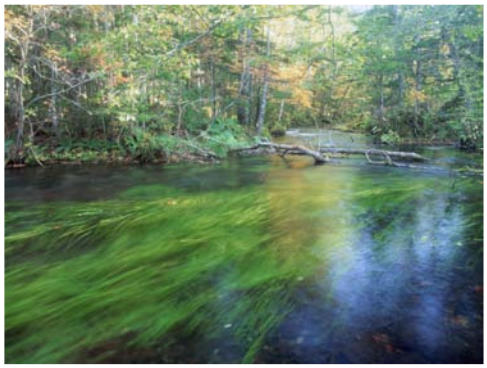
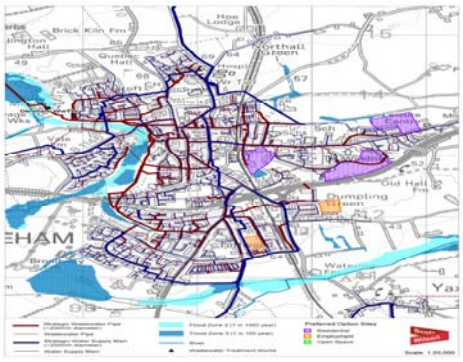
# Breckland Water Cycle Study
# **Phase 2: Detailed Study**

Final Technical Report
May 2010





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# Revision Schedule

**Breckland Water Cycle Study - Detailed Study - DRAFT Technical Report**
May 2010

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# 1 Introduction

## 1.1 Growth in Breckland

1.1.1 Breckland is set to become one of the fastest growing areas in the East of England. Over the period 2001 to 2021, it is expected that up to 15,200 homes will be built within the Breckland area, representing a challenge to Breckland District Council (BDC) in ensuring the environment has the capacity to sustain this level of proposed growth and development.

1.1.2 Within the Breckland area, Thetford has been identified as a Key Centre for Development and Change (KCDC) in the East of England Regional Spatial Strategy (RSS). Over the period 2001 to 2021, it is expected that up to 6,000 homes will be built in and around Thetford. Additionally, Thetford has been identified by Communities and Local Government (CLG) as one of 29 National Growth Points (NGP).

1.1.3 Elsewhere in Breckland, the LDF Core Strategy (CS), in line with the RSS and national planning policy, will focus growth (up to 2026) to sustainable locations where services, jobs and infrastructure exist. The Core Strategy has identified the market towns of Attleborough, Dereham, Swaffham and Watton as sustainable locations for growth.

1.1.4 The objective of the Breckland Water Cycle Study (WCS) is to identify any constraints on housing and employment growth planned for the Breckland area up to 2026 that may be imposed by the water cycle and how these can be resolved i.e. by ensuring that appropriate water infrastructure is provided to support the proposed development. Furthermore, it should provide a strategic approach to the management and use of water which ensures that the sustainability of the water environment in the region is not compromised.

## 1.2 Water Cycle Study Phases

1.2.1 The Breckland Water Cycle Study (WCS) has been reported in 2 phases. A Phase 1 Outline WCS was completed in May 2008 (Reference 1)[1] for Thetford, followed by a Phase 1 Outline WCS (Reference 2) for remaining growth in the district as a whole (November 2008)2.

1.2.2 Both Phase 1 reports assessed the baseline conditions of various elements of the water cycle in Breckland, including the natural water environment and the capacity of the water services infrastructure that would be used to support growth. In addition, the phase 1 studies undertook a high level assessment of the likely growth locations and proposed levels of growth in the district, and determined where growth would be achievable within the existing capacity of both the infrastructure and the water environment.

1.2.3 The Phase 1 reports informed the strategic approach for growth as set out in the Breckland CS, demonstrating that growth in the district was possible subject to further more detailed assessment of key environmental and infrastructure issue identified.

1.2.4 The Phase 2 detailed study continued on from the Phase 1 studies and was undertaken for growth across the district, including Thetford. It has taken the findings of the Outline studies, and determined the detailed solutions required to deliver growth for the specific identified preferred

[1] Scott Wilson (2008) – Thetford Water Cycle Study, Outline report
[2] Scott Wilson (2008) – Breckland Water Cycle Study, Outline report

development allocations, including detailed information on the cost of this infrastructure and the policy required to deliver it[3]. The outcome as been the development of a *water cycle strategy* for the district which informs site specific and other DPDs of the water environment and water infrastructure issues that need to be considered in bringing growth forward at various sites, including guidance for developers in conforming with the requirements of the strategy. The Water Cycle Strategy is reported through the Stage 2 Detailed WCS for Breckland

## 1.3 Phase 2 - Reporting Format

1.3.1 The undertaking of a Phase 2 Detailed WCS involves a significant amount of technical data collation, analysis and interpretation. However, it is acknowledged that the WCS key purpose is to act as a planning evidence base and hence, the Breckland Detailed WCS has been reported via two distinct documents:

- A Non Technical Planning Report - to act as the principal planning reference for the WCS which summarises the overall water cycle strategy, provides the key findings of the study in relation to the Local Development Framework and the various documents which it informs and sets out planning implications of the solutions proposed from the study; and
- A Technical report - setting out:
    - what solutions are required to deliver the strategy;
    - how the strategy was developed;
    - details of the data used;
    - detail of how the capacity and new infrastructure assessments were undertaken;
    - detailed results and findings from the assessments;
    - further discussion around the policy and legislative drivers affecting the assessments and conclusions; and
    - detail on the policy required to deliver the infrastructure and mitigation required; and

1.3.2 Its aim is to act as the technical reference for the evidence base to Breckland's LDF, giving sufficient information to the various key technical stakeholders involved in the study to demonstrate that the strategy developed is robust and achievable.

1.3.3 This report represents the Breckland WCS Phase 2 – Technical Report.

## 1.4 Steering Group

1.4.1 The Phase 2 Detailed WCS has been overseen by a Steering Group consisting of representatives from the following stakeholders:

- Breckland District Council (BDC);
- Norfolk County Council (NCC);

[3] Following agreement with the project steering group, and due to the considerable uncertaintly in deriving costs for infrastructure where developer contribution levels is not certin, costs have been reported separately as a technical note and not published in this Report. The costing technical note has been provided to inform Breckland's ongoing feasibility studies.

- Natural England (NE);
- Environment Agency; and
- Anglian Water Services (AWS).

1.4.2 The stakeholders have provided information and expertise to the study, and have guided the development of the strategy at several key stages. This input has ensured that a strategy has been developed that all key stakeholders can sign up to, allowing agreement to be reached on water environment and water infrastructure issues with respect to the growth set out in BDC's LDF.

## 1.5 Wastewater Treatment Issues

1.5.1 The completion of the Phase 1 Outline WCS for Breckland, determined that accommodation of growth at Attleborough would be challenging with respect to providing sufficient capacity for wastewater treatment, whilst also achieving the required water quality targets downstream of the town. This was in acknowledgement that the proposed growth would almost double the population and hence double the volume of wastewater generated at the town which currently discharges into the headwaters of the River Thet where there is limited water quality capacity to accept further discharges.

1.5.2 In recognition of this issue at Core Strategy stage, a smaller working group was established to discuss the specific issue of wastewater treatment at Attleborough. This work group was made up of representative from BDC, AWS, Scott Wilson and the Environment Agency. The working group outputs have fed into and informed the water cycle strategy developed in the Phase 2 WCS.

## 1.6 Infrastructure Costing

1.6.1 Both water supply (and treatment) and wastewater treatment are the responsibility of AWS within the Breckland study area. At present, the Water Industry Act 1991, and agreements between Ofwat and water companies prevent developers contributing towards the provision of water resource schemes (which are also to be used to serve other development), water treatment and upgrades to existing wastewater treatment facilities. These elements of the WCS will be funded by customer charges which are set by Ofwat over the 5 year AMP periods through the Periodic Review process. Customer charges are set across a company's supply area and the same charges apply for all customers equally (i.e. customers in one area will not pay more than in another area even if costs for new infrastructure to service that area are higher). Hence there is no possibility for seeking contributions to this type of infrastructure and the cost for it has not been detailed.

1.6.2 It is possible that new wastewater treatment facilities which are proposed solely for a development area can be funded by developers and in some cases, later adopted by the incumbent water company. Developers can also consider funding the development of a new water resource (and water treatment facility) proposed to serve a new development specifically, which again, could be later adopted by the incumbent water company. Developer funding would be considered as part of this Water Cycle Strategy, if new wastewater treatment and water supply options are considered solely to serve new development areas.

1.6.3 The provision of strategic level wastewater and water supply mains as part of the water cycle strategy can be part contributed to by developers. In the case where it is required specifically to deliver new development, there are mechanisms that would allow developer contributions to be made towards the funding of water supply and wastewater networks or mains infrastructure on a scale commensurate with the number of housing proposed by each developer. If investment is required to local water or wastewater networks, Ofwat takes the view that water and wastewater companies should seek to part finance this work through contributions from developers. This reduces the financing burden on existing customers, who would otherwise have to pay for it through increases in general charges.

1.6.4 In addition, flood risk infrastructure required to service a development can be entirely funded from developer contributions.

1.6.5 Developer contributions can therefore be sought for wastewater and water supply mains, and flood risk infrastructure, and (in rarer cases) where new wastewater treatment facilities and water resource schemes are required solely for new development. In order to avoid confusion, when a water infrastructure solution is proposed, this WCS report details who is responsible for delivering it, maintaining it and funding it.

1.6.6 Where developers can contribute towards infrastructure, section 10 details the potential mechanisms that could be adopted to provide this funding. Details of the indicative costs of the infrastructure that can be funded (partly or wholly) by developers are provided in a separate technical note to Breckland Council.

# 2 Data Summary

## 2.1 Data Supplied

2.1.1 The undertaking of a Water Cycle Study requires a large amount of data collection, much of which is reliant on the willingness of third parties to supply in order to allow the study to be progressed. In some cases, the availability of data with respect to water cycle infrastructure and future planning is not available within the time required to undertake the assessment and various assumptions have to be used to enable the study to continue.

2.1.2 This study has built on data collated as part of the Phase 1 Outline Study and requested further detailed information where required. A catalogue of the data collected, identifying the data provider in each case, is included in Appendix A: Data Request.

## 2.2 Status of Key Data and Reports

### Water Resources Management Plan (2009)

2.2.1 The publication of AWS's final Water Resource Management Plan (WRMP) has been delayed during the process of undertaking the detailed WCS, and hence much of the analysis for water resource availability for the study has been undertaken using AWS's draft Water Resources Management Plan 2009 (dWRMP)[4] and a Statement of Response to the consultation on the dWRMP[5]

2.2.2 However, the final WRMP was made available in February 2010, and the final plan has been used in determining the final water resource solutions taken forward to support growth in Breckland.

### Water Framework Directive

2.2.3 Since the completion of the Thetford and Breckland Outline WCS, the Environment Agency published their Final River Basin Management Plans (RBMP) for England and Wales as required under the Water Framework Directive (WFD). The final plans were published in December 2009, following sign off from the Secretary of State for the Environment. The Final Anglian RBMP has been used within the Detailed WCS to inform the water quality and wastewater assessments.

### Habitats Directive & the Review of Consents

2.2.4 Specific mention is given in this section to the Habitats Directive at it has a significant influence on both the wastewater and waste supply strategies, owing to an ongoing review process that has been undertake by the Environment Agency and Natural England over several years and is due to complete in March 2010.

2.2.5 The review process is referred to as the Review of Consents (RoC) process. The process requires the Environment Agency to review all of the existing discharge consents or abstraction licences it has issued for both discharges and abstractions to and from rivers or groundwater. The review is to determine whether, when used to their maximum permitted level, the current

[4] Draft WRMP AWS, 2008
[5] SoR, AWS, 2009

licences and consents are likely to be impacting on the integrity of ecologically designated sites which became protected under the Habitats Directive. The licences and consents being reviewed were issued prior to sites becoming designated, so the review is a retrospective process necessitated by the new legislative requirements brought in by the Habitats Directive and is transposition into UK law as the Habitats Regulations.

2.2.6 The potential effects of the consents and licences are considered in isolation and in combination with others. In relation to consents to discharge, the pollutant load of these discharges is considered as well as the impact of the volume of discharge on habitat integrity; whilst for abstraction licences, the direct impact of reduced water availability in a groundwater or river system is determined for impact on any protected habitat reliant on the river or groundwater.

2.2.7 The RoC process goes through three stages:

- Stages 1 & 2 - identifying all consents and licences which could impact on designated sites;
- Stage 3 - undertaking Appropriate Assessments (AA) of sites potentially affected by licences and abstraction, determining which permissions cannot be ruled out as having an impact; and,
- Stage 4 - Site Action Plans are produced for each designated site, which identifies and appraises options. It sets out the action the Environment Agency propose to take on each consent or abstraction which cannot be ruled out as having an impact as a result of the review. The options for licences or consents are generally to affirm them, modify them or revoke them.

2.2.8 If the conclusion is to revoke or modify any permission, the Environment Agency must work with the licence or consent holder to ensure that they are compensated by considering alternatives for replacing the lost permission.

2.2.9 At the time of undertaking the Breckland Detailed WCS, the Environment Agency was in the process of consulting on its Stage 4 findings which reports on the Site Option Plan (SOP) for consents which cannot be ruled out as not impacting on designated sites.

2.2.10 In terms of wastewater, discharge consents for permitting discharge into the River Wensum SAC are being considered, hence wastewater discharge from Dereham (via the Wendling Beck) is being considered as part of the review.

# 3 Methodologies

## 3.1 Introduction

3.1.1 This technical report has assessed the water cycle issues and infrastructure by considering the potential allocations of each growth town in turn and presented as separate chapters. To avoid repetition of methodologies and assessment details within each growth town chapter, the methodologies have been presented as a separate chapter and are described in this section.

## 3.2 Water Resources and Water Efficiency

3.2.1 Water resources are an important factor which needs to be considered in developing a growth strategy for an area. Breckland is fortunate in having large quantities of groundwater held within the Chalk aquifers which underlie large parts of the East Anglian region. These aquifers also provide important feeds to the baseflow of the region's rivers and numerous wetlands areas. It is therefore important to take a regional perspective when assessing the water resources of an area.

3.2.2 The East of England is also one of the driest parts of the country and this combined with the high demand from its residents (both permanent and tourist populations) and industrial (including agriculture) sources, means that Breckland lies within an area of 'serious water stress' (Reference 3)[6].

3.2.3 The water resources assessment has assessed the extra demands which are likely to occur from the Regional Spatial Strategies growth plans reviewed the available water resources which may be available to match these demands and assessed the phasing of schemes to meet the extra growth in demand. Additionally, the assessment has looked at the impact climate change may place on the region's water resources in the future and whether additional new resource schemes will be required as a result of climate change.

3.2.4 The Breckland Detailed Water Resources assessment has been based on information provided by Anglian Water in its final Water Resources Management Plan (WRMP) (Reference 4[7]).

### Water Resources

3.2.5 The Water Resources assessment builds on the findings of the Thetford and Breckland Outline WCS and confirms the existing baseline with respect to available water resources and where the water to supply the new development will be sourced. This includes an assessment of water demand exerted from new residential and non-residential development, the identification of where this water will be sourced from, the impacts of climate change on the preferred solution and the impacts of increased water efficiency measures in existing properties on the total water demand in the Breckland District, and the achievability of water neutrality[8].

[6] Environment Agency, 2008 – Areas of Water Stress: final Classification
[7] AWS, 2010 – Water Resources Management Plan, Main report
[8] Defined as total demand for water in the district after development, is no greater than it is before development takes place.

### Water Demand from Residential Development

3.2.6 Four Residential Demand (RD) scenarios have been modelled for proposed housing growth in the growth towns in the Breckland District based on different water use rates (Table 3-1).

**Table 3-1 Water Use Scenarios for Residential Demand**

| Scenario | Scenario Description | Occupancy Rate | Water use rate (l/head/d) |
|---|---|---|---|
| 1a | Water Company Forecast (Current) | 2.3 | 142 |
| 1b | Water Company Forecast (2035) | 2.1 | 130 |
| 2 | Code for Sustainable Homes 1&2 | 2.1 | 120 |
| 3 | Code for Sustainable Homes 3&4 | 2.1 | 105 |
| 4 | Code for Sustainable Homes 5&6 | 2.1 | 80 |

3.2.7 Scenario 1a uses the current water use rate of an average Anglian Water Services (AWS) metered customer (142 litres/head/day (l/h/d)), and the current average occupancy rate of 2.3 people per property based on figures reported in the Ofwat Security of Supply Report 2007-2008[9]. It is included to represent a 'standstill' scenario.

3.2.8 Scenario 1b is based on AWS planned water demand forecast which sees a gradual reduction in metered demand, from 142 l/h/d in 2009 to 130 l/h/d by 2030 (as reported in AWS WRMP [10]), and occupancy rate from 2.3 in 2009 to 2.1 by 2035/36, based on AWS's 2008 Strategic Direction Statement[11].

3.2.9 Scenarios 2-5 represent the different Code for Sustainable Homes (CSH) water use rates, and are calculated to show what water demand could be achieved with high water efficiency measures in place in new residential dwellings. In line with AWS's 2008 Strategic Direction Statement[12], occupancy rates are assumed to decline from 2.3 in 2009 to 2.1 by 2035/26.

3.2.10 A 10% headroom allowance[13] has been added to the RD calculations to account for uncertainties.

### Water Demand from Non-Residential Development

3.2.11 An estimate of the Non-residential Demand (NRD) has been undertaken (Table 3-2) based on the maximum employment land allocation in each development town. This provides a worst-case scenario in terms of non-residential water demand.

3.2.12 The NRD has been calculated for the proposed employment growth in Breckland, based on a percentage of the residential demand representing the NRD. Scott Wilson's estimates of residential demand were compared to AWS's estimates of total demand (including NRD) and the difference expressed as a percentage has been used to determine NRD estimates.

[9] Ref – Ofwat, Security of Supply, 2007-2008
[10] Ref – AWS WRMP 2010
[11] Ref – AWS 2008 Strategic Direction Statement (p 14, April 2008)
[12] Ref – AWS 2008 Strategic Direction Statement (p 14, April 2008)
[13] Headroom is the minimum buffer that a prudent water company should add to demand to cater for specified uncertainties, such as the under-estimation of certain parameters, as well as taking account of the uncertainties from climate change.

**Table 3-2 Water Use Scenarios for Non-Residential Demand**

| Scenario | Scenario Description | % of Residential Demand |
|---|---|---|
| 5 | Lowest Estimate of Non-Residential Land Allocation | 16% |
| 6 | Highest Estimate of Non-Residential Land Allocation | 31% |

3.2.13 A 10% headroom allowance[14] has been added to the NRD calculations to account for uncertainties.

**Total Water Demand from Proposed Development**

3.2.14 By combining the NRD and RD, the total demands from new housing and employment development in the towns were estimated.

**Climate Change Impacts**

3.2.15 Climate change is predicted to impact on water resources in a number of ways:

- warmer, drier winters are predicted which is likely to result in lower river flows during summer and early autumn, which will reduce the available water for surface water abstractions during the summer;
- wetter winters, but drier warmer summers will result in changes in the timing and amount of natural recharge that occurs to aquifers via infiltration. It is likely to result in a greater amount of winter and early spring recharge, but a longer period over which aquifer levels deplete (less summer rain and warmer temperatures into autumn). As a result more water may be available from groundwater during winter and early spring; but less in summer and into autumn; and
- warmer and drier summers are likely to increase demand for water supplies, especially for uses such as garden watering.

3.2.16 It is important to consider these impacts when planning for water resources over the next 25 years. As such, water companies must ensure that the effects of climate change are factored into their water resource plans.

3.2.17 The water resource assessment undertaken for this study has considered the effect of climate change on water resources based on information provided by AWS, and information contained in their WRMP.

## Water Efficiency

3.2.18 Given the scarcity of available raw resources in the region, it is key that the WCS process considers options for how demand from new development can be managed via effective policy to ensure that future demand for new water supply is minimised. By reducing water demand from new homes to a minimal level, new development could be served with the capacity present in existing abstraction licences, thereby negating any potential impacts on ecological sites that could occur from developing new water resource schemes.

[14] Headroom is the minimum buffer that a prudent water company should add to demand to cater for specified uncertainties, such as the under-estimation of certain parameters, as well as taking account of the uncertainties from climate change.

3.2.19 There is also potential that a WCS can influence policy on water use from existing customers to further secure future water supplies. A water efficiency plan (WEP) has therefore been developed to feed into policy recommendations for Breckland's key Development Plan Documents (DPDs) to be included in the Local Development Framework (LDF).

3.2.20 The first step in a water efficiency plan is to consider the water efficiency measures being adopted by AWS in its WRMP. It should be assumed that these measures will be undertaken, and this will aid in identifying additional measures that are required through policy within the LDF.

**Anglian Water's WEP**

3.2.21 In undertaking their water resource management, Ofwat require that water companies undertake a twin-track approach to providing sufficient water supply to its customers, both existing and in the future. Twin-track management refers to the two step process that Water Companies must take in the management process; with the first step being a reduction in water usage (demand) whilst step two is identifying new water resources (supply) to develop where there is predicted to be a shortfall in supply to meet demand.

3.2.22 The first step is achieved by proactive demand management which is undertaken in two main ways: demand reduction (reducing customer usage); and by reducing leakage from its supply pipe network.

3.2.23 A summary of AWS's planned water demand management measures included in their WRMP are as follows:

- Water Metering – AWS is actively encouraging customers to opt for a water meter, as metered customers use less water than unmetered customers. A targeted enhanced metering programme to improve metering levels (currently at 60%) in certain 'key' areas by up to 80% by 2015 and 90% by 2035 has been proposed.
- Tariffs[15] – no changes are planned. AWS's view is that water is not like other commodities and that people will continue to use what they need, therefore changes in tariffs will not alter people's habits.
- Water Efficiency – Good practice guidance is followed where possible (Ofwat, 2006).
- Leakage – AWS is proposing to continue to operate at below the Economic Level of Leakage[16] (ELL); this is despite the expected increase of around 20% on the current leakage levels which is expected to occur as a result of extension to the distribution network over the next 25 years.

**Water Efficiency in New Homes**

3.2.24 New homes can be fitted with a range of fixtures and fittings to reduce demand, in addition, new developments can have community wide measures to reduce the demand in water, this can range from rainwater harvesting to grey water recycling[17].

3.2.25 The Code for Sustainable Homes (CSH) sets out the maximum water demand required to meet the different levels of the code and gives examples how this level of efficiency can be reached.

[15] Tariffs refer to charging different prices for different levels of water use (as with other utilities such as gas and electricity)
[16] Economic Level of Leakage - The level of *leakage* for which the cost of achieving and then maintaining that level is exactly offset by savings in capital and operating costs.
[17] the use of wash water from showers and sinks in toilets after on site treatment

This provides a flexible outline for improving the overall sustainability of a house. Table 3-3 outlines the water demand that needs to be achieved to reach each of the sustainability levels.

**Table 3-3 Code for Sustainable Homes – Water consumption targets for the different code levels and examples of how these targets can be attained in new build**

| Code for sustainable homes levels. | Amount of Water (litres per person per day) | Examples of how to achieve water efficiency level. |
|---|---|---|
| 1 | 120 | Install efficient equipment within the home – 18l max volume dishwasher and 60l max volume washing machine. Install 4/6l dual flush toilets. Install 6-9l/min showers. Educate users about how to be efficient water users. Installation of water meters. |
| 2 | 120 | |
| 3 | 105 | As above. In addition, install water butts and equipment to use rainwater in the garden. Install aerating fixtures into bathrooms and kitchens.<br>Include surface water management in the surrounding development. |
| 4 | 105 | |
| 5 | 80 | As above, in addition: Grey water recycling, reduction of surface water from the development. Provide water audits for people to show them where they can reduce water usage. |
| 6 | 80 | |

3.2.26 The examples of water efficiency measures included in Table 3-3 are an outline of the possible ways to improve water efficiency. There are many more possibilities that are site specific. Many of these are shown in the Ofwat water efficiency initiatives[18] for water and sewerage companies and it is recommended that these are assessed and considered for inclusion in new development as part of the Breckland WEP. Other steps which should be considered in new builds include: rainwater harvesting from roofs and paved areas (through the use of permeable surfaces); grey water recycling (with some mains support) which can provide enough water to run all toilets, a washing machine and outside taps.

**Water Neutrality**

3.2.27 Water neutrality is a concept whereby the total demand for water within a planning area after development has taken place is the same (or less).than it was before development took place. In order for the water neutrality concept to work, the additional demand created by new development needs to be offset by reducing the demand from existing population and employment. If this can be achieved, the overall balance for water demand is 'neutral'.

3.2.28 A high level water neutrality assessment has been undertaken as part of the Breckland WCS (Section 9) to provide an indication of the possibility of achieving water neutrality within each of the development towns.

[18] OFWAT, 2006, Water Efficiency Initiatives – Good Practice Register Water Sewerage Companies (England and Wales) – 2006,http://www.ofwat.gov.uk/aptrix/ofwat/publish.nsf/AttachmentsByTitle/goodpracticeregister_2007.pdf/$FILE/goodpracticeregister_2007.pdf Accessed 28-03-08.

## 3.3 Wastewater Treatment

3.3.1 In order to determine how much of the additional wastewater generated in each growth town could be treated at the nearest wastewater treatment works (WwTW), it was necessary to determine the treatment capacity at each WwTW, in terms of volumetric, quality and process capacity. Calculations undertaken in the Outline WCS were updated using the latest effluent flow information and water quality data from Anglian Water Services (AWS) and the Environment Agency respectively for the WwTW most relevant to the location of growth within each town; Thetford, Attleborough, Dereham, Swaffham and Watton WwTWs.

### WwTW Volumetric (Consent) Capacity

3.3.2 The WwTW volumetric consent capacity assessment has been undertaken using measured effluent flow data provided by AWS; this provides a more accurate representation of the effluent flows currently being treated at the works. At the time of undertaking the Outline studies, this information was not available, and therefore, the Outline baseline calculations have been updated with the new flow information and presented in this study.

3.3.3 The current and future headroom capacity at the WwTWs has been calculated from the volumetric capacity (i.e. the difference between the maximum dry weather flow (DWF) that AWS are permitted to discharge under the discharge consent and the current DWF that is treated from the existing population), using industry standard calculations to determine the volume of additional flow. This is based on the assumption that AWS would seek the funding required to upgrade the processes in the works (if necessary) to treat the additional flow to the standard required under the existing licence.

**Assumptions**

3.3.4 The following assumptions, based on information provided by AWS, have been used in undertaking the WwTW volumetric consent capacity assessment:

- Measured Dry Weather Flow (DWF[19]) was provided for all five WwTWs by AWS. The measured flows were compared to calculated flows and where there was a large variation between the two, it was agreed with AWS that the calculated DWF would be used for the purposes of the wastewater treatment capacity calculations.
- Where the measured flow is close to the amount AWS are allowed to discharge under their current consent, the Environment Agency have agreed that where the measured discharge flow (DWF) is greater than consent, they will increase the amount of discharge that can be consented with a degree of 'headroom' (10%). For the purposes of this assessment, the proposed new flow consents, which the Environment Agency is likely to approve, have been used to assess current and future volumetric capacity at the WwTW.
- Where new Dry Weather Flow (DWF) consents have been proposed and agreed (at Attleborough, Dereham and Swaffham) these have been used to represent the current consented DWF for the works. The new proposed consents represent the current actual DWF treated by the works and as such, it was assumed that there is no further capacity at the works to accommodate additional flow from proposed development and therefore AWS

[19] DWF or Dry Weather Flow is a measure of baseflow in a sewerage system during dry weather, and is therefore meant to represent wastewater flow derived almost solely from human activity (trade and domestic) to seperare out surface water drainage following rainfall events.

would need to seek a new DWF consent from the Environment Agency and/or upgrade the works to accommodate the additional flow at these works;

- Where there are no new DWF flow consents (at Thetford and Watton), the current capacity (headroom) has been calculated against the current consent using either measured flow provided by AWS (for Watton) or calculated flow (for Thetford) where the measured flow was significantly less than the calculated flow;
- For Thetford, the current calculated DWF was calculated using population (domestic and holiday) and trade flow figures provided by AWS and assuming a domestic consumption of 144 litres per head per day (l/h/d), a holiday consumption of 55 l/h/d, and a trade flow of 1,132 m3/d;
- The future wastewater flow (DWF) was calculated assuming that the following parameters (as provided by AWS[20]) will account for both residential and non-residential demand, based on the housing figures provided by Breckland District Council:
    - A consumption of 151 l/h/d;
    - An occupancy rate of 2.4.
- DWF is calculated as PG + I + E where PG is the population consumption (population multiplied by consumption), I is the infiltration rate (calculated as 25% of PG) and E is the trade flow.
- Future housing and employment growth figures, as provided by Breckland District Council (see individual growth town chapters) have been used in all volumetric capacity calculations to estimate future effluent flow and volumetric capacity at the WwTWs;

## WwTW Quality (Consent) Capacity

3.3.5 The WwTW quality consent capacity has been assessed for each of the WwTWs to ensure that future growth could achieve compliance with the WFD water quality standards for the receiving watercourses as well as assessing the potential impact of the strategy against the Habitats Regulations and protected sites.

**Water Framework Directive Compliance**

3.3.6 In order to determine what is required from the future discharges in terms of their treated quality, it was important to undertake an assessment of the existing quality of the receiving watercourses in relation to the classifications of watercourses under the WFD.

3.3.7 The WFD is the most significant piece of water legislation since the creation of the EU. The overall requirement of the directive is that all water bodies in the UK must achieve “good status” by 2015 unless there are grounds for deferring this until 2027.

3.3.8 The WFD also combines the water quality standards with standards for water resources, water availability, hydromorphology (i.e. habitat quality) and groundwater status with ecological requirements.

3.3.9 The delivery of the WFD will be achieved by a series of management plans within each EU member state. The Environment Agency has therefore separated England and Wales into a

[20] These figures were provided by AWS as a worst case assessment of capacity, and therefore differ from those provided in Table 3-1 Water Use Scenarios for Residential Demand.

series of 'management basins' and each has its own plan called a River Basin Management Plan (RBMP). The Breckland study area and its water bodies are included within the Anglian RBMP. The Final Anglian RBMP, published in December 2009, has been used to inform the Breckland Detailed WCS (Reference 5)[21]

3.3.10 Broadly, the RBMPs undertake the following for different water bodies (river, lake, aquifer, canal or coastal water) within the plan area:

- set out the standards (developed nationally) for each parameter that need to be met in each water body in order to achieve different levels of status (for water quality, this covers high, good, moderate, bad or poor status);
- classify the overall status of each water body, and provide classifications broken down into each status type (ecology, biology, chemical, water resource etc);
- for water bodies not meeting 'good overall status' determine what 'measures' are required in order to improve the overall status of each water body. This leads to the determination of a 'programme of measures' (POMs) which need to be implemented in order to allow good status to be reached for each water body by 2015 (or later if there are grounds for derogation); and
- determine which water bodies are 'heavily modified' (HMWB) or artificial (AWB) and hence only need to meet a status of 'good potential'. This specific status acknowledges that there are anthropogenic pressures on, or modifications to some water bodies that prevent good status being met and that it would be too cost prohibitive (or detrimental to water body users) to remove the barriers that prevent attainment of good status.

3.3.11 An important aspect that had to be considered in this assessment is the policy requirement of the WFD that there is a presumption against any development that would cause a deterioration within a classification status of a waterbody (i.e. a reduction in a river classification from high status to good status as a result of a discharge would not be acceptable, even though the overall target of good status as required under the WFD is still maintained). Also, development must not prevent future attainment of 'good status', hence it is not acceptable to allow an impact to occur just because other impacts are causing the status of a water body to already be moderate or less. This is on the basis that the POMs may remove the existing barrier to attainment of good status and the development impact then may become the limiting factor.

3.3.12 Some water bodies have been designated as artificial (AWB) or heavily modified (HMWB) if they are substantially modified or created for water supply, urban purposes, flood protection and navigation. This designation is important because it recognises their uses, whilst making sure that ecology is protected as far as possible. Where water bodies have been identified as AWB or HMWB they are required to meet a status of 'good potential'. This specific status acknowledges that there are anthropogenic pressures on, or modifications to some water bodies that prevent good status being met and that it would be too cost prohibitive (or detrimental to water body users) to remove the barriers that prevent attainment of good status.

3.3.13 The WwTW quality consent capacity assessment deals specifically with the attainment of the WFD water quality standards in relation to the additional discharges likely as a result of proposed future growth.

[21] Environment Agency (2009), Anglian River Basin Management Plan

Water Quality Baseline

3.3.14 The water quality of the receiving watercourses has been assessed against the proposed WFD standards for rivers where data has been provided by the Environment Agency. For all other watercourses the assessment from the Anglian RBMP has been used to indicate the current water quality in the watercourses likely to be impacted by increase in WwTW discharges; the watercourses for where data has been provided is included in the water quality treatment section for each growth town.

3.3.15 Figure 3-1 illustrates the WFD classifications for main rivers in the Breckland District. These are mapped based on the Environment Agency classifications as provided in the final Anglian RBMP.

Water Framework Directive Standards

3.3.16 The UK Technical Advisory Group (UKTAG) for the WFD proposed standards for lowland and high alkalinity typology water and upland and low alkalinity typology water bodies are provided in Table 3-1 and Table 3-5. All the assessed water bodies within the area are classified as 'lowland and high alkalinity' typology waters and therefore these standards will apply to these water bodies. However, where a water body has been designated as a Salmonid Fishery, the 'upland and low alkalinity' standards will be applied for BOD and Dissolved Oxygen (DO) which is because in these conditions the standards required by fish are tighter than those required by invertebrates.

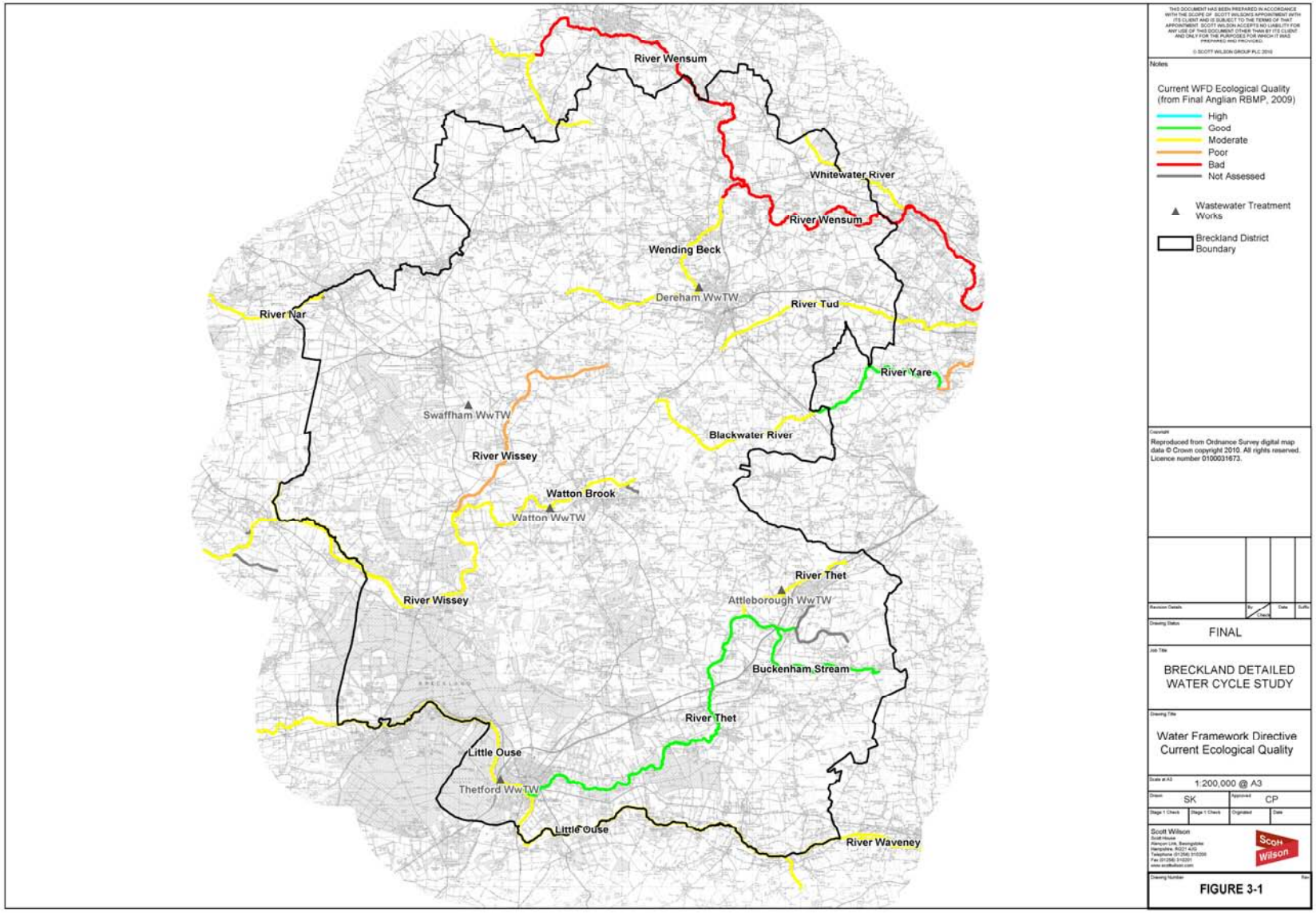
**Table 3-4 Proposed WFD Standards for Lowland and High Alkalinity Typology Waters**

| Proposed WFD Targets (Lowland and High Alkalinity) | | | | |
|---|---|---|---|---|
| Determinand | HES (mg/l) | GES (mg/l) | MES (mg/l) | PES (mg/l) |
| BOD (90%ile) | 4 | 5 | 6.5 | 9 |
| Ammonia (90%ile) | 0.3 | 0.6 | 1.1 | 2.5 |
| Dissolved Oxygen (DO) (10%ile) | 70 | 60 | 54 | 45 |
| Orthophosphate (Mean) | 0.05 | 0.12 | 0.25 | 1 |

**Table 3-5 Proposed WFD Standards for Upland and Low Alkalinity Typology Waters**

| Proposed WFD Targets (Upland and Low Alkalinity) | | | | |
|---|---|---|---|---|
| Determinand | HES (mg/l) | GES (mg/l) | MES (mg/l) | PES (mg/l) |
| BOD (90%ile) | 3 | 4 | 6 | 7.5 |
| Ammonia (90%ile) | 0.2 | 0.3 | 0.75 | 1.1 |
| Dissolved Oxygen (DO) (10%ile) | 80 | 75 | 64 | 50 |
| Orthophosphate (Mean) | 0.05 | 0.12 | 0.25 | 1 |

**Figure 3-1 WFD Classification for Breckland District (based on classifications provided in Environment Agency Anglian RBMP)**



3.3.17 Phosphate is generally poor throughout the Breckland study area. This is a situation that is common throughout East Anglia and will require catchment initiatives to address the problem. The Environment Agency have confirmed that the issues associated with meeting the proposed WFD standards for Orthophosphate can largely only be dealt with outside the remit of the WCS, as it is a catchment/regional/national issue that will not be possible to address within the WCS for point sources of discharge. However, measures to reduce the impact of P discharges to a minimum have been assessed as part of this Detailed WCS.

3.3.18 The only current legislative driver that directly requires reductions in point sources of Phosphate is the Urban Wastewater Treatment Directive (UWWTD) which requires limitations based on whether a WwTW discharges into a designated Sensitive Area (Eutrophic); however, this is not directly based on a target concentration for the river and only limits discharge from large WwTWs with PE greater than 10,000 (2 mg/l limit – annual average) or 100,000 (1 mg/l – annual average).

3.3.19 The Habitats Directive (HD) and the Habitats Regulations has designated some sites as areas that require protection in order to maintain or enhance the rare ecological species or habitat associated with them. A retrospective review process has been ongoing since the translation of the HD into the UK Habitats Regulations (HR) called the Review of Consents (RoC). The RoC process requires the Environment Agency to consider the impact of the abstraction licences and discharge consents it has previously issued on sites which became protected (and hence designated) under the HR. If the RoC process identifies that an existing licence or consent cannot be ruled out as having an impact on a designated site, then the Environment Agency are required to either revoke or alter the licence or consent. As a result of this process, P restrictions on some discharge consents have been introduced as a result of the HD to ensure that any identified impact on downstream sites is mitigated. Although the HD does not directly stipulate conditions on discharge of P the HR can, by the requirement to ensure no detrimental impact on designated sites, require restrictions on discharges to (or abstractions) from water dependent habitats that could be impacted by anthropogenic manipulation of the water environment.

3.3.20 Currently, only Dereham and Thetford have a P discharge limitation with a consented discharge limit of 2mg/l P (mean).

Water Quality Capacity Assessment

3.3.21 In order to ensure that the additional treated wastewater discharge as a result of proposed development in the Breckland study area does not impact against attainment of WFD and HD water quality standards, indicative consent standards have been calculated for the WwTWs based on the current proposed growth in the study area and in line with the proposed residential and employment growth in the area.

3.3.22 Three scenarios have been modelled for each WwTW based on whether the works is calculated as exceeding its current or proposed DWF consent following the proposed residential and employment development in each of the towns (Table 3-6). Each of these scenarios assumes different legislative requirements for the consent compliance, and therefore provides a robust assessment of the consents that could be imposed as a result of the requirement to treat additional wastewater at each of the five WwTWs.

3.3.23 Water quality monitoring information was provided by the Environment Agency and this has been examined to ensure there were no significant outliers, and the data period was restricted (in the

majority of cases between 2004 and 2008) to provide a representative dataset of the current water quality situation and ensure reliability and robustness in the derived summary statistics.

3.3.24 For the majority of WwTWs upstream and downstream monitoring information was available. Where this monitoring information was unavailable or where the upstream water quality was shown to be less than 'good', it was agreed with the Environment Agency, it should be assumed that the upstream quality achieves WFD Status 'Good' and the midpoint values from this class should be used in modelling the required consents. This is inline with the approach taken for the neighbouring Norwich WCS and assumes that all measures have been taken upstream to achieve 'good ecological statuses or 'potential' so as not to unduly penalise the water company through potentially poor upstream quality. In reality, in some catchments there may be little opportunity to reduce other inputs in order to meet good status, in which case further modelling may need to be undertaken and the assumptions used within this assessment reviewed.

3.3.25 Simple mass balance Monte Carlo simulations have been undertaken using the Environment Agency's River Quality Planning (RQP) tool (v2.5). This provides an indication of the degree of change required in consent standards in order to achieve compliance with WFD standards and legislation assuming the full planned growth within the Breckland study area. This has been undertaken for all WwTWs and utilised upstream water quality information where available.

3.3.26 Indicative consents have been modelled for five scenarios (see Table 3-6), which vary in the restrictions placed on the consents and compliance with WFD and Habitat's Directive[22] (HD) targets. These provide an indication of the potential constraints and consent requirements for growth within the Breckland District, recognising that full compliance with the WFD may not be possible given the current quality of the receiving watercourses and volume of growth planned for key towns within the District. The scenarios therefore provide a range of options of how growth can be accommodated within the study area whilst minimising the impact on the downstream water environment within the confines of existing technology. All scenarios include for revised consents introduced under the Environment Agency's National Environment Programme (NEP) for infrastructure improvements for AMP5 to address increases in flow consents and/or compliance with Habitat's Directive.

3.3.27 This assessment is intended to provide an indication of the possible impacts the new standards might have on future wastewater discharges and water quality conditions in the Breckland study area to identify whether the discharge consents are feasible, but will be subject to future refinement based on AWS's AMP programme.

[22] Compliance with the Habitat's Directive relates to Phosphorous only and must ensure that there is no net increase in the load of P where DWF is planned to increase beyond its current DWF consent. Increases in DWF where the DWF consent will not be exceeded can be ignored as the full consent limits will have already been assessed under the Review of Consents (RoC).

## Table 3-6: Water Quality Capacity Assessment – Modelling Scenarios

| Scenario | Variant | Description | Assessment Criteria | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | WwTW to be assessed | BOD & Ammonia | | Phosphorous | | |
| | | | | WFD compliance | Limit consent to BATNEEC (5mg/l BOD & 1mg/l NH4) | WFD compliance | Limit consent to BATNEEC (1mg/l P) | HD compliance |
| A - Planned Deterioration<br><br>*Assumes discharge is not required to achieve EA policy of no deterioration in the downstream watercourse* | A1: Consents limited to BATNEEC | Assumes volumetric consents can be increased and that these new consents must achieve WFD and HD targets downstream, but limiting consents to BATNEEC | Only where DWF exceeds consent | ✓ | ✓ | ✓ | ✓ | × |
| | A2: % deterioration impact with BATNEEC | Assuming volumetric consents can be increased at works that require an increase, what would be the impact on d/s compliance if revised quality consents for these works where limited to BATNEEC | Only where DWF exceeds consent | ✓ | ✓ | ✓ | ✓ | × |
| | A3: Consents beyond BATNEEC | Assuming volumetric consents can be increased at works that require an increase, what would the revised consents need to be for these works to meet WFD and HD directive, ignoring limitations of BATNEEC | Only where DWF exceeds consent | ✓ | × | ✓ | × | × |
| B - Compliance with WFD and HD Targets | B1: Consents limited to BATNEEC | Assumes all watercourses need to meet WFD targets (not just where increased DWF consents are required), but limiting revised consents to BATNEEC | All | ✓ | ✓ | ✓ | ✓ | × |
| | B2: % deterioration impact with BATNEEC | Assuming all watercourses need to meet WFD targets (not just where increased DWF consents are required), but limiting revised consents to BATNEEC what would be the impact on d/s compliance of limiting revised consents to BATNEEC | All | ✓ | ✓ | ✓ | ✓ | × |
| | B3: Consents beyond BATNEEC | Assumes all watercourses need to meet WFD targets (not just where increased DWF consents are required), what would the revised consents need to be for these works to meet WFD and HD directive, ignoring limitations of BATNEEC | All | ✓ | × | ✓ | × | × |
| C - Meeting WFD and HD with the Exception of WFD P | | Assumes all watercourses need to meet WFD targets (not just where increased DWF consents are required) with the exception of the WFD P target, but limiting revised consents to BATNEEC | All | ✓ | ✓ | × | ✓ | × |

| Scenario | Variant | Description | Assessment Criteria | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | WwTW to be assessed | BOD & Ammonia | | Phosphorous | | |
| | | | | WFD compliance | Limit consent to BATNEEC (5mg/l BOD & 1mg/l NH4) | WFD compliance | Limit consent to BATNEEC (1mg/l P) | HD compliance |
| D - WFD Deterioration - High to Good<br><br>*Assumes that meeting 'good' status as opposed to 'high' as a minimum is acceptable under the policy requirements* | D1 - limited by BATNEEC | Assumes all watercourses need to meet WFD targets (not just where increased DWF consents are required) but allowing downstream compliance to move from high to good status and limiting revised consents to BATNEEC | All | ✓ | ✓ | ✓ | ✓ | × |
| | D2 - No BATNEEC limits | Assumes all watercourses need to meet WFD targets (not just where increased DWF consents are required) but allowing downstream compliance to move from high to good status, but not limiting consents to BATNEEC | All | ✓ | × | ✓ | × | × |
| E - Load Standstill (Compliance with HD) | E1: Consents limited to BATNEEC | | Only where DWF exceeds consent | ✓ | ✓ | ✓ | ✓ | ✓ |
| | E2: Consents beyond BATNEEC | | Only where DWF exceeds consent | ✓ | × | ✓ | × | ✓ |

Catchment Review of Phosphorus Sources

3.3.28 A review has been undertaken of the catchment issues and initiatives for Phosphorus that have recently or are currently being undertaken in the Breckland catchment with respect to the England Catchment Sensitive Farming Delivery Initiative (ECSFDI, Appendix C: Breckland Phosphorus Review). The scheme looks at investigating the contribution and impacts of both diffuse and point sources of P to river catchments, and in relation to the Breckland WCS, the River Wensum and River Little Ouse (Thetford Area) catchments.

3.3.29 The results, where relevant, have been discussed in the water quality sections for growth town assessments.

## 3.4 Wastewater Infrastructure

3.4.1 In order to determine capacity in the wastewater network for transferring wastewater from new development to treatment facilities, it was necessary to combine information from AWS's network models (where available) and with spreadsheet calculations of capacity. Detailed models are not available for all growth locations within Breckland, hence it has also been necessary to discuss and agree capacity issues directly with AWS, particularly where existing network issues are causing sewer flooding problems.

3.4.2 The wastewater infrastructure assessment was undertaken in a number of stages:

- All foul sewers of 200mm diameter or greater were identified and mapped based on the GIS files of the wastewater network provided by AWS. These were classified as either gravity drained or pumped, and any associated sewage pumping stations were identified. The network was then assessed to identify the likely routes for wastewater transmission from the development sites to the local wastewater treatment works (WwTW) and compared to any known and/or likely capacity constraints;
- Modelling outputs and wastewater infrastructure recommendations provided by AWS were summarised for each of the development towns and potential (known) solutions mapped;
- High level calculations for critical sections of the existing sewer were undertaken to highlight any potential issues within the existing network to accommodate the proposed growth within the key towns. This was only undertaken for Thetford greenfield development sites, Dereham and Attleborough; a review of the AWS modelling outputs and recommendations showed that Swaffham and Thetford town centre had adequate capacity within their existing sewer networks to accommodate the proposed growth in the respective development areas; and,
- For Thetford, where a new strategic sewer was required to serve large volumes of development, the required pipe size has been calculated.

3.4.3 In undertaking the assessment of the capacity of critical sections of the gravity sewers, the following parameters were used:

- The size of the sewer has been obtained from GIS sewer records provided by AWS;
- The gradient of the sewer has been assumed to be 1 in 400;
- A pipe roughness (ks) value of 3mm has been used;
- Maximum allowable proportional depth of sewer has been taken as 0.75; and

- Where the sewer drains a catchment that has existing industrial/commercial developments, a percentage of the sewer capacity has been set aside for trade effluent. This percentage has been derived from the volume of flow currently being treated at the works from trade compared to total measured flow being treated at the works.

3.4.4 In undertaking the assessment of the capacity of the critical sections of sewer rising mains, the following parameters were used:

- The size of the sewer has been obtained from GIS sewer records provided by AWS; and
- A maximum flow velocity of 1.8m/s has been assumed. (This is in line with recommendations of Sewers For Adoption (Reference 6[23]).

3.4.5 Knowing the capacity of the sewer that is available to domestic flow, the theoretical maximum population that can drain to the sewer has been assessed using the formula:

D.1.5 $DWF_{peak} = P_f(PG) + I$ *where:*

- Peak Factor (Pf ) was taken as 6
- G was taken as 131l/h/d (i.e. 90% of a per capita water demand of 146 litres being returned to sewer (OFWAT Security of Supply Rpt (06-07) data for AWS – [Reference 7[24]])
- Infiltration (I) was taken as 25% of PG.

3.4.6 The theoretical maximum population was converted to properties by assuming a property occupancy ratio of 2.3 people per property. This is based on current occupancy rates within the Breckland District.

3.4.7 To obtain an indicative property headroom of the sewer, the number of existing properties that are already draining to that section of sewer was deducted from the theoretical maximum number of properties that can be served by the sewer.

3.4.8 It should be noted that there are significant portions of the study area that have combined sewers. As a result of the complexity of the sewer network and the absence of a network model, the effect of surface water drainage has not been taken into account. This together with the inevitable gross uncertainty in the accuracy of the parameters listed above means that the results of this assessment are only indicative and are not intended to provide an accurate assessment of the existing and future wastewater network capacity.

3.4.9 Where site specific assessments for solutions have been required, the methodologies for these are discussed within the wastewater infrastructure sections for the growth town assessments.

## 3.5 Flood Risk Management

3.5.1 It is essential to review the management of flood risk in the Detailed WCS to ensure that the risk of flooding to the preferred options sites is quantified, that where possible development is steered away from high risk areas (Flood Zones 2 and 3), flood mitigation measures are planned in a strategic manner, and there is no deterioration to existing communities' standard of protection.

[23] WRc (2006) Sewers for Adoption, 6th edition
[24] OFWAT (2007) Security of Supply, 2006-07 Report

3.5.2 Identification of the potential sources of flood risk to the preferred options sites allows an assessment of the risks of all forms of flooding to and from a development in order to identify any potential development constraints with respect to flood risk. Planning Policy Statement 25 (PPS25) (Reference 8)[25]. emphasises the need for a risk-based approach to be adopted by planning authorities through the application of the Source-Pathway-Receptor model.

3.5.3 The Source-Pathway-Receptor model firstly identifies the causes or 'sources' of flooding to and from a development. The identification is based on a review of local conditions and consideration of the effects of climate change. The nature and likely extent of flooding arising from any one source is considered, e.g. whether such flooding is likely to be localised or widespread. The presence of a flood source does not always imply a risk. The exposure pathway or 'flooding mechanism' determines the risk to the receptor and the effective consequence of exposure. For example, sewer flooding does not necessarily increase the risk of flooding unless the sewer is local to the site and ground levels encourage surcharged water to accumulate. The varying effect of flooding on the 'receptors' depends largely on the sensitivity of the target. Receptors include any people or buildings within the range of the flood source, which are connected to the source by a pathway.

3.5.4 In order for there to be a flood risk, all the elements of the model must be present. Furthermore effective mitigation can be provided by removing one element of the model, for example by removing the pathway or receptor.

3.5.5 It is also important to ensure that as well as mitigating against flood risk to development, the development should not increase flood risk in the area, and therefore mitigation options in the form of sustainable drainage systems (SuDS) need to be considered.

### Management of Flood Risk to Development

3.5.6 The assessment of flood risk to the development, and subsequent management of this risk in relation to proposed development, has been undertaken using the Strategic Flood Risk Assessments (SFRA) produced for Breckland District Council.

3.5.7 The Breckland District Level 1 SFRA, completed in 2005 and updated in 2007 to comply with PPS25 covers an assessment of strategic flood risk in the towns of Attleborough, Dereham, Swaffham, Thetford and Watton from all potential sources of flooding, including fluvial, surface water, groundwater and artificial sources. The Level 1 SFRA has allowed Breckland Council to determine the variations in flood risk across the entire administrative area for spatial planning purposes and to undertake the Sequential Test as set out in PPS25.

3.5.8 The Thetford Level 2 SFRA, completed in July 2009 (Reference 9[26]), provides supplementary information to the Breckland Level 1 SFRA on flood risk issues specific to Thetford Town Centre. The Level 2 SFRA and accompanying GIS data will be used by Breckland Council in conjunction with the Level 1 SFRA to assess key areas of interest development potential in areas of flood risk.

3.5.9 The Level 2 SFRA focuses on Thetford Town Centre and undertook a flood hazard mapping exercise to investigate the strategic flood risk associated with the watercourses located within Thetford Town Centre. The Level 2 SFRA mapping was based on outputs from a flood risk mapping exercise of the River Thet and the Little Ouse undertaken for the Environment Agency

[25] CLG, PPS25 2010
[26] Mott MacDonald (200) – Berckland SFRA

in 2006, and additional flood extent outlines produced in 2007, to inform the updated Level 1 SFRA. The Level 2 SFRA mapping provides additional flood depth and hazard mapping to inform the strategic land allocation process.

### Management of Flood Risk from Development

3.5.10 Greenfield and undeveloped sites rely on natural drainage to convey or absorb rainfall. In general, site development reduces the permeability of the site, increasing the volume and rate of water running off the site to nearby watercourses, potentially increasing flood risk to downstream areas. Therefore appropriate drainage arrangements are required for new developments to ensure that flood risk to others is not increased.

3.5.11 According to Annex F within PPS25 the surface water arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect. In addition, according to Annex D within PPS25, developers should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

3.5.12 In order to ensure there is no increase in surface water runoff, attenuation of runoff is required to manage surface water runoff generated during the 1% annual probability storm event, inclusive of climate change.

3.5.13 In order to calculate the proposed approximate attenuation volumes, the Quick Storage Estimate function of the Microdrainage WinDes software suite has been utilised. The calculations have used the following assumptions:

- Rainfall values and hydrological inputs have been provided from the Catchment Descriptors obtained from the FEH CD-ROM;
- Greenfield runoff rates were derived using the IoH124 method;
- Two development scenarios for each development area have been assumed, 80% and 90% developable area to provide assumed areas of impermeable surfacing;
- Approximate infiltration rates have been estimated using information derived geological information based on relevant British Geological Survey (BGS) maps and soils information derived from the Soilscapes website (http://www.landis.org.uk/soilscapes); and,
- In order to account for climate change, an increase of 30% has been applied to rainfall values – this is inline with the requirements stated in Table B.2 of PPS25 which recommends a 30% increase in peak rainfall intensity up to 2115.

3.5.14 As per PPS25, proposed development should ensure runoff rates from the development are no greater than pre-development rates. In order to ensure a conservative estimation of attenuation rates, it is assumed that all development sites would be required to attenuate to greenfield runoff rates. In reality, some development areas, for example in central Thetford, are likely to be brownfield sites and therefore to meet the requirements of PPS25 would be required to attenuate to brownfield rates of runoff. Such details would be calculated and agreed during the completion of site-specific FRAs.

3.5.15 Relevant guidelines and building regulations (such as PPS25, its Practice Guide (Reference 10)[27] and Building Regulations, Part H (Reference 11)[28] require that the disposal of surface water is managed in a hierarchical approach, as follows:

- An infiltration system such as a soakaway, or where this is not possible;
- A watercourse or water body, or where this is not possible;
- A surface water sewer.

3.5.16 The Breckland Detailed WCS has undertaken an assessment of the potential runoff volumes as a result of the proposed development in the district and has made suggestions for the potential methods of surface water attenuation and management, in line with the above hierarchy and the Sustainable Drainage Systems (SuDS) Management Train, as described in the CIRIA C695 document, the SuDS Manual (Reference 12)[29]. In addition, potential constraints to SuDS such as proximity to Environment Agency Source Protection Zones, at each development site have been considered.

3.5.17 Appendix E: SuDS Calculations contains a summary of the model parameters and results from the Microdrainage WinDes attenuation volume calculations.

## 3.6 Infrastructure Phasing

3.6.1 Phasing has been determined based on the limitations of each element of water infrastructure in terms of housing numbers. The maximum required growth as indicated in Breckland's preferred trajectory for each town has been compared to the maximum number of houses that can be developed within the restrictions imposed by capacity constraints across each water cycle infrastructure element. In each case, the biggest restriction has been used to determine maximum housing numbers irrespective of whether other infrastructure requirements would allow more growth to proceed. The resultant phasing recommendations have been demonstrated visually in a series of infrastructure timelines presented in each growth town assessment.

3.6.2 In addition, outline costings for each element of infrastructure have been developed to support Breckland council's infrastructure planning process. These costs have been reported in a separate technical advisory note to Breckland Council

[27] CLG (2009) PPS25 Practice Guide
[28] ODPM (2006) Building regulations Part H
[29] CIRIA (2007) The SuDS Manual

# 4 Thetford Growth Town Assessment

## 4.1 Introduction

4.1.1 Thetford is the largest town within the Breckland District and is Norfolk's fourth largest urban centre. It is a significant employment centre for the region with an estimated 17,000 jobs. It is the principal retail, service and employment centre in the south of the Breckland District. Thetford has been identified as a Key Centre for Development and Change (KCDC) in the East of England Regional Spatial Strategy (RSS) and has additionally been identified by central government as a New Growth Point (NGP).

4.1.2 The Breckland Spatial Strategy[30] identified Thetford as the main strategic location for growth in the Breckland District up to 2026, targeting it with providing 6,500 new homes and 5,000 new jobs over the period 2008-2026. The majority of the development will be on greenfield land, with allocations consisting of a strategic urban extension to the north-east of the town within the boundary of the A11.

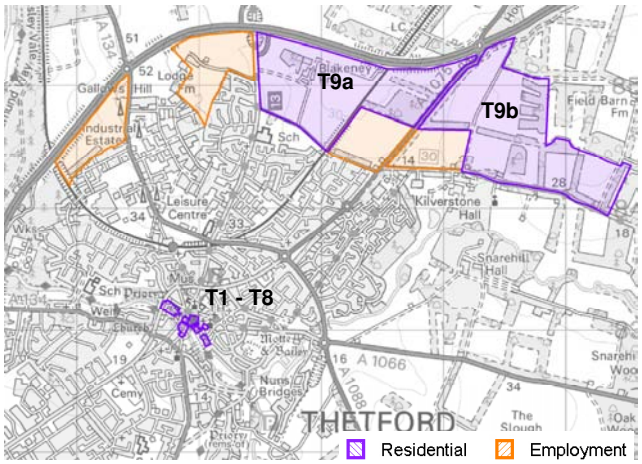
4.1.3 Table 4-1 provides the housing and employment growth figures for Thetford for the period 2008 - 2026. Figure 4-1 shows the proposed phasing of the planned housing growth.

**Table 4-1 Housing and Employment Growth in Thetford (2008 – 2026)**

| Housing | No. of Dwellings |
|---|---|
| Already Built (as of April 2008) | 1,000 |
| Currently Permitted (as of April 2008) | 348 |
| New Allocations | 6,500 |
| Total | 7,848 |
| **Housing to be Assessed (= Total – Already Built)** | **6,848** |

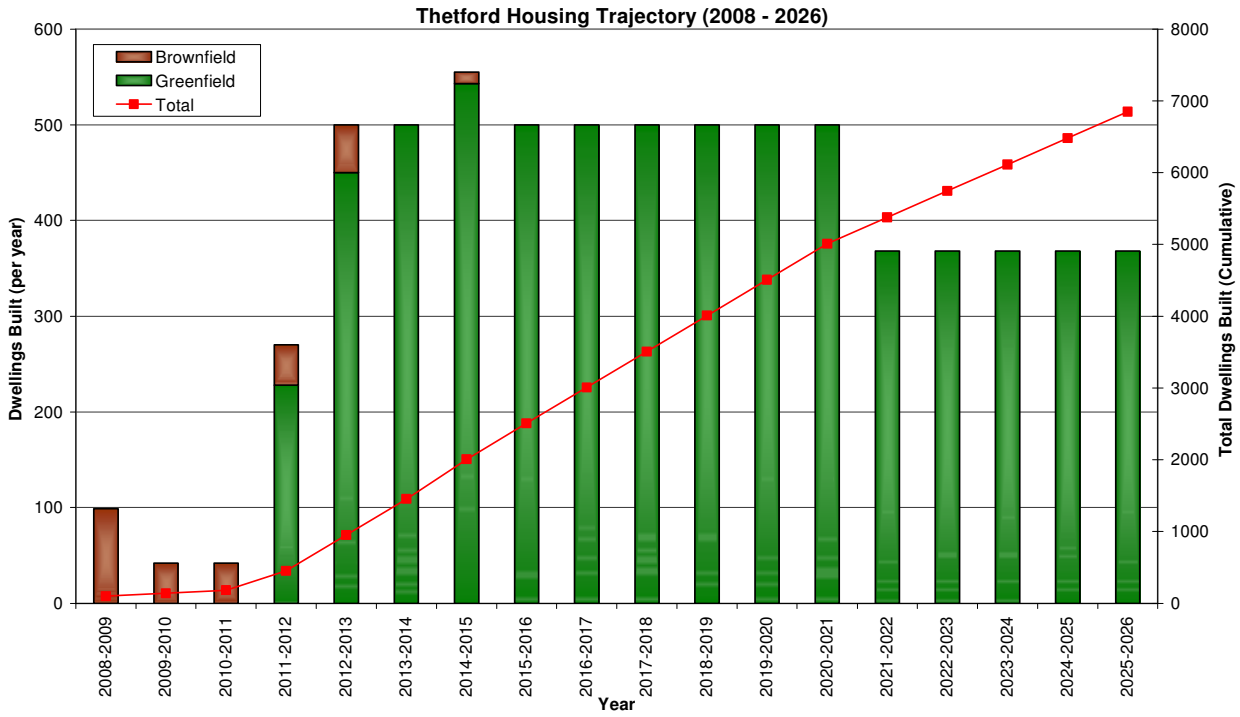
| Employment | Jobs |
|---|---|
| Proposed Jobs | 5,000 |
| Land Required | 30 - 40 hectares |
| **Employment to be Assessed** | **5,000** |

Location of Development




[30] Core Strategy and Development Control Policies DPD – Adopted 2009, Breckland District Council, 2009

**Figure 4-1 Housing Growth in Thetford (2008 – 2026)**




## Outline WCS Findings

4.1.4 The Thetford Outline WCS was completed in May 2008 and highlighted the following key issues in terms of the water cycle and infrastructure for Thetford:

- there is sufficient capacity in existing raw water resources and strategic water supply infrastructure to facilitate growth up to 2021; however there is a potential for impact to the Thetford Golf Course SSSI and a component part of the Breckland SAC as a result of abstraction from Two Mile Bottom. At current water consumption rates, growth between 2021 and 2026 will require upgrades to existing supply mains and will require new resources to be developed;
- introducing strict water efficiency in new housing stock may reduce reliance on new resources beyond 2021;
- there is generally sufficient wastewater treatment capacity to accommodate growth up to 2021 and the Little Ouse has sufficient capacity to take further discharges of treated wastewater (in terms of water quality and volume) without significant upgrades required to Thetford WwTW; however, an upgrade to Thetford WwTW will be required to treat wastewater from new development up to 2026 both in terms of volume and the treatment process to meet tighter consents on the quality of discharge;
- as with the rest of the east of England, meeting Water Framework Directive (WFD) targets for Phosphorus will be a concern and will require further investigation;

- the sewerage system is generally adequate to accommodate growth up to 2010. In order for there to be no increase in sewer flooding in the town, new strategic mains will be required to service new development areas; and,
- fluvial flooding has occurred historically in the town centre of Thetford and some development is required within these areas at a higher risk of flooding. Mitigation is required to ensure that development in these areas is safe and conforms to PPS25. Sewer flooding and Combined Sewer Overflows (CSOs) have occurred historically, and new infrastructure is required to ensure that this is not exacerbated by new development.

## 4.2 Water Resources

### Baseline Confirmation

4.2.1 The Thetford Outline WCS reported that there is sufficient capacity in existing raw water resources and strategic water supply infrastructure to facilitate growth up to 2021 but at current water consumption rates, growth between 2021 and 2026 will require upgrades to existing supply mains and will require new resources to be developed. Additionally, water demand to supply growth up to 2021 and beyond, has the potential to impact the Thetford Golf Course SSSI and a component part of the Breckland SAC as a result of abstraction from Two Mile Bottom.

4.2.2 The Residential Demand (RD) scenarios as defined in the Water Resources Methodology (Section 3.2) have been modelled for the proposed residential growth in Thetford (Table 4-2).. The results show that the new houses would demand around 2.5 Ml/d if they were built to current specifications and water use (142 l/h/d). The lowest demand estimate from new housing development (Scenario 4 – CSH 5&6 at 80 l/h/d) would demand around 1.3 Ml/d.

**Table 4-2 Residential Demand for Planned Growth in Thetford[31]**

| Scenario | | Water Use Rate (l/h/d) | Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|
| 1a | Water Company Forecast (Current) | 142 | 2.24 | 2.46 |
| 1b | Water Company Forecast (2035) | 130 | 1.87 | 2.06 |
| 2 | Code for Sustainable Homes 1&2 | 120 | 1.73 | 1.90 |
| 3 | Code for Sustainable Homes 3&4 | 105 | 1.51 | 1.66 |
| 4 | Code for Sustainable Homes 5&6 | 80 | 1.15 | 1.27 |

4.2.3 The Non-Residential Demand (NRD) has been calculated for the proposed employment growth in Thetford, based on a percentage of the residential demand (see Water Resources Methodology (Section 3.2)). Taking the minimum RD (Scenario 4) and the maximum RD (Scenario 1a) for planned growth in Thetford (Table 4-2), the NRD has been estimated for the water demand scenarios (Table 4-3). This shows that water demand from employment growth could range from between around 0.2 Ml/d to 0.8 Ml/d (with an allowance for headroom) depending on the final land allocation for employment sites, and the job types that are created.

