Outline WCS has identified that fluvial flood risk is not widespread in the Borough and that growth can be accommodated in the lowest flood risk areas. The greatest risk of flooding potentially arises from surface water flooding in urban areas, although these risk areas are also not widespread.

The Level 1 SFRA and WCS note there is capacity to use infiltration drainage techniques across the Borough and recommend their use. Surface water drainage from new or redevelopments should first consider infiltration techniques, followed by controlled discharge to watercourses through approval from the EA, or finally by controlled discharge into the surface water drainage system through approval from the drainage provider. It should be noted only water free from pollutants is suitable for infiltration. All sites should separate surface water and foul water discharges.

Recommendations

Based on the water cycle elements, the Centralised Growth option is seen as the preferred option. A summary of the main constraints associated with the different spatial options is presented below.

Growth Option	Constraint and Mitigation Required
Option 1: Centralised Growth	**PREFERRED OPTION** Housing numbers provided for this assessment still provide for minimal development in the Ingatestone and Doddinghurst WwTW catchments, which have no capacity for growth. Mitigation is required to enable this option to be delivered. This could comprise either relocation of development or additional assessment of WwTW and receiving water capacity within existing consent.

Growth Option	Constraint and Mitigation Required
Option 2: Transport Led Growth	Housing numbers provided for this assessment still provide for minimal development in the Doddinghurst WwTW catchment and increased housing compared to Option 1 in Ingatestone WwTW catchment, both of which have no capacity. The mitigation required to enable this option to be delivered could be more costly than Option 1 and include additional revisions to Ingatestone WwTW consent, which would need approval from the Environment Agency.
Option 3: Semi-Dispersed Growth	Increased housing numbers in both Doddinghurst and Ingatestone compared to Options 1 and 2. It is unlikely that Anglian Water and the Environment Agency would permit increasing both consents at these two works.
Option 4: Dispersed Growth	Increased housing numbers in both Doddinghurst and Ingatestone compared to Options 1, 2 and 3. It is unlikely that Anglian Water and the Environment Agency would permit increasing both consents at these two works.

Recommendations for policy and future work are presented below.

Summary of WCS Recommendations
Recommendation 1: Centralised Growth Option It is recommended that the Council promotes the Centralised Growth Option. The WCS has identified the capacity of wastewater treatment works in the north of the Borough as the main limiting factor, therefore Option 1 which has the least amount of growth proposed in this area is considered preferable.
Recommendation 2: Policy for water efficiency Planning policies should require developers to design all new homes to meet the minimum water use standard in Level 3/4 of the Code for Sustainable Homes (105 l/p/d) or ensure any wider sustainable design policy, development plans or briefs require this standard for water use. The local planning authority should consider a policy for non-household development making it mandatory for commercial buildings to be assessed by a BREEAM assessor, with the expectation that buildings meet Good standard for water consumption targets for the building type (industrial/commercial/office/retail/education etc).
Recommendation 3: Additional work to address constraints The Council should consider identifying alternatives to growth in Doddinghurst and Ingatestone elsewhere in the Borough, as the study has identified there is no capacity for growth at these wastewater treatment works. If alternative locations for accommodating necessary growth cannot be found, a detailed assessment of the impacts of growth on the flow consent and receiving watercourse in the Doddinghurst and Ingatestone sewer catchments should be carried out in an addendum to this WCS.

Summary of WCS Recommendations

Recommendation 4: SuDS Policy

All development should include appropriate sustainable drainage systems (SuDs) for the disposal of surface water, in order to avoid any increase in flood risk or adverse impact on water quality.

For brownfield developments SuDs features shall be required so as to achieve a reduction from the existing runoff rate but must at least, result in no net additional increase in runoff rates.

SuDs features should normally be provided on-site. If this cannot be achieved, then more strategic forms of SuDs may suffice. In such circumstances, developers will need to contribute toward the costs of provision via Section 106 Agreements or the strategic tariff. In all cases, applicants will need to demonstrate that acceptable management arrangements are funded and in place so that these areas are well maintained in future.

SuDs should be sensitively designed and located to promote improved bio-diversity, an enhanced landscape and good quality spaces that improve public amenities in the area.

The preferred hierarchy of managing surface water drainage from any development is through first infiltration measures, secondly attenuation and discharge to watercourses, and if these cannot be met, through discharge to surface water only sewers.

Recommendation 5: Disconnection of surface drainage from foul network

It is recommended that the Council adopts a policy that will ensure redeveloped brownfield sites disconnect any surface water drainage from the foul network.

Recommendation 6: Water sustainability assessment for all developments

It is suggested that the Council considers a policy which makes it compulsory for all new developments to submit a Water Sustainability Assessment as part of their planning application. This would enable developers to demonstrate that their application meets the criteria recommended in parts 2, 4 and 5 above. That is developers should demonstrate:

1. the development will meet the water consumption level 3/4 from the Code for Sustainable Homes for all residential developments
2. non-residential developments should demonstrate that they have been assessed by a BREEAM assessor, with the expectation that buildings meet Good standard for water consumption targets for the building type
3. for all developments SuDS have been incorporated to control surface water run-off
4. for the redevelopment of brownfield sites, any surface water draining to the foul sewer network has been disconnected and is managed through SuDS
5. a Flood Risk Assessment has been completed where required. This should be approved by the Environment Agency and in line with the requirements of Planning Policy Statement 25
6. the developer has contacted the sewerage provider to assess the capacity of the receiving foul sewer network and the need to contribute to any additional off site connections for the development
7. the developer has contacted the water supply provider to assess the requirements for supply infrastructure to the development

Contents

Glossary

AMP	Asset Management Plan
AWS	Anglian Water Services Ltd
BOD	Biological Oxygen Demand
BREEAM	Building Research Establishment Environmental Assessment Method
CAMS	Catchment Abstraction Management Strategy
CLG	Communities and Local Government
CFMP	Catchment Flood Management Plan
CSH	Code for Sustainable Homes
CSO	Combined Sewer Overflow
Defra	Department for Environment, Food and Rural Affairs
DPD	Development Plan Document
DWF	Dry Weather Flow
EA	Environment Agency
EIA	Environmental Impact Assessment
ESW	Essex and Suffolk Water
GIS	Geographical Information System
GQA	General Quality Assessment
IUD	Integrated Urban Drainage
LDF	Local Development Framework
l/h/d	Litres per household per day
LPA	Local Planning Authority
Ml/d	Megalitres per day
pcc	Per capita consumption
PPS25	Planning Policy Statement 25
PR	Periodic Review (for water companies' investment plans)
RBD	River Basin District
RBMP	River Basin Management Plan
RSS	Regional Spatial Strategy
SAC	Special Area of 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
TW	Thames Water
WCS	Water Cycle Study
WFD	Water Framework Directive
WRMP	Water Resource Management Plan
WRZ	Water Resource Zone
WwTW	Wastewater Treatment Works
UKCIP	United Kingdom Climate Change Impacts Programme
UKCP	United Kingdom Climate Projections

1. Introduction

1.1 Background and Aims

A Water Cycle Study (WCS) is one of a number of strategic studies used by Local Planning Authorities (LPAs) as part of the evidence base for Local Development Plans and Frameworks. The Study will propose necessary strategic infrastructure and policy requirements to achieve planned growth without compromising, and where possible enhancing, the water environment. It also aims to identify the phasing of water infrastructure requirements so that these do not constrain the timing of proposed development, in this instance, up to 2031. Where environmental constraints on housing growth exist that cannot be accommodated by infrastructure solutions these are identified and recommendations for further work made.

Key issues that should be addressed in a WCS include:

- Assessing the capacity of the current water infrastructure to accommodate growth without adversely affecting the environment by considering:
  - The availability of water resources;
  - The capacity of the existing infrastructure for supply, sewerage and drainage;
  - The environmental capacity of receiving watercourses to receive wastewater; and
  - The potential to increase flood risk.
- Determining the potential impact of development in the context of requirements of environmental legislation including the Water Framework Directive, Habitats Directive and any other relevant water cycle policy;
- Identifying the infrastructure necessary to achieve growth within the constraints of the environment and legislation; and
- Developing a strategy for a phased approach to development that allows for growth whilst providing sufficient time for the identified infrastructure needed to support development to be adopted.

The Study provides a mechanism to bring together the range of water related issues under a single framework and ensure that stakeholders have their say. Most of the data and information used in a Water Cycle Study already exists within stakeholder organisations and one key benefit of the partnership approach is unlocking and joining up this understanding and information and making it available to others.

It is important to understand the different scales at which the artificial elements of the water cycle (water supply, sewerage and drainage) are managed, and the impacts this has on assessing constraints to growth. Water supply is managed strategically, as there is a high level of connectivity in the water supply network and water can be moved great distances from raw water sources (rivers, reservoirs, or groundwater) to the point of delivery. Generally, new

developments can be connected to the main system relatively easily in most cases. In contrast, wastewater treatment works (WwTW) have much smaller defined catchment areas and so the location of development relative to the capacity of the nearest treatment works and receiving water can be critical. Although drainage issues are specific to individual developments, the integration of drainage development across sites offers significant potential for green space/habitat creation, in addition to reducing flood risk and potentially water demand.

A Level 1 Strategic Flood Risk Assessment (SFRA) has been prepared by Entec alongside this Water Cycle Study, to review flood risks to the Borough. The findings of the SFRA are summarised within Section 3.5 of this study.

1.2 The Water Cycle and National Guidance

The Water Cycle describes the pathways and processes through which the water we use moves through the natural environment, as well as through the above and below ground infrastructure on which the domestic population and industry depend. Figure 1.1 illustrates the traditional image of the water cycle showing the various routes that water and water vapour travel within a river basin from the formation of rainclouds to eventual discharge to the sea.

Figure 1.1 Traditional Water Cycle without Artificial Influence

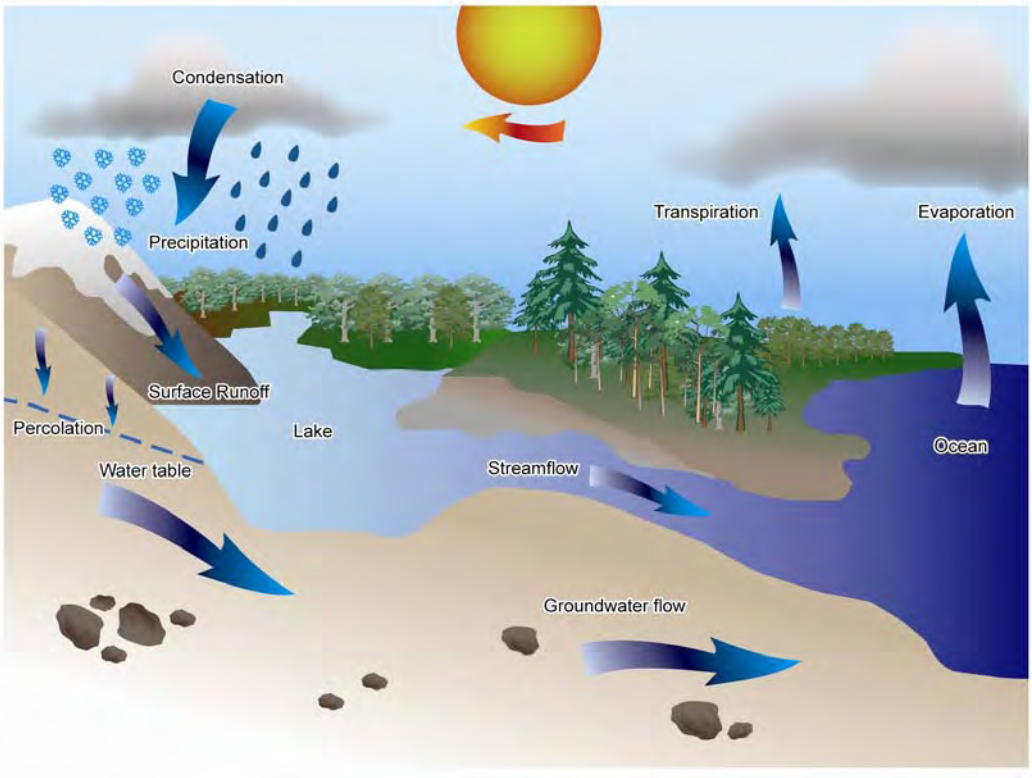
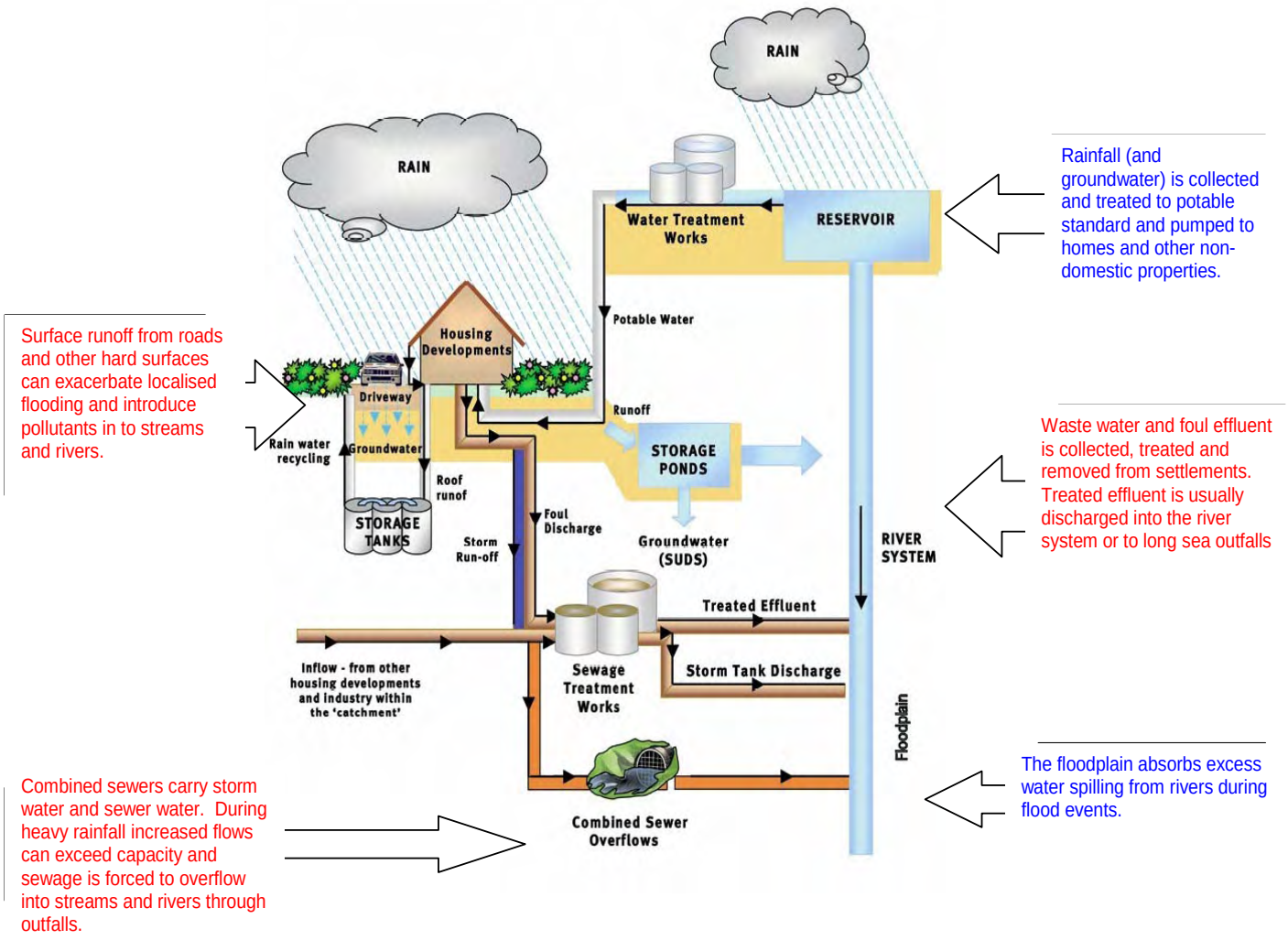


Figure 1.2 illustrates the added complexities within the urban water cycle (in schematic form) as a result of housing development and the infrastructure required to support it. The main differences between the natural and the urbanized water cycle relate to the rate of surface runoff (and percolation in to the ground), and the streamflow. In

the urbanized cycle, water is captured and stored for use, and this water generally only re-enters the river network once it has been used and then treated at wastewater treatment works. Heavy rainfall events, however, can lead to untreated wastewater being discharged through sewer overflows. Hence, the timing and quality of water entering the river network can be significantly different in the urban version of the cycle.

Figure 1.2 Schematic Urban Water Cycle based on Current Practice



Source of background figure: Environment Agency website

The Environment Agency (EA) has issued National Guidance to ensure that water cycle studies are carried out in a consistent way (http://publications.environment-agency.gov.uk/pdf/GEHO0109BPFF-e-e.pdf). This guidance outlines the required approach for the Scoping, Outline and Detailed phases of water cycle studies. These are explained below.

- **Scoping**: The primary aim of the Scoping Phase is to collate and review existing information (e.g. previous studies and monitoring data) on the water environment within the study area, identify development plans and engage with key stakeholders, including the Environment Agency, water companies and drainage authorities, to identify key issues that require consideration in the following stages of the work;

- **Outline**: The primary aim of the Outline Phase is to identify potential environmental and water infrastructure constraints to development to provide an evidence base to support the Core Strategy and identification of preferred sites for development. The study should identify areas of uncertainty that may require further detailed studies;

- **Detailed**: The Detailed Phase aims to resolve areas of uncertainty identified in the Outline Phase through further more detailed studies. It identifies what water cycle management measures and infrastructure are needed, where and when they are needed, who is responsible for providing the systems, and by what deadline. This may involve an assessment of the costs and benefits of options. It also provides guidance to the local authorities to facilitate implementation and funding of the Strategy.

This report comprises a combination of the Scoping and Outline phases as set out in the National Guidance.

1.3 Structure of the Report

This report is structured by the following chapters:

- **Chapter 2: Development and Growth**, provides an overview of the national and local policies relevant to growth and the water environment in Brentwood Borough;

- **Chapter 3: Existing Water Environment**, presents the baseline scenario of water resources, water quality, wastewater treatment, sewerage and flood risk;

- **Chapter 4: Neighbouring Issues,** summarises the findings of Water Cycle Studies from neighbouring authorities, where these have been completed;

- **Chapter 5: Potential Constraints to Development**, reviews baseline data to determine where constraints to growth exist in the Borough;

- **Chapter 6: Capacity for Growth**, assesses the capacity of the environment and water infrastructure during the proposed growth period against spatial growth options under consideration;

- **Chapter 7: Climate Change**, reviews the impacts that should be considered from climate change on the water cycle; and

- **Chapter 8: Conclusions and Recommendations**, summarises the findings and presents the preferred growth option and policy recommendations.

Chapters 3 and 4 presents the tasks for the Scoping phase of the study, comprising the data and literature review. Chapters 5 to 8 present the core tasks of the Outline phases.

The data and analyses presented in this combined Scoping and Outline Phase provide an evidence base for making planning decisions at a strategic level. This evidence should be used to consider which options will best support land allocations and planning policies. It does not provide an instant answer for determining individual planning applications but provides a guide at a strategic level on potential constraints in the water environment and related infrastructure.

1.4 The Study Area

The Study Area agreed by the Steering Group includes the whole of Brentwood Borough administrative area. Mapping outputs present the local authority boundary in the context of the water environment and related infrastructure. Where necessary a wider area has been reviewed, for example to determine the water resource planning and wastewater treatment works catchments that overlap neighbouring authority areas.

Brentwood Borough is predominantly rural with a population of approximately 73,200 (Office of National Statistics 2008 mid-year estimate). The main settlement is the town of Brentwood, with the next biggest settlement the village of Ingatestone, followed by the remaining small to large villages.

2. Development and Growth

2.1 Planning Policy Context

National and local planning policy sets out guidance and requirements for delivering sustainable development and therefore addresses, amongst other things: housing and employment growth and its distribution; water management and protection; infrastructure provision; and flood risk management. In May 2010, the new Government announced they were to abolish the regional planning framework. The following sections therefore outline current relevant planning policy for the study area. Section 2.1.2 discusses the recent regional changes in more detail.

2.1.1 National Policy

Government guidance is provided through a series of Planning Policy Statements (PPSs), the most relevant of which are summarised in the table below.

Table 2.1 National Planning Policy

PPS1 Delivering Sustainable Development, Supplement to PPS1: Planning & Climate Change
PPS1 and its 2006 supplement sets out how the planning system can deliver sustainable development by responding to climate change including achieving zero carbon development and implementing the Code for Sustainable Homes. PPS1 requires local planning authorities (LPAs) to prepare development plans which are in line with the principles for sustainable development and promote outcomes in which environmental, economic and social objectives are achieved together over time. This should be achieved using a spatial planning approach. Specifically, planning authorities should identify land suitable for meeting housing and other types of development taking into account the need to provide essential infrastructure and avoid flood risk. PPS1 advises that LPAs should promote amongst other things: - the sustainable use of water resources; and - the use of sustainable drainage systems in the management of runoff. The supplement advises LPAs to take into account the capacity of existing and potential infrastructure including water supply, sewage and sewerage, to service future development sites in ways consistent with successfully adapting to likely changes in the local climate.

Table 2.1 (continued) National Planning Policy

PPS3 Housing
PPS3 (2010) underpins the delivery of the Government's strategic housing policy objectives where the goal is to ensure that everyone has the opportunity to live in a decent home, which they can afford, in a community where they want to live. Most future development within the district will be for housing. PPS3 requires that 'new housing should be built on previously developed land' (PDL) before greenfield land. PPS25 reiterates this requirement in its Exception Test.
PPS12 – Creating Strong, Safe and Prosperous Communities through Local Spatial Planning
PPS 12 (2008) outlines the nature of local spatial planning and the key components of local spatial plans and how they should be prepared. It should be taken into account by LPAs in preparing Local Development Frameworks (LDFs) which include development plan documents (DPDs) and other local development documents (LDDs). With regard to infrastructure, PPS12 states that Core Strategies should be supported by evidence of what physical, social and green infrastructure is needed to enable the amount of development proposed for the area, taking account of its type and distribution. This evidence should cover who will provide the infrastructure and when it will be provided. The Core Strategy should draw on and in parallel influence any strategies and investment plans of the local authority and other organisations. **The water cycle study forms part of the robust and credible evidence base which will underpin policies within the Authority's local development plan.**
PPS23 – Planning and Pollution Control
PPS23 advises that "any consideration of the quality of land, air or water and potential impacts arising from development, possibly leading to impacts on health, is capable of being a material planning consideration" so that potential contamination can be identified at an early stage and mitigated through planning.
PPS25 – Development and Flood Risk
PPS25 aims to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding. It also aims to ensure that new development does not increase the risk of flooding elsewhere. Where, in exceptional circumstances, new development is necessary in such areas then the aim is to make it safe without increasing flood risk elsewhere and, where possible, to reduce flood risk overall. This approach is supported in the Government's Pitt review of the summer 2007 flooding, in which the comments in PPS25 are reiterated. It makes it clear that developments within flood zone 2 and 3 should not be allowed to proceed unless there is clear proof that they are compatible developments for these zones, and that LPAs should become responsible for local flooding.

2.1.2 Regional Context

As the region is one of the driest in England, water resources are limited, with supply-demand known to be a problem in particular areas. Regional policy provided key guidance regarding water infrastructure, efficiency, integrated management and flood risk in the East of England. In particular, it advocated a co-ordinated approach to plan making through a programme of water cycle and river cycle studies to ensure proposed growth is sustainable and to help address issues of water supply and quality, wastewater treatment and flood risk currently experienced and forecast for the future should growth occur.

Under the Planning and Compulsory Purchase Act 2004, Regional Spatial Strategies replaced Structure Plans as the strategic planning framework for regions in England. The Regional Spatial Strategy (RSS) for the East of England (known as the East of England Plan) was adopted in May 2008 and provided a regional framework within which Local Planning Authorities prepare their Local Development Frameworks (LDFs) for the period to 2021. At the start of this study, the RSS was being reviewed to provide a framework to 2031.

