

6. Water Quality and Wastewater Treatment

6.1 Introduction

This section considers the capacity of the water environment to receive wastewater discharges without detrimental effects, or non compliance with environmental standards, and assesses the capacity of the existing wastewater infrastructure to collect and treat wastewater in relation to the proposed housing growth. Anglian Water Services (AWS) is the statutory (but not sole) provider for wastewater in the Borough of King's Lynn and West Norfolk.

There are 24 WwTWs serving the Borough of King's Lynn and West Norfolk (Figure 6.1³). Three WwTWs also serve areas outside the Borough: West Walton WwTW serving Wisbech in Fenland District, and Sculthorpe and Barton Bendish WwTWs serving rural areas to the east of the study area. Future housing development in the wider Wisbech area means that this growth also needs to be considered in the assessment of West Walton WwTW. The Sculthorpe and Barton Bendish WwTW catchments cover rural areas outside the Borough boundary and are, therefore, not considered further in this assessment. Figure 6.1 also shows the catchment areas of the WwTWs which indicates that some areas of the Borough are outside the sewered catchments and properties in these areas are, therefore, assumed to be served by cesspits and septic tanks.

The assessment presented in the Section is focussed on the WwTWs listed in Table 6.1. Wastewater from a large proportion of the planned growth will be served by King's Lynn, Downham Market, Heacham and West Walton WwTWs. Several WwTWs have exceeded their current consented Dry Weather Flows and, therefore, have no capacity to receive additional flows unless the consent is modified. An assessment of the impact on the receiving waters will be required before an increase in dry weather flow can be consented.

The receiving waters in the Borough (see also Section 2.2) range from the Ely Ouse with a substantial upstream catchment, smaller rivers that extend beyond the Borough (River Nar and Wissey) to minor rivers that are contained within the study area (River Babingley, River Ingol and River Heacham). The nature of the receiving waters of the key WwTWs are also described in Table 6.1.

³ There are also a number of private sewage works but these are not considered as they are unlikely to be affected by the planned growth.



Table 6.1 Wastewater Treatment Works

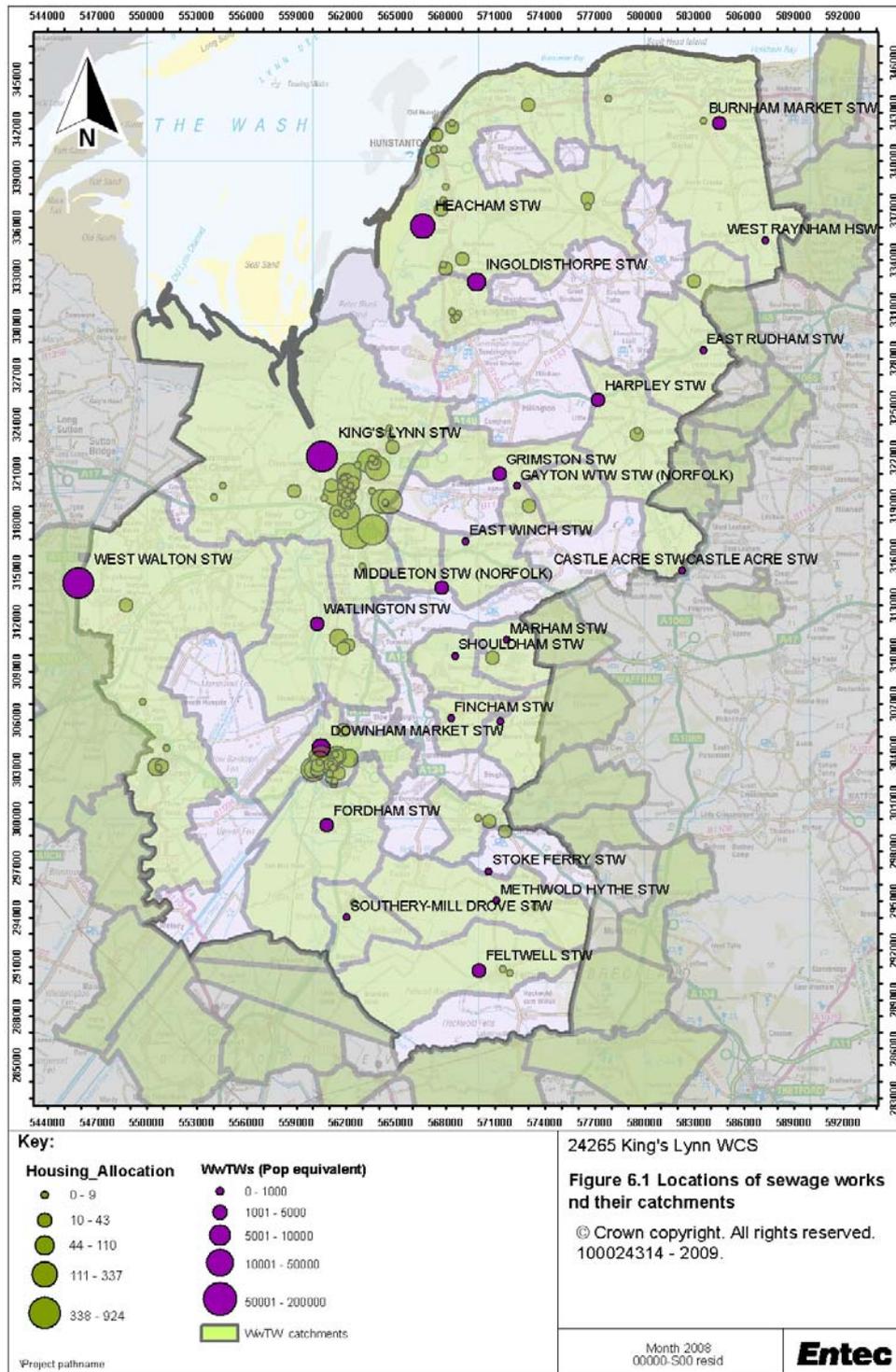
Wastewater Treatment Works	Nature of Receiving Water	Key Issues
King's Lynn WwTW	Tidal Great Ouse. High level of dilution provided by tidal flux in the receiving water	Would serve most of the planned growth in the Borough.
West Walton WwTW	Tidal Great Ouse. High level of dilution provided by tidal flux in the receiving water	Also serves increased wastewater flows from areas of Wisbech in Fenland District
Downham Market WwTW	Flood Relief Channel and The Flood Relief Channel directs flood water from the Ely Ouse and Cut Off Channel at Denver Sluice into the tidal river at King's Lynn and stores a large volume of water during non flood conditions.	Would serve planned growth in Downham Market area.
Heacham WwTW	Discharges into the Heacham River, immediately upstream of the Wash, such potential impacts are mainly related to coastal waters.	Would serve planned growth in Hunstanton and Heacham areas.
Burnham Market WwTW	Discharges into River Burn that flows into the North Norfolk Coast	Currently exceeds consented Dry Weather Flow
Fincham WwTW	Lode Dyke. Small slow flowing river.	Currently exceeds consented Dry Weather Flow
Grimston WwTW	Gaywood River. Small slow flowing river.	Currently exceeds consented Dry Weather Flow
Harpley WwTW	Babingley Stream. Small slow flowing river.	Currently exceeds consented Dry Weather Flow
Middleton WwTW	River Nar. High quality slow flowing river (BAP river).	Currently exceeds consented Dry Weather Flow
Watlington WwTW	Tidal Great Ouse	Currently exceeds consented Dry Weather Flow
Sculthorpe WwTW	River Wensum	Impact on SAC