[31] Lowest demand in green, highest demand in red

**Table 4-3 Non-Residential Demand for Planned Growth in Thetford31**

| RD Scenario | NRD Scenario | | Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|
| 1a | 5 | Lowest Estimate of Non-Residential Land Allocation | 0.36 | 0.40 |
| | 6 | Highest Estimate of Non-Residential Land Allocation | 0.70 | 0.77 |
| 4 | 5 | Lowest Estimate of Non-Residential Land Allocation | 0.18 | 0.20 |
| | 6 | Highest Estimate of Non-Residential Land Allocation | 0.36 | 0.40 |

4.2.4 The total water demand from new development in Thetford will therefore range from around 1.5 Ml/d to 3.2 Ml/d (Table 4-4), but the lower estimate would be dependent on new houses being built to a CSH 5&6 level, with a water demand of 80 l/h/d and the lowest estimate of non-residential demand. In reality, the water demand exerted from the new development in Thetford is likely to be towards the higher end of the range, unless policy is included to stipulate that all new residential development needs to meet a CSH level requirement. Recommended policy is included in section 11.

**Table 4-4 Highest and Lowest Total Demand Estimates for Planned Growth in Thetford**

| RD Scenario | | NRD Scenario | | Total Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|---|
| 4 | Code for Sustainable Homes 5&6 | 5a | Lowest Estimate of Minimum Non-Residential Land Allocation | 1.32 | 1.46 |
| 1a | Water Company Forecast (Current) | 6b | Highest Estimate of Maximum Non-Residential Land Allocation | 2.94 | 3.23 |

4.2.5 The assessment presented here is in terms of the additional water demand generated by the new development, under a range of water demand scenarios. However, the changing behaviour of the existing population, and retrofitting of water saving devices into existing properties has the potential to lower the total future water demand for Thetford, and should be considered as part of any future water demand assessment. This is discussed in more detail in the Water Efficiency section (see 9.2.1 onwards).

## Solution Refinement

4.2.6 In AWS's final WRMP, Thetford lies in Water Resource Zone[32] (WRZ) 9 (i.e. outside WRZ 7, the main zone covering the Breckland towns). The overall supply/demand balance for WRZ 9 shows no deficits (under either average or peak demand conditions), although 3 out of 9 Planning Zones[33] (PZ) in WRZ 9 do have small deficits by the end of the WRP period (2036/37). Thetford will continue to be reliant on spare groundwater sources (within their existing licence capacity) in order to supply the extra demand growth at least initially. Beyond a certain date, the major growth

[32] Water Resource Zone - 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.
[33] Planning Zone - An area with a population of customers served not exceeding 50,000 which comprises a whole number of parishes.

in Thetford will require improved distribution links with the neighbouring PZs and potentially importing Great Ouse Groundwater Scheme (GOGS) water in the future.

4.2.7 The extra Deployable Output[34] available to meet the extra demands in Thetford are based on the assumption of additional groundwater resources continue to be available in the Thetford area. In AWS's final WRMP, the preferred option to overcome deficits in Thetford is the Barnham Cross Transfers which would bring in treated water from neighbouring PZs with surpluses. The available resources from existing groundwater licences and from the Barnham Cross Transfers are shown in Table 4-5. It is has been assumed that there is no loss of Deployable Output from any existing sources within Thetford as a consequence of the Environment Agency's Review of Consent Process.

**Table 4-5 Available Spare Water Resources to supply Thetford**

| Resource Options | Average Deployable Output (Ml/d) |
|---|---|
| Maximise Spare Groundwater Licence | 2 |
| Barnham Cross Transfers (surplus treated-water in other PZs) | 1.5 (+ 6.4 incl. GOGS water) |

## Preferred Solution

4.2.8 The phasing of water resource developments within Thetford will depend on future water use rates. These could range between 3.2 Ml/d (Scenario 1a - high water demand) and 1.5 Ml/d (Scenario 4 - low water demand). Table 4-6 shows the phasing of water resource developments in Thetford based on the high and low water demand scenarios.

**Table 4-6 Phasing of Water Resource Developments in Thetford (excluding impacts of Climate Change)**

| Source | High Water Demand (RD Scenario 1a) | Low Water Demand (RD Scenario 4) |
|---|---|---|
| Maximise Spare Groundwater Licences | Incrementally from 2009 | Existing GW licence sufficient through to 2025/26 |
| Barnham Cross Transfers | AMP6 (in 2018) | |

4.2.9 Under the high water demand scenario (1a), the additional growth forecast for Thetford will require extra groundwater to be abstracted from local sources with spare licensed capacity e.g. the Two Mile Bottom Borehole, up until 2018 (in AMP6), when a further additional transfer-in via the Barnham Cross source works will be required. It should be noted that in the AWS's final WRMP, the Water Company refer to the need for Barnham Cross Transfers within AMP5 (2010-2015) in order to support growth further south around Ely.

4.2.10 Under the low water demand scenario, the extra groundwater to be abstracted from sources around Thetford, the spare licensed capacity available locally will be sufficient to last through to end of planning period (2025/26).

### Option Funding and Responsibility

4.2.11 The costs for the water resource schemes required at Thetford will be borne solely by AWS via the Price review and AMP process. Developers cannot contribute to these water resource solutions as they are not required specifically for the new development.

[34] Deployable Output is the water which is available for supply during dry years

4.2.12 Delivery and maintenance of the solutions will be the responsibility of AWS under the regulation of Ofwat, the Environment Agency and the Drinking Water Inspectorate (DWI).

4.2.13 Delivering water efficiency in new homes will be the responsibility of the developer and the cost (of construction and maintenance) will be borne solely by the developer.

4.2.14 Some water efficiency and water saving methods are proposed for *existing* development by AWS as part of their twin-track approach to managing water resources in the region. These elements (such as meter penetration, and provision of water butts for existing homes) are funded solely by AWS as part of the Price review and AMP process, and also from AWS own investment. Water meters are provided for new properties by AWS as standard practice.

## Climate Change Impacts

4.2.15 The effects of climate change (CC) on water resources supplying Thetford are presented in Table 4-7.

**Table 4-7 Effects of Climate Change on Available Water Resources to Thetford**

| Resource Options | CC effects | Comment |
|---|---|---|
| Maximise Spare Groundwater Licences | Negligible | A reduction of 0.22 Ml/d by 2035 for all groundwater sources within Breckland. |
| Barnham Cross Transfers | Negligible | Assume extra water from GW sources |

4.2.16 In general, the heavy reliance on groundwater within Thetford (and Breckland) and the resilience of its storage to changes in groundwater levels will mean that the impacts of CC are relatively minor. In summary, the effects on these sources will be to advance the requirement for schemes by approximately one year under the High Water Demand (RD Scenario 1a).

4.2.17 AWS's final WRMP includes a commitment to investigate further the affects of the UKCP09 scenarios in the lead-up to the next periodic review process in 2015.

## Ecological Issues

4.2.18 Water resource schemes developed to meet water demand from new development have the potential to lead to adverse water flow and depth effects in the Breckland SAC & SPA, Norfolk Valley Fens SAC (specifically Thompson Water Carr & Common SSSI and Swangey Fen SSSI) and other nationally and/or internationally important sites close to Thetford. Therefore, it is essential that the WCS takes account of the requirements of the Conservation (Natural Habitats &c) Regulations 1994 (as amended), which interprets the EU Habitats Directive into English law. The Regulations require land use plans to take steps (through a process dubbed Habitat Regulations Assessment) to ensure that a policy framework exists to enable their implementation without adverse effects (either alone or in combination with other plans and projects) on internationally designated wildlife sites, specifically Special Protection Areas (SPA), Special Areas of Conservation (SAC) and, as a matter of UK Government policy, sites designated under the Convention on Wetlands of International Importance 1979 ('Ramsar sites').

**Thetford Water Resource Schemes & Ecological Considerations**

4.2.19 The water resources assessment has confirmed that water to supply new development within Thetford may require the maximisation of spare groundwater licenses and the development of new groundwater source locally, plus potentially some Aquifer Storage and Recovery (ASR).

4.2.20 The use of spare capacity within existing licences should not be an issue as the Environment Agency assesses fully licensed volumes in their Review of Consents (RoC) process, irrespective of whether the current actual volume of abstraction is less than the licensed volume. As such the environmental constraints on the licensed capacity (and any need to reduce the licensed capacity) will have already been considered in the RoC process and do not need to be reconsidered here.

4.2.21 The use of transferred water from Barnham Cross treatment works is currently supported by the Environment Agency through the approval of AWS's WRMP and hence it is considered that the abstractions required to support the transfer are unlikely to impact on designated (or other ecological sites); however, until such time as the additional transfer is required it will not be possible to determine the aquifer from which the additional water will be drawn. Therefore, potential sites that could be impacted are considered in this WCS, along with guidelines required to protect them. This information can be used for future reference once the new transfer scheme is required specifically for growth in Thetford. As already detailed, the Barnham Cross transfer is also required to support anticipated growth in nearby Ely (East Cambs district).

4.2.22 Because the transfer is supported by the Environment Agency, it is considered that the limitations as described in following sections will not affect the yield from a new source such that the abstraction should not determinately impact on any of the identified sites. It is also likely that the source will be located away from Thetford and hence these sites may not be affected.

**Potential Impacts on Hydrologically Sensitive Ecological Sites Local to Thetford**

4.2.23 Thetford is geographically constrained by the Breckland Special Area of Conservation (SAC) & Special Protection Area (SPA). Many of the habitats for which the SAC was designated (dry heathland, inland sand dunes and calcareous grassland) are not dependent on specific water levels or flows other than generally good drainage. However, two habitats ('alluvial forests with alder & ash' and 'natural eutrophic lakes') are sensitive to changes in groundwater levels and quality. The great crested newt populations for which the SAC is also designated, while water dependent, are not particularly sensitive to changes in water levels provided that standing water is retained in their breeding pools during the March-June breeding season and until the young emerge in August-October. High water quality is not particularly important for great crested newts.

4.2.24 Local groundwater abstraction (although not necessarily for public water supply) has had an adverse effect in the past upon the alluvial forests and natural eutrophic lakes.

4.2.25 Seven nationally and/or internationally important sites that are linked to the underlying chalk aquifer lie within 10km of Thetford, some of which (Thetford Golf Course & Marsh, Stanford Training Area) are immediately adjacent to Thetford:

- Thetford Golf Course & Marsh SSSI (Breckland SAC) – alder woodland lies adjacent to Thetford and contains (in addition to large areas of heathland) areas of fen and an area of alder woodland (the latter of which is an SAC qualifying feature) which are sensitive to reductions in water level and are dependent on a high water table linked to the Little Ouse;
- Stanford Training Area SSSI (Breckland SAC) - the fluctuating meres (Fowl Mere, Devil's Punchbowl and Home Mere), fed by groundwater, are internationally important qualifying features as 'natural eutrophic lakes'. The site also includes other areas of standing water,

wetlands and many springs and streams. These are traditionally largely unaffected by abstraction and should remain so.

- East Wretham Heath SSSI (Breckland SAC) - is the oldest established Breckland nature reserve. Its principal scientific interest lies in the two fluctuating meres, Ringmere and Langmere, and in the areas of Breckland grassland. Ringmere and Langmere are part of a unique series of water bodies found only on this site and the nearby Stanford Training Area SSSI. They are internationally important qualifying features as 'natural eutrophic lakes'. They are supplied from and directly influenced by the chalk ground water and with water levels fluctuating in a cyclical but irregular fashion, conditions have been created for the development of an unusual series of aquatic and periodically inundated plant and animal communities.
- Thompson Water Carr & Common SSSI (Norfolk Valley Fens SAC) - is also sensitive. Of the many hydrologically sensitive features, the alkaline fens, alder forest and Desmoulin's Whorl snail are the main internationally qualifying features;
- Swangey Fen SSSI (part of Norfolk Valley Fens SAC) – alkaline fens, alder forest and other wetland features. Swangey Fen SSSI is fed by chalk water seepages along the north slope with the central fen mainly fed by lateral flow from these together with surface water inputs in winter. Seepage flow may be insufficient to maintain wet conditions in the lower part of the fen during the summer and even the upper seepage zones tend to become summer-dry;
- Weston Fen SSSI (Waveney & Little Ouse Valley Fens SAC) – Desmoulin's Whorl snail, calcareous fen and other wetland features;
- Middle Harling Fen SSSI – general wetland features linked to the chalk aquifer, particularly calcareous fen. The majority of the calcareous fen in the valley bottom is dominated by blunt-flowered rush *Juncus subnodulosus* with frequent purple moor-grass *Molinia caerulea* (description on SSSI citation sounds like a version of M22 *Juncus subnodulosus - Cirsium palustre* fen meadow which does have a stronghold in Norfolk).

4.2.26 Guideline Standards for Protection of Ecological Sites from Development in Thetford are provided in Table 4-8.

**Table 4-8: Ecological Guidelines for Development in Thetford**

| Type | Site | Guideline Standards |
|---|---|---|
| Fluctuating Meres (i.e. 'natural eutrophic lakes') | • Stanford Training Area SSSI<br>• East Wretham Heath SSSI | Any delay in rewetting after a naturally dry period does not exceed one month, and any increase in frequency of drying does not exceed one in 30 years. |
| Alluvial Forests (i.e. alder woodland) | • Thetford Golf Course & Marsh SSSI<br>• Thompson Water Carr & Common SSSI<br>• Swangey Fen SSSI | The requirements for this habitat are:<br>• Winter water-levels at or very near the ground surface.<br>• Spring water levels should be maintained within 5 cm of the ground surface.<br>• Summer maximum and minimum levels should be between 5 and 45 cm below the ground surface, accepting that optimal seedling growth occurs with water levels between 10 and 30 cm below ground level. This should maintain the typical canopy and under-storey species. |
| Desmoulin's Whorl Snail | • Thompson Water Carr & Common SSSI<br>• Weston Fen SSSI | In general it is likely that if hydrological conditions in Thompson Water Carr & Common and Weston Fen remain acceptable for this species they will also be acceptable for other sensitive features. The most significant populations of Desmoulin's Whorl snail at Thompson Water Carr and Common SSSI lie to the north-east of the site where the regional Chalk aquifer is close to the surface, and where water chemistry is optimal for populations of Desmoulin's whorl snail to thrive (see Appendix x).<br>In order for the population of Desmoulin's Whorl snail to be maintained at Thompson Water Carr and Common SSSI, it will be necessary to maintain the regional Chalk aquifer at levels close to the naturalised hydrological regime. |
| Alkaline Fens/Mires | • Swangey Fen SSSI | In general it is likely that if hydrological conditions in Swangey Fen remain acceptable for this habitat (M13 *Schoenus nigricans-Juncus subnodulosus* mire) they will also be acceptable for other sensitive features. Key factors are: shallow groundwater level, surface discharge (e.g. flushing) and the avoidance of flow-reversal.<br>Groundwater level:<br>• It is advised that the average 'normal year' shallow groundwater table should provide wet conditions under foot throughout a normal year and should not drop more than 10cm below ground level.<br>• This shallow groundwater table should be related to flushing flows from groundwater discharges, as opposed to the management of surface water levels through structures. It is the flushing groundwater that provides the hydrochemical conditions in the surface layer which enables the M13 community to thrive.<br>• The variability of the groundwater level in a 'normal year' should not drop under 1 SD from 10cm below ground level, e.g. -22.4 cm.<br>• The duration, frequency and intensity of drought periods should not be significantly increased by abstraction or surface water management.<br>• The flushing of groundwater is critical in maintaining the hydrological conditions with the soil to allow M13 to thrive. Therefore a significant reduction in flushing flow will be disadvantageous to the M13 community. |

## 4.3 Water Supply Infrastructure

4.3.1 The water supply network has been supplied by AWS for analysis in this Phase 2 WCS. A strategic main passes to the east of the proposed development areas and would be sufficient to feed the new development areas.

4.3.2 However, the developers would be responsible for funding an extension rising main to the development areas as there is no water mains coverage within the development areas, and this would most likely require a new local pumping station. Local connections would then be required on a house by house basis.

**Option Funding and Responsibility**

4.3.3 The costs for new rising main and pumping station should be borne by the developer because they are required specifically for the new development areas. Details of indicative costs are provided in a separate technical note to Breckland Council. Options for funding mechanisms are discussed further in Section 10 of this report.

4.3.4 The construction and operation of the rising main would be undertaken by AWS. However, an option is available whereby developers pay directly for the construction of the main and pumping station, and AWS adopt (or requisition) the infrastructure once it is built and take on the ongoing maintenance and operation. This option would require the infrastructure to be designed and built to AWS's specific requirements; and as such, the developer would need to liaise with AWS over the detailed route, sizing and location of the infrastructure.

4.3.5 Costs for dwelling connections for water supply are usual costs borne by the developer for any new housing developer and as such are not considered in this WCS.

## 4.4 Wastewater Treatment

### Baseline Confirmation

4.4.1 The Thetford Outline WCS reported that Thetford Wastewater Treatment Works (WwTW) generally has sufficient wastewater treatment capacity (in terms of volumetric and quality consent headroom) to accommodate growth up to 2021. It also concluded that the Little Ouse (as the receiving watercourse) has sufficient water quality capacity against current water quality standards, to take further discharges of treated wastewater (in terms of water quality and volume) without the need for significant upgrades to the works' treatment process.

4.4.2 However, an increase to the volumetric and quality consents and/or an upgrade to Thetford WwTW may be required to treat wastewater from new development up to 2026 both in terms of volume and the treatment process to meet tighter consents on the quality of discharge, particularly with regards to meeting the Water Framework Directive (WFD) targets for Phosphorus.

**Wastewater Treatment Volumetric (Consent) Capacity**

4.4.3 The current consented Dry Weather Flow (DWF), and therefore volumetric consent capacity, for Thetford WwTW is 8,810 $m^3$/d. The measured flow for the WwTW, as provided by AWS, is 1,279 $m^3$/d, which is significantly less than the calculated DWF of 5,138 $m^3$/d and therefore, after

discussions with AWS, it was agreed that the calculated DWF would be used for the purposes of the wastewater treatment capacity calculations.

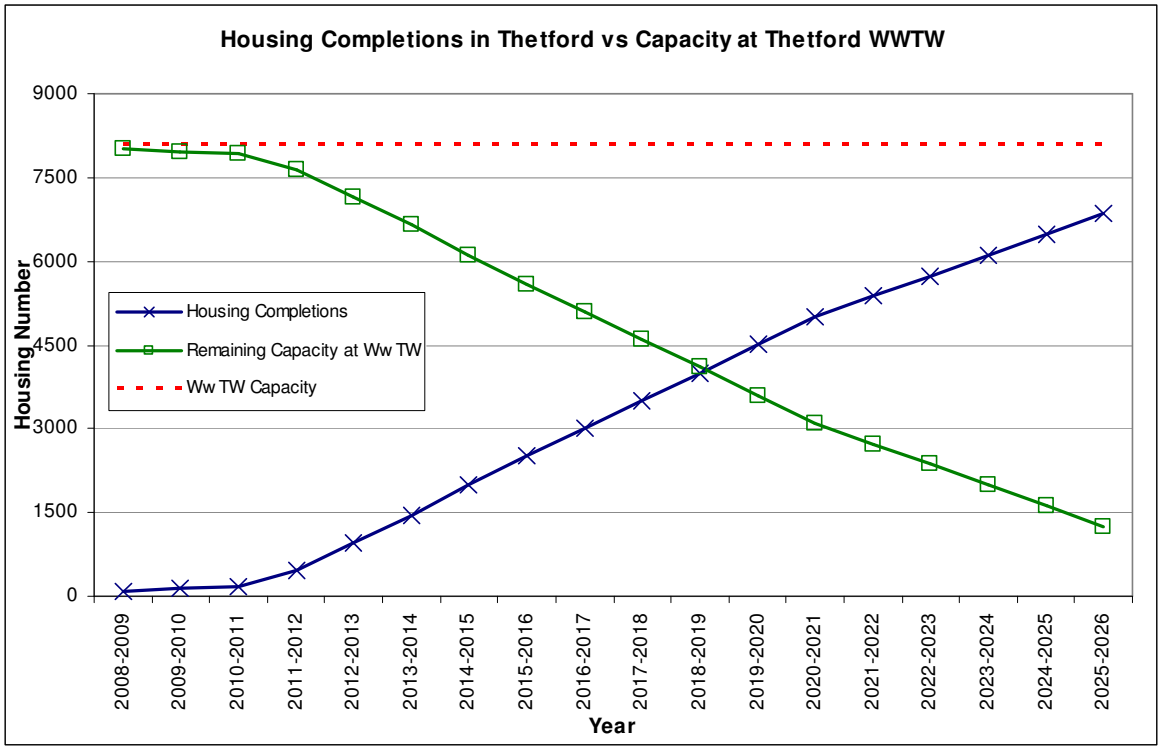
4.4.4 The calculated DWF, 5,138 $m^3$/d, gives rise to a volumetric consent headroom capacity of 3,672 $m^3$/d. The calculated capacity is sufficient to allow the WwTW to treat flow from a further 19,454 people (at 151 l/h/d consumption) which is equivalent to around 8,106 new homes (with occupancy rate of 2.4) before breaching the current volumetric consent.

4.4.5 Thetford is expected to provide 6,848 homes and 5,000 'commercial' jobs by 2026, equating to an increase in the current Population Equivalent (PE) and flow of around 16,435 and 3,102 $m^3$/d respectively. Based on the growth target figures for Thetford, basic headroom capacity calculations show that the WwTW has capacity in its volumetric consent to treat wastewater flows for all of the proposed development up to 2026.

4.4.6 As Thetford WwTW will not exceed its current flow consent as a result of growth, there is no requirement to alter the quality conditions applied to the consent. The Environment Agency has modelled the impact of the operation of the WwTW on the quality of the Little Ouse and has determined that the quality condition applied to P needs to be tightened in order to meet WFD targets. These changes are not planned for in AMP5 by AWS; however, they are likely to be required at some point in the future regardless of whether growth goes ahead or not.

4.4.7 Figure 4-2 shows the phased housing development and corresponding volumetric consent capacity at the works during the period 2008 – 2026. Details of the volumetric consent capacity are included in Appendix H: WwTW Capacity Calculations.

**Figure 4-2 Proposed Housing Development in Thetford and Capacity at Thetford WwTW (2008 - 2026)**



### Wastewater Treatment Quality (Consent) Capacity

4.4.8 Thetford WwTW discharges into the Little Ouse, which is classified as a cyprinid fishery. The Environment Agency monitoring observations for the period 2004 – 2008 show that, under current conditions, the Little Ouse will achieve WFD 'high ecological status' proposed standards upstream of Thetford WwTW for Biochemical Oxygen Demand (BOD), Ammonia and Dissolved Oxygen (DO); Orthophosphate (P) will only achieve 'moderate ecological status'. Downstream of the works, the BOD and DO standard for 'high ecological status' will be achieved and Ammonia will achieve 'good ecological status'; the P standard will again only achieve 'moderate ecological status'.

4.4.9 The assessment of the Environment Agency monitoring results for the Little Ouse upstream and downstream of Thetford WwTW against the proposed WFD standards are provided in Table 4-9. The WFD status and classification information provided in Table 4-9 is summarised from the Anglian RBMP. It should be noted that the classifications for waterbody parameters included in the plan differ slightly to the analysis of the monitoring data itself. The WFD classification for Biochemical Oxygen Demand (BOD) is based on the monitoring information provided by the Environment Agency against proposed WFD standards, as BOD is not specifically reported within the Anglian RBMP.

**Table 4-9 WFD Assessment of Environment Agency Monitoring Results Upstream and Downstream of Thetford WwTW**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sampling Point Code** | | 43M02 | | | | | 45M02 | | | | |
| **Name** | | Little Ouse (Upstream of Thetford WwTW) | | | | | Little Ouse (Downstream of Thetford WwTW) | | | | |
| **Stretch** | | Black Bourne to River Thet | | | | | Thet to Santon Downham | | | | |
| **Easting** | | 587400 | | | | | 585000 | | | | |
| **Northing** | | 282500 | | | | | 284000 | | | | |
| **Water Quality Monitoring Data Assessment (against WFD Standards)** | **Year** | 2004-2008 | | | | | 2005-2008 | | | | |
| | Data | Average (mg/l) | Count | Std Dev (mg/l | 90/10%ile/ Average (mg/l) [WFD Target] | WFD Status | Average (mg/l) | Count | Std Dev (mg/l | 90/10%ile/ Average (mg/l) [WFD Target] | WFD Status |
| | BOD | 1.39 | 47 | 0.82 | 2.34 | | 1.16 | 48 | 0.52 | 1.80 | |
| | Ammonia | 0.04 | 60 | 0.04 | 0.08 | | 0.19 | 48 | 0.17 | 0.41 | |
| | DO as % Sat | 91.64 | 60 | 18.56 | 75.42 | | 92.35 | 48 | 11.15 | 81.62 | |
| | Orthophosphate | 0.20 | 60 | 0.05 | 0.20 | | 0.14 | 48 | 0.05 | 0.14 | |
| **WFD Classification** | Water Body ID | GB105033043090 | | | | | GB105033043400 | | | | |
| | Hydromorphological Status | Heavily Modified *Flood Protection* | | | | | Heavily Modified *Flood Protection, Navigation, Urbanisation* | | | | |
| | Current Overall Status | Moderate | | | | | Moderate | | | | |
| | Current Ecological Status | Moderate | | | | | Moderate | | | | |
| | Current Chemical Status | N/A | | | | | Good | | | | |
| | Overall Status Objective | Good Ecological Potential by 2027 | | | | | Good Ecological Potential by 2027 High Chemical Status by 2015 | | | | |

| Key | |
|---|---|
| **WFD Target** | **WFD Classification Status** |
| Pass WFD 'Good' Target | High Status |
| Marginal Pass (Within 10%) | Good Status |
| Fail WFD 'Good' Target | Moderate Status |
| | Poor Status |
| | Bad Status |
| | N/A – Does Not Require Assessment |

4.4.10 Indicative consent standards have been calculated for Thetford WwTW based on the proposed growth by Breckland District Council within Thetford; this will result in Thetford WwTW treating 8,240 $m^3$/d of wastewater by 2026. The consents have been calculated for the modelling scenarios defined in Section 3.3.

4.4.11 Table 4-10 shows the consents required based on the proposed phasing of growth. This assumes that the river is either achieving 'good ecological status' (GES) or 'high ecological status' (HES) upstream of the discharge based on the methodology discussed in Section 3.3.

### Table 4-10: Thetford WwTW Calculated Quality Consent Requirements

| | | BOD | | | | Ammonia | | | | P | | | | Planning Considerations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2010 | 2015 | 2020 | 2026 | 2010 | 2015 | 2020 | 2026 | 2010 | 2015 | 2020 | 2026 | |
| Current Consent | | 35 | | | | 16 | | | | 2 | | | | |
| Scenario A: Planned Deterioration | A1 | 35 | 35 | 35 | 35 | 16 | 16 | 16 | 16 | 2 | 2 | 2 | 2 | ✓ |
| | A3 | 35 | 35 | 35 | 35 | 16 | 16 | 16 | 16 | 2 | 2 | 2 | 2 | ✓ |
| Scenario B: Compliance with WFD | B1 | 35 | 35 | 35 | 35 | 7.5 | 6.5 | 5.5 | 5 | 1 | 1 | 1 | 1 | × (P) |
| | B3 | 35 | 35 | 35 | 35 | 7.5 | 6.5 | 5.5 | 5 | 1 | 1 | 1 | 0.9 | ✓ |
| Scenario C: Compliance with WFD (excl. P) | C1 | 35 | 35 | 35 | 35 | 7.5 | 6.5 | 5.5 | 5 | - | - | - | - | ✓ |
| Scenario D: WFD Deterioration | D1 | 35 | 35 | 35 | 35 | 16 | 14 | 12.5 | 11 | 1 | 1 | 1 | 1 | × (P) |
| | D2 | 35 | 35 | 35 | 35 | 16 | 14 | 12.5 | 11 | 1 | 1 | 1 | 0.9 | ✓ |
| Scenario E: Load Standstill (compliance with HD)[35] | E1 | 35 | 35 | 35 | 35 | 16 | 16 | 16 | 16 | 2 | 2 | 2 | 2 | ✓ |
| | E2 | 35 | 35 | 35 | 35 | 16 | 16 | 16 | 16 | 2 | 2 | 2 | 2 | ✓ |
| **Recommended Consents** | | **35** | | | | **5** | | | | **1** | | | | |
| **Key** | | No consent tightening required | | | | Consent tightening within BATNEEC | | | | Consent limited to BATNEEC | | | | Consent beyond BATNEEC required |

### Table 4-11: Current WFD Status & Quality Consent for Thetford WwTW

| Determinand | Current WFD Status | | D/S WFD Standard (Required) | Current Quality Consent (mg/l) | Planned Change to Quality Consent (mg/l) |
|---|---|---|---|---|---|
| | U/S | D/S | | | |
| BOD | H | H | High - 4 mg/l (90%ile) | 35 | No Change |
| Ammonia | H | H | High - 0.3 mg/l (90%ile) | 16 | No Change |
| Orthophosphate | G | G | Good - 0.12 mg/l (Mean) | 2 | No Change |

[35] The calculated required consents are laxer than the existing 35, 16 and 1mg/l consents, so whilst tighter discharge concentrations are required to comply with load standstill, they are still laxer than the current consents. Therefore to avoid confusion, it has been reported that the required consents which will not change in the future for load standstill

4.4.12 As Thetford WwTW will not exceed its current DWF consent under future growth conditions there is currently no legislative driver to reduce the quality consents, which are granted based on the full utilisation of the DWF consent. Any deterioration can be considered to be planned for as part of the granting of the full discharge consent; therefore, the current quality consents would not need to be changed under this scenario (Scenario A – the planned deterioration scenario).

4.4.13 Although the consent will not need to change, it is important to consider the impact of growth (and current WwTW operation) on the compliance with WFD status immediately downstream of the WwTW as the WFD requires all stretches of watercourse to comply with the standards set. Under this scenario (Scenario B), the current consent would require a reduction in the Ammoniacal-N (95%ile) condition from 16 mg/l to around 5 mg/l by 2026. This is as a result of downstream watercourse currently being assessed as high ecological status; should the high status be allowed to deteriorate to 'good' (Scenario D), the Ammoniacal-N consent would only need to be tightened to 11 mg/l. The BOD consent, currently at 35 mg/l BOD (95%ile), would not require tightening.

4.4.14 The water quality upstream of the WwTW, is currently achieving Moderate Ecological Status for Phosphorus, and therefore using the agreed Environment Agency approach (see Section 3.3), the modelling results (Scenario B) indicate that by 2026 a P consent of around 1mg/l (Mean) will be required at Thetford WwTW to achieve full compliance with the 0.12 mg/l (Mean) WFD P standard downstream of the works. This corresponds with the proposed measures identified by the Environment Agency in the National Environmental Programme (NEP) which state that for Thetford WwTW a scheme is required to meet objectives for Phosphorus standards in rivers under the WFD. The NEP identified that there was biological evidence of damage to downstream ecology (MTR[36]) in the Little Ouse and that action in combination with Brandon WwTW improvements should ensure full compliance the WFD targets. The National SIMCAT model identified that improvements at the discharge, to a consent of 1mg/l (Mean) will achieve water body compliance with the WFD standard for P. The new consent is proposed for implementation by end of December 2012, though AWS have stated that this will not be implemented at Thetford WwTW until AMP6 (post-2015).

4.4.15 The indicative calculations show that by AMP7 (2020-2026), the P consent would potentially need to be tighter than the proposed 1mg/l; however, these calculations are currently only indicative and should not be considered as descriptive of the exact parameter requirements of the future consent. It is considered that the AMP7 consent of 0.9mg/l is sufficiently close to the proposed consent of 1mg/l under AMP6 to be considered achievable within future planned improvements for the works.

## Wastewater Treatment Preferred Solution

### Option Identification

4.4.16 It is considered that the preferred solution to wastewater treatment for Thetford is the utilisation of the existing licence, which accounting for planned deterioration, will not require a change in flow or quality consent to accommodate growth. Therefore no significant upgrades are required at the WwTW.

[36] MTR – Mean Trophic Rank

#### Option Funding and Responsibility

4.4.17 Although no specific changes are required to the consent at Thetford WwTW, AWS may need to make small upgrades or alterations to the treatment processes or hydraulic design of the WwTW in order to utilise the identified capacity within the flow consent. Any cost associated with these changes will be borne solely by AWS via the Price review and AMP process. Developers cannot contribute to upgrades at existing WwTW as they are not required specifically for the new development.

4.4.18 Delivery and maintenance of any upgrade to the WwTW will be the responsibility of AWS under the regulation of Ofwat, and the Environment Agency.

### Ecological Issues

4.4.19 The Review of consents process has determined that Thetford WwTW at current licensed capacity is not impacting on any ecologically designated sites downstream. Because there is no proposal to increase flow above the current consent, it is considered that there would be no downstream impact in protected sites as a result of growth at Thetford.

## 4.5 Wastewater Infrastructure

### Baseline Confirmation

4.5.1 The Thetford Outline WCS reported that Thetford is currently served by a sewerage system which all drains to Thetford STW located to the west of the town centre. It was assumed that any spare 'capacity' in the existing wastewater network would be required to cater for the infill development (identified for Thetford as approximately 1,000 new properties) and for increases in storm flows with climate change[37] in order to prevent an increase in sewer flooding within the existing urban extent of Thetford. The conclusion from this assumption was that there was no spare capacity in the wastewater network and that the majority of new development in the proposed greenfield areas would require new wastewater transmission infrastructure.

4.5.2 The outline assessment did conclude that, as well as capacity for infill, there is further capacity in the existing wastewater network in the north of the town to allow development to occur with connections up to approximately a 1000 homes (estimated to take place between 2008 and 2010) in this location; however, confirmation and utilisation of this capacity would be required on a case-by-case basis through a pre-development enquiry, and strategic scale investment would be required from 2010 onwards in terms of wastewater network infrastructure in order to service the new development. The outline study identified a potential route for a new mains sewer connecting potential development sites to the east and north of the town. Now that the preferred option for location of the development is known, this detailed assessment has considered the final route, size, layout, and construction timelines of the new mains sewer[38].

4.5.3 Figure 4-3 illustrates the existing wastewater network in Thetford.

[37] Climate change is predicted to lead to an increase in winter rainfall and an increase in the frequency of storm events with a high intensity of rainfall which will lead to more frequent overloading of sewer systems
[38] inidicative costs are provided as a separate technical note

## Wastewater Strategy Preferred Solution

4.5.4 Calculations have been undertaken to determine a route for the proposed strategic sewer serving the development areas to the north and northeast of the town. These calculations have included the determination of likely pipe sizes, where the pipe can be drained by gravity and where a Pumping Station (PS) will be required. An indication of the time require to commission and begin building it (based on the temporal and spatial phasing of development proposed) have also been assessed.

### Assumptions

4.5.5 A number of assumptions have been made in determining the wastewater transmission strategy for Thetford up to 2026:

- all proposed housing and employment growth in Thetford will drain to, and be treated at, Thetford WwTW;
- there is adequate capacity (up to 1,000 dwellings) within the existing network serving the town centre development sites to transmit the wastewater generated from these sites to Thetford WwTW without any required upgrade to the network;
- up to 1,000 dwellings may be able to connect to the existing mains sewer located to the north east of the town, via local connections. However, this capacity would need to be verified by developers on a site by site basis by submitting a pre-development enquiry to AWS. As such, for the purposes of the WCS assessment, it is assumed that all development to the north of the town (on greenfield sites) will not be able to connect to the existing sewer network;
- greenfield development (to the north and east of the town) will require a new sewer to be built to transfer wastewater from these development areas to Thetford WwTW;
- any new wastewater pipeline must avoid the scheduled iron age religious site and associated enclosures on Gallows Hill (previously referred to as the Boudicca site) to the northwest of the town;
- all brownfield/infill development in the town centre will utilise the existing network and provide local connections to this. Modelling of the capacity of the existing network has not been undertaken as part of this assessment as this will be undertaken by AWS on a case by case basis through pre-development enquiries;
- spatial phasing for Thetford is most likely to occur from west to east but it is assumed that the pipe will be built in one stage, with connections to the new mains sewer as phases of the development take place; and
- the route outlined in this WCS is indicative only, and is intended to demonstrate that a solution is feasible. It may be that a different preferred solution is implemented during AWS's asset planning process during future AMPs, according to actual timing and phasing constraints that occur at the time of development.

### Proposed Solution

4.5.6 Table 4-12 shows the proposed route for the new wastewater pipeline serving the development areas to the north and northeast of Thetford.

4.5.7 The proposed route for the new pipeline would run north-westerly to the A11 and then run westerly parallel to the south embankment of the road to Thetford WwTW. The pipeline would run to the north of the Boudicca site. Through this area it is suggested that the main would be laid in the highway verge.

4.5.8 The system would be a mixture of pumped and gravity drains (300mm in diameter), with a pumping station pumping the wastewater from the north-easterly development areas (at the upstream end of the proposed pipeline) to the gravity drained pipes to the south of the A11/A1086 interchange. The gravity drains then drain to Thetford WwTW. Appendix I: Thetford Wastewater Network Calculations details the main components and requirements for the proposed wastewater strategy.

**Table 4-12: Thetford Wastewater Transmission Strategy Components**

| Item | Pump Rate (l/s) | Length | Diameter |
|---|---|---|---|
| Pumping Station | 78 l/s (litres per second) | N/A | N/a |
| Rising Main | N/A | 2.6km | 300mm |
| Gravity Sewer | N/A | 2.1km | 300mm |

**Timelines**

4.5.9 An indicative programme for the proposed pipeline is provided in Table 4-13. The design and planning period to contract award is of 30 month duration due to the need to acquire railways and highways consents owing to the proposed location of the pipeline to the south of the A11 and the requirement for the new pipe to pass beneath the railway line.

4.5.10 Assuming a start date of 2010 (the beginning of AMP5), the pipeline could be completed in 2013/2014. This means, that realistically, it will not be possible to connect any new development in the development areas to the new wastewater pipeline until mid-2013 at the earliest.

**Table 4-13: Wastewater Strategy Indicative Programme**

| Phase | Duration |
|---|---|
| Design/Planning to Contract Award | 30 months |
| Construction Period | 12 months |
| **TOTAL** | **42 months (3.5 Years)** |

**Option Funding and Responsibility**

4.5.11 The costs for new wastewater main and pumping station should be borne by the developer because they are required specifically for the new development areas. Details of indicative costs are provided in a separate technical note to Breckland Council. Options for funding mechanisms are discussed further in Section 10 of this report.

4.5.12 The construction and operation of the wastewater main would be undertaken by AWS. However, an option is available whereby developers pay directly for the construction of the main and pumping station, and AWS adopt (or requisition) the infrastructure once it is built and take on the ongoing maintenance and operation. This option would require the infrastructure to designed and built to AWS's specific requirements; and as such, the developer would need to liaise with AWS over the detailed route, sizing and location of the infrastructure.

## Figure 4-3: Thetford Wastewater Network

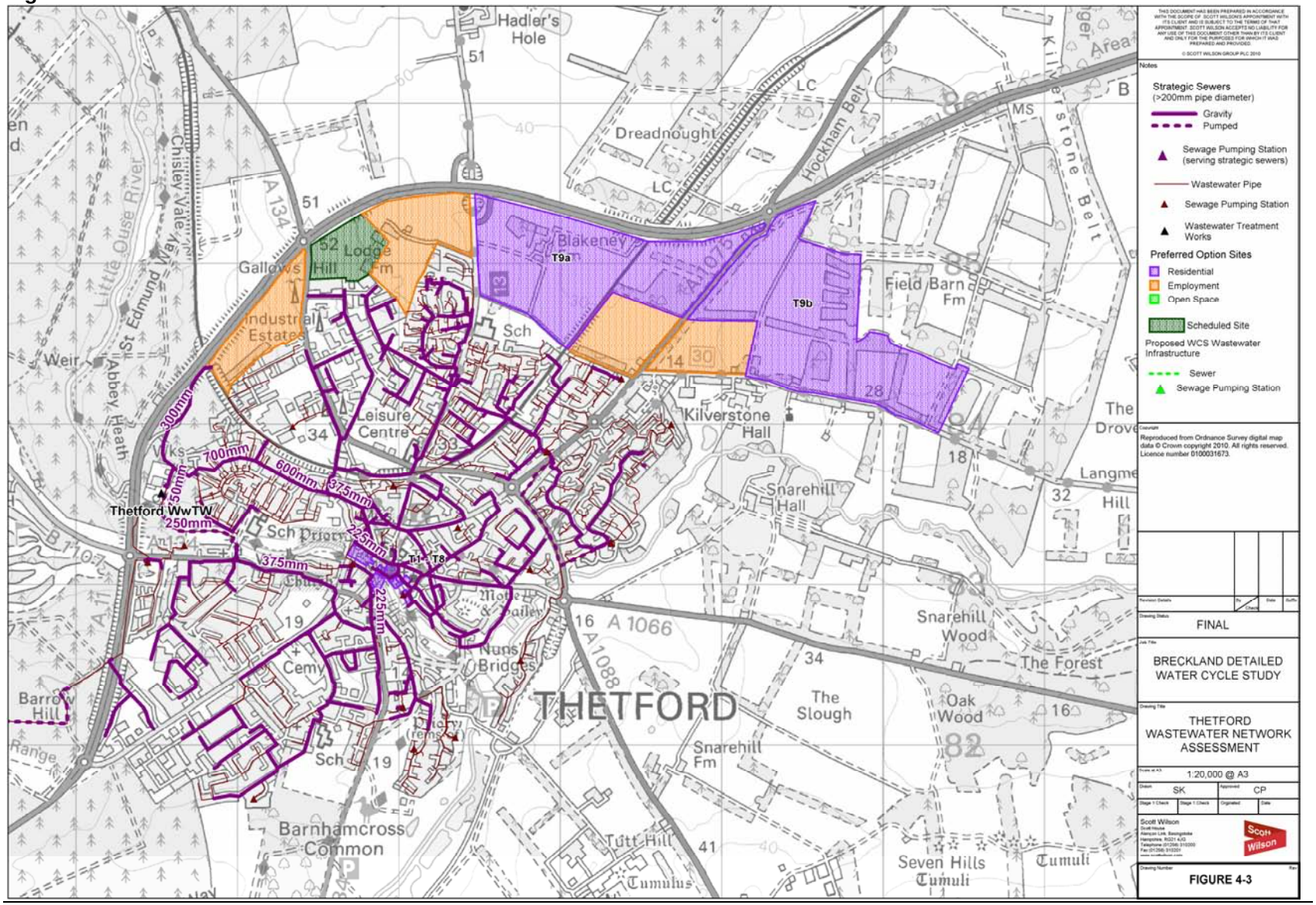
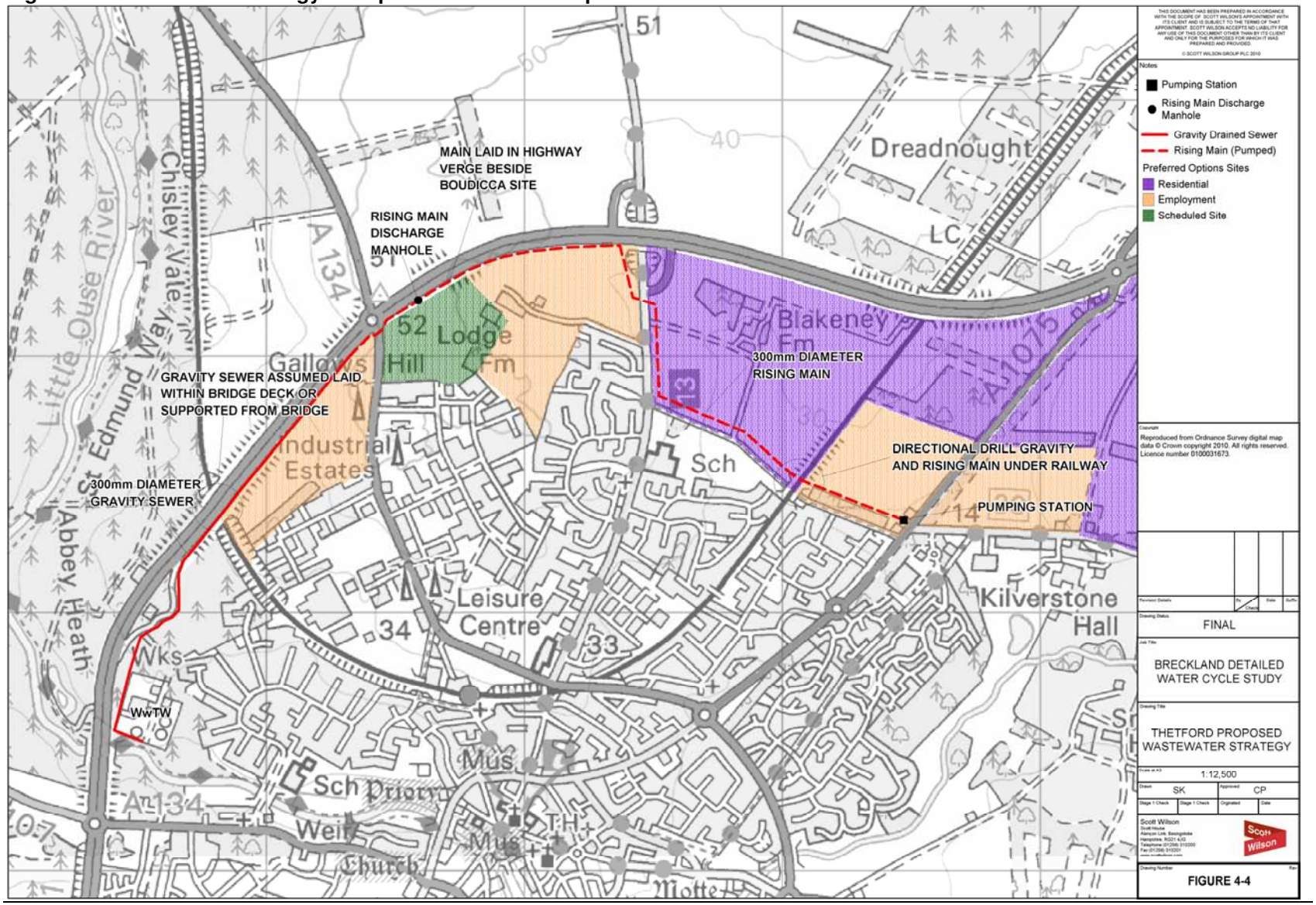


**Figure 4-4: Wastewater Strategy – Proposed Wastewater Pipeline Route**



## 4.6 Flood Risk Management

### Management of Flood Risk to Development

4.6.1 Table 4-14 provides an assessment of the flood risk to proposed development in Thetford based on the findings of the Level 1 SFRA undertaken for the Breckland District (Reference 9) and the Thetford Level 2 SFRA (Reference 13)[39]. There is not considered to be a flood risk to proposed development on preferred options site T9b, though it should be noted that the Level 1 SFRA recommends that development should be planned to ensure that runoff from the A11 (which has recorded infrastructure failure flood events but not in the vicinity of the site) will not affect any new property.

4.6.2 An infrastructure failure event has been recorded on the northern boundary of preferred options site T9a, on the A11. The Level 1 SFRA recommends that development should be planned to ensure that runoff from the A11 will not affect new property and that the new development will not exacerbate the sewer flooding of the existing development to the south of the site.

4.6.3 Assuming the recommendations from the SFRA are followed when designing and building development on the sites, there is not considered to be any flood risk constraints associated with developing on the T9a and T9b preferred option sites in Thetford.

4.6.4 The town centre preferred options sites (T1 - T8) which all lie within Flood Zone 2 or 3 have been assessed in more detail in the Thetford Level 2 SFRA. The findings and mitigation recommendations from this study are presented in Table 4-15 to Table 4-18. It should be noted that the Level 2 SFRA assessed four favoured development areas as opposed to the eight preferred options sites which had not been determined at the time of the study. As such, the preferred sites have been assigned to one of these four areas for the purposes of this assessment.

[39] Scott Wilson (2009) Thetford Level 2 SFRA

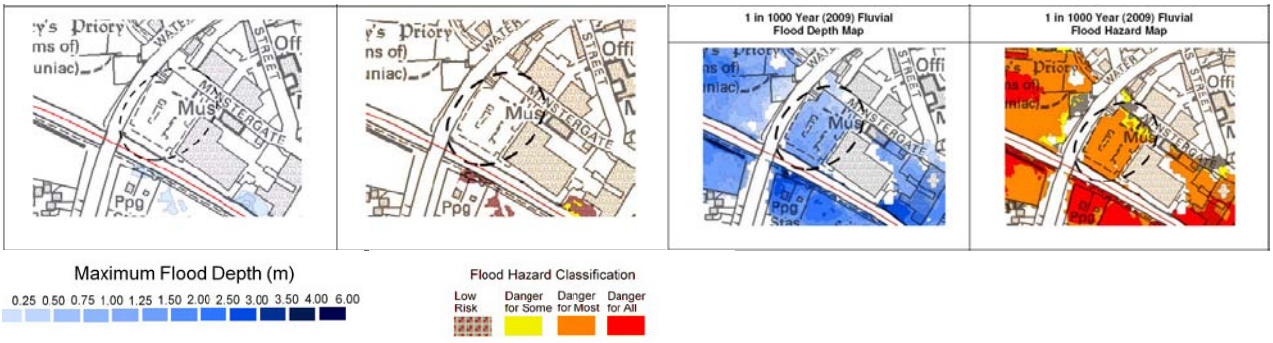
## Table 4-14: Thetford Flood Risk to Development Assessment

| Preferred Option Site | Development Type | Area (Ha) | Flood Risk Constraints | | | | Flood Risk Assessment |
|---|---|---|---|---|---|---|---|
| | | | Fluvial | Critical Drainage/ Surface Water Flooding | Groundwater | Artificial Water Sources | |
| T1 | Employment | 0.6 | ✓ | × | × | × | Entire site lies within Flood Zone 2 and northern boundary overlies Flood Zone 3.<br><br>**There is considered to be a flood risk to development at the site and therefore mitigation may be required. See Table 4-15 for more detailed flood risk assessment and mitigation options.** |
| T2 | Employment/ Residential | 0.2 | ✓ | × | × | × | Entire site lies within Flood Zone 2.<br><br>**There is considered to be a flood risk to development at the site and therefore mitigation may be required. See Table 4-16 for more detailed flood risk assessment and mitigation options.** |
| T3 | Employment/ Residential | 0.5 | ✓ | × | × | × | Entire site lies within Flood Zone 2.<br><br>**There is considered to be a flood risk to development at the site and therefore mitigation may be required. See Table 4-16 for more detailed flood risk assessment and mitigation options.** |
| T4 | Employment/ Residential | 0.1 | ✓ | × | × | × | Entire site lies within Flood Zone 2.<br><br>**There is considered to be a flood risk to development at the site and therefore mitigation may be required. See Table 4-16 for more detailed flood risk assessment and mitigation options.** |
| T5 | Employment | 0.2 | ✓ | × | × | × | Entire site lies within Flood Zone 2.<br><br>**There is considered to be a flood risk to development at the site and therefore mitigation may be required. See Table 4-17 for more detailed flood risk assessment and mitigation options.** |
| T6 | Employment | 0.4 | ✓ | ✓ | × | × | Entire site lies within Flood Zone 2. Two reported sewer flooding events to south of site.<br><br>**There is considered to be a flood risk to development at the site and therefore mitigation may be required. See Table 4-17 for more detailed flood risk assessment and mitigation options.** |
| T7 | Employment | 0.1 | ✓ | × | × | × | Half of site lies within Flood Zone 2.<br><br>**There is considered to be a flood risk to development at the site and therefore mitigation may be required. See Table 4-17 for more detailed flood risk assessment and mitigation options.** |

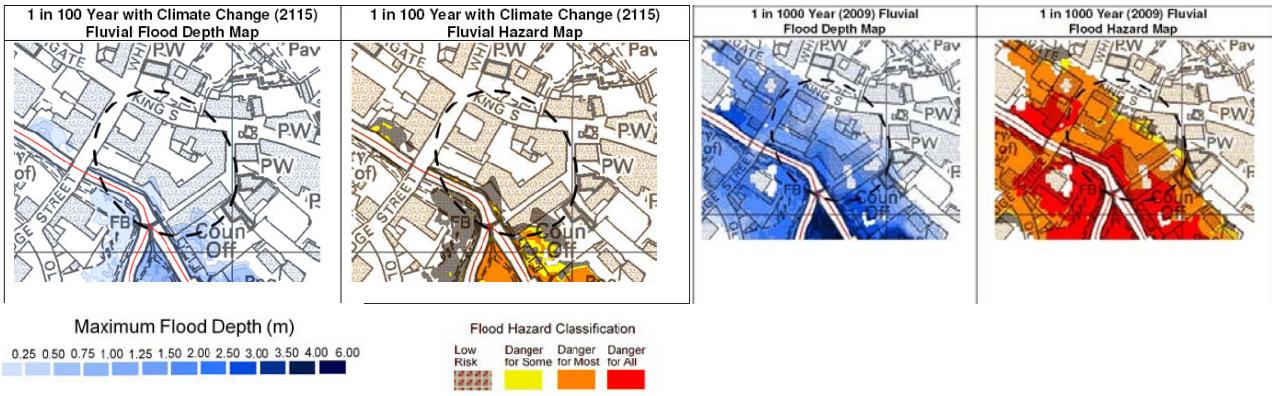
| | | | Flood Risk Constraints | | | | |
|---|---|---|---|---|---|---|---|
| T8 | Employment | 1.2 | ✓ | × | × | × | Entire site lies within Flood Zone 2.<br><br>**There is considered to be a flood risk to development at the site and therefore mitigation may be required. See Table 4-18 for more detailed flood risk assessment and mitigation options.** |
| T9a | Residential | 83.7 | × | ✓ | × | × | Infrastructure failed flood event recorded on northern boundary of site on the A11.<br><br>The SFRA L1 suggests that development should be planned to ensure that runoff from the A11 will not affect any new property, and that the new development will not exacerbate the sewer flooding of the existing development to the south of the site.<br><br>**Assuming the above restrictions are applied, there is not considered to be a flood risk to development at the site.** |
| T9b | Residential | 99.8 | × | × | × | × | The SFRA L1 suggests that development should be planned to ensure that runoff from the A11 will not affect any new property.<br><br>**Assuming the above restrictions are applied, there is not considered to be a flood risk to development at the site.** |

## Table 4-15: Thetford Flood Risk to Development Assessment - Site T1 (from Thetford Level 2 SFRA)

| SFRA Area 1 – WCS Site T1 | |
|---|---|
| Sequential Test | Site is located predominantly in Flood Zone 2 with land also located in the future Flood Zone 3a.<br><br>Flood Zone 2 is appropriate for all developments types, with the exception of highly vulnerable uses, where it is necessary to apply the Exception Test. Flood Zone 3a is appropriate for less vulnerable uses.<br><br>The Exception Test is required for more vulnerable uses and essential infrastructure, proposed within Flood Zone 3a. |
| Flood Defences | The Level 1 SFRA indicates that there are no formal fluvial defences within Thetford Town Centre.<br><br>A site walkover for the Level 2 SFRA indicate the presence of informal defences, consisting of concrete and masonry walls (raised in sections) along the river bank. |
| Flood Depth and Hazard | Inundation from the future 1 in 100 year event occurs towards the north and east of area 4, adjacent to the river. Depths up to 0.3 m are experienced; the predominant hazard is low risk.<br>The current 1 in 1000 year flood extent covers the majority of area 4 with depths ranging from 0.1 m up to 2m. The associated hazard within the flood extent is predominantly danger for most – danger for all. |
| Safe Access and Egress | Safe access and egress routes should be achievable to the north west via Bridge Street and Old Bury Road during the future 1 in 100 year event. Safe access and egress during the 1 in 1000 year event would be restricted. The 1 in 1000 year flood extent width in this location has a maximum of 90 m. The EA flood warning service provides a minimum of two hours warning prior to the onset of a flood event, which should be adequate time to evacuate flood risk areas. |
| Potential Development | Existing development within this area includes the Anchor Hotel. This area is also used as a public car park and Bus Station. Potential development at this location may include a new educational establishment. |
| Recommendations | • Development should be sequentially located based on flood risk vulnerability classification (PPS25 Table D.2), to areas of lowest risk. Land at high risk adjacent to the river could become green open space, increasing amenity value and attractiveness of the site;<br>• Finished floor levels should be set above the future 1 in 100 year flood level when accounting for the anticipated effects of climate change for the life of the development, including an additional 300 mm freeboard allowance;<br>• Incorporation of SuDS to ensure flood risk to third parties is not increased. SuDS attenuation techniques should be given priority over infiltration, to ensure groundwater SPZs are protected;<br>• A site specific FRA should provide details of flood warning and evacuation plans. |

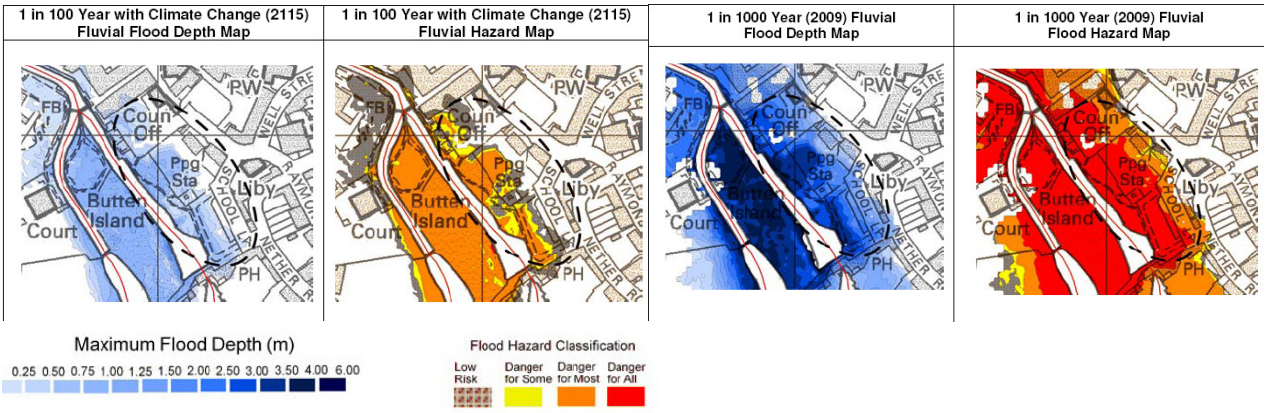


## Table 4-16: Thetford Flood Risk to Development Assessment - Sites T2, T3 and T4 (from Thetford Level 2 SFRA)

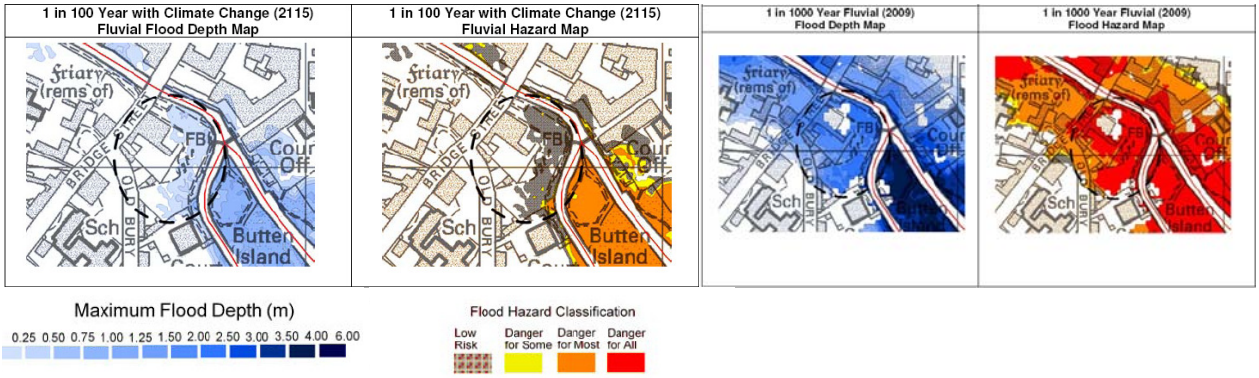
| SFRA Area 2 – WCS Site T2, T3 and T4 | |
|---|---|
| Sequential Test | Sites T2, T3 and T4 predominantly in Flood Zone 2, and in accordance with PPS25 the sites are appropriate to accommodate all developments types, with the exception of highly vulnerable uses, where it is necessary to apply the Exception Test.<br><br>Southern parts of site T3 and T4 lies within future (2115) Flood Zone 3a. Flood Zone 3a is appropriate for less vulnerable uses. The Exception Test would be required for more vulnerable and essential infrastructure. |
| Flood Defences | Level 1 SFRA indicates there are no formal fluvial flood defences within Thetford Town Centre.<br><br>Site walkover as part of Level 2 SFRA showed that the river bank consists of a timber panel structure with concrete crest. A two stage channel is apparent in this location. The upper channel remains dry, except during peak flows, providing public access along the riverside. A number of steps (and also a slope) link this riverside area to the higher ground set back from the river. |
| Flood Depth and Hazard | The future 1 in 100 year event is limited to the riverside of sites T3 and T4. Depths up to 0.25 m are experienced with the predominant hazard being low risk.<br><br>Inundation from the current 1 in 1000 year event is extensive with depths ranging from 0.1 m up to 2 m across sites T2, T3 and T4. The associated hazard within the flood extent is predominantly danger for most with areas located adjacent to the river classified as danger for all. |
|  | |
| Safe Access and Egress | Safe access and egress routes are achievable (on foot and by car) to the north via Kings Street and White Hart Street during the future 1 in 100 year fluvial flood event. During the 1 in 1000 year event safe access and egress would be restricted. The 1 in 1000 year flood extent in this location has a maximum width of 85 m. The EA flood warning service provides a minimum of two hours warning prior to the onset of a flood event, which should be adequate time to evacuate flood risk areas. |
| Potential Development | The sites currently consist of leisure and retail development. Potential development at these locations may include a multi floor development consisting of retail, leisure and residential uses. In accordance with PPS25, residential development is appropriate within Flood Zone 2, although where possible, it should be located above less vulnerable development. |
| Recommendations | • Development in T3 and T4 should be sequentially located based on flood risk vulnerability classification (PPS25 Table D.2). to areas of lowest risk;<br>• Residential development should be located outside of the future 1 in 100 year extent, and where possible located above less vulnerable development, within Flood Zone 2;<br>• Incorporation of SuDS to ensure flood risk to third parties is not increased. SuDS attenuation techniques should be given priority over infiltration, to ensure groundwater SPZs are protected;<br>• A site specific FRA should provide details of flood warning and evacuation plans. |

## Table 4-17: Thetford Flood Risk to Development Assessment - Sites T5, T6 and T7 (from Thetford Level 2 SFRA)

| SFRA Area 3 – WCS Site T5, T6 and T7 | |
|---|---|
| Sequential Test | T5, T6 and T7 are all located within Flood Zone 2, whilst T5 and T6 also lie within the future Flood Zone 3a. Flood Zone 2 is appropriate for all developments types, with the exception of highly vulnerable uses, where it is necessary to apply the Exception Test. Flood Zone 3a is appropriate for less vulnerable uses. The Exception Test would be required for more vulnerable and essential infrastructure if they were to be located in these areas. |
| Flood Defences | The Level 1 SFRA indicates that there are no formal fluvial defences within Thetford Town Centre.<br><br>A site walkover for the Level 2 SFRA reported a timber structure with concrete crest along some sections of the river bank. Further upstream towards Bridges Walk the river bank consists of a substantial raised masonry wall. These informal defences offer some protection to the adjacent land in the vicinity of Bridges Walk. |
| Flood Depth and Hazard | The future 1 in 100 year event outline extends approximately 40 m from the river which overlies the southern parts of T5 and T6. Depths up to 1 m with an associated hazard of danger for most are experienced.<br><br>Inundation from the current 1 in 1000 year event is extensive with depths across T5 and T6 ranging from 0.1 m up to 2.4 m. The associated hazard within the flood extent is predominantly danger for most – danger for all.<br><br>Site T7 does not fall within a flood hazard zone. |
| Safe Access and Egress | Safe access and egress routes should be achievable (on foot and by car) to the east via Tanner Street and School Lane during the future 1 in 100 year event.<br><br>During the 1 in 1000 year event safe egress would be restricted. The EA flood warning service provides a minimum of two hours warning prior to the onset of a flood event, which should be adequate time to evacuate flood risk areas, during the 1 in 1000 year event. |
| Potential Development | This sites currently consist of green open space adjacent to the river, with car parking and some private development set back from the river.<br>Potential development at this location should retain existing green open space, with major development set back from the river. |
| Recommendations | • Development should be sequentially located based on flood risk vulnerability classification (PPS25 Table D.2), to areas of lowest risk. Land at high risk adjacent to the river should be retained as existing green open space;<br>• Finished floor levels should be set above the future 1 in 100 year flood level when accounting for the anticipated effects of climate change for the life of the development, including an additional 300 mm freeboard allowance;<br>• More vulnerable development should be located outside of the future 1 in 100 year extent, and where possible located above less vulnerable development, within Flood Zone 2;<br>• Where small-scale less vulnerable development is proposed adjacent to the river, flood resilient construction measures should be adopted;<br>• Incorporation of SuDS to ensure flood risk to third parties is not increased. SuDS attenuation techniques should be given priority over infiltration, to ensure groundwater SPZs are protected;<br>• A site specific FRA should provide details of flood warning and evacuation plans. |



### Table 4-18: Thetford Flood Risk to Development Assessment - Sites T8 (from Thetford Level 2 SFRA)

| SFRA Area 4 – WCS Site T8 | |
|---|---|
| Sequential Test | Site predominantly in Flood Zone 2, and in accordance with PPS25, appropriate to accommodate all development types, with the exception of highly vulnerable uses, where it would be necessary to apply the Exception Test. |
| Flood Defences | Level 1 SFRA indicates there are no formal fluvial flood defences within Thetford Town Centre. However, there is a natural earth bank along the river in the vicinity of this site. |
| Flood Depth and Hazard | The site is located outside the 1 in 100 year fluvial flood extent.<br><br>Inundation from the 2009 1 in 1000 year event is extensive with depths across the site ranging from 0.1m up to 1.3m. The associated hazard within the 1 in 1000 year flood extent is predominantly danger for most. |
| |  |
| Safe Access and Egress | Safe access and egress should be achievable (on foot and by car) to the north via Minstergate during the future (2115) 1 in 100 year fluvial flood event.<br><br>During the 1 in 1000 year event safe access and egress would be restricted.<br>The EA flood warning service, which covers the area, provides a minimum of two hours warning prior to the onset of a flood event. This would allow adequate time to evacuate the area during both the future 1 in 100 year fluvial event and the current 1 in 1000 year fluvial event. |
| Potential Development | Site is currently used for parking. Potential development at the location includes construction of a new multi storey car park. In accordance with PPS25, this type of development is considered appropriate in Flood Zone 2. |
| Recommendations | • Incorporation of SuDS to ensure flood risk to third parties is not increased. SuDS attenuation techniques should be given priority over infiltration, to ensure groundwater SPZs are protected;<br>• Where underground parking is proposed a site specific FRA should ensure that access points and any venting or other penetrations are situated 300 mm above the 1 in 100 year fluvial flood level when accounting for the anticipated effects of climate change for the life of the development;<br>• A site specific FRA should provide details of flood warning and evacuation plans. |

#### Option Funding and Responsibility

4.6.5 The costs for the incorporating flood resilient measures and for raising finished floor levels should be borne by the developer as part of the building design and construction.