During the course of this study the Secretary of State for Communities and Local Government announced he was revoking Regional Spatial Strategies (letter to Chief Planning Officers, 6 July 2010) and would be bringing forward legislation in the Autumn in the form of a Localism Bill to provide the legal basis for their abolition. The aim of this new bill is to encourage local planning authorities to be the responsible authorities for determining the right level of local housing provision in their area without the influence of regional housing targets.

Brentwood Borough is part of the London Arc, which comprises the areas closest to and most strongly influenced by London, as well as bordering the Chelmsford Growth Point and Thames Gateway Growth Point. The East of England Plan required the delivery of at least 3,500 dwellings between 2001 and 2021 in Brentwood and the creation of 56,000 jobs in Braintree, Brentwood, Chelmsford, Epping Forest, Harlow, Maldon, and Uttlesford, which could result in between 9,000 and 18,000 new jobs in Brentwood Borough up to 2031 (*Greater Essex Study*, Essex County Council, 2009). Growth at this level would increase the demand for water and sewerage services. The East of England Plan Review proposed house building for the Borough should continue to 2031 at the level set out in the 2008 adopted RSS, i.e. an annual average of 170 homes.

Although regional policies will, following legislation, no longer form part of the development plan for Brentwood, the need for a co-ordinated approach continues. Following the abolition of regional housing targets, local authorities will need to determine the level of house building in their areas. In common with other local authorities, Brentwood Council had been planning for housing in line with the RSS target, but in light of the changes the Council may decide to revisit district wide housing numbers.

It should be noted that the latest available information with regards to housing and employment targets has been used at the time of writing, i.e. regional plan targets, and these figures may be subject to change. Potential housing trajectories for the Borough used in this study are set out in the following section. Fundamental changes to the planning framework during the course of this study, described above, mean, therefore, that these trajectories should be treated as hypothetical and in no way exhaustive.

2.1.3 Local Planning Policy

The Core Strategy / Development Plan

Up until the change of Government in May 2010, work towards a Core Strategy was focused on delivering the minimum requirement of houses set out in the RSS, i.e., approximately 170 net additional dwellings annually. After subtracting an oversupply in excess of 200 dwellings (between 2001 and 2009 house building exceeded the regional target), this left 3180 dwellings to deliver between 2011 and 2031.

In December 2009 Brentwood Council and Local Strategic Partnership consulted on four spatial options to guide the distribution and location of new housing (*Pathway to a Sustainable Brentwood* consultation document). This includes: provision of housing centrally around Brentwood; an option focussed on dispersing housing along transport corridors; a semi dispersed option; and a dispersed option. Table 2.2 sets out the four spatial options, and housing numbers used in the WCS assessment by ward. Each growth option sees the delivery of 3,180 homes between 2010 and 2031. It is the Council's preference to use suitable brownfield sites in line with the requirements of PPS3, rather than greenfield sites, where this is feasible.

Due to the division in Brentwood town between two wastewater treatment works, the Central Growth Option 1 is assessed using two scenarios, considering greenfield development in either the Thames Water or in Anglian Water sewerage catchments. These are presented later in the report as Option 1a (greenfield development in Brentwood wastewater treatment works catchment) and Option 1b (greenfield development in Shenfield wastewater treatment works catchment). Appendix A gives a breakdown of development per treatment works.

Table 2.2 Illustrative Growth Scenarios Assessed (no. of houses)

Ward	Centralised Option 1	Transport Led Option 2	Semi Dispersed Option 3	Dispersed Option 4
Brentwood Wards	2041	1681	1611	1541
Brizes and Doddinghurst	34	34	104	134
Herongate, Ingrave and West Horndon	20	160	160	230
Hutton Wards	377	377	377	377
Ingatestone	96	216	176	144
Pilgrims Hatch	98	98	98	98
Shenfield	27	127	97	57
South Weald	26	26	26	26
Tipps Cross	33	33	103	133
Warley	428	428	428	440
Total	**3180**	**3180**	**3180**	**3180**

Appendix A sets out the breakdown of development by type (planning permission, windfall and SHLAA sites) by wastewater treatment works, used in the study

Data Sources for Potential Development Sites

Housing numbers have been sourced from the following:

- Brentwood Draft Strategic Housing Land Availability Assessment (SHLAA), work undertaken by consultants during the Outline WCS programme;
- Outstanding, i.e. unimplemented, planning permissions; and

- Assumed windfall locations and number based on the percentage of outstanding permissions for windfall sites per ward, provided by Brentwood Borough Council.

Information provided by the Council suggests that an annual average of 78 new homes can be expected to be built on windfall sites each year in the Borough. This study only takes into account half the total expected number of windfalls over the period modelled, however. The reason for this is to remain consistent with the Draft SHLAA, which discounts windfall sites from the first ten years, and to keep the overall Borough housing figure in line with the (former) regional target.

Assumed Distribution of Development Types

Under all options, all brownfield sites identified in Appendix 4 of the Draft SHLAA as being potentially developable sites have been included in the assessment, with the exception of one site at Woodlands School, Warley. Due to its location, this site has only been included in Option 4: Dispersed Growth. No assumption has been made whether specific sites will come forward for development or be allocated but it may be reasonably assumed for the purposes of this study that over the plan period this level of brownfield site provision will be identified.

Figures for the number of homes on greenfield sites have been provided by the Council per ward. These are based on the assumption that the majority of future development in the Borough will take place on brownfield land and that the Council will need to make up any shortfall to meet the eventual agreed level of growth by allowing development on greenfield sites. Approximate numbers of homes on greenfield sites needed to make up the deficit have subsequently been mapped to indicative wastewater treatment work catchments for this study. As discussed above, as Brentwood wards are divided between Thames Water Brentwood WwTW and Anglian Water Shenfield WwTW, the Centralised Option 1 has been assessed under two scenarios. Option 1a assumes greenfield development takes place on sites in Brentwood urban area served by Brentwood WwTW, and Option 1b assumes greenfield development takes place on sites in Brentwood urban area served by Shenfield WwTW.

Whilst the regional plan indicated an employment growth target which could result in between 9,000 and 18,000 new jobs in the Borough, the location of future employment has not yet been identified and is therefore not included in the assessments of this study. Any increase in employment land could potentially add further strain on the capacity of the water infrastructure and water environment.

This Water Cycle Study has reviewed the existing water environment and the potential impacts of the four growth options. This assessment has been used to recommend policies and measures for sustainable growth and has suggested which of the four spatial options is preferable with regard to the water environment and constraints. The study will therefore assist the delivery of growth in a timely and structured manner and help ensure that an integrated approach to the management of the water environment is applied throughout the Borough.

2.2 Water and Sewerage Infrastructure Planning

Water and sewerage companies plan for investment in infrastructure to supply new development through the Asset Management Plan (AMP) process which runs in five year cycles. This process is regulated by the Water Services Regulation Authority (OFWAT), which reviews the plans and sets the level of investment the water company can deliver in the AMP period.

The current AMP period is AMP5 (2010-2015) and water companies have recently completed the process of preparing their programme and capital expenditure plan, referred to as Price Review 2009 (PR09). The Water Cycle Study covers a longer planning period and can therefore inform longer term water company asset planning.

Within the study area, water supply is divided between Essex and Suffolk Water and Veolia Water Three Valleys. Public sewerage is provided by Thames Water, in the west of Brentwood town, and by Anglian Water over the remaining parts of the Borough.

Water companies are required to produce Water Resources Management Plans (WRMP) which report longer term planning related to the development of water resources over a period of 25 years. The Water Resource Management Plan identifies investment in water resources schemes to meet additional demand related to population growth and changes in per capita consumption of water. This study has used the findings of the WRMP for Essex and Suffolk Water and Veolia Water Three Valleys to determine the water resource capability for growth in the Borough.

2.3 Legislation and Guidance

Legislation and guidance for water related issues, such as water quality, flood risk management and urban drainage, have a significant impact on managing the urban water cycle and are often the cause of changes in water infrastructure, as much as development pressures.

There is currently an unprecedented level of change in the legislation and guidance for water related issues. Some of these changes are driven by European Directives; others are in response to national pressures, for instance from the 2007 summer floods. These changes are either currently being implemented, soon to be applied or likely to change in next five to ten years. Given that the timetable for the Water Framework Directive (WFD) spans the next 18 years in three six-year cycles, water companies expect to use the first period to carry out the majority of investigations to establish the necessary investment. This will provide an opportunity to assess improvements delivered through other quality investments.

Primary legislation which sets the context relating to the water cycle is summarised in Table 2.3 below.

Table 2.3 Primary Water Related Legislation

Water Framework Directive
The Water Framework Directive sets out a requirement to achieve good ecological status in rivers, estuaries and coastal waters, together with good status of groundwater by at least 2027. It presents a unique opportunity for holistic environmental management for all users of the water environment. The WFD is set within a River Basin Planning context. The Environment Agency has divided England and Wales into nine river basin districts in order to manage targets on both surface water and groundwater quality. For each River Basin District, a River Basin Management Plan has been prepared for protecting and improving the water environment in line with WFD requirements. River Basin Management Plans were published in December 2009 and set the objectives and programme of measures to meet these objectives for first River Basin Planning cycle, running until December 2015. **Brentwood Borough is located on the boundary of the Thames and the Anglian River Basin Districts and as such both the Thames and Anglian RBMP have been consulted for this study (refer to Section 3.1).**
Habitats Directive
The Habitats Directive recognises the increasing demand and pressure on wildlife from human activity and aims to protect the wild plants, animals and habitats that make up our diverse natural environment. The European Directive created a network of protected areas of national and international importance. These are called 'Natura 2000' sites and include Habitats Directive Special Areas of Conservation (SACs). The Habitats Directive has been transposed into English law as the Conservation (Natural Habitats &c) Regulations 1994, now known as the Habitats Regulations. Existing and future water management has the potential to affect a number of the designations and the Environment Agency Review of Consents process has identified a series of amendments that will be required to existing abstraction licences and discharge consents if adverse effects on the European Sites are to be avoided.
Urban Wastewater Treatment Directive
The Urban Wastewater Treatment Directive (UWWTD) regulates the collection and treatment of wastewater from residential properties and industry. Under this Directive receiving waters can be designated as 'Sensitive' where additional levels of treatment are required at significant contributing discharges. These can either be direct discharges or those upstream of the designated reach / water body that serve a population equivalent in excess of 10,000. One type of sensitive area is the "Sensitive Area [Eutrophic]", where elevated nutrient concentrations, mainly nitrogen or phosphorus, present a risk to the ecological status of the receiving water. In these areas, larger sewage discharges must be treated to reduce nutrient loads.

Table 2.3 (continued) Primary Water Related Legislation

Nitrates Directive
Adopted by the European Union in 1991, this Directive aims to reduce water pollution caused by nitrogen from agricultural sources and to prevent such pollution occurring in the future. The Directive requires Defra and the Welsh Assembly Government to identify surface or groundwaters that are, or could be high in nitrate from agricultural sources. Nitrogen is one of the nutrients that can affect plant growth. Once a surface water or groundwater has been identified as being high or potentially high in nitrate from agricultural sources, all land draining to that water is designated as a Nitrate Vulnerable Zone. Within these zones, farmers must observe an action programme of measures which include restricting the timing and application of fertilisers and manure, and keeping accurate records.
Freshwater Fish Directive
Designed to protect and improve the quality of rivers and lakes to encourage healthy fish populations. It sets water quality standards and monitoring requirements for areas of water which are chosen, or 'designated' by Defra. These 'designated' areas of water are selected because they are significant bodies of water which are capable of supporting fish populations.
Floods Directive and Flood Risk Regulations 2009
The Floods Directive is designed to help Member States prevent and limit floods and their damaging effects on human health, the environment, infrastructure and property. It requires Member States to first carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding. For such zones they would then need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention, protection and preparedness by 2015. The Directive applies to inland waters as well as all coastal waters across the whole territory of the EU. The Flood Risk Regulations 2009, published December 2009, transposes the Directive into UK law. The regulations set the legislative obligation for relevant authorities to provide information to the Environment Agency where reasonable to fulfil the requirements of the Floods Directive. Named authorities in the regulations include the lead local flood authority, a district council for an area, an internal drainage board(s), a highway authority, water company, reservoir undertakers, navigation authority, Natural England, Historic Building and Monuments Commission for England, the Countryside Council for Wales and Welsh Ministers.
Floods and Water Management Act 2010
The Flood and Water Management Act was published in April 2010. It is designed to improve how the UK prepares for and responds to flood emergencies and better protect water quality and water supplies during drought. It also gives 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. As well as giving more responsibility to water and sewerage companies it encourages 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.

3. Existing Water Environment

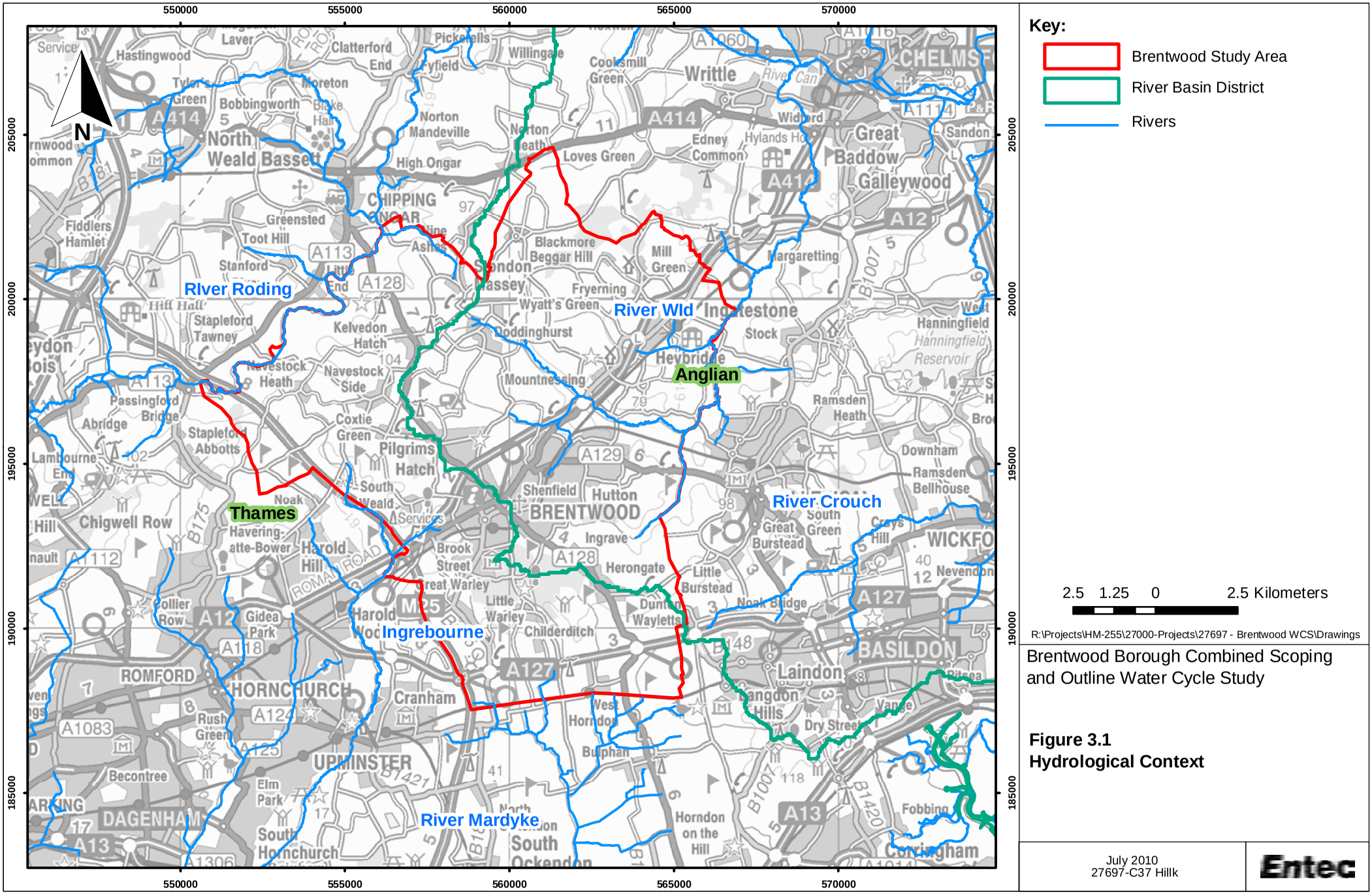
3.1 General Setting

Brentwood lies in the south west of the county of Essex, adjacent to and east of the Greater London Metropolitan area and is located entirely within the Metropolitan Green Belt. The M25 forms the Borough's western boundary with the London Borough of Havering. The Borough is predominantly rural in character and less than 20% of the land area is built up. The town of Brentwood is the only significant settlement, comprising some 50,000 residents (of the Borough's total population of 73,000).

The rural areas of the Borough comprise small villages set within a rolling landscape, comprising a mix of agricultural land, woodlands and parks. With regard to hydrology, Brentwood is located on the watershed of the River Wid catchment, the Rivers Roding, Beam and Ingrebourne catchment (including the River Roding, Rom and Weald Brook) and the Mar Dyke catchment. The catchment divide runs predominantly north south through the west of the Borough, with the River Wid lying within the WFD Anglian River Basin District and draining north to the North Sea via the River Chelmer, and the Roding, Beam and Ingrebourne catchment and Mar Dyke lying within the WFD Thames River Basin District, and draining to the River Thames.

The average annual rainfall received within the study area is 594mm, as monitored at Margaretting and Gaynes Park (standard period 1961 to 1990 average). This is less than the average of 897mm for England and Wales (Source: Met Office, Centre for Ecology and Hydrology, Wallingford, UK).

The main rivers in the Borough are presented in Figure 3.1 below, which also presents the divide between the two Water Framework Directive river basins.



3.2 Water Supply

Water supply undertakers (water companies) have a statutory duty to provide public water supplies. The Environment Agency is responsible for managing water resources in the form of reviewing, granting (or refusing) water abstraction licences. It is the water companies' responsibility to manage water once it enters the supply network. Water companies' supply areas are broken down into water resource zones (WRZ). A WRZ is defined as the largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a resource shortfall. These zones are often not co-incident with surface water catchments and represent networks of supply sources, rather than river catchments or aquifers. This section presents relevant water resource information in terms of these zones.

Information on public water supply has been taken from Essex and Suffolk Water and Veolia Water Central Water Resource Management Plans (WRMPs). Additional information on local supply infrastructure has also been made available by the companies, specifically for the purpose of this study.

Approximately three quarters of the study area is supplied by Essex and Suffolk Water, within their Essex water resource zone. The rest is supplied by Veolia Water Central (formerly known as Three Valleys Water, and subsequently referred to as Veolia Water). This small area of the study including the settlements of Doddinghurst, Kelvedon Hatch and surrounding rural areas is in the Northern water resource zone.

Figure 3.2 shows the regional scale of the Essex and Northern water resources zones. It shows the area over which growth in the study area could contribute to pressure, and the graphs presented summarise the companies' baseline supply / demand forecast, which is discussed further in Section 3.2.1 below.

3.2.1 Water Resource Management

Water companies plan how they will manage supply and demand based on forecasts of annual average conditions in a dry year, and also in a peak demand period, if they have one. The following paragraphs report on deficits that are forecast in dry years and/or peak periods. In basic terms a dry year is one in which demand for water is more than is usual in a typical 'normal' year. A 'peak period' represents average daily demand during the hottest/driest point usually at the height of summer. To remove the effect of intense demand over a few days, the peak period is usually based on demands over a few weeks. A peak period is not the same as a drought. Droughts are defined based on water resource trigger levels. A water company can plan to manage its resources specifically to cover peak demand periods, preventing drought conditions occurring. In many cases a water company abstraction license permits more abstraction during the peak period than during the rest of the year.

Veolia Water's WRMP assesses resources in both the dry year and the peak demand periods. Essex and Suffolk Water's WRMP only assesses resources in the dry year period because their demand combined with their water resources system does not drive the need to assess the peak demand.

Water Resources in the Essex WRZ (Essex and Suffolk Water)

Currently Essex and Suffolk Water deploy 400 megalitres (Ml) of water in the Essex zone every day[1]. The study area comprises approximately 7% of zone based on spatial coverage. The vast majority of supplies in the wider resource zone (94%) are surface water, taken from the rivers Chelmer, Blackwater, Stour and the Roman River which support pumped storage reservoirs at Hanningfield and Abberton. A large surface water transfer is also made from the Ely Ouse river system in Norfolk, augmenting supplies in Essex. Additional water resources are provided by the Stour Augmentation Groundwater Scheme (SAGS), and the Langford Recycling Scheme. The remaining 6%[2] of the public water supply comes from chalk groundwater sources in the south and south west of the zone. Water supplies are also supported by the Chigwell bulk supply from Thames Water (20%).

There is currently a dry year supply deficit in the Essex zone of 22 megalitres per day (Ml/d). This means that if dry year conditions were experienced there might be a need for customer restrictions. Unless new resources are developed and demand management activities are increased, the deficit will increase to 52Ml/d by 2025/26s (due to population growth and reductions in existing abstractions to meet environmental sustainability objectives).

Climate change is expected to reduce deployable output by 10.4 Ml/d by 2034/35 (9Ml/d by 2025/26), as stated in the ESW company report. At the same time demand is expected to increase due to climate change, although the Company has not quantified this specifically. Increase in demand due to growth includes local authority housing growth levels (originally taken from the East of England Plan), amended in the short term to reflect the suppressed housing market (Essex and Suffolk Water Final WRMP Main report, page 85). Climate change is not driving the need for investment (WRMP main report, page 290) but is forecast to increase the size of the deficit that Essex and Suffolk Water is forecasting.

Water Resources in the Northern WRZ (Veolia Water)

Veolia Water has confirmed that the northern part of the study area does have local supplies but that these are supported by 312 Ml/d from across the whole Northern zone, predominantly from groundwater sources. During the peak period the average daily demand during the peak week[3] of 358 Ml/d is deployed to meet the higher demand[4]. The Northern zone has sufficient water resources to supply the forecast annual average demand until 2027 at which point a small deficit occurs. However, the situation in the peak period is less secure. Under the peak period scenario, the small existing surplus is forecast to fall into deficit from 2015. The deficit is then forecast to

[1] Essex and Suffolk Water WRMP WRP1-BL

[2] Based on Essex and Suffolk Water WRMP WRP5

[3] Veolia Water Revised draft WRMP Main report, page 12

[4] Veolia Water WRMP Main report, page 72

increase (Figure 3.2), assuming no new resources are developed and there are no further demand management activities. The main constraint during the critical period is pumping and treatment capacity[5].

Climate change is forecast to contribute to this deficit. Veolia Water has forecast a decrease in deployable output of 27.28Ml/d at average and 29.53Ml/d at peak conditions[6] (at the Company level by 2034/35). The Company has not presented the impact on its individual resource zones. Veolia Water anticipates that domestic household demand could increase by 1.3 per cent by 2020. However, the impact of climate change on demand is even less certain than the impact on supply and so Veolia Water has taken it into account within its headroom component.

The demand forecast also takes account of housing growth policy targets and associated population growth. The Company anticipates that the population it serves is set to increase considerably over the next 25 years. The demand forecast includes an initial suppression until 2014/15 in response to the current economic downturn followed by a rapid rise in completions, before returning to the policy predictions of the regional plan in the longer term[7].

Restoring Sustainable Abstractions

Where water company abstractions are suspected of contributing to pressure on habitats protected under the Habitats Directive, those abstractions and their impact on river flows and /or groundwater levels are investigated, and if necessary, a reduction in the abstraction volume is sought by the Environment Agency. This type of reduction in abstraction is called a 'Sustainability Reduction' and is likely to result in the affected water company seeking alternative water resources to compensate for the loss.

Water supply in the Essex water resource zone will be reduced by 5Ml/d as the abstraction from the Blackwater estuary has been confirmed as contributing to low flows in the river/estuary. Water Supply in the Northern Zone will be reduced by 14.8Ml/d (annual average and peak) from 2015 due to sustainability reductions at two sites within the River Mimram and Beane catchment[8]. In its WRMP Veolia Water states that this will result in "*additional imports of water to meet demand in the zone*".