6.2 Environmental Capacity

The Environmental Capacity of receiving waters to receive additional flows of wastewater is determined by the amount of dilution provided and existing chemical and ecological status. These factors will determine how much water quality in the receiving water will change as a result of increasing wastewater flows and whether this change is ecologically harmful.



Figure 6.1 Locations of sewage works and their catchments



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6.2.1 Dilution

The tidal Great Ouse and River Nene provide a high level of dilution because of the large tidal flux of water at the discharge point. In contrast, the small inland rivers in the Borough provide much less dilution of wastewater flow and are, therefore, likely to be most sensitive to growth. The Flood Relief Channel provides a high level of dilution of flow of wastewater from Downham Market WwTW during periods when water is released to the Channel from the Ely Ouse and Cut Off Channel but during dry periods there is little flow through the Flood Relief Channel. The impact of increased wastewater flow is, therefore, likely to be greatest in the summer when flows are low.

6.2.2 Water Quality of Watercourses

The environmental capacity of watercourses in the study area to receive additional wastewater flows can be also be assessed by comparing current water quality with Water Framework Directive water quality targets. Where targets for Good Chemical Status are exceeded, pollution from wastewater and other sources will need to be reduced to achieve Good Ecological Status, the ultimate objective of the legislation. Consequently, there will be no capacity to receive additional flows unless the quality of the wastewater effluent is improved.

Information to compare historical water quality in the study area with Water Framework Directive standards is not readily available. However, the Environment Agency has been monitoring the health of all receiving waters through the General Quality Assessment (GQA) Scheme for many years which can be used as a guide to current environmental capacity. The GQA classification provides a snapshot of receiving water quality based on the following aspects:

- Chemistry - water chemistry based on the following key determinands: Biological Oxygen Demand (BOD), Dissolved Oxygen (DO) and Ammonia.
- Nitrate.
- Phosphorus.
- Biology - based on the biodiversity of organisms living in the river and on the river bed.
- Chemistry and Biology are measured based on categories A-F, which represent 'Very Good' to 'Bad' water quality. Nitrate and Phosphorus categories are based on levels within the water, ranging from 1-6, that represent 'very low' to 'very high' nutrient levels respectively. The 2007 dataset provides the latest readily available snapshot of river water quality and is used in this scoping assessment.

Table 6.2 compares the river water quality, based on 2007 GQA data, upstream and downstream of some of the key rivers in the study area and Table 6.3 compares upstream and downstream water quality at the key WwTWs in the Borough that affect inland waters .



Broadly, the GQA grades can be used to indicate the likelihood of meeting Water Framework Directive targets.

- i. A GQA grade for phosphorus of 4 or above indicates that the average phosphorus concentrations is greater than 0.1mg/l which compares to the WFD target of 0.12 mg/l. This is exceeded in most of the watercourses, particularly, downstream of the wastewater treatment works indicating that there is little capacity to receive additional wastewater flow.
- ii. The GQA chemistry grade is a combined assessment of Ammonia, BOD and Dissolved Oxygen. A grade of C or worse indicates that the watercourse is likely to exceed one of the WFD targets for these parameters.

Table 6.2 Water Quality in Selected Reaches of Key Rivers in the Borough

River	Site Selection	U/s WQ site (2007 Data)				D/s WQ site (2007 data)			
		Ch	Biol	Nit	Ph	Ch	Biol	Nit	Ph
Nar	Sites furthest upstream and downstream on the river, within the study area	A	A	5	2	B	A	5	2
Babingley		A	A	6	2	B	-	6	2
Wissey		B	A	5	4	B	-	5	3

Ch - Chemistry classification Biol - Biology Nit - Nitrate Ph - Phosphate

High levels of nitrate and phosphate are observed upstream and downstream of WWTWs at most of the works which will make Water Framework targets difficult to achieve. In contrast, the GQA data indicates that the WFD targets for Ammonia, BOD and Dissolved Oxygen is less likely to limit environmental capacity.