## Management of Flood Risk from Development

4.6.6 In order to manage the flood risk generated from new development as a result of generation of additional surface water runoff, it was necessary to calculate the storage volumes of surface water required to maintain runoff rates and volumes at the current Greenfield level (as per methodology – see section 3.5.12 onwards). Table 4-19 provides the potential attenuation

requirements for the preferred option sites in Thetford. The calculations have been undertaken for two development assumptions: a 90% hardstanding coverage and 80% hardstanding.

**Table 4-19: Attenuation Requirements for Preferred Option Sites in Thetford**

| Pref Option Site | Approx area | | Geology and Soils | SPZ | Greenfield Runoff Rates (l/s) | | Max. Storage ($m^3$) | | Max. Storage using infiltration ($m^3$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 90% Area | 80% Area | | | 90% Area | 80% Area | 90% Area | 80% Area | 90% Area | 80% Area |
| T9a West | 72 | 64 | Largely permeable geology and soils | Zone 2 | 87 | 78 | 84,482 | 74,983 | 35,292 | 31,368 |
| T9b East | 90 | 80 | | | 90 | 80 | 105,993 | 94,026 | 43,904 | 39,215 |
| Town Centre Sites | | | | | | | | | | |
| T1 | 0.54 | 0.48 | Heterogeneous geology. Sandy soils with naturally high groundwater | Zone 2 | 3 | 3 | 482 | 431 | 348 | 310 |
| T2 | 0.18 | 0.16 | | | 1 | 1 | 162 | 144 | 116 | 103 |
| T3 | 0.45 | 0.4 | | | 3 | 2 | 405 | 357 | 324 | 257 |
| T4 | 0.09 | 0.08 | | | 1 | 1 | 81 | 70 | 58 | 51 |
| T5 | 0.18 | 0.16 | | | 1 | 1 | 162 | 144 | 116 | 103 |
| T6 | 0.36 | 0.32 | | | 2 | 2 | 324 | 280 | 232 | 116 |
| T7 | 0.09 | 0.08 | | | 1 | 1 | 81 | 70 | 58 | 51 |
| T8 | 0.9 | 0.8 | | | 5 | 5 | 806 | 718 | 327 | 515 |

**Potential SuDS at Thetford**

4.6.7 The geology and soils underlying the large preferred options sites to the north of the town (T9a and T9b) are believed to be permeable and therefore conducive to the use of infiltration SuDS methods. Due to the large site areas, it is likely that both smaller scale source control methods (e.g. soakaways, infiltration trenches) and larger scale regional control methods (e.g. infiltration basins) could be used. A review of relevant OS mapping (1:40,000 scale) indicates that the nearest significant watercourse to the sites is the Little Ouse. However, in order to connect to this, a small ('B' class road) and potential third party land would have to be crossed. Therefore, infiltration methods should be investigated as the primary method of surface water management. It should be noted at this point that all surface water and foul water drainage from redeveloped sites should be separated.

4.6.8 The geology and soils underlying the preferred options sites in the town centre (T1-8) have the potential to be conducive for infiltration methods. However, the presence of naturally high groundwater and thin clay layers could be a significant constraint. In addition, as these sites are mostly pre-developed brownfield land, there is a potential for the presence of contaminants to be present. Therefore a full ground investigation would be required prior to development of a surface water management strategy. Given the limited area of the sites, it is likely that small-scale source control SuDS methods (e.g. soakaways) would be most appropriate. In the event that infiltration is not possible, source control and attenuation could be provided by green roofs, permeable paving reservoirs and/or water recycling. The proximity of the sites to the Little Ouse River should allow connection to the watercourse as long as the runoff rate is controlled to that of current conditions.

4.6.9 The presence of a SPZ Zone 2 local to all preferred options sites could present some potential constraints to the use of infiltration method, particularly if there are significant contaminants be present within underlying soils. It may be that only clean roof runoff will be acceptable for discharge to ground. Discussions on suitable infiltration SuDS will be needed with the Environment Agency prior to adoption of a surface water management strategy in order to determine the acceptable level and type of infiltration.

4.6.10 Appendix E: SuDS Calculations contains a summary of the model parameters and results from the Microdrainage WinDes attenuation volume calculations for Thetford.

**Option Funding and Responsibility**

4.6.11 The costs for SuDS required at Thetford to meet with the requirements of PPS25, will be borne solely by the developer and the detailed requirements for them should be developed via a site specific FRA. However, it is the responsibility of the LPA (in this case Breckland Council) to ensure a funding mechanism is put in place when granting permission under the Flood and Water Management Act (Reference 15). Options for securing this funding are included in section 10 of this report.

4.6.12 Delivery of SuDS will be the responsibility of the developer; however the 'approving body' under the Flood and Water Management Act must approve the SuDS prior to construction. In most cases, ongoing maintenance of SuDS will also be the responsibility of the approving body under the Flood and Water Management Act as part of wider surface water management responsibilities. The approving body is the unitary authority which for Breckland will be Norfolk County Council.

## 4.7 Infrastructure Phasing

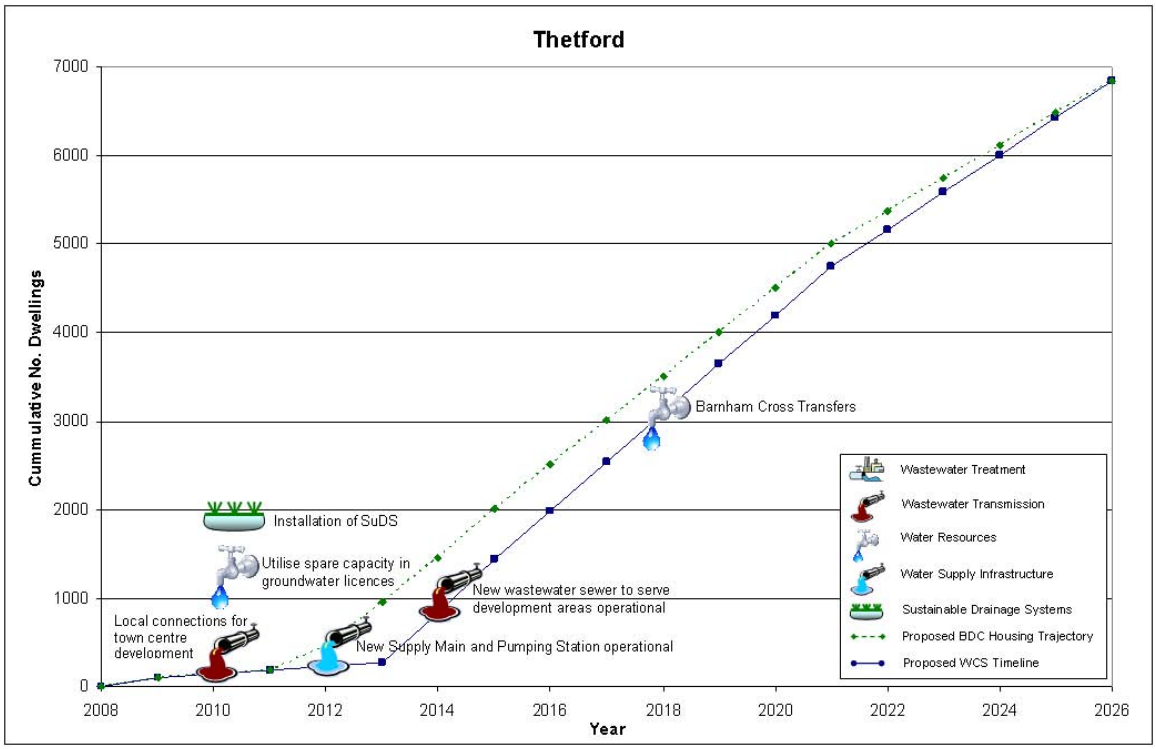
4.7.1 Figure 4-5 provides the infrastructure timeline for Thetford. This is based on the conclusions from the water resources, wastewater treatment and infrastructure and flood risk management assessments. The timeline is based on a number of assumptions as detailed below.

**Assumptions**

- A new supply main and pumping station will be required for supplying water to the greenfield development sites to the north of Thetford. This will require a lead-in time of 3 years, i.e. operational in 2013;
- Until such time as the new water supply pipe is built (2012), development can only occur in the town centre where there are sufficient local connections to the mains supply;
- A new wastewater sewer and associated pumping station will be required for transmitting wastewater from the greenfield sites to Thetford WwTW. This will require a lead-in time of 3.5 years, i.e. operational in 2014;
- Until such time as the new wastewater sewer is built (2014), development can occur in the town centre where there are sufficient local connections to and capacity within the existing sewer network; however, calculations of hydraulic capacity have shown that there is potential for up to 1000 homes to be built in site T9a and connect to existing sewers in the north west of the town. The capacity for this connection would need to be investigated on a case by case basis by developers requesting a pre-development application report from AWS which would involve more detailed hydraulic modelling of capacity;

- Some development can occur in 2013-2014 on the greenfield development areas but these cannot be occupied until the new wastewater sewer is operational;
- There is sufficient capacity within the existing sewer network to accommodate wastewater generated by the proposed growth in the town centre development sites;
- A new water resource scheme, the Barnham Cross Transfers which would bring in treated water from neighbouring water planning zones with surpluses, is planned for 2018 to supply water to development in Thetford. Up to then, spare capacity in the existing groundwater licences will be utilised; and,
- The development sites will require the installation of SuDS prior to the commencement of occupation of development and it is recommended that these are constructed prior to main site construction to provide water quality benefits for sediment reduction during site preparation; however, this is not expected to impact on the development timescales.

**Figure 4-5: Thetford Infrastructure Timeline**



# 5 Attleborough Growth Town Assessment

## 5.1 Introduction

5.1.1 Attleborough is the third largest town in the Breckland District and serves as an administration and service centre, providing a focus for retail and employment.

5.1.2 The Breckland Spatial Strategy[40] identified Attleborough as a major focus for employment and residential growth, targeting it with providing 4,000 new homes and between 1,500 and 2,000 new jobs over the plan period (2008-2026). The majority of this development will be on greenfield land to the south of the town.

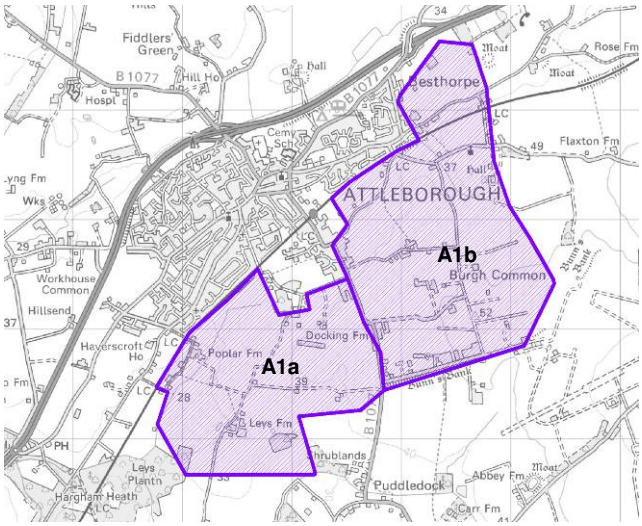
5.1.3 Table 5-1 provides the housing and employment growth figures for Attleborough for the period 2008 - 2026. Figure 5-1 shows the proposed phasing of the planned housing growth.

**Table 5-1 Housing and Employment Growth in Thetford (2008 – 2026)**

| Housing | No. of Dwellings |
|---|---|
| Already Built (as of April 2008) | 461 |
| Currently Permitted (as of April 2008) | 79 |
| New Allocations | 4,000 |
| Total | 4,540 |
| **Housing to be Assessed (= Total – Already Built)** | **4,079** |

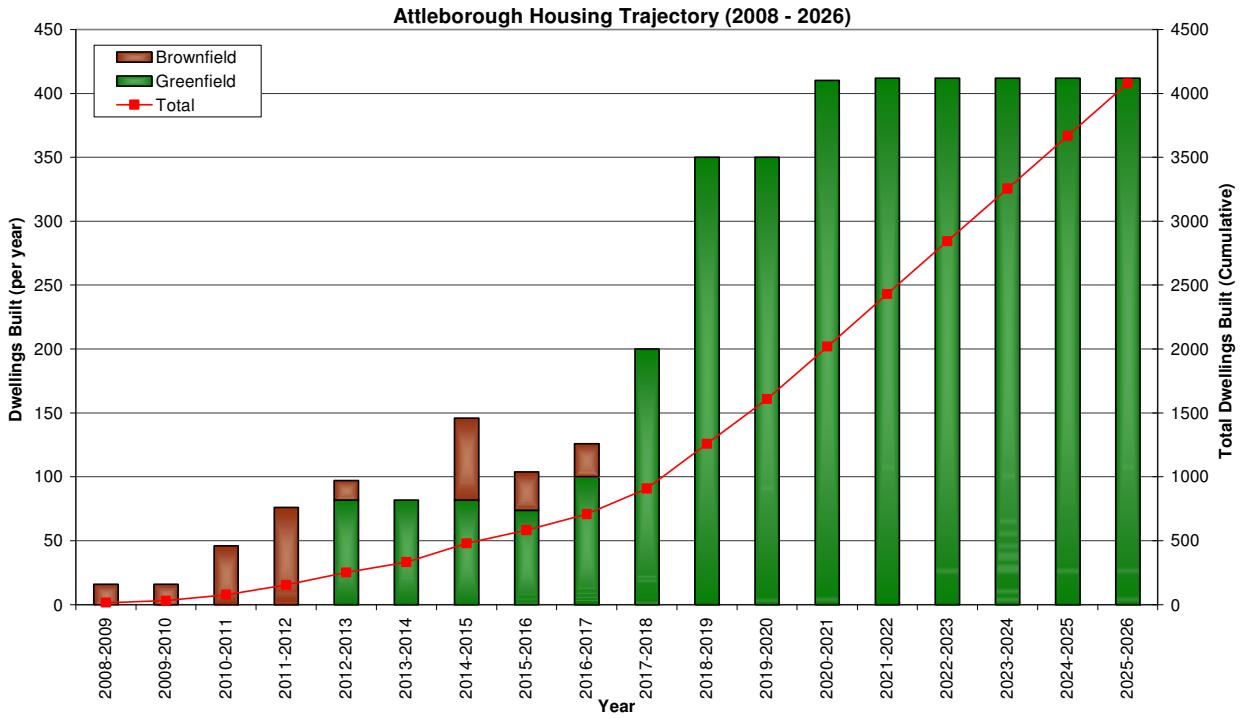
| Employment | Jobs |
|---|---|
| Proposed Jobs | 1500 - 2000 |
| Land Required | 10 hectares |
| **Employment to be Assessed** | **2,000** |

Location of Development[41]




[40] Core Strategy and Development Control Policies DPD – Adopted 2009, Breckland District Council, 2009
[41] Sites shown for Attleborough include potential location of employment and residential

**Figure 5-1 Housing Growth in Attleborough (2008 – 2026)**




## Outline WCS Findings

5.1.4 The Breckland Outline WCS was completed in November 2008 and highlighted the following key issues in terms of the water cycle and infrastructure for Attleborough:

- there is sufficient capacity in existing raw water resources to allow development in the short-term but by 2026 a supply/demand deficit is predicted for the 'planning zone' in which the town of Attleborough lies. A new resource is therefore required for development up to 2026;
- the scale of growth in the town is such that even with highly aspirational 100% metering, large scale retrofitting of water efficiency devices in new homes and attainment of Code for Sustainable Homes level 5 or 6 for new development, there will be an overall net increase in demand as a result of new development;
- Attleborough WwTW has limited capacity in terms of the additional wastewater it can treat up to 2026. The treatment works will require major investment beyond 2013. There will be a requirement to upgrade the process capacity of the works to meet a likely tightening of the BOD, ammonia and Phosphate effluent discharge consents as there is a current and future concern with meeting Dissolved Oxygen standards and Phosphorous standards in the River Thet;
- the existing wastewater network infrastructure within Attleborough can only support less than half the 4,400 new properties and 2,000 jobs proposed growth without exacerbating existing sewer flooding problems. The remaining growth would have to be accommodated with new strategic mains infrastructure; and
- The Breckland Level 1 SFRA highlighted that fluvial flooding and occasional surface water flooding have been reported within the town of Attleborough; however, suitable development

options exist that will avoid flood risk areas or allow mitigation of the flooding sources. Additionally, the physical capacity of the River is sufficient to accommodate the additional wastewater discharge without increasing downstream flood risk.

## 5.2 Water Resources

### Baseline Confirmation

5.2.1 The Breckland Outline WCS reported that there is sufficient capacity in existing raw water resources to allow development in Attleborough the short-term but by 2026 a supply/demand deficit is predicted for the 'planning zone' in which the Attleborough lies which is linked to demand from nearby Wymondham (covered in the Norwich Stage 2 WCS – undertaken by Scott Wilson 2009). Increase in the use of the existing abstraction licence capacity near Attleborough has the potential to impact on three European designated sites (Norfolk Valley Fens SAC, Breckland SAC and Breckland SPA) and 10 water sensitive Sites of Special Scientific Interest. Additionally there is limited spare capacity in the existing groundwater and surface water resources which could limit development of local sources further. A new resource is therefore required for development up to 2026.

5.2.2 The Residential Demand (RD) scenarios as defined in the Water Resources Methodology (Section 3.2) have been modelled for the proposed residential growth in Attleborough (Table 5-8). The results show that the new houses would demand around 1.5 Ml/d if they were built to current specifications and water use (142 l/h/d). The lowest demand estimate from new housing development (Scenario 4 – CSH 5&6 at 80 l/h/d) would demand around 0.75 Ml/d.

**Table 5-2 Residential Demand for Planned Growth in Attleborough[42]**

| Scenario | | Water Use Rate (l/h/d) | Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|
| 1a | Water Company Forecast (Current) | 142 | 1.33 | 1.47 |
| 1b | Water Company Forecast (2035) | 130 | 1.11 | 1.22 |
| 2 | Code for Sustainable Homes 1&2 | 120 | 1.03 | 1.13 |
| 3 | Code for Sustainable Homes 3&4 | 105 | 0.90 | 0.99 |
| 4 | Code for Sustainable Homes 5&6 | 80 | 0.69 | 0.75 |

5.2.3 The Non-Residential Demand (NRD) has been calculated for the proposed employment growth in Attleborough, based on a percentage of the residential demand (see Water Resources Methodology Section 3.2). Taking the minimum RD (Scenario 4) and the maximum RD (Scenario 1a) for planned growth in Attleborough (Table 5-2), the NRD has been estimated for the water demand scenarios (Table 5-3). This shows that water demand from employment growth could range from between around 0.1 Ml/d to 0.2 Ml/d (with an allowance for headroom) depending on the final land allocation for employment sites, and the job type created.

[42] Lowest demand in green, highest demand in red

**Table 5-3 Non-Residential Demand for Planned Growth in Attleborough[31]**

| RD Scenario | NRD Scenario | | Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|
| 1a | 5 | Lowest Estimate of Non-Residential Land Allocation | 0.09 | 0.10 |
| | 6 | Highest Estimate of Non-Residential Land Allocation | 0.17 | 0.19 |
| 4 | 5 | Lowest Estimate of Non-Residential Land Allocation | 0.05 | 0.06 |
| | 6 | Highest Estimate of Maximum Non-Residential Land Allocation | 0.09 | 0.10 |

5.2.4 The total water demand from new development in Attleborough will therefore range from around 0.8 Ml/d to 1.7 Ml/d (Table 5-4), but the lower estimate would be dependent on new houses being built to a CSH 5&6 level, with a water demand of 80 l/h/d and the lowest estimate of non-residential demand. In reality, the water demand exerted from the new development in Attleborough is likely to be towards the higher end of the range, unless policy is included to stipulate that all new residential development needs to meet a CSH level requirement. Recommended policy is included in section 11.

**Table 5-4 Highest and Lowest Total Demand Estimates for Planned Growth in Attleborough**

| RD Scenario | | NRD Scenario | | Total Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|---|
| 4 | Code for Sustainable Homes 5&6 | 5a | Lowest Estimate of Minimum Non-Residential Land Allocation | 0.74 | 0.81 |
| 1a | Water Company Forecast (Current) | 6b | Highest Estimate of Maximum Non-Residential Land Allocation | 1.50 | 1.65 |

5.2.5 The assessment presented here is in terms of the additional water demand generated by the new development, under a range of water demand scenarios. However, the changing behaviour of the existing population, and retrofitting of water saving devices into existing properties has the potential to lower the total future water demand for Attleborough, and should be considered as part of any future water demand assessment. This is discussed in more detail in the Water Efficiency section below.

## Solution Refinement

5.2.6 In AWS's final WRMP, the settlements of Wymondham and Attlebrough are considered together in Planning Zone (PZ) 42. Because of the sizable growth in both of these towns, the forecasts of supply/demand balance show deficits under average and peak conditions of 5.8 and 2 Ml/d respectively by 2036/37. However, it is considered that the growth in Attleborough by the end of the plan period (2025/26) should be adequately served by the schemes set out in the WRMP .

5.2.7 It has been assumed that no spare groundwater licence capacity is available within Attleborough to meet forecast growth, at least under the high water demand scenario (RD 1a)..

5.2.8 Under the high demand scenario, the extra Deployable Output[43] available to meet the extra demands in Attleborough/Wymondham will come from additional groundwater resource development to take place within Breckland. Amongst the options mentioned in the AWS's final WRMP is the use of satellite boreholes at High Oak to supply the existing Wicklewood source works. The selection of this source in the final WRMP is based on the aim of locating boreholes up to 5 km away from the source works, in order to reduce impacts on either the River Yare or Little Ouse (the later possibly involving use of the GOGS licence currently designed for river augmentation purposes). The available spare resources from High Oak and existing groundwater licences (under low water demand conditions elsewhere in Breckland) are shown in Table 5-5. It is has been assumed that there is no loss of Deployable Output from any existing sources within Attleborough as a consequence of the Environment Agency's Review of Consent Process.

**Table 5-5 Available Spare Water Resources to supply Attleborough**

| Resource Options | Average Deployable Output (Ml/d) |
|---|---|
| Maximise Spare Groundwater Licence | 0.6 (available under low growth scenario only) |
| New Groundwater Resource Development | 3.8 (High Oak B/hs) |

## Preferred Solution

5.2.9 The phasing of water resource developments within Attleborough will depend on future water use rates. These could range between 1.65 Ml/d (Scenario 1a - high water demand) and 0.8 Ml/d (Scenario 4 - low water demand). Table 5-6 shows the phasing of water resource developments in Attleborough based on the high and low water demand scenarios.

**Table 5-6 Phasing of Water Resource Developments in Attleborough (excluding impacts of Climate Change)**

| Source | High Water Demand (RD Scenario 1a) | Low Water Demand (RD Scenario 4) |
|---|---|---|
| Maximise Spare Groundwater Licence | Not available | Incrementally from 2009 |
| New Groundwater Resource Development | AMP5 (2015) | AMP6 (2018) |

5.2.10 Under the high water demand scenario (1a), a new groundwater resource development is required immediately in order to overcome deficits which will arise under average conditions in Attlebrough/Wymondham. In AWS's final WRMP, it is proposed to address this deficit, at least initially by an active water efficiency campaign to overcome shortfalls in the early part of AMP5 (2010-14). After this date (around 2015), the need for the groundwater scheme is required.

5.2.11 Under the low water demand scenario, the growth will be met initially from spare licence capacity and then from a new groundwater resource development which would be required in AMP6, around 2018.

**Option Funding and Responsibility**

5.2.12 The costs for the water resource schemes required at Attleborough will be borne solely by AWS via the Price review and AMP process. Developers cannot contribute to these water resource solutions as they are not required specifically for the new development.

[43] Deployable Output is the water which is available for supply during dry years

5.2.13 Delivery and maintenance of the solutions will be the responsibility of AWS under the regulation of Ofwat, the Environment Agency and the Drinking Water Inspectorate (DWI).

5.2.14 Delivering water efficiency in new homes will be the responsibility of the developer and the cost (of construction and maintenance) will be borne solely by the developer.

5.2.15 Some water efficiency and water saving methods are proposed for *existing* development by AWS as part of their twin-track approach to managing water resources in the region. These elements (such as meter penetration, and provision of water butts for existing homes) are funded solely by AWS as part of the Price review and AMP process, and also from AWS own investment. Water meters are provided for new properties by AWS as standard practice.

### Climate Change Impacts

5.2.16 The effects of climate change (CC) on water resources supplying Attleborough are presented in Table 5-7.

**Table 5-7 Effects of Climate Change on Available Water Resources to Attleborough**

| Resource Options | CC effects | Comment |
|---|---|---|
| Existing and New Groundwater Licences | Negligible | A reduction of 0.22 Ml/d by 2035 for all groundwater sources within Breckland. |

5.2.17 In general, the heavy reliance on groundwater within Breckland and the resilience of its storage to changes in groundwater levels will mean that the impacts of CC are relatively minor and will advance the requirement of schemes by approximately one year under both scenarios (see Table 5-6)..

5.2.18 AWS's final WRMP includes a commitment to investigate further the affects of the UKCP09 scenarios in the lead-up to the next periodic review process in 2015.

### Ecological Issues

5.2.19 Initially Attleborough will be reliant on spare groundwater sources (within their existing licence capacity) in order to supply the extra demand growth. Since the necessary water resources are within the limits of the existing licences their impact upon European sites will have already been considered through the Environment Agency's Review of Consents process. As such there is no need for further consideration in this Water Cycle Study.

5.2.20 The use of additional water from High Oak boreholes is currently supported by the Environment Agency through the approval of AWS's WRMP and hence it is considered that the abstractions required to support the transfer are unlikely to impact on designated (or other ecological sites). The selection of this source in the final WRMP is based on the aim of locating boreholes up to 5 km away from the source works, in order to reduce impacts on either the River Yare or Little Ouse.

## 5.3 Water Supply Infrastructure

5.3.1 The water supply network has been supplied by AWS for analysis in this Phase 2 WCS. A strategic main passes through both development areas in Attleborough and both would be sufficient to feed the new development areas. However, the developers would be responsible for extensive local connections would then be required on a house by house basis.

5.3.2 Costs for dwelling connections for water supply are usual costs borne by the developer for any new housing developer and as such are not considered specifically in this WCS.

## 5.4 Wastewater Treatment

### Baseline Confirmation

5.4.1 The Breckland Outline WCS reported that Attleborough Wastewater Treatment Works (WwTW) has limited capacity in terms of the additional wastewater it can treat up to 2026, and the treatment works was likely to require major investment beyond 2013. It also reported that whilst it was likely to be feasible to treat the additional flow to the required standards under existing legislation, there was potential for there to be downstream Dissolved Oxygen (DO) impacts in the River Thet. The assessment against draft water quality standards proposed to meet the future requirements of the Water Framework Directive (WFD) suggested that there was potential for future failure of the Ammonia, DO and Phosphate standards without tightening of the existing effluent quality consents at the WwTW.

**Wastewater Treatment Volumetric (Consent) Capacity**

5.4.2 The current consented Dry Weather Flow (DWF), and therefore volumetric consent capacity, for Attleborough WwTW is 2,500 $m^3$/d. However, a new proposed consent of 3,331 $m^3$/d, as agreed by the Environment Agency and AWS, is expected to be in force in early 2010 and therefore for the purposes of this WwTW assessment, the new consent has been used.

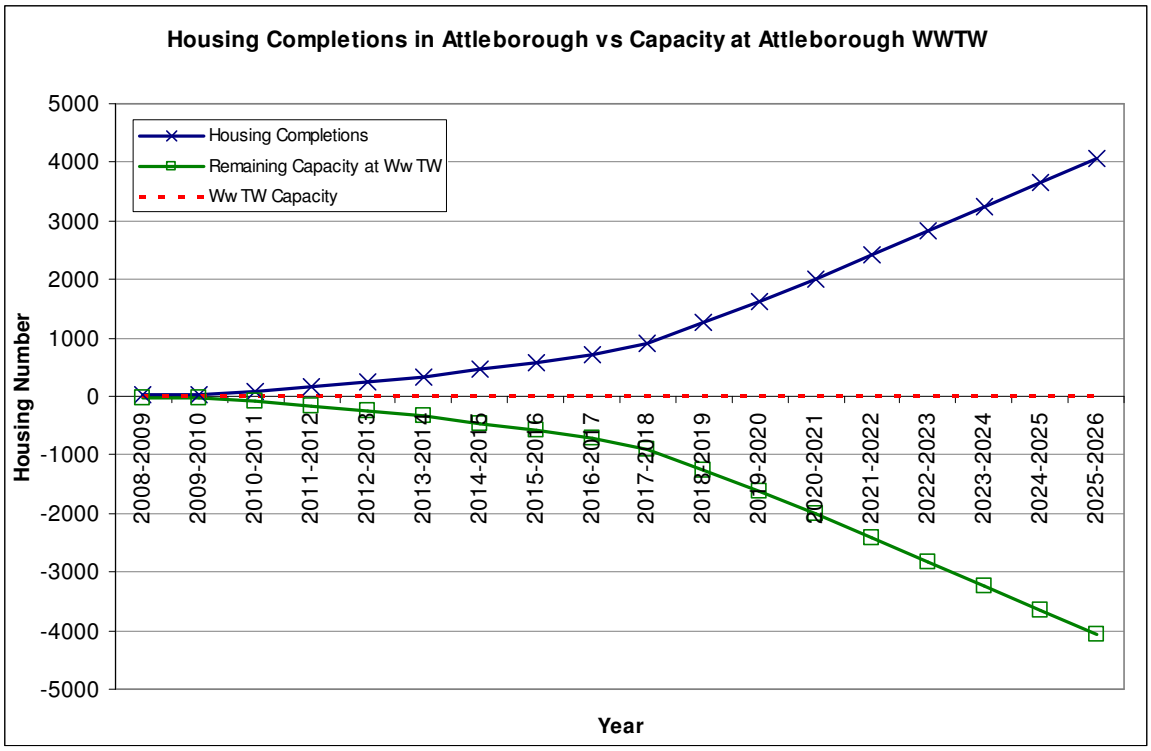
5.4.3 The measured flow for the WwTW, as provided by AWS, is 2,273 $m^3$/d. However, under the new consent it is assumed that the flow being treated at the works is equal to the new consent and therefore there is no further capacity for further growth without the requirement to apply for a new flow consent to treat and discharge that DWF. As such, this assessment assumes that there is no volumetric consent capacity to accommodate flow from further wastewater.

5.4.4 Attleborough is expected to provide 4,079 homes and 2,000 ‘commercial’ jobs by 2026, equating to an increase in the current Population Equivalent (PE) and flow of 9,790 and 1,848 $m^3$/d respectively. AWS will need to apply for a new DWF (and associated quality) consent to treat this additional flow before any additional flow generated from new development can be treated and discharged from the works.

5.4.5 In discussions with the Environment Agency they have stated that as long as there is sufficient evidence to show that there are no 'physical watercourse capacity issues with the additional discharge, then they are likely to accept a variation to the discharge consent to allow more flow to be treated from the works (if AWS confirm they have the treatment capacity to do so). The Breckland Outline WCS report demonstrates no flood risk concerns with additional discharge up to the growth figures being assessed.

5.4.6 Figure 5-2 shows the phased housing development and corresponding volumetric consent capacity at the works during the period 2008 – 2026. Details of the volumetric consent capacity are included in Appendix H: WwTW Capacity Calculations.

**Figure 5-2 Proposed Housing Development in Attleborough and Capacity at Attleborough WwTW (2008 - 2026)**




### Wastewater Treatment Quality (Consent) Capacity

5.4.7 Attleborough WwTW discharges into the River Thet, which is classified as a cyprinid fishery. The Environment Agency monitoring observations for the period 2004 – 2008 show that, under current conditions, the River Thet will achieve all WFD 'good ecological status' proposed standards upstream of Attleborough WwTW, with Biological Oxygen Demand (BOD), Ammonia and DO being classed as 'high ecological status'. Downstream of the works, the BOD standard for 'high ecological status' will be achieved and there will be marginal compliance of the 'good ecological status' for Ammonia and Dissolved Oxygen (DO); the Orthophosphate (P) standard will not be achieved which could in part be attributable to the effluent discharge upstream.

5.4.8 The assessment of the Environment Agency monitoring results for the River Thet upstream and downstream of Attleborough WwTW against the proposed WFD standards are provided in Table 5-8. The WFD status and classification information provided in Table 5-8 is summarised from the Anglian RBMP. It should be noted that the classifications for waterbody parameters included in the plan differ slightly to the analysis of the monitoring data itself. The WFD classification for Biochemical Oxygen Demand (BOD) is based on the monitoring information provided by the Environment Agency against proposed WFD standards, as BOD is not specifically reported within the Anglian RBMP.

### Table 5-8 WFD Assessment of Environment Agency Monitoring Results Upstream and Downstream of Attleborough WwTW

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sampling Point Code** | | 44M01 | | | | | 44M02 | | | | |
| **Name** | | River Thet (Upstream of Attleborough WwTW) | | | | | River Thet (Downstream of Attleborough WwTW) | | | | |
| **Stretch** | | B1077 Road Bridge Attleborough - Attleborough WwTW | | | | | Attleborough WwTW - Portwood Brook | | | | |
| **Easting** | | 603700 | | | | | 602400 | | | | |
| **Northing** | | 295500 | | | | | 294800 | | | | |
| **Water Quality Monitoring Data Assessment (against WFD Standards)** | **Year** | 2004-2008 | | | | | 2004-2008 | | | | |
| | Data | Average (mg/l) | Count | Std Dev (mg/l | 90/10%ile/ Average (mg/l) [WFD Target] | WFD Status | Average (mg/l) | Count | Std Dev (mg/l | 90/10%ile/ Average (mg/l) [WFD Target] | WFD Status |
| | BOD | 1.27 | 60 | 0.54 | 1.99 | | 1.36 | 65 | 0.55 | 2.14 | |
| | Ammonia | 0.08 | 60 | 0.09 | 0.15 | | 0.25 | 65 | 0.28 | 0.60 | |
| | DO as % Sat | 95.31 | 60 | 20.91 | 73.91 | | 80.57 | 65 | 15.81 | 62.06 | |
| | Orthophosphate | 0.06 | 60 | 0.03 | 0.06 | | 0.44 | 59 | 0.52 | 0.44 | |
| **WFD Classification** | Water Body ID | GB105033047830 | | | | | GB105033047830 | | | | |
| | Hydromorphological Status | Not Designated | | | | | Not Designated | | | | |
| | Current Overall Status | Moderate | | | | | Moderate | | | | |
| | Current Ecological Status | Moderate | | | | | Moderate | | | | |
| | Current Chemical Status | N/A | | | | | N/A | | | | |
| | Overall Status Objective | Good Ecological Status by 2027 | | | | | Good Ecological Status by 2027 | | | | |

| Key | | |
|---|---|---|
| **WFD Target** | | **WFD Classification Status** |
| Pass WFD 'Good' Target | | High Status |
| Marginal Pass (Within 10%) | | Good Status |
| Fail WFD 'Good' Target | | Moderate Status |
| | | Poor Status |
| | | Bad Status |
| | | N/A – Does Not Require Assessment |

5.4.9 Indicative consent standards have been calculated for Attleborough WwTW based on the proposed growth by Breckland District Council within Attleborough; this will result in Attleborough WwTW treating 5,179 $m^3$/d of wastewater by 2026. The consents have been calculated for the modelling scenarios defined in Section 3.3. Table 5-9 shows the consents required for the different scenarios modelled. This assumes that the river is either achieving 'good ecological status' or 'high ecological status' upstream of the discharge based on the methodology discussed in Section 3.3.

### Table 5-9: Attleborough WwTW Calculated Quality Consent Requirements

| | | BOD | | | | Ammonia | | | | P | | | | Planning Considerations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2010 | 2015 | 2020 | 2026 | 2010 | 2015 | 2020 | 2026 | 2010 | 2015 | 2020 | 2026 | |
| Current Consent | | 10 | | | | 3 | | | | 1 | | | | |
| Scenario A: Planned Deterioration | A1 | 7 | 7 | 6.5 | 6 | 1.1 | 1.1 | 1.1 | 1 | 1 | 1 | 1 | 1 | × (P) |
| | A3 | 7 | 7 | 6.5 | 6 | 1.1 | 1.1 | 1.1 | 1 | 0.2 | 0.1 | 0.1 | 0.1 | ✓ |
| Scenario B: Compliance with WFD | B1 | 7 | 7 | 6.5 | 6 | 1.1 | 1.1 | 1.1 | 1 | 1 | 1 | 1 | 1 | × (P) |
| | B3 | 7 | 7 | 6.5 | 6 | 1.1 | 1.1 | 1.1 | 1 | 0.2 | 0.1 | 0.1 | 0.1 | ✓ |
| Scenario C: Compliance with WFD (excl. P) | C1 | 7 | 7 | 6.5 | 6 | 1.1 | 1.1 | 1.1 | 1 | - | - | - | - | ✓ |
| Scenario D: WFD Deterioration | D1 | 9 | 9 | 8.5 | 8 | 1.1 | 1.1 | 1.1 | 1 | 1 | 1 | 1 | 1 | × (P) |
| | D2 | 9 | 9 | 8.5 | 8 | 1.1 | 1.1 | 1.1 | 1 | 0.2 | 0.1 | 0.1 | 0.1 | ✓ |
| Scenario E: Load Standstill (compliance with HD) | E1 | 10 | 10 | 10 | 6 | 3 | 3 | 3 | 2.5 | 1 | 1 | 1 | 1 | ✓ |
| | E2 | 10 | 10 | 10 | 6 | 3 | 3 | 3 | 2.5 | 1 | 1 | 1 | 1 | ✓ |
| **Recommended Consents** | | **6** | | | | **1** | | | | **1** | | | | |

| **Key** | No consent tightening required | Consent tightening within BATNEEC | Consent limited to BATNEEC | Consent beyond BATNEEC required |
|---|---|---|---|---|

### Table 5-10: Current WFD Status & Quality Consent for Attleborough WwTW

| Determinand | Current WFD Status | | D/S WFD Standard (Required) | Current Quality Consent (mg/l) | Planned Change to Quality Consent (mg/l) |
|---|---|---|---|---|---|
| | U/S | D/S | | | |
| BOD | H | H | High - 4 mg/l (90%ile) | 13 | 10 (from 2015) |
| Ammonia | G | G | Good - 0.6 mg/l (90%ile) | 4 | 3 (from 2015) |
| Orthophosphate | G | G | Good - 0.12 mg/l (Mean) | 2 | 1 (from 2013) |

## Wastewater Treatment Preferred Solution

### Option Identification

5.4.10 Attleborough WwTW is a filter based system that works to a current consent of 13mg/l BOD and 4mg/l of Ammonia on a 95%ile basis. As a result of an increase in the flow consent, these consents are to be lowered to 10mg/l BOD and 3mg/l Ammonia by 2015 to ensure no deterioration in current river water quality.

5.4.11 This assessment has shown that Attleborough WwTW is currently performing well and with respect to BOD, the treatment capacity at the works would not require a significant upgrade to reach the required consent of 6mg/l BOD. However, the current processes available at the works would not be able to treat the current volume of wastewater to the required Ammoniacal-N standard.

5.4.12 To treat to an Ammoniacal-N 95%ile consent of 1mg/l would require a significant increase in the nitrification capability of the current works, and with the additional flow, would most likely require the addition of a further process stream to treat more flow to a tighter Ammoniacal-N consent. A series of options have therefore been discussed with the Breckland Wastewater Working Group (comprising of AWS, the Environment Agency and Breckland District Council) for feasibility, and AWS have agreed that, from a technical point of view, it would be possible to treat the future wastewater flows generated at Attleborough to the required standard (95%ile 7mg/l BOD and 1mg/l of Ammoniacal-N) through development of one of the options described in Table 5-11. Locations of the discharge options included in Table 5-11 are included in Figure 5-3.

## Table 5-11: Options Identified as part of Breckland Detailed WCS to Treat Wastewater Generated by Planned Growth in Attleborough

| Option | Description | Discharge Point | Receiving Watercourse | Considerations |
|---|---|---|---|---|
| 1 | All effluent (current population and growth) treated at Attleborough WwTW and discharged at existing discharge point | TM02949506 | Tributary of River Thet | • Would require the addition of tertiary treatment to the existing works to achieve the Ammoniacal–N and P consent;<br>• Requires the addition of a further process stream to treat the additional volumes of flow to the higher standard for Ammoniacal-N and BOD;<br>• Likely that a consent condition of less than 1mg/l of P (less than BATNEEC) would be required to protect against further downstream failure of the Orthophosphate WFD target;<br>• AWS have confirmed that the option is technically feasible, as land around the works is likely to be available for expansion; however, it is unlikely to be the preferred option as it would be difficult to undertake the upgrades whilst maintaining standards for the ongoing treatment of wastewater from the existing population.<br>• This option would require consent (for the volumetric element of the discharge) of the Heast Harling IDB (EHIDB)[44] where the discharge is to IDB maintained watercourses. The IDB will require annual payments, or commuted sum payments for increased discharges |
| 2 | All effluent treated at Attleborough WwTW but discharged at new discharge point on the River Thet downstream of Buckenham Stream | TM00409355 | River Thet (d/s of Buckenham Stream) | • Effluent treated at Attleborough WwTW would be discharged further downstream (in the River Thet) to allow greater dilution and reduce tightening of current consents.<br>• Requirement to transfer treated effluent to new discharge point.<br>• Provides the greatest opportunity for modular phasing of extensions but would be more expensive for a network solution, which would probably end up being a direct pumped connection to the WwTW, so as to minimise the impact of development on the existing infrastructure and associated Combined Sewer Overflows (CSOs). This will be dependent on the availability of a suitable off site discharge pipeline route. |
| 3 | All effluent from new development treated at Old Buckenham WwTW and discharged to Buckenham Stream | TM06129045 | Buckenham Stream | • Reopening/commissioning of existing WwTW at Old Buckenham.<br>• All effluent from new development would be transferred to the WwTW for treatment and discharge into Buckenham Stream.<br>• Discharge located upstream of Swangey Fen SSSI |
| 4 | All effluent from new development treated at new WwTW and discharged to tributary of the Buckenham Stream to the south of the proposed development areas. | TM03759280 | Stream | • New WwTW to be built with Best Available Technology, to accommodate the wastewater generated from development beyond 2015.<br>• New WwTW could achieve tighter standards without the need to modify the existing works and for a potentially lower cost.<br>• There would be a significant lead-in time to build and commission a new WwTW.<br>• The practicality of designing and operating a plant which starts with a small |

[44] EHIDB are responsible for the Buckenham Stream, and the River Thet from Attleborough to Swangey Lakes

| Option | | Description | Discharge Point | Receiving Watercourse | Considerations |
|---|---|---|---|---|---|
| | | | | | number of homes and then grows to accommodate 4,000 plus properties may require further investigation.<br>• Separate discharge consent for new WwTW whilst Attleborough WwTW would continue to operate under its current consent.<br>• The discharge point for the new works could be located further downstream at a point where available flow for dilution would be higher and hence consent standards would likely be less stringent and therefore require less intensive treatment. |
| 5 | A | All effluent from growth treated at new WwTW and discharged to the River Thet downstream of Buckenham Stream –<br><br>current population uses existing Attleborough WwTW and consents to remain as those planned under AMP5 schemes. | TM00409355 | River Thet<br>(d/s of Buckenham Stream – as option 2) | • New WwTW to be built with Best Available Technology, to accommodate the wastewater generated from development beyond 2015.<br>• New WwTW could achieve tighter standards without the need to modify the existing works and for a potentially lower cost.<br>• There would be a significant lead-in time to build and commission a new WwTW.<br>• The practicality of designing and operating a plant which starts with a small number of homes and then grows to accommodate 4,000 plus properties may require further investigation.<br>• Separate discharge consent for new WwTW whilst Attleborough WwTW would continue to operate under its current consent.<br>• The discharge point for the new works could be located further downstream at a point where available flow for dilution would be higher and hence consent standards would likely be less stringent and therefore require less intensive treatment. |
| | B | All effluent from new development treated at new WwTW and discharged point to the River Thet downstream of Buckenham Stream –<br><br>Current population uses existing *Attleborough WwTW but* Ammoniacal-N consent of 2mg/l to be applied. | | | • New WwTW to be built with Best Available Technology, to accommodate the wastewater generated from development beyond 2015.<br>• New WwTW could achieve tighter standards without the need to modify the existing works and for a potentially lower cost.<br>• There would be a significant lead-in time to build and commission a new WwTW.<br>• The practicality of designing and operating a plant which starts with a small number of homes and then grows to accommodate 4,000 plus properties may require further investigation.<br>• Separate discharge consent for new WwTW whilst Attleborough WwTW would continue to operate under its current consent for BOD, but would operate under a 2mg/l Ammoniacal-N consent (95%ile) allowing less stringent P consent at new WwTW<br>• The discharge point for the new works could be located further downstream at a point where available flow for dilution would be higher and hence consent standards would likely be less stringent and therefore require less intensive treatment. |

### Option Selection

5.4.13 The options described within Table 5-11 have been assessed by both AWS and the Environment Agency to calculate the likely volumes of wastewater to be treated at both Attleborough WwTW and/or a new WwTW under the differing scenarios, and these volumes have then been used by the Environment Agency to determine the likely sanitary and phosphate consents to be applied at each of the works dependent on the proposed discharge points.

5.4.14 In terms of the WFD standards, phosphates remain challenging throughout the UK and especially the East of England, and although WCS work must attempt to achieve P standards for WFD, not achieving WFD P targets will not necessarily be a deciding factor in whether the growth will be achievable. In most cases, WCSs are not able to answer the question of whether WFD P targets for rivers are more important than achieving growth and decisions with respect to P will need to be made at a higher level (involving Defra, Environment Agency policy advisors, and regional and national government). As such, the WCS informs the decision and presents the facts as to the best solution achievable.

5.4.15 Ammonia standards are the key concern and WFD targets must be met given the toxicity impact of Ammonia on aquatic ecology and additional impacts on in-stream dissolved oxygen..

5.4.16 The results from the Environment Agency consent assessment are provided in Table 5-12 and illustrated in Figure 5-3, Figure 5-4 and Figure 5-5. The proposed wastewater flow consents are based on AWS calculations which include an allowance of 18 l/h/d for non-household flows such as schools, pubs and offices, and a safety factor of 20%. They also assume that all 4,000 proposed dwellings are built by 2021. Additionally, differing consumption rates have been used for sites based on whether they are transferred to the existing WwTW (in which case an average of metered and unmetered consumption rates for the Anglian region have been used – 143 l/h/d) or a new WwTW (which assumes homes will be built to a higher water efficiency level – 134 l/h/d). The calculations used to estimate the flows are provided in Appendix G: Anglian Water Calculations of Future Attleborough WwTW .

5.4.17 Only options 1, 2 and 5 have been considered as part of the Environment Agency consent assessment, with options 3 and 4 being considered unfeasible by both the working group, based on the fact that the proposed discharge locations for these two options would only result in a 0.3 dilution ratio and not offer a significant benefit over the existing discharge location.

5.4.18 Both Option 2 and Option 5 give workable solutions in terms of meeting BOD and Ammonia WFD conditions, but only Option 2 can give potential compliance for P also.

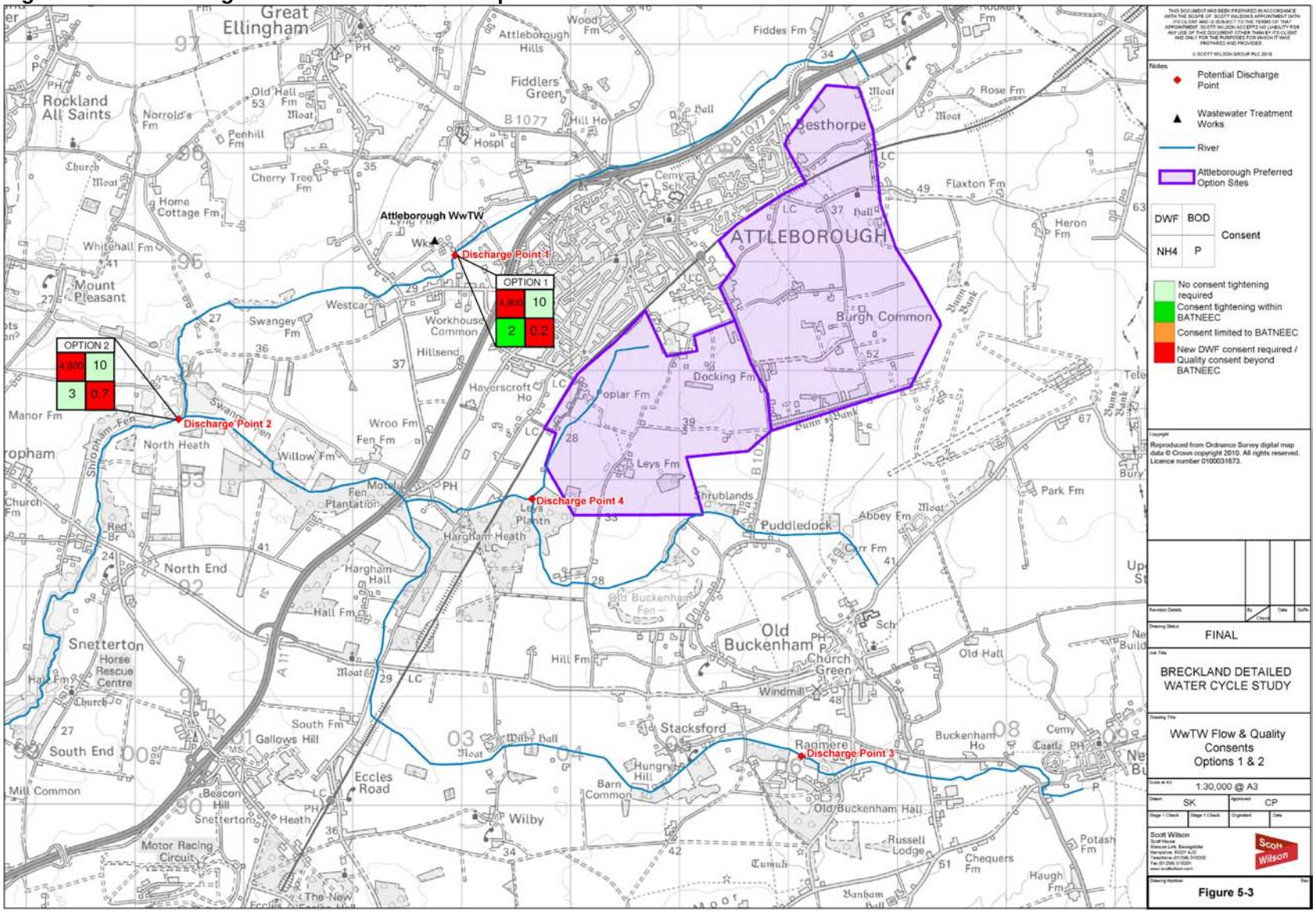
## Table 5-12: Attleborough Wastewater Treatment Options Assessment – Required Consents

| Current Consent | | WwTW | DWF ($m^3/d$) | BOD (mg/l) | NH4 (mg/l) | P (mg/l) | Comments |
|---|---|---|---|---|---|---|---|
| Current Consent | | Attleborough | 3,331 | 10 | 3 | 1 | |
| Option 1 | | Attleborough | 4,800 | 12 | 2 | 0.2 | • River Flows used are higher than those used in WCS modelling so offer greater dilution |
| Option 2 | | Attleborough | 4,800 | 20 | 3 | 0.7 | |
| | | Attleborough | 4,800 | 20 | 4 | 0.7 | • Allows for WFD class deterioration from High to Good for Ammonia |
| Option 5 | | Attleborough | 3,331 | 10 | 3 | 1 | |
| | A | New | 1,800 | 50 | 0.8 | 0.8 | • Ammonia limit is tighter than BAT as the AMP5 flow limit for Attleborough WwTW is set to maintain the current load and therefore the river downstream if not predicted to achieve WFD Good Status. Any river "headroom" is solely due to natural purification over the three kilometres between the existing and proposed new discharge.<br>• Phosphate limit is tighter than BAT but in combination with the existing Attleborough WwTW consent, the river may still achieve the WFD Good target. |
| | B | Attleborough | 3,331 | 10 | 2 | 1 | • By tightening the Ammonia consent limit at the existing WwTW to 2mg/l, the river will achieve WFD Good status and the Ammonia limit required for the new discharge is much less stringent. |
| | | New | 1,800 | 50 | 6.5 | 0.8 | |

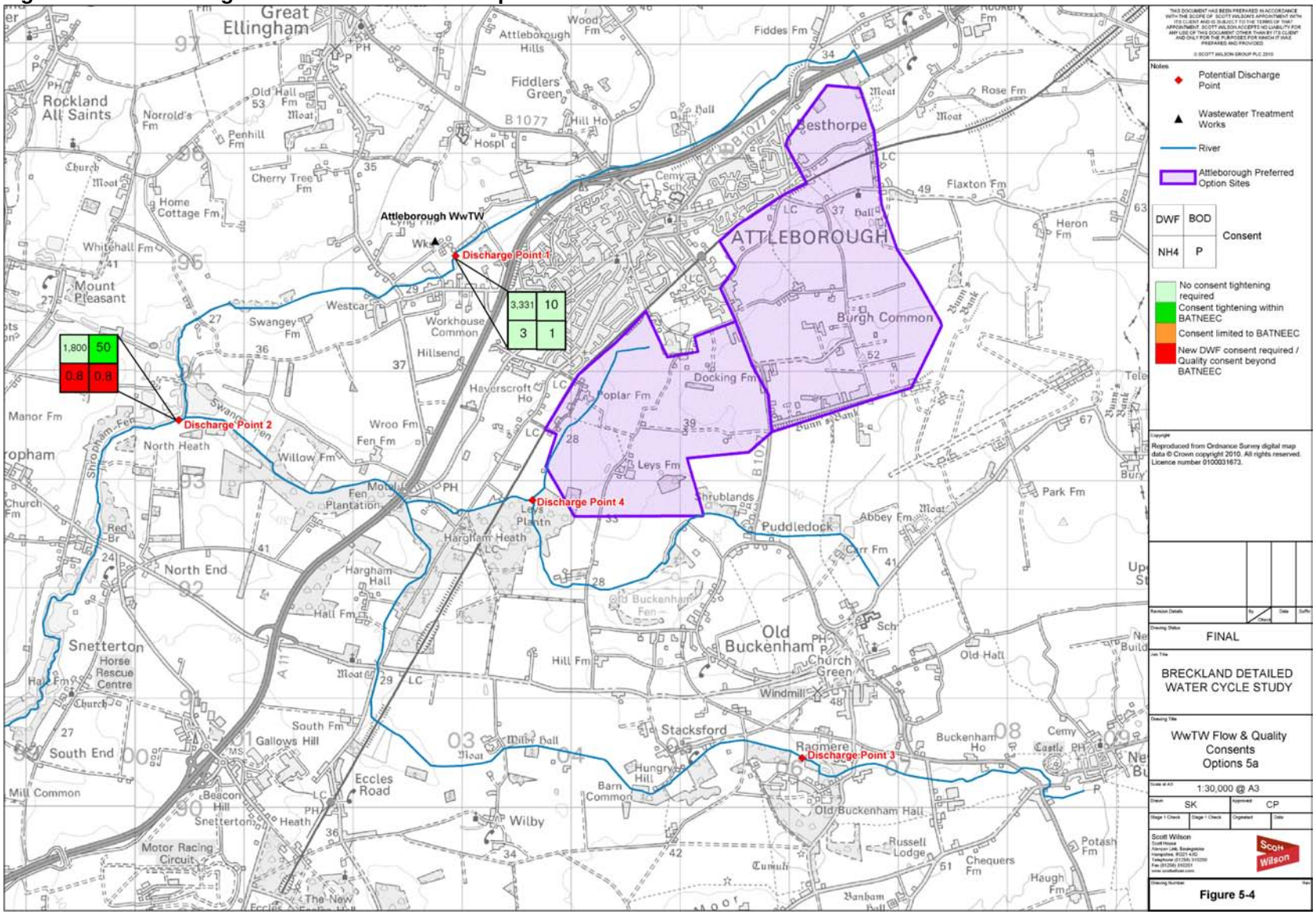
**Key**

| No consent tightening required | Consent tightening within BATNEEC | Consent limited to BATNEEC | Consent beyond BATNEEC required |
|---|---|---|---|

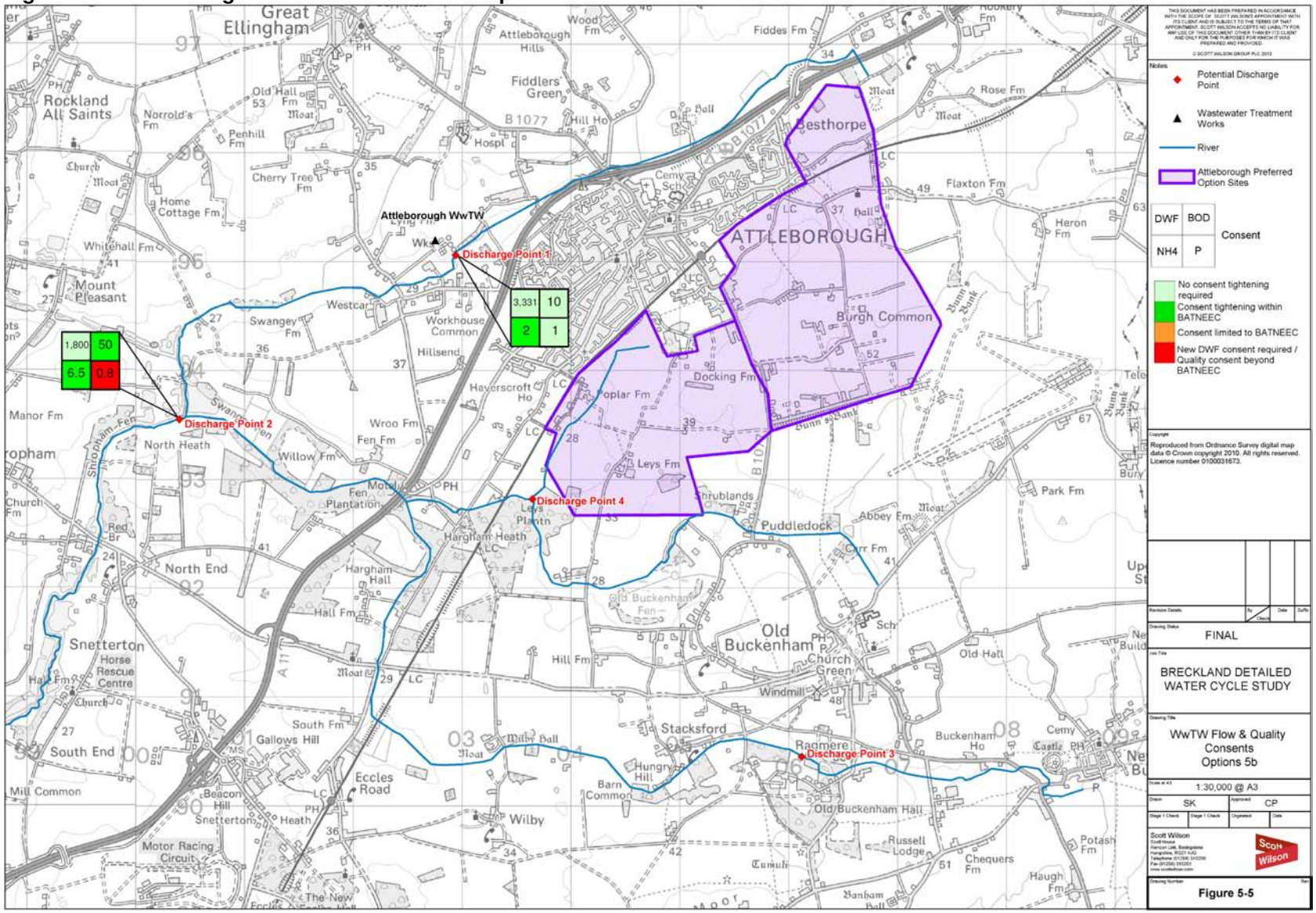
## Figure 5-3: Attleborough Wastewater Treatment Options 1 & 2



## Figure 5-4: Attleborough Wastewater Treatment Option 5a



## Figure 5-5: Attleborough Wastewater Treatment Option 5b



## Preferred Option

5.4.19 The Wastewater working group has determined that the preferred option for a wastewater treatment solution at Attleborough is option 2: all effluent from new development treated at Attleborough WwTW but discharged at new discharge point on the River Thet downstream of Buckenham Stream. This would give the greatest flexibility in terms of modular extensions to the existing WwTW, thereby minimising impact on treatment of wastewater from the existing population. A new Activated Sludge (AS) treatment stream would be required at the WwTW in order to meet the consent standards for the new discharge point.

5.4.20 The quality consent to be applied to the new discharge point would be 20mg/l BOD, 3 mg/l Ammoniacal-N and 1 mg/l of P (95 percentile, 95 percentile, and mean respectively). RQP modelling has indicated a figure of 0.7mg/l P (mean) as being required; however, through the wastewater working group, the Environment Agency have agreed that a 1mg/l P (mean) consent in combination with the new AMP5 P limit at Thetford WwTW is likely to allow the River Thet to achieve its target status of 'Good' downstream.

5.4.21 Therefore, the preferred solution is achievable within BATNEEC.

### Transfer Pipeline

5.4.22 In order to facilitate the option, a transfer pipeline is required from Attleborough WwTW to the proposed discharge location point (See Figure 5-3). A potential route has been identified for this transfer pipeline (see Figure 5-6). This avoids any river crossings and the Swangey Fen SSSI. However, the preferred route will be subject to a detailed environmental screening study and would need to be confirmed at planning stage by AWS.

### Option Funding and Responsibility

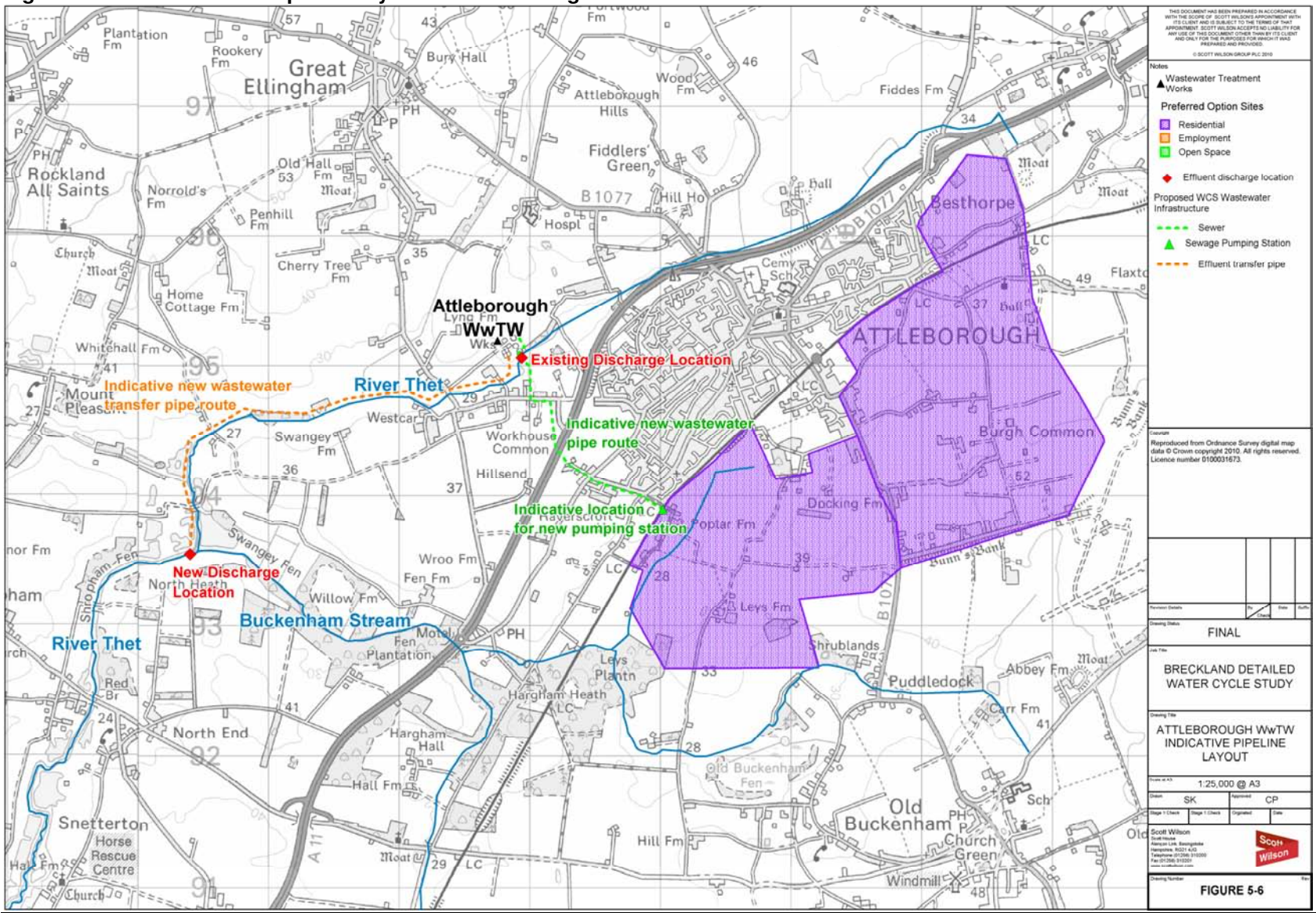
5.4.23 The upgrades required at Attleborough WwTW, including the new transfer pipeline for the discharge will be borne solely by AWS via the Price review and AMP process. Developers cannot contribute to upgrades at existing WwTW as they are not required solely for the new development.

5.4.24 Delivery and maintenance of any upgrade to the WwTW will be the responsibility of AWS under the regulation of Ofwat, and the Environment Agency (volumetric discharges from the existing discharge point will remain under jurisdiction of the EHIDB).

## Ecological Issues

5.4.25 The WCS has determined that there are no European sites downstream of the new discharge point that would be affected by water quality changes as a result of the preferred solution. In addition, because the proposed solution would maintain water quality downstream in order to meet requirements for the WFD water quality standards, there is unlikely to be any impact on ecology generally downstream.

## Figure 5-6: New Indicative Pipeline Layout for Attleborough WwTW



## 5.5 Wastewater Infrastructure

### Baseline Confirmation

5.5.1 The Breckland Outline WCS reported that the existing wastewater network infrastructure within Attleborough can only support less than half the 4,400 new properties and 2,000 jobs proposed growth without exacerbating existing sewer flooding problems. The remaining growth would have to be accommodated with new strategic mains infrastructure.

5.5.2 Figure 5-7 illustrates the existing wastewater network within Attleborough.

### Wastewater Strategy Preferred Solution

5.5.3 More detailed calculations of capacity suggest that up to 1,600 properties could be accepted within the existing network as demonstrated in Figure 5-7. It is recommended that this is agreed on a case by case basis with AWS via pre-development applications.

5.5.4 Development beyond the first 1,600 will require a new main to be constructed, or for the existing 250mm main to be upgraded to the west of the town in order for the flow from the new development areas to be transferred to the WwTW.

5.5.5 Development of a new wastewater main (or upgrading of the existing main to the west of the town) to serve development could also be used to connect the existing wastewater connections associated with the combined system to the south west of the existing development. This would allow the current combined system to be separated out, thus removing the polluting load of the CSO which discharges to the headwaters of the stream to the West of Docking Farm.