Both water companies are concerned that abstractions could be reduced in the future as the Environment Agency determines sustainability reductions and reviews time limited abstraction licences. Water Resource Management Plan guidelines (Environment Agency, 2007, Water resources planning guideline, Bristol) state that only sustainability reductions that have been confirmed should be included in the company supply forecasts. Veolia Water is concerned that future reductions could be as much as 33.84 Ml/d at average and 32.61 Ml/d at peak;

[5] Veolia Water Revised draft WRMP Main report, page 8

[6] Veolia Water Revised draft WRMP Main report, page 123

[7] Veolia Water Revised draft WRMP Main report, page 80

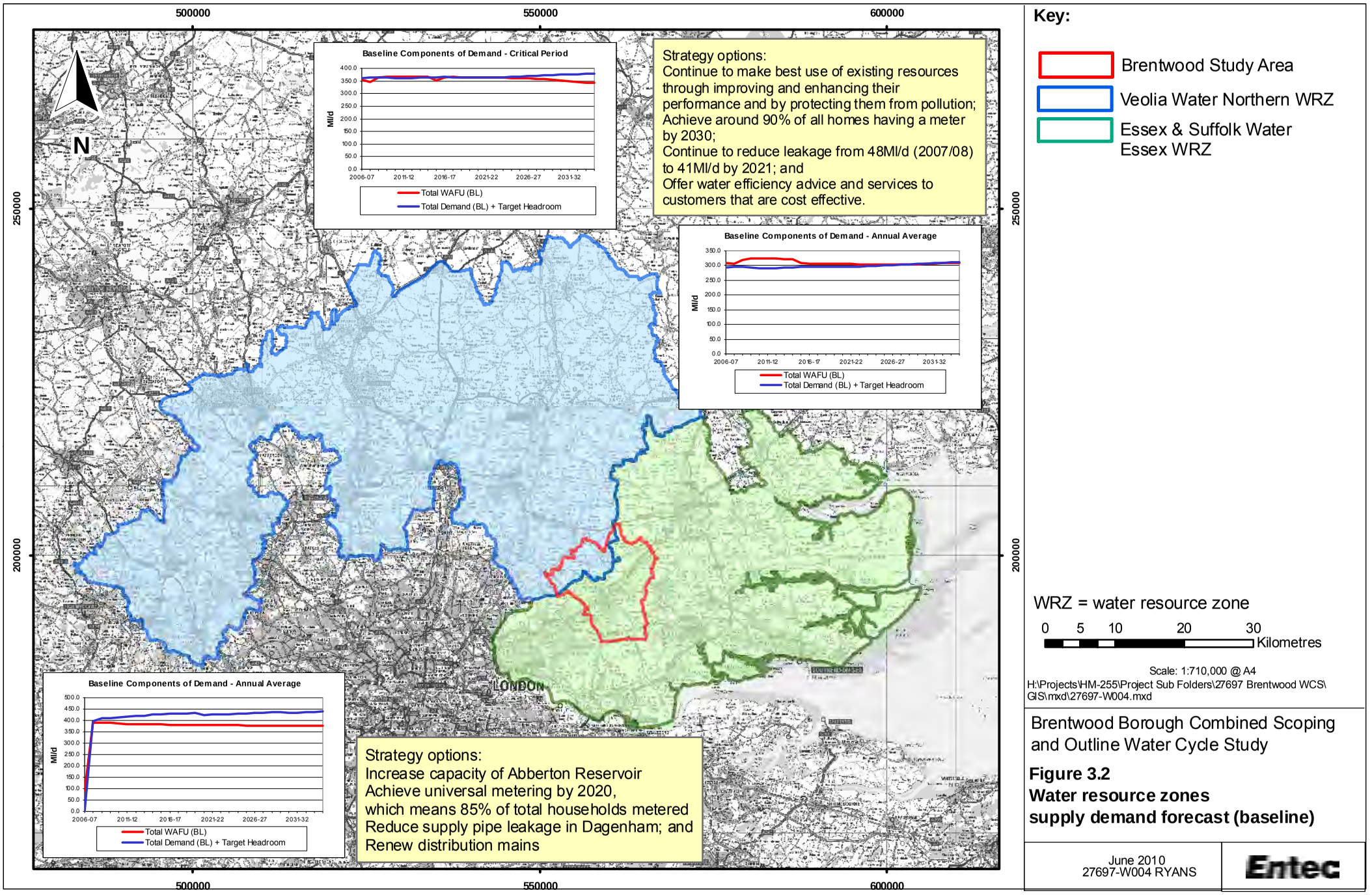
[8] Veolia Water Revised draft WRMP Main report, page 50

however this value is uncertain as it has not been confirmed if future sustainability reductions will be enforced by the Environment Agency.

Additional supplementary information on water resources in the study area is provided in Appendix B.

3.2.2 Groundwater Protection

Development can be constrained by the need to protect groundwater from contamination, pollution or over-abstraction. This last issue is particularly important for groundwater sources that are used to provide public water supply. A review of the Environment Agency's source protection zones data on the Agency's website shows that there are no source protection zones within the water cycle study area. Groundwater quality is discussed further in Section 3.3.2.



Key:

- Brentwood Study Area
- Veolia Water Northern WRZ
- Essex & Suffolk Water Essex WRZ

WRZ = water resource zone

0 5 10 20 30 Kilometres

Scale: 1:710,000 @ A4

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Brentwood Borough Combined Scoping and Outline Water Cycle Study

Figure 3.2
Water resource zones supply demand forecast (baseline)

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3.3 Water Quality

Water quality of rivers, lakes and groundwater is a good indicator of their general health in terms of their ecology, biodiversity and amenity. The Water Framework Directive (WFD) is the principal legislative driver dictating the targets for surface and groundwater quality and under which actions to achieve compliance are implemented and monitored. Other EC Directives, such as the Habitats Directive and Urban Wastewater Treatment Directive also set objectives for specific designated waters, which contribute to the overall target of achieving good water body status and WFD compliance by 2015.

The Environment Agency has been monitoring the health of all receiving waters (watercourses receiving effluent discharges) for a number of years through the previous General Quality Assessment (GQA) scheme based on chemistry, biology and nutrients. In 2007, the monitoring programme changed to align with WFD requirements. Previous results from the GQA scheme are not directly comparable with the current regime but it is the WFD standards that drive future improvements to water quality.

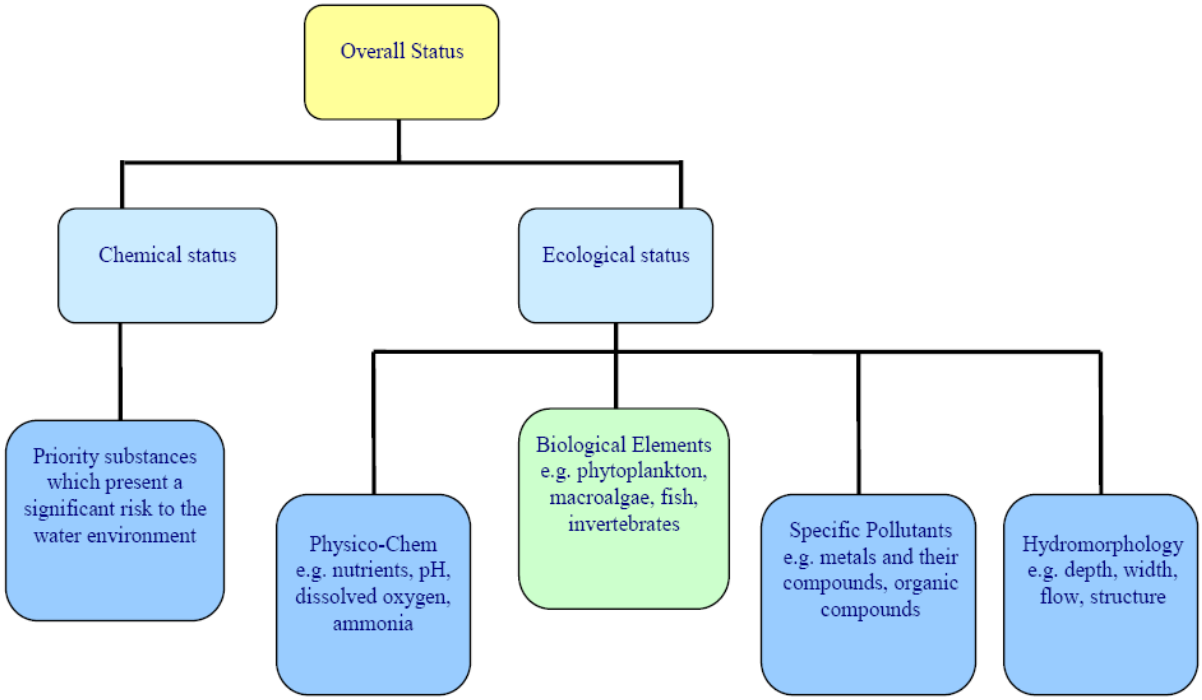
Under the WFD programme, water quality targets are set in the River Basin Management Plans (RBMP), with the aim of reaching 'Good Status' in all water bodies. Good status is determined by the Ecological and Chemical Status of the water body (see Figure 3.3 taken from the Anglian RBMP, 2009). An explanation of the key elements is as follows:

- *Chemical Status*: Chemical status is assessed by compliance with environmental standards for chemicals that are listed in the Environmental Quality Standards Directive 2008/105/EC1. These chemicals include priority substances, priority hazardous substances and eight other pollutants carried over from the Dangerous Substance 'Daughter Directives'. Chemical status is recorded as 'good' or 'fail', which is determined by the worst scoring chemical. An assessment of chemical status is only required in water bodies where priority substances and other specific pollutants are known to be discharged in significant quantities; and

- *Ecological Status*: Ecological classification is summarised in Figure 3.3, comprising four groups - Biological, Physico-Chemical Specific Pollutants and Hydro-morphological. It should be noted that the hydro-morphological element only helps define High Ecological Status. Ecological status is recorded on the scale of High, Good, Moderate, Poor or Bad. 'High' denotes largely undisturbed conditions and the other classes represent increasing deviation from this natural condition – from here on described as 'reference condition'. The ecological status classification for the water body, and the confidence in this, is determined by the worst scoring quality element.

The Chemical Status and status of the Physico-chemical elements of Ecological Status are both helpful in understanding the water quality context for this Study.

Figure 3.3 The Components of Overall Status for the Water Framework Directive



3.3.1 Surface Water Quality

The Anglian and Thames River Basin Management Plans (RBMPs) cover the Borough. To the East is the Combined Essex catchment of the Anglian RBMP, encompassing the rivers and tributaries of the Stour, Colne, Pant/Blackwater, Chelmer, Crouch and Roach, along with the smaller catchments of Sixpenny, Tenpenny, Holland and Asheldham Brookand. To the South and West the area is covered by two catchments of the Thames RBMP; the Roding, Bream and Ingrebourne and South West Essex catchments, predominantly covering the Mar Dyke. Physical modifications due to urbanisation, agricultural runoff, urban runoff, abstraction for water supply and barriers to fish movement play a key role in determining the status of rivers and lakes in these catchments.

Currently only 7% of surface water bodies in the Combined Essex and 9% in the South West Essex Catchment are achieving either good overall status in line with WFD standards (no water bodies are achieving good status in the Roding Beam and Ingrebourne catchment). Water supply abstraction, point source discharges from water industry sewage works, diffuse inputs from agriculture and poorly managed urban drainage all play a key role in determining the status of rivers in these catchments.

Figure 3.4 presents the overall status of water bodies in the Brentwood study area. The water bodies are either of Poor or Moderate status. Table 3.1 presents the main statistics for the three catchments from the River Basin Management Plans, showing the percentage of rivers and lakes currently meeting Good overall status. Although no change in the percentage of rivers reaching Good status is planned for 2015, there are some planned improvements specific to certain elements. The relevant RBMPs indicate that the target for Good Status is 2027. Earlier targets

have been dismissed because of disproportionate costs or technical infeasibility of measures. Appendix C presents more detailed information on individual water bodies in the Brentwood study area, which shows that failure of phosphate standards is common to watercourses within all three catchments, with the River Wid also failing standards for ammonia. Some watercourses in the Roding and Ingrebourne catchments have also been assessed under the Dangerous Substances Directive, with the River Roding failing targets for the hydrocarbon Benzo (ghi) perelyene, the herbicide isoproturon and the pesticide/biocide Tributyltin.

Table 3.1 Overall Water Framework Directive Statistics for Catchments in Study Area

River and Lake Water Bodies	Combined Essex		Roding, Bream and Ingrebourne		South West Essex	
	Now	2015	Now	2015	Now	2015
% at good status overall (chemical and ecological)	7	7	0	0	9	9
% improving for one or more elements in rivers		8		31		18

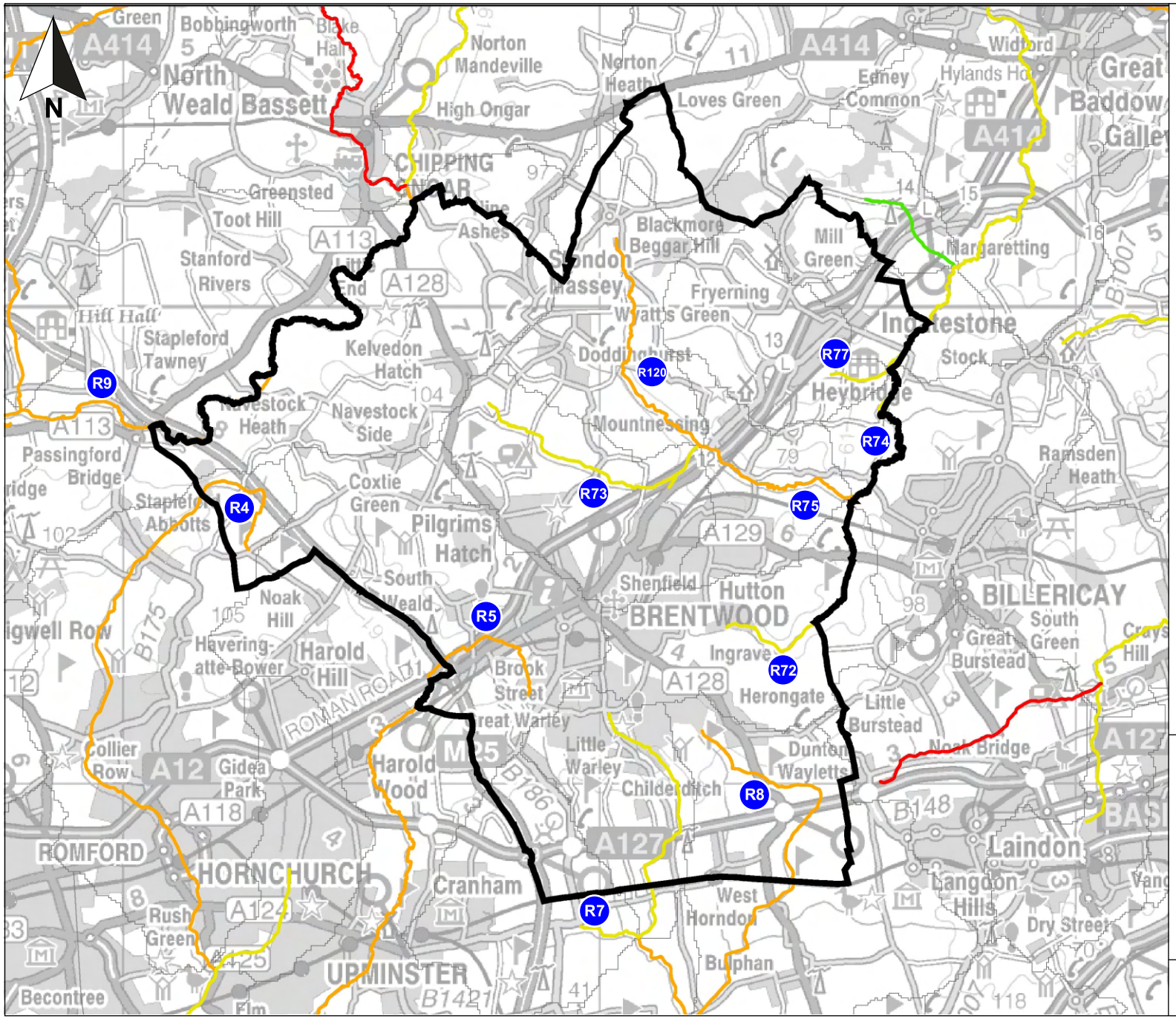
The RBMPs set out key actions in the catchments for improving water quality. Table 3.2 summarises the key actions from the overall Anglian RBMP and for the three catchments that intersect the Borough.

Table 3.2 Summary of Key Actions from the River Basin Management Plans

River Basin	Catchment (main river in study area)	Main Settlements Affected	Key Actions Relevant to the Study Area
Anglian	All	All	General actions for local authorities across the whole Anglian River Basin District are to include water efficiency policies in Spatial Strategies and Local Development Plans/Frameworks. It is advised that local authorities ensure that planning policies require water efficiency standards in new development that exceed extant Buildings Regulations and are linked to the Code for Sustainable Homes level 3 and above, and Building Research Establishment Environmental Assessment Method (Breeam) standards.
Anglian	Combined Essex (River Wid)	Ingatestone, Doddinghurst, Shenfield and Hutton wards of Brentwood town, Ingrave and Herongate	Schemes and installations of passes to provide habitat improvement, and eel migration; Essex & Suffolk Water have appointed officers to work with people to reduce pesticides entering watercourses; and Floating pennywort removal projects.
Thames	Roding, Bream and Ingrebourne	Kelvedon Hatch, Pilgrims Hatch, Brentwood wards	The Environment Agency will investigate current levels of abstraction in the Upper Roding; The Environment Agency will work with partners to improve water quality from urban diffuse pollution in Mayes Brook; and The Environment Agency will investigate methods of improving fish passages.

Table 3.2 (continued) Summary of Key Actions from the River Basin Management Plans

River Basin	Catchment (main river in study area)	Main Settlements Affected	Key Actions Relevant to the Study Area
Thames	South West Essex (Mar Dyke)	Warley, West Horndon	The RBMP will assess key pressures in the catchment and prioritise water bodies in the worst state for assessment.



Brentwood Borough
Brentwood WCS

Figure 3.4
Overall WFD Status of Water Bodies in the Study Area

July 2010
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3.3.2 Groundwater Quality

The quality of water in groundwater bodies is defined by both quantitative and chemical status in the River Basin Management Plans. Groundwater bodies in the study area (Anglian and Thames River Basin Districts) are generally designated as having a good quantitative status, with minimal predicted change to 2015, seen in Table 3.3. However the chemical status of groundwater bodies in the Borough is classified as Poor and deteriorating. Within the Thames and Anglian River Basin Districts there are some failures against environmental standards due to elevated levels of nitrate, pesticides and other contaminants, with a widespread trend of increasing nitrate levels. An investigation is to be carried out to identify the sources of these levels by the Environment Agency and partner organisations. In the Anglian RBD, diffuse pollution is one potential source of contamination. Significant volumes of groundwater are no longer being abstracted by Veolia Water as a direct result of quality problems[9] and subsequent restrictions that have been put into force by the Environment Agency.

Table 3.3 Overall WFD Status for Groundwater Bodies in the Study Area

Groundwater bodies	Anglian River Basin Districts		Thames River Basin Districts	
	Now	2015	Now	2015
% at good quantitative status	65	65	35	35
% at good Chemical status	65	65	43	46
% at good overall status	45	45	17	17

As discussed in Section 3.2.2 there are no source protection zones within Brentwood Borough and surrounding area.

3.3.3 Designated Sites

The legislative drivers for water quality are presented in Table 2.3, which includes European legislation to protect receiving waters and their dependant habitats that are considered particularly sensitive. Sites of Special Scientific Interest within the study area are presented in Figure 3.5, with tables of their designations in Table 3.4. There are no Special Protection Areas (SPAs) or Special Areas of Conservation (SACs), designated by the Habitats Directive, within the study area, or close by in surrounding areas. However, the Chelmer Estuary downstream of the River Wid is a designated SPA/SAC due to wintering waders and wildfowl, which could be affected by changes in water quality and quantity upstream. There are designated LoWS/CWS (Local Wildlife Sites/ County Wildlife Sites) in the area that will need consideration with any changes in water quality.

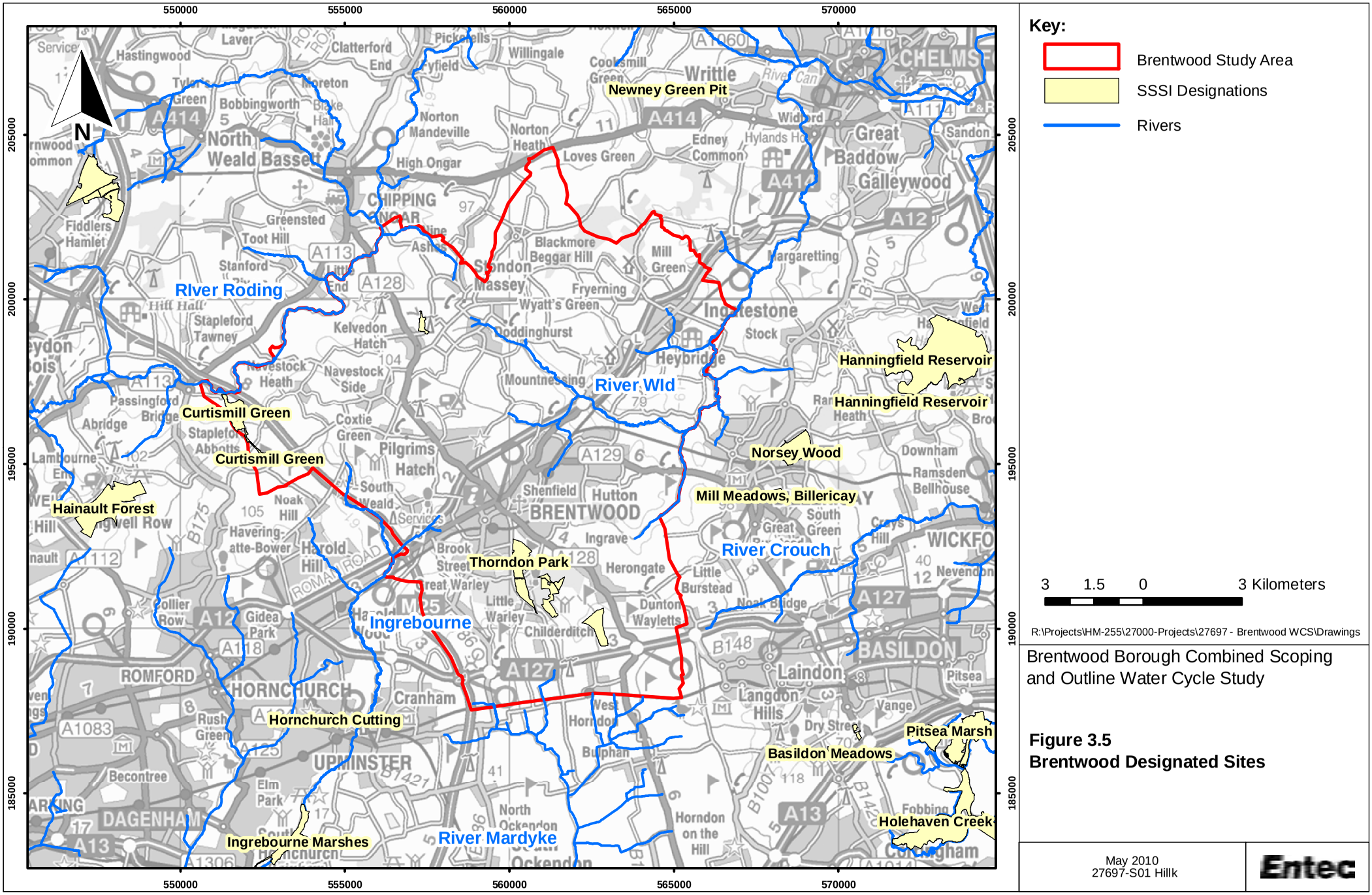
[9] Veolia Water Revised draft WRMP Main report, page 65

There are also designated sites associated with the water supply network for the Borough, for example Abberton Reservoir SPA and Hanningfield Reservoir SSSI, however impacts on these sites will be considered by the water companies in their assessments of deployable outputs and do not need to be specifically considered here.