The WFD's no deterioration policy is expected to apply to all future discharges in the area. As a minimum requirement, where proposed growth is likely to cause a breach in the current consent conditions, the Environment Agency will require an overall standstill in the load to prevent deterioration in the receiving water quality. The implications are that where flow, through growth, is allowed to exceed the consented flow (through renegotiation of revised flow consents), a pro-rata reduction in the effluent quality will be expected. It is reasonable to expect that the BAT and BATNEEC principles⁴ will also apply.

⁴ The tightening of effluent quality standards should not exceed those considered achievable using the Best Available Techniques (BAT) and/or the Best Available Technique Not Entailing Excessive Costs (BATNEEC).



Table 6.3 River Water Quality Upstream and Downstream of Key WwTW (shading indicates fails RE class)

WwTW	Receiving Water	U/s WQ site (2007 Data)				D/s WQ site (2007 data)			
		Ch	Biol	Nit	Ph	Ch	Biol	Nit	Ph
Downham Market	Tributary of Great Ouse/ Flood Relief Channel	B	A	5	5	C	-	5	5
Burnham Market WwTW	River Burn								
Fincham WwTW	Lode Dyke. Small slow flowing river.								
Grimston WwTW	Gaywood River. Small slow flowing river.								
Harpley WwTW	Babingley Stream. Small slow flowing river.								
Middleton WwTW	River Nar. High quality slow flowing river (BAP river).								

Ch - Chemistry classification Biol - Biology Nit - Nitrate Ph - Phosphate

6.2.3 River Basin Management Plans

The initial assessment of water body WFD compliance in the Anglian region has recently been published in the draft River Basin Management Plan (RBMP) by the Environment Agency. This states that only 13% of water bodies in the Anglian region currently achieve good status; the majority of failures to meet good status are because of the phosphate element of classification. The Environment Agency has not yet made an assessment of most of the rivers within the King's Lynn and West Norfolk Borough. However, the River Nar is identified as having a WFD ecological status classification of 'moderate potential' and 'high' chemical status, with predicted qualities for 2015 to be 'moderate Potential' and 'good' respectively. This same assessment was also made for the River Wissey. The initial classification of HMAWBs in the Borough shows moderate ecological potential for most inland water bodies. The relevant figures are presented in Appendix F.

The draft River Basin Management Plans for the area identifies the following actions (see Table 3.3): none of these works are affected by the primary locations for housing growth.

1. Improvement of polluting discharge (continuous) at Sculthorpe WwTW (Habitats Directive). This is related to the River Wensum SAC under the Habitats Directive as outlined above.
2. Improvement of polluting discharge (continuous) at Castle Acre WwTW, Harpley WwTW, Henley WwTW and Sculthorpe WwTW (Groundwater Directive and SSSI). These are related to discharges to soakaway that have the potential to contaminate groundwater. The Castle Acre discharge may also affect the River Nar.



3. Investigations into intermittent groundwater discharges at Bircham Newton STW, Fritcham Abbey Road STW, Rougham (Norfolk) STW and West Acre River Road STW (Groundwater Directive). These are related to discharges to soakaways that have the potential to contaminate groundwater.

The coastal stretches from Heacham to Wells-next-the-Sea have not yet been assessed for ecological status, with regards to the WFD, with no predicted qualities given for the compliance date of 2015. Current chemical status is identified as 'high' between Heacham and Holme-next-the-Sea, with the remaining coastline not yet assessed. Predicted chemical quality for this stretch in 2015 is 'good' status.

With regard to estuaries, the WFD status for Scolt Head Island site (near Burnham Market), in the north-east of the King's Lynn and West Norfolk coastal area, is identified as having a 'high' chemical quality, with 'good' quality status predicted for 2015. No assessment has yet been made of the ecological status. The Great Ouse Estuary is given an ecological status of 'moderate potential' and 'high' chemical status, with predicted qualities of 2015 of 'moderate' ecological potential and 'good' chemical status. The Wash inner estuary, covering the area just south of Heacham across to Scrane End on the Western edge of the Wash, is given an overall ecological status of 'moderate' and chemical status of 'moderate', with the same predicted qualities for 2015 as the Ouse Estuary. Relevant figures from the draft RBMP are presented in Appendix F.

6.2.4 Protected Areas

Habitats Directive

None of the WwTWs within the study area discharge upstream on inland European Sites with the exception of Sculthorpe WwTW which discharges into the River Wensum SAC. In the recent Habitats Directive Review of Consents (RoC); none of the discharge consents within the study area have been identified as requiring modification to protect the designated sites (Figure 2.5) with the exception of the impact of phosphorus emissions from Sculthorpe WwTW on the River Wensum.

Although most of the WwTWs in the study area are upstream of the Wash SAC/SPA, the analysis in Review indicated that wastewater discharges have no adverse affect on this site and this conclusion was based on the high dilution of pollution loads provided by sea water such that the conclusion will not be altered by the increases in wastewater flow associated with the planned growth.

Bathing Waters

From 1996 to 2008, all designated Bathing Waters (Figure 2.5) in the study area, i.e. Hustanton Beach, Hustanton Main Beach and Heacham, as well as those nearby, i.e. Wells, have passed standards, predominantly meeting the stricter 'guideline' standards. Full compliance results are given in Appendix G, Table G.1, with summary information shown in Table 6.4.



Table 6.4 Bathing Water Results - Summary Information

	Hunstanton Beach			Hunstanton Main Beach			Heacham			Wells		
	F	I	G	F	I	G	F	I	G	F	I	G
1998-1995	✓	✓	✓				✓	✓	✓		✓	
1996-2007		✓	✓		✓	✓		✓	✓		✓	✓
2008			✓		✓			✓				✓
Key	Fail (F)			Imperative (I)			Guideline (G)			Category not fulfilled		

Anglian Water has recently reviewed historical Bathing Water compliance data against the new standards of the revised Bathing Waters Directive which are summarised below. They have also commissioned coastal modelling studies to assess potential risk of non compliance in relation to the new standards. These studies have indicated that Heacham Beach will have a significant risk of non compliance and, as a result, a programme of monitoring and modelling investigations has been proposed for PR09 which will include investigations of the sources of coliform bacteria to Heacham River including the urban catchment and, in particular, the surface water sewer system. Mitigation options to reduce coliform loads will also be assessed.