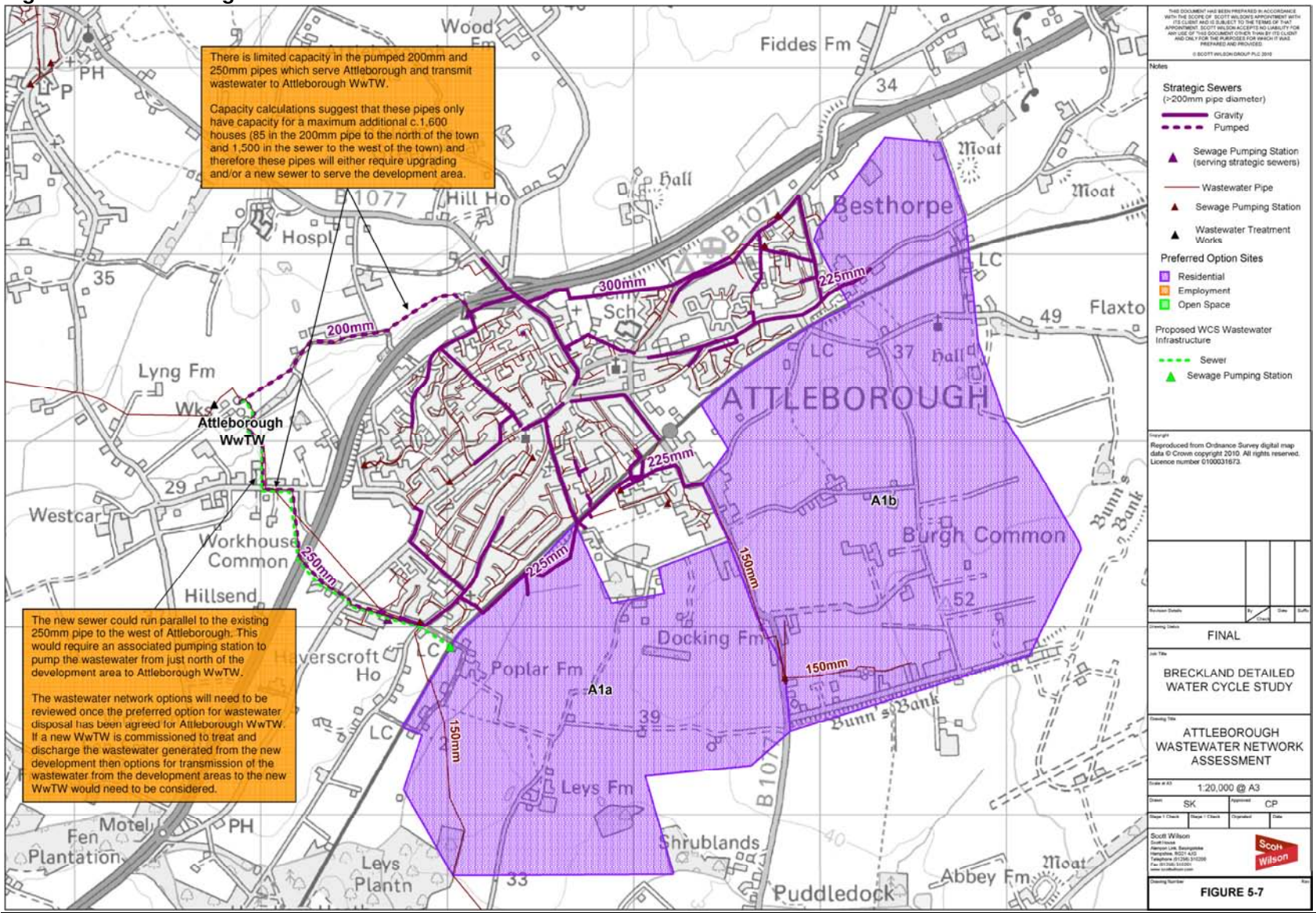
5.5.6 An indicative route and commentary is provided in Figure 5-7.

**Option Funding and Responsibility**

5.5.7 The costs for the new wastewater main and pumping station should be borne by the developer because they are required specifically for the new development areas. Details of indicative costs are provided in a separate technical note to Breckland Council. Options for funding mechanisms are discussed further in Section 10 of this report.

5.5.8 The construction and operation of the wastewater main would be undertaken by AWS. However, an option is available whereby developers pay directly for the construction of the main and pumping station, and AWS adopt (or requisition) the infrastructure once it is built and take on the ongoing maintenance and operation. This option would require the infrastructure to designed and built to AWS's specific requirements; and as such, the developer would need to liaise with AWS over the detailed route, sizing and location of the infrastructure.

## Figure 5-7: Attleborough Wastewater Network



## 5.6 Flood Risk Management

### Management of Flood Risk to Development

5.6.1 Table 5-13 provides an assessment of the flood risk to proposed development in Attleborough based on the findings of the Level 1 SFRA undertaken for the Breckland District. Both of the preferred options sites contain some areas covered by Flood Zone 3 and development within these sites should follow the site based sequential test and be directed towards those areas at lower flood risk. This is considered achievable given the size of the sites; however, East Harling IDB (EHIDB) are responsible for the Industrial Estate stream and Buckenham Stream which do not have detailed hydraulic modelling developed for them and hence do not have modelled outlines. Developers in the main development areas will need to consider flood risk from these watercourses and potentially assess the extent of flood risk through a site specific FRA. The EHIDB should be consulted for development in close proximity to these watercourses.

5.6.2 Specific restrictions, as suggested by the Level 1 SFRA regarding development close to these watercourses are provided in Table 5-13; these recommend that development should not take place along a corridor of 30 metres to 100 metres either side of the watercourses, depending on the watercourse. Additionally, the SFRA recommends that drainage in site A1b will require attenuation to ensure that flooding further downstream in Besthorpe Stream is not exacerbated.

5.6.3 Assuming the recommendations from the SFRA are followed when designing and building development on the sites, there is not considered to be any flood risk constraints associated with developing on the preferred option sites in Attleborough.

## Table 5-13: Attleborough Flood Risk to Development Assessment

| Preferred Option Site | Development Type | Area (Ha) | Flood Risk Constraints | | | | Flood Risk Assessment |
|---|---|---|---|---|---|---|---|
| | | | Fluvial | Critical Drainage/ Surface Water Flooding | Groundwater | Artificial Water Sources | |
| A1a | Residential | 258.2 | ✓ | × | × | × | Industrial Estate IDB Drain runs through northwest of site and lies within Flood Zone 3. Southern part of site lies with Flood Zone 3 of stream.<br><br>The SFRA L1 assesses that development should not take place along a corridor of 30 metres either side of the Industrial Estate IDB Drain.<br><br>Development should not take place within the flood zone of the stream to the south of the development site.<br><br>**Assuming the above restrictions are applied, there is not considered to be a flood risk to development at the site.** |
| A1b | Residential | 372.0 | ✓ | × | × | × | Factory Drain, White House Lane Drain, Stubley Farm Drain and Besthorpe Stream run through site.<br><br>The site lies within Flood Zone 3 of Besthorpe Stream and Attleborough Stream (to northeast of site).<br><br>Recorded fluvial flood event from Besthorpe Stream to northwest boundary of site.<br><br>Breckland District Council records report Attleborough Stream flooded several times due to capacity issues, in particular of the culvert under Norwich Road.<br><br>Houses on the Norwich Road have been flooded up to a depth of 3 ft. Ditches have also been reported to be blocked.<br><br>SFRA L1 suggests that development should be avoided:<br>• within a 100m corridor adjacent to Bastehorpe stream upstream of the railway line.<br>• within 20 metres of Whitehouse Lane Drain.<br>• adjacent to the 100m length of Factory Drain 1 closest to Whitehouse Lane Drain (downstream) as this area will be flooded in the 1% (1 in 100 year) event.<br>• within the flood zone of the Attleborough Stream to the northeast of the site.<br><br>Drainage will require attenuation to ensure that flooding further downstream in Besthorpe Stream is not exacerbated.<br><br>**Assuming the above restrictions are applied, there is not considered to be a flood risk to development at the site.** |

## Management of Flood Risk from Development

5.6.4 Table 5-14 provides the potential attenuation requirements for the preferred option sites in Attleborough. The calculations have been undertaken for two development assumptions: a 90% hardstanding coverage and 80% hardstanding.

**Table 5-14: Attenuation Requirements for Preferred Options Sites in Attleborough**

| Pref Option Site | Approx area | | Geology and soils | SPZ | Greenfield Runoff Rates (l/s) | | Max. Storage ($m^3$) | | Max. Storage using infiltration ($m^3$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 90% Area | 80% Area | | | 90% Area | 80% Area | 90% Area | 80% Area | 90% Area | 80% Area |
| A1a (West) | 234 | 208 | Heterogeneous geology and soils. Northern extent with freely draining soils | Partialzone 2 and 3 | 1,209 | 991 | 218,324 | 198,271 | 147,064 | 131,494 |
| A1b (East) | 333 | 306 | | None | 1,507 | 1,353 | 321,396 | 285,015 | 210,507 | 187,159 |

**Potential SuDS at Attleborough**

5.6.5 The geology and soils at Attleborough is believed to be relatively heterogeneous. The northern extents of both development site areas are believed to be underlain by freely draining soils with the southern extents underlain by slowly permeable soils.

5.6.6 Due to the large preferred option site areas, there is potential to use many different SuDS techniques throughout the SuDS management train from source control on individual housing blocks to regional control via wet ponds or retention basins. A basic review of OS 1:40,000 scale mapping indicates the presence of various small watercourses at the site for potential connection to the surface water management scheme. The attenuation figures provided are indicative at this stage, as it is not known what the geographical extent of the new sites. It is likely that not all of the outlined areas will be developed, and as such the storage requirements ill be less. Connection of the site to these watercourses will require the consent of the EHIDB.

5.6.7 Where feasible, infiltration techniques should be encouraged to manage surface water runoff. However, due to the size of the site, diversion of all surface water to the northern extents may remove hydrological inputs to watercourses or catchments to the south of the site. Therefore, surface water management schemes for the sites should be reviewed at a strategic site level to ensure the overall sustainability of the management techniques. There is potential to link strategic surface water features such as swales or ponds along blue corridors where existing streams flow through the site, allowing surface water to be held back prior to discharge. These attenuation options would provide scope to create a linked wetland system that also allows infiltration to groundwater below during the summer. Developers should consider maintaining and enhancing green and blue corridors for amenity value through the utilisation of surface attenuation SuDS in the development areas.

5.6.8 The EHIDB have indicated that any proposals for on-site attenuation storage should consider the potential for off-site attenuation storage utilising existing storage volume at the gravel pits at Swangey. This would also reduce the requirement to excavate storage ponds on the site(s) and the resultant need to dispose of large quantities of soil and would hence be more sustainable.

The IDB will require commuted sum payments for any surface water discharges to the IDB maintained watercourses

5.6.9 Appendix E: SuDS Calculations, contains a summary of the model parameters and results from the Microdrainage WinDes attenuation volume calculations for Attleborough.

**Option Funding and Responsibility**

5.6.10 The costs for SuDS required at Attleborough to meet with the requirements of PPS25, will be borne solely by the developer and the detailed requirements for them should be developed via a site specific FRA. However, it is the responsibility of the LPA (in this case Breckland Council) to ensure a funding mechanism is put in place when granting permission under the Flood and Water Management Act. Options for securing this funding are included in section 10 of this report.

5.6.11 Delivery of SuDS will be the responsibility of the developer; however the 'approving body' under the Flood and Water Management Act must approve the SuDS prior to construction. In most cases, ongoing maintenance of SuDS will also be the responsibility of the approving body under the Flood and Water Management Act as part of wider surface water management responsibilities. The approving body is the unitary authority, which for Breckland will be Norfolk County Council.

**Infrastructure Phasing**

5.6.12 Figure 5-8 provides the infrastructure timeline for Attleborough. This is based on the conclusions from the water resources, wastewater treatment and infrastructure and flood risk management assessments. The timeline is based on a number of assumptions as detailed below.

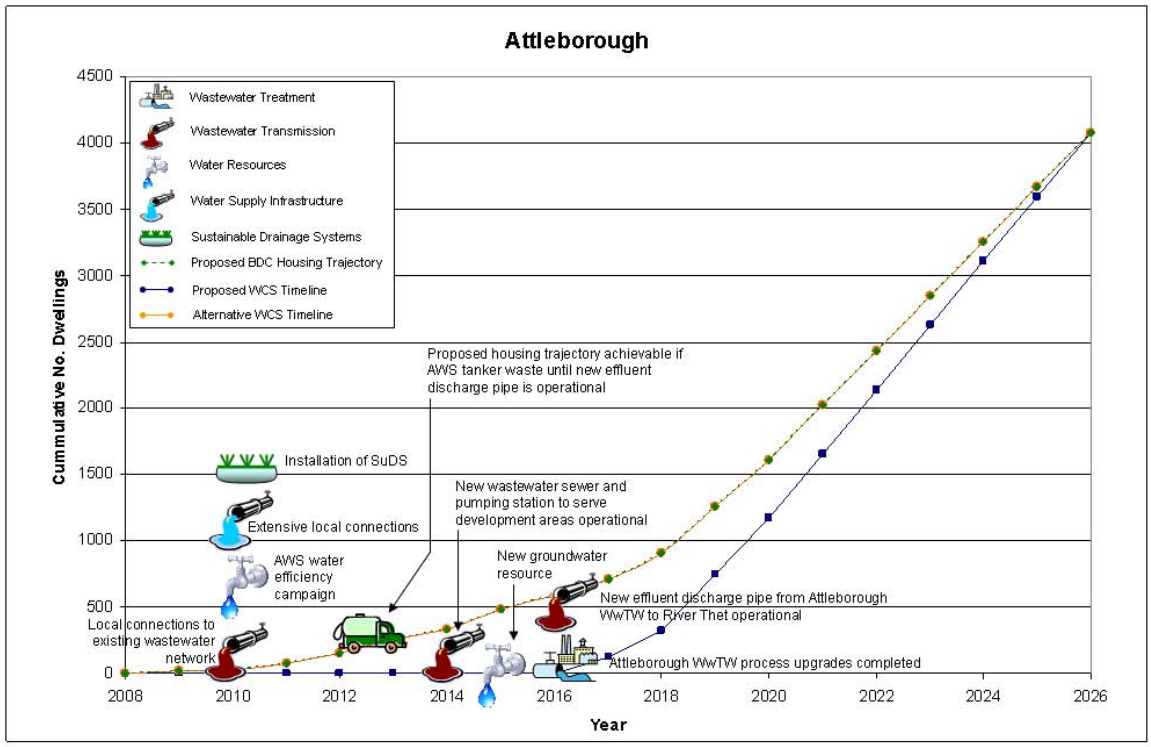
**Assumptions**

- Extensive local connections to the existing water mains serving the development areas will be required for supplying water to the development sites in Attleborough. This will require a lead-in time of 1 year, i.e. operational in 2011;
- A new wastewater sewer and associated pumping station will be required for transmitting wastewater from the site to Attleborough WwTW. This will require a lead-in time of 3.5 years to construct and be operational; however it is likely that early development could make use of existing capacity before the new wastewater main is required;
- Until such time as the new wastewater sewer is built, development could potentially connect to the existing sewer network (to the north of the development areas) which potentially has a capacity to serve some new housing. Local connections to these sewers will be required and capacity would need to be confirmed with AWS on a case by case basis (via pre-development enquiries);
- The wastewater strategy identified that to treat and discharge the effluent generated by the proposed development in Attleborough upgrades to the process capacity at Attleborough WwTW and a new discharge pipe running from Attleborough WwTW to the River Thet will be required. The WwTW and transfer pipeline is expected to have been upgraded/built by 2016;
- Until such time as the new wastewater discharge pipe and WwTW upgrades are complete (2014), it has been assumed that no development will be possible within Attleborough because the WwTW is currently at its consented flow limit (subject to confirmation by AWS);

however, AWS have stated that they could tanker the sewage from the new housing development prior to AMP 6 when the new discharge point would be operational. This would allow development to come forward prior to the building and completion of the discharge pipe and would allow the proposed Breckland trajectory to be achieved as an alternative to the worst case scenario in Figure 5-8. It is also possible that Anglian Water could determine an allowable number of completions that could be connected based on reducing per capita consumption from existing properties and from declining occupancy rates.

- A new water resource scheme will be required in 2015 to supply water to development in Attleborough. Up to then, a water efficiency campaign will be run by AWS to overcome shortfalls in the early part of AMP5 (2010-14); and,
- The development sites will require the installation of SuDS but this is not expected to impact on the development timescales.

**Figure 5-8: Attleborough Infrastructure Timeline**



# 6 Dereham Growth Town Assessment

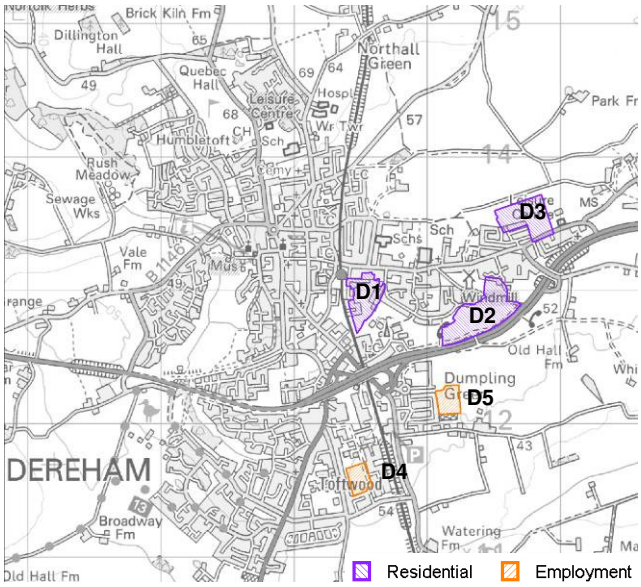
## 6.1 Introduction

6.1.1 Dereham is the second largest town in the Breckland District and serves as the administration and service centre for the north of the District, providing a focus for retail and employment.

6.1.2 The Breckland Spatial Strategy[45] identified Dereham as experiencing significant employment growth coupled with focused housing growth to enhance its position as the administrative centre of Mid-Norfolk. Dereham is targeted with providing 2,000 new homes and up to 1,800 jobs over the plan period (2001-2026). There will be a gradual growth within the town with priority given to brownfield sites within the town, followed by brownfield sites adjoining the town and then peripheral greenfield sites.

6.1.3 Table 6-1 provides the housing and employment growth figures for Dereham for the period 2008 - 2026. Figure 6-1 shows the proposed phasing of the planned housing growth.

**Table 6-1 Housing and Employment Growth in Thetford (2008 – 2026)**

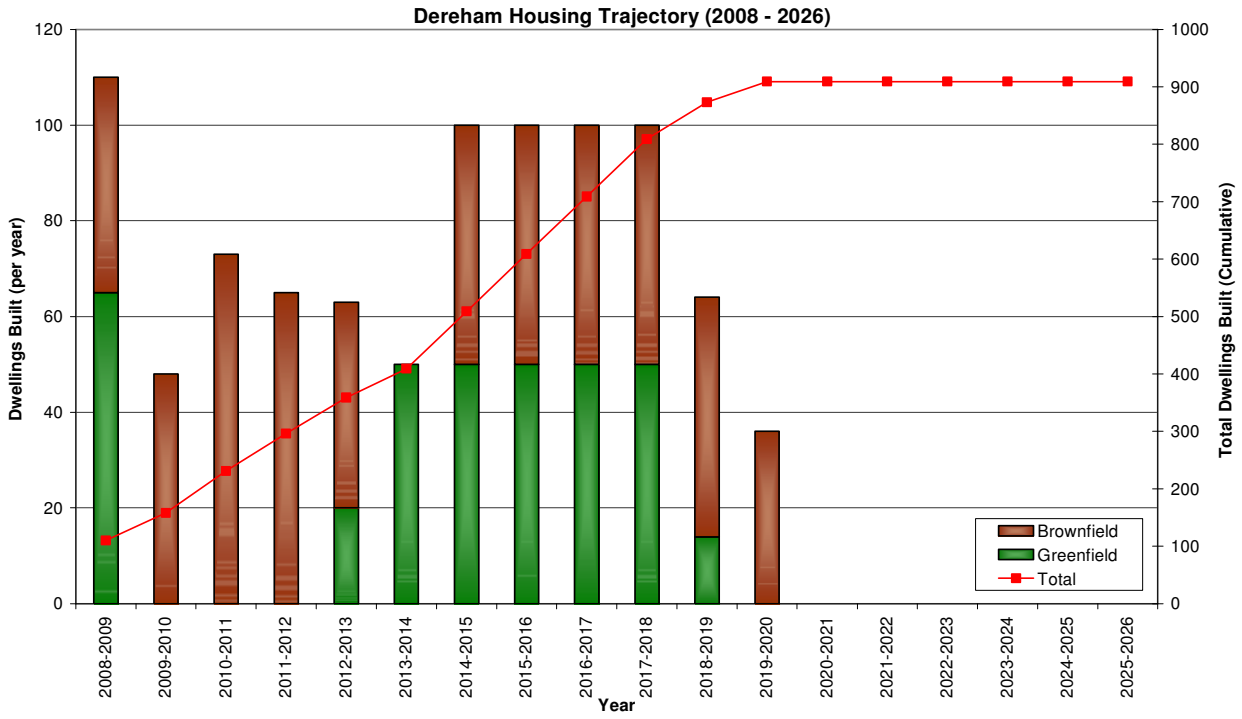
| Housing | No. of Dwellings | Location of Development |
|---|---|---|
| Already Built (as of April 2008) | 1,062 |  |
| Currently Permitted (as of April 2008) | 309 | |
| New Allocations | 600 | |
| Total | 1,971 | |
| **Housing to be Assessed (= Total – Already Built)** | **909** | |

| Employment | Jobs |
|---|---|
| Proposed Jobs | 900 - 1,800 |
| Land Required | 5 - 10 hectares |
| **Employment to be Assessed** | **1,800** |



[45] Core Strategy and Development Control Policies DPD – Adopted 2009, Breckland District Council, 2009

**Figure 6-1 Housing Growth in Dereham (2008 – 2026)**




## Outline WCS Findings

6.1.4 The Breckland Outline WCS was completed in November 2008 and highlighted the following key issues in terms of the water cycle and infrastructure for Dereham:

- there is likely to be sufficient capacity in existing raw water resources to allow development in the short-term but by 2026 a supply/demand deficit is predicted for the 'planning zone' in which the Dereham lies. Increase in the use of the existing abstraction licence capacity near Dereham has the potential to impact on 3 European designated sites. A new resource is therefore required for development up to 2026;
- due to the smaller scale of development in the town (relative to it's existing population), with highly aspirational 100% metering, large scale retrofitting of water efficiency devices in new homes and attainment of Code for Sustainable Homes level 5 or 6 for new development, there could be a theoretical overall net decrease in demand as a result of new development;
- Dereham WwTW has available capacity in terms of the additional wastewater it can treat to accommodate the proposed growth up to 2026; but with the increased effluent load and more stringent water quality standards under the WFD, there is likely to be a requirement to invest on process capacity at the works in order to tighten the ammonia and Phosphate effluent discharge consents as there is a current and future concern with meeting Dissolved Oxygen standards and Phosphorous standards in the Wendling Beck downstream;
- there may be scope for new housing development to be served by the existing trunk sewer that serves the WwTW if development is located to the west of the town. Any new development over 50 or so houses to the east of the town is likely to require new strategic infrastructure to supply the new development; and

- historically fluvial flooding (from Dereham Stream) and occasional surface water flooding has been reported within the town of Dereham, with the town identified as a hotspot for sewer flooding.
- Additionally, assessments have shown that the physical capacity of Wendling Beck is likely to be sufficient to accommodate the additional wastewater without increasing downstream flood risk.

## 6.2 Water Resources

### Baseline Confirmation

6.2.1 The Breckland Outline WCS reported that there is likely to be sufficient capacity in existing raw water resources to allow development in the short-term but by 2026 a supply/demand deficit is predicted for the 'planning zone' in which the Dereham lies. Increase in the use of the existing abstraction licence capacity near Dereham has the potential to impact on three European designated sites (Norfolk Valley Fens SAC, Broads SAC and Broadlands SPA/Ramsar) and six water sensitive Sites of Special Scientific Interest, which may impact on the Bure Broads and Marshes SSSI (the principal relevant element of the Broads SAC/Broadlands SPA). Additionally there is limited spare capacity in the existing groundwater and surface water resources which could limit development of local sources further. A new resource is therefore required for development up to 2026 which in Anglian Water's draft WRMP is catered for by the proposed Great Ouse Groundwater Scheme (GOGS).

6.2.2 The Residential Demand (RD) scenarios as defined in the Water Resources Methodology (Section 3.2) have been modelled for the proposed residential growth in Dereham (Table 6-2).. The results show that the new houses would demand around 0.3 Ml/d if they were built to current specifications and water use (142 l/h/d). The lowest demand estimate from new housing development (Scenario 4 – CSH 5&6 at 80 l/h/d) would demand around 0.2 Ml/d.

**Table 6-2 Residential Demand for Planned Growth in Dereham[46]**

| Scenario | | Water Use Rate (l/h/d) | Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|
| 1a | Water Company Forecast (Current) | 142 | 0.30 | 0.33 |
| 1b | Water Company Forecast (2035) | 130 | 0.25 | 0.28 |
| 2 | Code for Sustainable Homes 1&2 | 120 | 0.23 | 0.25 |
| 3 | Code for Sustainable Homes 3&4 | 105 | 0.20 | 0.22 |
| 4 | Code for Sustainable Homes 5&6 | 80 | 0.15 | 0.17 |

6.2.3 The Non-Residential Demand (NRD) has been calculated for the proposed employment growth in Dereham, based on a percentage of the residential demand (see Water Resources Methodology (Section 3.2)). Taking the minimum RD (Scenario 4) and the maximum RD (Scenario 1a) for planned growth in Dereham (Table 6-2), the NRD has been estimated for the water demand scenarios (Table 6-9). This shows that water demand from employment growth could range from between around 0.1 Ml/d to 0.2 Ml/d (with an allowance for headroom) depending on the final land allocation for employment sites, and the job types that are created.

[46] Lowest demand in green, highest demand in red

**Table 6-3 Non-Residential Demand for Planned Growth in Dereham**[31]

| RD Scenario | NRD Scenario | | Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|
| 1a | 5 | Lowest Estimate of Non-Residential Land Allocation | 0.09 | 0.10 |
| | 6 | Highest Estimate of Non-Residential Land Allocation | 0.17 | 0.19 |
| 4 | 5 | Lowest Estimate of Non-Residential Land Allocation | 0.05 | 0.06 |
| | 6 | Highest Estimate of Maximum Non-Residential Land Allocation | 0.09 | 0.10 |

6.2.4 The total water demand from new development in Dereham will therefore range from around 0.2 Ml/d to 0.5 Ml/d (Table 6-10), but the lower estimate would be dependent on new houses being built to a CSH 5&6 level, with a water demand of 80 l/h/d and the lowest estimate of non-residential demand. In reality, the water demand exerted from the new development in Dereham is likely to be towards the higher end of the range, unless policy is included to stipulate that all new residential development needs to meet a CSH level requirement. Recommended policy is included in 11.

**Table 6-4 Highest and Lowest Total Demand Estimates for Planned Growth in Dereham**

| RD Scenario | | NRD Scenario | | Total Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|---|
| 4 | Code for Sustainable Homes 5&6 | 5a | Lowest Estimate of Minimum Non-Residential Land Allocation | 0.20 | 0.22 |
| 1a | Water Company Forecast (Current) | 6b | Highest Estimate of Maximum Non-Residential Land Allocation | 0.47 | 0.52 |

6.2.5 The assessment presented here is in terms of the additional water demand generated by the new development, under a range of water demand scenarios. However, the changing behaviour of the existing population, and retrofitting of water saving devices into existing properties has the potential to lower the total future water demand for Dereham, and should be considered as part of any future water demand assessment. This is discussed in more detail in the Water Efficiency section below.

## Solution Refinement

6.2.6 AWS's final WRMP identifies no deficits under average supply/demand balance conditions; however a deficit of 0.4 Ml/d is forecast during the peak demand conditions by 2034/35. It is considered that, because the additional demand from growth in Dereham is les than the Deployable Output from the proposed schemes. that this deficit will not affect growth by the end of the planning period (2025/26) for this WCS. It has been assumed that no spare groundwater licence capacity is available within Dereham to meet forecast growth, at least under the high water demand scenario.

6.2.7 Under the high demand scenario, the extra Deployable Output[47] available to meet the extra demands in Dereham will come from additional groundwater resource development to take place within Breckland. Amongst the options mentioned in the AWS's final WRMP is the use of satellite

[47] Deployable Output is the water which is available for supply during dry years

boreholes to supply the West Bradenham source works. The selection of this source in the final WRMP is based on the fact that this borehole, which was drilled as an alternative source to the Watton source works in order to reduce impacts further downstream on the River Wissey, is now no longer required for this purpose. The available spare resources from West Bradenham and existing groundwater licences (under low water demand conditions elsewhere in Breckland) are shown in Table 6-5. It is has been assumed that there is no loss of Deployable Output from any existing sources within Dereham as a consequence of the Environment Agency's Review of Consent Process.

**Table 6-5 Available Spare Water Resources to Supply Dereham**

| Resource Options | Average Deployable Output (Ml/d) |
|---|---|
| Maximise Spare Groundwater Licence | 0.2 (available under low growth scenario only) |
| New Groundwater Resource Development | 0.9 (West Bradenham B/hs) |

## Preferred Solution

6.2.8 The phasing of water resource developments within Dereham will depend on future water use rates. These could range between 0.5 Ml/d (Scenario 1a - high water demand) and 0.2 Ml/d (Scenario 4 - low water demand). Table 6-6 shows the phasing of water resource developments in Dereham based on the high and low water demand scenarios.

**Table 6-6 Phasing of Water Resource Developments in Dereham (excluding impacts of Climate Change)**

| Source | High Water Demand (RD Scenario 1a) | Low Water Demand (RD Scenario 4) |
|---|---|---|
| Maximise Spare Groundwater Licence | Not available | Incrementally from 2009 |
| New Groundwater Resource Development | AMP5 (2014) | AMP7 (2022) |

6.2.9 Under the high water demand scenario, a new groundwater resource development is required immediately in order to overcome deficit which could arise under peak week conditions in Dereham. In AWS's final WRMP, it is proposed to address this deficit, at least initially by an active water efficiency campaign to overcome shortfalls in the early part of AMP5 (2010-13). After this date (around 2014), the groundwater scheme will be required.

6.2.10 Under the low water demand scenario, the growth will be met initially from spare licence capacity and then from a new groundwater resource development which would be required in AMP7, around 2022.

**Option Funding and Responsibility**

6.2.11 The costs for the water resource schemes required at Dereham will be borne solely by AWS via the Price review and AMP process. Developers cannot contribute to these water resource solutions as they are not required specifically for the new development.

6.2.12 Delivery and maintenance of the solutions will be the responsibility of AWS under the regulation of Ofwat, the Environment Agency and the Drinking Water Inspectorate (DWI).

6.2.13 Delivering water efficiency in new homes will be the responsibility of the developer and the cost (of construction and maintenance) will be borne solely by the developer.

6.2.14 Some water efficiency and water saving methods are proposed for *existing* development by AWS as part of their twin-track approach to managing water resources in the region. These elements (such as meter penetration, and provision of water butts for existing homes) are funded solely by

AWS as part of the Price review and AMP process, and also from AWS own investment. Water meters are provided for new properties by AWS as standard practice.

### Climate Change Impacts

6.2.15 The effects of climate change (CC) on water resources supplying Dereham are presented in Table 6-7.

**Table 6-7 Effects of Climate Change on Available Water Resources to Dereham**

| Resource Options | CC effects | Comment |
|---|---|---|
| Existing and New Groundwater Licences | Negligible | A reduction of 0.22 Ml/d by 2035 for all groundwater sources within Breckland. |

6.2.16 In general, the heavy reliance on groundwater within Breckland and the resilience of its storage to changes in groundwater levels will mean that the impacts of CC are relatively minor and will and will advance the requirement for schemes by approximately one year under both scenarios (see Table 6-6).

6.2.17 AWS's final WRMP includes a commitment to investigate further the affects of the UKCP09 scenarios in the lead-up to the next periodic review process in 2015.

### Ecological Issues

6.2.18 Since the necessary water resources are within the limits of the existing licences their impact upon European sites will have already been considered through the Environment Agency's Review of Consents process. As such there is no need for further consideration in this Water Cycle Study.

## 6.3 Water Supply Infrastructure

6.3.1 The water supply network has been supplied by AWS for analysis in this Phase 2 WCS. Adequate supply mains pass through, or are located close to all proposed development sites in Dereham. AWS have indicated that a new 350mm ID link across the A47 is also being constructed to serve development areas to the south and southeast of the town.

6.3.2 However, the developers would be responsible for funding local connections on a house by house basis.

6.3.3 Costs for dwelling connections for water supply are usual costs borne by the developer for any new housing developer and as such are not considered in this WCS.

## 6.4 Wastewater Treatment

### Baseline Confirmation

6.4.1 The Breckland Outline WCS reported that Dereham Wastewater Treatment Works (WwTW) generally has sufficient wastewater treatment capacity (in terms of volumetric and quality consent headroom) to accommodate growth up to 2026.

6.4.2 However, with the increased effluent load and more stringent water quality standards under the WFD, there is likely to be a requirement to invest on process capacity at the works in order to tighten the ammonia and Phosphate effluent discharge consents as there is a current and future concern with meeting Dissolved Oxygen standards and Phosphorous standards in the Wendling Beck.

6.4.3 The position has since altered during the undertaking of the detailed study. The Environment Agency and AWS have been in negotiation regarding the process by which DWF is measured from WwTWs in the region. Using the new methodology, it was determined that the flow currently being treated at Dereham WwTW is greater than the flow it is consented to treat. Therefore, a revision to the consent has been applied for and this revised consented flow does not provide for any headroom to treat flow from growth. Any increase in wastewater flow to Dereham WwTW therefore needs to consider further changes to the consent and potentially, the treatment processes.

**Wastewater Treatment Volumetric (Consent) Capacity**

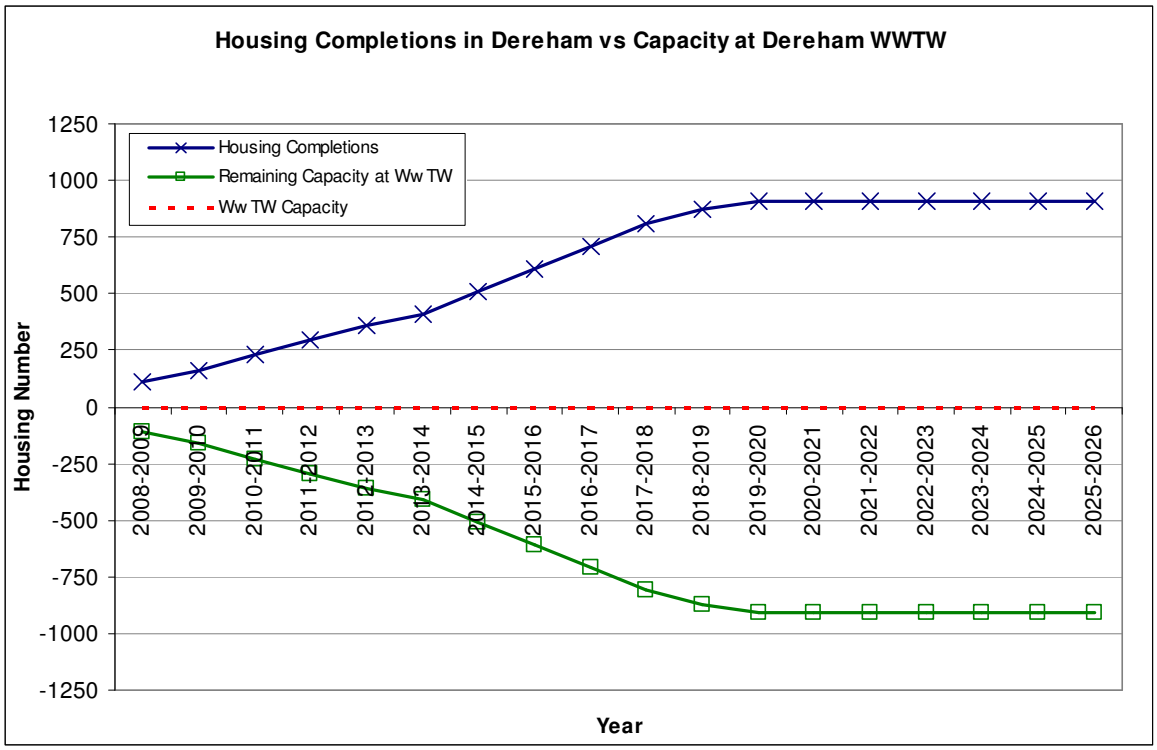
6.4.4 The current consented Dry Weather Flow (DWF), and therefore volumetric consent capacity, for Dereham WwTW is 3,769 $m^3$/d. However, a new proposed consent of 4,980 $m^3$/d, as agreed by the Environment Agency and AWS, is expected to be in force in early 2010 and therefore for the purposes of this WwTW assessment, the new consent has been used.

6.4.5 The measured flow for the WwTW, as provided by AWS, is 4,191 $m^3$/d. However, under the new consent it is assumed that the flow being treated at the works is equal to the new consent and therefore there is no further capacity for further growth without the requirement to apply for a new flow consent to treat and discharge that DWF. As such, this assessment assumes that there is no volumetric consent capacity to accommodate flow from further wastewater.

6.4.6 Dereham is expected to provide 909 homes and 1,800 'commercial' jobs by 2026, equating to an increase in the current Population Equivalent (PE) and flow of 2,182 and 412 $m^3$/d respectively. AWS would need to apply for a new DWF (and associated quality) consent to treat this additional flow before any additional flow generated from new development can be treated and discharged from the works.

6.4.7 Figure 6-2 shows the phased housing development and corresponding volumetric consent capacity at the works during the period 2008 – 2026. Details of the volumetric consent capacity are included in Appendix H: WwTW Capacity Calculations.

**Figure 6-2 Proposed Housing Development in Dereham and Capacity at Dereham WwTW (2008 - 2026)**




**Wastewater Treatment Quality (Consent) Capacity**

6.4.8 Dereham WwTW discharges into the Wendling Beck. The Environment Agency monitoring observations for the period 2003 – 2008 show that, under current conditions, the Wendling Beck will only achieve WFD 'good ecological status' proposed standards upstream of Dereham WwTW for BOD, with Ammonia and Orthophosphate (P) achieving 'moderate ecological status' and DO achieving 'poor ecological status'. Downstream of the works, the BOD and Ammonia standard for 'high ecological status' will be achieved and there will be compliance of the 'good ecological status' for DO and P.

6.4.9 The assessment of the Environment Agency monitoring results for Wendling Beck upstream and downstream of Dereham WwTW against the proposed WFD standards are provided in Table 6-8. The WFD status and classification information provided in Table 6-8 is summarised from the final Anglian RBMP 2009. The WFD classification for Biochemical Oxygen Demand (BOD) is based on the monitoring information provided by the Environment Agency against proposed WFD standards, as BOD is not specifically reported within the Anglian RBMP. In addition, the Wendling Beck upstream of the WwTW has not been classified in the RBMP and hence has not been reported here. It does, however, include the results of the monitoring data upstream which shows that the watercourse quality improves downstream of the Dereham WwTW discharge point.

6.4.10 The Wendling Beck ultimately discharges into the River Wensum SAC and hence discharges must conform to the findings of the Habitats Directive RoC process on potential downstream impact.

6.4.11 Indicative consent standards have been calculated for Dereham WwTW based on the proposed growth by Breckland District Council within Dereham; this will result in Dereham WwTW treating 5,392 $m^3$/d of wastewater by 2026. The consents have been calculated for the modelling scenarios defined in Section 3.3.

6.4.12 Table 6-9 shows the consents required based on the proposed phasing of growth. This assumes that the river is either achieving 'good ecological status' (GES) or 'high ecological status' (HES) upstream of the discharge based on the methodology discussed in Section 3.3.

6.4.13 The modelling results show that under future growth conditions and in compliance with the WFD, Dereham WwTW will need to be treating effluent from the works to a standard of 7.5 mg/l (95%ile) BOD, 0.8 mg/l (95%ile) Ammoniacal-N, and 0.2 mg/l (Mean) Phosphorus. The BOD consent is achievable within Best Available Technology Not Entailing Excessive Cost (BATNEEC), but both the Ammoniacal-N (0.8 mg/l, 95%ile) and Phosphorus (0.2 mg/l, Mean) consents will require solutions beyond BATNEEC to treat the effluent to the required quality and comply with both the WFD and Habitats Directive (Scenarios B and E).

6.4.14 Both BOD and Ammonia are currently achieving high status in the watercourse downstream of the WwTW. If this status were allowed to deteriorate to 'good' (Scenario D), then there would be no requirement to tighten the existing BOD consent, and the Ammoniacal-N consent would require tightening to 1.5 mg/l (95%ile) which is achievable with BATNEEC.

6.4.15 Alternative discharge solutions will need to be investigated to identify how effluent from the proposed development within the town will be treated and discharged and this is discussed in section 6.4.32 onwards.

## Table 6-8 WFD Assessment of Environment Agency Monitoring Results Upstream and Downstream of Dereham WwTW

| Sampling Point Code | | WEN123 | | | | | WEN140 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | | Tributary of Wendling Beck (Upstream of Dereham WwTW) | | | | | Wendling Beck (Downstream of Dereham WwTW) | | | | |
| Stretch | | Tributary of Wendling Beck Upstream of Scarning Fen – Wendling | | | | | Wendling - Wensum | | | | |
| Easting | | 598846 | | | | | 596600 | | | | |
| Northing | | 311752 | | | | | 315300 | | | | |
| Water Quality Monitoring Data Assessment (against WFD Standards) | Year | 2003-2006 | | | | | 2005-2008 | | | | |
| | Data | Average (mg/l) | Count | Std Dev (mg/l | 90/10%ile/ Average (mg/l) [WFD Target] | WFD Status | Average (mg/l) | Count | Std Dev (mg/l | 90/10%ile/ Average (mg/l) [WFD Target] | WFD Status |
| | BOD | 1.95 | 47 | 1.28 | 4.05 | | 1.04 | 46 | 0.65 | 1.90 | |
| | Ammonia | 0.29 | 47 | 0.44 | 0.61 | | 0.11 | 47 | 0.11 | 0.27 | |
| | DO as % Sat | 84.12 | 46 | 23.35 | 41.79 | | 88.69 | 48 | 11.68 | 71.28 | |
| | Orthophosphate | 0.17 | 47 | 0.08 | 0.17 | | 0.08 | 47 | 0.05 | 0.08 | |
| WFD Classification | Water Body ID | | | | | | GB105034051020 | | | | |
| | Hydromorphological Status | | | | | | Heavily Modified *Flood Protection, Land Drainage* | | | | |
| | Current Overall Status | | | | | | Moderate | | | | |
| | Current Ecological Status | | | | | | Moderate | | | | |
| | Current Chemical Status | | | | | | N/A | | | | |
| | Overall Status Objective | | | | | | Good Ecological Potential by 2027 | | | | |

| Key | |
|---|---|
| **WFD Target** | **WFD Classification Status** |
| Pass WFD 'Good' Target | High Status |
| Marginal Pass (Within 10%) | Good Status |
| Fail WFD 'Good' Target | Moderate Status |
| | Poor Status |
| | Bad Status |
| | N/A – Does Not Require Assessment |

## Table 6-9: Dereham WwTW Calculated Quality Consent Requirements

| | | BOD | | | | Ammonia | | | | P | | | | Planning Considerations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2010 | 2015 | 2020 | 2026 | 2010 | 2015 | 2020 | 2026 | 2010 | 2015 | 2020 | 2026 | |
| Current Consent | | 10 | | | | 3 | | | | 1 | | | | |
| Scenario A: Planned Deterioration | A1 | 8 | 7.5 | 7.5 | 7.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | × (NH4 & P) |
| | A3 | 8 | 7.5 | 7.5 | 7.5 | 0.8 | 0.8 | 0.8 | 0.8 | 0.2 | 0.2 | 0.2 | 0.2 | ✓ |
| Scenario B: Compliance with WFD | B1 | 8 | 7.5 | 7.5 | 7.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | × (NH4 & P) |
| | B3 | 8 | 7.5 | 7.5 | 7.5 | 0.8 | 0.8 | 0.8 | 0.8 | 0.2 | 0.2 | 0.2 | 0.2 | ✓ |
| Scenario C: Compliance with WFD (excl. P) | C1 | 8 | 7.5 | 7.5 | 7.5 | 1 | 1 | 1 | 1 | - | - | - | - | × (NH4) |
| Scenario D: WFD Deterioration | D1 | 10 | 10 | 10 | 10 | 1.5 | 1.5 | 1.5 | 1.5 | 1 | 1 | 1 | 1 | × (P) |
| | D2 | 10 | 10 | 10 | 10 | 1.5 | 1.5 | 1.5 | 1.5 | 0.2 | 0.2 | 0.2 | 0.2 | ✓ |
| Scenario E: Load Standstill (compliance with HD) | E1 | 9 | 9 | 9 | 9 | 3 | 2.5 | 2.5 | 2.5 | 1 | 1 | 1 | 1 | × (P) |
| | E2 | 9 | 9 | 9 | 9 | 3 | 2.5 | 2.5 | 2.5 | 1 | 1 | 0.9 | 0.9 | ✓ |
| **Recommended Consents** | | **7** | | | | **1** | | | | **1** | | | | |

| **Key** | No consent tightening required | Consent tightening within BATNEEC | Consent limited to BATNEEC | Consent beyond BATNEEC required |
|---|---|---|---|---|

## Table 6-10: Current WFD Status & Quality Consent for Dereham WwTW

| Determinand | Current WFD Status | | D/S WFD Standard (Required) | Current Quality Consent (mg/l) | Planned Change to Quality Consent (mg/l) |
|---|---|---|---|---|---|
| | U/S | D/S | | | |
| BOD | H | H | High - 4 mg/l (90%ile) | 10 | No Change |
| Ammonia | H | H | High - 0.3 mg/l (90%ile) | 4 | 3 (by 31 March 2015) |
| Orthophosphate | G | G | Good - 0.12 mg/l (Mean) | 1 | No Change |

## Ecological Issues

6.4.16 Dereham WwTW discharges to the Wendling Beck which is a tributary of the River Wensum SAC. The SAC is approximately 8.5km downstream of Dereham WwTW.

6.4.17 The River Wensum was designated as an SAC for:

- watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation;
- White-clawed (or Atlantic stream) crayfish Austropotamobius pallipes;
- Desmoulin`s whorl snail Vertigo moulinsiana;
- Brook lamprey Lampetra planeri; and
- Bullhead Cottus gobio.

6.4.18 The Environment Agency RoC process identified the following designated SAC features in Table 6-11 as having a requirement for good water quality and specific targets.

**Table 6-11: Water quality standards for the interest features of the River Wensum SAC**

| Indicator | Feature and Target |
|---|---|
| Biological class - Environment Agency's General Quality Assessment scheme | bullhead - >='b'<br>brook lamprey - >='b'<br>white-clawed crayfish >='b'<br>Desmoulin's whorl snail >='b'<br><br>In addition, no drop in class from existing situation |
| River Ecosystem Class | bullhead - >=RE2<br>brook lamprey - >=RE2<br>white-clawed crayfish>=RE3<br>Desmoulin's whorl snail >= RE2<br><br>In addition, no drop in class from existing situation |
| Suspended solids (annual average). | bullhead - <=25 mgl $l^{-1}$<br>brook lamprey <=25 mgl $l^{-1}$<br>white-clawed crayfish <=25mg$l^{-1}$ |
| Soluble Reactive Phosphorus (annual mean)<br><br>(equivalent to Total Reactive Phosphorus / Orthophosphorus) | An annual average phosphate concentration of 0.04mg/l from the upstream limits of the SSSI to Sculthorpe; 0.06mg/l from Sculthorpe to Taverham Bridge; and 0.1mg/l from Taverham Bridge to the downstream limit of the SAC. |

6.4.19 In addition, the further additional information on water quality sensitivities have been obtained regarding the interest features of the SAC and are included in Appendix D: Breckland Ecological Appraisal.

6.4.20 The Environment Agency concluded in their RoC process that nutrient enrichment of the River Wensum was a matter for concern, especially as phosphorous concentrations were shown to be elevated above acceptable standards. The Environment Agency further suggested that discharge consents have been shown to contribute nearly 75% of all phosphorous loads to the river system.

In their Review of Consents, the Agency identified twenty sources of phosphorous that were contributing nearly 95% the phosphorous loading to the River Wensum catchment, of which many were Wastewater Treatment Works. Of the twenty consents, fourteen WwTW accounted for nearly 62% of point source loads and are listed in Table 6-12: It can be seen from this table that Dereham WwTW was one of the works identified as making a significant contribution to the overall 'in combination' adverse effect on integrity of the SAC.

**Table 6-12: Major WwTW contributing to point source loads of P in the River Wensum SAC[48]**

| Agency Ref | Description of permission, plan or project |
|---|---|
| AEELF12301 | South Raynham HSW |
| AEENF1189 | Sculthorpe WWTW |
| AEENF119B | Weasenham St Peter |
| AEENF12055 | Foulsham WWTW |
| AEENF12100 | Stibbard Moor End WWTW |
| AEENF12129 | Horningtoft WWTW |
| AEENF1305 | Reepham WWTW |
| AEENF1327 | East Rudham WWTW |
| AEENF15448 | Fakenham WWTW |
| **AEENF527** | **Dereham WWTW** |
| AW4NF1046X | Swanton Morely Airfield WWTW |
| AW4NF199X | North Elmham WWTW |
| AW4NF405X | Weasenham All Saints WWTW |
| AW4NF624X | Belaugh WWTW |

6.4.21 The conclusions of the Environment Agency RoC process are leading to improvements to the WwTWs above (including Dereham) in order to reduce the phosphate concentrations in their discharged effluent to acceptable levels (which have been determined to be 1 mg/l) and thereby ensure (when considered in combination with RoC driven improvements to other WwTWs that discharge into other tributaries of the Wensum) that the overall phosphate concentration in the River Wensum SAC falls below the identified damage thresholds for the species and habitats for which the SAC was designated.

6.4.22 However, an increase in wastewater that would be treated at Dereham WwTW as a result of the additional development planned for the town may lead to a need to further improve the treatment technology in order to ensure that it continues to comply with the discharge constraints imposed

[48] (Source: Environment Agency Review of Consents Reports for the River Wensum SAC)

by the RoC process, since a larger volume of wastewater will otherwise place greater pressure on the phosphate stripping process and will lead to an overall larger volume of phosphorus entering the receiving watercourse. Further improvements would ensure that Dereham WwTW does not once again contribute to an overall cumulative adverse effect on the integrity of the River Wensum SAC when considered in combination with the other WwTWs that discharge into watercourses draining into the SAC (particularly the 13 additional works identified in Table 3-5).

6.4.23 It is understood that once the improvements being delivered under AMP5 are in place (i.e. 1mg/l mean P condition), Dereham WwTW will be at the limits of BATNEEC such that further treatment improvements to improve phosphate stripping will not be feasible.

6.4.24 It will therefore not be possible for the Environment Agency to increase the consented effluent P concentration at Dereham WwTW unless they are able to tighten the standards for another WwTW in order to ensure that the overall phosphorus loading the River Wensum SAC does not increase. As such, it will not be possible to route all planned new development at Dereham through Dereham WwTW without contravening the Habitats Directive. In order to deliver the planned scale of housing it is therefore essential to explore options to reroute the wastewater to other WwTW's (that either do not discharge to the River Wensum, or which do discharge to the Wensum but have sufficient capacity to receive the additional volumes while adhering to phosphate standards).

6.4.25 Despite this, a review of catchment, or diffuse sources of P in the catchment has been undertaken. This review is reported in detail in Appendix C: Breckland Phosphorus Review, with relevant issues discussed in the proceeding section.

**Catchment Review of Phosphorus Sources**

6.4.26 The River Wensum catchment, which includes Wendling Beck, was identified for the England Catchment Sensitive Farming Initiative Delivery (ECSFID) programme due to high predicted P and sediment loss to watercourses. The catchment's main priority problem is run off from agricultural fields which contains sediment and associated phosphate. Modelling data and anecdotal evidence has indicated that there is potentially a high risk of diffuse water pollution from agriculture.

6.4.27 The ECSFID results, as provided in Table C-5 of Appendix C: Breckland Phosphorus Review (included below Table 6-13) have been assessed to calculate the P loading from Wendling Beck (which receives the wastewater discharge from Dereham wastewater treatment works) in relation to the rest of the catchment and downstream monitoring point on the River Wensum at Sweet Briar Road Bridge. The results indicate that the Wendling Beck catchment (which contains Dereham WwTW), contributes 9% of the total Soluble Reactive Phosphorus (SRP) load and 11.1% of the Total Phosphorus load in the Wensum catchment (based on observations at the downstream monitoring location – Wensum at Sweet Briar Road Bridge).

6.4.28 Assuming Dereham WwTW discharges the additional wastewater generated as a result of the proposed growth in the town (909 properties and 1,800 jobs accounting for an additional 412 $m^3$ Dry Weather Flow per day) to Wendling Beck at a concentration of 1 mg/l (mean), this would result in an additional 0.412kg/d of load being discharged to the watercourse; an additional 150.5 kg/pa. Under future conditions, assuming all other contributions to the Wendling Beck and Wensum catchments remain the same and there is not dissolving of P in the watercourse, the P load in the Wendling Beck would increase by 9% to 1,863.5 kg/pa. This would result in an increased loading to the Wensum catchment of 0.8%, and Wendling Beck contributing 9.8% of the load observed at the downstream of the Wensum catchment.

**Table 6-13: Percentage contribution of SRP and Total P throughout the Wensum Catchment**

| Site Order | Site Name | Soluble Reactive Phosphorus | | Total Phosphorus | |
|---|---|---|---|---|---|
| | | Load (Kg/pa) | % Contribution of load observed at downstream Wensum | Load (Kg/pa) | % Contribution of load observed at downstream Wensum |
| 1 | Wensum at Black Lane Worthing | 304 | 1.6% | 434 | 1.8% |
| 2 | Wensum at Helhoughton Bridge | 689 | 3.6% | 845 | 3.5% |
| 3 | Tat at Tatterford Common | 2,263 | 11.9% | 2,347 | 9.7% |
| 4 | Wensum at Sculthorpe Mill | 3,311 | 17.5% | 3,798 | 15.7% |
| 5 | **Wendling Beck** at Worhting Bridge | 1,713 | **9.0%** | 2,685 | **11.1%** |
| 6 | Wensum at Swanton Morley Bridge | 7,683 | 40.6% | 11,906 | 49.2% |
| 7 | Wensum at Great Withchingham Bridge | 11,910 | 62.9% | 18,170 | 75.1% |
| 8 | Tud at Costessey Park Bridge | 2,501 | 13.2% | 6,964 | 28.8% |
| 9 | Wensum at Sweet Briar Road Bridge | 18,939 | 100% | 24,180 | 100% |

6.4.29 It is considered that this additional load of P is relatively small in relation to the additional loading of P from catchment sources and other sources to the Wensum SAC as a whole. Modelling undertaken for the WCS has shown that 'load standstill' i.e. no increase in load from current loading, could be achieved if discharge from Dereham was restricted to 0.9mg/l (mean) of P. This is because the WwTW currently routinely operates beyond its consent of 1mg/l and hence a formal consent of 0.9mg/l would mean no net increase in load (see Table 6-9 – scenario E2). This modelling exercise reinforces the stipulation that the additional load of P into the Wensum catchment as a result of growth at Dereham would be low

6.4.30 Nevertheless, in order to be able to show that there would be no impact, a catchment model of the Wensum system would need to be re-run with the additional discharge limited to 1mg/l to determine whether downstream concentrations are likely to be increased beyond the thresholds indentified for qualifying features in Table 6-11.

6.4.31 Therefore, other options have been considered for discharge as part of this detailed WCS and these are described in the following sections.

## Wastewater Treatment Preferred Solution

### Option Identification

6.4.32 Following the conclusion of the initial assessment undertaken for this detailed WCS, a review of the Dereham flow figures was undertaken and discussed with Breckland DC and AWS. There is a significant difference between the measure DWF figure and the revised consent applied for.

6.4.33 In addition, AWS undertook a review of their predictions for changes in catchment population growth and have determined that with predicted movement of the population in Dereham, the overall occupancy rate of dwellings across the town will fall. This coupled with greater water efficiency from existing housing stock (as a result of demand management proposals in the WRMP) and with further policy controls on water efficiency for new development would reduce water demand from existing population, allowing a limited increase in overall housing stock over the plan period. AWS have estimated that up to 80 units per annum could be accommodated within the existing flow consent, preventing the need for the new proposed consent to be altered.

6.4.34 This position would mean that there would be no need to alter the flow consent or quality consent for Dereham, and that as long as growth is limited to 80 units per annum, then growth in Dereham can be accommodated. It should be noted that the 80 units per annum accommodates for the planned growth allocation for Dereham of 600 homes (i.e. 80 units per year cannot be build year on year once the allocated completion figure has been reached).

6.4.35 A result of this position is that Breckland's growth trajectory will need to be limited to 50-80 units per annum up until 2031 (but limited to 600 dwellings in total) and this is reflected in the infrastructure timeline reported in Figure 6-4. It is also recommended that a policy is put forward through the LDF for all new homes in Dereham to meet CfSH levels 3 or 4 as a minimum, with an aspiration to achieve levels 5 or 6. To achieve code levels 3 anf 4 it is mandatory for all homes to have a water use of 105l/h/d. Achieving such efficiencies in new homes in Dereham is essential to enusirng that the 50-80 new dwellings per annum can be accommodated at the existing WwTW.

### Option Funding and Responsibility

6.4.36 Although no specific changes are required to the consent at Dereham WwTW, AWS may need to make small upgrades or alterations to the treatment processes or hydraulic design of the WwTW in order to utilise the identified capacity within the flow consent. Any cost associated with these changes will be borne solely by AWS via the Price review and AMP process. Developers cannot contribute to upgrades at existing WwTW as they are not required specifically for the new development.

6.4.37 Delivery and maintenance of any upgrade to the WwTW will be the responsibility of AWS under the regulation of Ofwat, and the Environment Agency.

6.4.38 Changes required to the P consent at Dereham WwTW have been submitted as part of AWS's business plan for AMP5 and works to remove P to the 1mg/l standard will be implemented from this year.

### Alternative option Identification

6.4.39 Although up to 80 homes per annum can be accommodated in Dereham, a range of options have been provided in this detailed WCS should development beyond 80 units per annum (or 600 in

total over the plan period) be considered. Investigations into these options would need to be considered by the developer on a case by case basis to determine their suitability.

6.4.40 The potential options considered are included in Table 6-14.

**Table 6-14: Options Identified as part of Breckland Detailed WCS to Reduce, Manage and Discharge the Effluent Generated by Planned Growth in Dereham**

| Option | Description | Considerations |
|---|---|---|
| 1 | Demand Management | • Create capacity to avoid the need for a volumetric consent increase<br>• Code for Sustainable Homes Levels 5 & 6 for new homes<br>• Funding for the retrofitting of existing properties |
| 2 | Soakaways | • Discharging into the ground in respect of P, rather than discharging to surface water, may be the preferable option as P moves less readily in groundwater as it is absorbed to soil particles. A similar scheme may be adopted at Aylsham in the Broadland district due to limitations discharge from the Aylsham WwTW.<br>• This solution would require a risk assessment to be undertaken to determine the potential risk to groundwater quality. |
| 3 | Discharge of treated effluent to the River Tud (to the south of Dereham) | • Reduces impact on River Wensum<br>• Would require the building of a 2.5 - 3.5km pipe to transfer treated effluent to the River Tud<br>• Would require further investigation to impacts on River Tud which is currently classed as Moderate Ecological Potential (targeted to achieve Good Potential by 2027) |
| 4 | New WwTW (to southwest of Dereham) | • Will treat and discharge flow generated by new development to the River Tud<br>• This option could be considered via a package treatment plant serving new development or a new AWS owned and operated WwTW to the south of the town. This would also allow for new sewerage mains to be laid avoiding the sewer flooding problem areas in the town centre.<br>• Would require further investigation to impacts on River Tud which is currently classed as Moderate Ecological Potential (targeted to achieve Good Potential by 2027). |

**Further Option Funding and Responsibility**

6.4.41 If more than 80 dwellings are proposed per year (or for greater than 600 compeltions in totoal over the planned period), developers will need to consider options for wastewater treatment as listed in Table 6-14. Investigations into the feasibility of these options will need to be funded by the developer on a case by case basis, as it currently taking place for the nearby town of Aylsham.

6.4.42 Funding of the option would need to be borne by the developer. An option is available whereby developers pay directly for the construction of the discharge option (and any associated mains), and AWS adopt (or requisition) the infrastructure once it is built and take on the ongoing maintenance and operation. This option would require the infrastructure to designed and built to AWS's specific requirements; and as such, the developer would need to liaise with AWS over the detailed route, sizing and location of the infrastructure.

6.4.43 A further option would be for the developer to pay for the construction of the treatment infrastructure and for this to be operated and maintained by a third part which later charges customers of the development to utilise the infrastructure.

## 6.5 Wastewater Infrastructure

### Baseline Confirmation

6.5.1 The Breckland Outline WCS reported there may be scope for new housing development to be served by the existing trunk sewer that serves the WwTW if development is located to the west of the town. Any significant new development to the east of the town is likely to require new strategic infrastructure to supply the new development.

6.5.2 Figure 6-3 illustrates the existing wastewater network within Dereham.

### Wastewater Strategy Preferred Solution

**Solution Options**

6.5.3 Table 6-1 demonstrates that the preferred housing development sites are all located to east of the town centre. Modelling information provided by AWS suggests that there is no capacity for additional connections to the main trunk sewer running east to west along Norwich Road, which is the main sewer that the new development areas would need to connect to. Further commentary is provided in See Figure 6-3.

6.5.4 It is considered that the network to the south of the town in sufficient to accept flows from the proposed employment sites D4 and D5; therefore, no solution is required for these sites. This capacity would need to be confirmed as a pre-development application prior to planning for these sites.

6.5.5 It is considered that, due to the proposed level of housing in sites D1-D3 (in excess of 200 homes), that attenuation of wastewater is not a viable option. This was considered as a solution to attenuate (or store) sewage from new development; creating sewage storage tank for the proposed sites.

6.5.6 Based on good design practice, it is not recommended to store wastewater for attenuation for more than 20 to 30 minutes without any form of treatment because the stored sewage will turn septic and will emit odour causing a public nuisance. Flow attenuation tanks are allowed for in existing combined systems where the sewage is considerably diluted with storm water and is designed such that only very diluted sewage (more >6 DWF flow) is discharged into nearby watercourses. However, it is a proposed policy for this WCS that surface water and foul water for new development is separated out, therefore attenuation times would need to be low for the new housing development sites.

6.5.7 Any storage of sewage has the potential to emit odour and it would need to comply with the regulatory requirements of IPPC relating to odorous emissions as The Pollution Prevention and Control (England & Wales) Regulations 2000 (the “PPC Regulations”) define “pollution” as.: “emissions as a result of human activity which may be harmful to human health or the quality of the environment, cause offence to any human senses, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment.

6.5.8 It is therefore considered that an upgrade to the trunk sewer along Norwich Road is required to accommodate the proposed growth areas, or a new main is constructed linking each development site and running parallel to the A47 to the south of the town before routing to the WwTW to the west.

**Proposed Solution**

6.5.9 The proposed solution is an upgrade to the existing Norwich Road trunk sewer. The proposed route would be to upgrade the main sewer along the Norwich Rd, along Norwich Street, up north High Street via Quebec Street and to then connect to the main sewer trunk of 450mm diameter at Swaffham Road. The route is detailed in Figure 6-3.

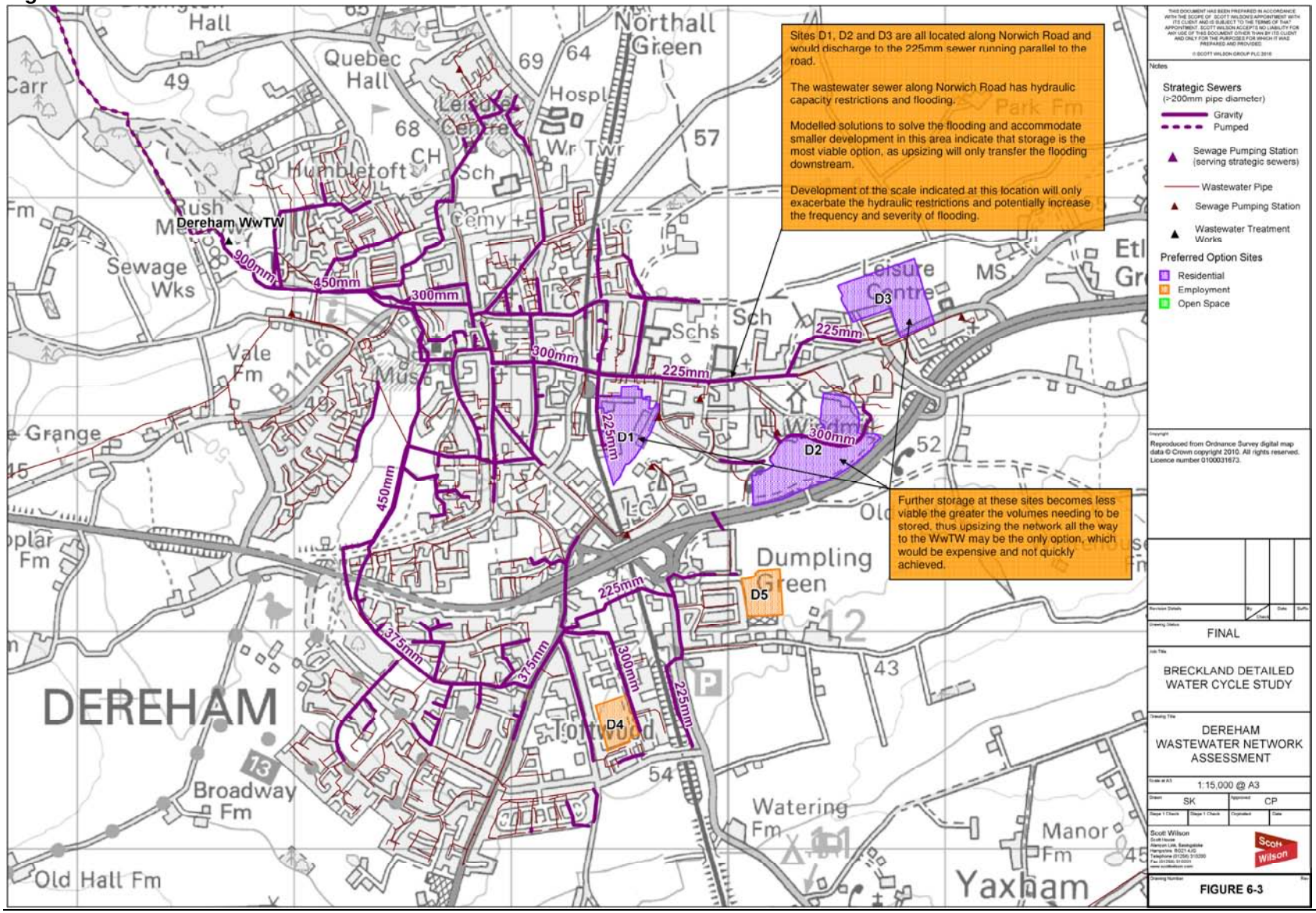
6.5.10 The construction of the upgrade would require sufficient time to phase the development to minimise disruption to existing wastewater flows and disruption through the town centre; therefore, a lead in time of at least four years would be required to construct and commission before new development could connect and be occupied.

**Option Funding and Responsibility**

6.5.11 The costs for the new (or upgrade to the) wastewater main through Norwich Road should be part borne by the developer. It is considered that the new infrastructure would not be solely funded by the developer because it could aid in alleviating existing sewer flooding problems in Dereham town centre (and hence benefit existing properties) and could free up further capacity for further connections. Details of indicative costs are provided in a separate technical note to Breckland Council which estimates the level of funding that might be appropriate for developers. Options for funding mechanisms are discussed further in Section 10 of this report.