Table 3.4 Sites of Special Scientific Interest in Brentwood Borough

Name	Reason for designation
The Coppice, Kelvedon Hatch	This is an ancient semi-natural broad-leaved woodland, developed over a complex geology of Claygate Beds, Bagshot Beds and Head deposits, in the small valley of a tributary of the River Roding. Two main woodland types are present: the base-rich springline Alder Woodland is uncommon, both nationally and in Essex, and the Coppice contains a more diverse flora than other local examples of this standard type. Due to the variation in the canopy and soil moisture content a mosaic of communities are found in the ground flora, which appears to be a natural response to local variations in drainage. This adds significantly to the interest of the site. The small stream which runs through the middle of the site provides an additional habitat.
Curtismill Green	Curtismill Green is an area of unimproved grassland and scrub about five miles west of Brentwood on soils derived from London Clay and Chalky Boulder Clay. It is a small, separate relic of the ancient Forest of Waltham, of which Epping Forest is the largest surviving fragment. The varying soil conditions give rise to both damp and dry grassland containing several species which are uncommon, decreasing or unusual in the county. Additional habitats are provided by areas of oak and hawthorn scrub and several ponds.
Thorndon Park	An area of semi-natural broad-leaved woodland and ancient parkland supporting a range of habitat types developed over Claygate and Bagshot Beds and gravels to the south of Brentwood. The woodland includes the Lowland Birch-Sessile Oak and Pedunculate Oak- Hornbeam types and the site supports an outstanding assemblage of Beetles (Coleoptera) including one species which is rare and vulnerable in Britain.

There are also additional designations for rivers within the Brentwood Borough, relating to the Freshwater Fish, Nitrates and Urban Waste Water Treatment Directives. Relevant Directive descriptions are given in Table 2.3, while relevant river reaches and designations are identified in Table 3.5 and discussed in the bullet points below.



Brentwood Borough Combined Scoping and Outline Water Cycle Study

Figure 3.5
Brentwood Designated Sites

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Table 3.5 Other Designations within the Study Area

Main Rivers	Designations
Haverings Grove Brook	Nitrates Directive, Urban Waste Water Treatment Directive
Chainbridge Tributary	Nitrates Directive
River Wid	Nitrates Directive, Urban Waste Water Treatment Directive, Freshwater Fish Directive
Mardyke East Tributary	Nitrates Directive
Mardyke West Tributary	Nitrates Directive
Rom/Bream	Nitrates Directive
Ingrebourne	Nitrates Directive, Freshwater Fish Directive
Roding	Nitrates Directive, Freshwater Fish Directive

- *Urban Waster Water Treatment Directive*: Urban Waste Water Treatment Directive designations are present on the River Wid and Haverings Grove Brook. The aim of this Directive is to ensure that all wastewater in the EU is treated to an appropriate standard, and this is dependent on the size of the wastewater treatment works and the sensitivity of the receiving watercourse;

- *Freshwater Fish Directive:* Freshwater Fish Directive designations within Brentwood Borough are of 'good' status, with the River Wid and Mardyke West Tributary identified as "cyprinid standard", suitable for supporting cyprinid fish, such as carps and minnows. Watercourses designated under this Directive are selected because they are significant bodies of water which are capable of supporting fish populations. The Directive gives them protection from chemicals that are harmful to fish, such as ammonia. Water quality must be maintained at a good standard for fish populations to grow. The Directive affects any discharges to designated waters including industry and sewage treatment plants. It will be the responsibility of Anglian Water and Thames Water to ensure that the sewage treatment plants continue to meet the quality targets throughout the growth period; and

- *Nitrate Vulnerable Zones*: All rivers within Brentwood Borough are Nitrate Vulnerable Zones according to designations of the Nitrates Directive. The Directive requires all known areas of land which drain into polluted waters (nitrate concentrations greater than 50 mg/l) to be designated. The designation leads to monitoring and implementation of measures where possible to reduce nitrate pollution from agricultural land within the designated zone. Housing growth is unlikely to affect the targets for this designation.

3.4 Wastewater and Sewerage

The information presented on wastewater treatment and sewerage in this study is based on data provided by Anglian Water (AW) and Thames Water (TW). Both companies provide public wastewater services in the study area, while the Environment Agency regulates the quality of effluent discharges to help protect water quality, the environment and human health. This is done through issuing environmental permits under the Environmental Permitting Regulations (England and Wales) 2010 which set the flow rates and water quality standards that must be achieved at the point of effluent discharge (previously known as discharge consents and quality consents). Within the more rural areas there are likely to be some smaller private sewerage treatment systems that are not included in this report, as growth is likely to focus on the larger settlements in the study area with no or minimal impact expected on these.

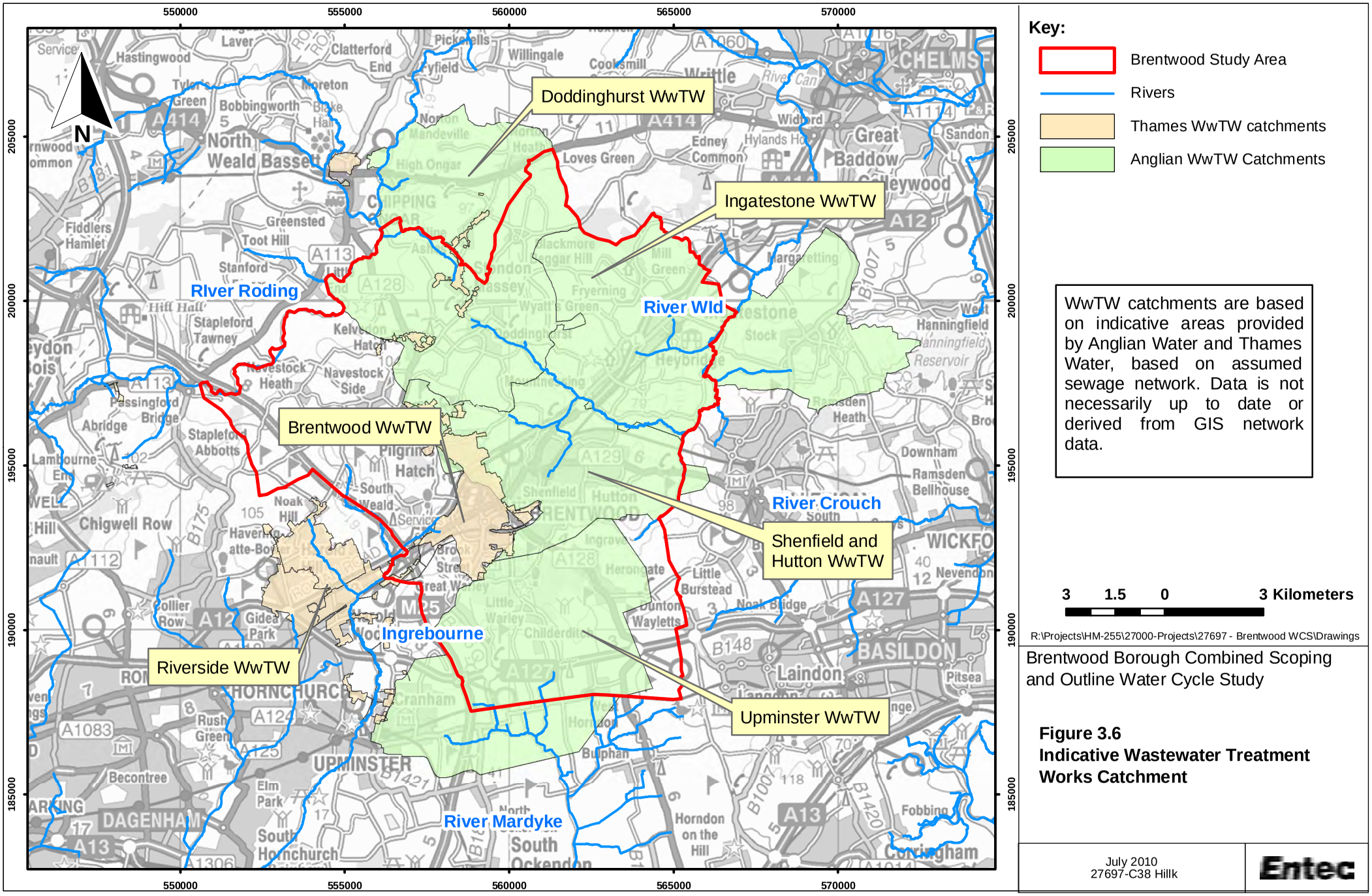
3.4.1 Wastewater Treatment Works

There are five wastewater treatment works (WwTW) in Brentwood Borough that serve the urban areas. The catchment areas for the treatment works is governed by the sewage infrastructure and network. A plan showing the WwTW catchments is presented in Figure 3.6, based on indicative catchment areas as provided by the sewerage providers. It should be noted that these catchments are not derived from detailed GIS sewer network data.

A fundamental factor describing the hydraulic, or flow, capacity of a WwTW is the 'Dry Weather Flow' (DWF), which is a measure of the incoming flow to the works derived from human activity (both domestic and trade), but excluding any storm-induced flows. The Environment Agency issues a maximum DWF rate as part of the individual works consents in order to protect the receiving watercourse from high flow rates.

All wastewater treatment works monitor the actual effluent flow volumes at the point of discharge. The difference between measured wastewater flows and consented DWFs provides a high level assessment of the available capacity at a works to receive additional inflows from growth without the need for additional infrastructure.

Measured and consented flow data were provided by the sewerage providers Anglian Water and Thames Water for the treatment works in the study area. The comparison between the measured and consented flows for these WwTWs is presented in Table 3.6. It is important to remember that in planning for flow to works, sewerage companies include a 'headroom' allowance for seasonal variation, which is not included here. It can be seen that all the works are currently operating within their consent limits.



Brentwood Borough Combined Scoping and Outline Water Cycle Study

Figure 3.6
Indicative Wastewater Treatment Works Catchment

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Brentwood WwTW and Shenfield and Hutton WwTW have the greatest spare flow capacity, and should be able to accommodate more of the proposed development. Upminster works also has capacity for additional growth. A comparison of measured flows with consented flows indicates there is limited capacity at Doddinghurst and Ingatestone WwTWs. Flow consents have recently been increased at these two works to meet the existing requirements from effluent flow. The increase does not take into account additional growth but has come to light following a flow compliance review. The proposed increases are therefore to better reflect the existing situation, and should not be regarded as providing headroom to accommodate any growth. Therefore whilst there appears to be some capacity, see Table 3.6, the Council should regard these two works as being at capacity and unable to accommodate any strategic growth without further variation in licence and potential investment. If a new discharge permit were required to accommodate growth in these sewer catchments, a corresponding tightening of the permitted quality limits would also be required by the Environment Agency to prevent deterioration of water quality in the receiving watercourses.

Table 3.6 Comparison between Consented and Measured Effluent Flows

Sewerage Provider	Wastewater Treatment Works Site	Consented DWF (m3/d)	Measured DWF (2010) (m3/d)	Difference between consented and measured DWF (m3/d)
AWS	DODDINGHURST	2,325	1,526	799
AWS	INGATESTONE	1,695	1,370	325
AWS	SHENFIELD AND HUTTON	12,650	7,807	4,843
AWS	UPMINSTER	6,300	3,761	2,539
TW	BRENTWOOD	18,690	6,487	12,203

Data provided from Anglian Water and Thames Water. Although comparison of measured and consented flow indicates hydraulic capacity, this does not include headroom allowance. Measured flows can also be subject to meter errors, inaccuracies and random annual variations. The Environment Agency and Anglian Water have advised that there is no capacity for growth at Doddinghurst and Ingatestone, hence they are highlighted in red.

3.4.2 Sewerage Network

Whilst there is capacity to receive additional flows at Brentwood, Shenfield and Hutton and Upminster works, the sewerage network that transfers flows to the works also needs to be considered. Anglian Water covers the sewerage network that supplies the majority of the Borough, not including parts of the Brentwood wards to the west (Brentwood West, South Weald and part of Brentwood South, Brentwood North, Pilgrims Hatch and Warley). Those proposing to develop in these wards will need to liaise with both Anglian Water and Thames Water, to identify which wastewater treatment works catchment a site is in, and which provider owns the sewer network, as there is some overlap between the two companies.

Anglian Water has advised that developments to the north and east of Shenfield will be easier to accommodate in the sewer network, because Shenfield WwTW is located east of the urban area. Developments on the western boundary of Shenfield WwTW catchment (see Figure 3.6 showing the indicative WwTW catchments) could potentially be constrained by the existing network.

Anglian Water has provided records of both internal and external sewer flooding incidents. These indicate that some parts of Ingatestone have in the past experienced sewer flooding. Information provided is on a post code basis and does not give detailed locations. Sewer flooding records do not necessarily indicate the source of the flooding, or that flooding will occur again, as Anglian Water will implement a programme to address such incidents. Nevertheless, previous sewer flooding records indicate potential existing capacity issues in the sewer network in the Ingatestone area.

The sewer network sometimes includes overflows that discharge a combination of rainfall and sewage directly into watercourses before wastewater treatment, in order to manage flows during heavy rainfall events and potential flood events. These are known as Combined Sewer Overflows (CSOs) and can impact on the water quality of the receiving watercourse if discharged.

It has been advised that only one CSO exists within Thames Water's catchment, however, this is hydraulically inactive. Although Anglian Water has no CSOs in the study area, there are eleven overflows in the sewer catchments within Brentwood, six of which are Emergency Overflows (from a pumping station or WwTW due to electrical or mechanical failure of pumps) and eight are Storm Sewer Overflows. There are three locations where the overflow is shared between an Emergency Overflow and a Storm Sewer Overflow. Although the discharge mechanism differs between CSOs and Storm Sewer Overflows, both result in a discharge of sewage and storm water into a watercourse.

Existing CSOs are an essential part of combined sewer (foul and surface water) systems. Without them homes, gardens and roads could flood with wastewater due to it backing up in the system. Since discharges usually occur at times of high flow, a CSO discharges a combination of wastewater and storm water. Discharges usually occur during heavy storm events when the capacity of the sewerage system is exceeded. Discharges occur directly into inland and coastal waters but the environmental impact is generally relatively small due to the dilute nature of the effluent.

It is the responsibility of the Water Companies and the Environment Agency to ensure that CSOs are operated and regulated in a way which does not cause adverse impact on the local amenity or the environment.

If development will lead to an increase in population in the wastewater catchment upstream of a CSO of more than 10%, the impact of growth should be assessed using Urban Pollution Management techniques such that mitigation required can be assessed in a detailed WCS.

3.4.3 Sludge Management

Most of the sludge that is produced by the wastewater treatment process in the study area is recycled to farmland as a soil conditioner. Anglian Water has an extensive programme of disposing of biosolids - treated sewage sludge -

to agricultural land. In the Asset Management Period 4 (2005 – 2010) the company planned to undertake an investment programme to ensure even higher quality standards of this treated sludge.

In the Strategic Direction Statement (http://www.anglianwater.co.uk/_assets/media/strategic-direction-statement.pdf) for the period 2010 – 2035, AWS aim to continue to adopt a strategy of recycling treated wastewater sludge to land, but also consider alternative arrangements such as thermal destruction and generating renewable energy. The amendment of the Sludge Directive will include some important emerging issues for sludge treatment, such as how treated sewage sludge is recycled to agriculture. One innovative approach being investigated by AWS is the use of sludge as a cement additive.

The majority of the sludge from Thames Water is used as a nutrient-rich fertiliser and the rest is used to generate renewable energy to help power their treatment works sites. To ensure sludge management is continued in a safe, sustainable and beneficial manner, Thames Water has identified the need to increase treatment capacity and secure additional appropriate future uses in the medium term (2010-2015). In the long term, from 2015 to 2035, they plan to implement a sustainable sludge strategy, maximising beneficial use and considering issues of acceptability, energy, transport, odour, nutrients and local constraints.

3.5 Flood Risk

A summary of the findings from Brentwood Level 1 Strategic Flood Risk Assessment is presented below:

- Fluvial flood risk in Brentwood Borough is generally confined to the river valleys such that the floodplains do not extend significant distances from the river channel;
- Urban areas coinciding with fluvial flood zones, as mapped by the Environment Agency, include Heybridge (Ingatestone Hall Brook), the western part of Brentwood town (Ingrebourne Brook) and near Chipping Ongar (Stondon Hall Brook);
- The majority of the draft SHLAA sites reviewed as part of the SFRA are located in Flood Zone 1;
- The potential risk associated with surface water run-off is identified in some of the settlements including, Brentwood, Blackmore, Doddinghurst, Heybridge and Ingatestone;
- Anecdotal evidence indicates that key infrastructure, such as the A12 to the north west of Brentwood, is at risk of surface water flooding;
- The South Essex Catchment Flood Management Plan (CFMP) states that there have been no records of groundwater flooding in South Essex although it notes that the areas of Thurrock and Tilbury to the south of Brentwood Borough are at risk from groundwater flooding due to high groundwater levels in the underlying chalk;
- Limited groundwater contour data is available for the extreme west of the Borough. These give groundwater levels typically between -10m and 10m AOD where ground levels range from 30m-70m AOD indicating that there is no risk from groundwater flooding;

- Mapping is provided in the SFRA which indicates, at a strategic level, the potential for infiltration sustainable drainage techniques in new developments, which is discussed further in Section 6.3.1 below; and

- Site specific Flood Risk Assessments are required for sites greater than 1 ha or within Flood Zone 2 or 3, and should consider all forms of flood risk including an allowance for climate change in accordance with the requirements of PPS25 (see Table 2.1). It is recommended that Drainage Impact Assessments (DIAs) are carried out for developments on all sites over 0.25 hectares.

3.6 Summary of Existing Environment

The points below present a summary of the existing water environment, as presented in this chapter.

- The Borough is located in the Anglian and Thames River Basin Districts. The main watercourses include the River Roding, River Wid, Ingrebourne River and Mar Dyke;

- Water is supplied by Essex and Suffolk Water to the majority of the Borough. The northern part of the Borough including Doddinghurst and Kelvedon Hatch is supplied by Veolia Water. The vast majority of supplies are surface water, taken from the rivers Chelmer, Blackwater, and the Roman River and the Stour Groundwater Augmentation Scheme, which support pumped storage reservoirs at Hanningfield and Abberton;

- Without any new resource schemes or demand management (the baseline), Essex and Suffolk forecast a deficit in the supply demand balance during a dry year (one in which demand for water is more than is usual in a typical 'normal' year) based on growth targets in the East of England Plan;

- Veolia Water forecast a baseline surplus in the supply demand balance until 2027, except for the peak period (representing average daily demand during the hottest/driest point usually at the height of summer). Under this scenario the baseline forecast for supply and demand is in deficit from 2015;

- Both water companies are concerned that abstractions could be reduced in the future as the Environment Agency determines sustainability reductions and reviews time limited abstraction licences;

- Under the Water Framework Directive, the majority of the Borough's rivers are designated Moderate Status, with the River Ingrebourne, Mardyke and Wid designated Poor Status;

- The Chelmer Estuary downstream of the River Wid is a designated SPA/SAC due to wintering waders and wildfowl, which could be affected by changes in water quality upstream;

- There are no groundwater source protection zones in the Borough;

- Public wastewater treatment is provided predominantly by Anglian Water. Parts of Brentwood, Pilgrim's Hatch and Great Warley are served by Thames Water's Brentwood WwTW;

- The Doddinghurst and Ingatestone WwTW operated by Anglian Water have been identified as being at capacity in terms of flow consent. If a new discharge permit were required to accommodate growth in these sewer catchments, a corresponding tightening of the permitted quality limits would also be

required by the Environment Agency to prevent deterioration of water quality in the receiving watercourses.

- Sewer flooding records indicate that flooding has previously occurred in the Ingatestone area; and
- The greatest flood risk in the Borough is derived from surface water run-off within existing urban areas, although the flood risk areas are not extensive.

4. Neighbouring Issues

Some of the Councils surrounding Brentwood Borough have prepared Water Cycle Studies to varying stages to review the potential constraints from the water environment and infrastructure to their planned growth, and potential impacts from development. This section reviews the findings of these neighbouring studies, based on the latest available published documents.

4.1 Chelmsford Phase 1 Water Cycle Study

A Phase 1 (Outline) Water Cycle Study was produced for Chelmsford Borough by Halcrow Ltd in February 2008. It is understood that an update to the Outline Study is ongoing but not yet publicly available. Key findings of 2008 the study were:

- No environmental constraints identified;
- Flood storage is required to prevent development in Chelmsford Town Centre, Chelmer Village and North Chelmsford from increasing flood risk;
- Essex and Suffolk Water identified short term improvements required to meet additional demand, and the increase in Abberton Reservoir capacity in the long term;
- Chelmsford wastewater treatment works is operating close to its capacity. Significant investment is required by Anglian Water to meet additional flows from proposed growth;
- The sewerage infrastructure does not have capacity to serve growth in North Chelmsford. A new strategic sewer will be required; and
- Receiving waters have capacity to receive additional flows from growth without decreasing river quality.

4.2 Essex Thames Gateway Scoping Water Cycle Study

A Scoping Study has been prepared for the local authorities of Basildon, Southend-on-Sea, Castle Point and Rochford. An Outline Study is currently being commissioned for Basildon, Castle Point and Rochford Councils. . The main issues are summarised below, as taken from the Scoping Study.

Future water demand in the region is expected to be met through the proposed increase in storage at Abberton Reservoir and increased abstraction and transfer from the Ely-Ouse transfer scheme which, if approved, will come online in 2014. Until the scheme is in place and operational, there will be a deficit in available water resources during drought years in Essex Thames Gateway area.

In the majority of cases there is sufficient treatment capacity and capacity in the network to allow planned development in the study area up to 2015. There is spare treatment capacity up to 2015 for Basildon WwTW.

Beyond 2015 (into AMP6), Basildon WwTW's treatment capacity will be limited because the final effluent pipeline which discharges to the Thames Tideway and the storm tank discharge will be unable to receive further flows. A solution will be required to allow development post 2015 to take place.

Several of the WwTW and future upgrades need to be assessed for the quality of the treated wastewater discharges to ensure that there is no deterioration in water quality of the receiving watercourses under the Water Framework Directive, the Shellfish Directive and the Bathing Waters Directive.

4.3 Thurrock Scoping Water Cycle Study

A Scoping Study was completed for Thurrock Council in February 2009 and an Outline study is currently being commissioned at the time of writing.

Based on the Scoping Study findings, there are no treatment capacity issues in terms of treating the generated wastewater from the proposed development within Thurrock, though there are currently sewerage infrastructure issues with transferring the generated wastewater to Tilbury waste water treatment works. Anglian Water has proposed to invest in a new trunk main in the AMP5 period such that capacity issues should be resolved by 2015. Development phasing will be needed to ensure capacity is available during this period.

4.4 Neighbouring Impacts on and from Brentwood Borough

The neighbouring WCSs summarised above generally do not identify constraints to growth from water resources or receiving water quality. The studies are based on draft Water Resource Management Plans. Essex and Suffolk Water's draft WRMP identified the potential for increasing capacity at Abberton Reservoir to improve security of supply over the growth period. The following sections of this report discuss the final Water Resource Management Plans and the confirmation that the Abberton Scheme is progressing.

Potential capacity issues are identified at Chelmsford wastewater treatment works and in the sewerage infrastructure in North Chelmsford and in the Tilsbury WwTW catchment in Thurrock. These issues will not affect growth in Brentwood.

As Brentwood Borough is located at the head of the main river catchments in the area, any new development has the potential to increase surface water run-off, through increased impermeable areas. Rain falling onto hard surfaces and through conventional piped drainage has the potential to be routed back into rivers more quickly than rain falling and infiltrating into natural surfaces, which can increase flood risk further downstream. If new development and drainage in Brentwood is not controlled, there is potential therefore to increase flood risk downstream in Chelmsford, Maldon, Basildon, Rochford, Castle Point and Thurrock. Flooding issues were identified in the WCS for Chelmsford, affecting Chelmsford Town Centre.

In line with national guidance on flooding (PPS25), all new developments (where FRAs are required) must ensure that surface water run-off is equal to or less than existing run-off rates. Development in Brentwood Borough will

therefore need to be compliant with these requirements, which will mitigate any potential increase in flood risk in downstream authority areas.