Parameter (/100ml)	Existing Directive		New Directive		
	Mandatory	Guideline	Sufficient	Good	Excellent
E. coli	2,000 (95%ile)	100 (80%ile)	500 (90%ile)	500 (95%ile)	250 (95%ile)
F. streptococci	No standard	100 (90%ile)	No standard	No standard	No standard
Intestinal entroccoci	No standard	No standard	185 (90%ile)	200 (95%ile)	100 (95%ile)
Total Coliforms	10,000 (95%ile)	500 (95%ile)	No standard	No standard	No standard

Shellfish Waters

Shellfish Water monitoring and investigations have not identified any non compliance issues in the Wash and North Norfolk Coast Shellfish Waters. UV disinfection at King’s Lynn sewage works was switched off a number of years ago because it was determined to have little benefit with regard to the Shellfish Waters.



6.3 Wastewater Infrastructure Capacity

The Environment Agency regulates the quality of effluent discharges to help protect water quality, the environment and human health. This is done through issuing discharge consents which prescribe the flow rates and water quality standards that must be achieved at the point of effluent discharge.

6.3.1 Flow Consents and Capacity for Additional Wastewater Flows

Effluent discharge flow consents are set to a certain design horizon and as a result there is commonly a population and flow headroom allowance available in the effluent consent. As the population increases this headroom is eroded and the risk of non-compliance, and thus risk of failure to meet the water quality objectives in the receiving water, increases.

A fundamental factor describing capacity is a treatment works' 'Dry Weather Flow' (DWF), which is a measure of the incoming flow to a WwTW derived from human activity (both domestic and trade), but excluding any storm-induced flows. 'Formula A', is commonly used to describe the flow passed forward for full treatment (i.e. not spilling from the sewer network via Combined Sewer Overflows (CSOs) following heavy rainfall).

The following data and assumptions were used to enable calculation of the increase in DWF that may result from the proposed growth.

- A household occupancy rate of 2.1 as advised by AWS (this is understood to be an average figure between currently higher rates and forecast decreasing rates to 2031);
- A wastewater consumption rate (per capita consumption or pcc rate) of 144 l/day per person, as advised by Anglian Water, representative of the whole area throughout the calculation period;
- A fixed value of 1.25 to allow for infiltration rate of 25% of consumption has been assumed to remain constant and representative in all WwTW catchments;
- 100% of the water supply is returned to sewer;
- No allowance has been made for changes in holiday populations or trade effluent contributions (i.e. no growth in holiday populations and trade effluent has been assumed); and
- No allowance has been made for increases in non-household (i.e. business and similar) water usage;

The existing capacity of the wastewater treatment works to receive additional flows is provided by comparing the current observed DWF with the consented value.

Table 6.5 presents the current consented DWFs at all WwTWs in the study area. Eight of the WwTWs in the study area (Burnham Market, Fincham, Grimston, Harpley, Heacham, Middleton, Watlington and West Walton WwTWs) currently will exceed their consented DWF values or is projected to exceed the consent over the next



planning period (AMP). This indicates that they would not be able to accommodate any additional housing growth without modification to the consent or a reduction in the per capita production in wastewater. Anglian Water is/will be negotiating higher DWF consents with the Environment Agency for a number of WwTWs in the area, in response to changes in the system of measuring DWF, which are also shown in Table 6.5. These, however, are subject to further assessment before approval and may require a tightening of the effluent quality standards to protect the receiving waters and meet 'no deterioration' policy. The proposed changes to the effluent quality consents at these works are presented in Table 6.6.

With regard to the main centres of growth, this analysis indicates that the current consented DWF does not constrain growth at King's Lynn or Downham Market but agreement is required on the proposed consented Dry Weather Flow at Heacham and West Walton. Further assessment of these issues at the major growth centres and WwTWs where the current consent is exceeded should be carried out in the detailed phase of the Water Cycle Study.

Table 6.7 shows some of the larger WwTWs within the Borough, and indicates the number of failures (exceedances) recorded for that WwTW, against the 50% and full limits for BOD, Ammonia and Suspended Solids (SS). This indicates at the key WwTWs that are likely to serve areas of population growth the compliance record is good suggesting the treatment processes are working well and are not overloaded.

Table 6.5 Dry Weather Flows for WwTW within the King's Lynn and West Norfolk Borough

Site Name	Spare DWF Capacity m ³ /day*	Proposed Consented DWF	Consented DWF	Planned Households	Number of houses allowed by current consent
BARTON BENDISH STW	-	-	50		-
BURNHAM MARKET STW	Exceeds DWF	1089	780	157	None
CASTLE ACRE STW	Unknown	156	150		-
DOWNHAM MARKET STW	563	-	2500	2955	1862.05
EAST RUDHAM STW	92	-	160	19	224.87
EAST WINCH STW	Exceeds DWF	-	159	2	None
FELTWELL STW	148	-	470	16	1064.81
FINCHAM STW	Exceeds DWF	143	100	77	None
FORDHAM STW	not available	-	490		-
GAYTON WTW STW (NORFOLK)	-	-	0		-
GRIMSTON STW	Exceeds DWF	1295	865	83	None
HARPLEY STW	Exceeds DWF	325	272	73	None
HEACHAM STW	Exceeds DWF	5968	4500	530	None
INGOLDISTHORPE STW	702	-	1400	19	2309.52