6.5.12 The construction and operation of the wastewater main would be undertaken by AWS. However, an option is available whereby developers pay directly for the construction of the main and pumping station, and AWS adopt (or requisition) the infrastructure once it is built and take on the ongoing maintenance and operation. This option would require the infrastructure to designed and built to AWS's specific requirements; and as such, the developer would need to liaise with AWS over the detailed route, sizing and location of the infrastructure.

## Figure 6-3: Dereham Wastewater Network



## 6.6 Flood Risk Management

### Management of Flood Risk to Development

6.6.1 The Level 1 SFRA describes Dereham as the county "hotspot" for sewer flooding and there are documented problems with the capacity of the Dereham Stream and the foul sewerage in Dereham.

6.6.2 Table 6-15 provides an assessment of the flood risk to proposed development in Dereham based on the findings of the Level 1 SFRA undertaken for the Breckland District. The assessment shows that some of preferred options site D3 lies within Flood Zone 3 whilst there has been a recorded sewer flooding event just north of site D4 on Rash's Green. The recorded sewer flooding event is not reported to have affected the proposed D4 development site and is considered to be limited in extent flood and therefore is there is not considered to be a flood risk to site D4. Though some of site D3 lies within Flood Zone 3 of the Neat herd Moor Drains and blockages have been reported within the ordinary watercourses along the northern boundary of the site, flooding from the smaller drains which run through the development site is considered to be limited in extent due to the size of the drains and their catchment. Therefore, it is considered that the risk of flooding to development within this site is limited and with appropriate mitigation measures, i.e. not building within the flood zones and ensuring finished floor levels are above the flood levels, there is no constraint to development at this site. There is not considered to be a flood risk to the preferred options sites D1, D2 and D5 within Dereham.

## Table 6-15: Dereham Flood Risk to Development Assessment

| Preferred Option Site | Development Type | Area (Ha) | Flood Risk Constraints | | | | Flood Risk Assessment |
|---|---|---|---|---|---|---|---|
| | | | Fluvial | Critical Drainage/ Surface Water Flooding | Groundwater | Artificial Water Sources | |
| D1 | Residential | 7.2 | × | × | × | × | Dereham Stream flood zone to south east boundary of site.<br><br>**There is considered to be no flood risk to development at this site; however, the sequential Test would need to be applied on a site basis to locate appropriate development within the lowest flood risk zones first** |
| D2 | Residential | 13.7 | × | × | × | × | Surface water flooding events recorded to east and west of site along A47.<br><br>SFRA L1 assesses that there is no flood risk to the development.<br><br>Storm and foul water sewage drainage networks have already been put in at the site.<br><br>**There is considered to be no flood risk to development at this site.** |
| D3 | Residential | 8.8 | ✓ | × | × | × | Ordinary watercourses (Neatherd Moor Drains) on site which contain Flood Zone 3.<br><br>Blockages have been reported in larger watercourse running along northern boundary of site.<br><br>Flooding from smaller drains into larger watercourse would be limited in extent due to size of drains and catchment.<br><br>**SFRA L1 assesses that the risk of flooding to possible development is limited. Sequential Test would need to be applied on a site basis to locate appropriate development within the lowest flood risk zones first** |
| D4 | Employment | 3.2 | × | ✓ | × | × | Recorded sewer flooding event just north of site, on Rash's Green.<br><br>**There is considered to be no flood risk to development at this site.** |
| D5 | Employment | 3.4 | × | × | × | × | **There is considered to be no flood risk to development at this site.** |

## Management of Flood Risk from Development

6.6.3 It is particularly important to provide sufficient attenuation and long term storage in this area to mitigate against an increase in flood risk to existing development close to drainage pathways.

6.6.4 Table 6-16 provides the potential attenuation requirements for the preferred option sites in Dereham. The calculations have been undertaken for two development assumptions: a 90% hardstanding coverage and 80% hardstanding

**Table 6-16: Attenuation Requirements for Preferred Options Sites in Dereham**

| Pref Option Site | Approx area | | Geology and soils | SPZ | Greenfield Runoff Rates (l/s) | | Max. Storage ($m^3$) | | Max. Storage using infiltration ($m^3$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 90% Area | 80% Area | | | 90% Area | 80% Area | 90% Area | 80% Area | 90% Area | 80% Area |
| D1 | 6.3 | 5.6 | Heterogeneous geology, slowly permeable soils | Zone 2/3 | 94 | 84 | 4,159 | 3,697 | 4,183 | 3,718 |
| D2 | 12.6 | 11.2 | | None | 189 | 168 | 8,319 | 7,395 | 8,367 | 7,437 |
| D3 | 8.1 | 7.2 | Mostly permeable geology but slowly permeable soils | Mostly none, partly Zone 3 | 121 | 108 | 5,348 | 4,754 | 5,378 | 4,781 |
| D4 | 2.7 | 2.4 | Heterogeneous geology, slowly permeable soils | None | 40 | 36 | 1,783 | 1,585 | 1,793 | 1,594 |
| D5 | 2.7 | 2.4 | | None | 40 | 36 | 1,783 | 1,585 | 1,793 | 1,594 |

**Potential SuDS at Dereham**

6.6.5 In general, the soils at Dereham are believed to be mainly impermeable and hence may not be suitable for infiltration methods of surface water management. Therefore, it is likely that surface water management at the Dereham sites would need to utilise source control methods such as green roofs, storage via permeable paving reservoirs or on-site storage such as retention basins or ponds. Given the site sizes and potential land take, sites D1, D2 and D3 would be potentially more viable for surface storage such as wet ponds. Deeper soakaways may be a possibility.

6.6.6 Should site investigations indicate that soils at Dereham are more permeable than indicated in Table 6-16 then infiltration methods should be investigated. Sites D1 and D3 could potentially be constrained by the proximity of these sites to a SPZ and so should be informed by a contaminated land assessment.

6.6.7 Appendix E: SuDS Calculations contains a summary of the model parameters and results from the Microdrainage WinDes attenuation volume calculations for Dereham.

**Option Funding and Responsibility**

6.6.8 The costs for SuDS required at Thetford to meet with the requirements of PPS25, will be borne solely by the developer and the detailed requirements for them should be developed via a site specific FRA. However, it is the responsibility of the LPA (in this case Breckland Council) to ensure a funding mechanism is put in place when granting permission under the Flood and Water Management Act. Options for securing this funding are included in section 10 of this report.

6.6.9 Delivery of SuDS will be the responsibility of the developer; however the 'approving body' under the Flood and Water Management Act must approve the SuDS prior to construction. In most cases, ongoing maintenance of SuDS will also be the responsibility of the approving body under the Flood and Water Management Act as part of wider surface water management responsibilities. The approving body is the unitary authority which for Breckland will be Norfolk County Council.

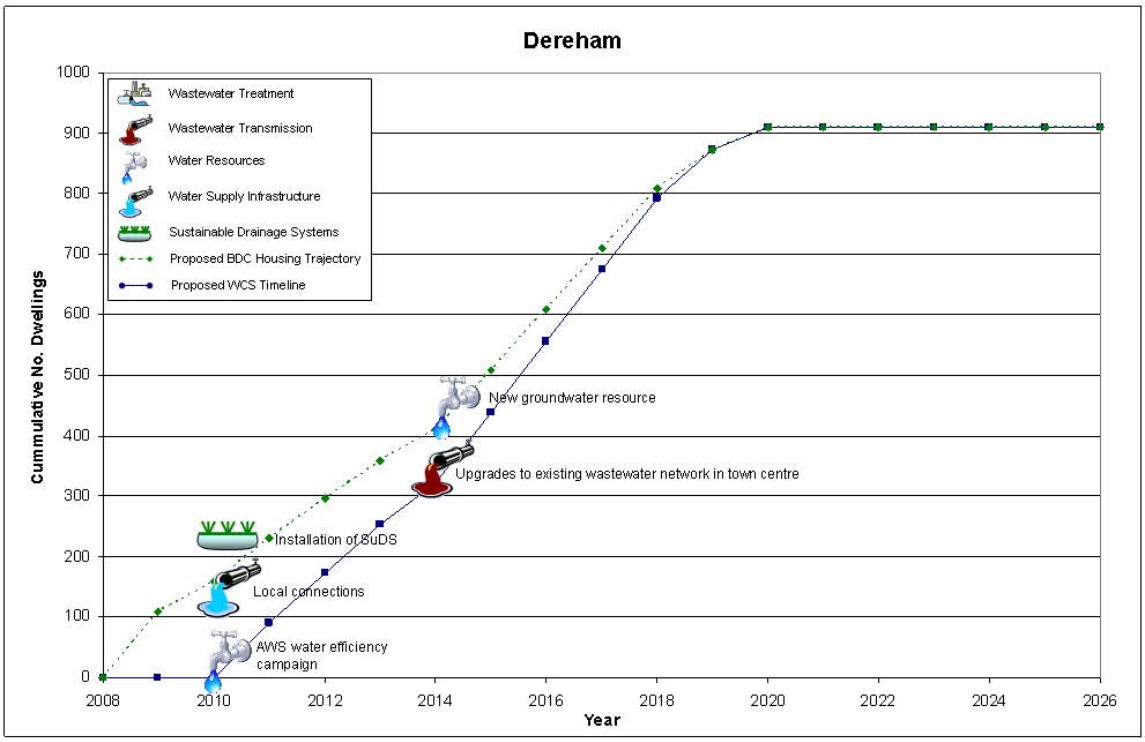
## 6.7 Infrastructure Phasing

6.7.1 Figure 6-4 provides the infrastructure timeline for Dereham. This is based on the conclusions from the water resources, wastewater treatment and infrastructure and flood risk management assessments. The timeline is based on a number of assumptions as detailed below.

**Assumptions**

- Local connections to the existing water mains serving the development areas will be required for supplying water to the development sites in Dereham. This will require a lead-in time of 1 year, i.e. operational in 2011;
- Dereham has known sewer flooding problems and limited capacity in the existing wastewater network. The wastewater network will require upgrading (subject to detailed modelling to confirm capacity in the existing network) and is expected to take 4 years to complete assuming a 2010 start date (subject to funding agreement and approval);
- Until such time as the wastewater network upgrades are completed (2014), large-scale development (other than small infill, such as 5-10 dwellings) cannot take place within Dereham;
- A new groundwater resource scheme will be required in 2014 to supply water to new development in Dereham. Until then a water efficiency campaign will be run by AWS to overcome shortfalls in the early part of AMP5 (2010-13); and,
- The development sites will require the installation of SuDS but this is not expected to impact on the development timescales.

**Figure 6-4: Dereham Infrastructure Timeline**



# 7 Swaffham Growth Town Assessment

## 7.1 Introduction

7.1.1 Swaffham is a mid-sized market town that provides a good range of services for day-to-day needs but has a limited capacity for expansion in the centre due to the constraints of its heritage buildings.

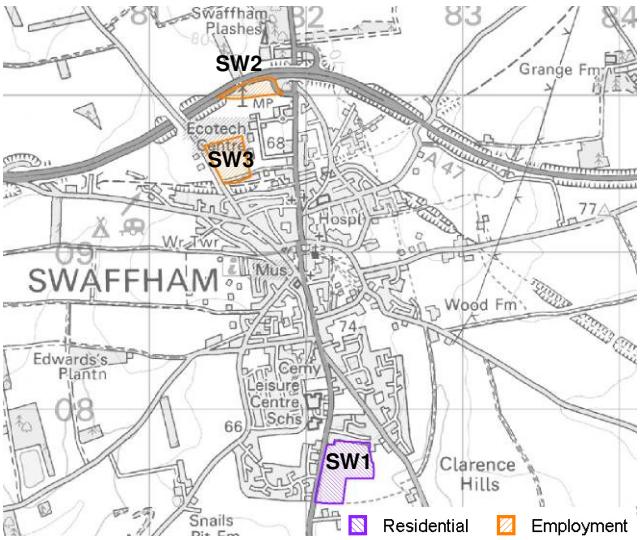
7.1.2 The Breckland Spatial Strategy[49] identified Swaffham as having limited potential for economic growth, with land around the Ecotech Centre in Swaffham, to the northwest of the town, being identified as being allocated for development. Swaffham is targeted with providing 1,000 new homes and 650 jobs over the plan period (2001-2026).

7.1.3 Table 7-1 provides the housing and employment growth figures for Swaffham for the period 2008 - 2026. Figure 7-1 shows the proposed phasing of the planned housing growth.

**Table 7-1 Housing and Employment Growth in Swaffham (2008 – 2026)**

| Housing | No. of Dwellings |
|---|---|
| Already Built (as of April 2008) | 214 |
| Currently Permitted (as of April 2008) | 499 |
| New Allocations | 250 |
| Total | 963 |
| **Housing to be Assessed (= Total – Already Built)** | **749** |

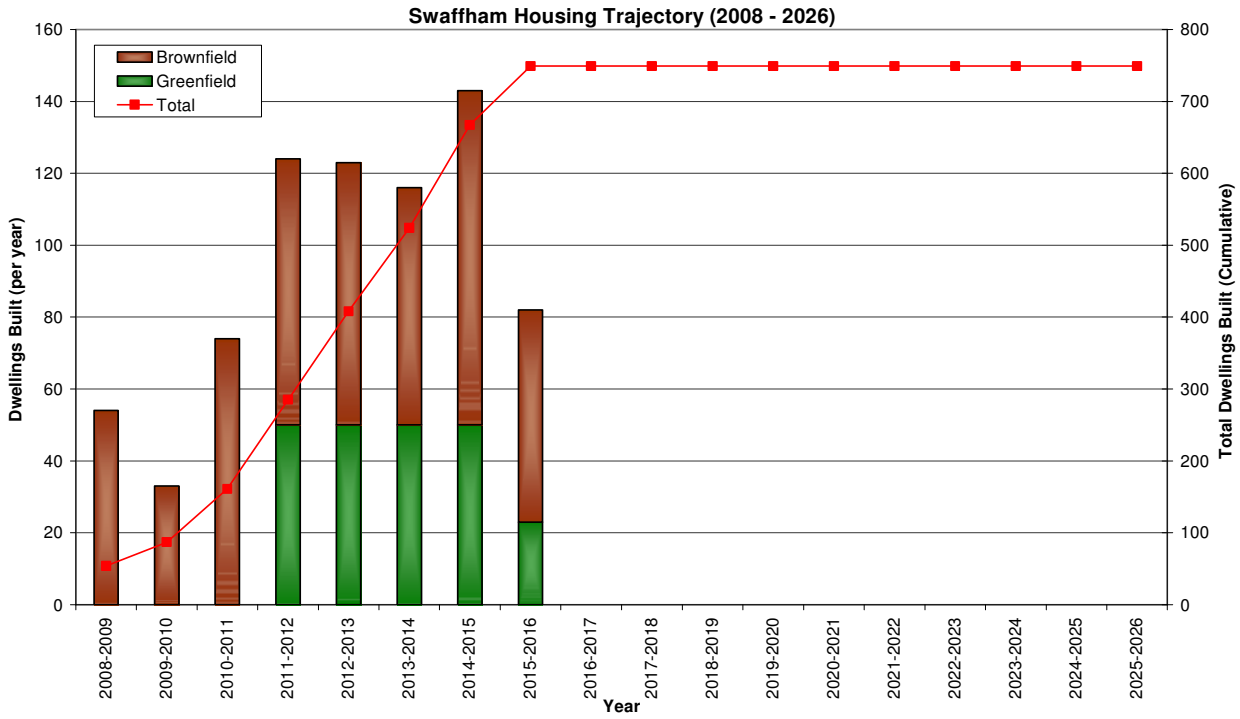
| Employment | Jobs |
|---|---|
| Proposed Jobs | 300 - 650 |
| Land Required | 5 hectares |
| **Employment to be Assessed** | **650** |

| Location of Development |
|---|
|  |



[49] Core Strategy and Development Control Policies DPD – Adopted 2009, Breckland District Council, 2009

**Figure 7-1 Housing Growth in Swaffham (2008 – 2026)**




## Outline WCS Findings

7.1.4 The Breckland Outline WCS was completed in November 2008 and highlighted the following key issues in terms of the water cycle and infrastructure for Swaffham:

- It is predicted that Swaffham will have a water supply deficit by 2026. In the short-term there is likely to be capacity in existing abstraction licences to meet the increased demand but Increase in the use of the existing abstraction licence capacity (in conjunction with Watton) has the potential to impact on one European designated site. Additionally there is limited spare capacity in the existing groundwater and surface water and hence significant investment in new water resources is required long-term;
- as with Dereham, a theoretical decrease in net water demand is possible which could alter the requirement for new resources;
- Swaffham WwTW has available capacity in terms of the additional effluent discharge it can process up to 2026, but with the increased effluent load and more stringent water quality standards under the WFD there may be a requirement to tighten the BOD, ammonia and Phosphate effluent discharge consents;
- the existing wastewater network infrastructure within Swaffham will require a new trunk sewer draining directly to the WwTW to serve development to the south of the town. Similarly, development to the west of the town would require significant strategic infrastructure to serve this area. Small sized developments could be accommodated with existing infrastructure in northeast of the town; and
- Historically sewer flooding has been reported in the north of the town. However, suitable development options exist that will avoid flood risk areas or allow mitigation of the flooding

sources by. Additionally, assessments have shown that the physical capacity of the River Wissey is sufficient to accommodate the additional wastewater discharge generated by the growth in the town, without increasing flood risk downstream.

## 7.2 Water Resources

### Baseline Confirmation

7.2.1 The Breckland Outline WCS reported that Swaffham will have a water supply deficit by 2026. In the short-term there is likely to be capacity in existing abstraction licences to meet the increased demand but Increase in the use of the existing abstraction licence capacity (in conjunction with Watton) has the potential to impact on one European designated site (Norfolk Valley Fens SAC), five water sensitive Sites of Special Scientific Interest and four County Wildlife Sites. Additionally there is limited spare capacity in the existing groundwater and surface water resources which could limit development of local sources further significant investment in new water resources is required long-term, e.g. by strengthening the links between Swaffham and Watton, allowing water to be pumped from the Carbrooke borehole near Watton, or from the Great Ouse Groundwater Scheme (GOGS).

7.2.2 The Residential Demand (RD) scenarios as defined in the Water Resources Methodology (Section 3.2) have been modelled for the proposed residential growth in Swaffham (Table 7-2).. The results show that the new houses would demand around 0.26 Ml/d if they were built to current specifications and water use (142 l/h/d). The lowest demand estimate from new housing development (Scenario 4 – CSH 5&6 at 80 l/h/d) would demand around 0.14 Ml/d.

**Table 7-2 Residential Demand for Planned Growth in Swaffham[50]**

| Scenario | | Water Use Rate (l/h/d) | Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|
| 1a | Water Company Forecast (Current) | 142 | 0.24 | 0.26 |
| 1b | Water Company Forecast (2035) | 130 | 0.20 | 0.22 |
| 2 | Code for Sustainable Homes 1&2 | 120 | 0.19 | 0.21 |
| 3 | Code for Sustainable Homes 3&4 | 105 | 0.17 | 0.19 |
| 4 | Code for Sustainable Homes 5&6 | 80 | 0.13 | 0.14 |

7.2.3 The Non-Residential Demand (NRD) has been calculated for the proposed employment growth in Swaffham, based on a percentage of the residential demand (see Water Resources Methodology (Section 3.2)). Taking the minimum RD (Scenario 4) and the maximum RD (Scenario 1a) for planned growth in Swaffham (Table 7-2), the NRD has been estimated for the water demand scenarios (Table 7-3). This shows that water demand from employment growth could range from between around 0.02 Ml/d to 0.1 Ml/d (with an allowance for headroom) depending on the final land allocation for employment sites, and the job types that are created.

[50] Lowest demand in green, highest demand in red

**Table 7-3 Non-Residential Demand for Planned Growth in Swaffham[31]**

| RD Scenario | NRD Scenario | | Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|
| 1a | 5 | Lowest Estimate of Non-Residential Land Allocation | 0.04 | 0.05 |
| | 6 | Highest Estimate of Non-Residential Land Allocation | 0.09 | 0.10 |
| 4 | 5 | Lowest Estimate of Non-Residential Land Allocation | 0.02 | 0.02 |
| | 6 | Highest Estimate of Maximum Non-Residential Land Allocation | 0.04 | 0.05 |

7.2.4 The total water demand from new development in Swaffham will therefore range from around 0.2 Ml/d to 0.4 Ml/d (Table 7-4), but the lower estimate would be dependent on new houses being built to a CSH 5&6 level, with a water demand of 80 l/h/d and the lowest estimate of non-residential demand. In reality, the water demand exerted from the new development in Swaffham is likely to be towards the higher end of the range, unless policy is included to stipulate that all new residential development needs to meet a CSH level requirement. Recommended policy is included in section 11

**Table 7-4 Highest and Lowest Total Demand Estimates for Planned Growth in Swaffham**

| RD Scenario | | NRD Scenario | | Total Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|---|
| 4 | Code for Sustainable Homes 5&6 | 5a | Lowest Estimate of Minimum Non-Residential Land Allocation | 0.15 | 0.17 |
| 1a | Water Company Forecast (Current) | 6b | Highest Estimate of Maximum Non-Residential Land Allocation | 0.33 | 0.36 |

7.2.5 The assessment presented here is in terms of the additional water demand generated by the new development, under a range of water demand scenarios. However, the changing behaviour of the existing population, and retrofitting of water saving devices into existing properties has the potential to lower the total future water demand for Swaffham, and should be considered as part of any future water demand assessment. This is discussed in more detail in the Water Efficiency section below.

## Solution Refinement

7.2.6 AWS's final WRMP identifies no deficits in the supply/demand balance through to 2025/26 within Swaffham. The amount of growth forecast to take place in Swaffham is comparatively small and will be met from spare groundwater sources (within their existing licence capacity). The most likely sources are all those located within Breckland.

7.2.7 The extra Deployable Output[51] available to meet the extra demands in Swaffham are based on the assumption that re-distributed Carbrooke, Beetly & Dereham and Old Buckenham Boreholes sources will be used to satisfy growth in Breckland.. The above sources have all received investment during the AMP4 period (2005-10), as reported in AWS's final WRMP. The available

[51] Deployable Output is the water which is available for supply during dry years

resources are shown in Table 7-5. It is has been assumed that there is no loss of Deployable Output from any existing sources within Swaffham as a consequence of the Environment Agency's Review of Consent Process.

**Table 7-5 Available Spare Water Resources to Supply Swaffham**

| Resource Options | Average Deployable Output (Ml/d) |
|---|---|
| Maximise Spare Groundwater Licence | 1-2 |

## Preferred Solution

7.2.8 The phasing of water resource developments within Swaffham will depend on future water use rates. These could range between 0.4 Ml/d (Scenario 1a - high water demand) and 0.2 Ml/d (Scenario 4 - low water demand). Table 7-6 shows the phasing of water resource developments in Swaffham based on the high and low water demand scenarios.

**Table 7-6 Phasing of Water Resource Developments in Swaffham (excluding impacts of Climate Change)**

| Source | High Water Demand (RD Scenario 1a) | Low Water Demand (RD Scenario 4) |
|---|---|---|
| Maximise Spare Groundwater Licence | Incrementally from 2009 | Incrementally from 2009 |

7.2.9 Under both the high and low water demand scenarios, the extra groundwater to be abstracted from sources with spare licensed capacity will be sufficient to last through to end of planning period (2025/26). Therefore, no new solution is required.

**Option Funding and Responsibility**

7.2.10 Delivering water efficiency in new homes will be the responsibility of the developer and the cost (of construction and maintenance) will be borne solely by the developer.

7.2.11 Some water efficiency and water saving methods are proposed for *existing* development by AWS as part of their twin-track approach to managing water resources in the region. These elements (such as meter penetration, and provision of water butts for existing homes) are funded solely by AWS as part of the Price review and AMP process, and also from AWS own investment. Water meters are provided for new properties by AWS as standard practice.

### Climate Change Impacts

7.2.12 The effects of climate change (CC) on water resources supplying Swaffham are presented in Table 7-7.

**Table 7-7 Effects of Climate Change on Available Water Resources to Swaffham**

| Resource Options | CC effects | Comment |
|---|---|---|
| Maximise Spare Groundwater Licences | Negligible | A reduction of 0.22 Ml/d by 2035 for all groundwater sources within Breckland. |

7.2.13 In general, the heavy reliance on groundwater within Breckland and the resilience of its storage to changes in groundwater levels will mean that the impacts of CC are relatively minor and will not require the addition of a new resource within the plan period.

7.2.14 AWS's final WRMP includes a commitment to investigate further the affects of the UKCP09 scenarios in the lead-up to the next periodic review process in 2015.

### Ecological Issues

7.2.15 The amount of growth forecast to take place in Swaffham is comparatively small and will be met from spare groundwater sources (within their existing licence capacity). The most likely source are those located within Breckland. Since the necessary water resources are within the limits of the existing licences their impact upon European sites will have already been considered through the Environment Agency's Review of Consents process. As such there is no need for further consideration in this Water Cycle Study.

## 7.3 Water Supply Infrastructure

7.3.1 The water supply network has been supplied by AWS for analysis in this Phase 2 WCS. Adequate supply mains pass through, or are located close to all proposed development sites in Swaffham. However, the developers would be responsible for funding local connections on a house by house basis.

7.3.2 Costs for dwelling connections for water supply are usual costs borne by the developer for any new housing developer and as such are not considered in this WCS.

## 7.4 Wastewater Treatment

### Baseline Confirmation

7.4.1 The Breckland Outline WCS reported that Swaffham Wastewater Treatment Works (WwTW) generally has sufficient wastewater treatment capacity (in terms of volumetric and quality consent headroom) to accommodate growth up to 2026.

7.4.2 However, with the increased effluent load and more stringent water quality standards under the WFD there may be a requirement to tighten the BOD, ammonia and Phosphate effluent discharge consents;

### Wastewater Treatment Volumetric (Consent) Capacity

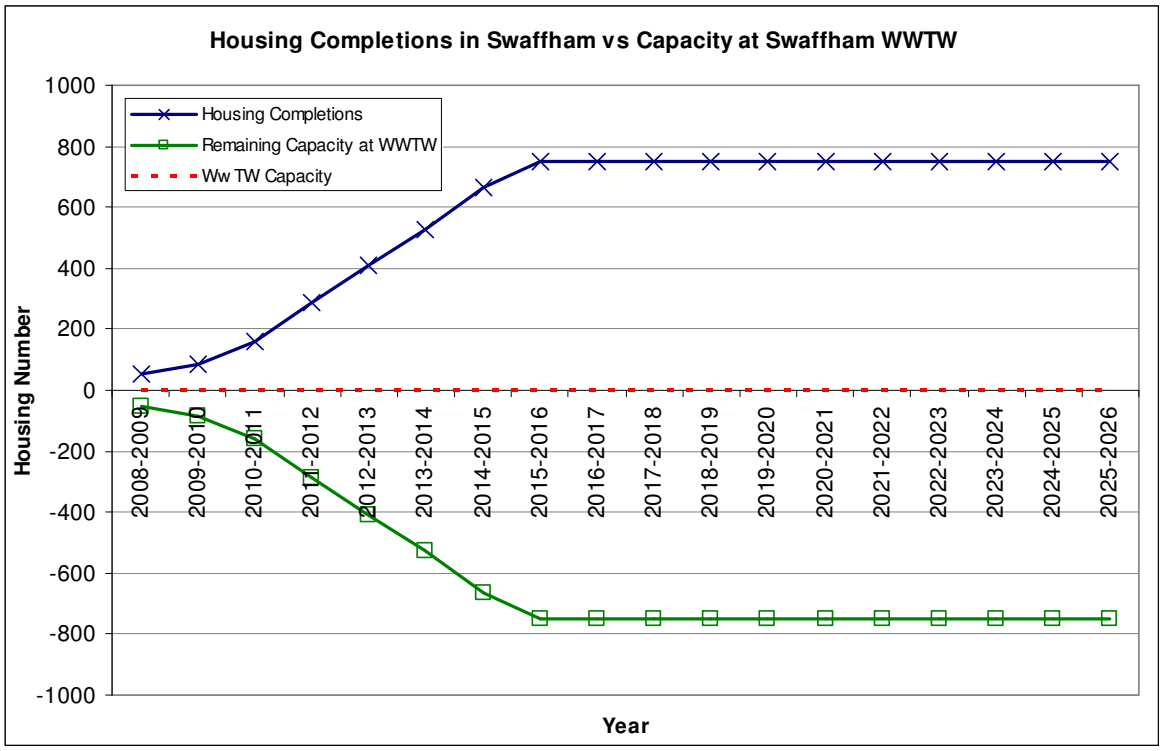
7.4.3 The current consented Dry Weather Flow (DWF), and therefore volumetric consent capacity, for Swaffham WwTW is 997 $m^3$/d. However, a new proposed consent of 1,602 $m^3$/d, as agreed by the Environment Agency and AWS, is expected to be in force in early 2010 and therefore for the purposes of this WwTW assessment, the new consent has been used.

7.4.4 The measured flow for the WwTW, as provided by AWS, is 452 $m^3$/d. However, under the new consent it is assumed that the flow being treated at the works is equal to the new consent and therefore there is no further capacity for further growth without the requirement to apply for a new flow consent to treat and discharge that DWF. As such, this assessment assumes that there is no volumetric consent capacity to accommodate flow from further wastewater.

7.4.5 Swaffham is expected to provide 749 homes and 650 'commercial' jobs by 2026, equating to an increase in the current Population Equivalent (PE) and flow of 1,798 and 339 $m^3$/d respectively. AWS will need to apply for a new DWF (and associated quality) consent to treat this additional flow before any additional flow generated from new development can be treated and discharged from the works.

7.4.6 Figure 6-2 shows the phased housing development and corresponding volumetric consent capacity at the works during the period 2008 – 2026. Details of the volumetric consent capacity are included in Appendix H: WwTW Capacity Calculations.

**Figure 7-2 Proposed Housing Development in Swaffham and Capacity at Swaffham WwTW (2008 - 2026)**



### Wastewater Treatment Quality (Consent) Capacity

7.4.7 Swaffham WwTW discharges into the River Wissey, which is classified as a salmonid fishery. The Environment Agency monitoring observations for the period 2004 – 2008 show that, under current conditions, the River Wissey will achieve WFD 'good ecological status' proposed standards upstream of Swaffham WwTW for BOD and DO, 'high ecological status' for Ammonia and 'poor ecological status' for Orthophosphate (P). Downstream of the works, the BOD and Ammonia standard for 'high ecological status' will be achieved and there will be marginal compliance of the 'good ecological status' for DO; the P standard will not be achieved.

7.4.8 As the River Wissey is classified as a Salmonid Fishery, different water quality objectives apply to the other assessed watercourses in the Breckland District. As a lowland, high alkalinity Salmonid Fishery, the upland, low alkalinity WFD standards are applied for DO and BOD; for Ammonia and P, the lowland, high alkalinity standards are used. This means that the River Wissey has a more stringent standard to achieve under the WFD due to its current salmonid designation.

7.4.9 The proposed WFD standards for both lowland and high alkalinity and upland and low alkalinity typology waters are provided in Table 3-4 and Table 3-5 respectively. The assessment of the Environment Agency monitoring results for the River Wissey upstream and downstream of Swaffham WwTW against the proposed WFD standards are provided in Table 7-9. The WFD status and classification information provided in Table 7-9 is summarised from the Anglian RBMP as submitted to the Secretary of State for approval on 22 September 2009. The WFD classification for Biochemical Oxygen Demand (BOD) is based on the monitoring information provided by the Environment Agency against proposed WFD standards, as BOD is not specifically reported within the Anglian RBMP.

### Table 7-8 WFD Assessment of Environment Agency Monitoring Results Upstream and Downstream of Swaffham WwTW

| Sampling Point Code | | 48M03 | | | | | 48M06 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | | River Wissey (Upstream of Swaffham WwTW) | | | | | River Wissey (Downstream of Swaffham WwTW) | | | | |
| Stretch | | Necton – Lower Farm South Pickenham | | | | | Lower Farm South Pickenham – Dugmore Farm | | | | |
| Easting | | 586600 | | | | | 583400 | | | | |
| Northing | | 306700 | | | | | 300900 | | | | |
| Water Quality Monitoring Data Assessment (against WFD Standards) | Year | 2004-2008 | | | | | 2004-2008 | | | | |
| | Data | Average (mg/l) | Count | Std Dev (mg/l | 90/10%ile/ Average (mg/l) [WFD Target] | WFD Status | Average (mg/l) | Count | Std Dev (mg/l | 90/10%ile/ Average (mg/l) [WFD Target] | WFD Status |
| | BOD | 1.70 | 45 | 1.34 | 3.84 | | 0.90 | 45 | 0.52 | 1.80 | |
| | Ammonia | 0.12 | 57 | 0.24 | 0.26 | | 0.05 | 57 | 0.08 | 0.10 | |
| | DO as % Sat | 92.55 | 56 | 15.60 | 76.01 | | 90.27 | 57 | 12.01 | 77.40 | |
| | Orthophosphate | 0.44 | 57 | 0.51 | 0.44 | | 0.27 | 57 | 0.17 | 0.27 | |
| WFD Classification | Water Body ID | GB105033047890 | | | | | GB105033047890 | | | | |
| | Hydromorphological Status | Not Designated | | | | | Not Designated | | | | |
| | Current Overall Status | Poor | | | | | Poor | | | | |
| | Current Ecological Status | Poor | | | | | Poor | | | | |
| | Current Chemical Status | N/A | | | | | N/A | | | | |
| | Overall Status Objective | Good Ecological Status by 2027 | | | | | Good Ecological Status by 2027 | | | | |

| Key | |
|---|---|
| **WFD Target** | **WFD Classification Status** |
| Pass WFD 'Good' Target | High Status |
| Marginal Pass (Within 10%) | Good Status |
| Fail WFD 'Good' Target | Moderate Status |
| | Poor Status |
| | Bad Status |
| | N/A – Does Not Require Assessment |

7.4.10 Indicative consent standards have been calculated for Swaffham WwTW based on the proposed growth by Breckland District Council within Swaffham; this will result in Swaffham WwTW treating 1,941 $m^3$/d of wastewater by 2026. The consents have been calculated for the modelling scenarios defined in Section 3.3.

7.4.11 Table 7-9 shows the consents required based on the proposed phasing of growth. This assumes that the river is either achieving 'good ecological status' (GES) or 'high ecological status' (HES) upstream of the discharge based on the methodology discussed in Section 3.3. For this

assessment the downstream river quality results for BOD were used to represent the upstream water quality as no midclass estimate was provided by the Environment Agency for BOD 'high' water quality status for salmonid (i.e. upland and low alkalinity) watercourses.

7.4.12 The no deterioration scenarios assume the P consent of 2mg/l (Mean).

7.4.13 The modelling results show that under future growth conditions and in compliance with the WFD, Swaffham WwTW will need to be treating effluent from the works to a standard of 9 mg/l (95%ile) BOD, 0.5 mg/l (95%ile) Ammoniacal-N, and 0.3 mg/l (Mean) Phosphorus. The BOD consent is achievable within Best Available Technology Not Entailing Excessive Cost (BATNEEC), but both the Ammoniacal-N (0.5 mg/l, 95%ile) and Phosphorus (0.3 mg/l, Mean) consents will require solutions beyond BATNEEC to treat the effluent to the required quality and comply with the WFD (Scenario B).

7.4.14 Both BOD and Ammonia are currently achieving high status in the watercourse downstream of the WwTW. If this status were allowed to deteriorate to 'good' (Scenario D), then there would be no requirement to tighten the existing BOD consent, and the Ammoniacal-N consent would require tightening to 1.5 mg/l (95%ile) which is achievable with BATNEEC.

7.4.15 Alternative discharge solutions will need to be investigated to identify how effluent from the proposed development within the town will be treated and discharged, particularly with regards to Phosphorous.

## Table 7-9: Swaffham WwTW Calculated Quality Consent Requirements

| | | BOD | | | | Ammonia | | | | P | | | | Planning Considerations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2010 | 2015 | 2020 | 2026 | 2010 | 2015 | 2020 | 2026 | 2010 | 2015 | 2020 | 2026 | |
| Current Consent | | 13 | | | | 3 | | | | - | | | | |
| Scenario A: Planned Deterioration | A1 | 10 | 9 | 9 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | × (NH4 & P) |
| | A3 | 10 | 9 | 9 | 9 | 0.6 | 0.5 | 0.5 | 0.5 | 0.3 | 0.3 | 0.3 | 0.3 | ✓ |
| Scenario B: Compliance with WFD | B1 | 10 | 9 | 9 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | × (NH4 & P) |
| | B3 | 10 | 9 | 9 | 9 | 0.6 | 0.5 | 0.5 | 0.5 | 0.3 | 0.3 | 0.3 | 0.3 | ✓ |
| Scenario C: Compliance with WFD (excl. P) | C1 | 10 | 9 | 9 | 9 | 1 | 1 | 1 | 1 | - | - | - | - | × (NH4) |
| Scenario D: WFD Deterioration | D1 | 13 | 13 | 13 | 13 | 2 | 1.5 | 1.5 | 1.5 | 1 | 1 | 1 | 1 | × (P) |
| | D2 | 13 | 13 | 13 | 13 | 2 | 1.5 | 1.5 | 1.5 | 0.3 | 0.3 | 0.3 | 0.3 | ✓ |
| Scenario E: Load Standstill (compliance with HD) | E1 | 12 | 10 | 10 | 10 | 2.5 | 2.5 | 2.5 | 2.5 | 2 | 1.5 | 1.5 | 1.5 | ✓ |
| | E2 | 12 | 10 | 10 | 10 | 2.5 | 2.5 | 2.5 | 2.5 | 2 | 1.5 | 1.5 | 1.5 | ✓ |
| **Recommended Consents** | | **9** | | | | **1** | | | | **1** | | | | |

| **Key** | No consent tightening required | Consent tightening within BATNEEC | Consent limited to BATNEEC | Consent beyond BATNEEC required |
|---|---|---|---|---|

## Table 7-10: Current WFD Status & Quality Consent for Swaffham WwTW

| Determinand | Current WFD Status U/S | Current WFD Status D/S | D/S WFD Standard (Required) | Current Quality Consent (mg/l) | Planned Change to Quality Consent (mg/l) |
|---|---|---|---|---|---|
| BOD | G | H | High - 3 mg/l (90%ile) | 15 | 13 (from 2015) |
| Ammonia | H | H | High - 0.3 mg/l (90%ile) | 10 | 3 (from 2015) |
| Orthophosphate | G | G | Good - 0.12 mg/l (Mean) | - | - |

### Wastewater Treatment Preferred Solution

#### Option Identification

7.4.16 AWS are in the process of applying for a new flow consent for Swaffham WwTW which will require improvements to meet the new tightened load balancing consent conditions. This new flow consent covers the current volume of wastewater treated and discharged by the works. To accommodate the proposed growth at the works, further improvements would be required and potentially another flow consent increase. The WwTW is known to have some flow compliance anomalies, which require resolution between AWS and the Environment Agency. The outcome of these discussions may affect the proposed flow consent increase application.

7.4.17 Via the wastewater working group, the Environment Agency and AWS consider that the problem with achieving compliance with the WFD targets downstream of the Swaffham WwTW discharge point is a result of the wastewater generated from the current population and that which has been approved (approximately 500 of the assessed 750 new dwellings). Therefore, they believe that the growth of approximately 250 dwellings will not materially alter the consent required to rectify the existing situation.

#### Option Funding and Responsibility

7.4.18 Although no specific changes are required to the quality consent at Swaffham WwTW specifically for proposed development, improvements are required at the WwTW to allow more flow to be treated and for tighter consents to be met to ensure downstream compliance with statutory water quality standards under the WFD as part of current operations. The WCS has identified these as issues with current wastewater volumes (and from extant planning permissions) and AWS will need to make upgrades or alterations to the treatment processes or hydraulic design of the WwTW. Any cost associated with these changes will be borne solely by AWS via the Price review and AMP process. Developers cannot contribute to upgrades at existing WwTW as they are not required specifically for the new development.

7.4.19 Delivery and maintenance of any upgrade to the WwTW will be the responsibility of AWS under the regulation of Ofwat, and the Environment Agency.

## 7.5 Wastewater Infrastructure

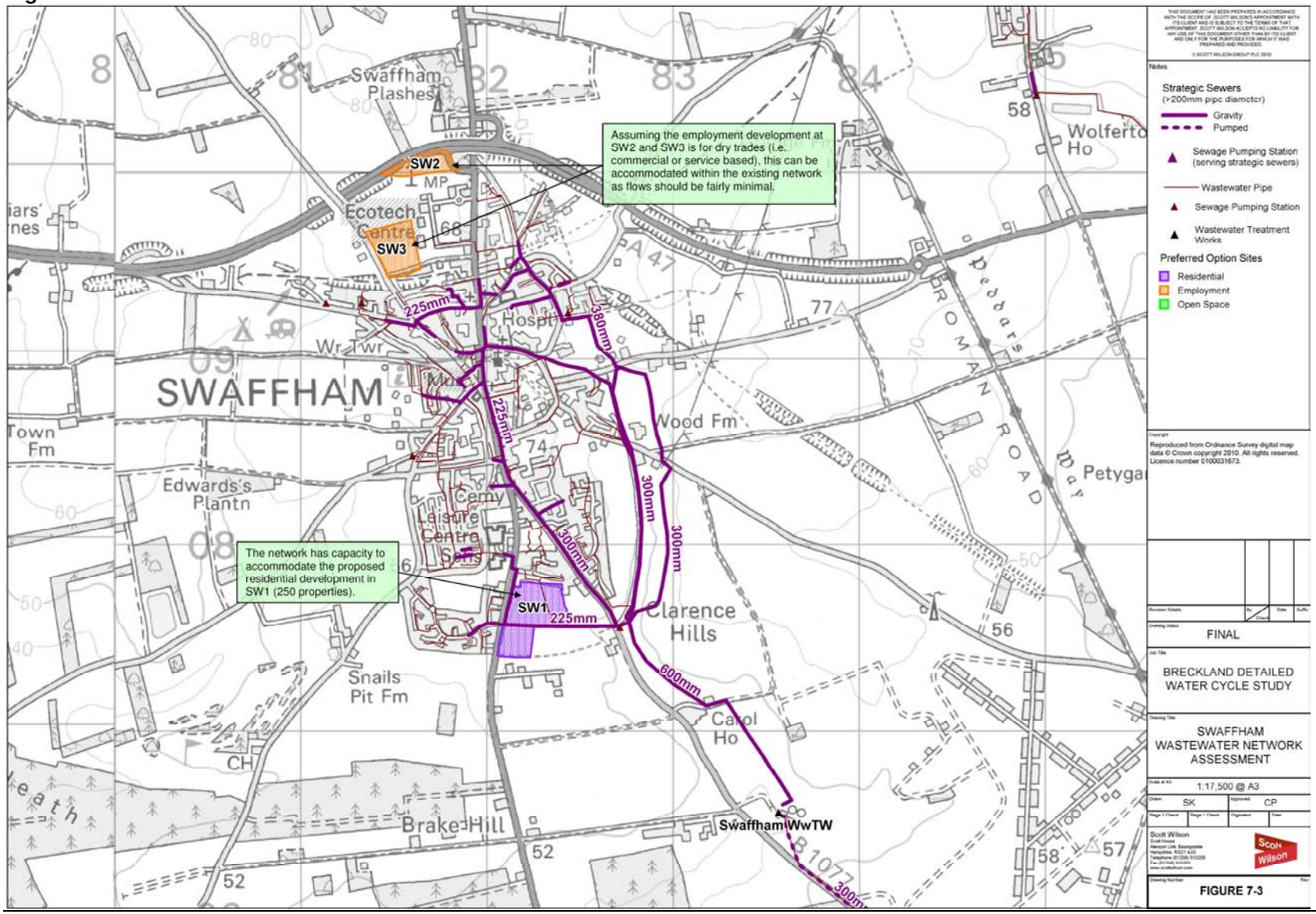
### Baseline Confirmation

7.5.1 The Breckland Outline WCS reported that the existing wastewater network infrastructure within Swaffham will require a new trunk sewer draining directly to the WwTW to serve development to the south of the town. Similarly, development to the west of the town would require significant strategic infrastructure to serve this area. Small sized developments could be accommodated with existing infrastructure in the northeast of the town.

7.5.2 Subsequent network modelling information and assessment of the impacts of the proposed growth on the wastewater network in Swaffham by AWS and as part of this WCS has confirmed that there is sufficient capacity within the existing network to serve development to the south of the town without requiring any upgrades to the network. Development of employment areas to the north of the town will also be able to be accommodated within the existing network assuming that the development is for dry trades (i.e. employment not requiring process water). Figure 7-3

illustrates the existing wastewater network within Swaffham. It is considered that no strategic upgrades or new mains are required to serve new development in Swaffham.

## Figure 7-3: Swaffham Wastewater Network



## 7.6 Flood Risk Management

### Management of Flood Risk to Development

7.6.1 Table 7-11 provides an assessment of the flood risk to proposed development in Swaffham based on the findings of the Level 1 SFRA undertaken for the Breckland District. The assessment shows that surface water and sewer flooding have been reported in close proximity to, but not within preferred option sites SW2 and SW3 respectively. Surface water flooding was reported on the A47 which runs parallel to the northern boundary of the SW2 and sewer flooding was reported in West Acre Road which runs parallel to the western boundary of the site. As neither of the flooding incidents occurred on the site itself and are considered to be limited in extent flood there is not considered to be a flood risk to any of the preferred options sites within Swaffham.

**Table 7-11: Swaffham Flood Risk to Development Assessment**

| Preferred Option Site | Development Type | Area (Ha) | Flood Risk Constraints | | | | Flood Risk Assessment |
|---|---|---|---|---|---|---|---|
| | | | Fluvial | Critical Drainage/ Surface Water Flooding | Groundwater | Artificial Water Sources | |
| SW1 | Residential | 9.9 | × | × | × | × | **There is considered to be no flood risk to development at this site.** |
| SW2 | Employment | 3.1 | × | ✓ | × | × | Surface water flooding reported on the A47 which borders the northern boundary of site.<br><br>**There is considered to be no flood risk to development at this site.** |
| SW3 | Employment | 5.8 | × | ✓ | × | × | Reported sewer flooding in West Acre Road on western boundary of site.<br><br>**There is considered to be no flood risk to development at this site.** |

### Management of Flood Risk from Development

7.6.2 Table 7-12 provides the potential attenuation requirements for the preferred option sites in Swaffham. The calculations have been undertaken for two development assumptions: a 90% hardstanding coverage and 80% hardstanding.

**Table 7-12: Attenuation Requirements for Preferred Option Sites in Swaffham**

| Pref Option Site | Approx area | | Geology and soils | SPZ | Greenfield Runoff Rates (l/s) | | Max. Storage ($m^3$) | | Max. Storage using infiltration ($m^3$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 90% Area | 80% Area | | | 90% Area | 80% Area | 90% Area | 80% Area | 90% Area | 80% Area |
| SW1 | 9 | 8 | Heterogeneous geology with freely draining soils | Zone 3 | 13 | 11 | 11,091 | 9,871 | 5,683 | 5,052 |
| SW2 | 2.7 | 2.4 | Glacial loam, permeable geology and soils | | 4 | 3 | 3,322 | 2,965 | 1,295 | 1,151 |
| SW3 | 5.4 | 4.8 | | | 8 | 7 | 6,662 | 5,912 | 2,590 | 2,302 |

**Potential SuDS at Swaffham**

7.6.3 The evidence summarised in Table 7-12 suggests that the sites at Swaffham would be conducive to infiltration techniques due to the favourable geology within the area. A review of OS mapping indicates that there are no significant watercourses within the vicinity of the sites. Therefore, a larger-scale storage device such as infiltration basin or pond might not have a natural connection. Hence it is likely that source control infiltration techniques (e.g. soakaways, infiltration trenches, swales or permeable surfacing) would be the primary method of surface water management. In the event that infiltration is not possible as the sole method of surface water management then connection to the existing surface water network (after attenuation) would need to be investigated.

7.6.4 The sites are all located within a SPZ Zone 3, which is unlikely to be a significant constraint unless high levels of contaminants would be mobilised as a result of the use of infiltration SuDS methods. A Ground investigation is therefore recommended for development sites at Swaffham.

7.6.5 Appendix E: SuDS Calculations contains a summary of the model parameters and results from the Microdrainage WinDes attenuation volume calculations for Swaffham.

**Option Funding and Responsibility**

7.6.6 The costs for SuDS required at Thetford to meet with the requirements of PPS25, will be borne solely by the developer and the detailed requirements for them should be developed via a site specific FRA. However, it is the responsibility of the LPA (in this case Breckland Council) to ensure a funding mechanism is put in place when granting permission under the Flood and Water Management Act. Options for securing this funding are included in section 10 of this report.

7.6.7 Delivery of SuDS will be the responsibility of the developer; however the 'approving body' under the Flood and Water Management Act must approve the SuDS prior to construction. In most cases, ongoing maintenance of SuDS will also be the responsibility of the approving body under the Flood and Water Management Act as part of wider surface water management responsibilities. The approving body is the unitary authority which for Breckland will be Norfolk County Council.

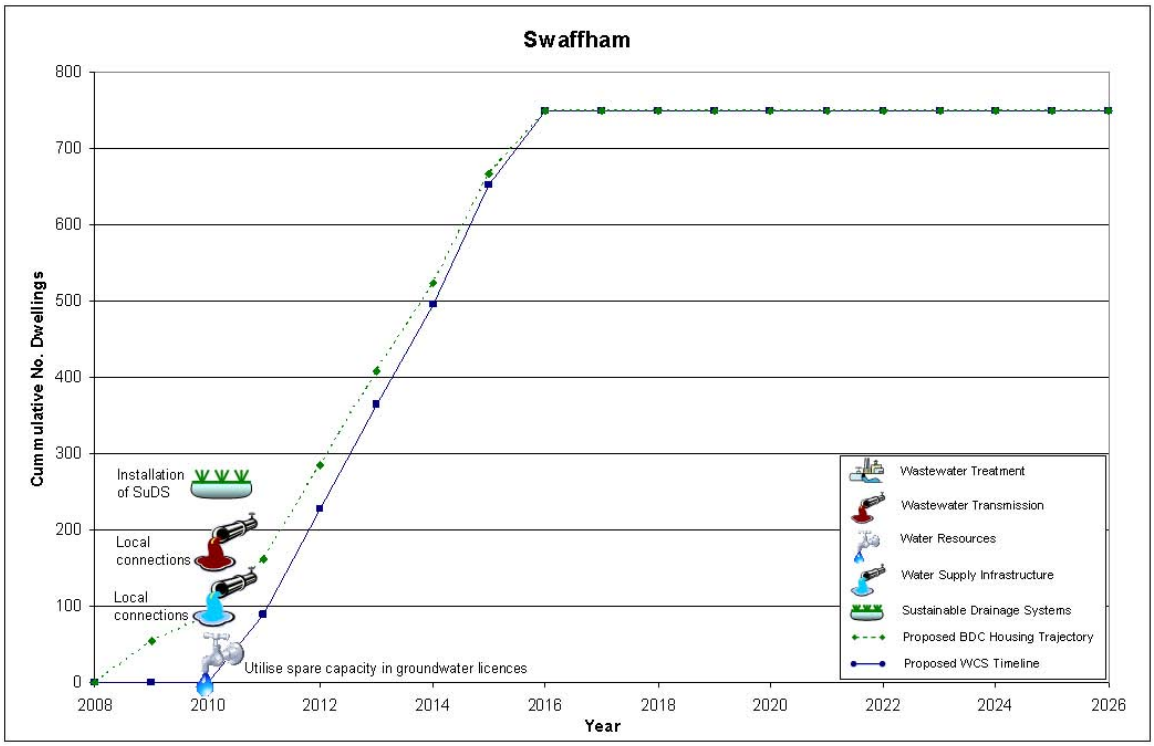
## 7.7 Infrastructure Phasing

7.7.1 Figure 7-4 provides the infrastructure timeline for Swaffham. This is based on the conclusions from the water resources, wastewater treatment and infrastructure and flood risk management assessments. The timeline is based on a number of assumptions as detailed below.

**Assumptions**

- Local connections to the existing water mains serving the development areas will be required for supplying water to the development sites in Swaffham. This will require a lead-in time of 1 year, i.e. operational in 2011;
- Local connections to the existing sewer network serving the development areas will be required for transmitting wastewater from the development areas to Swaffham WwTW. This will require a lead-in time of 1 year, i.e. operational in 2011;
- Spare capacity in the existing groundwater licences will be utilised to supply water to the proposed developments in Swaffham; and,
- The development sites will require the installation of SuDS but this is not expected to impact on the development timescales.

**Figure 7-4: Swaffham Infrastructure Timeline**



# 8 Watton Growth Town Assessment

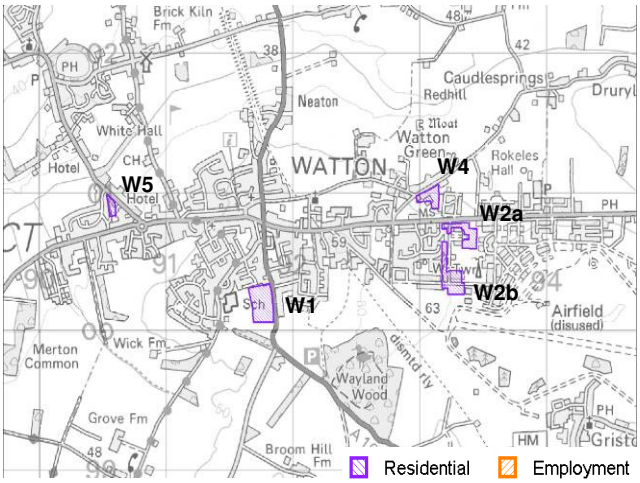
## 8.1 Introduction

8.1.1 Watton is a mid-sized market town that provides a good range of services for day-to-day needs but has a limited capacity for expansion in the centre due to the constraints of its heritage buildings and a Conservation Area.

8.1.2 The Breckland Spatial Strategy[52] identified Watton as having limited potential for economic growth, with the proposed growth in jobs occurring within the town or existing employment areas. Watton is targeted with providing 900 new homes and 250 jobs over the plan period (2001-2026). The majority of the housing development will be on brownfield sites within and on the periphery the of town, and development of peripheral greenfield sites.

8.1.3 Table 8-1 provides the housing and employment growth figures for Watton for the period 2008 - 2026. Figure 8-1 shows the proposed phasing of the planned housing growth.

**Table 8-1 Housing and Employment Growth in Thetford (2008 – 2026)**

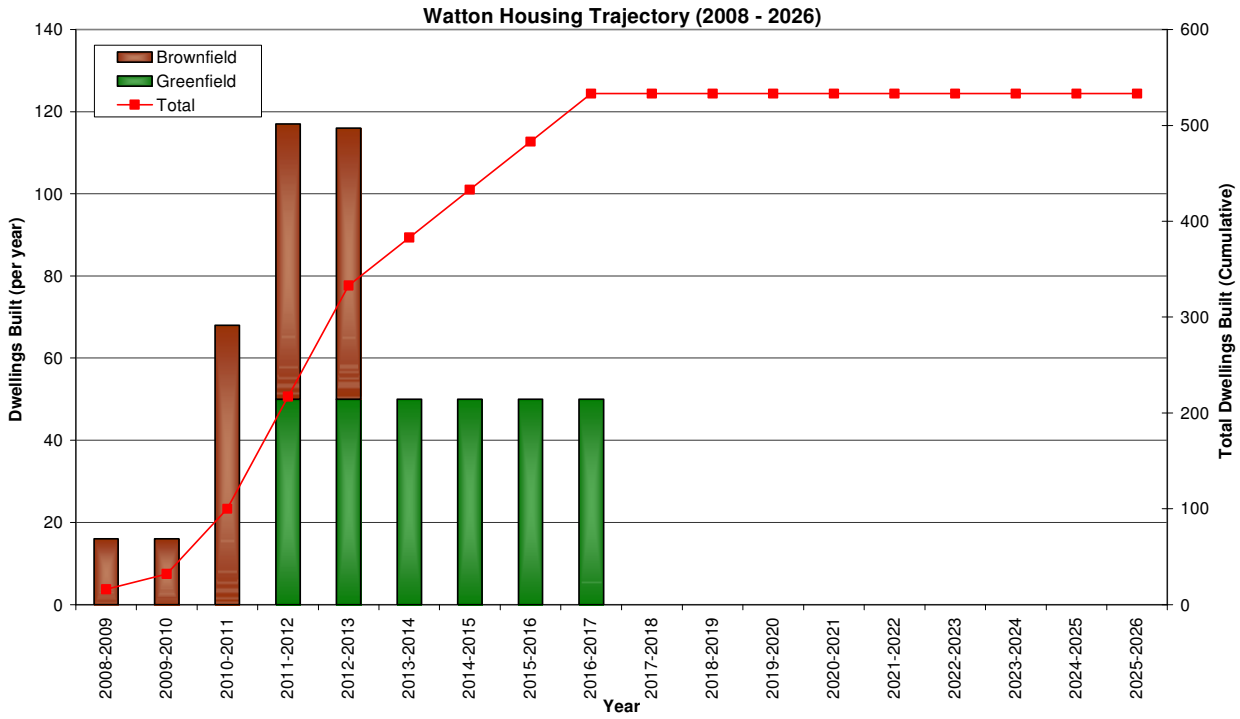
| Housing | No. of Dwellings | Location of Development |
|---|---|---|
| Already Built (as of April 2008) | 367 |  |
| Currently Permitted (as of April 2008) | 233 | |
| New Allocations | 300 | |
| Total | 900 | |
| **Housing to be Assessed (= Total – Already Built)** | **533** | |

| Employment | Jobs |
|---|---|
| Proposed Jobs | 250 |
| Land Required | N/A |
| **Employment to be Assessed** | **250** |



[52] Core Strategy and Development Control Policies DPD – Adopted 2009, Breckland District Council, 2009

**Figure 8-1 Housing Growth in Watton (2008 – 2026)**




## Outline WCS Findings

8.1.4 The Breckland Outline WCS was completed in November 2008 and highlighted the following key issues in terms of the water cycle and infrastructure for Watton:

- it is predicted that Watton will have a slight water surplus by 2026 and therefore significant investment in new water resources is unlikely to be required;
- as with Dereham and Swaffham, a theoretical decrease in net water demand is possible;
- Watton WwTW has available capacity in terms of the additional effluent discharge it can process, to accommodate the proposed growth up to 2026; but with the increased effluent load and more stringent water quality standards under the WFD, there may be a requirement to tighten the Phosphate effluent discharge consent in the future;
- the existing wastewater network infrastructure within Watton may be able to accommodate the proposed growth via the existing trunk sewer that serves the WwTW if development is located in south and west of the town; and
- historically fluvial and sewer flooding has been reported in the town. However, suitable development options exist that will avoid flood risk areas or allow mitigation of the flooding sources. Additionally, assessments have shown that the physical capacity of Watton Brook is likely to be sufficient to accommodate the additional wastewater discharge generated by the growth in the town, without increasing flood risk downstream.

## 8.2 Water Resources

### Baseline Confirmation

8.2.1 The Breckland Outline WCS reported that Watton will have a slight water surplus by 2026 and therefore significant investment in new water resources is unlikely to be required.

8.2.2 The Residential Demand (RD) scenarios as defined in the Water Resources Methodology (Section 3.2) have been modelled for the proposed residential growth in Watton (Table 8-2). A 10% headroom allowance[53] has been added to the demand calculations to account for uncertainties. The results show that the new houses would demand around 0.2 Ml/d if they were built to current specifications and water use (142 l/h/d). The lowest demand estimate from new housing development (Scenario 4 – CSH 5&6 at 80 l/h/d) would demand around 0.1 Ml/d.

**Table 8-2 Residential Demand for Planned Growth in Watton[54]**

| Scenario | | Water Use Rate (l/h/d) | Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|
| 1a | Water Company Forecast (Current) | 142 | 0.17 | 0.19 |
| 1b | Water Company Forecast (2035) | 130 | 0.15 | 0.17 |
| 2 | Code for Sustainable Homes 1&2 | 120 | 0.13 | 0.14 |
| 3 | Code for Sustainable Homes 3&4 | 105 | 0.12 | 0.13 |
| 4 | Code for Sustainable Homes 5&6 | 80 | 0.09 | 0.10 |

8.2.3 There is no major non-residential development planned within Watton, the proposed 250 jobs being created in existing employment areas. Therefore, the total water demand from new development in Watton will be wholly produced by residential growth and range from around 0.1 Ml/d to 0.2 Ml/d (Table 8-3), but the lower estimate would be dependent on new houses being built to a CSH 5&6 level, with a water demand of 80 l/h/d and the lowest estimate of non-residential demand. In reality, the water demand exerted from the new development in Watton is likely to be towards the higher end of the range, unless policy is included to stipulate that all new residential development needs to meet a CSH level requirement. Recommended policy is included in section 11

**Table 8-3 Highest and Lowest Total Demand Estimates for Planned Growth in Watton**

| RD Scenario | | NRD Scenario | | Total Water Demand (Ml/d) | Including 10% Headroom (Ml/d) |
|---|---|---|---|---|---|
| 4 | Code for Sustainable Homes 5&6 | 5a | Lowest Estimate of Minimum Non-Residential Land Allocation | 0.09 | 0.10 |
| 1a | Water Company Forecast (Current) | 6b | Highest Estimate of Maximum Non-Residential Land Allocation | 0.17 | 0.19 |

8.2.4 The assessment presented here is in terms of the additional water demand generated by the new development, under a range of water demand scenarios. However, the changing behaviour of the existing population, and retrofitting of water saving devices into existing properties has the potential to lower the total future water demand for Watton, and should be considered as part of

[53] Headroom is the minimum buffer that a prudent water company should add to demand to cater for specified uncertainties, such as the under-estimation of certain parameters, as well as taking account of the uncertainties from climate change.
[54] Lowest demand in green, highest demand in red

any future water demand assessment. This is discussed in more detail in the Water Efficiency section below.

### Preferred Solution

8.2.5 AWS' final WRMP which was published in February 2010 identifies no deficits in the supply/demand balance through to 2025/26 in Watton. The refurbishment of the Carbrooke Borehole source near Watton in AMP4 (2005-10), is reported in the final WRMP. The assumption is therefore made that spare capacity from this groundwater sources will be sufficient to provide the supply to meet future growth within Watton. There will therefore be no requirement for any new water resources schemes in order to satisfy growth in the town.

8.2.6 However, it is still important to consider water efficiency to reduce the increase in demand that will be generated as a result of this growth.

**Option Funding and Responsibility**

8.2.7 Delivering water efficiency in new homes will be the responsibility of the developer and the cost (of construction and maintenance) will be borne solely by the developer.

8.2.8 Some water efficiency and water saving methods are proposed for *existing* development by AWS as part of their twin-track approach to managing water resources in the region. These elements (such as meter penetration, and provision of water butts for existing homes) are funded solely by AWS as part of the Price review and AMP process, and also from AWS own investment. Water meters are provided for new properties by AWS as standard practice.

## 8.3 Water Supply Infrastructure

8.3.1 The water supply network has been supplied by AWS for analysis in this Phase 2 WCS. A adequate supply mains pass through, or are located close to all proposed development sites in Swaffham. However, the developers would be responsible for funding local connections on a house by house basis.

8.3.2 Costs for dwelling connections for water supply are usual costs borne by the developer for any new housing developer and as such are not considered in this WCS.

## 8.4 Wastewater Treatment

### Baseline Confirmation

8.4.1 The Breckland Outline WCS reported that Watton Wastewater Treatment Works (WwTW) generally has sufficient wastewater treatment capacity (in terms of volumetric and quality consent headroom) to accommodate growth up to 2026.

8.4.2 However, with the increased effluent load and more stringent water quality standards under the WFD, there may be a requirement to tighten the Phosphate effluent discharge consent in the future.

### Wastewater Treatment Volumetric (Consent) Capacity

8.4.3 The current consented Dry Weather Flow (DWF), and therefore volumetric consent capacity, for Watton WwTW is 2,650 $m^3$/d. The measured flow for the WwTW, as provided by AWS, is 2,026 $m^3$/d, giving rise to a headroom capacity of 624 $m^3$/d. The calculated headroom capacity is sufficient to allow the WwTW to treat flow from a further 3,644 people which is equivalent to around 1,735 new homes (excluding any employment growth).

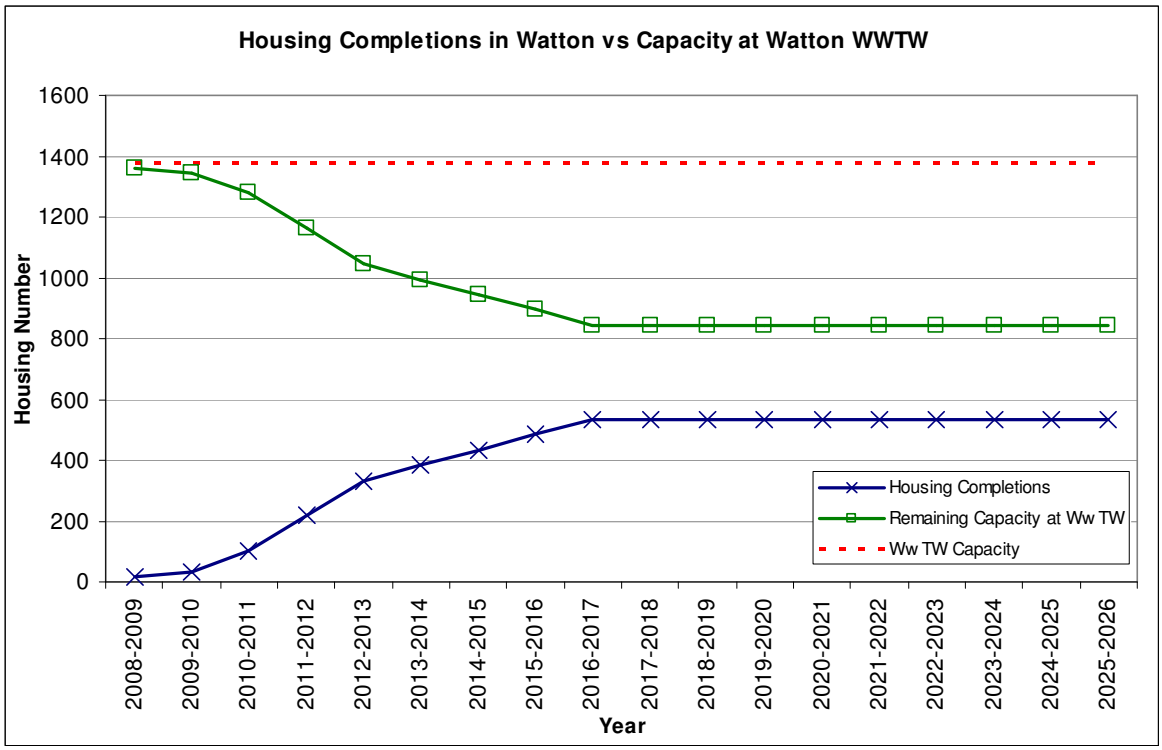
8.4.4 Watton is expected to provide 533 homes and 250 'commercial' jobs by 2026, equating to an increase in the current Population Equivalent (PE) and flow of around 1,279 and 241 $m^3$/d respectively. Based on the growth target figures for Watton, basic headroom capacity calculations show that the WwTW has capacity in its volumetric consent to treat wastewater flows for all of the proposed development up to 2026.

8.4.5 As Watton WwTW will not exceed its current flow consent as a result of growth, there is no requirement to alter the quality conditions applied to the consent. The Environment Agency has considered the impact of the operation of the WwTW on the quality of the Watton Brook as part of the WFD review and has determined that the consents are currently adequate (no improvement scheme proposed in AMP5).