An Outline Study is currently being commissioned for Basildon, Castle Point and Rochford Councils. It is possible that the Shenfield works might be used to alleviate some wastewater treatment issues in neighbouring Basildon. This could potentially erode capacity at the works for growth in Brentwood, however. The following sections review the existing capacity and potential impacts at Shenfield WwTW.

5. Potential Constraints to Development

This section presents the potential constraints to development based on the state of the existing environment and water infrastructure, as assessed in Chapter 3 and based on data provided by third parties. Constraints for development are presented in the summary section below in a traffic light context, for each topic area and for each spatial growth option.

A series of annotated maps is also provided to direct the reader to the main constraints to development.

5.1 Environmental Constraints

5.1.1 Water Resources

Essex and Suffolk Water has developed a strategy to secure public water supplies over the next 25 years (i.e. to remove the baseline deficit identified in Chapter 3). Under the Company's strategy there will still be a small deficit until 2013-14, but after that the Company has schemes planned that will lead to a supply surplus (of approximately 25 Ml/d).

The key element of the strategy is to develop Abberton reservoir, to increase capacity to pump and store excess water during long-term high rainfall periods (winter). The Abberton pumped storage reservoir is situated just outside the Essex Water Resource Zone, south of Colchester. Essex and Suffolk Water plans to enlarge the capacity of the existing reservoir. Water would be pumped from the Combined Essex Catchment Abstraction Management Scheme (CAMS), which is over abstracted during low flows. However, the scheme is designed to pump excess surface water into the reservoir during period of high flow, i.e. during the winter. The main technical drawback of this type of scheme is low rainfall during a dry winter. The water resource is supported by a transfer from the Ely Ouse (in Norfolk) into the Essex zone (known as the Ely Ouse to Essex Transfer Scheme).

The Company considers the Abberton scheme to be essential to remove the existing deficit. Demand management is also a core element of the strategy but this will not remove the deficit in the short term and so the Abberton reservoir cannot be deferred or delayed. Planning permission has been granted for the scheme and AMP5 funding has been approved for whole scheme. The construction of a raised reservoir began in January 2010 and is due to be completed by December 2012.

Essex and Suffolk Water's opinion is that other options to increase its water resources are limited (Final WRMP).

The CAMS assessment (Figure 5.1) shows that the only catchment where additional water is available for abstraction is the Roding, Beam, and Ingrebourne catchment. Essex and Suffolk Water states that it has, "*previously undertaken investigations to assess the potential for development of new abstractions from the River Roding and the Chalk aquifer*". The Company has concluded that despite water being available, "*No resource development is possible, largely due to reasons of poor water quality combined with relatively small quantities*

available which would make any resource development immediately uneconomic"[10]. Furthermore, it is unlikely that the Environment Agency would grant license variations to increase abstraction in this area.

Figure 5.1 illustrates the CAMS assessment and its relevance to the resource development elements of the water company strategies. CAMS Water Resource Management Units (WRMU) which intersect the WRZs are shown on this figure as those most likely to be of relevance to this assessment, however it should be noted that sources of supply for WRZ are not always within the spatial extent of the zone, which could bring other catchments into the picture. In addition, water supply in Essex is heavily dependant on the Ely Ouse to Essex Transfer Scheme in Norfolk and so it is conceivable that constraints from resource in the Norfolk catchments could have implications for increased demand in the Brentwood area.

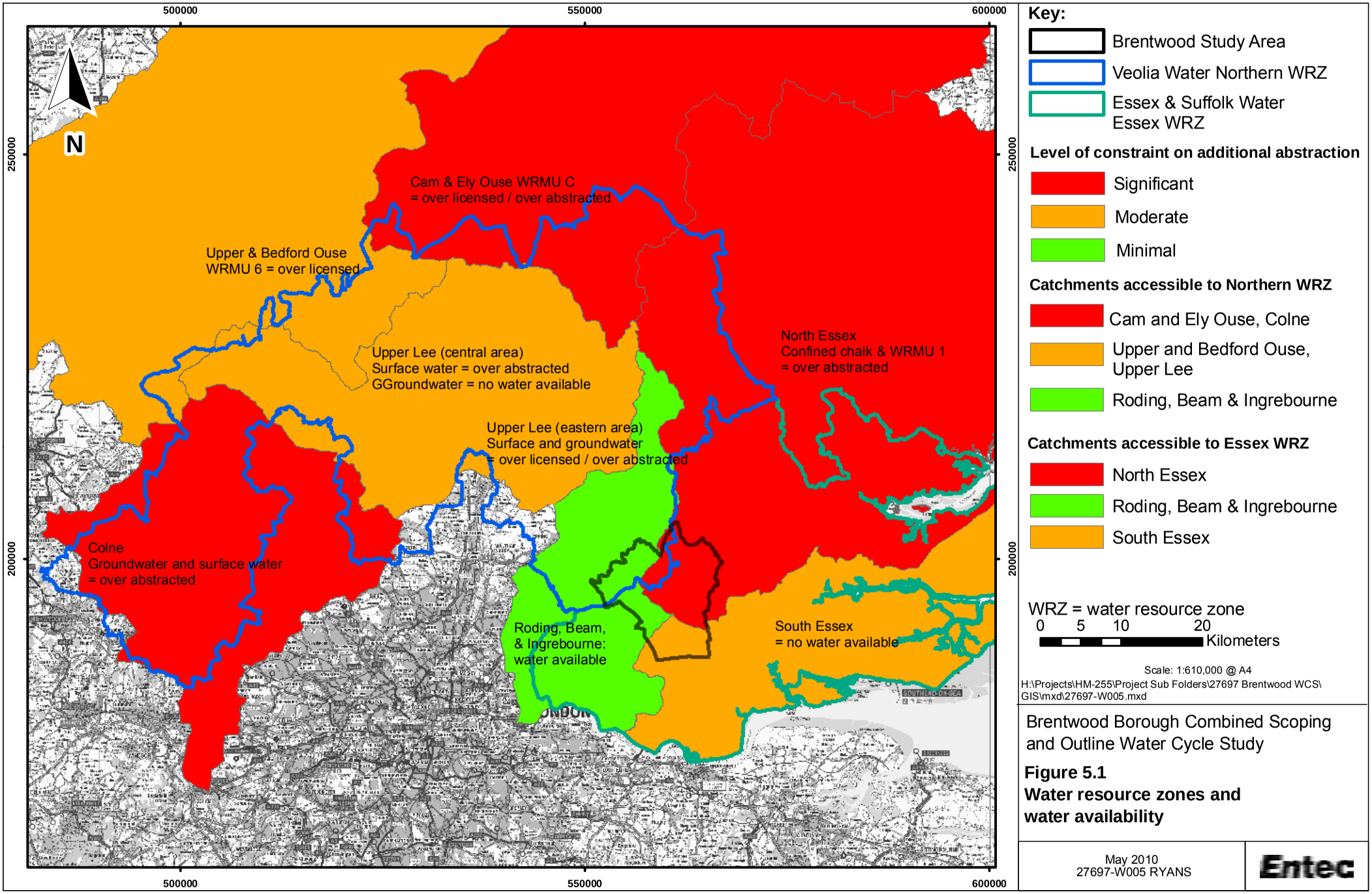
Essex is in an area of Serious Water Stress (Identifying areas of water stress, Environment Agency Consultation document, January 2007) and so options to develop new resources are limited. Therefore, the other elements of the water resource management plan are demand management. Essex and Suffolk Water include plans to:

- Achieve universal metering by 2020. ESW has committed to have universal metering across the Essex resource zone by the end of 2020, and will have 60% of properties metered by 2015[11] (no decisions have been made on the areas that would be chosen first to begin the compulsory programme). Universal metering means 85% of total households as 15% cannot be metered due to complex supply pipe arrangements and unreasonable costs;
- Reduce supply pipe leakage in Dagenham; and
- Renew distribution mains.

This suggests that as long as the Abberton Reservoir scheme is successfully delivered and metering schemes go ahead as planned there should be secure water supplies until at least 2034/35 (end of the current forecast horizon in the WRMP). The success of the Abberton Scheme may negate the need to further explore issues of constraint on water supply.

[10] Essex and Suffolk Water Final WRMP Main Report, page 305

[11] Essex and Suffolk Water Final WRMP Main report, page 222



Brentwood Borough Combined Scoping and Outline Water Cycle Study

Figure 5.1
Water resource zones and water availability

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In contrast to Essex and Suffolk Water, Veolia Water resources are dominated by groundwater from the unconfined chalk aquifer and so its options to secure public water supplies are different. Veolia Water is also in an area of Serious Water Stress (Identifying areas of water stress, Environment Agency Consultation document, January 2007) and customers in the area have the highest levels of per capita consumption in the country (Environment Agency's representation on Veolia Water's draft water resources management plan, August 2008). Therefore the Company's preferred strategy is constrained to securing supplies through demand management rather than development of new resources. Demand management will be led throughout the planning period to 2035, although there is a significant uncertainty over whether demand reductions will be sustained in the longer term. Key elements from the WRMP are summarised below:

- Continue to make best use of existing resources through improving and enhancing their performance and by protecting them from pollution;
- Continue the compulsory 'change of occupier' metering programme, optant metering, and metering all new homes. The aim is to achieve around 90% of all homes having a meter by 2030;
- Continue to reduce leakage. In the Northern zone the target is to reduce leakage from 48Ml/d (2007/08) to 41Ml/d by 2021[12];
- Offer water efficiency advice and services to customers that are cost effective;
- Working (researching) with other water companies to ensure investment in resource development options can be brought forward. This is particularly important if the effects of metering decline, or if the effects of climate change are more rapid than anticipated; and
- Consider compensating for sustainability reductions by spending additional capital to increase capacity at existing sources (currently constrained by treatment/pumping infrastructure rather than by licence constraint).

The CAMS assessment (Figure 5.1) shows that there is some water available in the Roding, Beam, and Ingrebourne catchments. As explained above, Essex and Suffolk Water has ruled out abstracting additional supplies from this catchment. There are some local sources in this catchment that are used to supply the study area. However, Veolia Water is unable to confirm whether these catchments will be used to increase water provision. Across the wider zone, which augments supply to the study area, groundwater has been assessed as 'no water available' or 'over abstracted'. The CAMS assessment of over abstraction is based on a representation of all recent actual abstractions from existing licenses. This suggests that there is scope for Veolia Water to increase its resources by fully utilizing their existing licenses to their maximum limits. The Environment Agency however would be unlikely to grant license variations to increase abstraction in this area

Based on the implementation of planned schemes in both water resource zones, water availability is not seen as a constraint to development in the study area based on existing resource availability and including confirmed sustainability reductions. As noted above, if the Environment Agency were to impose further sustainability reductions, this could potentially reduce the resource availability to both companies.

[12] Veolia Water Revised draft WRMP Main report, page 121

5.1.2 Water Quality

Rivers in Brentwood Borough are classified as being of 'Moderate to Poor Status' under the Water Framework Directive (WFD) standards. The WFD introduces some new environmental standards that will help to improve the ecological health of inland waters to achieve 'Good Status'. The main aims of the WFD are to prevent deterioration and enhance the status of the water environment, including groundwater. For many rivers, a combination of measures that tackle both diffuse (both agricultural and urban runoff) and point sources (such as sewage discharges) will be required to meet the WFD standards.

Environmental permits (previously quality consents) are set for wastewater discharges in order to protect the water quality in the receiving waters. Sewerage providers and the Environment Agency will monitor compliance against the quality consent to ensure wastewater treatment works are operating properly. Nevertheless, advanced planning and appropriate management will help to ensure that sustainable development contributes to a safe, clean and healthy environment, rather than being a source of long term problems to water quality.

River Basin Management Plans set out a number of actions for various stakeholders, including local authorities, to contribute to water quality improvements in line with WFD requirements. These will need to be followed to ensure no further deterioration of the water quality status in the Borough's watercourses. For example, as identified in Section 3.4.1 above, if a new discharge permit were required to accommodate growth in the Doddinghurst and Ingatestone sewer catchments, a corresponding tightening of the permitted quality limits would also be required by the Environment Agency to prevent deterioration of water quality in receiving watercourses. Furthermore, during the next AMP cycle (post 2015) it may be necessary for Quality Permit Limits at all treatment works to be reviewed and if necessary tightened to meet the requirements of the WFD. This may mean that works will need to operate close to or beyond the current economic limit of treatment, which may pose a constraint to planned growth in the future.

Groundwater quality has been identified as being at Poor chemical status and deteriorating, which has been seen to affect some of the groundwater sources used in Veolia Water's Northern resource zones. However, based on the implementation of planned schemes as set out in their WRMP, groundwater quality is not seen as a constraint to water resource availability in the study area despite the impact of groundwater quality on some of their sources.

5.1.3 Flood Risk

Brentwood Level 1 Strategic Flood Risk Assessment has assessed flood risks in the Borough based on mapping undertaken by the Environment Agency. It concluded that flood risks do not generally constrain development as the majority of the draft SHLAA sites reviewed in the assessment are in Flood Zone 1. Risks from rivers are closely contained near the river channels, and groundwater flood risk is considered to be minimal. Surface water flooding poses a potential risk, and should be considered in site specific Flood Risk Assessments for new development. For a more detailed assessment of strategic flood risks, please refer to the Level 1 SFRA report (Entec, 2010).

5.2 Infrastructure Constraints

5.2.1 Water Supply

All new developments require individual supply pipes and the water companies have a statutory duty under the Water Industry Act 1991 (article 45 section 1) to connect to mains any building that has domestic water use, or where part of the building has a domestic use. Development within pre-existing developed sites can generally be connected to the mains network with limited delay. It is advisable that the local authority confirms development plans with the water companies as soon as possible to ensure that connections can be made as required, particularly if there is widespread and/or large scale development planned simultaneously. If development is planned in areas not currently served by the mains infrastructure then the water companies may require a longer lead-in time to prepare and install the required infrastructure.

At this stage detailed information has not been provided regarding the location of sources that are primarily used to supply the study area. Similarly, it is not known which water treatment works serve the area and so it has not been possible to determine what capacity there is, or what constraints there may be if there was a need to increase capacity. However, this information will be used by the supply companies in reviewing detailed planning applications.

Notwithstanding this gap in detailed information, in the case of Veolia Water the company has confirmed that the villages it supplies within the study area (Kelvedon Hatch, Navestock Heath, Navestock Side, Doddinghurst, and Stonden Massey) are primarily supplied by local abstraction bore holes. In addition, a trunk main supplies at peak periods. Engineers from the water company have confirmed that growth in these wards (Brizes and Doddinghurst and Tipps Cross ward) at the relatively low level set out in the illustrative scenarios in this study would not generate the need for additional mains upgrades, although this is subject to precise housing locations. If planned development is located close to existing built up areas then it is likely that the only infrastructure required would be the domestic supply pipes.

5.2.2 Wastewater Treatment

Environmental Permit - Flow Consent

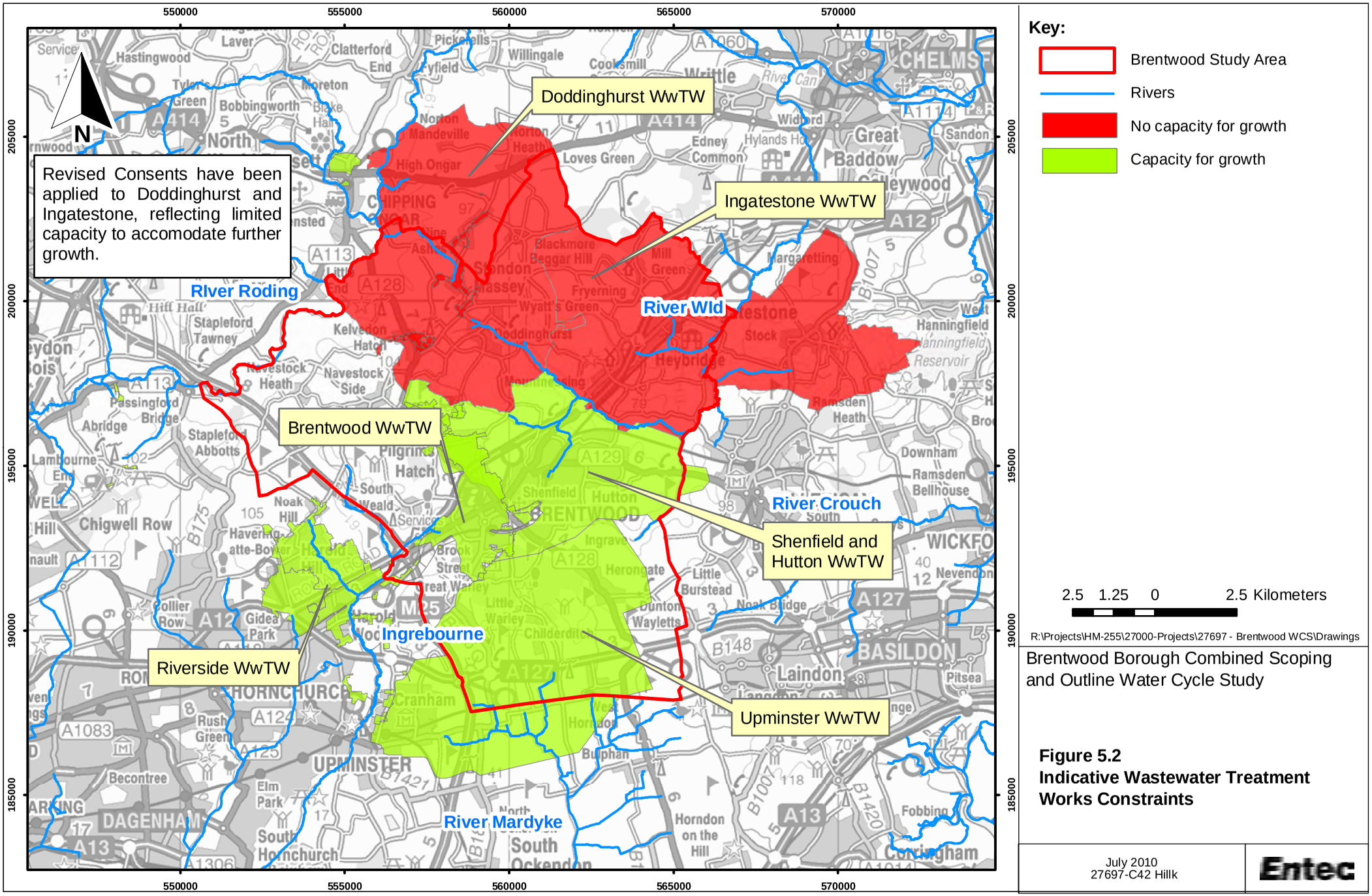
Anglian Water and Thames Water have provided the existing consented/permitted wastewater flow, known as Dry Weather Flow (DWF), for each of their works in the study area. Measured flows from each of the works have been deducted from the consented flow to indicate at a high level that hydraulic/flow capacity currently exists in the consented DWF.

Comparing measured flows to the consent for flow volume provides a high level assessment of potential flow capacity at a wastewater treatment works. However, this assessment is very crude, as there are inevitable margins of error associated with the equipment used to measure the outflow from any treatment works. This assessment does not take account of onsite infrastructure, hydraulic throttles, land take or financial issues that might prevent

the delivery of physical flow against consented flow. Furthermore, sewerage providers also allow for headroom on the consented flow to allow for uncertainties and seasonality of flows. Nevertheless, this comparison provides an approximate assessment of the existing capacity.

The assessment is based on existing consents and does not take into account any planned improvements during the AMP5 period, from 2010 to 2015, to accommodate planned growth. Flow consents have recently been increased at Doddinghurst and Ingatestone WwTW to meet the existing requirements from effluent flow. The increase does not take into account additional growth but has come to light following a flow compliance review. The proposed increases are to better reflect the existing situation, and should not be regarded as providing headroom to accommodate any growth. Where growth is proposed in the catchments of these works, it will be necessary for a consent variation application to be made, at which time the consent limits will be reviewed and if necessary tightened.

With the exception of Doddinghurst and Ingatestone WwTWs, flow capacity does exist at the remaining works in the Borough. As discussed above this does not account for on site infrastructure that might be required to deliver the consented flow. Figure 5.2 presents the constraints at the indicative catchments to the WwTW to show which areas of the Borough could be affected.



Brentwood Borough Combined Scoping and Outline Water Cycle Study

Figure 5.2
Indicative Wastewater Treatment Works Constraints

July 2010
27697-C42 Hillk

Entec

Environmental Permit - Quality Consent

The Environment Agency's 'no deterioration' policy is expected to apply to all future discharges in the area. As a minimum requirement, where proposed growth will cause a breach in the current flow consent conditions, the Agency will require an overall standstill in the load to prevent deterioration in the receiving water quality. The implications are that where flow, through growth, is allowed to exceed the consented flow (through renegotiation of revised flow consents), a pro-rata improvement in the effluent quality will be expected. The WFD, however, is not only about maintaining existing water quality standards but is also about striving for improvements. Improvements in specific water quality parameters, such as nutrients, are still expected to be required for many wastewater discharges, regardless of any proposed changes to the flow element of discharge consents.

As discussed in Section 5.1.2, tightening of permits (for quality) may be considered for the next River Basin Plan or the next Price Review, which may mean that in order to achieve 'Good' status or potential in the receiving watercourses under the Water Framework Directive the quality aspects of the permit may need to be tightened to beyond the current economic limit of treatment. This could potentially create a constraint to treating sewage from further development at the works, even without any need to increase the flow consent.

5.2.3 Sewer Network

There are potential constraints to developments from sewerage where:

- The sewer capacity cannot accommodate additional flows;
- New or upgraded mains are required to connect new developments to mains with capacity; which would be funded by the developer, or
- Developments are located at a long distance from treatment works and there are capacity issues between a development site and the works.

Appendix D provides site specific commentary for the Council, and other interested parties, on the sewerage capacity for sites identified in Brentwood Draft SHLAA.

Sewer flooding records indicate potential constraints in the sewer network in the Ingatestone area.

5.2.4 Surface Water Drainage

The risk of flooding from surface water run-off, sewers and culverted watercourses can be relatively high in urban areas. New developments can increase the area of impermeable surfaces through new roads and roofs, which has the potential to increase flooding from surface-water run-off both on the proposed site and to existing property downstream.

The Environment Agency has recently prepared maps showing a high level assessment of areas that may be susceptible to surface water flooding. This mapping is presented in the Level 1 SFRA in Figures A6a, A6b, A6c

and A6d. These show that within the study area, there are areas of more, medium and less susceptibility to surface water flooding. Several of the settlements in the Borough are affected, with the risk zones being confined to local topographic low points. There are also areas of potential surface water flood risk throughout the rural parts of the Borough.

5.3 Summary of Potential Constraints

Table 4.1 presents a summary of the constraints identified for each option and each element of the water cycle assessed.

The key for the traffic light system is as follows:

	Development ok, no constraints identified
	Development may be ok, minor constraints identified, mitigation required to meet planned trajectory
	Development should not proceed due to major constraint

Table 5.1 Summary of Potential Water Cycle Constraints

Topic Area	Option 1: Centralised	Option 2: Transport Led	Option 3: Semi Dispersed	Option 3: Dispersed
Water Resource Availability	Essex and Suffolk Water has included plans to resolve the potential deficit in supply, mainly through increasing the capacity of the Abberton Reservoir and through demand management and metering in existing homes. It will also be important that the Council encourages water efficiency in new homes to support Essex and Suffolk Water's resource management plans over the growth period. Minimal growth in Veolia Water's Northern zone under all options. Based on water companies' water resource management plans, a surplus in the supply demand balance will enable growth planned in Brentwood to proceed without constraint.			
Water Quality	Receiving waters for surface water run-off are of Moderate to Poor overall status. Groundwater Chemical Status is Poor and deteriorating, Quantitative Status is Good within the Borough. The Council should work with Environment Agency and water companies to deliver actions identified in River Basin Management Plans to meet WFD targets. If the quality permit limits at treatment works are tightened to meet the requirements of the Water Framework Directive, or in response to increased discharge volume permits, this may mean that the works will need to operate close to or beyond the current economic limit of treatment, which may present a constraint to growth in the future. The overall Moderate to Poor status means that there is additional work required to bring watercourses to Good Status.			
Flood Risk	**Fluvial flood risks:** closely follow watercourse channels and do not pose a significant constraint to development. **Surface Water flood risks:** small urban areas of Brentwood susceptible to surface water flooding. Site specific FRAs required under all options. **Groundwater flood risks:** Minimal risk of groundwater flooding across Borough.			
Water Supply Infrastructure	Not assessed in detail. Detailed site assessments required.			