Site Name	Spare DWF Capacity m ³ /day*	Proposed Consented DWF	Consented DWF	Planned Households	Number of houses allowed by current consent
KINGS LYNN STW	15175	-	21600	7077	9722.94
MARHAM STW	-	-	0		-
METHWOLD HYTHE STW	-	-	0		-
MIDDLETON STW (NORFOLK)	Exceeds DWF	-	260	52	None
SHOULDHAM STW	not available	-	170		-
SOUTHERY-MILL DROVE STW	not available	-	215		-
STOKE FERRY STW	145	-	282	202	453.37
WATLINGTON STW	Exceeds DWF	1343	769	326	None
WEST WALTON STW	Exceeds DWF	14894	14421	792	None

1. Where analysis for PRO9 indicates that the works is or will exceed the DWF no further capacity is available at the works without modification to the consent.
2. Where there is capacity the spare capacity is determined by comparing measured flows provided by Anglian Water and the current consented flow
3. The proposed DWF is based on measured flows from TSFR reports (10%ile)

Table 6.6 Proposed Changes to Consent Conditions for WwTWs Serving the Study Area

WwTW Name	Consent (mg/l)			
	BOD	Proposed BOD	NH3	Proposed NH3
BURNHAM MARKET	25	25	10	8
CASTLE ACRE				
FINCHAM				
GRIMSTON				
HARPLEY				
DOWNHAM MARKET	12	-	5	-
HEACHAM	13	-	5	-
INGOLDISTHORPE	15	-	5	-
KING'S LYNN	50	-	-	-
STOKE FERRY	13	-	10	-
WATLINGTON	39	-	-	-
WEST WALTON	40	-	20	-



Table 6.7 Compliance Record at key WwTWs

WwTW Name	Time Period	No. Failures BOD		No. Failures Ammonia		No. Failures - SS	
		50%	Full	50%	Full	50%	Full
Burnham Market	Sept. 2007 - Nov. 2008	0	0	1	0	2	0
Downham Market	Aug. 2007- Nov. 2008	0	0	1	0	0	0
Heacham	Jul. 2007 - Nov. 2008	0	0	6	1	0	0
Ingoldsthorpe	Jul. 2007 - Nov. 2008	0	0	0	0	0	0
King's Lynn	Jul. 2007 - Oct. 2008	0	0	-	-	0	0
Stoke Ferry	Aug. 2007 - Oct. 2008	1	1	2	1	2	0
Watlington	Aug. 2007 - Nov. 2008	0	0	-	-	0	0
West Walton	Jul. 2007 - Nov. 2008	0	0	-	-	1	0

Even where there is good DWF capacity, treatment and conveyance issues may occur as inflows to the works increase, including pumping station or inlet works restrictions, flooding and storm tank capacity issues, and treatment capacity although these issues are addressed through Anglian Water's asset management programme. Consequently, not all the difference between consented and measured flow is available for growth and flow is not the only constraint on treatment capacity. This requires further consideration in the Detailed Phase of the WCS.

An AWS Stage 2 report was provided by Anglian Water for Downham Market WwTW. This confirms that there is more than sufficient DWF capacity at this works to cope with the planned growth in the catchment. However, on-site flooding from the inlet works is an issue. Removing the hydraulic restriction at the inlet works (and providing additional storm storage) will alleviate flooding and allow more flow to be passed for treatment. However, this will cause the flow to full treatment to become a potential risk issue (i.e. exceed capacity) by 2016. The overall limiting stage appears to be the biological treatment capacity at the works, which is predicted to exceed its capacity, due to growth, by 2011. Modifications and/or enhancements will therefore be required to accommodate the changing incoming loads and consents. The possibility of re-instating the currently disused biofilters into service will be investigated by AWS. Moreover, the completion of the Hayfields development will bring residential properties to within 10m of the WwTW boundary which may constrain any modifications to the hydraulic and treatment capacity of the works and, therefore, place a constraint on growth in in the sewerage catchment.

Anglian Water has also indicated that Heacham WwTW is also close to capacity under peak flow conditions and may, therefore, need to be extended. Potential constraints on development of the WwTWs needs to be considered in the Detailed Phase of the work.

No other detailed reports or studies have been received for any other WwTWs in the Borough.



Trade effluent

Anglian Water provided data from their trade effluent database for King's Lynn WwTW which shows that in 2006 the total consented flow from traders was 10265m³/day (measured flow was 3500 m³/day) mainly from food processing factories. However, the largest factory, Campbells, with a consented flow of 3000 m³/day (measured flow in 2006 of 1190 m³/day), has now closed, providing the works with additional hydraulic headroom to accommodate increased domestic wastewater flows.

Water Efficiency

Two water efficiency scenarios, involving the use of pcc rates of 120 and 105 l/h/d for all new housing, were tested to determine their impact on wastewater DWFs arriving at the four main WwTWs between 2008 and 2031. Figures 6.2 to 6.5 present the findings of these calculations. It can be seen that the additional dry weather inflows to most WwTWs would be reduced generally by between 2% and 4% (and up to 15% for Downham Market WwTW) under water efficiency scenarios (Levels 1/2 and 3/4 respectively) compared to the average growth scenario.