8.4.6 However, modelling undertaken for this WCS has shown that the impact of accommodating growth is that immediate downstream compliance with the WFD water quality targets will not be possible. It may therefore be necessary to consider upgrades to the treatment processes at Watton WwTW in order to treat the proposed volume of wastewater from new development up to 2026 to the required quality. Figure 8-2 shows the phased housing development and corresponding volumetric consent capacity at the works during the period 2008 – 2026.

8.4.7 Details of the volumetric consent capacity are included in Appendix H: WwTW Capacity Calculations.

**Figure 8-2 Proposed Housing Development in Watton and Capacity at Watton WwTW (2008 - 2026)**




**Wastewater Treatment Quality (Consent) Capacity**

8.4.8 Watton WwTW discharges into Watton Brook, which is not a designated fishery. The Environment Agency monitoring observations for the period 2004 – 2008 show that, under current conditions, Watton Brook will achieve all WFD 'good ecological status' proposed standards upstream of Watton WwTW, with BOD, Ammonia and DO being classed as 'high ecological status', and P achieving a marginal pass. Downstream of the works, the BOD and DO standards for 'high ecological status' will be achieved and there will be marginal compliance of the 'good ecological status' for Ammonia; the Orthophosphate (P) standard will not be achieved which could in part be attributable to the effluent discharge upstream.

8.4.9 The current downstream water quality means that any increases to the WwTW effluent as a result of additional growth will need to ensure that there is no deterioration from the 'high ecological status' for BOD and DO and the 'good ecological status' for Ammonia. Orthophosphate concentrations in the river downstream of the works will need to be improved to reach the 'good ecological status' by 2015.

8.4.10 The assessment of the Environment Agency monitoring results for Watton Brook upstream and downstream of Watton WwTW against the proposed WFD standards are provided in Figure 8-2. The WFD status and classification information provided in Figure 8-2 is summarised from the Anglian RBMP as submitted to the Secretary of State for approval on 22 September 2009. The WFD classification for Biochemical Oxygen Demand (BOD) is based on the monitoring information provided by the Environment Agency against proposed WFD standards, as BOD is not specifically reported within the Anglian RBMP.

### Table 8-4 WFD Assessment of Environment Agency Monitoring Results Upstream and Downstream of Watton WwTW

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sampling Point Code** | | 48M14 | | | | | 48M15 | | | | |
| **Name** | | Watton Brook (Upstream of Watton WwTW) | | | | | Watton Brook (Downstream of Watton WwTW) | | | | |
| **Stretch** | | A1075 Road bridge Newton – Watton WwTW | | | | | Watton WwTW – Road Bridge u/s Bodney Camp | | | | |
| **Easting** | | 590428 | | | | | 587200 | | | | |
| **Northing** | | 301100 | | | | | 300800 | | | | |
| **Water Quality Monitoring Data Assessment (against WFD Standards)** | **Year** | 2004-2008 | | | | | 2004-2008 | | | | |
| | Data | Average (mg/l) | Count | Std Dev (mg/l | 90/10%ile/ Average (mg/l) [WFD Target] | WFD Status | Average (mg/l) | Count | Std Dev (mg/l | 90/10%ile/ Average (mg/l) [WFD Target] | WFD Status |
| | BOD | 1.78 | 45 | 0.90 | 3.10 | | 1.95 | 46 | 0.84 | 3.01 | |
| | Ammonia | 0.15 | 57 | 0.15 | 0.25 | | 0.18 | 58 | 0.13 | 0.38 | |
| | DO as % Sat | 98.61 | 56 | 16.80 | 83.47 | | 91.74 | 57 | 13.90 | 75.98 | |
| | Orthophosphate | 0.12 | 57 | 0.06 | 0.12 | | 0.89 | 58 | 0.62 | 0.89 | |
| **WFD Classification** | Water Body ID | GB105033047870 | | | | | GB105033047870 | | | | |
| | Hydromorphological Status | Heavily Modified *Flood Protection* | | | | | Heavily Modified *Flood Protection* | | | | |
| | Current Overall Status | Moderate | | | | | Moderate | | | | |
| | Current Ecological Status | Moderate | | | | | Moderate | | | | |
| | Current Chemical Status | N/A | | | | | N/a | | | | |
| | Overall Status Objective | Good Ecological Potential by 2027 | | | | | Good Ecological Potential by 2027 | | | | |

| **Key** | |
|---|---|
| **WFD Target** | **WFD Classification Status** |
| Pass WFD 'Good' Target | High Status |
| Marginal Pass (Within 10%) | Good Status |
| Fail WFD 'Good' Target | Moderate Status |
| | Poor Status |
| | Bad Status |
| | N/A – Does Not Require Assessment |

8.4.11 Indicative consent standards have been calculated for Watton WwTW based on the proposed growth by Breckland District Council within Watton; this will result in Watton WwTW treating 2,267 $m^3$/d of wastewater by 2026.

8.4.12 Table 8-5 shows the consents required based on the proposed phasing of growth. This assumes that the river is either achieving 'good ecological status' (GES) or 'high ecological status' (HES) upstream of the discharge based on the methodology in Section 3.

8.4.13 As Watton WwTW will not exceed its current DWF consent under future growth conditions there is currently no requirement to reduce the quality consents, which are granted based on the full utilisation of the DWF consent. Therefore, the current quality consents would not need to be changed under this scenario (Scenario A).

8.4.14 Should future legislation requirements (i.e. such as the WFD) dictate a review of the quality consents, then under this scenario (Scenario B), the receiving watercourse downstream of Watton WwTW would be required to achieve WFD standards of 4 mg/l (90%ile BOD)[55], 0.6mg/l (90%ile Ammonia) and 0.12 mg/l (Mean, P) in Watton Brook (see Table 8-6). This would require a reduction in the Ammoniacal-N (95%ile) consent from 6 mg/l to around 3.5 mg/l by 2026. The BOD consent, currently at 15 mg/l BOD (95%ile), would not require tightening.

8.4.15 The water quality upstream of the WwTW, is currently achieving Moderate Ecological Status for Phosphorus, and therefore using the agreed Environment Agency approach (see Section 3), the modelling results (Scenario B) indicate that by 2026 a P consent of around 0.4mg/l (Mean) will be required at Watton WwTW to achieve full compliance with the 0.12 mg/l (Mean) WFD P standard downstream of the works. This is beyond the current BATNEEC limit of 1 mg/l and therefore alternative solutions may need to be investigated, or a compliance point further downstream will need to be considered. As a minimum, a P consent of 1 mg/l is likely to be required at the WwTW.

[55] Current water quality shows that Watton Brook downstream of Watton WwTW is achieving 'high ecological status' for BOD and DO; under the no deterioration policy water quality for BOD and DO, should not deteriorate from this in the future.

### Table 8-5: Watton WwTW Calculated Quality Consent Requirements

| | | BOD | | | | Ammonia | | | | P | | | | Planning Considerations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2010 | 2015 | 2020 | 2026 | 2010 | 2015 | 2020 | 2026 | 2010 | 2015 | 2020 | 2026 | |
| Current Consent | | 15 | | | | 6 | | | | 2 | | | | |
| Scenario A: Planned Deterioration | A1 | 15 | 15 | 15 | 15 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 2 | ✓ |
| | A3 | 15 | 15 | 15 | 15 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 2 | ✓ |
| Scenario B: Compliance with WFD | B1 | 15 | 15 | 15 | 15 | 3.5 | 3.5 | 3.5 | 3.5 | 1 | 1 | 1 | 1 | × (P) |
| | B3 | 15 | 15 | 15 | 15 | 3.5 | 3.5 | 3.5 | 3.5 | 0.4 | 0.4 | 0.4 | 0.4 | ✓ |
| Scenario C: Compliance with WFD (excl. P) | C1 | 15 | 15 | 15 | 15 | 3.5 | 3.5 | 3.5 | 3.5 | - | - | - | - | ✓ |
| Scenario D: WFD Deterioration | D1 | 15 | 15 | 15 | 15 | 3.5 | 3.5 | 3.5 | 3.5 | 1 | 1 | 1 | 1 | × (P) |
| | D2 | 15 | 15 | 15 | 15 | 3.5 | 3.5 | 3.5 | 3.5 | 0.4 | 0.4 | 0.4 | 0.4 | ✓ |
| Scenario E: Load Standstill (compliance with HD) | E1 | 15 | 15 | 15 | 15 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 2 | ✓ |
| | E2 | 15 | 15 | 15 | 15 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 2 | ✓ |
| **Recommended Consents** | | **15** | | | | **3.5** | | | | **1** | | | | |
| **Key** | | No consent tightening required | | | | Consent tightening within BATNEEC | | | | Consent limited to BATNEEC | | | | Consent beyond BATNEEC required |

### Table 8-6: Current WFD Status & Quality Consent for Watton WwTW

| Determinand | Current WFD Status | | D/S WFD Standard (Required) | Current Quality Consent (mg/l) | Planned Change to Quality Consent (mg/l) |
|---|---|---|---|---|---|
| | U/S | D/S | | | |
| BOD | H | H | High - 4 mg/l (90%ile) | 15 | No Change |
| Ammonia | G | G | Good - 0.6 mg/l (90%ile) | 6 | No Change |
| Orthophosphate | G | G | Good - 0.12 mg/l (Mean) | 2 | No Change |

### Wastewater Treatment Preferred Solution

#### Option Identification

8.4.16 It is considered that the preferred solution to wastewater treatment for Watton is the utilisation of the existing licence, which accounting for planned deterioration, will not require a change in flow or quality consent to accommodate growth. Therefore no significant upgrades are required at the WwTW, however, AWS have stated that extensions would be required to treat the additional load generated from proposed development in the town.

#### Option Funding and Responsibility

8.4.17 Although no specific changes are required to the consent at Watton WwTW, AWS may need to make small upgrades or alterations to the treatment processes or hydraulic design of the WwTW in order to utilise the identified capacity within the flow consent. Any cost associated with these changes will be borne solely by AWS via the Price review and AMP process. Developers cannot contribute to upgrades at existing WwTW as they are not required specifically for the new development.

8.4.18 Delivery and maintenance of any upgrade to the WwTW will be the responsibility of AWS under the regulation of Ofwat, and the Environment Agency.

## 8.5 Wastewater Infrastructure

### Baseline Confirmation

8.5.1 The Breckland Outline WCS reported that the existing wastewater network infrastructure within Watton may be able to accommodate the proposed growth via the existing trunk sewer that serves the WwTW if development is located in the south and west of the town.

8.5.2 Figure 8-3 illustrates the existing wastewater network within Watton.

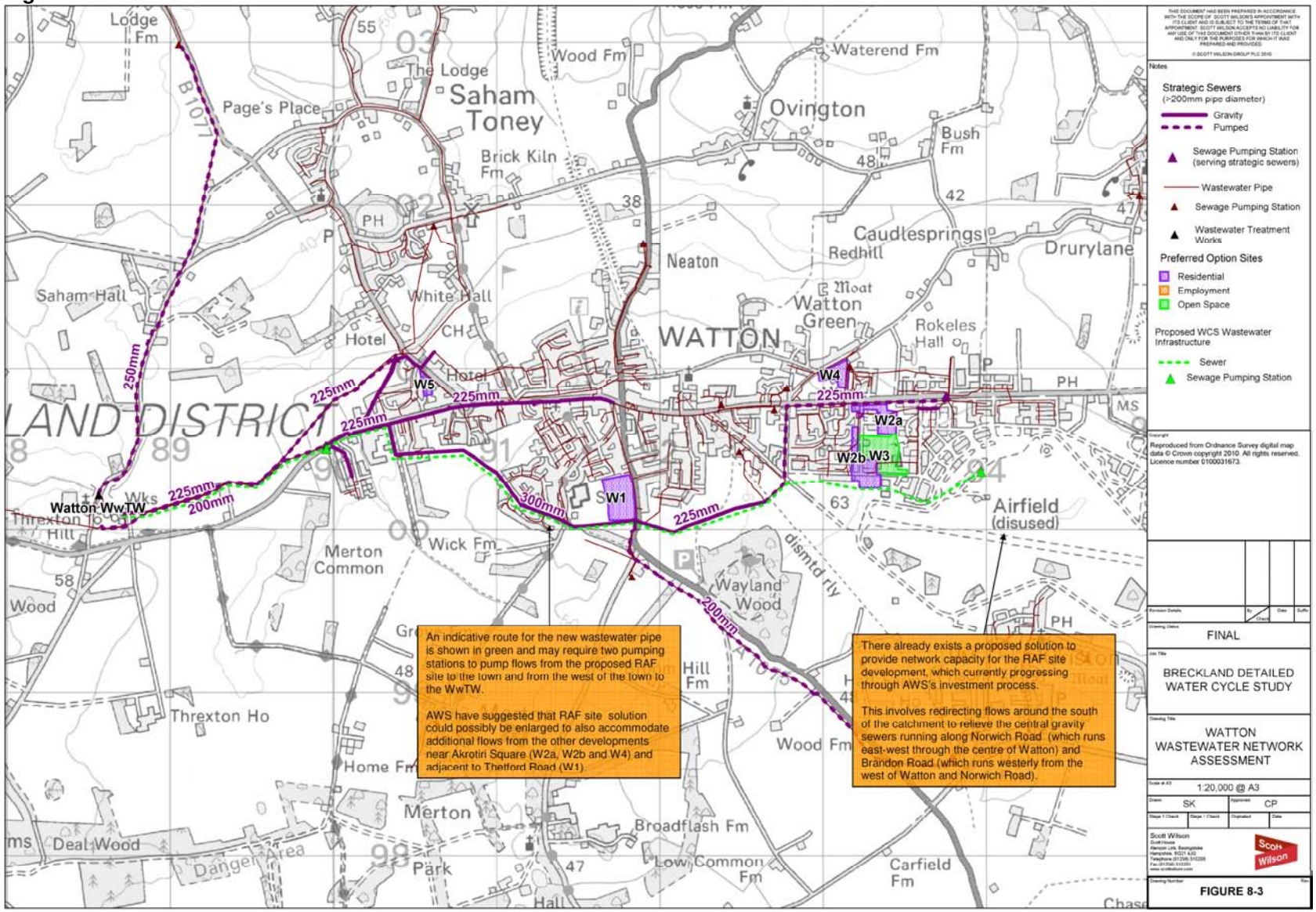
### Wastewater Strategy Preferred Solution

8.5.3 Modelling and AMP5 upgrade programmes provided by AWS suggest that whilst existing capacity in the network is fairly limited, a new mains solution is proposed to serve the RAF site. An indication of the route of this new solution is provided within Figure 8-3. The new solution would pass through, or in close proximity to proposed development sites W1-W3, and as such, the new sites would be able to connect to the new main.

8.5.4 AWS have indicated that the new main could be increased in size to accommodate the small amounts of additional wastewater generated at the new sites, and that a cost commensurate with the scale of the development at each site will be sought from the developers of sites W1 – W3.

8.5.5 It is considered by AWS that sites W1 and W5 have sufficiently low amounts of development to allow connection to the existing system.

## Figure 8-3: Watton Wastewater Network



### Option Funding and Responsibility

8.5.6 Currently, AWS are funding (via the Price Review and AMP5 process) the new wastewater main for the re-development of the former RAF site to the Southeast of Watton. This solution will have to be upsized slightly to allow for the proposed development at sites W1-W3 to connect to it. The costs for the upsizing of the new main should be borne by the developer. Details of indicative costs are provided in a separate technical note to Breckland Council. Options for funding mechanisms are discussed further in Section 10 of this report.

8.5.7 The construction and operation of the wastewater main would be undertaken by AWS.

## 8.6 Flood Risk Management

### Management of Flood Risk to Development

8.6.1 Table 8-7 provides an assessment of the flood risk to proposed development in Watton based on the findings of the Level 1 SFRA undertaken for the Breckland District. The assessment shows that only preferred options site W5, to the northwest of Watton, has any reported incidents of flooding in the vicinity of the site, with sewer flooding reported in Swaffham Road which runs parallel to the eastern boundary of the proposed site. This is considered to be an isolated event with limited flood risk to nearby properties and therefore there is not considered to be a flood risk to any of the preferred options sites within Watton.

**Table 8-7: Watton Flood Risk to Development Assessment**

| Pref Option Site | Development Type | Area (Ha) | Flood Risk Constraints | | | | Flood Risk Assessment |
|---|---|---|---|---|---|---|---|
| | | | Fluvial | Critical Drainage/ Surface Water Flooding | Groundwater | Artificial Water Sources | |
| W1 | Residential | 4.4 | × | × | × | × | **There is considered to be no flood risk to development at this site.** |
| W2a | Residential | 2.2 | × | × | × | × | **There is considered to be no flood risk to development at this site..** |
| W2b | Residential | 3.3 | × | × | × | × | **There is considered to be no flood risk to development at this site..** |
| W3 | Open Space | 5.0 | × | × | × | × | **There is considered to be no flood risk to development at this site..** |
| W4 | Residential | 1.7 | × | × | × | × | **There is considered to be no flood risk to development at this site..** |
| W5 | Residential | 0.7 | × | ✓ | × | × | Reported sewer flooding in Swaffham Road on eastern boundary of site.<br><br>**There is considered to be no flood risk to development at this site.** |

### Management of Flood Risk from Development

8.6.2 Flood risk from development Table 4-19 provides the potential attenuation requirements for the preferred option sites in Watton. The calculations have been undertaken for two development assumptions: a 90% hardstanding coverage and 80% hardstanding

**Table 8-8: Attenuation Requirements for Preferred Option Sites in Watton**

| Pref Option Site | Approx area | | Geology and soils | SPZ | Greenfield Runoff Rates (l/s) | | Max. Storage ($m^3$) | | Max. Storage using infiltration ($m^3$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 90% Area | 80% Area | | | 90% Area | 80% Area | 90% Area | 80% Area | 90% Area | 80% Area |
| W1 | 3.6 | 3.2 | Mostly permeable geology with freely draining soils | Zone 3 | 4.8 | 4.3 | 4,213 | 3,739 | 1,794 | 1,595 |
| W2a | 1.8 | 1.6 | | Zone 1 | 2.4 | 2.1 | 2,107 | 1,878 | 897 | 798 |
| W2b | 2.7 | 2.4 | | | 3.6 | 3.2 | 3,160 | 2,809 | 1,346 | 1,196 |
| W3 | 4.5 | 4 | | | 6 | 5.3 | 5,267 | 4,687 | 2,243 | 1,994 |
| W4 | 1.8 | 1.6 | | | 2.4 | 2.1 | 2,107 | 1,878 | 897 | 798 |
| W5 | 0.9 | 0.8 | Heterogeneous geology with naturally wet soils | Zone 1/2 | 5.4 | 4.8 | 751 | 668 | 550 | 489 |

**Potential SuDS at Watton**

8.6.3 In general, the soils and geology in and around Watton are believed to be conducive for infiltration techniques such as soakaways, infiltration trenches, filter drains or swales. For some of the larger sites (such as W1 or W3), given the higher attenuation volumes required, infiltration techniques could be combined with large storage features such as retention basins. Due to the land take required, these may not be as applicable for the smaller sites. A review of relevant OS 1:40,000 scale mapping indicates that there are no significant watercourses local to sites W1 to W4. Therefore, any outflow connections required may have to discharge into the existing surface water sewer network with suitable attenuation.

8.6.4 Given the location of site W5 near the base of a river valley, it is likely that soils may be naturally wet which could reduce the potential for infiltration SuDS techniques. If this is the case then other source control methods could be investigated such as storage via permeable paving reservoirs, green roofs or water recycling. The river is located approximately 200m northwest of the site, however, connecting the surface water management scheme to this river would require crossing of the B1077 road and existing developments with could present a significant constraint. Therefore, connection to the existing surface water sewer network may be the most viable option for this site.

8.6.5 All sites are located within a SPZ with the majority of sites being within Zone 1 – Inner Protection. This could place constraints on the quality of water being infiltrated and therefore, SuDS options and designs should be informed by contamination assessments. It is likely that runoff to ground will be limited to clean roof run off only, unless water quality control techniques such as oil interceptors are included in permeable paving and other infiltration devices.

8.6.6 Appendix E: SuDS Calculations contains a summary of the model parameters and results from the Microdrainage WinDes attenuation volume calculations for Watton.

**Option Funding and Responsibility**

8.6.7 The costs for SuDS required at Thetford to meet with the requirements of PPS25, will be borne solely by the developer and the detailed requirements for them should be developed via a site specific FRA. However, it is the responsibility of the LPA (in this case Breckland Council) to ensure a funding mechanism is put in place when granting permission under the Flood and Water Management Act. Options for securing this funding are included in section 10 of this report.

8.6.8 Delivery of SuDS will be the responsibility of the developer; however the 'approving body' under the Flood and Water Management Act must approve the SuDS prior to construction. In most cases, ongoing maintenance of SuDS will also be the responsibility of the approving body under the Flood and Water Management Act as part of wider surface water management responsibilities. The approving body is the unitary authority which for Breckland will be Norfolk County Council.

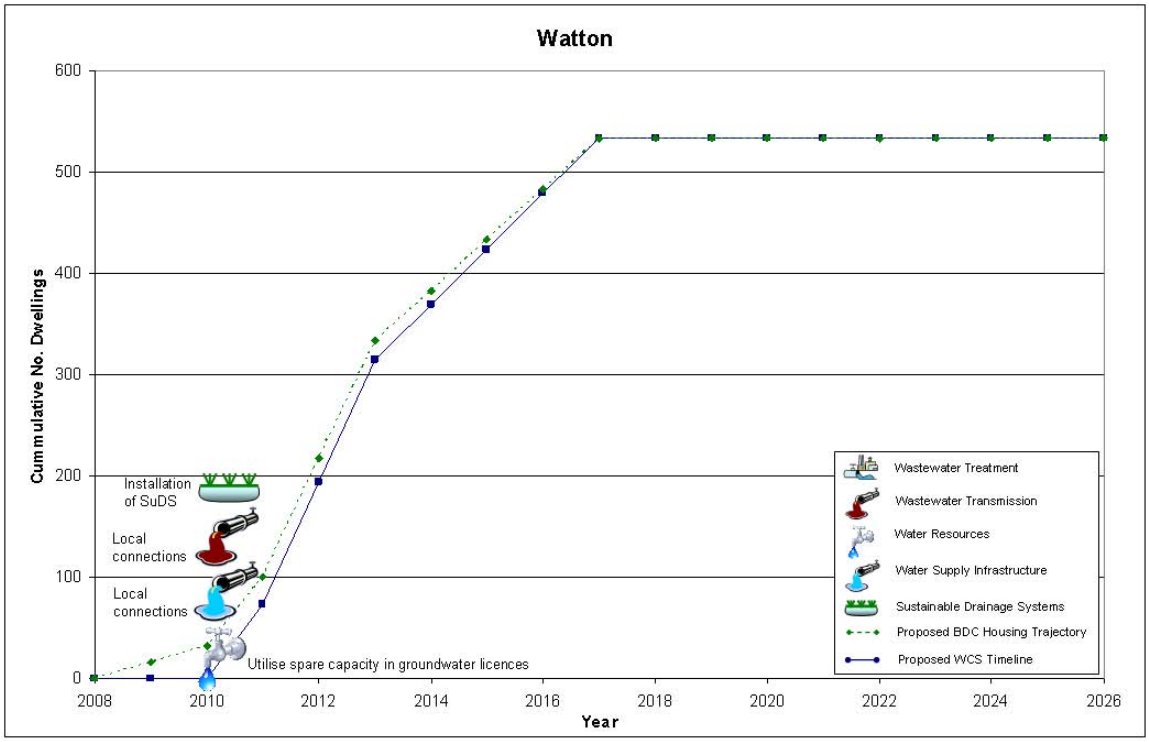
## 8.7 Infrastructure Phasing

8.7.1 Figure 8-4 provides the infrastructure timeline for Watton. This is based on the conclusions from the water resources, wastewater treatment and infrastructure and flood risk management assessments. The timeline is based on a number of assumptions as detailed below.

**Assumptions**

- Local connections to the existing water mains serving the development areas will be required for supplying water to the development sites in Watton. This will require a lead-in time of 1 year, i.e. operational in 2011;
- Local connections to the existing sewer network serving the development areas W4 and W5 will be required for transmitting wastewater from the development areas to Watton WwTW. Sites W1-W3 will be required to connect to the new wastewater trunk main solution proposed for the RAF site. This will require a lead-in time of 1 year, i.e. operational in 2011;
- Spare capacity in the existing groundwater licences will be utilised to supply water to the proposed developments in Watton; and,
- The development sites will require the installation of SuDS but this is not expected to impact on the development timescales.

**Figure 8-4: Watton Infrastructure Timeline**



# 9 Water Neutrality

## 9.1 Introduction

9.1.1 Water neutrality is a concept whereby the total demand for water within a planning area after development has taken place is the same (or less).than it was before development took place. In order for the water neutrality concept to work, the additional demand created by new development needs to be offset by reducing the demand from existing population and employment. If this can be achieved, the overall balance for water demand is 'neutral'.

9.1.2 This section considers the feasibility of achieving water neutrality in the Breckland district for the planned growth. It has been presented as a separate section as it is considered that it is currently only an aspiration and not a position that can currently be supplemented with the implantation of supportable policy. Water neutrality requires a programme of retrofitting to be adopted in existing homes and it has been considered by the steering group that current mechanisms for securing developer funding to it, and creating policy that allows it to occur in existing homes is lacking.

9.1.3 The likelihood of achieving water neutrality can be enhanced by maximising water efficiency within new developments (housing and employment) by introducing a water neutrality concept at a development wide level. It is an aim for any development, (new housing or new employment), to use no more water than is absolutely necessary and re-use as much water as is practical. It is theoretically possible, that by using development wide rain water harvesting, grey water recycling and water reuse, to reduce demand for new potable demand to zero. However, in reality some 'clean' water will always be required for drinking water supplies.

### Water Neutrality in Future Residential Development

9.1.4 In assessing the feasibility of water neutrality, the first step is to consider whether the savings created by installing meters into existing unmetered homes would be sufficient to offset the increase in water demand from the new development. This is because metering is a specific water management scenario proposed by AWS in its WRMP and is a generally accepted as a management measure which brings immediate tangible benefits.

9.1.5 On average, the savings created per person as a result of installing a water meter is 12 litres a day.

### Water Efficiency in Existing Homes

9.1.6 There are possibilities within existing development to achieve significant savings and to improve efficiency and reduce the baseline water consumption, thereby theoretically freeing up water availability for new homes. Existing homes can be retrofitted with a range of fixtures to increase efficiency in these homes, this can include:

- Water efficient fixtures and fittings – for example, flow restrictors or aerating fixtures;
- Low flush or dual flush toilets;
- Water efficient dishwashers and washing machines
- Installation of water butts for garden use; and

- Additionally, education of the existing population about water efficiency and in particular about water efficient fixtures, fittings and appliances can help to reduce water demand. This can be achieved through, for example, water audits or community education programmes.

9.1.7 Based on findings from the Environment Agency report Water Efficiency in the South East of England[56], some of these measures have been considered as a guide to potential reductions in water demand through the use of water efficient measures in existing homes (Table 9-1).

**Table 9-1: Water Saving Methods[57]**

| Water Saving Method | Potential Saving | Comments/uncertainty. |
|---|---|---|
| Ultra Low Flush replacement Scheme | 50-55l/hhold/d | 4.5l toilet assumed to be used. Need incentive to replace old toilets with low flush toilets. |
| Variable flush retrofit device | 21-29l/hhold/d | Need incentive to buy equipment and install the equipment. Potential problems with operation particularly if installed incorrectly. |
| Low flow shower head scheme | 12-14l/hhold/day | Cannot be used with electric, power or low pressure gravity fed systems. |
| Metering Scheme | 5-10% reduction. = 33.5/hhold/d saved | This can be implemented through compulsory metering or through metering on change of occupancy. |
| Low use fittings | 49.9l/hhold/day (conservative est.) | This includes fitting low use taps, low flow showerhead and a variable flush device. |

9.1.8 The water savings in Table 9-1 for litres per household were converted into litres per head per day using the occupancy rate of 2.3. These were then collated to provide four demand management options to use in existing homes as presented in Table 9-2.

**Table 9-2: Demand Management Options for Existing Homes[57]**

| Option | Potential Saving | Measures Included |
|---|---|---|
| Option 1 | 41.5 l/h/d | Meter, low flush toilet and a low flow shower. |
| Option 2 | 36.3 l/h/day | Meter and the low use fittings. |
| Option 3 | 27.0 l/h/day | No Meter, low flush toilet and low flow shower. |
| Option 4 | 21.7 l/h/day | No Meter and low use fittings |

## 9.2 Thetford

### Water Neutrality in Future Residential Development

9.2.1 The proportion of unmetered houses in the Anglian region is approximately 40%, so assuming 9,412 existing properties; approximately 3,765 will not have a meter. Based on an occupancy rate of 2.3, this results in a potential saving of 0.1Ml/d. Calculations of demand from new housing presented in this WCS suggest that, even if new homes are built to a code level 5 or 6 under the CSH (80l/h/d), demand for water from new properties would be 1.27Ml/d.

9.2.2 This shows that the necessary savings to achieve neutrality in Thetford as a result of 100% metering of existing properties cannot be achieved. This is as a result of the already high levels

[56] Ref – Water Efficiency in the South East of England
[57] Costs for retrofitting are reported separately in the costing technical note provided sas a supplmenet document to Breckland Counci

of water metering in the Anglian Region (assumed to be around 60%) and the significant levels of housing which are proposed for the town. Therefore a wider programme of measures to improve water efficiency may be required for both homeowners and businesses within Thetford in order to meet the extra demand from new development.

### Water Efficiency in Existing Homes

9.2.3 Assuming that 40% of the existing households in Thetford are currently unmetered and could therefore benefit from the largest potential water saving (Water demand Option 1 - 41.5 l/h/d – see Table 9-2) and the remaining 60% of the population could benefit from Option 3 (27 l/h/d), the fitting of low flow toilets and showers, the total potential water saving from existing development would be 0.71 Ml/d (0.36 Ml/d from unmetered properties and 0.35 Ml/d from metered).

9.2.4 The lowest water demand scenario (Scenario 4) for new residential development, which requires all new houses to be built to CSH Level 5 & 6 (80 l/h/d), would demand an extra 1.27 Ml/d (including a 10% headroom allowance) water and hence, even with the retrofitting of water efficient measures and meters in existing homes, 0.55 Ml/d of water would still need to be sourced to supply the new development in Thetford and hence, water neutrality would not be possible within Thetford after planned growth up to 2026. This is shown in Table 9-3 along with the results for all the scenarios modelled. Red in the table reflects that water neutrality is not feasible for that scenario. However, undertaking the measures as described above would significantly reduce the demand for new supplies and would ensure that only half of the existing licence capacity available for further abstraction would need to be utilised for the town.

**Table 9-3: Water Neutrality Calculations for All New Homes in Thetford**

| Scenario | Water Demand from New Houses (Ml/d) | Water Availability (Ml/d) | | | |
|---|---|---|---|---|---|
| | | Option 1 | Option 2 | Option 3 | Option 4 |
| Scenario 1a | 2.46 | -2.10 | -2.10 | -1.75 | -1.82 |
| Scenario 1b | 2.06 | -1.70 | -1.70 | -1.35 | -1.42 |
| Scenario 2 | 1.9 | -1.54 | -1.54 | -1.19 | -1.26 |
| Scenario 3 | 1.66 | -1.30 | -1.30 | -0.95 | -1.02 |
| Scenario 4 | 1.27 | -0.91 | -0.91 | -0.56 | -0.63 |

## 9.3 Attleborough

### Water Neutrality in Future Residential Development

9.3.1 On average, the savings created per person as a result of installing a water meter is 12 litres a day. The proportion of unmetered houses in the Anglian region is approximately 40%, so assuming 4,431 existing properties in Attleborough; approximately 1,772 will not have a meter. Based on an occupancy rate of 2.3, this results in a potential saving of 0.04Ml/d. Calculations of demand from new housing presented in this WCS suggest that, even if new homes are built to a code level 5 or 6 under the CSH (80l/h/d), demand for water from new properties would be 0.75Ml/d.

9.3.2 This shows that the necessary savings to achieve neutrality in Attleborough as a result of 100% metering of existing properties cannot be achieved. This is as a result of the already high levels of water metering in the Anglian Region (assumed to be around 60%) and the significant levels of housing which are proposed for the town. Therefore a wider programme of measures to improve water efficiency may be required for both homeowners and businesses within Attleborough in order to meet the extra demand from new development.

### Water Efficiency in Existing Homes

9.3.3 Assuming that 40% of the existing households in Attleborough are currently unmetered and could therefore benefit from the largest potential water saving (Water demand Option 1 - 41.5 l/h/d) and the remaining 60% of the population could benefit from Option 3 (27 l/h/d from the fitting of low flow toilets and showers), the total potential water saving from existing development would be 0.34 Ml/d (0.17 Ml/d from unmetered properties and 0.17 Ml/d from metered).

9.3.4 As discussed, the lowest water demand scenario (Scenario 4) for new residential development, which requires all new houses to be built to CSH Level 5 & 6 (80 l/h/d), would demand an extra 0.75 Ml/d of water and hence, even with the retrofitting of water efficient measures and meters in existing homes, 0.4 Ml/d of water would still need to be sourced to supply the new development in Attleborough and hence, water neutrality would not be possible within Attleborough after planned growth up to 2026. This is shown in Table 9-4 along with the results for all the scenarios modelled. Red in the table reflects that water neutrality is not feasible for that scenario. However, undertaking the measures as described above would significantly reduce the demand for new supplies.

**Table 9-4: Water Neutrality Calculations for All New Homes in Attleborough**

| Scenario | Water Demand from New Houses (Ml/d) | Water Availability (Ml/d) | | | |
|---|---|---|---|---|---|
| | | Option 1 | Option 2 | Option 3 | Option 4 |
| Scenario 1a | 1.47 | -1.30 | -1.30 | -1.14 | -1.17 |
| Scenario 1b | 1.22 | -1.05 | -1.05 | -0.89 | -0.92 |
| Scenario 2 | 1.13 | -0.96 | -0.96 | -0.80 | -0.83 |
| Scenario 3 | 0.99 | -0.82 | -0.82 | -0.66 | -0.69 |
| Scenario 4 | 0.75 | -0.58 | -0.58 | -0.42 | -0.45 |

## 9.4 Dereham

### Water Neutrality in Future Residential Development

9.4.1 The proportion of unmetered houses in the Anglian region is approximately 40%, so assuming 9,235 existing properties in Dereham; approximately 3,694 will not have a meter. Based on an occupancy rate of 2.3, this results in a potential saving of 0.1Ml/d. Calculations of demand from new housing presented in this WCS suggest that, even if new homes are built to a code level 5 or 6 under the CSH (80l/h/d), demand for water from new properties in Dereham would be 0.17Ml/d.

9.4.2 This shows that the necessary savings to achieve neutrality in Dereham as a result of 100% metering of existing properties cannot be achieved, although it would move Dereham to being very close to water neutrality. It would only require an additional water saving of 5 l/h/d in unmetered properties to achieve neutrality; for new dwellings built to a CSH Level 3 or 4, this

additional saving would be 10 l/h/d and these reductions could be achieved by simple retrofitting of efficient fixtures and fittings in all existing homes across Dereham.

### Water Efficiency in Existing Homes

9.4.3 Assuming that 40% of the existing households in Dereham are currently unmetered and could therefore benefit from the largest potential water saving (Option 1 - 41.5 l/h/d) and the remaining 60% of the population could benefit from Option 3 (27 l/h/d), the fitting of low flow toilets and showers, the total potential water saving from existing development would be 0.69 Ml/d (0.35 Ml/d from unmetered properties and 0.34 Ml/d from metered).

9.4.4 The highest water demand scenario (Scenario 1a) for new residential development, which assumes all new houses will be built to the current AWS water use rate for metered houses (142 l/h/d) would demand an extra 0.33 Ml/d (including a 10% headroom allowance) water and with the retrofitting of water efficient measures and meters in existing homes, the proposed development could be water neutral, with a water surplus of 0.02 Ml/d (Table 9-5). If the new homes were built to the lowest CSH Level (1 or 2 – 120 l/h/d), there would be a water surplus of around 0.45 Ml/d, suggesting that a combination of water efficient development of new homes and water efficiency measures in existing development could make water neutrality achievable within Dereham.

**Table 9-5: Water Neutrality Calculations for All New Homes in Dereham**

| Scenario | Water Demand from New Houses (Ml/d) | Water Availability (Ml/d) | | | |
|---|---|---|---|---|---|
| | | Option 1 | Option 2 | Option 3 | Option 4 |
| Scenario 1a | 0.33 | 0.02 | 0.02 | 0.37 | 0.30 |
| Scenario 1b | 0.28 | 0.07 | 0.07 | 0.42 | 0.35 |
| Scenario 2 | 0.25 | 0.10 | 0.10 | 0.45 | 0.38 |
| Scenario 3 | 0.22 | 0.13 | 0.13 | 0.48 | 0.41 |
| Scenario 4 | 0.17 | 0.18 | 0.18 | 0.53 | 0.46 |

## 9.5 Swaffham

### Water Neutrality in Future Residential Development

9.5.1 On average, the savings created per person as a result of installing a water meter is 12 litres a day. The proportion of unmetered houses in the Anglian region is approximately 40%, so assuming 2,974 existing properties in Swaffham; approximately 1,190 will not have a meter. Based on an occupancy rate of 2.3, this results in a potential saving of 0.03Ml/d. Calculations of demand from new housing presented in this WCS suggest that, even if new homes are built to a code level 5 or 6 under the CSH (80l/h/d), demand for water from new properties in Swaffham would be 0.14Ml/d.

9.5.2 This shows that the necessary savings to achieve neutrality in Swaffham as a result of 100% metering of existing properties cannot be achieved. This is as a result of the already high levels of water metering in the Anglian Region (assumed to be around 60%) and the significant levels of housing which are proposed for the town relative to its current population. Therefore further initiatives to improve water efficiency in new homes will be required for both homeowners and businesses within Swaffham in order to meet the extra demand from new development.

### Water Efficiency in Existing Homes

9.5.3 Assuming that 40% of the existing households in Swaffham are currently unmetered and could therefore benefit from the largest potential water saving (Option 1 - 41.5 l/h/d) and the remaining 60% of the population could benefit from Option 3 (27 l/h/d), the fitting of low flow toilets and showers, the total potential water saving from existing development would be 0.22 Ml/d (0.11 Ml/d from unmetered properties and 0.11 Ml/d from metered).

9.5.4 The highest water demand scenario (Scenario 1a) for new residential development, which assumes all new houses will be built to the current AWS water use rate for metered houses (142 l/h/d) would demand an extra 0.26 Ml/d (including a 10% headroom allowance) of water and with the retrofitting of water efficient measures and meters in existing homes, the proposed development could be close to water neutral, with a water deficit of 0.04 Ml/d (Table 9-6). If the new homes were built to the highest CSH Level (5 or 6 – 80 l/h/d), there would be a water surplus of around 0.08 Ml/d, suggesting that a combination of water efficient development of new homes and water efficiency measures in existing development could make water neutrality achievable within Swaffham.

**Table 9-6: Water Neutrality Calculations for All New Homes in Swaffham**

| Scenario | Water Demand from New Houses (Ml/d) | Water Availability (Ml/d) | | | |
|---|---|---|---|---|---|
| | | Option 1 | Option 2 | Option 3 | Option 4 |
| Scenario 1a | 0.26 | -0.15 | -0.15 | -0.04 | -0.06 |
| Scenario 1b | 0.22 | -0.11 | -0.11 | 0.00 | -0.02 |
| Scenario 2 | 0.21 | -0.10 | -0.10 | 0.01 | -0.01 |
| Scenario 3 | 0.19 | -0.08 | -0.08 | 0.03 | 0.01 |
| Scenario 4 | 0.14 | -0.03 | -0.03 | 0.08 | 0.06 |

## 9.6 Watton

### Water Neutrality in Future Residential Development

9.6.1 On average, the savings created per person as a result of installing a water meter is 12 litres a day. The proportion of unmetered houses in the Anglian region is approximately 40%, so assuming 4,598 existing properties in Watton; approximately 1,839 will not have a meter. Based on an occupancy rate of 2.3, this results in a potential saving of 0.05Ml/d. Calculations of demand from new housing presented in this WCS suggest that, even if new homes are built to a code level 5 or 6 under the CSH (80l/h/d), demand for water from new properties in Watton would be 0.1Ml/d.

9.6.2 This shows that the necessary savings to achieve neutrality in Watton as a result of 100% metering of existing properties cannot be achieved, although it would move Watton to being very close to water neutrality. It would only require an additional water saving of 8 l/h/d in unmetered properties to achieve neutrality; for new dwellings built to a CSH Level 3 or 4, this additional saving would be 14 l/h/d and these reductions could be achieved by simple retrofitting of efficient fixtures and fittings in all existing homes across Watton.

## Water Efficiency in Existing Homes

9.6.3 Assuming that 40% of the existing households in Watton are currently unmetered and could therefore benefit from the largest potential water saving (Option 1 - 41.5 l/h/d) and the remaining 60% of the population could benefit from Option 3 (27 l/h/d), the fitting of low flow toilets and showers, the total potential water saving from existing development would be 0.35 Ml/d (0.18 Ml/d from unmetered properties and 0.17 Ml/d from metered).

9.6.4 The highest water demand scenario (Scenario 1a) for new residential development, which assumes all new houses will be built to the current AWS water use rate for metered houses (142 l/h/d) would demand an extra 0.19 Ml/d (including a 10% headroom allowance) water and with the retrofitting of water efficient measures and meters in existing homes, the proposed development could achieve water neutrality, with a water surplus of 0.16 Ml/d (Table 9-7). If the new homes were built to the highest CSH Level (5 or 6 – 80 l/h/d), there would be a water surplus of around 0.25 Ml/d, suggesting that a combination of water efficient development of new homes and water efficiency measures in existing development could make water neutrality achievable within Watton.

**Table 9-7: Water Neutrality Calculations for All New Homes in Watton**

| Scenario | Water Demand from New Houses (Ml/d) | Water Availability (Ml/d) | | | |
|---|---|---|---|---|---|
| | | Option 1 | Option 2 | Option 3 | Option 4 |
| Scenario 1a | 0.19 | -0.01 | -0.01 | 0.16 | 0.12 |
| Scenario 1b | 0.17 | 0.01 | 0.01 | 0.18 | 0.14 |
| Scenario 2 | 0.14 | 0.04 | 0.04 | 0.21 | 0.17 |
| Scenario 3 | 0.13 | 0.05 | 0.05 | 0.22 | 0.18 |
| Scenario 4 | 0.10 | 0.08 | 0.08 | 0.25 | 0.21 |

# 10 Infrastructure Funding Options

## 10.1 Funding Options - Introduction

10.1.1 It is important that the Breckland WCS considers mechanisms for obtaining and securing funding toward water infrastructure that the developers can contribute to. The following sections describe possible options in relation to limitations placed on developer contribution to water services under the Water Resources Act 1991, which Breckland should consider as part of producing policy for the LDF.

### S106 Contributions

10.1.2 Under Section 106 of the Town and Country Planning Act 1990, developer contributions, also known as planning obligations may be sought when planning conditions are inappropriate to enhance the quality of development and to enable proposals that might otherwise have been refused to go ahead in a sustainable manner.

10.1.3 Developer contributions are intended to ensure that developers make appropriate provision for any losses or supply additional facilities and services that are required to mitigate the impact of a development. For example affordable housing, school places, roads, pedestrian crossings and other transport facilities, open spaces or equipped playgrounds or new long term maintenance of open space, travel plans, residents parking schemes, public art, libraries and other community buildings.

10.1.4 Government Circular 05/2005 includes a necessity test that ensures that all developer contributions are directly linked to a specific impact of the development and that the funds acquired are to be used for that purpose. The circular states that the obligations will be:

- necessary;
- relevant to planning;
- directly related to the proposed development;
- fairly and reasonably related in scale and kind to the proposed development; and
- reasonable in all other respects.

10.1.5 Planning permission cannot be granted without a completed agreement in place. Developer contributions may be used to:

- restrict development or use of the land in a specified way;
- require specified operations or activities to be carried out on the land;
- require land to be used in any specified way; and
- require a sum or sums to be paid to the authority on a specified date or dates.

10.1.6 Section 106 agreements are very frequently used in the strategic planning process for provision of key infrastructure requirements. However, in general the charge levied is required to be commensurate with the developer's impact.

10.1.7 Therefore, in the case of wastewater network, water supply network and surface water attenuation provision, a single section 106 levy cannot be applied to all new development and a cost apportionment mechanism would have to be derived dependent on the level of impact each development is likely to have and this is not always a straightforward process. For instance, the WCS has shown that the provision of SuDS and the relative costs will differ for different development areas according to the level of infiltration that is possible (according to geology) or acceptable (according to groundwater source protection zones).

### Tariff System

10.1.8 Similar to a section 106 agreement and used successfully by the Milton Keynes Partnership, a tariff system charges a single per dwelling fee to a developer to contribute towards the strategic infrastructure required to service it. However, the regulations introduced to accompany the Community Infrastructure Levy (CIL) make it clear that tariffs will no longer be used after 2014 by which time, infrastructure related to development will principally be secured by the CIL in combination with s106 agreements where applicable.

10.1.9 Generally, this does not include for water infrastructure but several WCSs are considering this as a potential option for providing a pot of funds to pay for strategic flood risk management infrastructure such as strategic SuDS and greywater recycling systems on a community level.

### Unilateral Undertaking

10.1.10 A Unilateral Undertaking is an offer of specific undertaking from a developer. It is usually considered to be quicker, less costly and advantageous to the applicant/owner, as the council does not need to be a party to such a deed. It is preferable to use this rather than Section 106 Agreement when:

- There is a straightforward contribution required;
- There is no requirement for the Council to covenant to do something;
- No payback requirement is necessary;
- No affordable housing is required;

10.1.11 This system could work well for providing developer sums towards strategic wastewater and water supply network infrastructure as Breckland do not necessarily need to covenant to provide the funding mechanism for water company infrastructure.

### Community Infrastructure Levy

10.1.12 There is now provision in legislation (under the Planning Act 2008) for introducing a Community Infrastructure Levy. Regulations under this act are expected to come into effect in Spring 2010 (subject to Ministerial approval) and these are intended to ensure that costs incurred in providing infrastructure to support development can be funded.

10.1.13 It is currently unclear precisely how this will apply to water infrastructure, and it will be up to local planning authorities to bring forward charging schedules; however, it does provide a likely mechanism. This Water Cycle Study should be used by Breckland Council as part of the evidence base for preparing a CiL document as part of the LDF, particularly in relation to those elements of water infrastructure which are not covered by the OFWAT regulations.

## 10.2 Proposed Funding Process

10.2.1 Section 106 or tariff systems are likely to be the best mechanism for providing funding to pay for strategic level flood risk management infrastructure such as SuDS. However, for funding the strategic wastewater and water supply mains, the situation is not so straightforward.

10.2.2 Under the Water Industry Act 1991, an Infrastructure charge may be levied on new and existing property connected to the public sewerage system for the first time. In cases where this is required in Breckland, this charge will be applied directly by AWS for new development that does not need new offsite infrastructure.

10.2.3 However, if the existing network infrastructure (water supply or wastewater) is not adjacent to a proposed site, the developer will be required to fund or at least contribute to this infrastructure through the requisition process under the Water Industry Act. The formal requisition procedures as set out in the Act (sections 41 and 98) a legal mechanism for developers to provide the necessary infrastructure to service their site.

10.2.4 How this process is ultimately undertaken for the proposed development in the Breckland cannot be decided by this WCS i.e. a decision could be taken that developers pay for new mains through a requisition process directly with AWS so that the developer pays for the infrastructure to be built and it is taken on, or requisitioned by AWS. However, because many of the wastewater main upgrades are strategic in nature, the conclusion of the funding element of this study is that a formal developer contribution mechanism should be set out for development which is dependent on the construction of new strategic wastewater and water supply mains before they can be built and serviced with wastewater collection.

10.2.5 The WCS has shown that wastewater treatment requirements of all proposed growth in the Breckland cannot be met without some investment in strategic wastewater mains (e.g., in Thetford and Attleborough) and as a result, developers should be required to contribute towards the provision of this infrastructure commensurate with the size of the development proposed.

## 10.3 Further Cost Considerations

### Minimisation of Cost

10.3.1 Even where direct funding of infrastructure is not an option, developers can at least contribute to minimising the capital cost of water infrastructure and policy can be developed to ensure that this is achieved.

10.3.2 It can be seen from this WCS that a key variable to provision of water services infrastructure is water consumption. To a large extent, developers can be encouraged to reduce this through initiatives such as grey water recycling, having developments with less impermeable surfaces, specifying higher quality materials for pipework etc. By way of example, if the percentage return to sewer can be reduced from 90% to 75%, the number of additional properties that can be accommodated per 1 m3/d headroom at an existing sewage treatment works is 0.8. If reducing the infiltration of ground water into drains supports the reduction in percentage return to drain by using higher quality drain pipes, the number of additional properties that can be supported per 1 m3/d headroom at the same WwTW can be further increased.

## Water Resource Provision - Employment

10.3.3 Since December 2005, non-household customers who are likely to be supplied with at least 50 mega litres of water per year at their premises are now able to benefit from a new Water Supply Licensing mechanism. If eligible, they may be able to choose their water supplier from a range of new companies entering the market. The Water Supply Licensing mechanism enables new companies to supply water once Ofwat has granted them a licence. These companies can compete in two ways:

- by developing their own water source and using the supply systems of appointed water companies (such as AWS) to supply water to customers' premises. This would be carried out under the combined water supply licence; or
- by buying water 'wholesale' from appointed water companies (such as AWS) and selling it on to customers. This would be done under a retail water supply licence.

# 11 Policy and Recommendations

## 11.1 Introduction

11.1.1 Following the completion of the Stage 2 Breckland WCS, the following recommendations are made to ensure that the overall water cycle strategy proposed is adhered to (through recommended policy) and that the study findings remain as current as possible based on best available information (through making the WCS a live document that is reviewed upon release of certain key water cycle related documents and information).

## 11.2 Water Cycle Policy

11.2.1 This section draws on the various assessments undertaken in this Detailed WCS study as well as previous WCS stages. It summarises the key issues and suggests direction for policies to be included in the Breckland LDF, future Area Action Plans and suggested Supplementary Planning Guidance documents to ensure that the aims of this WCS and a sustainable water environment are achieved.

### General

**Policy Recommendation 1: Development Phasing**

11.2.2 New homes should not be built until agreement has been reached with the water and wastewater provider that sufficient capacity in existing or future water services infrastructure is available in accordance with the Breckland WCS.

11.2.3 *Reason: The WCS has demonstrated some capacity within existing infrastructure; however this capacity is limited and upgrades (or new) infrastructure is required in some places to deliver full housing requirements up to 2026. Development must not be permitted to develop until the water services infrastructure is in place to service it.*

**11.2.4 Policy Recommendation 2: Developer Contribution**

11.2.5 As well as connection fees required under the Water Industry Act, developers will be required to contribute to strategic wastewater network infrastructure required specifically to service new development areas proposed in the Breckland Core Strategy.

11.2.6 *Reason: The WCS has shown that in general, contributions directly to treatment and water supply infrastructure is not possible under the Water Resources Act 1991. However, AWS are able to requisition or adopt infrastructure funded by developers which is required solely for new development. This position is encouraged by Ofwat and hence developer contribution will be required towards the proposed wastewater network solutions for growth in Thetford, Watton and Attleborough..*

### Wastewater treatment and transmission

**Policy Recommendation 3: Strategic Wastewater Network**

11.2.7 Recognition is made that the provision of a new strategic wastewater mains will be required in Thetford, Attleborough and Watton to connect new development areas and transfer much of the wastewater generated to the WwTW for treatment at each town.

*11.2.8 The LDF needs to ensure that the provision of this wastewater mains is fully supported.*

**Policy Recommendation 4: Strategic Wastewater Treatment**

11.2.9 Recognition is made that the provision of upgrades to wastewater treatment facilities at Thetford and Attleborough is required in order for demands of future growth to be met. Expansion of these works will be required.

*11.2.10 Reason: The WCS has demonstrated that some of the WwTW will need to add process streams or expand the capacity of processes in order to treat the additional flow, or to higher standards to meet current and future water legislation (WFD and HD standards). The LDF needs to ensure that the expansion of some WwTW sites is fully supported.*

**Policy Recommendation 5: Protection of Amenity**

11.2.11 Development will only be permitted adjacent to WwTW only if the distance between the works is sufficient to allow adequate odour dispersion (400m).

*11.2.12 Reason: The WCS has demonstrated that Dereham and Thetford WwTWs are located close to proposed new development areas. Therefore, development would need to be managed so as to prevent nuisance from odour associated with the treatment process.*

## Water Resources & Supply

**Policy Recommendation 6: Water Efficiency**

11.2.13 All new houses should be designed to have a water demand in keeping with at least levels 3 & 4 in the Code for Sustainable Homes in an effort to move the district as close to water neutrality as possible, particularly in Dereham and Swaffham were reductions in generation of wastewater flow are required.

*11.2.14 Reason: The WCS has highlighted that water resources are 'seriously stressed' in the study area and that, and that WwTW are at or close to their limits for further wastewater treatment. The study has also shown that combining investment in measures to reduce water use in existing homes with new homes built to high levels of water efficiency targets under the code for sustainable homes, it is theoretically possible to attain close to water neutrality[58] at the end of the plan period in most locations.*

**Policy Recommendation 7: Protection of Water Resources**

11.2.15 New development will not be permitted in source protection zones unless the Environment Agency is satisfied that the risk is acceptable.

*11.2.16 Reason: The WCS has highlighted that water supply in the Breckland study area is highly dependent on groundwater abstraction and as such, it is important to continue to protect the areas that recharge the groundwater through suitable management of surface activities. Several Development locations (particularly in Watton) are over or close to source protection zones around abstraction boreholes and hence Environment Agency agreement will need to be achieved for some development types in these areas.*

[58] Water neutrality refers total water use of all homes in the study area after new development is complete (2026) is no greater than the base year (2009).

**Policy Recommendations 8 & 9: Dereham Wastewater Treatment and Water Efficiency in Dereham**

11.2.17 New development falling within the Dereham WwTW catchment will be limited to 50-80 units per annum; and

11.2.18 New housing development falling within the Dereham WwTW catchment should achieve water use meeting the requirements of levels 3 & 4 under the Code for Sustainable Homes and where possible, should aim to achieve levels 5 & 6.

*11.2.19 Reason: The WCS has highlighted that treatment capacity at Dereham WwTW is limited and currently at capacity. An increase in treated flow is not possible within the limits of available technology in order to protect downstream water quality and designated Habitats Directive sites (Wensum SAC). Therefore, further headroom to accommodate for growth can only be achieved by increasing water efficiency for existing housing stock and ensuring that new housing is as water efficient as possible.*

## Flood risk and drainage

**Policy Recommendation 10: Site drainage**

11.2.20 All new development, including that on brownfield development, should be served by separate surface water and wastewater drainage. No new development will be permitted to discharge runoff to foul drainage connections.

11.2.21 *Reason: The WCS has highlighted that sewer flooding and Combined Sewer Overflows are an existing concern in several Breckland growth areas (particularly Watton and Dereham) and that with climate change, capacity will be limited. Therefore further discharges of surface water to foul or combined drainage should not be permitted to prevent exacerbation of existing problems.*

**Policy Recommendation 11: Surface Water Management**

11.2.22 All new development, including that on brownfield development, should not be constructed until sufficient surface water management and attenuation has been provided to ensure that flood risk from the development as a result of surface water runoff can be managed in line with PPS25 both during construction and the design life of the development.

11.2.23 *Reason: The WCS has determined that management of surface water is key to preventing downstream flood risk as a result of development. Therefore, design of runoff attenuation (through SuDS design) needs to be built into developments as part of the master plan and as part of the Environmental Management Plan for construction for major developments. The WCS has provided advice on the size, location and type of SuDS that will be suitable in each development location.*

**Policy Recommendation 12: Specific Flood Risk for Thetford**

11.2.24 The Level 2 Thetford SFRA provides guidance to Breckland District Council on the preparation of detailed flood risk policies for sites, including requirements and conditions to be considered at the planning stage. The policies recommended as part of Level 2 SFRA for Thetford, and based on work undertaken for both the Level 2 study and the Breckland District Level 1 SFRA are provided here to ensure that flood risk is taken account of appropriately during the planning process. The specific policy recommendations include:

- Breckland Council should adopt the 1 in 100 year event with climate change flood extent as Flood Zone 3a;
- Development should be safe throughout its life, to achieve this dry pedestrian egress and emergency vehicular access should be achievable above the 1 in 100 year flood level, when accounting for the anticipated effects of climate change;
- Where development is proposed within the 1 in 1000 year flood extent, an evacuation plan should be prepared in liaison with the Environment Agency and Norfolk County Council emergency planners. The Flood Plan should set out specific actions based on the level of flood warning;
- In accordance with PPS25, development should be sequentially located based on flood risk vulnerability classification (PPS25 Table D.2), to areas of lowest risk. Opportunities to increase biodiversity and improve amenity value (e.g. pedestrian / cycle routes along the river) should be sought in areas of higher risk adjacent to the river;
- A development should not increase flood risk on site or elsewhere, and where possible, opportunities should be taken to decrease overall flood risk;
- The Environment Agency requires compensation (level for level and volume for volume) for loss of floodplain storage in Flood Zone 3a/b. A site specific FRA should demonstrate that loss of floodplain will have no risk on existing third party developments;
- SuDS should be implemented to ensure that runoff from the site (post development) is either to greenfield runoff rates where the site is undeveloped at present or provide betterment, where possible, where the site is previously developed. This should include space set-aside within the confines of the site to accommodate SuDS;
- In the application of SuDS techniques it is recommended that attenuation techniques are given priority, due to Thetford Town Centre being located within a SPZ. In general, infiltration techniques should not be used in areas where the underlying groundwater is considered sensitive;
- Developments should look to incorporate water re-use and minimisation technology for example green roofs and rainwater harvesting. This will aid developments in the adoption of source control SuDS as part of PPS25 requirements;
- Basements should not be used for habitable purposes. Where an underground car park is proposed, it is necessary to ensure that access points and any venting or other penetrations are situated 300 mm above the 1 in 100 year fluvial flood level when accounting for the anticipated effects of climate change for the life of the development;
- The EA requires development to be set-back a distance of 9 m from a watercourse to allow appropriate access for routine maintenance and emergency clearance, if necessary The Environment Agency should be consulted on development involving the carrying out of works or operations in the bed of, or within 20 metres of the top of a bank of, a main river[59];
- Development should not have a detrimental impact on the water environment through changes to water chemistry or resource and this should be ensured through the use of drainage systems which limit the occurrence of pollution to the water environment.

[59] Introduced by Statutory Instrument 2006 No.2375 "The Town and Country Planning (General Development Procedure) (Amendment) (No.2) (England) Order 2006". Available at www.opsi.gov.uk/si/si2006/uksi_20062375_en.pdf

## 11.3 Developer Checklist

11.3.1 In addition to the high level policy suggestions, a developer checklist has been provided. The checklist includes for all the necessary steps that a developer would need to take to meet with the key water based legislative and policy requirements.

11.3.2 The overall intention is that all developers would be asked to use the water cycle developer checklist as part of the planning application process and to submit a completed version with their planning applications. The Environment Agency is a statutory consultee with regards to flood risk and the water environment and as such, will need to sign up to the checklist as will the partner authorities, Natural England and the water and wastewater undertaker. The checklist provided in this Detailed WCS has been developed from examples used in previous WCS as well as the Environment Agency's national standard checklist available on their website. The checklist refers to different levels of policy to make it clearer to the developer as to which are driven by mandatory national policy, which are driven by Environment Agency requirements and which are driven by local policy.

11.3.3 The Detailed Study checklist has been provided as a 'working document' which should be revised as development scenarios and housing numbers are updated. More relevant site specific details can then be included to make it a document which can be used as part of the planning process for developers once Area Action Plans or other LDDs are being developed.

11.3.4 The checklist is provided in Appendix F: Developer Checklist.

## 11.4 Further Work Suggestions

11.4.1 It is recommended that the Breckland Detailed Water Cycle Study remains a live document and its recommendations and findings are reviewed and reassessed as updates are made to key inputs and legislation such as the WFD, the Habitats Directive RoC process and updates to AWS's Water Resources Management Plan (WRMP) on a 5 yearly cycle.

11.4.2 A timeline of when the WCS may have to be updated in line with the changes in legislation and drivers is included in Appendix B: Timeline of Likely WCS Changes.

# 12 References

**Reference 1:** Scott Wilson (May 2008) *Thetford Water Cycle Study, Outline Report*, report written for Breckland Council. Thetford.

**Reference 2:** Scott Wilson (Nov 2008) *Breckland Water Cycle Study, Outline Report*, report written for Breckland Council, Thetford.

**Reference 3:** Environment Agency (2008) *Areas of water stress: final Classification*, Environment Agency, Bristol.

**Reference 4:** Anglian Water Services (Feb 2010) *Water Resources Management Plan, Main Report*.

**Reference 5:** Environment Agency (2009) *Anglian River Basin Management Plan,* Environment Agnecy, Bristol.

**Reference 6:** Wrc (2006) *Sewers for Adoption, Edition 6.*

**Reference 7:** OFWAT (2007) *Security of Supply Report, 2006-07 report.*

**Reference 8:** CLG (2010) *Planning Supporting Statement 25: Development and Flood Risk (PPS25)*, London.

**Reference 9:** Mott MacDonald (2007) *Breckland District Strategic Flood Risk Assessment*, report for Breckland Council, Thetford.

**Reference 10:** CLG (2009) *Planning Policy Statement 25: Development and Flood Risk – Practice Guide,* London.

**Reference 11:** ODPM (2006) *The Buildings Regulations 2000, Part H: Drainage and waste disposal, 2002 Edition*, London.

**Reference 12:** CIRIA (2007) *The SuDS Manual (C697)*, London

**Reference 13:** Scott Wilson (2009) *Thetford Level 2 Strategic Flood Risk Assessment)*, Report produced for Breckland Council, Thetford.

**Reference 14:** CIRIA (2010) *WaND: Guidance on water cycle management for new developments (C690)*, London.

**Reference 15:** *Flood and Water Management Act, 2010*. (c.29), London: HMSO.

# Appendix A: Data Request

| Data Type | Stakeholder Source | Priority | Received | When | Format | Notes |
|---|---|---|---|---|---|---|
| Thetford AAP - Feb 09 - Preferred options | Breckland | 1 | Yes | 25/03/2009 | Hard and pdf | |
| Breckland Core Strategy & Development control Policies - proposed submission document | Breckland | 1 | Yes | 25/03/2009 | Hard and pdf | |
| Core Strategy' conforming sites | Breckland | 1 | Yes | 26/03/2009 | GIS | |
| Preferred sites for Breckland | Breckland | 1 | Yes | 06/11/2009 | GIS | Preferred Site Allocation sites for Thetford, Dereham, Swaffham and Watton |
| Attleborough Economic Impact Study | Breckland | 1 | Yes | 26/03/2009 | pdf | |
| Breckland Final HRA report | Breckland | 1 | Yes | 26/03/2009 | pdf | |
| Breckland development levels, pashing and growth numbers | Breckland | 1 | Yes | 22/03/2009 | hard and word | |
| Level 1 SFRA for Breckland | Breckland | 1 | Yes | 01/03/2009 | pdf | |
| Thetford Town Centre Development Sites | Breckland | 1 | Yes | 02/04/2009 | GIS | The sites that require testing through the SFRA |
| Housing Sites Completed and With Permissions at 1st April 2009 | Breckland | 1 | Yes | 02/06/2009 | GIS | The housing sites which have been completed or have planning permission as of 1st April 2009 within Breckland District |

# Appendix B: Timeline of Likely WCS Changes

As documented throughout the Detailed WCS, several key sources of information from statutory processes have not been made available in time to inform the study within the timeframe permitted by the Breckland District Council LDF publication. As there are several key water resource elements to the unavailable information the agreement of the Breckland WCS steering group is therefore that the WCS remains a live document and is reviewed if and when all the information is made available. A best estimate of when the information should be made available and hence used in a review of the Breckland WCS is presented in table J1 below.

**Table B-1: Suggested Review dates for the WCS pertaining to key uncompleted inputs**

| Document / Study | Reason not available | Key relevance to the GNWCS | Likely date of availability |
|---|---|---|---|
| **Stage 4 RoC – Site Action Plans and decision on sustainability reduction** | RoC process not due to finish until 2010 | Full information on the extent of the sustainability reduction at the Costessey surface water abstraction point is not known. This will alter the current water resource availability in the study area and hence the water resources strategy proposed in this Stage 2b report will need to be revisited | Spring 2010 |

# Appendix C: Breckland Phosphorus Review

## England Catchment Sensitive Farming Delivery Initiative (ECSFDI)

## Introduction

This technical appendix provides a summary of activities and reporting in Norfolk with relevance to Breckland WCS

Agriculture is a key strand in the rural economy and contributes to rural employment and social cohesion. However, agriculture has potential to impact water resources and water quality. Following significant investment to improve water quality by the water industry; especially programmes to comply with WwTW consent requirements, recent policy developments have seen an increasing attention on agriculture and other rural diffuse pollution. In rural and semi-rural areas, agriculture can contribute a significant proportion of the total loads of substances found in watercourses, such as phosphorus, nitrate, sediment, pesticides, faecal material and organic substances (Haygarth, et al. 2005). However, despite significant research is it difficult to derive the relative source (point vs. diffuse) and impact.

This is an on-going issue. Although it is essential that the water industry invests to protect water quality, catchment scale data is needed to determine the impact of such investment compared to the underlying water quality. This section aims to summarise recent reports on the relative importance of point and diffuse pollution (in this case to surface watercourses) and also to outline Government response in relation to Norfolk and Breckland. As yet, there are no available data or reports on the combined regional effects of measures to improve water quality. This is highly overdue and is at the heart of the Water Framework Directive. Such information is desirable to aid regional planning; guide cost-effective water investment (in all its forms); and generally as an aid to discussing the future management of the water environment.

Water pollution is usually divided into point source, or diffuse (non-point). Point source pollution is defined by the European Environment Agency (EEA) as 'a stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution; e.g. a pipe, ditch, ship, ore pit, factory smokestack.' These discharges are usually relatively straightforward to manage. In recent decades there have been significant reductions from a range of point sources to water such as WwTW's, industry and agriculture (e.g. slurry stores). However, there is still an underlying water quality problem in many parts of the UK, and this situation is repeated internationally in developed countries.

While point source pollution of watercourses is relatively well understood and regulated, there is an underlying problem of poor water quality from some rural and urban areas. This is in the form of diffuse pollution (i.e. without a single point of origin or not introduced into a receiving stream from a specific outlet). Individually, these discharges are usually insignificant, but cumulatively, they can cause water quality problems. However, the issues are not evenly distributed, either spatially, or temporally, and herein lie the many problems with their management.

### Water Quality: Impacts from Point and Diffuse Sources

The magnitude, timing and chemistry of substances are different from point and diffuse sources. Phosphorus is a good example, and is particularly relevant to the water quality issues on sensitive rivers in the Breckland area (e.g. River Wensum).

Phosphorus is usually the limiting nutrient in freshwater systems (e.g. Withers and Lord, 2002). P is typically mobilised with sediment during storm events (e.g. Edwards and Withers, 1998) but it is recognised

that the relationship between nutrient load, water concentration and trophic state is often site-specific, depending on the type and sensitivity of the watercourse (e.g. Mainstone et al. 2000).

Point and diffuse sources of phosphorus vary during a typical year and can affect the loads observed in watercourses, with river flow smallest during summer months in response to lower rainfall. Discharge of P from WwTW will be relatively constant throughout the year, regardless of river flow whereas by comparison, the majority of diffuse inputs will be driven by heavy rainfall and as a generalisation, this will occur predominantly in the autumn and winter. Thus, the contribution of P from WwTW and diffuse sources will tend to be greatest in the summer and winter, respectively. This masks significant seasonal variation and the responses will be driven by a range of environment and farm management practices.