Table 5.1 (continued) Summary of Potential Water Cycle Constraints

Topic Area	Option 1: Centralised	Option 2: Transport Led	Option 3: Semi Dispersed	Option 3: Dispersed
Wastewater Treatment Works	Capacity in flow and quality consent at main works (Shenfield, Brentwood and Upminster WwTW). No capacity for minimal growth in Doddinghurst and Ingatestone WwTW, but can potentially be mitigated by either identifying alternative locations for development or from further assessment.	No capacity at Doddinghurst and Ingatestone WwTW, which would prevent these options coming forward without further investment and phasing at the WwTWs.		
Sewer Network	Refer to Appendix D for site specific comments.			
Surface Drainage	No major constraints identified.	Potential constraint in sewer network (previous flooding issues) in Ingatestone area could constrain surface water drainage issues where a higher rate of growth is planned in this area.	Potential constraint in sewer network (previous flooding issues) in Ingatestone area could constrain surface water drainage issues where a higher rate growth is planned in this area.	Potential constraint in sewer network in Ingatestone area (previous flooding issues) could constrain surface water drainage issues where a higher rate of growth is planned in this area.

6. Capacity for New Development

This section assesses the future capacity of the water cycle to accommodate growth from 2010 to 2031 to inform planning policies and land allocations in Brentwood Borough. The demands of growth on water resources, wastewater treatment and receiving waters and flood risks are reviewed and scenarios discussed. A sensitivity analysis is included on the four growth options to account for uncertainty in the planned housing trajectory.

6.1 Water Supply

Based on the implementation of the water companies demand management schemes and resource development schemes, there is sufficient capacity for housing development in the Borough at a level comparable to the former regional target. The Council should look to support the water companies' plans and RBMP actions, where possible. Reducing household demand for water is one of the most useful ways of ensuring development is sustainable. It is significantly easier to reduce demand in new homes rather than existing homes as planners are able to introduce clauses into planning applications requiring that new homes meet water efficiency levels as prescribed by the Code for Sustainable Homes. This is something that the Council can exert significant influence over. In contrast, reducing demand in existing homes requires significant effort to influence consumptive behaviour and uptake of more water efficient fittings and appliances. However, this is something that the Council could help to influence by working with water supply companies and the wider community.

For the purposes of this study, the estimated future demand for the whole Borough has been assessed against two water efficiency scenarios; the "most efficient" and "least efficient" scenarios. The assumptions made under these two scenarios are described in Table 6.1.

Table 6.1 Water Efficiency Assumptions

MOST EFFICIENT
Existing household pcc is 10% below water company forecast*
Forecast households: All new homes reach CSH level 4 as a minimum
35% at 80 l/h/d household water use
65% at 105 l/h/d household water use
LEAST WATER EFFICIENT
Existing household pcc is 10% above water company forecast*
Forecast households: Over half of new homes only reach CSH level 1
45% at 130 l/h/d household water use
55% at 150 l/h/d household water use

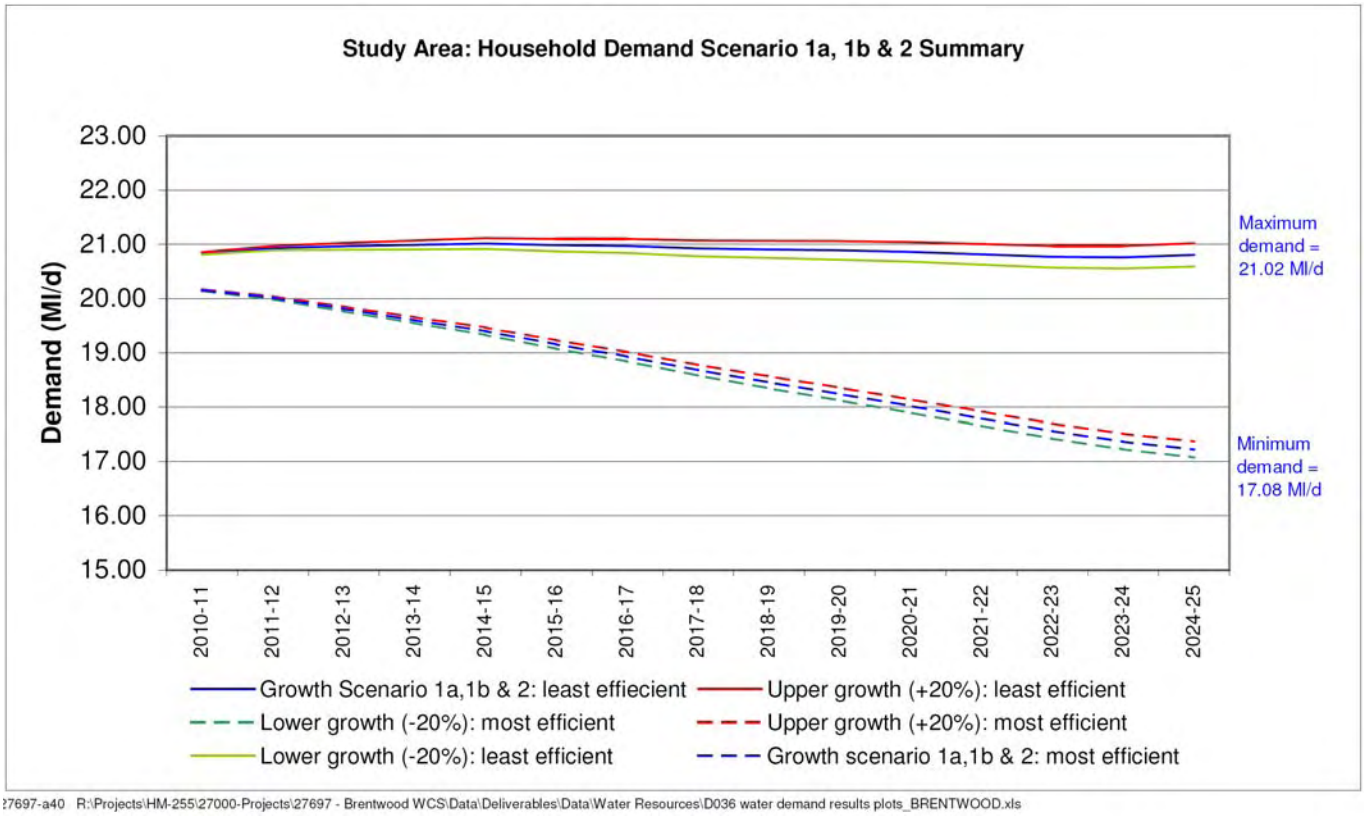
*Based on the forecast annual change to per capita consumption (pcc) from Water Resource Management Plans for existing households, l/h/d = litres per household per day

The four growth options relate to the spatial options and the total proposed housing is the same under each option. To take account of uncertainty in the illustrative housing trajectory, the future demand from a 20% variance in total housing numbers has also been assessed. Figure 6.1 presents the results of this assessment.

It should be noted that the demand estimations assume that the distribution of housing is set out as per Growth Options 1 and 2. Growth Options 3 and 4 were also tested but did not noticeably affect the predicted increase in demand, and are therefore not presented.

Figure 6.1 indicates that by 2026, approximately 3.5 Ml/d of water could be saved in the most water efficient scenario compared to a least efficient scenario, which represents business as usual scenario. This provides strong evidence for supporting the Code for Sustainable Homes Level 3/4 given the role that this can play in contributing to sustainable development and reducing future water demand. The general trend for overall demand to decrease very slightly against the least efficient options, and a steeper decrease in the most efficient option reflects a combination of metering (changing to a lower pcc) and water efficiency assumptions in both unmeasured and measured pcc (improvements in the market such as changes in appliances etc but also effect of any water efficiency programmes the company deploys).

Figure 6.1 Impact of Water Efficiency Scenarios on Demand for Water Supply



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6.2 Wastewater Treatment Works and Water Quality

Using the increase in housing numbers represented by the four illustrative growth scenarios, as provided to Entec by Brentwood Council (Section 2.1.3, Table 2.2), an assessment of the future flows arriving at the six main works serving the Borough has been undertaken. For Anglian Water assets, a consumption rate of 144 l/day per person, and a fixed infiltration rate of 25% have been assumed. For the Thames Water works, a consumption rate of 175 l/day per person has been assumed. These different values have been provided to Entec by the two sewerage providers as values they use to determine if future upgrades are required. The assessments used in this study are presented only as a guide and do not constitute detailed assessments.

Headroom allowance has not been included, which sewerage companies add onto the predicted DWF to allow for seasonal variations. It must be remembered that headroom will be added to the predicted DWF by the sewerage providers to allow for seasonal variation; therefore the works may reach capacity slightly earlier than suggested in these graphs, once headroom is added.

Figure 6.2 presents the DWF estimation for each of the treatment works serving the Borough. For each works, the consented flow is presented and compared to the existing measured flow and the estimated future flow by 2031 for the total proposed growth under each option.

The proposed consented DWFs have recently been increased at Doddinghurst and Ingatestone WwTW to reflect the existing flows at the works. These works should therefore be considered to be already at capacity. Therefore the apparent 'headroom' shown on the graph, where the future DWF is greater than the future predicted DWF, is to allow for seasonal variation in the flow regimes and potential increases in non-household flows. This presents a potential constraint to development in the catchments served by these two works, until additional capacity can be programmed, funded and delivered at both works. If a change in flow consent is permitted, it is likely that the Environment Agency will require a pro-rata improvement in the effluent quality.

The high level assessment indicates that in general there is capacity at the other WwTW in the Borough based on the existing flow consents and the larger difference between this and estimated DWFs under all growth options.

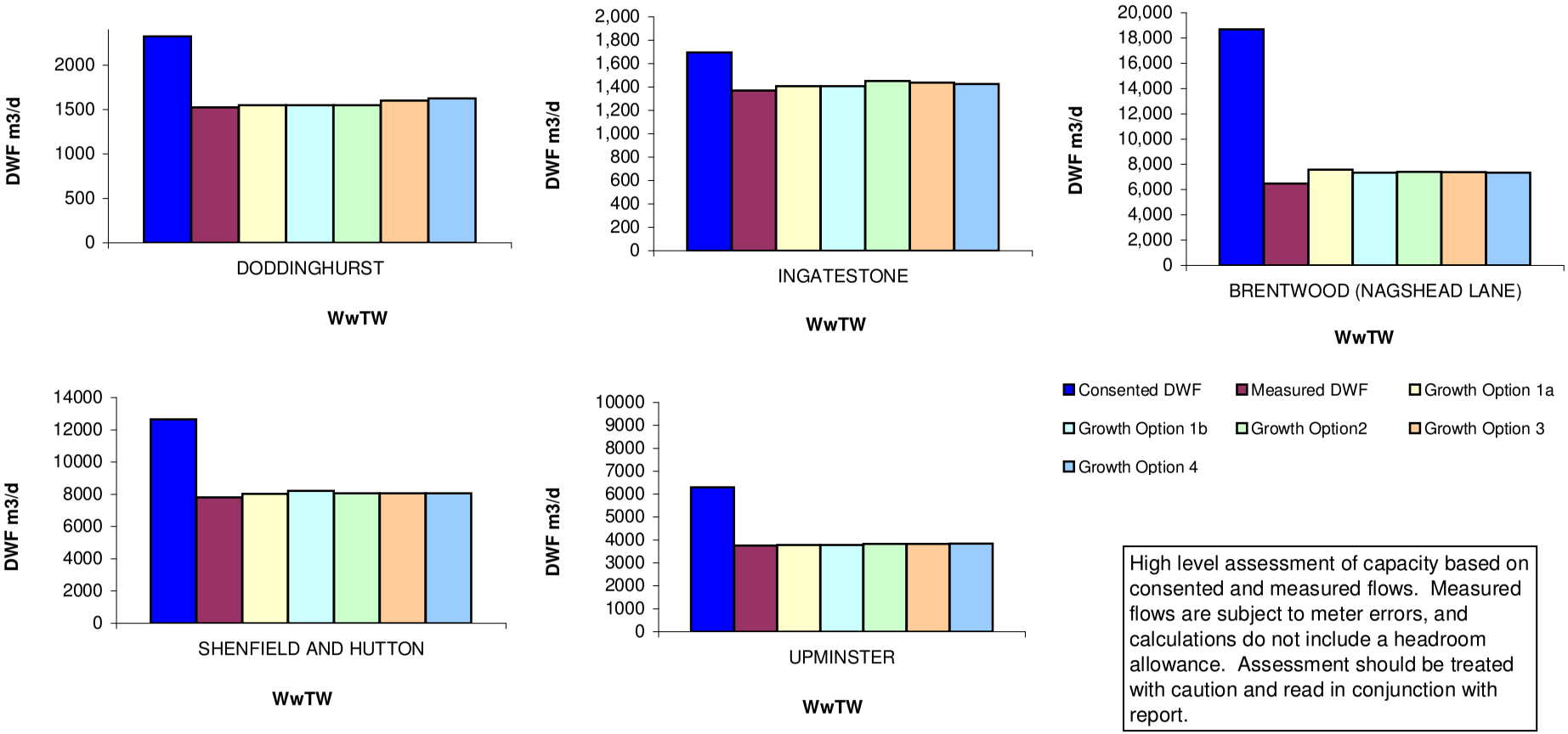
To alleviate wastewater treatment pressures in neighbouring Basildon District it is possible that parts of the Billericay urban area might be served by the Shenfield works. An Outline WCS is being commissioned for Basildon Council, and it is advised that tri partite discussions are held between Brentwood, Basildon and Anglian Water so that all parties work together regarding the future growth draining to Shenfield WwTW.

Appendix E presents the sensitivity assessment whereby estimated DWF has been determined for each WwTW for 20% higher and lower growth across each option. The variance does not result in significant changes to estimated DWF, such that the overall conclusions on capacity remain unchanged.

Based on the assessment above, there is flow capacity at the wastewater treatment works for housing development at a level comparable to the former regional target in Brentwood. As long as growth levels remain within the flow consent, the Environment Agency and Anglian Water have advised that there are no future capacity issues with regard to water quality. However, tightening of permits may be considered for the next River Basin Plan or the

next Price Review, which may mean that in order to achieve 'Good' status or potential in receiving waters under the Water Framework Directive the quality aspects of the permit may need to be tightened to beyond the current economic limit of treatment.

Figure 6.2 Wastewater Treatment Works Capacity Assessment, estimated flow with additional housing



High level assessment of capacity based on consented and measured flows. Measured flows are subject to meter errors, and calculations do not include a headroom allowance. Assessment should be treated with caution and read in conjunction with report.

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6.3 Sustainable Flood Risk Management

In order to minimise flooding resulting from heavy rainfall and drainage constraints, development plans must consider the potential runoff and discharge rates from potential development sites, and consultation must take place with the sewerage undertaker to determine existing capacity of the drainage network. PPS25 advocates consideration of flood risk and sustainable drainage throughout all stages of the planning process and states that all developments greater than one hectare must provide a Flood Risk Assessment to consider surface water management to prevent increased flood risk downstream. Although flooding from rivers will not generally constrain development within the study area, new development provides a unique opportunity to promote sustainable management of flooding through drainage and run-off control. This section sets out the potential capacity for implementing sustainable drainage.

6.3.1 Sustainable Drainage (SuDS)

The Environment Agency promotes the use of Sustainable Drainage Systems (SuDS). SuDS are designed to reduce the potential impact of new and existing developments with respect to surface water drainage discharges by making more use of natural processes to convey surface water away from development. They aim to:

- Control runoff at source;
- Improve water quality by treating runoff and removing pollutants prior to discharge off site;
- Enhance the amenity value of a development;
- Encourage groundwater recharge; and
- Integrate with the environmental surroundings.

By implementing SuDS measures, multiple benefits can be achieved that include improved water quality and amenity value, reducing in storm overflows, contributing to Green Infrastructure and the creation of important habitats, as well as flood risk mitigation.

SuDS are the name given to a drainage approach, rather than any particular drainage type, and are often described in terms of a “management train”, a series of progressively larger scale practices to manage runoff and control water quality. The management train is:

- **Prevention**, Application at individual sites, e.g. use of rainwater harvesting, management to prevent accumulation of pollutants;
- **Source Control**, Control of runoff at or very near to its source e.g. through permeable pavements, green roofs etc;
- **Site Control**, Management of water in a local area or site e.g. by routing water from building roofs and car parks to large soakaways or infiltration/detention basins;

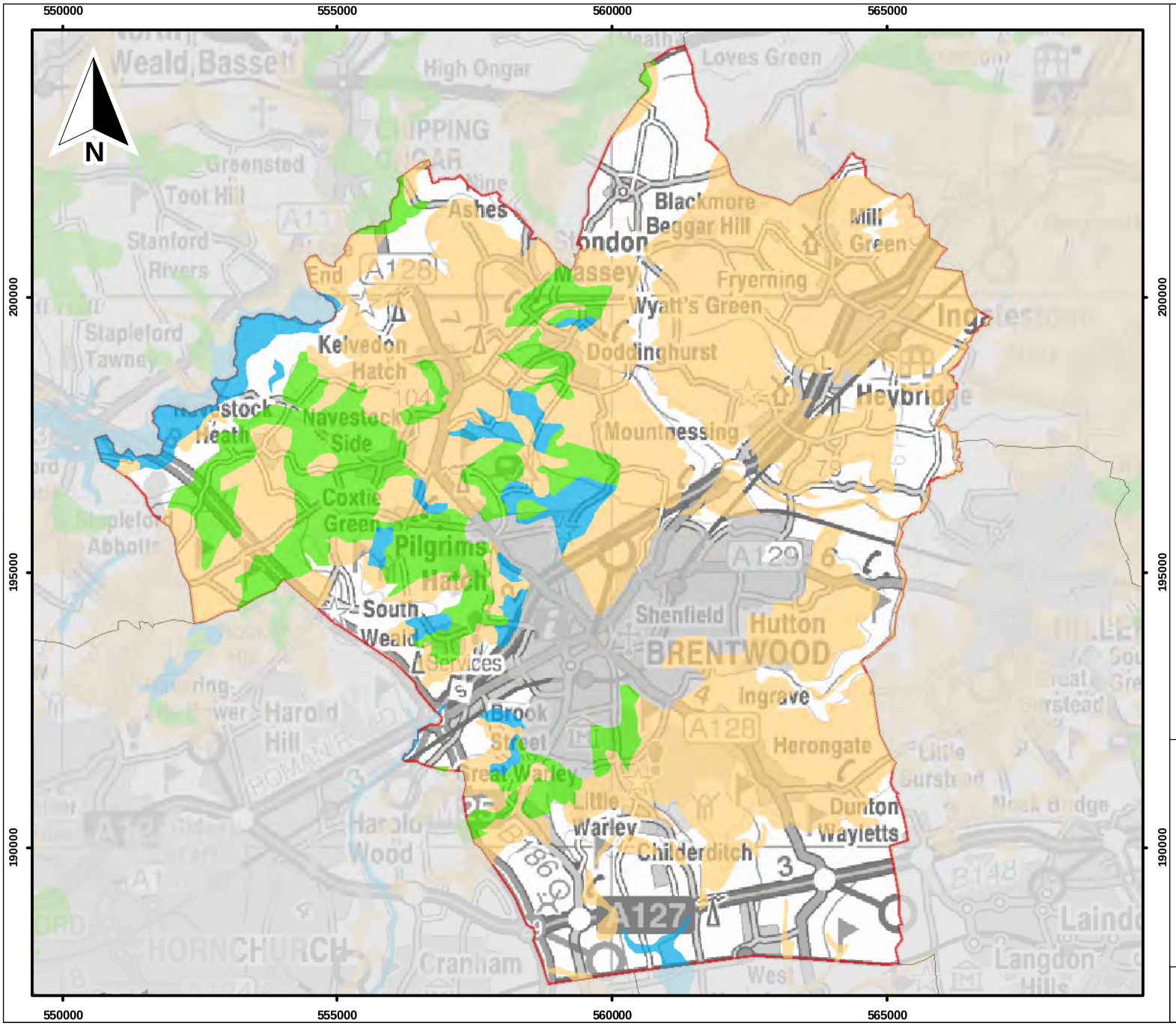
- **Regional Control**, Management of runoff from a site or number of sites, typically in a balancing pond or wetland.

Infiltration techniques are generally the preferred SuDS method because these provide Source Control close to the location of run-off generation. Groundwater vulnerability data provides an indication of the potential for using infiltration techniques based on the aquifer type and leaching potential of the soils. The study area is predominantly located on soils classed as having variably permeable groundwater and various degrees of leaching potentials ("Minor Aquifer, Low Leaching Potential", Minor Aquifer, Intermediate Leaching Potential" and Minor Aquifer, High Leaching Potential"). Over the majority of the Borough, soils are classified as having Low Leaching Potential, indicating a 'Low' potential for infiltration. In parts of Brentwood town and Shenfield, Hutton and Warley areas, the default groundwater vulnerability classifications for urban areas provide insufficient information to determine the infiltration potential therefore site specific assessments will be needed. Figure 6.3 presents the infiltration potential. It is advised that site specific infiltration tests are undertaken during detailed planning applications however, to determine in more detail the local site capacity for infiltration SuDS. There are no groundwater source protection zones for public water supply abstractions in the Borough, which can present further constraint to infiltration techniques to prevent water supplies from being contaminated.

If infiltration techniques are not feasible, the next preferred method should be controlled discharged of clean surface water into surrounding drains or watercourses. PPS25 states that surface water run-off should not be greater than the run-off rate prior to development. The Environment Agency will review Flood Risk Assessments for planning applications greater than 1 ha (or within Flood Zones 2 or 3) to ensure that the drainage requirements are met in line with PPS25. Furthermore it is advised in the Level 1 SFRA for Brentwood that all developments greater than 0.25 ha undertake Drainage Impact Assessments. The purpose of these assessments is to review the surface water drainage requirements for the site and identify the most suitable method of drainage and discharge. The final solution to surface water run-off, if infiltration or discharge to a watercourse is not feasible, would consider controlled discharge into the surface water drainage network. By keeping surface water drainage separate from foul sewers, the risk of flooding in the foul sewer network is reduced.

Developers should contact the sewerage and drainage provider as early as possible in the planning process if discharge to the drainage network is required to control the surface water drainage. Developers for all sites should also discuss requirements to connect to the foul sewer network as early as possible to allow the providers to determine the most suitable connection point and available capacity. For redevelopment of brownfield sites, developers should disconnect any surface water drainage from the foul network and use the preferred hierarchy for treatment of surface water run-off:

- Firstly by using infiltration techniques;
- Secondly by discharging to a surface watercourse; and
- Thirdly discharging to the surface water drainage network, if no other alternative is available.



Key:

Brentwood Borough

Suitability of Infiltration SuDS

- High
- Intermediate
- Low
- Urban Area - no classification (site specific assessment required)

Areas which are blank have no aquifer present and are therefore unclassified

High level assessment based on aquifer status and leaching potential from large scale groundwater vulnerability maps. Site specific infiltration tests should be undertaken to determine the local site potential for infiltration SUDS.