Figure 6.2 Impact of water efficiency measures on future DWF in King's Lynn WwTW

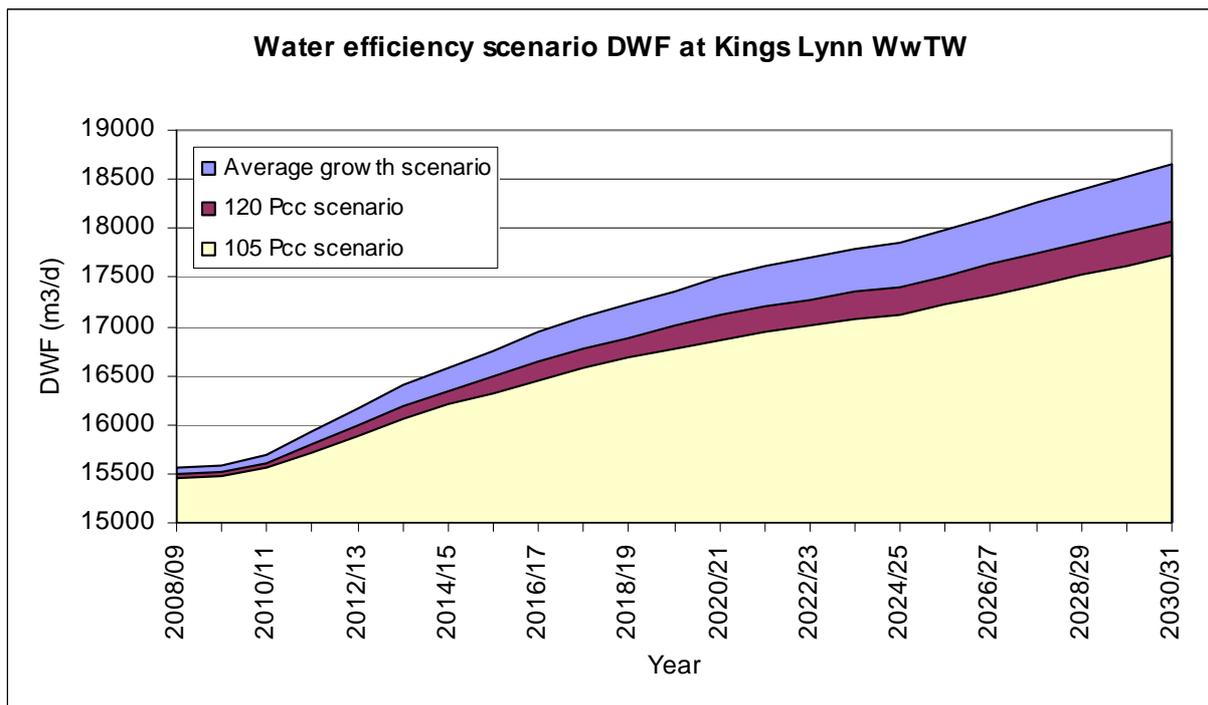


Figure 6.3 Impact of water efficiency measures on future DWF in Downham Market WwTW