Of all forms of diffuse phosphorus, most will be found in the total fraction, associated with suspended sediments and mobilised primarily during rainfall (e.g. Macleod and Haygarth, 2003). Soil erosion and overland flow are recognised as the most significant transport mechanisms, and have been exacerbated as a consequence of changes in cultivation, cropping practices and the intensification of livestock systems (Withers et al., 1998).

Agriculture is not the only source of suspended sediment and sediment-bound P. Other sources include trackways, runoff from roads and verges via drains, especially in winter when grass is not growing and verges get 'cut up' by vehicles. The issue of sediment from rural roads has not been well studied. One exception is a project on the River Leadon, which has focused on the role of metalled and unmetalled roads in the delivery of sediment from fields to rivers. For example, the River Leadon has a high annual suspended sediment yield (>350 t km-2 yr-1) and c. 30% of this sediment was estimated to be delivered to the river via this pathway (Foster, 2005).

The impact of relative sources of P is also related to seasonal ecology and form of P. Whereas P from WwTW tends to be water soluble and therefore readily available for plant uptake, the majority of P from agriculture is bound to sediment and is not readily available. Additionally, the relative contribution of WwTW source P to the total concentration in the water column tends to increase in low, summer flows and this coincides with an absence of limiting factors to eutrophication (light, temperature etc). This not to say that agricultural sources are not important; the relative contribution of readily available P compared to sediment-bound P can be variable. Additionally, sediment bound P can become available and thus a long-term source of soluble P from river beds.

## Agriculture and Water Quality – Government Response

There are significant Government funded programmes which aim to reduce the risk of water pollution from agriculture. These follow review reports (e.g. Defra 2002 & 2004; Haygarth, et al. 2005); continued research into farm & rural measures to improve water quality (e.g. Cuttle, et al .2005; Haygarth, et al. 2002) and instruments to enable their uptake (e.g. Dampney, et al. 2002). Given the importance of agriculture and water protected areas in Norfolk, there are several initiatives.

The Government's Water Strategy, (Defra, 2008), recognised the importance of the England Catchment Sensitive Farming Delivery Initiative (ECSFDI) in tackling diffuse water pollution from agriculture (DWPA). The ECSFDI was initially a two year scheme, running from 2006-2008, subsequently extended to 2015 (subject to funding). Its aim is to raise awareness of DWPA and encourage changes in behaviours and practices to tackle it.

The ECSFDI is part of Defra's Programme which aims to tackle DWPA in order to meet the objectives of the Water Framework Directive (WFD). It is one element of the supportive approach in the policy package which Ministers have agreed for the WFD Programmes of Measures (PoMs). However, until PoMs are established (by 2012) the ECSFDI represents early action to tackle a known and widespread problem.

The ECSFDI encourages integration with other policy instruments like cross compliance, agri-environment schemes and with objectives such as nutrient, soil, flood risk management, ecosystems approach.

Priority catchments were identified by the Environment Agency and Natural England based on Water Framework Directive Risk Maps and designated sites at risk from diffuse pollution. Further detailed work was conducted through catchment appraisals and technical analysis to enable targeting of delivery to maximise impact. Forty were initially identified, and several of these were in Norfolk, covering a large area of Norwich, Breckland & Thetford.

## Norfolk ECSFDI Priorities

Generally, catchment appraisals show that in Norfolk, soil erosion and runoff from arable fields is the main cause of diffuse water pollution from agriculture (DWPA). The main ECSFDI priority catchments and drivers are shown in Table C-1. These include the Rivers Bure, Ant and Muckfleet; Wensum; Yare & Waveny; and Little Ouse (Thetford).

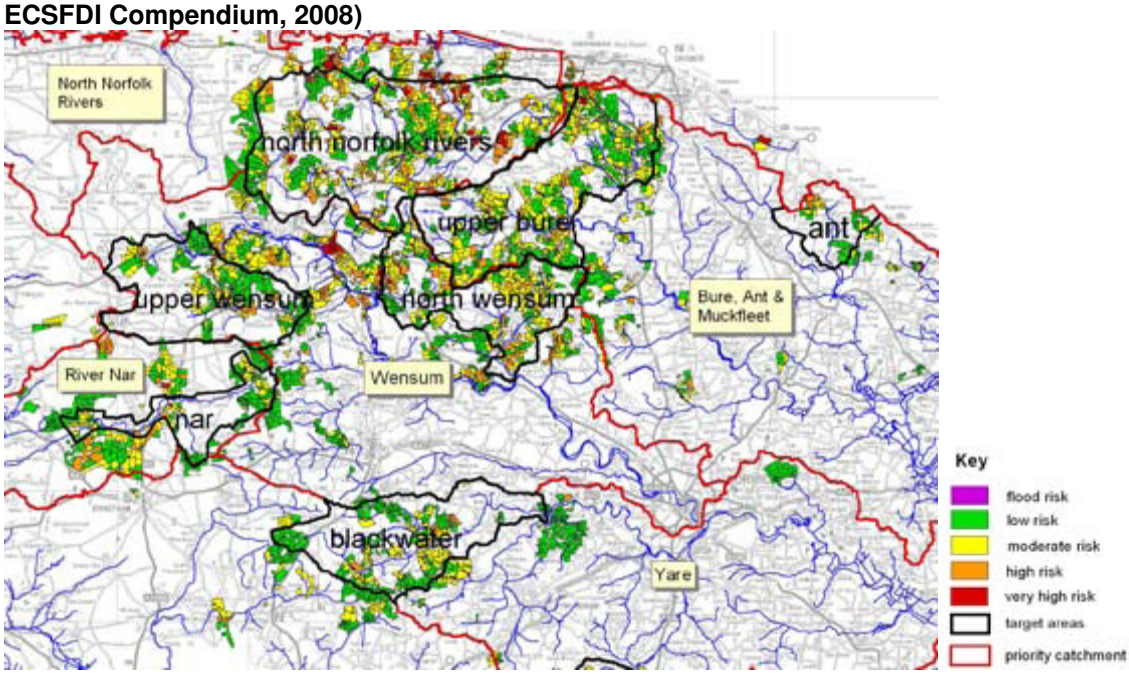
**Table C-1: ECSFDI Assessment for Catchments in Breckland WCS Area**

| Name | Nutrients | Sediment | Pesticides | Sheep Dip | Bathing Waters | Flood risk | Significant AMP investment by water companies | SSSI designation | Natura 2000 designation | Ramsar designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 - River Wensum | ✓ | ✓ | | | | | ✓ | ✓ | ✓ | × |
| 10 - Little Ouse (Thetford Area) | ✓ | ✓ | ✓ | | | | | × | × | × |

Free workshops and 1:1 farm visits, offering advice on how to complete and implement an ELS Soil Management Plan (SMP), are the main tools being used to change farming practices. In common with other priority catchments, a range of grants are also available to assist in the cost of eligible capital expenditure to reduce the risk of diffuse pollution. This has been extended to cover 2008-2015 (Defra, 2008b).

To keep track of progress, SMPs are being digitised by the Norfolk CSF team. This pictorial method of showing progress shows the areas covered by SMPs, and also where the most problematic areas are, as shown in Figure C-1.

**Figure C-1: Flood Risk and Soil Management Plan Target Areas in Norfolk under ECSFDI (Source: ECSFDI Compendium, 2008)**




Norfolk CSFOs have gained much anecdotal evidence on the scale of sediment and phosphate problems. This puts ECSFDI in a strong position to address DWPA issues and change farming practices. This approach, in combination with diffuse pollution risk assessment models, can be effective in identifying specific problem areas at multiple scales (field corners to subcatchments) which can sometimes be responsible for a significant proportion of a diffuse loading. Such areas can be missed by broad-scale modelling alone. Where resources allow, experience shows that there is no substitute for experienced farm advisors making field, farm and catchment visits to target mitigation measures.

**ECSFDI Priority Catchments in Norfolk Relevant to Breckland WCS**

River Wensum

The two Wensum target areas are south of Fakenham and around Reepham (both to the north of the Breckland study area). The two areas total approximately 25% of the total area of the catchment which is 63,000 hectares and has approximately 180 holdings. The CSF project in these areas will focus on reducing sediment and phosphate diffuse pollution.

The target areas were selected for the following reasons:

- Soil type, generally light (sandy loam) or medium (sandy clay loam or clay loam).
- High predicted P and sediment loss to watercourses.

The priority problems and issues for the River Wensum catchment are detailed in Table C-2.

**Table C-2: River Wensum**

| Priority Problem/Issue | Description | Justification |
|---|---|---|
| Run off from agricultural fields | Sediment and associated phosphate | From appraisals which cover modelling data and anecdotal evidence, areas have been identified which indicate potentially high risk of diffuse water pollution from agriculture. |

Little Ouse (Thetford Area)

The Little Ouse target area covers the Little Ouse River and the land draining into it and its tributaries from the source East of Thetford to where it joins the River Great Ouse near Littleport. Also the River Wissey, the land draining into it and its tributaries from the source near Great Cressingham to the Great Ouse near Downham Market.

The priority problems and issues for the Little Ouse catchment are detailed in Table C-3.

**Table C-3: Little Ouse (Thetford Area)**

| Priority Problem/Issue | Description | Justification |
|---|---|---|
| Excess Nitrates and Phosphates from FYM and slurry applications and storage. | High concentrations of livestock, particularly pigs and poultry, in the northern, eastern and southern target areas of the catchment along with inefficient manure and crop nutrition management. | Research reports, water quality data from Environment Agency and Anglian Water Services. DWPA problems for SSSIs, modelled data and anecdotal evidence all point to this being a problem that adds significantly to high N and P loadings. |
| Occasional excess Nitrates and Phosphates. Growing of N leaky crops such as peas and oilseed rape, and inefficient users of P such as potatoes. | The area is under intensive arable and horticultural crop production. | Research reports, water quality data from Environment Agency and Anglian Water Services. DWPA problems for SSSIs, modelled data and anecdotal evidence all point to this being a problem that adds significantly to high N and P loadings. |
| Soil erosion and soil wash from steeper slopes/lighter soil and areas of heavier soils in arable fields in the headwaters of the Wissey and Little Ouse causes sediment deposition. Fen and sand blows occur when soils are dry and there is a lack of crop cover. | Relatively small areas of sandy soils with slopes greater than 3° particularly those with maize and root cropping. | Data analysis has highlighted these areas and soil risk assessment makes them high risk. |
| Nitrates and Phosphates causing eutrophication/loss of certain habitats and species. | DWPA cited as being a cause of unfavourable/declining condition in certain SSSIs and SACs. It has caused the de-notification of Hinderclay Fen. | EN condition assessment reports and Remedy Reports, EA Reviews of Consents – appropriate assessment Stage 3 reports, wildlife trust evidence, etc. |
| Localised pesticide problems occur periodically – been detected. | Exceedances of the maximum admissible concentration necessitates removal at water treatment works, blending or shut-down of abstraction for a period/permanently. | Awaiting Anglian Water Services actual pesticide exceedances data. |

# Monitoring

Large scale catchment implementation projects are rarely able to support an adequate monitoring programme to determine effectiveness. For ECSFDI, an evaluation framework has been put in place. However, actual water quality improvements are likely to take some time to become apparent for the majority of this work. Therefore, proxy indicators of success in the form of changes in farming practices have also been recorded. Data from the monitoring was also used to model impacts of the Initiative.

The impact of the ECSFDI is being assessed through a Monitoring & Evaluation Framework that includes:

- Farmer engagement - Quantifying the amount of advice provided to land managers and their advisers.
- Changes in farmer awareness and attitude – Surveying farmers to determine the extent to which CSF engagement with them results in behavioural change, essential to optimise environmental outcomes.
- Changes in farming practice - Quantifying what happens on farms to reduce diffuse water pollution as a result of the CSF Initiative.
- Reductions in pollution load - Estimating reductions in diffuse pollution entering watercourses as a result of the CSF Initiative.
- Improvements in water quality - Modelling changes in water quality and progress towards Water Framework Directive objectives.

Although the monitoring programme is comprehensive, the forty priority catchments cover a large area and inevitably resources or technical limitations dictate that detailed water quality monitoring and modelling needs to be targeted. For this reason, not all catchments in Norfolk have the same degree of detail.

Routine Environment Agency GQA monthly water quality sampling is conducted in all 40 CSF Priority Catchments. Although usually adequate for assessment of point sources, concentrations of substances such as nutrients in rivers exhibit considerable spatial and seasonal variability and monthly grab samples will not reflect this. Storm events, for example, can mobilise nutrients from several sources and transient, but potentially very important, large concentrations of substances such as N and P will not be captured by monthly sampling regimes. Thus, a potentially large proportion can be missed. For example, Johnes (2007) found that usually between 5-10% of total P can be carried in the top 5 flow events of a year, but this increased up to 50% in particularly flashy rivers.

Given that routine monitoring does not purposely monitor any storm events the underestimate of loads in rivers is probably large. There are also seasonal effects, such as a natural 'flush' of nitrate from soil during early autumn in as the soil reaches field capacity and field drains begin to flow. This can be very variable, depending on a wide range of factors; most significantly field moisture status and rainfall; monthly sampling can miss a significant proportion of this important seasonal even and therefore underestimate average annual concentrations and total loads.

With these points in mind, CSF implemented a water quality monitoring programme with monitoring locations selected to begin to determine the baseline influence of diffuse emissions to watercourses. Eighty-nine sites were located across nine of the forty catchments, representative of different geographic areas, river types, farm management and DWPA issues. The following description is taken from ECSFDI (2008b):

Within each of the monitored catchments, sites were located:

(1) At a representative site (or sites) upstream of significant point source discharges

(2) At the downstream end of sub-catchments targeted for ECSFDI advice delivery

(3) At the catchment outlet

(4) At other strategic locations to assess inputs from other sub-catchments

This contrasts with typical routine monitoring sites, which tend to be downstream of point-source Wastewater Treatment Works (WwTW) discharges.

Two sampling strategies were adopted:

(1) Weekly 'spot' sampling only

(2) Weekly 'spot' sampling plus hourly auto-sampler (ISCO 6712) samples triggered when the river stage exceeded a pre-defined threshold (equivalent to the long-term 10-percentile flow) plus 15 (or 30) - minute multi-parameter environmental probe (YSI 6600) readings.

Strategy 2 was adopted (wherever possible) at key sites within 'flashy' catchments (defined by a Base Flow Index </= 0.7), where rapid variations in flow have the potential to result in highly variable pollutant loadings. Key sites were those (a) at the downstream end of areas targeted by CSFOs for advice delivery (i.e. DWPA 'hotspots') and (b) at the downstream end of the whole river catchment.

At all other sites, Strategy 1 was adopted.

Flow records were usually obtained from established Environment Agency Gauging Stations. Analyses of resultant data, and calculation of loadings, were undertaken by WRC (ECSFDI, 2008c).

## Wensum Catchment Characteristics

In the Norfolk region, intensive monitoring focussed on the River Wensum, due predominantly to its National and European designations (SSSI and SAC) and history of study.

The Wensum catchment is characterised by rich loams, silts and sandy peats, which offer high-grade agricultural land. The influence of soil types strongly affects the hydrological properties of the soils and river network. Although influenced by soil texture, permeability is determined largely by the underlying glacial deposits of clays, sands or gravels. The soils in the river valley are of low permeability where coarse loams overlie clay, while the highly permeable sandy loams on the valley slopes are highly fertile but require irrigation.

The floodplain soils are dominated by soils of the Isleham 2 Association (861b) which are peaty sandy soils affected by groundwater. The floodplain between Alderford and Norwich are Adventurers' 2 Association (1024b) which are semi-amorphous peats, often overlying sandy subsoils.

In the headwaters, the soils are a mix of Barrow (581f) – deep well drained coarse loamy soils developed over clayey subsoils, and patches of Newport (551g) series – wind and water erodible sandy soils. This series is more extensive between Reepham and Norwich.

There is a clear correlation between topography, geology and soil erodibility that highlights the steeper valley sides and lighter sandy/sandy loam soils as sensitive to both water and wind erosion (Hodge, et al 1984) and the need for careful management of the erodible soils of the area is highlighted.

### Wensum Monitoring

Monitoring Strategy 1 was adopted at selected sites in the Wensum catchment. This is because the River Wensum is groundwater (base flow) dominant, with some direct surface run-off, and direct recharge to the river and drain network. The hydrological regime is that of a groundwater fed river, with base flow indices of 0.85 in the upper reaches to Fakenham and 0.7 at Costessey Mill. Water level management of the river and drain network significantly affects the levels and flows within the floodplain (Sear et al., 2006).

Although Strategy 2 would be the preferred methodology to establish reasonably accurate concentrations, flows and loads, such an intensive monitoring regime is usually prohibitive. Such intensive monitoring is therefore usually limited to detailed research projects, such as that detailed by Hillman et al, (2005), where autosamplers and flow gauging structures were used successfully to collect several years of baseline data

on diffuse emissions of nutrients, faecal bacteria and pesticides in a flashy semi-upland catchment of Northumberland.

Due to the resources needed to monitor diffuse emissions, recent studies have attempted to quantify the errors associated with alternative, less intensive monitoring programmes (e.g. Johnes, 2008; Scholefield et al., 2008). In relation to the Wensum, the general message from these studies is that a weekly sampling strategy may give reliable results in baseflow dominant catchments. However, even groundwater dominant catchments can be inherently variable in terms of soil characteristics, land management and topography, and consideration should be given to the influence of these factors on hydrology before such a methodology is implemented.

Several substances were considered in the monitoring programme, including nutrients (NO3, TP, SRP, MRP); faecal bacteria; pesticides (arable and grassland herbicides) and suspended sediment, together with basic determinands such as conductivity, pH and temperature. Not all of these substances were included in all catchments however; the actual monitoring suite being determined by the pressures identified during the catchment selection process.

The analyses of resultant data on phosphorus included a tentative identification of the relative importance of point and diffuse sources in a catchment. Put simply, TP was assumed to be of largely agricultural (diffuse) origin, while SRP was assumed to be largely of point source (STW discharge) origin. When such an analyses is combined with flow, dilution of P with flow was assumed to indicate a dominance from point sources, while increasing concentrations of P with flow was assumed to indicate a dominance of diffuse sources.

The locations of monitoring sites in the Wensum catchment and tributaries thereof are listed in Table C-4 and illustrated in Figure C-2.

**Table C-4: Locations of Weekly Monitoring Sites in the Wensum Catchment (Jan to Dec 2007)**

| Priority Catchment | EA Sample Point Name | NGR |
|---|---|---|
| River Wensum | River Wensum @ Sweet Briar Road Bridge | TG2060009500 |
| | River Wensum @ Great Witchingham Bridge | TG1070018700 |
| | River Wensum @ Swanton Morley Bridge | TG0210018500 |
| | River Wensum @ Sculthorpe Mill | TF8930030400 |
| | River Wensum @ Black Lane Worthing | TF8990023800 |
| | River Wensum @ Helhoughton Bridge | TF8730026800 |
| | River Tat @ Tatterford Common | TF8670028000 |
| | River Tud @ Costessey Park Bridge | TG1700011200 |
| | Wendling Beck (Whitewater) @ Pear Tree Corner Bridge | TF9980020100 |

### Wensum Results

The River Wensum water quality monitoring programme included nutrients, suspended sediment and pesticides. The following summary is taken from ECSFDI, (2008b) and the results from the P assessment presented as a summary in Table C-5.

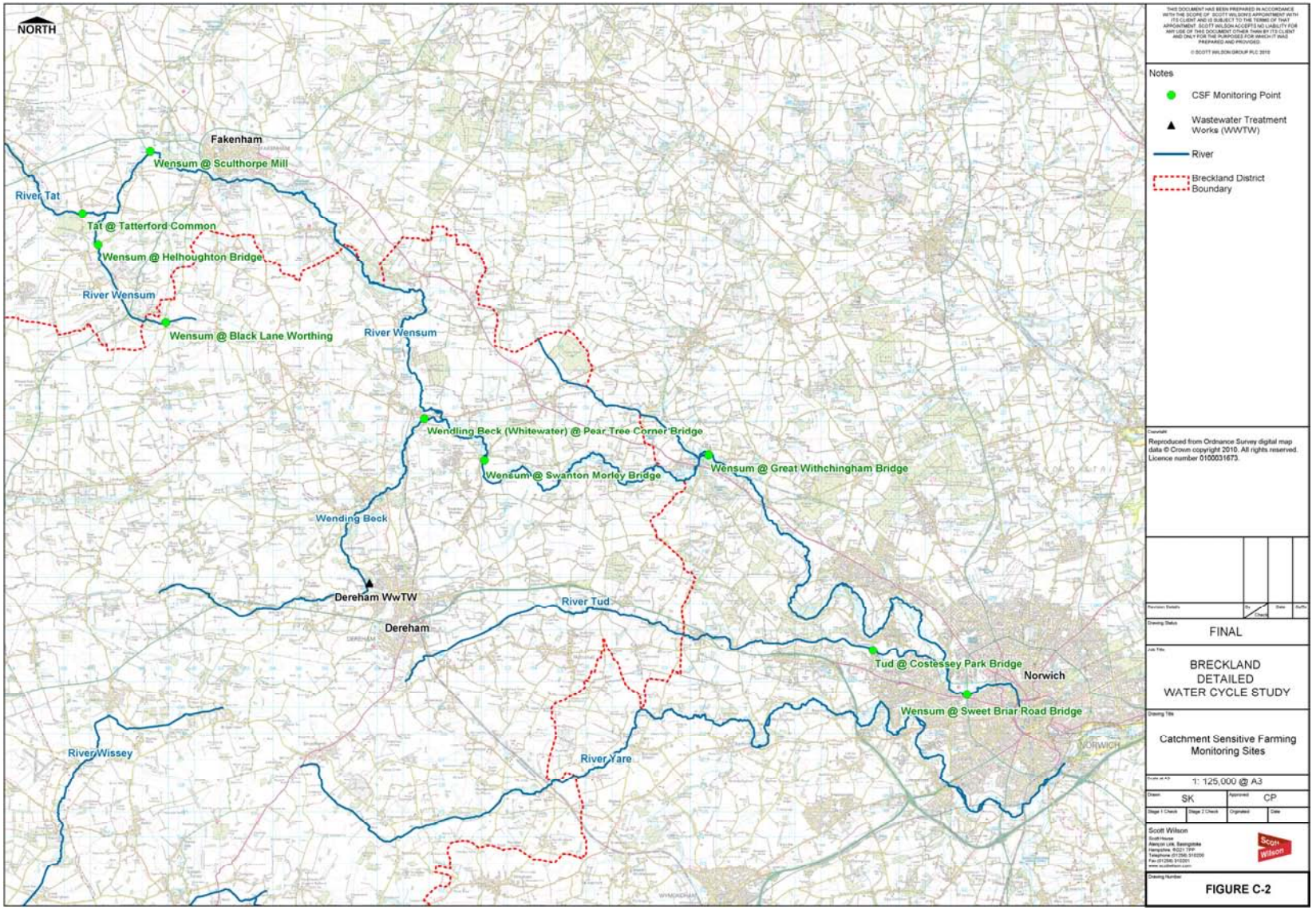
Highest sediment concentrations were recorded from the River Tud and middle and lower River Wensum. The main loading to the Wensum was in the middle reaches (Target Area). Strong diffuse signals were

evident for most sites, with more complex sources in the upper reaches of the Wensum and River Tat tributary.

Highest TP concentrations were recorded from the River Tud, the load from which was c. 30% of that in the lower Wensum. A significant TP loading was evident in the middle reaches of the Wensum. SRP concentrations were highest in the Tud and Tat tributaries. Diffuse TP signals were evident at all sites except one in the upper Wensum (complex). For SRP, sources for the main River Wensum were predominantly diffuse and those for the tributaries complex. The importance of diffuse sources increased at all sites under high flow conditions.

Highest nitrate concentrations were recorded from the Upper Wensum Target Area and the River Tat. A significant loading was evident in the middle reaches of the Wensum. Complex nitrate signals were recorded for all sites except the most downstream site on the Wensum itself (point).

## Figure C-2: Catchment Sensitive Farming Monitoring Sites



## Table C-5: Concentrations, Loads and Sources of P in the Wensum Catchment

| Site Name | Total phosphorus | | Soluble Reactive Phosphorus | | Total Reactive Phosphorus | | % TP as SRP | | | Main source (inferred) | Main source (inferred) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flow-weighted Mean (mg/l) | Load (Kg/pa) | Flow-weighted Mean (mg/l) | Load (Kg/pa) | Flow-weighted Mean (mg/l) | Load (Kg/pa) | High Flow | Medium Flow | Low Flow | SRP | TP |
| Tud at Costessey Park Bridge | 0.32 | 6,964 | 0.12 | 2,501 | 0.13 | 2,786 | 80 | 95 | | complex | diffuse |
| Tat at Tatterford Common | 0.14 | 2,347 | 0.13 | 2,263 | 0.13 | 2,194 | 86 | 97 | | complex | diffuse |
| Wensum at Helhoughton Bridge | 0.07 | 845 | 0.05 | 689 | 0.05 | 723 | 84 | 89 | | diffuse | diffuse |
| Wensum at Sculthorpe Mill | 0.09 | 3,798 | 0.08 | 3,311 | 0.08 | 3,299 | 85 | 95 | 86 | complex | complex |
| Wendling Beck at Pear Tree Corner | 0.11 | 2,685 | 0.06 | 1,713 | 0.08 | 1,948 | 70 | 89 | | complex | diffuse |
| Wensum at Black Lane Worthing | 0.11 | 434 | 0.07 | 304 | 0.08 | 352 | 72 | 91 | | complex | diffuse |
| Wensum at Swanton Morley Bridge | 0.11 | 11,906 | 0.07 | 7,683 | 0.08 | 8,937 | 77 | 94 | | diffuse | diffuse |
| Wensum at Great Witchingham Bridge | 0.12 | 18,170 | 0.07 | 11,910 | 0.08 | 12,521 | 74 | 90 | | diffuse | diffuse |
| Wensum at Sweet Briar Road Bridge | 0.11 | 24,180 | 0.09 | 18,939 | 0.09 | 17,593 | 74 | 91 | | diffuse | diffuse |

### General Results

Initially, a Catchment Change Matrix (CCM) was developed which uses published values of the efficiency of measures to reduce diffuse pollution compared against a baseline situation. The baseline was modelled using NEAP-N (diffuse N) and Psychic (diffuse P and sediment). This method has recognised limitations, and it is hoped to refine the model based on cumulative impacts and on enhanced water quality monitoring data.

Modelling results indicate that, at a local scale, significant reductions in agricultural nutrient, sediment and pathogen losses can be expected as a result of ECSFDI activity. At the catchment scale predicted reductions are generally small (less than 10%), although in some catchments relatively large reductions are predicted (c. 20-40%). There are significant differences in the responsiveness of catchments to DWPA control measures. This variation has been reflected in a simple catchment typology that is potentially useful for informing future advice delivery strategies and for strategic decisions such as what level of resources to allocate to a catchment and when to stop advice delivery in that catchment.

Phosphorus and sediment were the greatest priorities across the CSF catchments.

For phosphorus in particular, predicted reductions in in-river phosphorus loads and concentrations were generally less than 5 per cent. **Defra, (2008) estimate that that actions in the Norfolk catchments could reduce concentrations of P by between 1 and 5% from agriculture in the Little Ouse catchment (1-5% of total).**

Larger reductions were, however, predicted for some catchments or sub-catchments targeted for advice delivery, the North Norfolk Rivers predicted as being especially successful with a 23-28% reduction in diffuse loadings in the target area.

If CSF activities were to be extended across the whole of each priority catchment, Defra (2008) predicted a reduction in total P loadings (including point sources) to watercourses of between 2-5%. Therefore, in isolation, the predicted changes are unlikely to secure significant additional compliance with WFD standards or guideline standards for SAC rivers. **In combination with planned and future improvements to sewage treatment works and other pollution sources, it is possible that the predicted reductions to agricultural sources may be more significant in terms of achieving future compliance.**

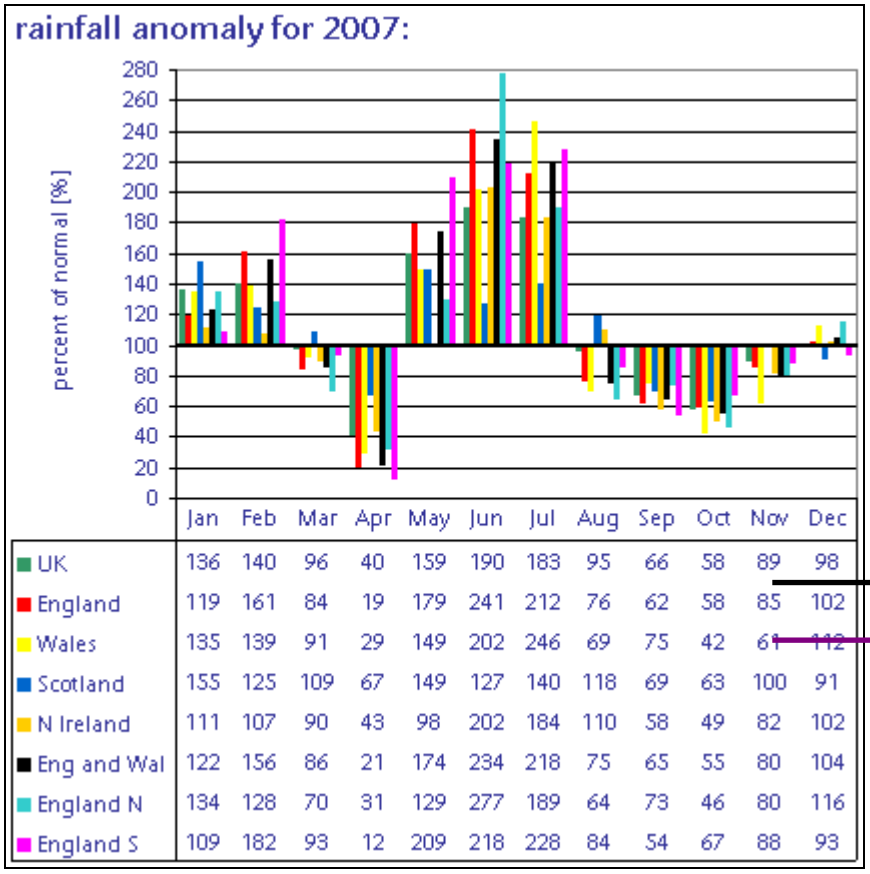
Across the modelled catchments, predicted in-stream reductions in total nitrogen were generally higher than those for phosphorus. This was attributed to a combination of the higher level of uncertainty in the modelling and a lesser influence from point sources. At the catchment scale, reductions of around 5 to 10% were predicted. Extending current advice activity across the catchments, typically increased the predicted reductions to around 20 per cent.

## Main Conclusions (Monitoring)

- ESCDI (2008c) found that monthly sampling underestimated the best available estimate of loads by an average of 17% across catchments, and increased uncertainty of results by +/- 38% to +/- 132%. Weekly spot sampling reduced this to +/- 6% and +/-6% to +/-33%.
- Data were available for the year Jan-Dec 2007. This was an exceptionally wet year with record summer rainfall (Figure C-3) which would be expected to skew all results significantly. Atypical weather is one of the main reasons for a long-term water quality monitoring strategy.

- The conclusion was that only results for TP were affected, being assessed as higher than long-term average loads. NB – this is open to debate, it is probable that all determinands were affected to a greater or lesser extent.
- Monitoring data was useful for examining the relative significance of point and diffuse sources and, at sites dominated by diffuse sources, for providing additional evidence of their significance. This element of the monitoring programme could be increased to improve diagnosis of pollutant sources; for example, by making greater use of boron (a tracer for sewage sources), bacterial source tracking and sediment-fingerprinting techniques.
- Consideration should be given to expanding the monitoring of key sites to other catchments that are either currently (e.g. Rivers Wyre and Little Ouse), or may in the future become, priorities for the ECSFDI.

**Figure C-3: Rainfall anomaly for 2007 (Source: Met Office)**




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UK | 136 | 140 | 96 | 40 | 159 | 190 | 183 | 95 | 66 | 58 | 89 | 98 |
| England | 119 | 161 | 84 | 19 | 179 | 241 | 212 | 76 | 62 | 58 | 85 | 102 |
| Wales | 135 | 139 | 91 | 29 | 149 | 202 | 246 | 69 | 75 | 42 | 61 | 112 |
| Scotland | 155 | 125 | 109 | 67 | 149 | 127 | 140 | 118 | 69 | 63 | 100 | 91 |
| N Ireland | 111 | 107 | 90 | 43 | 98 | 202 | 184 | 110 | 58 | 49 | 82 | 102 |
| Eng and Wal | 122 | 156 | 86 | 21 | 174 | 234 | 218 | 75 | 65 | 55 | 80 | 104 |
| England N | 134 | 128 | 70 | 31 | 129 | 277 | 189 | 64 | 73 | 46 | 80 | 116 |
| England S | 109 | 182 | 93 | 12 | 209 | 218 | 228 | 84 | 54 | 67 | 88 | 93 |

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# Appendix D: Breckland Ecological Appraisal

In addition to compliance with general environment legislation such as the Water Framework Directive, Water Cycle Studies (WCS) should also be compliant with the requirements of the Conservation (Natural Habitats &c) Regulations 1994 (as amended), which interprets the EU Habitats Directive into English law.

This technical assessment has been completed using information in the draft Water Resources Management Plan (dWRMP) released by Anglian Water in 2009.

The Regulations require land use plans to take steps (through a process dubbed Habitat Regulations Assessment) to ensure that a policy framework exists to enable their implementation without adverse effects (either alone or in combination with other plans and projects) on internationally designated wildlife sites, specifically Special Protection Areas (SPA), Special Areas of Conservation (SAC) and, as a matter of UK Government policy, sites designated under the Convention on Wetlands of International Importance 1979 ('Ramsar sites').

Since Water Cycle Studies inform Core Strategies and other local authority Development Plan Documents it is essential that the WCS takes account of the thresholds above or below which damage to international wildlife sites will occur when devising abstraction or effluent discharge solutions.

In the case of the Breckland WCS, it was identified during Phase 1 that Breckland SAC, the River Wensum SAC and Norfolk Valley Fens SAC (specifically Thompson Water Carr and Common SSSI, Foulden Common SSSI, Great Cressingham Fen SSSI and Swangey Fen SSSI) are those sites within Breckland district for which the development covered by the WCS may lead to adverse water flow and depth effects.

Waveney & Little Ouse Valley Fens SAC (Redgrave & Lopham Fens SSSI and Blo'Norton & Thelnetham Fen SSSI) also lies on the southernmost border of the district and are hydrologically sensitive.

At this stage the water resource supply for the Breckland development has not been definitively established and as such supply options may involve sites other than those identified above. However, it is understood that the supply options are likely to involve the following:

**Table D-1: Potential Available Water Resources to Breckland**

| Resource Options | Average/Peak DO (Ml/d) |
|---|---|
| Maximise Spare GW Licences – a) Breckland, b) Thetford & c) Norwich - Thorpe St Andrews B/h | a) 3/4.1 b) 2/2 (tbc) c) 4 (tbc) |
| New GW Resource Development | a) none b) 0.7 (tbc) c) 4 (tbc) [Avg. only] b) in conjunction with ASR scheme up to 2 Ml/d (see note 1 below) |
| Effluent Re-use Schemes (see note 2 below) | 12.3 [Avg. only] |
| Surface water from River Wissey (within existing licence quantity from Cut-off Channel) | 6/9 (potentially a small amount available) |
| Bulk Transfer Schemes (Trent Transfer Scheme) | 10 (tbc) [ Avg. only] |

Notes:
1) ASR Aquifer Storage and Recovery schemes involve storing water under ground in the winter and re-using this water in the summer.
2) Effluent Re-use scheme proposed by the draft WRMP was to take Whittlingham final effluent and to re-inject it down-stream of the Costessey intakes

The main points to note are as follows:

- Most of Breckland will continue to be supplied from spare groundwater (GW) sources (within their existing licence capacity) from the Breckland and Thetford areas;
- Major growth in Thetford will require the development of a new GW source locally, plus potentially some Aquifer Storage and Recovery (ASR);
- The other main growth centre of Attleborough, along with Wymondham, will be supplied from local GW sources plus a contribution from the Greater Norwich supply area.

The use of spare capacity within existing licences should not be an issue as the Environment Agency always assesses fully licensed volumes in their Review of Consents process, irrespective of whether the current actual volume of abstraction is less than the licensed volume. As such the environmental constraints on the licensed capacity (and any need to reduce the licensed capacity) will have already been considered in the RoC process and do not need to be reconsidered here.

The River Trent transfer option is understood to be effectively an alternative for the Abberton Reservoir raising scheme. However, since the Abberton Scheme now has approval it is assumed that the Trent Transfer Scheme is now unlikely to form part of the water supply schemes for Breckland. It is therefore not considered further in this document.

However, the development of a new local groundwater source in the Thetford area will not have been covered by the RoC process (since it is as yet unlicensed) and could affect numerous hydrologically sensitive sites local to Thetford.

The effluent re-use proposal for the River Wensum (intended to supplement flows in the lower Wensum by re-distributing effluent that currently discharges to the Yare at Whitlingham STW, thereby allowing increased abstraction from the Wensum at Costessey without detrimentally reducing flows in that River) also needs to be considered but only from a water quality aspect – pumping treated effluent into the SAC will augment downstream flows but could also affect phosphate levels in the River.

The below section restricts itself to consideration of abstraction from the Chalk aquifer around Thetford. Water quality standards for the River Wensum are considered in a separate document.

## Hydrologically Sensitive Sites Local to Thetford (i.e. within 10km)

Thetford is physically very constrained by the Breckland Special Area of Conservation & Special Protection Area. Many of the habitats for which the SAC was designated (dry heathland, inland sand dunes and calcareous grassland) are not dependent on specific water levels or flows other than generally good drainage. However, two habitats ('alluvial forests with alder & ash' and 'natural eutrophic lakes') are sensitive to changes in groundwater levels and quality. The great crested newt populations for which the SAC is also designated, while water dependent, are not particularly sensitive to changes in water levels provided that standing water is retained in their breeding pools during the March-June breeding season and until the young emerge in August-October. High water quality is not particularly important for great crested newts.

Local groundwater abstraction (although not necessarily for public water supply) has had an adverse effect in the past upon the alluvial forests and natural eutrophic lakes.

There are several nationally or internationally important wildlife sites local to Thetford that are not hydrologically sensitive:

- The two parts of the SAC closest to Thetford are Barnhamcross Common SSSI and Thetford Heath SSSI, both of which are designated for their calcareous grassland and dry heath and as such are not especially sensitive to abstraction from the underlying aquifer;
- The Breckland Forest SSSI and Breckland Farmland SSSI surround large parts of Thetford and constitute part of the Breckland SPA. The SPA is designated for woodlark, nightjar and stone curlew. The former (for which the dry Breckland Forest SSSI provides excellent habitat) are both species of dry heathland and recently cleared areas in conifer plantations and as such are not particularly sensitive to abstraction from the underlying aquifer. The latter (for which Breckland Farmland SSSI provides excellent habitat) is a species of arable farmland and is also not sensitive to abstraction. The SSSI interest of the forest is slightly dependent on changes in water levels as there are diverse invertebrate communities that occupy small pools in the forest, but these are unlikely to be affected by abstraction. The SSSI interest of the farmland is not adversely affected by abstraction;
- Bridgham & Brettenham Heaths SSSI, Grime's Graves SSSI and Weeting Heath SSSI and Weather & Horn Heaths SSSI & Berner's Heath SSSI all support dry heathland and are therefore not hydrologically sensitive;
- Cranwich Camp SSSI is designated for calcareous grassland and is therefore also not hydrologically sensitive;

However, within 10km of Thetford lie seven nationally and/or internationally important sites that are linked to the underlying chalk aquifer, some of which (Thetford Golf Course & Marsh, Stanford Training Area) are immediately adjacent to Thetford:

- Thetford Golf Course & Marsh SSSI (Breckland SAC) – alder woodland lies adjacent to Thetford and contains (in addition to large areas of heathland) areas of fen and an area of alder woodland (the latter of which is an SAC qualifying feature) which are sensitive to reductions in water level and are dependent on a high water table linked to the Little Ouse;
- Stanford Training Area SSSI (Breckland SAC) - The fluctuating meres (Fowl Mere, Devil's Punchbowl and Home Mere), fed by groundwater, are internationally important qualifying features as 'natural eutrophic lakes'. The site also includes other areas of standing water, wetlands and many springs and streams. These are traditionally largely unaffected by abstraction and should remain so.
- East Wretham Heath SSSI (Breckland SAC) - is the oldest established Breckland nature reserve. Its principal scientific interest lies in the two fluctuating meres, Ringmere and Langmere, and in the areas of Breckland grassland. Ringmere and Langmere are part of a unique series of water bodies found only on this site and the nearby Stanford Training Area SSSI. They are internationally important qualifying features as 'natural eutrophic lakes'. They are supplied from and directly influenced by the chalk ground water and with water levels fluctuating in a cyclical but irregular fashion, conditions have been created for the development of an unusual series of aquatic and periodically inundated plant and animal communities.
- Thompson Water Carr & Common SSSI (Norfolk Valley Fens SAC) - is also sensitive. Of the many hydrologically sensitive features, the alkaline fens, alder forest and Desmoulin's Whorl snail are the main internationally qualifying features;
- Swangey Fen SSSI (part of Norfolk Valley Fens SAC) – alkaline fens, alder forest and other wetland features. Swangey Fen SSSI is fed by chalk water seepages along the north slope with the central fen mainly fed by lateral flow from these together with surface water inputs in winter. Seepage flow may be insufficient to maintain wet conditions in the lower part of the fen during the summer and even the upper seepage zones tend to become summer-dry;

- Weston Fen SSSI (Waveney & Little Ouse Valley Fens SAC) – Desmoulin's Whorl snail, calcareous fen and other wetland features;
- Middle Harling Fen SSSI – general wetland features linked to the chalk aquifer, particularly calcareous fen. The majority of the calcareous fen in the valley bottom is dominated by blunt-flowered rush Juncus subnodulosus with frequent purple moor-grass Molinia caerulea (description on SSSI citation sounds like a version of M22 Juncus subnodulosus - Cirsium palustre fen meadow which does have a stronghold in Norfolk).

Any plans for increased abstraction from the chalk aquifer local to Thetford must therefore have serious regard to the vulnerability of the hydrologically connected sites identified above. This consideration will hopefully be aided by the following guideline standards.

**Fluctuating meres (i.e. 'natural eutrophic lakes')** (as found at Stanford Training Area SSSI and East Wretham Heath SSSI)

Any delay in rewetting after a naturally dry period does not exceed one month, and any increase in frequency of drying does not exceed one in 30 years.

**Alluvial Forests (i.e. alder woodland)** (as found at Thetford Golf Course & Marsh SSSI, Thompson Water Carr & Common SSSI and Swangey Fen SSSI)

The requirements for this habitat are:

- Winter water-levels at or very near the ground surface
- Spring water levels should be maintained within 5 cm of the ground surface.
- Summer maximum and minimum levels should be between 5 and 45 cm below the ground surface, accepting that optimal seedling growth occurs with water levels between 10 and 30 cm below ground level. This should maintain the typical canopy and under-storey species.

**Desmoulin's whorl snail** (as found at Thompson Water, Carr & Common SSSI and Weston Fen SSSI)

In general it is likely that if hydrological conditions in Thompson Water Carr & Common and Weston Fen remain acceptable for this species they will also be acceptable for other sensitive features. The most significant populations of Desmoulin's Whorl snail at Thompson Water, Carr and Common SSSI lie to the north-east of the site where the regional Chalk aquifer is close to the surface, and where water chemistry is optimal for populations of Desmoulin's Whorl snail to thrive.

High groundwater levels throughout the year are considered to be one of the most important factors influencing the distribution of Desmoulin's Whorl snail. In lowland river floodplains with many snail inhabited sites, there are also numerous, apparently suitable sedge-dominated habitats where the snail is absent, probably due to unfavourable groundwater levels.

Detailed studies of the hydrological requirements of Desmoulin's Whorl snail have been undertaken at Chilton Foliat and Thompson Common, which are respectively within the Kennet and Lambourn Floodplain and the Norfolk Valley Fens Special Areas of Conservation (Tattersfield & McInnes 2003).

Water levels were gauged by taking repeated measurements from a grid of dip-wells installed on each site, while snail distribution and density were also recorded. Maximum snail densities, at locations where the hydrological conditions were considered to be at, or close to, the snail's optimum, were recorded where water levels were continuously above the ground surface throughout the year, and where mean annual water levels were more than 0.25 m above the surface. Annual fluctuations at these locations were

between about 0 m and 0.6 m above ground level. Medium-density snail populations were associated with conditions where water levels fluctuated within 0.2 m of the surface, both above and below ground level. The critical minimum summer water level threshold, where the snail occurs but only at very low abundance, was estimated to be 0.5 m below surface ground level. However, it is unlikely that populations would be sustained under such conditions.

There is no indication that water flow rates are a limiting factor.

**Table D-2: Desmoulin's Whorl Snail Hydrological Requirements**

| *V. moulinsiana* | Water Level | Fluctuations in Water Level | Minimum Water Level | With Ground Surface |
|---|---|---|---|---|
| Presence of *V. moulinsiana* | | | Summer -0.5m Winter -0.4m | |
| High Population | Greater than +0.25m | 0m to +0.6m | | Water level never/very rarely falls below ground |
| Medium Population | 0m | -0.25m to +0.2m | | Water level fluctuates between -0.2, and +0.2m during the year |
| Low Population | Less than 0m | -0.4m to 0m | | Surface inundation rare |

That said, this work relates to floodplain habitats, and it is difficult to apply to a complex undulating terrain such as is present on Thompson Water, Carr and Common SSSI. In order for the population of Desmoulin's Whorl snail to be maintained at Thompson Water, Carr and Common SSSI, it will be necessary to maintain the regional Chalk aquifer at levels close to the naturalised hydrological regime.

**Alkaline fens/mires** (as found at Swangey Fen SSSI)

In general it is likely that if hydrological conditions in Swangey Fen remain acceptable for this habitat (M13 *Schoenus nigricans-Juncus subnodulosus* mire) they will also be acceptable for other sensitive features. Key factors are: shallow groundwater level, surface discharge (e.g. flushing) and the avoidance of flow-reversal. Groundwater level:

- It is advised that the average 'normal year' shallow groundwater table should provide wet conditions under foot throughout a normal year and should not drop more than 10cm below ground level.
- This shallow groundwater table should be related to flushing flows from groundwater discharges, as opposed to the management of surface water levels through structures. It is the flushing groundwater that provides the hydrochemical conditions in the surface layer which enables the M13 community to thrive.
- The variability of the groundwater level in a 'normal year' should not drop under 1 SD from 10cm below ground level, e.g. -22.4 cm.
- The duration, frequency and intensity of drought periods should not be significantly increased by abstraction or surface water management.
- The flushing of groundwater is critical in maintaining the hydrological conditions with the soil to allow M13 to thrive. Therefore a significant reduction in flushing flow will be disadvantageous to the M13 community.

## Conclusion

Any plans for increased abstraction from the chalk aquifer local to Thetford must therefore have serious regard to the vulnerability of the hydrologically connected sites surrounding Thetford.

## Wensum SAC features of interest

The following information on water quality requirments of qualifying features has been used as part of this study:

**Bullhead**[60]

Philippart (1979) found the lower tolerable pH limit to be 4.7. Although no studies have been conducted to determine the upper tolerable limit, this is known to reach about pH 7 in upland streams and 9 in lowland chalk streams in which bullheads occur. The upper tolerable limit is therefore likely to be >9.0. Brown trout, which typically occur sympatrically with bullhead, require a minimum dissolved oxygen concentration of 40% saturation, and it is likely that a similar level is required by bullheads. Provided oxygen saturation remains high, bullhead can tolerate high concentrations of nitrogen compounds.

**Brook Lamprey**[61]

As with other lamprey species, there are relatively few data available concerning the water quality requirements of the brook lamprey (Alabaster & Lloyd 1982). Occasional mortalities have been reported that have been ascribed to pollution, but few details are available.

**Larvae**

Potter et al. (1970, 1986) have shown that oxygen tension is a major factor in the maintenance of the burrowing habit of larvae. They can survive almost anoxic conditions in their burrows for only a few hours, after which they must come out or die. However, they can tolerate low oxygen tension, and may remain in their burrows for some time under these conditions (Hill & Potter 1970).

Laboratory studies on the effect of temperature on the development of embryos have shown that successful hatching of free-swimming ammocoetes is only possible within a relatively restricted range of water temperatures (Damas 1950). Hardisty & Potter (1971) note that 'the kind of fluctuations that sometimes occur in the spring (particularly in small streams) might adversely affect the production of hatched larvae'. Thomas (1962) has shown that, in Lampetra lamottenii (and Petromyzon marinus), ammocoetes are most active at water temperatures between 10ºC and 14ºC.The preferred temperature for Lampetra planeri was identified by Schroll (1959) as 12ºC.

The onset of transformation of larvae usually occurs in a short period (three to four weeks) and it may be that temperature is the operative factor (Potter 1970, Hardisty & Potter 1971).There are also indications that, in successive years, the time of onset of metamorphosis in Lampetra planeri in the field has varied according to the prevailing spring temperatures (Hardisty & Potter 1971).

**Adults**

[60] Ecology of the Bullhead Conserving Natura 2000 Rivers Ecology Series No. 4 Mark L Tomlinson and Martin R Perrow
[61] Ecology of the River, Brook and Sea Lamprey Conserving Natura 2000 Rivers Ecology Series No. 5 Peter S Maitland

The brook lamprey is regarded as being sensitive to pollution, but few data appear to be available. Some pollution in the lower reaches of quite a number of rivers in Britain appears to be tolerated. In the absence of specific tolerance data for this species it must be assumed that conditions in all parts of any river where brook lampreys occur, or pass through on migration, are at least UK Water Quality Class B (in England, Wales and Northern Ireland) or A2 (in Scotland).

**White-clawed crayfish**

Populations in the UK are associated with chalk, limestone or sandstone deposits in water bodies where calcium content is a minimum of 5 mg/l and pH ranges of between 6.5 and 9.0 (alkaline). Oxygen levels below 5 mg/l for more than a few days in summer months may cause stress.

**Desmoulin's whorl snail**

No specific additional data

**Watercourses characterised by Ranunculion fluitantis and Callitricho-Batrachion**

The River Wensum constitutes the CB1 'Lowland, low-gradient Potamogeton/Sagittaria' eutrophic river community. This vegetation type typically occurs on large, slow-flowing lowland rivers with a stable base flow and a substrate consisting mainly of silts or clays. Potamogeton spp. (particularly Potamogeton pectinatus) and Myriophyllum spicatum are particularly prominent within the plant community, while Ranunculus species are less noticeable than in many other CB types, with Ranunculus penicillatus ssp. pseudofluitans and Ranunculus fluitans being characteristic.

# Appendix E: SuDS Calculations

| **Thetford** | | | | | | | | | | | 90% Developed | | | 80% developed | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Preferred Options Site | Preferred Options Site Name | Approx NGR | Area (ha) | Area 90% (ha) | Area 80% (ha) | Geology | Soils | Soil Index | SPZ | Infiltration Coefficient | 100yr Greenfield runoff (l/s) | Max Storage (no infil.) | Max Storage (with infil.) | 100yr Greenfield runoff (l/s) | Max Storage (no infil.) | Max Storage (with infil.) |
| T9a | West | TL 889 848 | 80 | 72 | 64 | Loam and gravel - largely permeable | Freely draining sandy or loamy soils | 0.15 | Zone 2 | 0.5 | 86.8 | 84482 | 35292 | 78.2 | 74983 | 31368 |
| T9b | East | TL 889 848 | 100 | 90 | 80 | | | | Zone 2 | | 105.9 | 105993 | 43904 | 95.4 | 94026 | 39215 |
| **Town Centre Sites** | | | | | | | | | | | | | | | | |
| T1 | | TL 868 831 | 0.6 | 0.54 | 0.48 | Sands and gravel with clay layers - heterogenous permeability | Loamy and sandy soils with naturally high groundwater | 0.3 | Zone 2 | 0.1 | 3.1 | 482 | 348 | 2.7 | 431 | 310 |
| T2 | | TL 868 831 | 0.2 | 0.18 | 0.16 | | | 0.3 | Zone 2 | 0.1 | 1 | 162 | 116 | 0.9 | 144 | 103 |
| T3 | | TL 868 831 | 0.5 | 0.45 | 0.4 | | | 0.3 | Zone 2 | 0.1 | 2.5 | 405 | 324 | 2.3 | 357 | 257 |
| T4 | | TL 868 831 | 0.1 | 0.09 | 0.08 | | | 0.3 | Zone 2 | 0.1 | 0.5 | 81 | 58 | 0.5 | 70 | 51 |
| T5 | | TL 868 831 | 0.2 | 0.18 | 0.16 | | | 0.3 | Zone 2 | 0.1 | 1 | 162 | 116 | 0.9 | 144 | 103 |
| T6 | | TL 868 831 | 0.4 | 0.36 | 0.32 | | | 0.3 | Zone 2 | 0.1 | 2 | 324 | 232 | 1.8 | 280 | 116 |
| T7 | | TL 868 831 | 0.1 | 0.09 | 0.08 | | | 0.3 | Zone 2 | 0.1 | 0.5 | 81 | 58 | 0.5 | 70 | 51 |
| T8 | | TL 868 831 | 1 | 0.9 | 0.8 | | | 0.3 | Zone 2 | 0.1 | 5.1 | 806 | 327 | 4.5 | 718 | 515 |

| **Attleborough** | | | | | | | | | | | **90% Developed** | | | **80% developed** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Preferred Options Site | Preferred Options Site Name | Approx NGR | Area (ha) | Area 90% (ha) | Area 80% (ha) | Geology | Soils | Soil Index | SPZ | Infiltration Coefficient | 100yr Greenfield runoff (l/s) | Max Storage (no infil.) | Max Storage (with infil.) | 100yr Greenfield runoff (l/s) | Max Storage (no infil.) | Max Storage (with infil.) |
| A1a | West | TM 053 946 | 260 | 234 | 208 | Part permeable (gravels and loams), part impermeable(clay) | Part impeded drainage, part freely draining | 0.3 | Partially (northwest and south) Zone 2/3. Mostly none | 0.1 | 1209.3 | 218324 | 147064 | 991 | 198271 | 131494 |
| A1b | East | TM 053 946 | 370 | 333 | 296 | | | | None | | 1507.3 | 321396 | 210507 | 1353.2 | 285015 | 187159 |

| **Dereham** | | | | | | | | | | | **90% Developed** | | | **80% developed** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Preferred Options Site | Preferred Options Site Name | Approx NGR | Area (ha) | Area 90% (ha) | Area 80% (ha) | Geology | Soils | Soil Index | SPZ | Infiltration Coefficient | 100yr Greenfield runoff (l/s) | Max Storage (no infil.) | Max Storage (with infil.) | 100yr Greenfield runoff (l/s) | Max Storage (no infil.) | Max Storage (with infil.) |
| D1 | Station Rd | TF 998 124 | 7 | 6.3 | 5.6 | Lower ground - largely hetergenous, sands with clay layers | Slowly permeable clay soils with impeded drainage | 0.45 | Zone 2/3 | 0.001 | 94.3 | 4159 | 4183 | 83.8 | 3697 | 3718 |
| D4 | Toftwood | TF 998 124 | 3 | 2.7 | 2.4 | | | 0.45 | None | 0.001 | 40.4 | 1783 | 1793 | 35.9 | 1585 | 1594 |
| D5 | Dumpling Green | TF 998 124 | 3 | 2.7 | 2.4 | | | 0.45 | None | 0.001 | 40.4 | 1783 | 1793 | 35.9 | 1585 | 1594 |
| D2 | Greenfields Rd | TF 998 124 | 14 | 12.6 | 11.2 | | | 0.45 | Zone 3 | 0.001 | 188.5 | 8319 | 8367 | 167.6 | 7395 | 7437 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D3 | Norwich Rd | TF 998 124 | 9 | 8.1 | 7.2 | Higher ground - mostly permeable (gravel and loams) | | 0.45 | None/Zone 3 | 0.001 | 121.2 | 5348 | 5378 | 107.7 | 4754 | 4781 |

| **Swaffham** | | | | | | | | | | | **90% Developed** | | | **80% developed** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Preferred Options Site | Preferred Options Site Name | Approx NGR | Area (ha) | Area 90% (ha) | Area 80% (ha) | Geology | Soils | Soil Index | SPZ | Infiltration Coefficient | 100yr Greenfield runoff (l/s) | Max Storage (no infil.) | Max Storage (with infil.) | 100yr Greenfield runoff (l/s) | Max Storage (no infil.) | Max Storage (with infil.) |
| SW2 | Turbine Way | TF 819 087 | 3 | 2.7 | 2.4 | Glacial loam - largely permeable | Freely draining sandy soils | 0.15 | Zone 3 | 0.5 | 3.9 | 3322 | 1295 | 3.4 | 2965 | 1151 |
| SW3 | W Acre Rd | TF 819 087 | 6 | 5.4 | 4.8 | Glacial loam - largely permeable | Freely draining sandy soils | 0.15 | Zone 3 | 0.5 | 7.7 | 6662 | 2590 | 6.9 | 5912 | 2302 |
| SW1 | Brandon Rd | TF 819 087 | 10 | 9 | 8 | Heterogenous - sands and gravels with thin clay layers | Freely draining loamy soils | 0.3 | Zone 3 | 0.1 | 12.9 | 11091 | 5683 | 11.4 | 9871 | 5052 |

| **Watton** | | | | | | | | | | | **90% Developed** | | | **80% developed** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Preferred Options Site | Preferred Options Site Name | Approx NGR | Area (ha) | Area 90% (ha) | Area 80% (ha) | Geology | Soils | Soil Index | SPZ | Infiltration Coefficient | 100yr Greenfield runoff (l/s) | Max Storage (no infil.) | Max Storage (with infil.) | 100yr Greenfield runoff (l/s) | Max Storage (no infil.) | Max Storage (with infil.) |
| W5 | Swaffham Rd | TF906008 | 1 | 0.9 | 0.8 | Lower ground - largely heterogenous, sands with clay layers | Naturally wet soils | 0.3 | Zone 1 | 0.1 | 5.4 | 751 | 550 | 4.8 | 668 | 489 |
| W1 | Thetford Rd | TF921006 | 4 | 3.6 | 3.2 | Higher ground - mostly permeable (gravel and loams) | Freely draining sandy soils | 0.15 | Zone 3 | 0.5 | 4.8 | 4213 | 1794 | 4.3 | 3739 | 1595 |
| W4 | Watten Green Rd | TF921006 | 2 | 1.8 | 1.6 | Higher ground - mostly permeable (gravel and loams) | Freely draining sandy soils | 0.15 | Zone 1 | 0.5 | 2.4 | 2107 | 897 | 2.1 | 1878 | 798 |
| W2a | Norwich Rd 1 | TF921006 | 2 | 1.8 | 1.6 | Higher ground - mostly permeable (gravel and loams) | Freely draining sandy soils | 0.15 | Zone 1 | 0.5 | 2.4 | 2107 | 897 | 2.1 | 1878 | 798 |
| W3 | Norwich Rd 2 | TF921006 | 5 | 4.5 | 4 | Higher ground - mostly permeable (gravel and loams) | Freely draining sandy soils | 0.15 | Zone 1 | 0.5 | 6 | 5267 | 2243 | 5.3 | 4687 | 1994 |
| W2b | Norwich Rd 3 | TF921006 | 3 | 2.7 | 2.4 | Higher ground - mostly permeable (gravel and loams) | Freely draining sandy soils | 0.15 | Zone 1 | 0.5 | 3.6 | 3160 | 1346 | 3.2 | 2809 | 1196 |

| Soil Index | Soil Type | Source Protection Zone (SPZ) | Description |
|---|---|---|---|
| 0.15 | Sandy, well drained | Zone 1 – Inner Protection Zone | Any pollution that can travel to the borehole within 50 days from any point within the zone is classed as being inside Zone 1 |
| 0.3 | Intermediate soils (sandy) | Zone 2 – Outer Protection Zone | Area that covers pollution that takes up to 400 days to travel to the borehole, or 25% of the total catchment area – whichever area is the biggest |
| 0.4 | Intermediate soils (silty) | Zone 3 – Total Catchment | The total area needed to support removal of water from the borehole, and to support any discharge from the borehole |
| 0.45 | Clayey poorly drained | | |
| 0.5 | Steep, rocky areas | | |

# Appendix F: Developer Checklist

Key

- Water Cycle Strategy Recommended Policy
- Environment Agency and Natural England Policy and Recommendations
- Local Policy
- National Policy or Legislation

| | Flood Risk Assessment Requirement Checklist | | Policy or Legislation |
|---|---|---|---|
| 1 | Is the Development within Flood Zones 2 or 3 as defined by the flood zone mapping in the SFRA? | Y - go to 5<br>N - go to 2 | |
| 2 | Development is within Flood Zone 1:<br>Site larger than 1 Ha?<br>Site smaller than 1 Ha? | <br>go to 5<br>go to 3 | |
| 3 | Is the development residential with 10 or more dwellings or is the site between 0.5Ha and 1Ha? | Y - go to 6<br>N - go to 4 | |
| 4 | Is the development non-residential where new floor space is 1,000m2 or the site is 1 Ha or more | Y - go to 6<br>N - go to 7 | |
| 5 | The development constitutes major development and requires a Flood Risk Assessment (in accordance with PPS25 and the relevant SFRA) and the Environment Agency are required to be consulted. | Go to 8 | PPS25 |
| 6 | The development constitutes major development and is likely to require a Flood Risk Assessment (in accordance with PPS25 and the relevant SFRA[62]) but the Environment Agency may not be required to be consulted. | Go to 8 | |
| 7 | An FRA is unlikely to be required for this development, although a check should be made against the SFRA and with the LPA to ensure that there is no requirement for a FRA on the grounds of critical drainage issues. Does the SFRA or does the LPA consider a Flood Risk Assessment (FRA) is required? | Y – go to 8<br>N – go to 9 | |
| 8 | Has an FRA been produced in accordance with PPS25 and the relevant SFRA? | Y/N or N/A | |
| | **Surface Water Runoff** | | **Policy or Legislation** |
| 9 | A) What was the previous use of the site?<br>B) What was the extent of impermeable areas both before and after development? | % before % after | Environment Agency Requirement for FRA. |

[62] Major Development according to PPS25 (as defined in the Town and Country Planning [flooding] [England] Direction 2007) is defined as:
(a) in respect of residential development, a development where the number of dwellings to be provided is 10 or more, or the site area is 0.5 hectares or more; or
(b) in respect of non-residential development, a development where the new floorspace to be provided is 1,000 square metres or more, or the site area is 1 hectare or more;

| | | | |
|---|---|---|---|
| 10 | If development is on a Greenfield site, have you provided evidence that post development run-off will not be increased above the Greenfield runoff rates and volumes using SuDS attenuation features where feasible (see also 18 onwards)? | Y/N or N/A | PPS25 |
| | If development is on a brownfield site, have you provided evidence that the post development run-off rate has not been increased, and as far as practical, will be decreased below existing site runoff rates using SuDS attenuation features where feasible (see also 17 onwards)? | Y/N or N/A | |
| 11 | Is the discharged water only surface water (e.g. not foul or from highways)?<br>If no, has a discharge consent been applied for? | Y/N<br>Y/N | Water Resources Act 1991 |
| 12 | A) Does your site increase run-off to other sites?<br>B) Which method to calculate run-off have you used? | Y/N | PPS 25 |
| 12 | Have you confirmed that any surface water storage measures are designed for varying rainfall events, up to and including, a 1 in 100 year + climate change event (see PPS25 Annex B, table B.2)? | Y/N | PPS25 |
| 13 | For rainfall events greater than the 1 in 100 year + climate change, have you considered the layout of the development to ensure that there are suitable routes for conveyance of surface flows that exceed the drainage design? | Y/N | PPS25 Guidance Notes |
| 14 | Have you provided layout plans, cross section details and long section drawings of attenuation measures, where applicable? | Y/N | |
| 15 | If you are proposing to work within 8 m of a watercourse have you applied, and received Flood Defence Consent from the Environment Agency? | Y/N or N/A | Water Resources Act 1991<br>Land Drainage Act 1991 |
| 16 | The number of outfalls from the site should be minimised. Any new or replacement outfall designs should adhere to standard guidance form SD13, available from the local area Environment Agency office. Has the guidance been followed? | Y/N | Guidance Driven by the Water Resources Act 1991 |
| | **Sustainable Drainage Systems (SuDS)** | | **Policy or Legislation** |
| 17 | A) Has the SuDS hierarchy been considered during the design of the attenuation and site drainage? Provide evidence for reasons why SuDS near the top of the hierarchy have been disregarded.<br>B) Have you provided detail of any SuDS proposed with supporting information, for example, calculations for sizing of features, ground investigation results and soakage tests? See CIRIA guidance for more information.<br>http://www.ciria.org.uk/suds/697.htm | Y/N | |
| 18 | A) Are Infiltration SuDS to be promoted as part of the development? If Yes, the base of the system should be set at least 1m above the groundwater level and the depth of the unsaturated soil zones between the base of the SuDS and the groundwater should be maximised.<br>B) If Yes – has Infiltration testing been undertaken to confirm the effective drainage rate of the SuDS? | Y/N<br>Y/N | PPS25 Guidance |
| 19 | A) Are there proposals to discharge clean roof water direct to ground (aquifer strata)?<br>B) If Yes, have all water down-pipes been sealed against pollutants entering the system form surface runoff or other forms of discharge? | Y/N<br>Y/N | |
| 20 | Is the development area above a Source Protection Zone (SPZ)? | If Y go to 21<br>If N go to 22 | Groundwater Regulations 1998 |
| 21 | A) Is the development area above an inner zone (SPZ1)?<br>B) If yes, discharge of Infiltration of runoff from car parks, roads and public amenity areas is likely to be restricted – has there been discussion with the Environment Agency as to suitability of proposed infiltration SuDS? | Y/N<br>Y/N | Groundwater Regulations 1998 |

| | | | |
|---|---|---|---|
| 22 | A) For infill development, has the previous use of the land been considered?<br>B) Is there the possibility of contamination?<br>C) If yes, infiltration SuDS may not be appropriate and remediation required to be undertaken. A groundwater Risk Assessment is likely to be required (Under PPS23) Has this been undertaken before the drainage design is considered in detail? | Y/N<br>Y/N<br>Y/N | PPS23 |
| 23 | Have oil separators been designed into the highway and car parking drainage?<br>PPG23: http://publications.environment-agency.gov.uk/pdf/PMHO0406BIYL-e-e.pdf | Y/N | PPG23 |
| 24 | Have you confirmed whether the proposed SuDS are to be adopted as part of public open space, or by a wastewater undertaker and provide supporting evidence?<br>Alternatively, have you provide details of the maintenance contributions to be provided over the life of the development. | Y/N<br>Y/N | |
| 25 | Have you provided details of any proposed measures to encourage public awareness of SuDS and increase community participation? | Y/N | |
| | **Water Consumption** | | **Policy or Legislation** |
| 26 | A) Have you provided the expected level of water consumption and hence the level to be attained in the Code for Sustainable Homes http://www.planningportal.gov.uk/england/professionals/buildingregs/sustainablehomes/<br>B) Have you considered whether the development can achieve a water consumption lower than 120 l/h/d (105 l/h/d for Levels 3 & 4 in the Code for Sustainable Homes, 80l/h/d as required for Levels 5 & 6) | Y/N | |
| 27 | Is the proposed development likely to achieve a water consumption of less than or equal to 125 l/h/d as consistent with the Communities and Local Government Building Regulations Part G (2009)? http://www.communities.gov.uk/publications/planningandbuilding/partg2009divisionalletter and http://www.planningportal.gov.uk/uploads/br/BR_PDF_draftADG_2009.pdf | Y/N | |
| 28 | Have you provided details of water efficiency methods to be installed in houses? | Y/N | |
| 29 | Have you confirmed whether the development will utilise rainwater harvesting and/or required tank sizes (see http://www.environment-agency.gov.uk/homeandleisure/drought/38559.aspx and http://publications.environment-agency.gov.uk/pdf/GEHO0108BNPN-E-E.pdf) | Y/N | |
| 30 | Has a practicable alternative strategy been included for the supply of water for fire fighting? | Y/N | |
| 31 | Have you confirmed whether grey water recycling is to be utilised and provided details? | Y/N | |
| 32 | Have you provided details of any proposed measures to increase public awareness and community participation in water efficiency? | Y/N | |
| | **Pollution Prevention** | | **Policy or Legislation** |
| 33 | Have you provided details of construction phase works method statement, outlining pollution control and waste management measures? See PPG2, PPG5, PPG6, PPG21(http://www.environment-agency.gov.uk/business/topics/pollution/39083.aspx) and DTI Site Waste Management Plan, (http://www.constructingexcellence.org.uk/resources/publications/view.jsp?id=2568) | Y/N | PPG2, PPG5, PPG6, PPG21 |

| | | | |
|---|---|---|---|
| 34 | A) Have you provided details of pollution prevention measures for the life of the development, such as oil and silt interceptors?<br>B) Have you considered whether permeable pavement areas are protected from siltation?<br>C) Have you provided details of maintenance – as with the SuDS? | Y/N<br>Y/N<br>Y/N | |
| | **Water Supply and Sewage Treatment** | | **Policy or Legislation** |
| 35 | Have you provided evidence to confirm that water supply capacity is available, and that demand can be met in accordance with the Breckland Water Cycle Strategy? | Y/N | |
| 36 | Have you provided evidence to confirm that sewerage and wastewater treatment capacity is available, and that demand can be met in accordance with the Breckland Water Cycle Strategy? | Y/N | |
| | **Conservation / Enhancement of Ecological Interest** | | **Policy or Legislation** |
| 37 | Have you confirmed that any green infrastructure, such as the surface water system, links to the neighbouring green infrastructure (River Corridors) to assist the creation and maintenance of green corridors? | Y/N | Green Infrastructure Study |
| 38 | Have you confirmed that at least 25% of flood attenuation ponds/wetlands will be designed for multifunctional uses, such as providing access, footpaths, cycleways, recreational uses, and submit outline details as suggested under Natural England guidelines? | Y/N | |
| 39 | A) Have you shown the impacts your development may have on the water environment?<br>B) Is there the potential for beneficial impacts? | Y/N<br>Y/N | Town and Country Planning Regulations 1999 |
| 40 | Have you confirmed all ponds within 500m of the site boundary have been surveyed for presence of great-crested newt populations? | Y/N | Habitats Directive |

Further information can be found in the Environment Agency's guide for developers:
http://www.environment-agency.gov.uk/business/sectors/32695.aspx

# Appendix G: Anglian Water Calculations of Future Attleborough WwTW Flow

| Option | | P | G l/h/d | PG cum/d | I cum/d | Safety factor cum/d | Flow cum/d | Discharge point | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | All flows to Attleborough STW | 18,500 | 143 | 2,646 | 1,360 | 801 | 4,800 | TM02949506 | Tributary of R Thet |
| 2 | All flows to Attleborough STW new discharge point | 18,500 | 143 | 2,646 | 1,360 | 801 | 4,800 | TM00409355 | River Thet |
| 3 | New development to Old Buckenham STW | 10733 | 143 | 1,535 | 384 | 384 | 2,300 | TM06129045 | Buckenham stream |
| 4 | New development to New STW | 8800 | 134 | 1,179 | 295 | 295 | 1,800 | TM03759280 | stream |
| 5 | New Development to New STW | 8800 | 134 | 1,179 | 295 | 295 | 1,800 | TM00409355 | River Thet |

Notes

1 Flows are for 2021 and assume that 4,000 houses are built by that date
2 G for existing sites is based on average of mtered and unmetered for Anglian region
3 G includes an allowance of 18 l/h/d (2021 estimate) for non-household flows (schools, pubs, offices etc.)
4 I based on measured flows for existing sites and 25% of PG for future.
5 Safety factor based on 20% of PG+I
6 Trade discharges are negligble (14cum/d).