0 1 2 3 4 Kilometres

Scale: 1:103,000 @ A4

H:\Projects\HM-255\Project Sub Folders\27697 Brentwood WCS\Drawings\27697_S41 Figure 6.3 Infiltration Potential.mxd

Brentwood Borough Combined Scoping and Outline Water Cycle Study

Figure 6.3
Brentwood Borough
Infiltration Potential

July 2010
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6.4 Summary of Future Capacity

- Water Resource Management Plans include schemes for demand management, and in Essex and Suffolk Water, the planned increase in capacity at Abberton Reservoir. These schemes will ensure there is capacity in the water resources to accommodate growth in the study area. Veolia Water has also advised indicatively that the minimal growth in their Northern resource zone can be accommodated;

- An assessment of the impacts of water efficiency has indicated that a saving of approximately 3.5 Ml/d could be achieved by the end of the growth period through implementing the Code for Sustainable Homes Level 3/4 for water consumption across all new homes, which would support the water companies demand management schemes;

- The quality limits at the wastewater treatment works currently have capacity for additional growth based on current water quality standards and wastewater treatment. However, tightening of permits may be considered for the next River Basin Plan or the next Price Review, which may mean that in order to achieve 'Good' status or potential under the Water Framework Directive the quality aspects of the permit may need to be tightened to beyond the current economic limit of treatment. This may constrain future growth;

- The Environment Agency and Anglian Water advise that there is currently no capacity at the Doddinghurst or Ingatestone WwTWs. This affects any potential growth located in Tipps Cross Ward, Ingatestone Fryerning and Mountnessing Ward and the eastern half of Brizes and Doddinghurst Ward (including Kelvedon Hatch and Doddinghurst);

- Capacity exists in the WwTW serving the remaining areas of the Borough;

- There is capacity for new developments to employ infiltration drainage techniques across much of the Borough. Surface water drainage from new or redevelopments should first consider infiltration techniques, followed by controlled discharge to watercourses through approval from the EA, or finally by controlled discharge into the surface water drainage system through approval from the drainage provider. All sites should separate surface water and foul water discharges.

7. Climate Change

7.1 Background

Climate change is likely to have major direct impacts on the water cycle as a result of changes in rainfall patterns and temperature/evaporation that will affect water resources, flood risks and dilution capacity of water bodies. Current climate change modelling broadly indicates that there will be wetter warmer winters and drier hotter summers and that some of these impacts will become evident within the timescale of the growth period up to 2031. Some of the preceding sections discuss the impacts of climate change on flood risks and water resources. This section presents a summary of wider impacts on the water cycle and what it means for development.

7.2 Climate Change Modelling and UKCP09

Assessment of climate change impacts is based on global climate models which take account of land use, air circulation, ocean systems, ice volumes and extent, the hydrological cycle and the carbon cycle. Detailed scenarios for the UK are generated using a regional climate model, a high resolution model which is part of the full global climate model. This model produces the output that forms the basis of the climate change predictions produced by the UK Climate Programme (UKCP). The climate range models have been run for a range of scenarios to account for uncertainty regarding future carbon emissions.

The latest output from the UK model (UKCP09) uses the same climate change models to previous outputs, but in contrast also produced probabilistic output based on a range of model set ups and referencing output from other climate change models. The output is also at a 25km resolution, which is much higher than the previous UKCIP02 predictions. This provides much greater spatial detail and also means that topographic features should be more accurate.

7.3 Climate Change and the Study Area

The associated key findings of predicted changes in summer temperature, winter temperature, summer precipitation and winter precipitation for the Medium Emissions scenario for the East of England in the 2020s as shown on the UKCP09 website (http://ukclimateprojections.defra.gov.uk/content/view/2178/499/) are:

- The central estimate of increase in **winter mean temperature** is 1.3ºC; it is very unlikely to be less than 0.6ºC and is very unlikely to be more than 2.2ºC;
- The central estimate of increase in **summer mean temperature** is 1.4ºC; it is very unlikely to be less than 0.5ºC and is very unlikely to be more than 2.5ºC;
- The central estimate of change in **winter mean precipitation** is 6%; it is very unlikely to be less than -3% and is very unlikely to be more than 16%; and

- The central estimate of change in **summer mean precipitation** is –7%; it is very unlikely to be less than –24% and is very unlikely to be more than 12%.

The result of increased winter rainfall and decreased summer rainfall will lead to water companies considering winter storage in order to conserve water when it becomes available, for dry periods in the summer months. The water companies' Water Resource Management Plans take account of climate change predictions to plan for resource management.

Increased rainfall during the winter should be considered with regard to fluvial and surface water flood risk, and the impacts on potential sewer overflows. Whilst overall rainfall is predicted to decrease during the summer months, there is potential for increased frequency of storms which could result in flash flooding during summer months.

PPS25 states that the following allowances should be considered when assessing flood risks:

Table 7.1 Table B.2 of PPS25 of Recommended National Precautionary Sensitivity Ranges

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

These are based on the previous UK climate change modelling outputs (UKCIP02), however the Environment Agency has assessed the UKCP09 forecasts and advised that developers and planners should continue to use these values.

7.4 Assessment of Environmental Capacity and Water Infrastructure Provision

The environmental capacity of the East of England may change over the growth period (2011-2031) as a result of climate change impacts. Areas of potential changes to capacity are listed below:

- Reduced summer rainfall will result in lower river flows which would reduce dilution of wastewater discharges. Compliance with environmental quality standards is, in some cases, based on 90 percentile values which tend to occur during the summer period; reduced river flows may have a magnified impact on compliance;

- Changes to rainfall patterns and increased temperatures may also further constrain water resource availability and reduce groundwater recharge;

- The resultant change in water table levels may also affect infiltration and leakage of water from the sewerage system;

- Increased winter rainfall and storm frequency has the potential to increase surface drainage flow into combined sewerage systems and therefore increase the hydraulic loading on these systems. This increases the risk of sewer overflows and their impact on receiving waters, particularly following long dry spells when sediments accumulate in the sewers and are flushed out by the intense rainfall, which could further reduce water quality on an event basis; and

- Increased winter rainfall, storm frequency and summer storm intensity has the potential to increase the intensity and frequency of fluvial flooding and urban drainage related flood events.

- Changes to water usage particularly in relation to irrigation of gardens and parkland using potable water. The benefits of rainwater harvesting and storage will also become more apparent. Demand for summer irrigation water for agriculture is also likely to increase; and

- Increased stress on wetlands. Consequently, these systems are likely to become less resilient to other perturbations such as impacts of abstractions and discharges.

7.5 Implications of Climate Change and Mitigation

This Scoping and Outline Study has identified that many of the rivers in the study area are at Moderate or Poor ecological status. Although no major constraints to growth have been identified with regard to environmental water quality, there is potential for constraints to occur in the future. High levels of growth could potentially compound the effect of wastewater flows on river water quality, if additional treatment cannot be delivered, for example, as a result of limited footprints for further development. The impact of climate change in reducing rainfall over the summer months has the potential to reduce dilution in rivers during the summer months, therefore increasing the concentration of certain elements. However, the sewerage providers and the Environment Agency have advised that water quality should not constrain development, although it may well do so in future.

Fluvial flood zones across the study area are generally limited and closely follow the channel alignments. PPS 25 requires that developments take into account the impacts of climate change, therefore any site specific Flood Risk Assessments should assess the site against the climate change flood zones from the SFRAs.

Surface water flooding events often have the potential to cause more damage than fluvial flooding as they tend to occur in urban areas. With the potential increase winter rainfall and storm events, combined with the increase in urbanisation, surface water flooding could become more frequent and more widespread than indicated on the Environment Agency's susceptibility to surface water flooding maps. PPS25 requires all new developments requiring Flood Risk Assessments to control surface run-off to the existing rates, reducing run-off where possible, to prevent any increase in surface water flooding. The use of Sustainable Drainage Systems can further offset the impact of increased run-off. Table B2 from PPS25 should be used to determine potential increases in rainfall from climate change for any site specific Flood Risk Assessments.

The pressure on water resources in the study area and wider supply zones could increase as a result of climate change and reduction in water availability, particularly over the summer months. Water company plans include an

allowance for climate change, therefore the assessments which identify that supply will not constrain growth remains valid for consideration of climate change impacts, based on their assessment of resource development and demand management schemes.

The analysis of water efficiency scenarios shows that a saving of approximately 3.5 Ml/d could be achieved in a water efficient scenario compared to a business as usual scenario by the end of the period under consideration, i.e. 2031. Through recommended policies for new homes to be water efficient, local planning authorities will be supporting water companies' demand management schemes and contributing to reducing pressure on water resources both now and in the future.

8. Conclusions and Recommendations

The Combined Scoping and Outline Water Cycle Study has assessed the potential impacts of four spatial growth options on the water environment. It should be noted that for the purposes of this study the capacity assessments for water resources and wastewater treatment have been undertaken at a strategic level and do not include detailed modelling or site specific assessments. Information for the assessments has been provided by third parties and Entec cannot be responsible for the validity or accuracy of third party data. The results therefore provide a strategic overview of issues in Brentwood Borough and do not constitute detailed assessments. Our recommendations below indicate where we feel that further detailed assessment may be necessary.

This concluding section discusses the preferred growth options with regard to the water cycle and provides recommendations for policies to be included in Brentwood's Local Development Plan to support sustainable growth and for future work to address identified constraints and issues.

8.1 Preferred Growth Scenario

The Council has yet to decide on the level of housing growth for the Borough. Based on information available to date, this study assumes a growth level of approximately 3000 net additional homes between 2011 and 2031. Four spatial options to deliver this growth have been assessed in this study. These are based on the following growth distributions:

- **Option 1: Centralised Growth**, majority of development in Brentwood North, South and West wards, Hutton and Shenfield wards;
  - Option 1a assesses the impacts of 500 homes on greenfield sites located in the Brentwood WwTW catchment, serving the west of Brentwood urban area;
  - Option 1b assesses the impacts of 500 homes on greenfield sites located in the Shenfield WwTW catchment, serving the east of Brentwood urban area;
- **Option 2: Transport Corridor Led Growth**, focusing development in Brentwood but providing housing and jobs in other sustainable locations at Ingatestone and West Horndon that have existing transport connections;
- **Option 3: Semi-Dispersed Growth**, development in the main settlements of Ingatestone, West Horndon, Doddinghurst, Ingrave, Mountnessing and Blackmore as well as Brentwood;
- **Option 4: Dispersed Growth**, development in the main settlements and smaller settlements across the Borough.

Housing numbers by ward, based on illustrative scenarios, are presented in Table 2.2, Section 2.1.3, and types of development (brownfield, greenfield, planning permissions and windfalls) and breakdown by wastewater treatment works catchment are presented in Appendix A.

Using information within the water companies Water Resource Management Plans, this study has identified that water resources will not constrain future development under all options as long as demand management schemes, including meeting the forecast per capita consumption, and the increase in capacity of Abberton Reservoir are delivered. Veolia Water's Northern resource zone has less ability to develop new resources and is therefore more dependant on demand management. The potential growth in the Borough in the Northern resource zone area increases from Options 1 to 4, although under all options the growth is minimal, ranging from approximate 150 to 400 homes over the growth period between the four options. Based on water resource availability, Option 1 would be the preferred growth option which has the least number of houses planned in the Veolia Northern resource zone.

Under all four potential spatial options, the Outline WCS assessment has identified that there is capacity in the flow consent of the main wastewater treatment works serving the Borough (Brentwood, Shenfield and Upminster works). The smaller works at Doddinghurst and Ingatestone do not have any capacity for future growth, based on recent changes to the flow consent to reflect the existing demand from households. Any future growth in these catchments may require Anglian Water to increase the flow consent further, which could have phasing implications. The Environment Agency's WFD no deterioration policy is expected to apply to all future discharges. The aim of this policy is to not only maintain existing water quality standards, but also strive for improvements. Therefore, if there is a need to negotiate an increase of the flow consents the Agency will require a pro-rata improvement in the effluent quality to prevent deterioration in the receiving water quality.

Option 1, which has the least amount of growth in the Doddinghurst and Ingatestone areas, would therefore be recommended as the preferred option based on wastewater treatment works capacity issues.

Mitigation will be required to address the potential impact of even minimal growth in the Doddinghurst and Ingatestone WwTW indicative catchment areas. This could include:

- Identifying alternative locations for development outside Doddinghurst and Ingatestone WwTW catchment areas; or
- Obtaining additional detailed assessment of flows to the Doddinghurst and Ingatestone WwTW that would arise from growth in Option 1, and the impact on the receiving water quality to determine if this can be accommodated in the existing license.

The assessments presented in this report provide an indication of the increases in flow that can be expected to result from housing growth. Significant levels of increased employment in the Borough may also contribute to increased demand and increases in effluent flows. It is suggested that the preferred location for employment growth should also be centralized to prevent any additional capacity issues at Doddinghurst and Ingatestone WwTWs.

Table 8.1 ranks the spatial options, based on capacities of these two WwTW identified in this study as the main limiting factors to growth in the Borough. It is acknowledged that other constraints outside the water cycle may dominate the Council's decision on growth locations.

Table 8.1 Preferred Growth Option, Constraints and Mitigation

Growth Option	Constraint and Mitigation Required
Option 1: Centralised Growth	**PREFERRED OPTION** Housing numbers provided for this assessment still include minimal development in the Ingatestone and Doddinghurst WwTW catchments, which have no capacity for growth. Mitigation is required to enable this option to be delivered. This could comprise identifying alternative locations for development or additional assessment of WwTW and receiving water capacity within existing consent.
Option 2: Transport Led Growth	Housing numbers provided for this assessment still include minimal development in the Doddinghurst WwTW catchment and increased housing compared to Option 1 in Ingatestone WwTW catchment, both of which have no capacity. The mitigation required to enable this option to be delivered could be more costly than Option 1 and include additional revisions to Ingatestone WwTW consent, which would need approval from the Environment Agency.
Option 3: Semi-Dispersed Growth	Increased housing numbers in both Doddinghurst and Ingatestone compared to Options 1 and 2. It is unlikely that Anglian Water and the Environment Agency would permit increasing both consents at these two works.
Option 4: Dispersed Growth	Increased housing numbers in both Doddinghurst and Ingatestone compared to Options 1, 2 and 3. It is unlikely that Anglian Water and the Environment Agency would permit increasing both consents at these two works.

8.2 Future Recommendations

The primary aim of the Scoping and Outline WCS is to collate and review existing information on the water environment and identify potential environmental and water infrastructure constraints to development. The information provides an evidence base to support planning policies and land allocations and identify or inform preferred options for development. The assessment draws on existing plans from water and sewerage companies and environmental regulators. Areas of uncertainty that may require further detailed studies should also be identified. These detailed WCSs aim to resolve areas of uncertainty and identify water cycle management measures and additional infrastructure required, where and when it is required, who is responsible for providing the systems, and by what deadline.

Section 8.1 above presents a summary of the findings and advises on the preferred spatial option, the Centralised Growth Option, from the water cycle constraints identified. The following sections set out recommendations that have arisen from this study. These comprise policies and actions the Council can implement, and details of future work required to address constraints in the wastewater infrastructure.

8.2.1 Policies and Measures for Water Efficiency

Water demand management is identified as a central part of the solution to ensure that development in the Borough is sustainable. The scenario assessments for water efficiency in this study have identified that a maximum saving of approximately 3.5 Ml/d could be achieved through the implementation of water efficiency measures in new

homes, based on a growth level for the Borough comparable to the former regional target, which remains the same under all four growth options (the location and distribution of new housing differs under each option, but not overall numbers).

The Council can actively support the water companies' plans for forecast future household demand by embedding water efficiency into planning policies. It is recommended that the Local Development Plan includes a policy to ensure that all new housing developments meet at least level 3/4 of the Code for Sustainable Homes (water element) and that all new non-residential schemes deliver water efficiency standards to gain credits against the BREAM assessment criteria. This approach would take forward actions in the Anglian RBMP to ensure that policies require water efficiency standards to be linked to the Code for Sustainable Homes level 3 and above (see Section 3.3.1).

The Environment Agency has highlighted that planning authorities have a key role in managing water resources via spatial plans that contain policies promoting the efficient use of water resources.

A recent study completed by Entec UK Ltd for the London Development Agency (Entec Report Reference 24205R121i3) has demonstrated that basic water efficiency measures (6/4 litre dual flush toilets, standard rather than power showers, restrained flow bathroom taps etcetera) are feasible in terms of performance and customer satisfaction, and are sufficient to enable all types of new households to reach Level 3/4 of the Code for Sustainable Homes. The study has not been published yet for a wider audience.

The impact of demand management often decays over time and consumption can begin to increase. It is recommended that the Council works with the water companies to identify actions, including those that can be taken by the Council with regard to land and buildings it owns and manages, that will help to maintain demand savings.

Both water companies' water resource management plan strategies include significant increases in household metering. It is recommended that the Council considers the benefits of metering and actively support the water companies' strategies to increase metering levels. However, the Council may be in a stronger position to reach out to reassure vulnerable customers and to ensure that their needs are protected whilst at the same time helping all residents manage their consumption.

BREEAM standards exist for different building types, from industrial and commercial to buildings used for office, retail or education, for example. It is also recommended that for non-residential development, planning authorities' policies include a mandatory assessment by a BREEAM assessor for non-residential developments, with the expectation that developments meet the Good standard as a minimum, with regard to water consumption targets.

The Council can also support the recommendations in both the Thames and Anglian RBMPs to encourage all rural businesses to adopt water efficiency measures, such as rainwater harvesting and recycling and use of storage reservoirs to support summer irrigation, to further support sustainable growth.

A recommended policy for water efficiency is set out below in Section 8.3.

8.2.2 Additional Work to Address Constraints

This study has identified that there are capacity issues in the existing wastewater infrastructure at Doddinghurst and Ingatestone to accommodate growth under all four scenarios investigated. It is therefore recommended that spatial options for growth locate development elsewhere in the Borough where treatment capacity is available. The findings of this study indicate that with regard to the water environment the Centralised Growth Option 1 would be preferred.

Even under the Centralised Growth Option 1, a small amount of growth may occur in these two catchments and therefore mitigation will be required. The following two sections set out proposed mitigation options that should be considered by the Council to overcome the WwTW constraints identified.

Amendments to Centralised Growth Options

The simplest solution to mitigating the WwTW constraints identified would be to identify alternative locations for housing for Option 1 so that land in the Doddinghurst and Ingatestone WwTW catchments is not developed, and the equivalent number of homes is provided elsewhere in the Borough. This would involve identifying sites outside these catchments, to offset the lost development capacity in Doddinghurst and Ingatestone. Sites affected by this recommendation are listed in Table 8.2 below, which indicates that it is a very small number of houses that would be removed from the overall growth target.

Table 8.2 Sites Affected by Doddinghurst and Ingatestone WwTW Capacity

WwTW Catchment	Site Reference	Site Address	Housing Capacity (number of dwellings)
Doddinghurst	288	Woodlands, School Road, Kelvedon Hatch	10
	280	Adjacent to 1 & 3 Orchard Place, Blackmore	2
	243	R/O Little Jerico, Church Street, Blackmore	3
	87	Land at rear of Hayden & Ardslia, Wyatts Green Road, Wyatts Green	1
Ingatestone	51	Adj. Everglades, Avenue Road, Ingatestone	4
	80	Meadowside, Swallows Cross Road, Mountnessing	1

Addendum to Scoping and Outline Phase

Despite the constraints outlined above, it is still possible that the Council may wish to consider the potential for developing these sites further, in which case additional assessment will be required. This would review the impact of increased flow and loads on the water quality of the receiving watercourses to determine if total planned housing

can be accommodated in the existing flow consent at the two works. This process requires water quality modelling which falls outside the remit of a Scoping and Outline Phase WCS.

It is recommended that an addendum to the Scoping and Outline WCS is prepared that assesses the impacts of growth on the constrained WwTWs. This stage would require further consultation between the Council, Anglian Water and the Environment Agency. At this stage it is advised that the additional assessment should use the existing Integrated Lake and Catchment (ILC) model developed by Entec for the Chelmer / Blackwater catchment to assess the implications of specific growth and wastewater treatment scenarios. This is currently being used by Anglian Water and is their preferred method for reviewing consent conditions. The model would enable the following to be determined:

- If a variation to a discharge consent is needed, including indicative consent conditions at wastewater treatment works (and when); and
- If flow changes will affect WFD targets, and how water quality can be maintained (ensuring no deterioration from current levels).

An addendum approach would allow the assessment to be carried out relatively quickly, and it is not considered that a full Detailed Phase WCS would be required for the Borough.

This approach to provide an addendum to the Outline WCS, rather than undertake a Detailed WCS, is advised based on the information available at the time of publication. The scope for a detailed study should, however, be discussed with the Steering Group using the latest intelligence, once the Council is ready to commence further assessment.

8.2.3 Consider Policies for Sustainable Surface Water Management

Fluvial flood risks are generally not widespread across the Borough and are closely confined to the watercourses. Groundwater flood risks are not generally present. The greatest risk of flooding arises from surface water flooding, although this is not widespread across the Borough's urban areas. In order to promote sustainable development and sustainable flood risk management, it is recommended that the Council adopts planning policies to ensure new developments implement Sustainable Drainage Systems (SuDs). In line with PPS25, all new developments greater than 1 hectare in footprint should undertake a Drainage Impact Assessment so that surface water run-off post development is no greater than pre-development rates. The Level 1 SFRA, prepared alongside this study, goes further to recommend that the Council introduces a policy for all developments greater than 0.25 ha to undertake Drainage Impact Assessments, so that the cumulative impact of small developments on the surface water drainage does not incrementally increase flood risk and erode drainage capacity. Climate change impacts on rainfall should also be considered. Suggested wording for a SuDS policy requirement to be incorporated within the **Local Development Plan** is set out in Box 1 below.

The Council may also wish to consider producing a SuDS and Green Infrastructure SPD which provides design guidance for the delivery of SuDS on strategic sites.

A new guidance document *Planning for SUDS – making it happen* is currently being prepared by CIRIA, focussing on delivering SuDS through the planning and development process to ensure successful sustainable drainage is effectively specified by planners and delivered by developers. The Council should take account of this guidance when developing their SuDS policy.

It is recommended that the Council adopts a policy that surface water and / or highway drainage is disconnected from foul or combined sewers when brownfield sites are redeveloped. In this way the flow volume entering the foul sewer can be decreased from the existing arrangement where surface water run-off is discharged to the foul sewer network.

All developers should make contact with the relevant sewerage provider at the earliest opportunity so that the foul network can be assessed and if necessary developer contributions identified for new infrastructure to connect to existing mains.

8.3 Summary of WCS Recommendations

The study has made recommendations on the preferred spatial growth option, identified policies that should be included in the Core Strategy in order to promote sustainable development in the Borough, and recommended future work to address constraints identified. A summary of these issues is presented in the box below:

Box 1 Summary of WCS Recommendations
Recommendation 1: Centralised Growth Option It is recommended that the Council promotes the Centralised Growth Option. The WCS has identified the capacity of wastewater treatment works in the north of the Borough as the main limiting factor, therefore Option 1 which has the least amount of growth proposed in this area is considered preferable.
Recommendation 2: Policy for water efficiency Planning policies should require developers to design all new homes to meet the minimum water use standard in Level 3/4 of the Code for Sustainable Homes (105 l/p/d) or ensure any wider sustainable design policy, development plans or briefs require this standard for water use. The local planning authority should consider a policy for non-household development making it mandatory for commercial buildings to be assessed by a BREEAM assessor, with the expectation that buildings meet Good standard for water consumption targets for the building type (industrial/commercial/office/retail/education etc).
Recommendation 3: Additional work to address constraints The Council should consider identifying alternatives to growth in Doddinghurst and Ingatestone elsewhere in the Borough, as the study has identified there is no capacity for growth at these wastewater treatment works. If alternative locations for accommodating necessary growth cannot be found, a detailed assessment of the impacts of growth on the flow consent and receiving watercourse in the Doddinghurst and Ingatestone sewer catchments should be carried out in an addendum to this WCS.

Box 1 Summary of WCS Recommendations

Recommendation 4: SuDS Policy

All development should include appropriate sustainable drainage systems (SuDs) for the disposal of surface water, in order to avoid any increase in flood risk or adverse impact on water quality.

For brownfield developments SuDs features shall be required so as to achieve a reduction from the existing runoff rate but must at least, result in no net additional increase in runoff rates.

SuDs features should normally be provided on-site. If this cannot be achieved, then more strategic forms of SuDs may suffice. In such circumstances, developers will need to contribute toward the costs of provision via Section 106 Agreements or the strategic tariff. In all cases, applicants will need to demonstrate that acceptable management arrangements are funded and in place so that these areas are well maintained in future.

SuDs should be sensitively designed and located to promote improved bio-diversity, an enhanced landscape and good quality spaces that improve public amenities in the area.

The preferred hierarchy of managing surface water drainage from any development is through first infiltration measures, secondly attenuation and discharge to watercourses, and if these cannot be met, through discharge to surface water only sewers.

Recommendation 5: Disconnection of surface drainage from foul network

It is recommended that the Council adopts a policy that will ensure redeveloped brownfield sites disconnect any surface water drainage from the foul network.