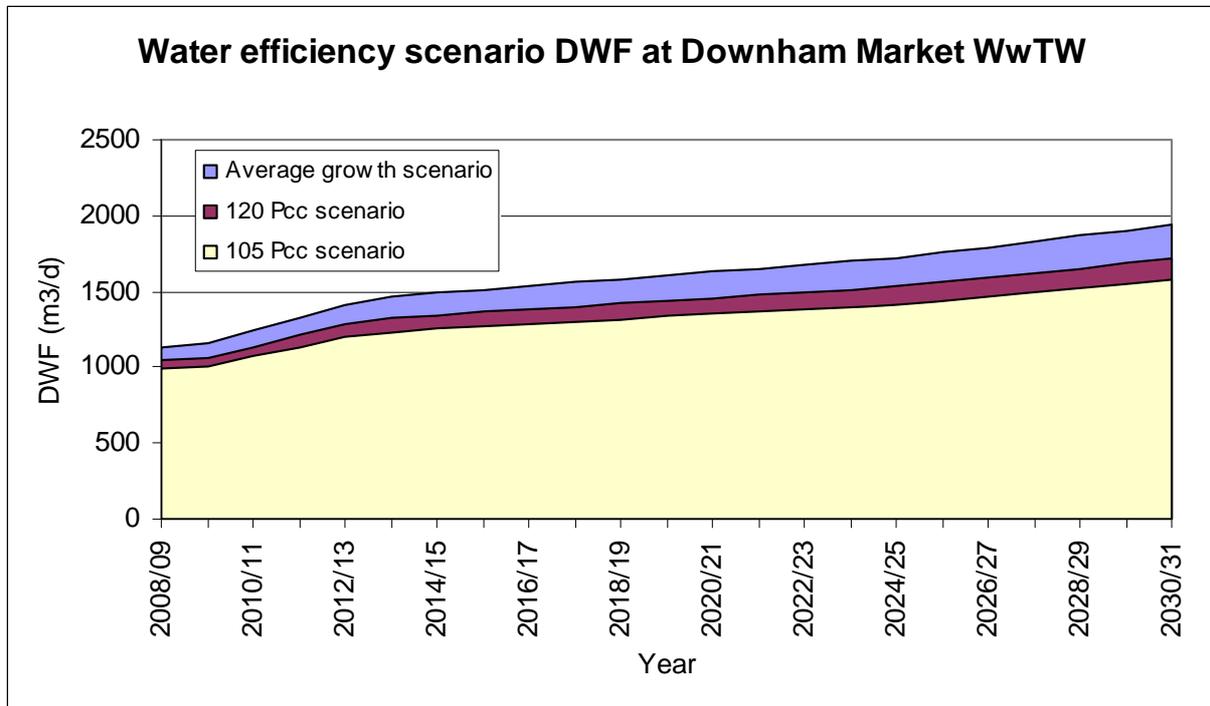


Figure 6.4 Impact of water efficiency measures on future DWF in Heacham WwTW

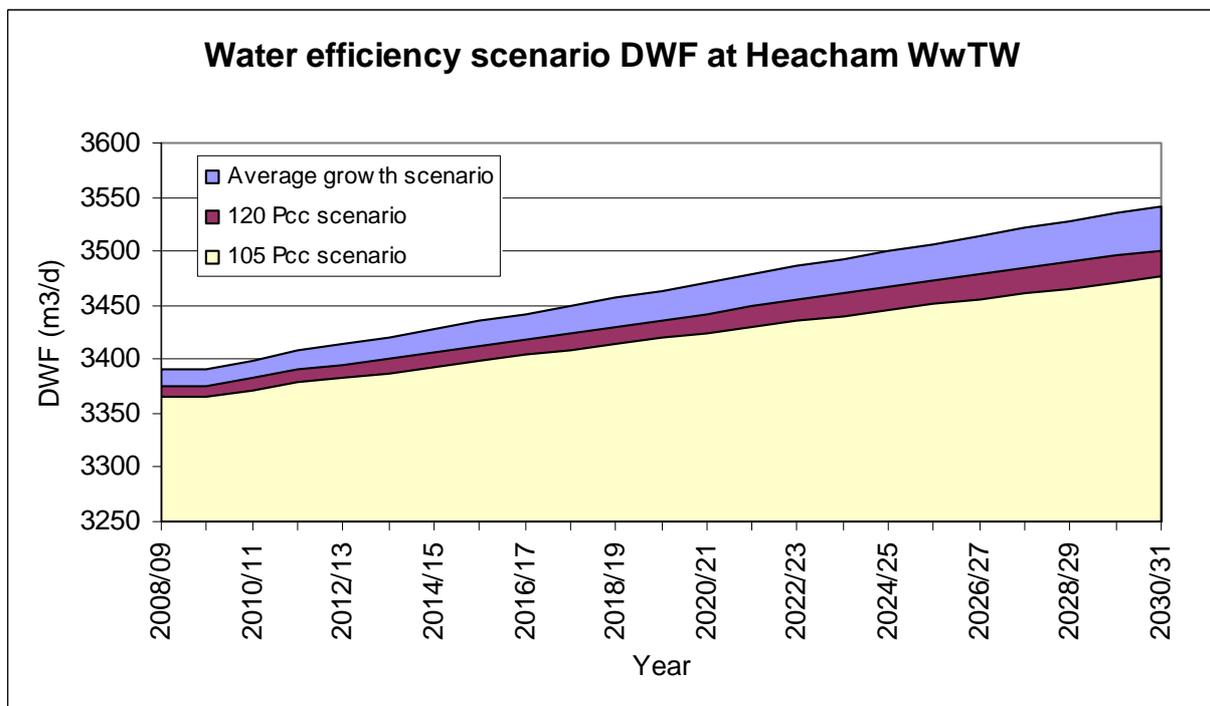
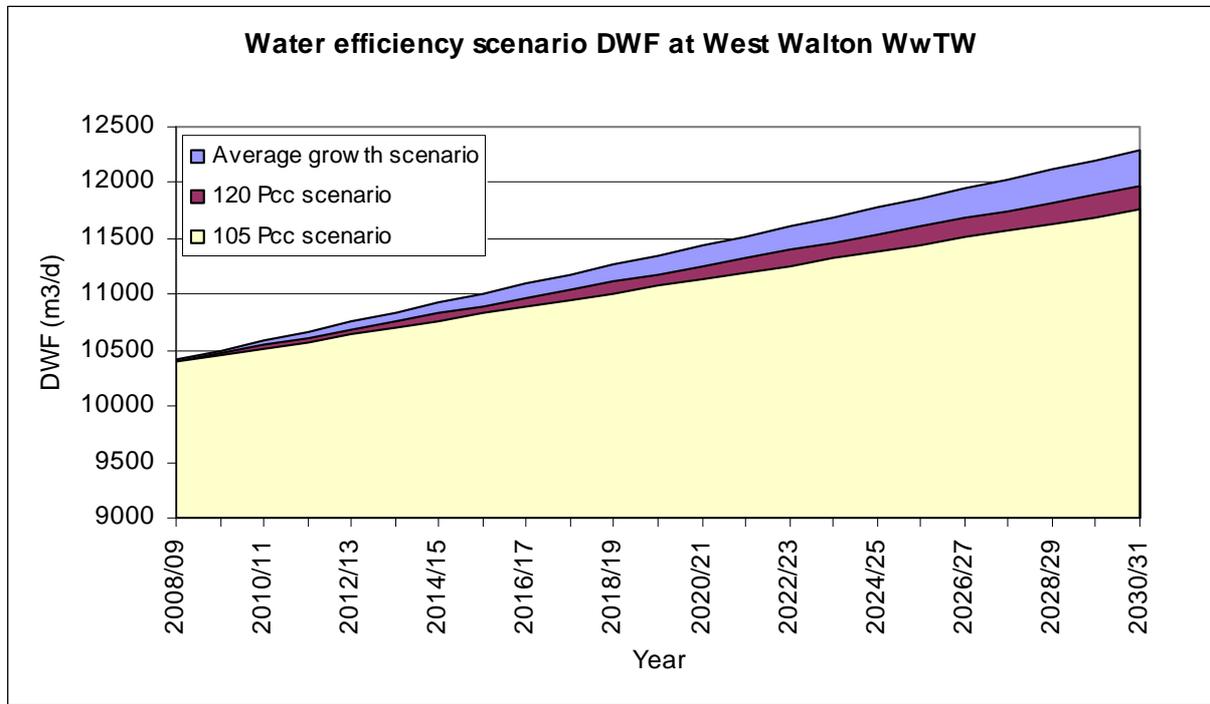


Figure 6.5 Impact of water efficiency measures on future DWF in West Walton WwTW



Decreases in wastewater flow associated with water demand reductions may impact in changes in sewage quality entering the works. These effects include increased sediment deposition in the flatter sewer sections, and hence a worsening of the first-flush effect of pollutants and sediment when CSOs spill, higher strength wastewater (i.e. higher BOD, ammonia and solids concentrations) which, in turn, may affect treatment processes.

Sewerage Network

Anglian Water has provided information on the sewerage catchments in the Borough in the form of Stage 2 reports for their PR09 submission. These internal studies are strategic in nature, but also inform the short term, detailed planning by identifying improvements and investment required for wastewater infrastructure based on confirmed growth during the next 5-year cycle of the Asset Management Plan (AMP) process. Sewer modelling, or review of modelling, is often employed to assess impact from population increases. A summary of the catchment characteristics is provided in Appendix G.