# Appendix H: WwTW Capacity Calculations

# Calculations



| Job Title | Breckland Water Cycle Study - Detailed Study | | | | | Date | Project Number |
|---|---|---|---|---|---|---|---|
| Element | **Watton WWTW Volumetric Capacity Assessment** | | | | | 10/09/2009 | D124801 |
| Originator | Checked | Revision | Suffix | Orig | | | |
| SK | | | Date | Check | | | |

**Site Name:** Watton WWTW
**Site Location:** TF88500010
**Receiving Watercourse:** Watton Brook

| **Base Data - Provided by AWS from June 2008 Return** | | | |
|---|---|---|---|
| Total PE | | 10,957 | PE |
| Domestic PE | Pd | 10,576 | PE |
| Holiday PE | Ph | 63 | PE |
| Trade Flow | E | 30 | m3/d |
| Dry Weather Flow Consent | DWF | 2,650 | m3/d |
| Flow to Full Treatment Consent | FtFT | - | m3/d |
| Measured Dry Weather Flow | mDWF | 2,026 | m3/d |

| **Current Calculated Flow** | | | |
|---|---|---|---|
| Population Consumption | PG = (Pd*Gd)+(Ph+Gh) | 1,526 | m3/d |
| Infitration | I = 0.25*PG | 382 | m3/d |
| Trade Flow | E | 30 | m3/d |
| Calculated DWF | cDWF = PG+I+E | 1,938 | m3/d |
| Calculated FtFT | cFtFT = 3PG*I*3E | 5,051 | m3/d |

| **Current Headroom Calculations** | | | |
|---|---|---|---|
| DWF Capacity | DWF - mDWF | 624 | m3/d |
| FtFT Capacity | FTFT - cFtFT | - | m3/d |
| Population Capacity | | 3,306 | PE |
| Dwelling Capacity | Population Capacity/OR | 1,377 | dwellings |

| **Future Housing Allocations** | | | |
|---|---|---|---|
| Number of Dwellings | Hf | 533 | dwellings |
| Additional Population | Phf = Hf*OR | 1,279 | PE |
| Additional Flow from Housing | PGhf = Phf*Gf | 193 | m3/d |
| Additional Infiltration from Housing | Ihf = 0.25*PGHf | 48 | m3/d |

| **Future Employment** | | | |
|---|---|---|---|
| Number of Commercial Jobs | Ecf | 0 | Jobs |
| Number of Industrial Jobs | Eif | 0 | Jobs |
| Additional Flow from Employment | Eef = (Ecf*Gc)+(Eif*Gi) | 0 | m3/d |

| **Future Calculated Flow** | | | |
|---|---|---|---|
| Additional DWF from Future Dev | aDWF = PGhf + Ihf +Eef | 241 | m3/d |
| Future Calculated DWF | fDWF = mDWF + aDWF | 2,267 | m3/d |
| Future Calculated FtFT | fFTfT=cFtFT+3PGhf*Ihf*3Eef | 5,679 | m3/d |

| **Future Headroom Calculations** | | | |
|---|---|---|---|
| DWF Capacity | DWF - fDWF | 383 | m3/d |
| FtFT Capacity | FTFT - fFTft | - | m3/d |
| Population Capacity | | 2,029 | PE |
| Dwelling Capacity | Population Capacity/OR | 845 | dwellings |

| **Parameters** | | | |
|---|---|---|---|
| ***Consumption*** | | | |
| Gd | Domestic | 0.144 | m3/d |
| Gh | Holiday | 0.055 | m3/d |
| Gc | Commercial | 0.028 | m3/d |
| Gi | Industry | 0.028 | m3/d |
| Gf | Future Domestic | 0.151 | m3/d |
| ***Dwelling Occupancy*** | | | |
| OR | Occupancy Rate | 2.4 | people |

Current DWF used in Assessment
Future Calculated DWF

#

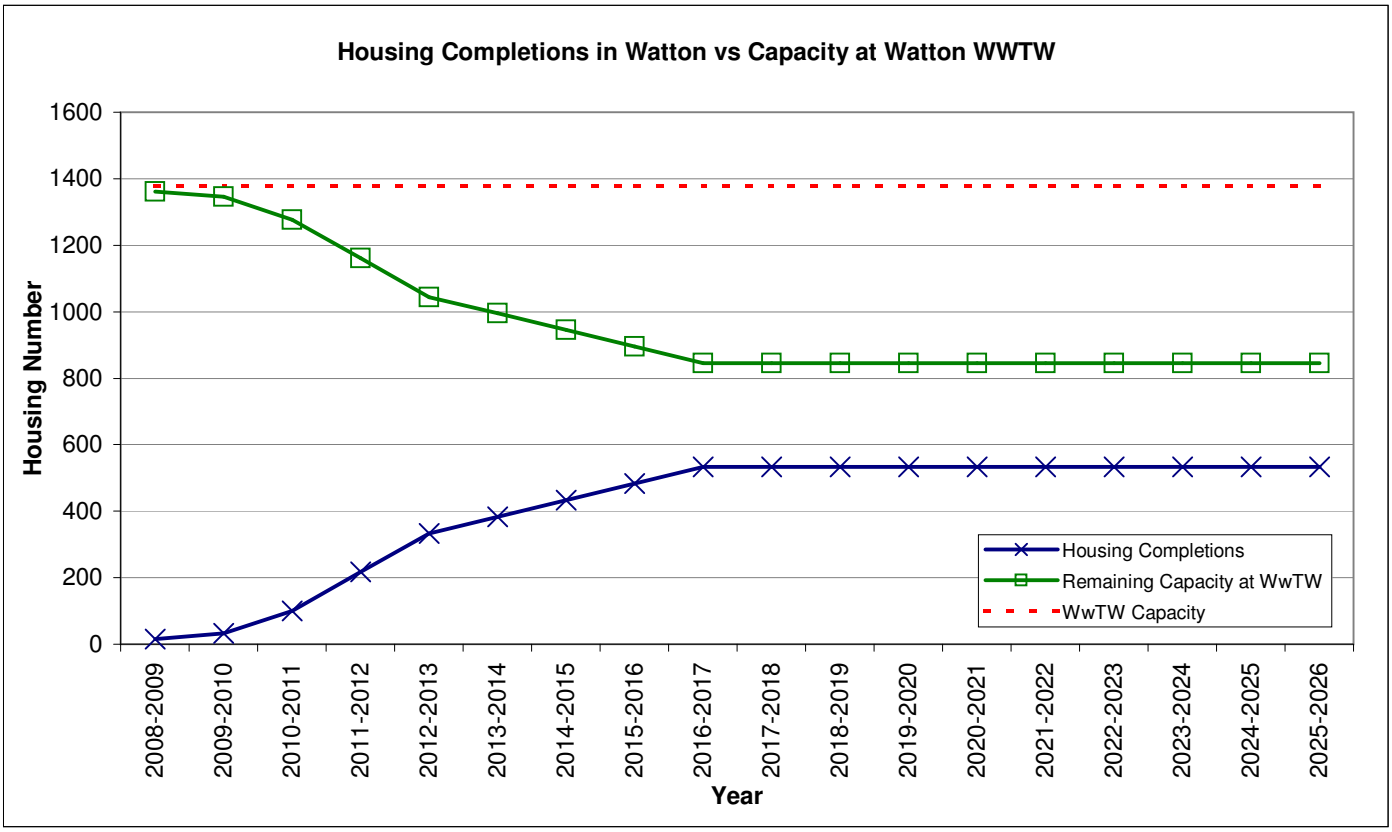
# Calculations



| Job Title | Breckland Water Cycle Study - Detailed Study | | | | | Date | Project Number |
|---|---|---|---|---|---|---|---|
| Element | **Watton WWTW Volumetric Capacity Assessment** | | | | | 10/09/2009 | D124801 |
| Originator | Checked | Revision | Suffix | Orig | | | |
| SK | | | Date | Check | | | |

*The calculations below relate only to housing growth and exclude any employment growth in the period 2008 - 2026*

| **Proposed Phasing of Future Housing Allocations in Watton** | | | | | |
|---|---|---|---|---|---|
| **Year** | **Greenfield** | **Brownfield** | **Total** | **Cumulative** | **Capacity** |
| 2008-2009 | 0 | 16 | 16 | 16 | 1,361 |
| 2009-2010 | 0 | 16 | 16 | 32 | 1,345 |
| 2010-2011 | 0 | 68 | 68 | 100 | 1,277 |
| 2011-2012 | 50 | 67 | 117 | 217 | 1,160 |
| 2012-2013 | 50 | 66 | 116 | 333 | 1,044 |
| 2013-2014 | 50 | 0 | 50 | 383 | 994 |
| 2014-2015 | 50 | 0 | 50 | 433 | 944 |
| 2015-2016 | 50 | 0 | 50 | 483 | 894 |
| 2016-2017 | 50 | 0 | 50 | 533 | 844 |
| 2017-2018 | 0 | 0 | 0 | 533 | 844 |
| 2018-2019 | 0 | 0 | 0 | 533 | 844 |
| 2019-2020 | 0 | 0 | 0 | 533 | 844 |
| 2020-2021 | 0 | 0 | 0 | 533 | 844 |
| 2021-2022 | 0 | 0 | 0 | 533 | 844 |
| 2022-2023 | 0 | 0 | 0 | 533 | 844 |
| 2023-2024 | 0 | 0 | 0 | 533 | 844 |
| 2024-2025 | 0 | 0 | 0 | 533 | 844 |
| 2025-2026 | 0 | 0 | 0 | 533 | 844 |
| **Total Delivery** | **300** | **233** | **533** | | |



# Calculations



| Job Title | Breckland Water Cycle Study - Detailed Study | | | | | Date | Project Number |
|---|---|---|---|---|---|---|---|
| Element | **Thetford WWTW Volumetric Capacity Assessment** | | | | | 10/09/2009 | D124801 |
| Originator | Checked | Revision | Suffix | Orig | | | |
| SK | | | Date | Check | | | |

**Site Name:** Thetford WWTW
**Site Location:** TL8553083570
**Receiving Watercourse:** Little Ouse

| **Base Data - Provided by AWS from June 2008 Return** | | | |
|---|---|---|---|
| Total PE | | 27,503 | PE |
| Domestic PE | Pd | 21,647 | PE |
| Holiday PE | Ph | 1,598 | PE |
| Trade Flow | E | 1,132 | m3/d |
| Dry Weather Flow Consent | DWF | 8,810 | m3/d |
| Flow to Full Treatment Consent | FtFT | 21,960 | m3/d |
| Measured Dry Weather Flow | mDWF | 1,279 | m3/d |

| **Current Calculated Flow** | | | |
|---|---|---|---|
| Population Consumption | PG = (Pd*Gd)+(Ph+Gh) | 3,205 | m3/d |
| Infitration | I = 0.25*PG | 801 | m3/d |
| Trade Flow | E | 1,132 | m3/d |
| Calculated DWF | cDWF = PG+I+E | 5,138 | m3/d |
| Calculated FtFT | cFtFT = 3PG*I*3E | 13,812 | m3/d |

| **Current Headroom Calculations** | | | |
|---|---|---|---|
| DWF Capacity | DWF - cDWF | 3,672 | m3/d |
| FtFT Capacity | FTFT - cFtFT | 8,148 | m3/d |
| Population Capacity | | 19,454 | PE |
| Dwelling Capacity | Population Capacity/OR | 8,106 | dwellings |

| **Future Housing Allocations** | | | |
|---|---|---|---|
| Number of Dwellings | Hf | 6,848 | dwellings |
| Additional Population | Phf = Hf*OR | 16,435 | PE |
| Additional Flow from Housing | PGhf = Phf*Gf | 2,482 | m3/d |
| Additional Infiltration from Housing | Ihf = 0.25*PGHf | 620 | m3/d |

| **Future Employment** | | | |
|---|---|---|---|
| Number of Commercial Jobs | Ecf | 0 | Jobs |
| Number of Industrial Jobs | Eif | 0 | Jobs |
| Additional Flow from Employment | Eef = (Ecf*Gc)+(Eif*Gi) | 0 | m3/d |

| **Future Calculated Flow** | | | |
|---|---|---|---|
| Additional DWF from Future Dev | aDWF = PGhf + Ihf +Eef | 3,102 | m3/d |
| Future Calculated DWF | fDWF = cDWF + aDWF | 8,240 | m3/d |
| Future Calculated FtFT | fFTfT=cFtFT+3PGhf*Ihf*3Eef | 21,878 | m3/d |

| **Future Headroom Calculations** | | | |
|---|---|---|---|
| DWF Capacity | DWF - fDWF | 570 | m3/d |
| FtFT Capacity | FTFT - fFTft | 82 | m3/d |
| Population Capacity | | 3,020 | PE |
| Dwelling Capacity | Population Capacity/OR | 1,258 | dwellings |

| **Parameters** | | | |
|---|---|---|---|
| ***Consumption*** | | | |
| Gd | Domestic | 0.144 | m3/d |
| Gh | Holiday | 0.055 | m3/d |
| Gc | Commercial | 0.028 | m3/d |
| Gi | Industry | 0.028 | m3/d |
| Gf | Future Domestic | 0.151 | m3/d |
| ***Dwelling Occupancy*** | | | |
| OR | Occupancy Rate | 2.4 | people |

Current DWF used in Assessment
Future Calculated DWF

#

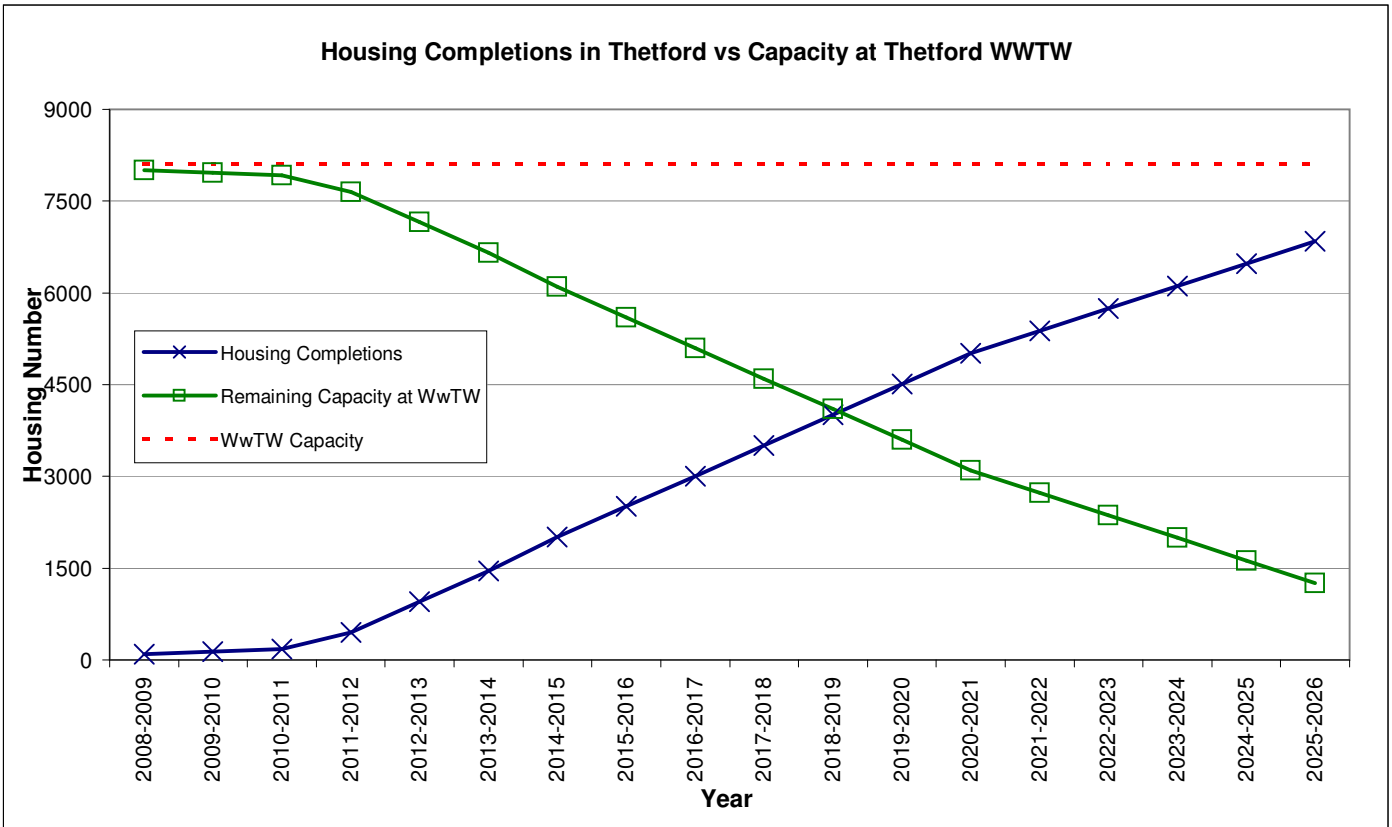
# Calculations



| Job Title | Breckland Water Cycle Study - Detailed Study | | | | | Date | Project Number |
|---|---|---|---|---|---|---|---|
| Element | **Thetford WWTW Volumetric Capacity Assessment** | | | | | 10/09/2009 | D124801 |
| Originator | Checked | Revision | Suffix | Orig | | | |
| SK | | | Date | Check | | | |

*The calculations below relate only to housing growth and exclude any employment growth in the period 2008 - 2026*

| **Proposed Phasing of Future Housing Allocations in Thetford** | | | | | |
|---|---|---|---|---|---|
| **Year** | **Greenfield** | **Brownfield** | **Total** | **Cumulative** | **Capacity** |
| 2008-2009 | 0 | 99 | 99 | 99 | 8,007 |
| 2009-2010 | 0 | 42 | 42 | 141 | 7,965 |
| 2010-2011 | 0 | 42 | 42 | 183 | 7,923 |
| 2011-2012 | 228 | 42 | 270 | 453 | 7,653 |
| 2012-2013 | 450 | 50 | 500 | 953 | 7,153 |
| 2013-2014 | 500 | 0 | 500 | 1453 | 6,653 |
| 2014-2015 | 543 | 12 | 555 | 2008 | 6,098 |
| 2015-2016 | 500 | 0 | 500 | 2508 | 5,598 |
| 2016-2017 | 500 | 0 | 500 | 3008 | 5,098 |
| 2017-2018 | 500 | 0 | 500 | 3508 | 4,598 |
| 2018-2019 | 500 | 0 | 500 | 4008 | 4,098 |
| 2019-2020 | 500 | 0 | 500 | 4508 | 3,598 |
| 2020-2021 | 500 | 0 | 500 | 5008 | 3,098 |
| 2021-2022 | 368 | 0 | 368 | 5376 | 2,730 |
| 2022-2023 | 368 | 0 | 368 | 5744 | 2,362 |
| 2023-2024 | 368 | 0 | 368 | 6112 | 1,994 |
| 2024-2025 | 368 | 0 | 368 | 6480 | 1,626 |
| 2025-2026 | 368 | 0 | 368 | 6848 | 1,258 |
| **Total Delivery** | **6561** | **287** | **6848** | | |




#

# Calculations



| Job Title | Breckland Water Cycle Study - Detailed Study | | | | | Date | Project Number |
|---|---|---|---|---|---|---|---|
| Element | **Swaffham WWTW Volumetric Capacity Assessment** | | | | | 10/09/2009 | D124801 |
| Originator | Checked | Revision | Suffix | Orig | | | |
| SK | | | Date | Check | | | |

**Site Name:** Swaffham WWTW
**Site Location:** TF83600670
**Receiving Watercourse:** River Wissey

| **Base Data - Provided by AWS from June 2008 Return** | | | |
|---|---|---|---|
| Total PE | | 7,036 | PE |
| Domestic PE | Pd | 6,842 | PE |
| Holiday PE | Ph | 190 | PE |
| Trade Flow | E | 1 | m3/d |
| Dry Weather Flow Consent | DWF | 1,602 | m3/d |
| Flow to Full Treatment Consent | FtFT | - | m3/d |
| Measured Dry Weather Flow | mDWF | 452 | m3/d |

| **Current Calculated Flow** | | | |
|---|---|---|---|
| Population Consumption | PG = (Pd*Gd)+(Ph+Gh) | 996 | m3/d |
| Infitration | I = 0.25*PG | 249 | m3/d |
| Trade Flow | E | 1 | m3/d |
| Calculated DWF | cDWF = PG+I+E | 1,246 | m3/d |
| Calculated FtFT | cFtFT = 3PG*I*3E | 3,239 | m3/d |

| **Current Headroom Calculations** | | | |
|---|---|---|---|
| DWF Capacity | DWF - DWF | 0 | m3/d |
| FtFT Capacity | FTFT - cFtFT | - | m3/d |
| Population Capacity | | **0** | PE |
| Dwelling Capacity | Population Capacity/OR | **0** | dwellings |

| **Future Housing Allocations** | | | |
|---|---|---|---|
| Number of Dwellings | Hf | 749 | dwellings |
| Additional Population | Phf = Hf*OR | 1,798 | PE |
| Additional Flow from Housing | PGhf = Phf*Gf | 271 | m3/d |
| Additional Infiltration from Housing | Ihf = 0.25*PGHf | 68 | m3/d |

| **Future Employment** | | | |
|---|---|---|---|
| Number of Commercial Jobs | Ecf | 0 | Jobs |
| Number of Industrial Jobs | Eif | 0 | Jobs |
| Additional Flow from Employment | Eef = (Ecf*Gc)+(Eif*Gi) | 0 | m3/d |

| **Future Calculated Flow** | | | |
|---|---|---|---|
| Additional DWF from Future Dev | aDWF = PGhf + Ihf +Eef | 339 | m3/d |
| Future Calculated DWF | fDWF = DWF + aDWF | 1,941 | m3/d |
| Future Calculated FtFT | fFTfT=cFtFT+3PGhf*Ihf*3Eef | 4,121 | m3/d |

| **Future Headroom Calculations** | | | |
|---|---|---|---|
| DWF Capacity | DWF - fDWF | **-339** | m3/d |
| FtFT Capacity | FTFT - fFTft | - | m3/d |
| Population Capacity | | **-1,796** | PE |
| Dwelling Capacity | Population Capacity/OR | **-748** | dwellings |

| **Parameters** | | | |
|---|---|---|---|
| ***Consumption*** | | | |
| Gd | Domestic | 0.144 | m3/d |
| Gh | Holiday | 0.055 | m3/d |
| Gc | Commercial | 0.028 | m3/d |
| Gi | Industry | 0.028 | m3/d |
| Gf | Future Domestic | 0.151 | m3/d |
| ***Dwelling Occupancy*** | | | |
| OR | Occupancy Rate | 2.4 | people |

Current DWF used in Assessment
Future Calculated DWF

#

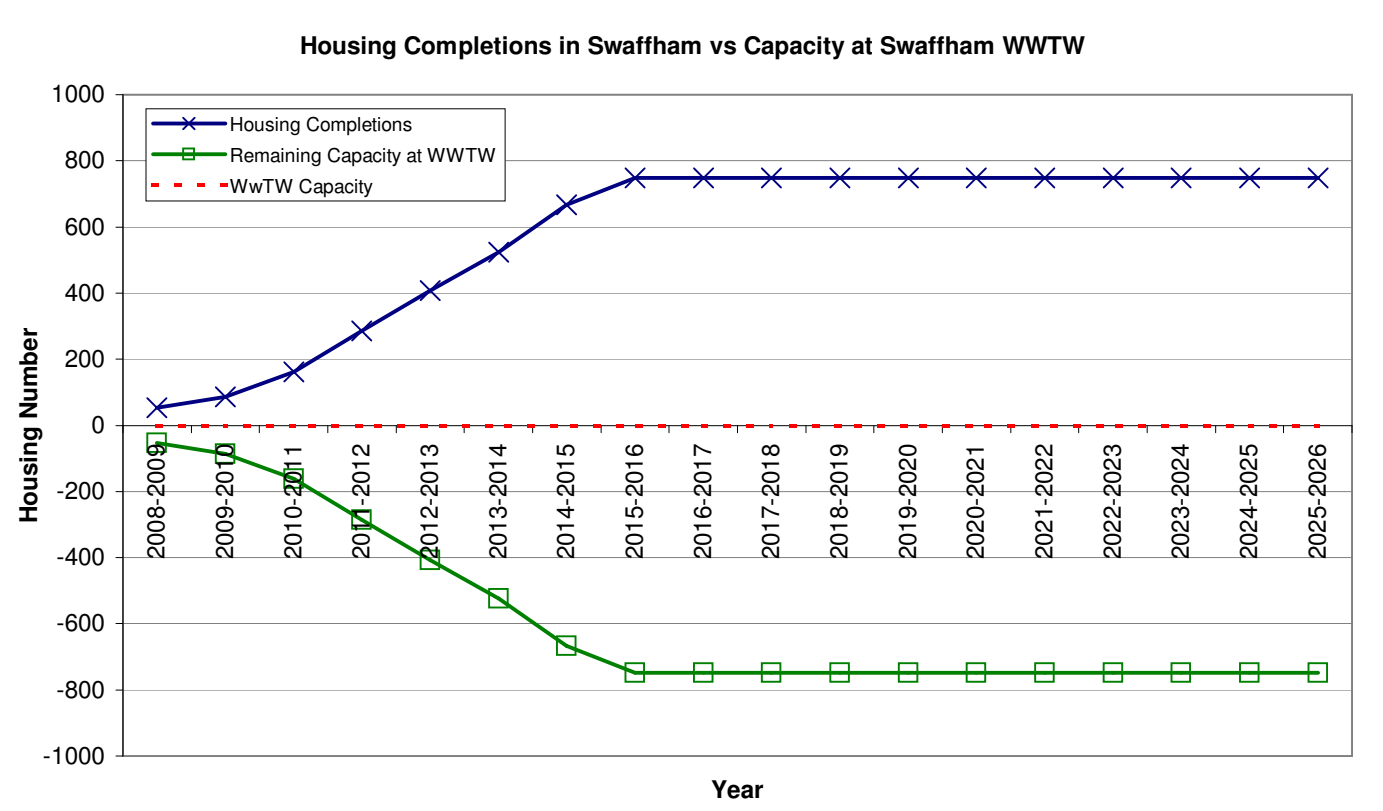
# Calculations



| Job Title | Breckland Water Cycle Study - Detailed Study | | | | | Date | Project Number |
|---|---|---|---|---|---|---|---|
| Element | **Swaffham WWTW Volumetric Capacity Assessment** | | | | | 10/09/2009 | D124801 |
| Originator | Checked | Revision | Suffix | Orig | | | |
| SK | | | Date | Check | | | |

*The calculations below relate only to housing growth and exclude any employment growth in the period 2008 - 2026*

| Proposed Phasing of Future Housing Allocations in Swaffham | | | | | |
|---|---|---|---|---|---|
| **Year** | **Greenfield** | **Brownfield** | **Total** | **Cumulative** | **Capacity** |
| 2008-2009 | 0 | 54 | 54 | 54 | -54 |
| 2009-2010 | 0 | 33 | 33 | 87 | -87 |
| 2010-2011 | 0 | 74 | 74 | 161 | -161 |
| 2011-2012 | 50 | 74 | 124 | 285 | -285 |
| 2012-2013 | 50 | 73 | 123 | 408 | -408 |
| 2013-2014 | 50 | 66 | 116 | 524 | -524 |
| 2014-2015 | 50 | 93 | 143 | 667 | -667 |
| 2015-2016 | 23 | 59 | 82 | 749 | -749 |
| 2016-2017 | 0 | 0 | 0 | 749 | -749 |
| 2017-2018 | 0 | 0 | 0 | 749 | -749 |
| 2018-2019 | 0 | 0 | 0 | 749 | -749 |
| 2019-2020 | 0 | 0 | 0 | 749 | -749 |
| 2020-2021 | 0 | 0 | 0 | 749 | -749 |
| 2021-2022 | 0 | 0 | 0 | 749 | -749 |
| 2022-2023 | 0 | 0 | 0 | 749 | -749 |
| 2023-2024 | 0 | 0 | 0 | 749 | -749 |
| 2024-2025 | 0 | 0 | 0 | 749 | -749 |
| 2025-2026 | 0 | 0 | 0 | 749 | -749 |
| **Total Delivery** | **223** | **526** | **749** | | |



# Calculations



| Job Title | Breckland Water Cycle Study - Detailed Study | | | | | Date | Project Number |
|---|---|---|---|---|---|---|---|
| Element | **Dereham WWTW Volumetric Capacity Assessment** | | | | | 10/09/2009 | D124801 |
| Originator | Checked | Revision | Suffix | Orig | | | |
| SK | | | Date | Check | | | |

**Site Name:** Dereham WWTW
**Site Location:** TF97701350
**Receiving Watercourse:** Wendling Beck

| **Base Data - Provided by AWS from June 2008 Return** | | | |
|---|---|---|---|
| Total PE | | 21,336 | PE |
| Domestic PE | Pd | 21,241 | PE |
| Holiday PE | Ph | 0 | PE |
| Trade Flow | E | 28 | m3/d |
| Dry Weather Flow Consent | DWF | 4,980 | m3/d |
| Flow to Full Treatment Consent | FtFT | 9,850 | m3/d |
| Measured Dry Weather Flow | mDWF | 4,191 | m3/d |

| **Current Calculated Flow** | | | |
|---|---|---|---|
| Population Consumption | PG = (Pd*Gd)+(Ph+Gh) | 3,059 | m3/d |
| Infitration | I = 0.25*PG | 765 | m3/d |
| Trade Flow | E | 28 | m3/d |
| Calculated DWF | cDWF = PG+I+E | 3,851 | m3/d |
| Calculated FtFT | cFtFT = 3PG*I*3E | 10,025 | m3/d |

| **Current Headroom Calculations** | | | |
|---|---|---|---|
| DWF Capacity | DWF - DWF | 0 | m3/d |
| FtFT Capacity | FTFT - cFtFT | -175 | m3/d |
| Population Capacity | | **0** | PE |
| Dwelling Capacity | Population Capacity/OR | **0** | dwellings |

| **Future Housing Allocations** | | | |
|---|---|---|---|
| Number of Dwellings | Hf | 909 | dwellings |
| Additional Population | Phf = Hf*OR | 2,182 | PE |
| Additional Flow from Housing | PGhf = Phf*Gf | 329 | m3/d |
| Additional Infiltration from Housing | Ihf = 0.25*PGHf | 82 | m3/d |

| **Future Employment** | | | |
|---|---|---|---|
| Number of Commercial Jobs | Ecf | 0 | Jobs |
| Number of Industrial Jobs | Eif | 0 | Jobs |
| Additional Flow from Employment | Eef = (Ecf*Gc)+(Eif*Gi) | 0 | m3/d |

| **Future Calculated Flow** | | | |
|---|---|---|---|
| Additional DWF from Future Dev | aDWF = PGhf + Ihf +Eef | 412 | m3/d |
| Future Calculated DWF | fDWF = DWF + aDWF | 5,392 | m3/d |
| Future Calculated FtFT | fFTfT=cFtFT+3PGhf*Ihf*3Eef | 11,095 | m3/d |

| **Future Headroom Calculations** | | | |
|---|---|---|---|
| DWF Capacity | DWF - fDWF | **-412** | m3/d |
| FtFT Capacity | FTFT - fFTft | -1,245 | m3/d |
| Population Capacity | | **-2,183** | PE |
| Dwelling Capacity | Population Capacity/OR | **-909** | dwellings |

| **Parameters** | | | |
|---|---|---|---|
| ***Consumption*** | | | |
| Gd | Domestic | 0.144 | m3/d |
| Gh | Holiday | 0.055 | m3/d |
| Gc | Commercial | 0.028 | m3/d |
| Gi | Industry | 0.028 | m3/d |
| Gf | Future Domestic | 0.151 | m3/d |
| ***Dwelling Occupancy*** | | | |
| OR | Occupancy Rate | 2.4 | people |

Current DWF used in Assessment
Future Calculated DWF

#

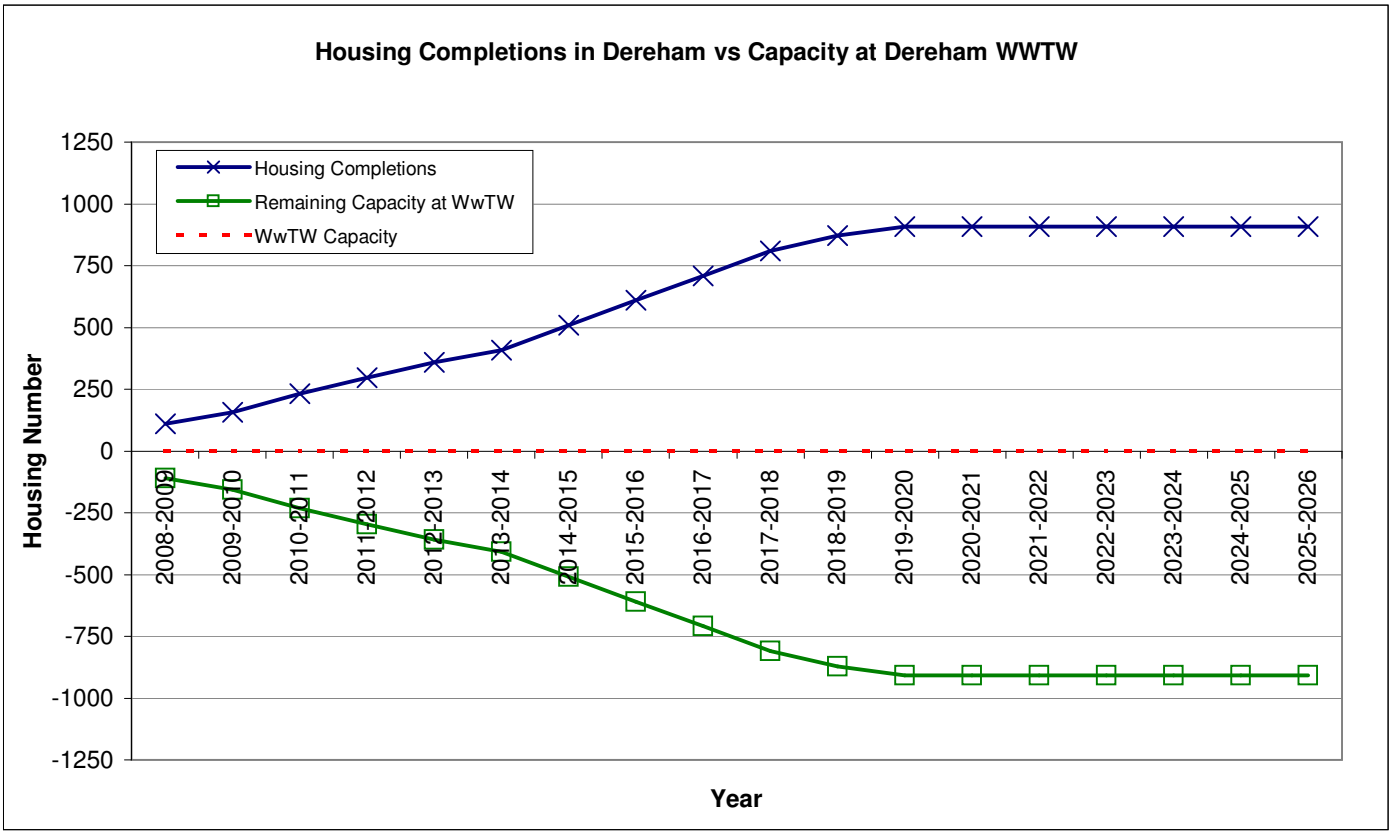
# Calculations



| Job Title | Breckland Water Cycle Study - Detailed Study | | | | | Date | Project Number |
|---|---|---|---|---|---|---|---|
| Element | **Dereham WWTW Volumetric Capacity Assessment** | | | | | 10/09/2009 | D124801 |
| Originator | Checked | Revision | Suffix | Orig | | | |
| SK | | | Date | Check | | | |

*The calculations below relate only to housing growth and exclude any employment growth in the period 2008 - 2026*

| Proposed Phasing of Future Housing Allocations in Dereham | | | | | |
|---|---|---|---|---|---|
| **Year** | **Greenfield** | **Brownfield** | **Total** | **Cumulative** | **Capacity** |
| 2008-2009 | 65 | 45 | 110 | 110 | -110 |
| 2009-2010 | 0 | 48 | 48 | 158 | -158 |
| 2010-2011 | 0 | 73 | 73 | 231 | -231 |
| 2011-2012 | 0 | 65 | 65 | 296 | -296 |
| 2012-2013 | 20 | 43 | 63 | 359 | -359 |
| 2013-2014 | 50 | 0 | 50 | 409 | -409 |
| 2014-2015 | 50 | 50 | 100 | 509 | -509 |
| 2015-2016 | 50 | 50 | 100 | 609 | -609 |
| 2016-2017 | 50 | 50 | 100 | 709 | -709 |
| 2017-2018 | 50 | 50 | 100 | 809 | -809 |
| 2018-2019 | 14 | 50 | 64 | 873 | -873 |
| 2019-2020 | 0 | 36 | 36 | 909 | -909 |
| 2020-2021 | 0 | 0 | 0 | 909 | -909 |
| 2021-2022 | 0 | 0 | 0 | 909 | -909 |
| 2022-2023 | 0 | 0 | 0 | 909 | -909 |
| 2023-2024 | 0 | 0 | 0 | 909 | -909 |
| 2024-2025 | 0 | 0 | 0 | 909 | -909 |
| 2025-2026 | 0 | 0 | 0 | 909 | -909 |
| **Total Delivery** | **349** | **560** | **909** | | |



# Calculations



| Job Title | Breckland Water Cycle Study - Detailed Study | | | | | Date | Project Number |
|---|---|---|---|---|---|---|---|
| Element | **Attleborough WWTW Volumetric Capacity Assessment** | | | | | 10/09/2009 | D124801 |
| Originator | Checked | Revision | Suffix | Orig | | | |
| SK | | | Date | Check | | | |

**Site Name:** Attleborough WWTW
**Site Location:** TM0294095070
**Receiving Watercourse:** River Thet

| **Base Data - Provided by AWS from June 2008 Return** | | | |
|---|---|---|---|
| Total PE | | 12,102 | PE |
| Domestic PE | Pd | 10,192 | PE |
| Holiday PE | Ph | 0 | PE |
| Trade Flow | E | 180 | m3/d |
| Dry Weather Flow Consent | DWF | 3,331 | m3/d |
| Flow to Full Treatment Consent | FtFT | 6,255 | m3/d |
| Measured Dry Weather Flow | mDWF | 2,273 | m3/d |

| **Current Calculated Flow (for Reference Only)** | | | |
|---|---|---|---|
| Population Consumption | PG = (Pd*Gd)+(Ph+Gh) | 1,468 | m3/d |
| Infitration | I = 0.25*PG | 367 | m3/d |
| Trade Flow | E | 180 | m3/d |
| Calculated DWF | cDWF = PG+I+E | 2,015 | m3/d |
| Calculated FtFT | cFtFT = 3PG*I*3E | 5,310 | m3/d |

| **Current Headroom Calculations** | | | |
|---|---|---|---|
| DWF Capacity | DWF - DWF | 0 | m3/d |
| FtFT Capacity | FTFT - cFtFT | 945 | m3/d |
| Population Capacity | | 0 | PE |
| Dwelling Capacity | Population Capacity/OR | 0 | dwellings |

| **Future Housing Allocations** | | | |
|---|---|---|---|
| Number of Dwellings | Hf | 4,079 | dwellings |
| Additional Population | Phf = Hf*OR | 9,790 | PE |
| Additional Flow from Housing | PGhf = Phf*Gf | 1,478 | m3/d |
| Additional Infiltration from Housing | Ihf = 0.25*PGHf | 370 | m3/d |

| **Future Employment** | | | |
|---|---|---|---|
| Number of Commercial Jobs | Ecf | 0 | Jobs |
| Number of Industrial Jobs | Eif | 0 | Jobs |
| Additional Flow from Employment | Eef = (Ecf*Gc)+(Eif*Gi) | 0 | m3/d |

| **Future Calculated Flow** | | | |
|---|---|---|---|
| Additional DWF from Future Dev | aDWF = PGhf + Ihf +Eef | 1,848 | m3/d |
| Future Calculated DWF | fDWF = DWF + aDWF | 5,179 | m3/d |
| Future Calculated FtFT | fFTfT=cFtFT+3PGhf*Ihf*3Eef | 10,114 | m3/d |

| **Future Headroom Calculations** | | | |
|---|---|---|---|
| DWF Capacity | DWF - fDWF | **-1,848** | m3/d |
| FtFT Capacity | FTFT - fFTft | -3,859 | m3/d |
| Population Capacity | | **-9,791** | PE |
| Dwelling Capacity | Population Capacity/OR | **-4,079** | dwellings |

| **Parameters** | | | |
|---|---|---|---|
| ***Consumption*** | | | |
| Gd | Domestic | 0.144 | m3/d |
| Gh | Holiday | 0.055 | m3/d |
| Gc | Commercial | 0.028 | m3/d |
| Gi | Industry | 0.028 | m3/d |
| Gf | Future Domestic | 0.151 | m3/d |
| ***Dwelling Occupancy*** | | | |
| OR | Occupancy Rate | 2.4 | people |

Current DWF used in Assessment
Future Calculated DWF

#

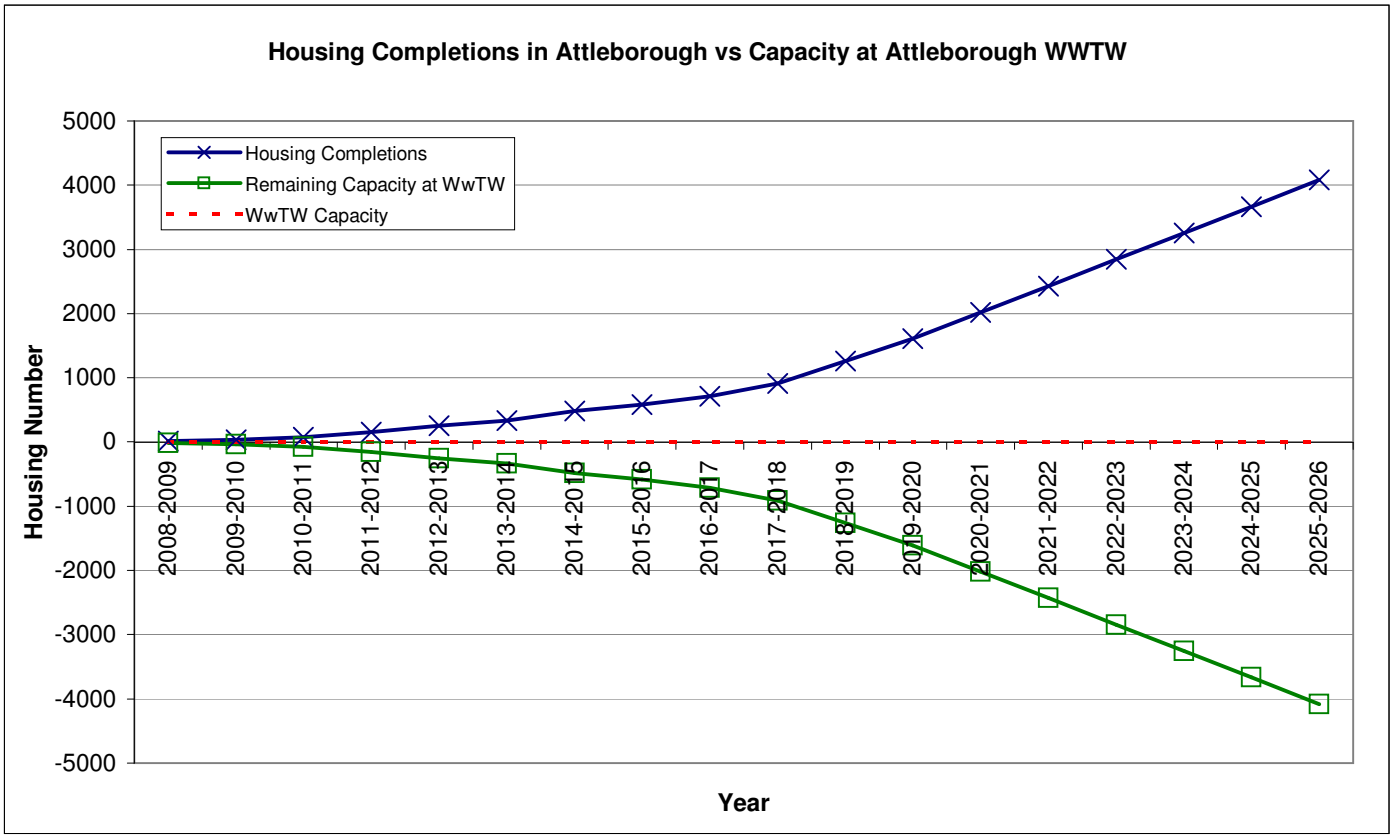
# Calculations



| Job Title | Breckland Water Cycle Study - Detailed Study | | | | | Date | Project Number |
|---|---|---|---|---|---|---|---|
| Element | **Attleborough WWTW Volumetric Capacity Assessment** | | | | | 10/09/2009 | D124801 |
| Originator | Checked | Revision | Suffix | Orig | | | |
| SK | | | Date | Check | | | |

*The calculations below relate only to housing growth and exclude any employment growth in the period 2008 - 2026*

| Proposed Phasing of Future Housing Allocations in Attleborough | | | | | |
|---|---|---|---|---|---|
| **Year** | **Greenfield** | **Brownfield** | **Total** | **Cumulative** | **Capacity** |
| 2008-2009 | 0 | 16 | 16 | 16 | -16 |
| 2009-2010 | 0 | 16 | 16 | 32 | -32 |
| 2010-2011 | 0 | 46 | 46 | 78 | -78 |
| 2011-2012 | 0 | 76 | 76 | 154 | -154 |
| 2012-2013 | 82 | 15 | 97 | 251 | -251 |
| 2013-2014 | 82 | 0 | 82 | 333 | -333 |
| 2014-2015 | 82 | 64 | 146 | 479 | -479 |
| 2015-2016 | 74 | 30 | 104 | 583 | -583 |
| 2016-2017 | 100 | 26 | 126 | 709 | -709 |
| 2017-2018 | 200 | 0 | 200 | 909 | -909 |
| 2018-2019 | 350 | 0 | 350 | 1259 | -1,259 |
| 2019-2020 | 350 | 0 | 350 | 1609 | -1,609 |
| 2020-2021 | 410 | 0 | 410 | 2019 | -2,019 |
| 2021-2022 | 412 | 0 | 412 | 2431 | -2,431 |
| 2022-2023 | 412 | 0 | 412 | 2843 | -2,843 |
| 2023-2024 | 412 | 0 | 412 | 3255 | -3,255 |
| 2024-2025 | 412 | 0 | 412 | 3667 | -3,667 |
| 2025-2026 | 412 | 0 | 412 | 4079 | -4,079 |
| **Total Delivery** | **3790** | **289** | **4079** | | |



# Calculations



| Job Title | Breckland Water Cycle Study - Detailed Study | | | | | Date | Project Number |
|---|---|---|---|---|---|---|---|
| Element | WWTW Volumetric Capacity Assessment | | | | | 10/09/2009 | D124801 |
| Originator | Checked | Revision | Suffix | Orig | | | |
| SK | | | Date | Check | | | |

**Purpose of Calculation**

To undertake an assessment of the volumetric capacity of Attleborough, Dereham, Swaffham, Thetford and Watton WWTW and calculate available headroom.

**Method of Calculation**

Spreadsheet

**Source/Reference Documents Used**

AWS WWTW Details (Breckland WCS Data.xls) provided 18-07-2008
Breckland District Council Development Levels and Phasing (Development Levels and Phasing.doc) provided 25-03-2009
OFWAT Security of Supply Rpt 2006-2007

**Key Parameters Used**

Dry Weather Flow (DWF)
Flow to Full Treatment (FtFT)
Measured Dry Weather Flow (mDWF) - used for Watton in place of current Calculated DWF
Current Population Served by WWTW (P)
Current Trade Flow Treated at WWTW (E)
Per Capita Water Demand (G)
Infiltration (I)
Property Occupancy Ratio (OR)

Calculated DWF = PG+I+E

where: PG=Pd*Gd+Ph*Gh
I=25%PG
E=trade flows m3/d

where: Pd=domestic poluation
Ph=holiday poluation
Gd=current domestic per capita consumption (144 l/h/d)
Gh=holiday per capita consumption (55 l/h/d)
Gc=commercial per capita consumption (28 l/h/d)

Calculated FtFT = 3PG+I+3E

The future Occupancy Rate (OR) is 2.4
The commercial employment per capita consumption (Gc) is 28 l/h/d
The future domestic (and employment) per capita consumption (Gf) is 151 l/h/d

# Appendix I: Thetford Wastewater Network Calculations

# Calculations

Section of

| Job Title | Breckland Water Cycle Study | | | | | | Date | D124801 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | Thetford Sewage Transfer Main | | | | | | 2 Sep 09 | | | | | |
| Originator | Checked | Revision | Suffix | Orig | | | | | | | | |
| EMF | PM | | Date | Check | | | | | | | | |

**Purpose of Calculation**

Preliminary sizing and budget costing of strategic foul sewage pumping system for development to north of town.

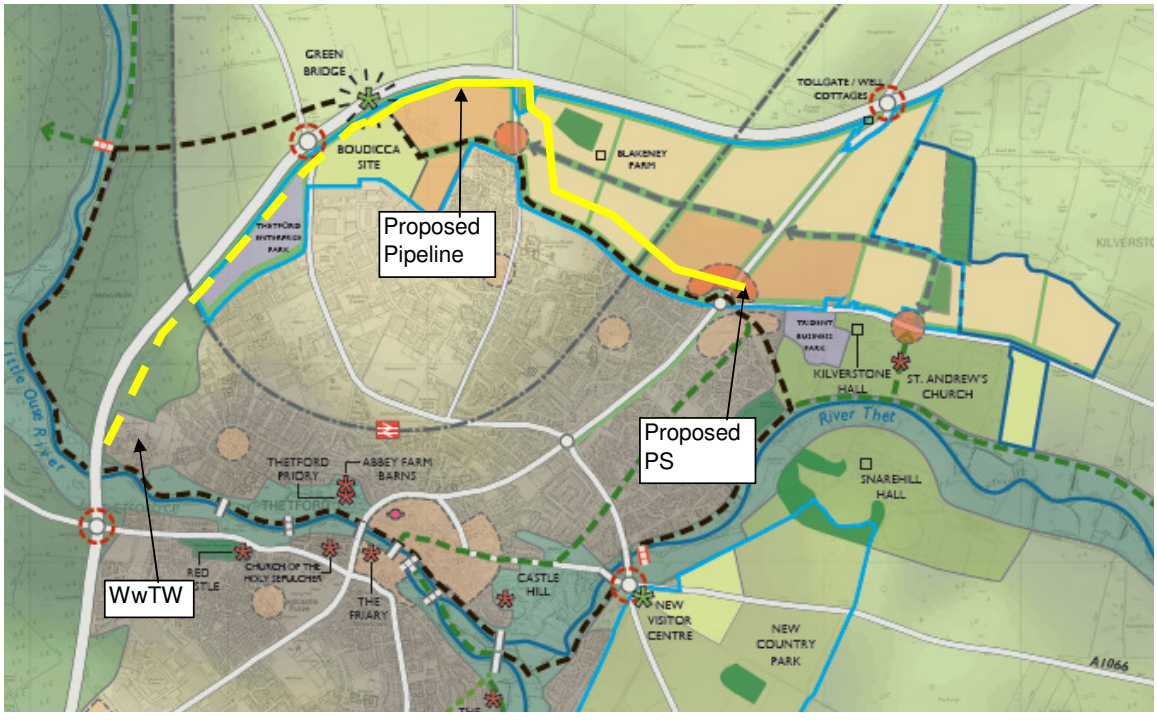
**Source/Reference Documents Used**

Anglian Water Services Strategic Direction Statement 2010-2035
Thetford Water Cycle Strategy Stage 1 Tender Document (Scott Wilson Document)
HR Wallingford's Tables for the Hydraulic Design of Pipes and Sewers
CIRIA Rpt 177 - Dry Weather Flow In Sewers
OFWAT Security of Supply Rpt 2006-2007
OFWAT Cost Base 2008 (Public domain data)
Emerging Preferred Options for the Growth and Regeneration of Thetford – Historic Past, Healthy Future
Water Supply - AC Twort

**Assumptions**

**Other Comments**

http://www.breckland.gov.uk/strategic_urban_design_framework-2.pdf



# Calculations

Section of

| Job Title | Breckland Water Cycle Study | | | | | | Date | D124801 |
|---|---|---|---|---|---|---|---|---|
| Element | Thetford Sewage Transfer Main | | | | | | 2 Sep 09 | |
| Originator | Checked | Revision | Suffix | Orig | | | | |
| EMF | PM | | Date | Check | | | | |

**Rising Main**

| | | | | | |
|---|---|---|---|---|---|
| DN300 | Ofwat Cost Base 2008 | | 180 £/m | 2.6 km | **515 £K** |
| | Inflation allow | 10% | 198 £/m | | |

NB Ofwat Cost Base data includes all project costs inc typical contingencies
[Compare SEWater RZ5 355mmOD PE100 SDR17 £211/m]

**Gravity sewer**

Minimum gradient circa 1in 100; maximum 1 in 20

Colebrook White equation

| | | | | |
|---|---|---|---|---|
| Ks | 1.5 | mm | | |
| Diameter | 300 | mm | | |
| Gradient | 0.01 | 1 in 100 | 0.05 | 1 in 20 |
| Flow | 97.983 | lps | 219.62 | lps |
| Velocity | 1.3862 | m/s | 3.107 | m/s |

Part Full pipes

| | | | | |
|---|---|---|---|---|
| Prop depth | 0.67 | | 0.67 | |
| Theta | 107.56 | | 133.1 | |
| Vp | 1.1081 | | 1.1072 | |
| Qp | 0.7893 | | 0.7887 | |
| Velocity | 1.536 | m/s | 3.4399 | m/s |
| Flow | 77.342 | lps | 173.21 | lps |

*Hence DN300 should suffice*

| | | | | | |
|---|---|---|---|---|---|
| | Ofwat Cost Base 2008 | | 337 £/m | 2.1 km | **778 £K** |
| | Inflation allow | 10% | 371 £/m | | |

**Cost Summary**

| | | |
|---|---|---|
| Pumping Station 78l/s 200kW | | 1,138 £K |
| Rising Main 2.6km DN300 | | 515 £K |
| Gravity sewer 2.1km DN300 | | 778 £K |
| Subtotal | | 2,432 £K |
| Contingencies | 25% | 608 £K |
| | | **3,040 £K** |

**Indicative Programme**

Design / Planning to contract award 30 months (esp for railways/highways consents)
Construction period 12 months

# Calculations

Section of

| Job Title | Breckland Water Cycle Study | | | | | | Date | D124801 |
|---|---|---|---|---|---|---|---|---|
| Element | Thetford Sewage Transfer Main | | | | | | 2 Sep 09 | |
| Originator | Checked | Revision | Suffix | Orig | | | | |
| EMF | PM | | Date | Check | | | | |

**Pump Duty Point**

| | | | |
|---|---|---|---|
| Min Suction level | 14.00 | | |
| Max Suction level | 16.00 | | |
| Discharge level | 53.00 | | |
| Design Flow | **77.6** l/s | 0.078 | m3/s |

| | | P1 | P2 | |
|---|---|---|---|---|
| Length | | 2600 | 10 | m |
| Minor loss allowance (K) | | 3.0 | 7.00 | |
| Diameter | | **300.0** | **200.0** | mm |
| Low Ks | 0.3 | 0.00423 | 0.03460 | |
| Design Ks | 0.6 | 0.00493 | 0.04119 | |
| High ks | 1.5 | 0.00629 | 0.05384 | |
| Velocity (m/s) | | 1.10 | 2.47 | |
| Hm | | 0.18 | 2.18 | |

| | | |
|---|---|---|
| Hs min | 37.0 | m |
| Hs max | 39.0 | m |
| Low Ks, Hs min | 50.7 | |
| Design Ks, Hs min | 52.6 | |
| **Design Ks, Hs max** | **54.6** | **m** |
| High Ks, Hs max | 58.2 | |

**Sewage Pumping Station cost estimate**

| | | | |
|---|---|---|---|
| COPI | = | 175 | |
| Q = flow | = | 0.078 | cumecs |
| H = total lift | = | 54.6 | m |
| η = efficiency | = | 40% | |
| Standby provision | = | 100 | % |
| Hence duty input power | = | 103.9 | kW |
| Total installed power | = | 207.8 | kW |
| COPI Q4'96 | = | 102 | |
| Hence inflation multiplier | = | 1.72 | |
| Civil | = | 534 | £K |
| M&E | = | 225 | £K |
| TOTAL TENDER COST | = | 759 | £K |
| Other Project Costs @ 50% | | 379 | £K |
| Total project cost | | **1,138** | **£K** |

*Notes*
Valid up to 150kW total installed power; use with caution above this.
Based on TR61 (May 01 model), base date Q4'96

# Calculations

Section of

| Job Title | Breckland Water Cycle Study | | | | | | Date | D124801 |
|---|---|---|---|---|---|---|---|---|
| Element | Thetford Sewage Transfer Main | | | | | | 2 Sep 09 | |
| Originator | Checked | Revision | Suffix | Orig | | | | |
| EMF | PM | | Date | Check | | | | |

**Data from Breckland Council**

**Housing Development & Phasing**

| Year | Green | Brown |
|---|---|---|
| 2008-09 | | 99 |
| 2009-10 | | 42 |
| 2010-11 | | 42 |
| 2011-12 | 228 | 42 |
| 2012-13 | 450 | 50 |
| 2013-14 | 500 | 0 |
| 2014-15 | 543 | 12 |
| 2015-16 | 500 | 0 |
| 2016-17 | 500 | 0 |
| 2017-18 | 500 | 0 |
| 2018-19 | 500 | 0 |
| 2019-20 | 500 | |
| 2020-21 | 500 | |
| 2021-2022 | 368 | |
| 2022-2023 | 368 | |
| 2023-2024 | 368 | |
| 2024-2025 | 368 | |
| 2025-2026 | 368 | |
| Total Delivery | **6561** | **287** |

New transfer main will be based on green field development i.e. 6561 properties

DWF = PG + I + E  3DWF = 3PG + I + 3E
Where
P = Population served
G = Ave domestic wastewater contribution per capita
I = Infiltration
E = Industrial Effluent Discharge

G is taken as percentage of consumed water per capita

| | | | |
|---|---|---|---|
| Domestic DWF | 146 | l/c/d | Ref: OFWAT Security of Supply Rpt (06-07) data for AWS |
| % returned to sewer | 90% | | |
| Therefore G = | 131.4 | l/c/d | |
| Occupancy Rate | 2.3 | p/prop | Range 2.1-2.3 see AWS Strategic Direction Statement 2010-2035 |
| I = | 25% | of PG | Should be conservative for new sewerage |
| E = | 86 | m3/d | Trident / Norwich Road |

| | | | | |
|---|---|---|---|---|
| DWF= | 2564 | m3/d | 29.7 | l/s |
| 3DWF = | 6702 | m3/d | **77.6** | l/s = design pump rate (suitable for a separate system) |

Plus Thetford Enterprise Park

| | | | |
|---|---|---|---|
| DWF= | 84 | m3/d | 1.0 l/s |
| 3DWF = | 252 | m3/d | 2.9 l/s |

NB Govt target 125 l/hd/d for new homes (AWS Strategic Direction Statement 2010-2035)

# Calculations

Section of

| Job Title | Breckland Water Cycle Study | | | | | | Date | D124801 |
|---|---|---|---|---|---|---|---|---|
| Element | Thetford Sewage Transfer Main | | | | | | 2 Sep 09 | |
| Originator | Checked | Revision | Suffix | Orig | | | | |
| EMF | PM | | Date | Check | | | | |

**Employment**
see "Emerging Preferred Options for the Growth and Regeneration of Thetford – Historic Past, Healthy Future"
Proposed Jobs 5000 total for the town
New Land Required 30-40 ha including Thetford Enterprise Park

| | | | |
|---|---|---|---|
| Thetford Enterprise Park | 18 | ha | |
| | 60000 | sq.m commercial | |
| | 700 | employees | |
| | 39 | employees/ha | |
| Trident Business Park | 6.0 | ha | (24ha - 18ha for Thetford Enterprise Park) |
| Undefined | 12.4 | ha | Norwich Road area |
| | 18.4 | at | 39 employees/ha= 716 employees |

Demands (see Twort)

| | |
|---|---|
| Offices | 65 l/hd/d |
| Department stores | 100-135 l/hd/d |
| Light industry | 250-500 l/hd/d |
| Average trade demand | 75-119 l/hd/d |
| Allow | 120 l/hd/d |

Hence assumed commerce/trade demand =
Thetford Enterprise Park **84 m3/d**
Trident / Norwich Road **86 m3/d**

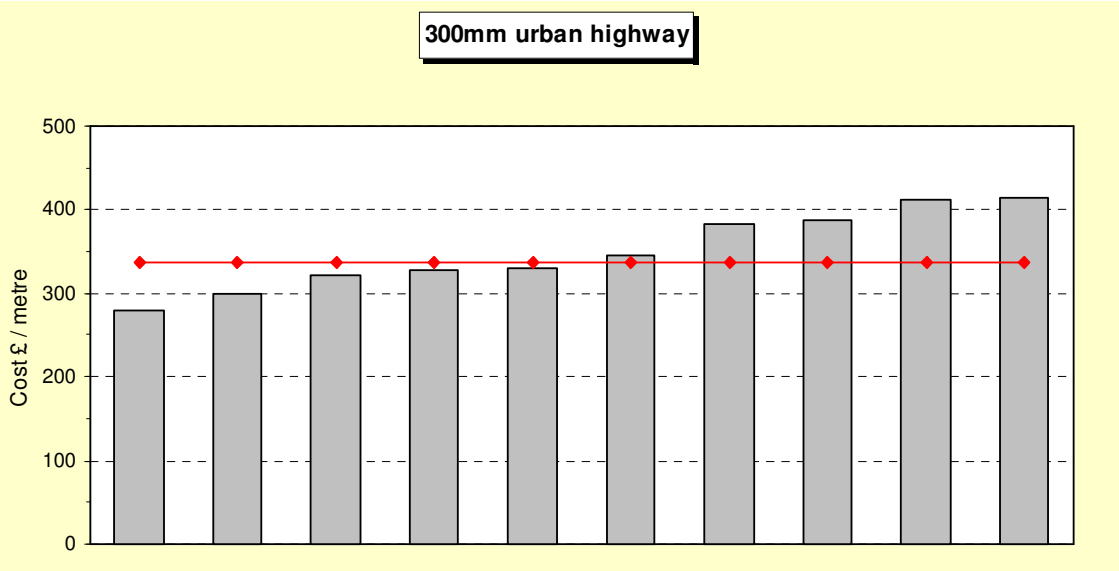
# Calculations

Section of

| Job Title | Breckland Water Cycle Study | | | | | | Date | D124801 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Element | Thetford Sewage Transfer Main | | | | | | | | | | | |
| Originator | Checked | Revision | Suffix | Orig | | | | | | | | |
| EMF | PM | | Date | Check | | | | | | | | |

## Periodic Review 2009
### First Cost Base submission (April 2008)

## Sewerage infrastructure standard costs - sewer laying 300mm




## Water infrastructure standard costs - mains laying 300mm