Recommendation 6: Water sustainability assessment for all developments

It is suggested that the Council considers a policy which makes it compulsory for all new developments to submit a Water Sustainability Assessment as part of their planning application. This would enable developers to demonstrate that the application meets the criteria recommended in parts 2, 4 and 5 above. That is developers should demonstrate:

1. the development will meet the water consumption level 3/4 from the Code for Sustainable Homes for all residential developments
2. non-residential developments should demonstrate that they have been assessed by a BREEAM assessor, with the expectation that buildings meet Good standard for water consumption targets for the building type
3. for all developments SuDS have been incorporated to control surface water run-off
4. for the redevelopment of brownfield sites, any surface water draining to the foul sewer network has been disconnected and is managed through SuDS
5. a Flood Risk Assessment has been completed where required. This should be approved by the Environment Agency and in line with the requirements of Planning Policy Statement 25
6. the developer has contacted the sewerage provider to assess the capacity of the receiving foul sewer network and the need to contribute to any additional off site connections for the development
7. the developer has contacted the water supply provide to assess the requirements for supply infrastructure to the development

Appendix A
Breakdown of Development Types per Growth Option

Table A1 sets out the total number of Brownfield sites, planning permissions, windfall sites and greenfield sites per ward for all four growth options, including the two scenarios for Option 1. It should be noted that these are illustrative scenarios designed to facilitate this study and do not preclude other options or scenarios that may come forward in future.

Table A1 Breakdown of Development type by Wastewater Treatment Works

Option 1a

WwTW	Planning Permissions	Brownfield	Greenfield	Windfalls	TOTAL
Brentwood	791	547	500	544	2382
Doddinghurst	17	16	0	27	60
Ingatestone	55	5	0	36	96
Shenfield	116	331	0	145	592
Upminster	16	6	0	28	50
TOTAL	995	905	500	780	3180

Option 1b

WwTW	Planning Permissions	Brownfield	Greenfield	Windfalls	TOTAL
Brentwood	791	547	0	544	1882
Doddinghurst	17	16	0	27	60
Ingatestone	55	5	0	36	96
Shenfield	116	331	500	145	1092
Upminster	16	6	0	28	50
TOTAL	995	905	500	780	3180

Option 2

WwTW	Planning Permissions	Brownfield	Greenfield	Windfalls	TOTAL
Brentwood	791	547	140	544	2022
Doddinghurst	17	16	0	27	60
Ingatestone	55	5	120	36	216
Shenfield	116	331	100	145	692
Upminster	16	6	140	28	190
TOTAL	995	905	500	780	3180

Option 3

WwTW	Planning Permissions	Brownfield	Greenfield	Windfalls	TOTAL
Brentwood	791	547	70	544	1952
Doddinghurst	17	16	140	27	200
Ingatestone	55	5	80	36	176
Shenfield	116	331	70	145	662
Upminster	16	6	140	28	190
TOTAL	995	905	500	780	3180

Option 4

WwTW	Planning Permissions	Brownfield	Greenfield	Windfalls	TOTAL
Brentwood	791	547	0	544	1882
Doddinghurst	17	16	200	27	260
Ingatestone	55	5	48	36	144
Shenfield	116	371	30	145	662
Upminster	16	6	182	28	232
TOTAL	995	945	460	780	3180

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Appendix B
Water Resources Supplementary Information

January 2011

Impact of Rainfall Levels on Resources

The availability of water resources is largely dependent on the amount and annual profile of rainfall in the area. There is little spatial variation in rainfall across Essex, with average levels between 555mm/yr and 590mm/yr common across much of Essex[13]. Rainfall across the Veolia Water Central area is slightly higher, ranging between approximately 580mm/year near the Essex border and 725mm/year further west (Gade at Bury Mill). Rainfall across the whole area relevant to this study is therefore considerably lower than the average for England which is 828mm/yr[14]. It is interesting to note that the driest recorded place in the United Kingdom is St Osyth, Essex, with just 513 mm per year[15]. Demand is high for this limited resource and the Environment Agency has assessed the area as being under Severe Water Stress[16].

Groundwater resources (significant to Veolia Water) are generally recharged during the winter when rainfall is more prolonged and evaporation is minimal. Winter rainfall is also valuable for replenishing surface water sources, e.g. pumped storage reservoirs which are a key component of the Essex water resource system.

Veolia Water has stated in its revised WRMP that "*it is the availability of groundwater that is critical to the impositions to restrict demand*"[17]. Groundwater in this area is susceptible to multi-season droughts (i.e. successive dry winters). The smaller volume of surface water is not as vulnerable to drought conditions as groundwater but is constrained marginally by abstraction licences.

Essex and Suffolk Water defines its level of service to customers as: appeals for restraint not more than 1 year in ten; a hosepipe ban not more than one year in twenty, and drought order restrictions on non essential use not more than one year in fifty.

Veolia Water defines its level of service to customers as: a hosepipe ban not more than one year in ten and a drought order for restriction of non-essential water use and 1 in 20 years return period[18].

Average levels are based on data from 1961-1990.

[13] http://www.nwl.ac.uk/ih/nrfa/station_summaries/op/EA-Anglian_map.html

[14] http://www.metoffice.gov.uk/climate/uk/averages/19611990/areal/england.html

[15] http://www.metoffice.gov.uk/corporate/library/factsheets/factsheet09.pdf, page 6

[16] Environment Agency (2007). Identifying areas of water stress.

[17] Veolia Water WRMP Main report, page 32

[18] Veolia Water Revised draft WRMP Main report, page 33

Impact of Climate Change

The recent UKCIP09 climate change projections indicate that there will be, "little change in the amount of precipitation (rain, hail, snow etc) that falls annually, but it is likely that more of it will fall in the winter, with drier summers, for much of the UK"[19]. In the Anglian Region (under a medium emissions scenario) winter precipitation is expected to increase by 10 to 20%.[20] Summer rainfall is expected to be 10 to 30% less than the current average. The impact of this is that there would be even less water available to abstract during the summer months, when demand is greatest. Surface water systems, as found in Essex, are more vulnerable to this type of change in rainfall pattern as water is available for a relatively short period of time, before it is consumed or flows to the sea. In contrast, increased winter rainfall could benefit groundwater dominated systems (such as Veolia Water's system) which tend to rely on winter rainfall to steadily recharge the aquifers.

[19] http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=248&Itemid=287

[20] http://ukclimateprojections.defra.gov.uk/content/view/1575/658/

Appendix C
WFD Status of Water Bodies in Brentwood Borough

Table C.1 contains information on the WFD status of the water bodies which lie within the Brentwood Study Area (see Figure 3.4). Water bodies are either of Poor or Moderate status and the relevant RBMPs indicate that the target for Good Status is 2027. Earlier targets have been dismissed because of disproportionate costs or technical infeasibility of measures. It can be seen that failure of phosphate standards is common to watercourses within all three catchments, with the Wid also failing standards for ammonia. Some watercourses in the Roding and Ingrebourne catchments have also been assessed under the Dangerous Substances Directive, with the River Roding failing targets for the hydrocarbon Benzo (ghi) perelyene, the herbicide isoproturon and the pesticide/biocide Tributyltin.

It should be noted that a number of the water bodies in the Wid catchment and the River Roding are classified as being Heavily Modified Water Bodies, indicating that they have been modified in some way by human activity.. This means that their WFD target is Good Ecological **Potential**, rather than Good Ecological **Status** and could involve different targets.

Table C.1 WFD Status/Potential for Water Bodies within the Brentwood Study Area

Water Body	Heavily Modified Water Body?	Ecological Status/ Potential	Biological/Chemical Elements at less than Good Status	Mitigation measures that define ecological potential (HMWB only)	Chemical Status	Overall Status/ Potential	Target Year for Good Ecological Status/ Potential
Anglian RBMP Combined Essex River Catchment: River Wid Catchment							
R75 - Wid	No	Poor	Poor: Invertebrates, Phosphate	N/A	N/A	Poor	2027
R73 – Chainbridge Tributary	Yes	Moderate	Moderate: Invertebrates, Phosphate	Appropriate channel maintenance strategies and techniques not in place.	N/A	Moderate	2027
R72 – Haverings Grove Brook	Yes	Moderate	Moderate: Fish	Appropriate channel maintenance strategies and techniques not in place.	N/A	Moderate	2027
R74 – Wid	Yes	Moderate	Moderate: Invertebrates, Ammonia Poor: Phosphate	Appropriate channel maintenance strategies and techniques not in place.	N/A	Moderate	2027

Water Body	Heavily Modified Water Body?	Ecological Status/ Potential	Biological/Chemical Elements at less than Good Status	Mitigation measures that define ecological potential (HMWB only)	Chemical Status	Overall Status/ Potential	Target Year for Good Ecological Status/ Potential
R77 – Wid	No	Moderate	Moderate: Fish	N/A	N/A	Moderate	2027
R120 – Doddinghurst Brook	No	Poor	Poor: Invertebrates, Phosphate , Ammonia	N/A	N/A	Poor	2027
Thames RBMP: South West Essex Catchment: Mar Dyke Catchment							
R8 – MarDyke (East Tributary)	No	Poor	Moderate: DO Poor: Invertebrates, Phosphate	N/A	N/A	Poor	2027
R9 – Mardyke (West Tributary)	No	Moderate	Moderate: Phosphates.	N/A	N/A	Moderate	2027
R7 – Mardyke	No	Moderate	Moderate: Phosphate	N/A	N/A	Moderate	2027
Thames RBMP: Roding Beam and Ingrebourne Catchment							
R5 – Ingrebourne	No	Poor	Moderate: Fish, Pytobenthos Poor: Invertebrate, Macrophytes Bad: Phosphate	N/A	Good	Poor	2027
R9 – Roding	Yes	Poor	Moderate: Fish, Invertebrates, Macrophytes, Phytobenthos Poor: Phosphate	A significant number of mitigation measures are not in place	Fail	Poor	2027
R4 – Rom/ Beam	No	Poor	Moderate: Invertebreates Poor: Fish	N/A	N/A	Poor	2027

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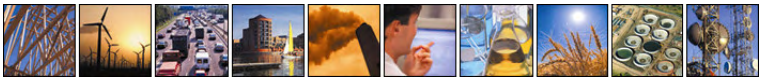
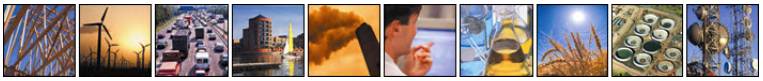
Appendix D
Commentary on Sewerage Infrastructure



The following tables provide a brief commentary on sewerage capacity for sites identified in Brentwood Draft Strategic Housing Land Availability Assessment (SHLAA). No assumption has been made that a site will either be allocated or come forward for development in future.

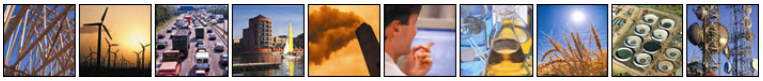
Brownfield Sites

Site Name & Address	Dwelling Capacity (net)	Wastewater Treatment Works	Sewerage Capacity
Sow & Grow Nursery with the Commercial Site and 2 Residential Properties, Ongar Road, Pilgrims Hatch	30	Brentwood	No public sewers available
Mascalls Hospital, Mascalls Park, Mascalls Lane, Warley	158	Brentwood	Sewer capacity needs to be checked. Some of the original hospital sewers are in a poor structural condition with root infiltration. Depends what were replaced as part of the recent housing development.
Land to the Rear of 10-20 Orchard Lane, Pilgrims Hatch	12	Brentwood	*
Land to the rear of 146-148 Hatch Road, Pilgrims Hatch	9	Brentwood	AWS recommend development avoided
Garages adjacent to 25 King George's Road, Pilgrims Hatch	6	Brentwood	*
Highwood Hospital, Geary Drive	180	Brentwood	Site split between TW and AWS but likely to drain to TW sewers. Capacity in TW sewers questionable. May need to connect to the deep level interceptor sewer as connecting to existing sewers may lead to flooding.
Garage Courts Adjacent to 49 Lavender Avenue, Pilgrims Hatch	10	Brentwood	*
Land adjacent to South Weald Parish Hall, Brentwood	15	Brentwood	No public sewers available
Keys Hall, Eagle Way, Brentwood	35	Brentwood	Maybe private or AWS sewers draining across the boundary into TW public sewers
18 Westbury Drive, Brentwood	92	Brentwood	Potential capacity in network, dwelling capacity to be confirmed
R/O Little Jerico, Church Street, Blackmore	3	Doddinghurst	No capacity at works, sewerage infrastructure ok



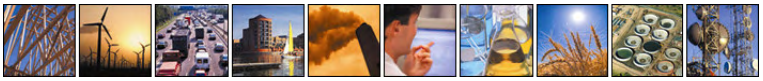
Adjacent to 1 & 3 Orchard Place, Blackmore	2	Doddinghurst	No capacity at works, sewerage infrastructure ok
Woodlands, School Road, Kelvedon Hatch	10	Doddinghurst	No capacity at works, sewerage infrastructure ok
Adj. Everglades, Avenue Road, Ingatestone	4	Ingatestone	No capacity at works, sewerage infrastructure ok
Meadowside, Swallows Cross Road, Mountnessing	1	Ingatestone	Would need septic tank
43-53 Ingrave Road, Brentwood	43	Shenfield	No infrastructure issues
Essex County Fire Brigade Headquarters, Rayleigh Road, Hutton	100	Shenfield	No infrastructure issues
Land at Ingrave Road (198, 198a, 198b & 176), Brentwood	70	Shenfield	No infrastructure issues
Land Opposite Button Common, Herongate	6	Shenfield	No infrastructure issues
Long Ridings, Roundwood Avenue, Hutton	13	Shenfield	No infrastructure issues
Hall Lane Farm, Little Warley	4	Shenfield	No infrastructure issues
Woodlands School, Hutton 482 Rayleigh Road, Hutton	40	Shenfield	No infrastructure issues
Woodlands School, West Horndon	40	Shenfield	Developer contribution needed to fund connection to mains, potentially costly
Land Adjacent to 110 Priests Lane, Shenfield	1	Shenfield	No infrastructure issues
Land between Tendring Court and Tillingham Bold, Hutton	10	Shenfield	No infrastructure issues
Land between 12 & 13 Magdalyn Gardens, Hutton	4	Shenfield	No infrastructure issues
Between 31 & 45 Goodwood Avenue, Hutton	3	Shenfield	No infrastructure issues
R/O Garage & Adjacent to 126 Brentwood Road, Ingrave	4	Shenfield	No infrastructure issues
Greenways, School Road, Kelvedon Hatch	7	Shenfield	No infrastructure issues
Rear of the Bull Public House Brook Street, South Weald, Brentwood	10	Shenfield	*
Land Adjacent Gayland, Thorndon Approach, Herongate	1	Shenfield	No infrastructure issues
The Forge, Great Warley Street, Warley	6	Upminster	*

* Data unavailable for these sites due to the SHLAA being unavailable at the time, or due to uncertainty between Thames Water and Anglian Water sewer network catchments

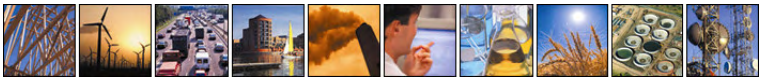


Greenfield Sites

Site Name & Address	Dwelling Capacity (net)	Wastewater Treatment Works	Sewerage commentary
Land at Honeypot Lane, Honeypot Lane, Brentwood	650	Brentwood	Overlapping issues, site in Brentwood WwTW catchment but in AWS sewerage network
Land off Doddinghurst Road, Land off Doddinghurst Road, Brentwood	500	Brentwood	Overlapping issues, site in Brentwood WwTW catchment but in AWS sewerage network
Sawyers Hall Farm, Sawyers Hall Lane, Brentwood	5	Brentwood	Overlapping issues, site in Brentwood WwTW catchment but in AWS sewerage network
End of Hove Close, adjacent end of Bayley's Mead, off Hanging Hill Lane, Brentwood,	45	Brentwood	Overlapping issues, site in Brentwood WwTW catchment but in AWS sewerage network
Land to east of Nags Head Lane, Brentwood	315	Brentwood	Overlapping issues, site in Brentwood WwTW catchment but in AWS sewerage network
Adjacent and Rear of 207 - 217 Crescent Road, Brentwood	2	Brentwood	Overlapping issues, site in Brentwood WwTW catchment but in AWS sewerage network
Rear of 83 - 93 Park Road, Brentwood	6	Brentwood	Overlapping issues, site in Brentwood WwTW catchment but in AWS sewerage network
Land Adj. 50 Spital Lane, Brentwood	10	Brentwood	Overlapping issues, site in Brentwood WwTW catchment but in AWS sewerage network
Land to the Rear Warley County Infants School, Evelyn Walk, Warley	12	Brentwood	Overlapping issues, site in Brentwood WwTW catchment but in AWS sewerage network
Brizes Corner Field, Blackmore Road, Kelvedon Hatch	18	Doddinghurst	*
Swedish Field, Stocks Lane, Kelvedon Hatch,	50	Doddinghurst	Capacity issues, AWS advise minimal development

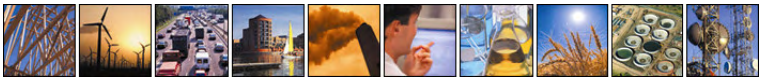


Wyatt's Field, Wyatt's Green	60	Doddinghurst	No capacity at works, sewerage potentially ok
Land to West of Place Farm Lane, Kelvedon Hatch	325	Doddinghurst	Capacity issues, AWS advise minimal development
Land to West of Nine Ashes Road, Nine Ashes Road, Stondon Massey	60	Doddinghurst	No capacity at works, sewerage potentially ok
Land at Church Road, Kelvedon Hatch	56	Doddinghurst	No capacity at works, sewerage issues, AWS advise up to 10 dwellings maximum
Land of Penny Pots Barn, Ongar Road, Stondon Massey	7	Doddinghurst	No capacity at works, sewerage potentially ok
Land south of Redrose Lane, backing onto Orchard Piece residential estate, Blackmore,	125	Doddinghurst	AWS advise against because of cost to developer re potential connection issues
Land adjacent to St Margaret's Church, Doddinghurst	60	Doddinghurst	No capacity at works, sewerage potentially ok if minimal development and capacity at works resolved
Local to Whitelands, Wyatt's Green	40	Doddinghurst	No capacity at works, sewerage potentially ok
Land at Parklands, High Street, Ingatestone	90	Ingatestone	Capacity issues
Land Adjacent to Mountnessing Primary School	32	Ingatestone	Capacity issues
Land Adjacent to Ingatestone by-pass, Ingatestone, (part bounded by Roman Road on two sides, to south of flyover)	85	Ingatestone	Capacity issues
Salmons Farm, Salmons Grove, Ingrave	44	Shenfield	Potential constraint at Ingrave pumping station, will need further assessment from AWS
Site Adjacent to Carmel,D36 Mascalls Lane, Warley	50	Shenfield	Potential connection issues
Land East of Brentwood	800	Shenfield	Potential connection issues
Three Oaks Meadow, Hanging Hill Lane, Hutton,	10	Shenfield	Potential connection issues
Land at Bayleys Mead, Bayleys Mead, Hutton	105	Shenfield	Potential connection issues
Home Meadow, Land Adjacent to 12 Tyburns, Hutton,	90	Shenfield	Potential connection issues
Land to the South East of Hutton	50	Shenfield	Potential capacity issue, developer contribution needed to upgrade or provide new mains
Officers Meadow, east of Chelmsford Road/land off Alexander Lane, Shenfield	900	Shenfield	New main required funded by developer
Land east of West Horndon Industrial Estate, West Horndon	60	Shenfield	*



West Horndon - Land East of Childerditch Lane	900	Upminster	Capacity ok for up to 200 between all greenfield sites in West Horndon
Thorndon Avenue and West of Tilbury Road, West Horndon	843	Upminster	Capacity ok for up to 200 between all greenfield sites in West Horndon

* Data unavailable for these sites due to the SHLAA being unavailable at the time, or due to uncertainty between Thames Water and Anglian Water sewer network catchments



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Appendix E
Sensitivity Analysis of Estimated Dry Weather Flow

The figure below, split over two pages, demonstrates the estimated Dry Weather Flow at the end of the growth period under each spatial growth option. The difficulty in viewing the difference in flow, resulting from 20% higher or lower growth, is an indication of the impact of the 20% variance on the overall effluent flow to the works.

The estimated DWF is for housing only. Additional effluent flow might arise from new employment development in these catchment areas, which would further erode potential capacity at the works.

Figure E1 Estimated DWF based on 20% Variance in Growth for Each Option

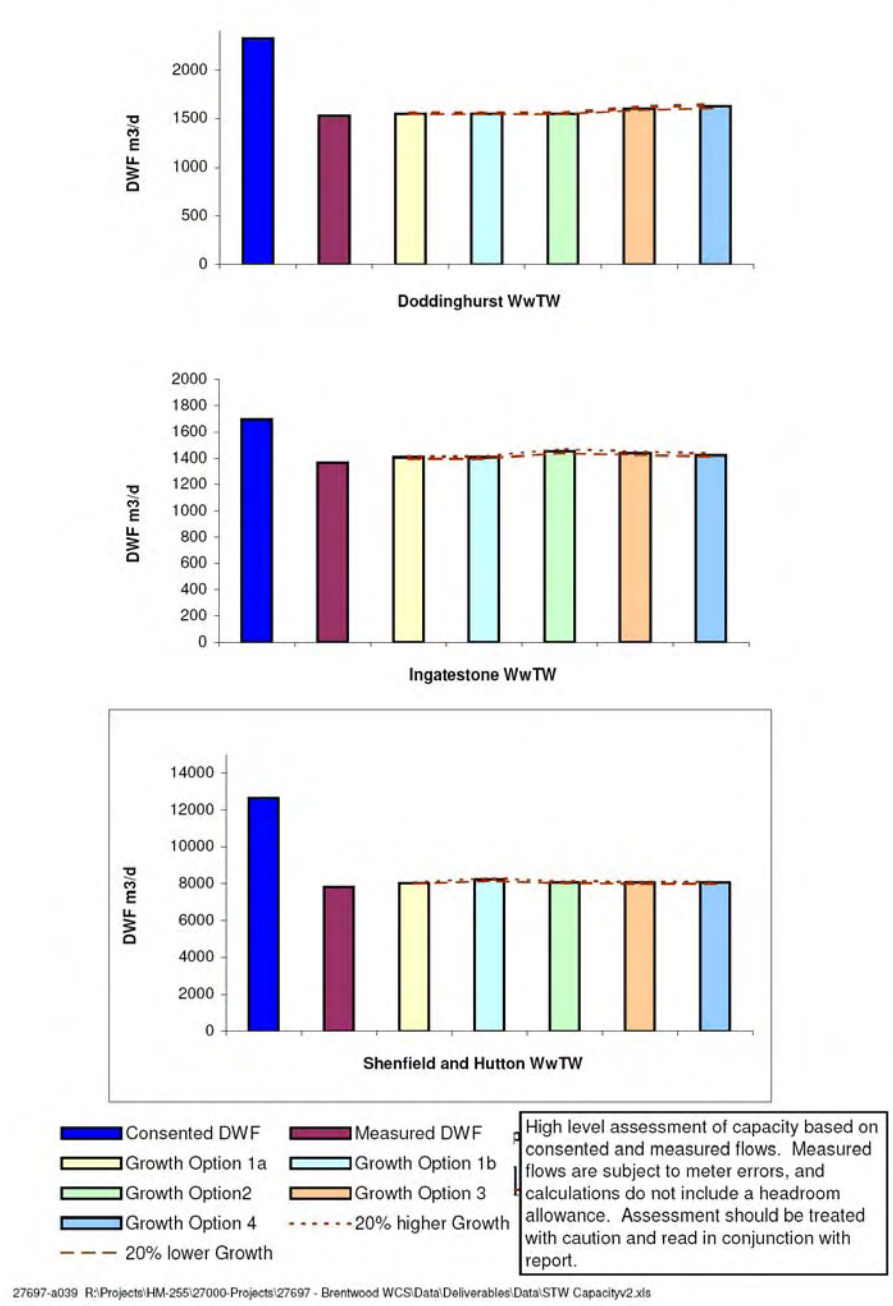

Figure E1 (continued) **Estimated DWF based on 20% variance in growth for each option**