The Stage 2 report on the Downham Market sewer network refers to a number of modelled flood events in the sewer system during a 1 in 5 year storm event. Downham Market WwTW itself has been known to flood in wet weather and without increasing capacity, hydraulic problems are predicted by the model around proposed development sites including surcharging in conduits to the north of the catchment. Overall, the local sewer system is currently at near full capacity and flooding volumes and extent in the region are forecast to increase, together with higher risk of CSO spills, if no improvements are provided. The report identifies solutions for individual



sites: a storage tank option is proposed for the Railway Road development; a new pumping station, rising main and other improvements are proposed for Crow Hill Farm and upsizing pipework is proposed for Hayfields.

The Stage 2 report for King's Lynn sewer system states that the town of King's Lynn is partially on separate sewers with surface water being generally disposed of via surface water sewers into local drains discharging to the River Great Ouse, its tributaries or to the River Gaywood and River Nar. The main issue with growth is identified as the requirement to increase local storage at CSOs and other areas prone to flooding. Individual solutions proposed include storage provided for the South Fairstead, Boal Quay Waterfront and Freebridge Community Housing areas, and upsizing gravity sewers and a pumping station to the south-east of King's Lynn.

The Stage 2 report for the West Walton catchment identifies the extensive industrial and housing growth in Wisbech as the major driver for improvements. There are existing plans for extending the current sewer system, providing additional storage and investigating CSOs. Specific solutions proposed include storage at Lynn Road pumping station, the construction of a parallel surface water sewer to prevent surface water flooding and a surface water storage tank off Chase Street.

The Stage 2 reports suggest that connecting the planned growth to the existing sewer network is likely to require, as expected, a number of local and regional improvements such as the provision of additional storage in the system, upsizing of sewers and pumping stations, new rising mains and CSO investigations and improvements. Funding for these upgrade works has to be sought via the normal route of investment in each AMP cycle. No ultimate constraints to the proposed development have been identified although it is important that the timing of this investment ties in with the proposed housing development which therefore requires further consideration in Phase 2 when the housing locations are more clearly defined.

6.3.2 Sludge Management

Wastewater sludge, produced through sedimentation and biological treatment of wastewater, requires treatment and disposal in a sustainable manner. The planned growth in the King's Lynn and West Norfolk Borough is expected to lead to increased sludge production and potentially affect future sludge management practices in the region.

Currently all sludge produced within the Borough is transported to King's Lynn WwTW, which is a designated sludge handling centre capable of producing a digested sludge cake. Anglian Water has stated that the additional sludge from predicted growth in the Borough will continue to be processed at King's Lynn and there would be no capacity issues.

6.3.3 Combined Sewer Overflows

There are 20 CSOs in the Borough, mostly located within the King's Lynn area, that potentially discharge into surface and coastal waters. The location of all CSOs is shown in Figure G.1 Appendix G. Recorded incident data provided indicates that there have been no cases of CSO operational problems. Anglian Water has stated that no CSOs in the region were facing compliance or other operational problems. During expansion of the sewerage



network to accommodate future growth, the performance of CSOs should be monitored to determine if any negative effects are caused by population growth. Anglian Water undertake regular wastewater asset assessments and modelling exercises, which cover CSO operation, as part of their AMP planning and would be able to highlight any need for improvements or further CSO studies.

6.4 Flood Risk and Drainage

Increases in wastewater flows have the potential to increase flood risk in the receiving watercourses. It may also result in additional drainage costs, particularly where pumping is required to transfer the water to higher level rivers (e.g. via Internal Drainage Board pumps). Any increase in discharge the Internal Drainage Board pumps requires consent from these organisations and may not be consented. These issues need to be assessed in more detail in Detailed Phase of the Water Cycle Study.

6.5 Interaction with Neighbouring Council Areas

Water quality in the Ely Ouse, River Wissey, the Cut Off Channel and the Flood Relief Channel are affected by housing development in the upstream catchments beyond the Borough of King's Lynn and West Norfolk. Housing growth in the upstream catchments will tend to result in deterioration in water quality coming into the Borough and, therefore, reduce headroom in the receiving water whilst tightening of discharge consents at upstream sewage works will increase headroom. Areas of significant population growth in the upstream catchment include Cambridge, Bury St Edmunds and Thetford in the Ely Ouse catchment and Swaffham and Watton in the Wissey catchment. Assessment of these issues requires collation of information and analysis on a larger catchment scale which is not possible at the Outline stage of the WCS. However, further consideration should be given to these issues in Phase 2 of the WCS.

As King's Lynn is at the coastal boundary of the river system housing development and provision of waste water infrastructure does not impact on neighbouring council areas.

6.6 Water Quality and Wastewater Assessment: Interim Conclusion

Q. Is Wastewater a Constraint to Growth in the Study Area?

Despite the level of proposed development, there is likely to be sufficient environmental and treatment capacity to support increases in wastewater flow at the major growth centres; King's Lynn and Downham Market as the increased wastewater flow will be within the current consented Dry Weather Flow at the treatment works. However, for the West Walton and Heacham growth areas, an increase in the consented DWF will be required to support the planned growth, although, bearing in mind the high dilution capacity of the receiving waters at these WwTWs, this is unlikely to place a constraint on growth.



The current consented DWF is exceeded at several of the inland works, particularly those where the current DWF is exceeded. However, only limited growth is planned in the catchments in these works and reductions in per capacity use of water will to some extent offset the impact of this growth on wastewater flows. Changes to the effluent quality consents are currently being considered by the Environment Agency and Anglian Water which, if agreed, will overcome any potential constraint on growth.

Nutrients are the most important potential constraint with regard to the environmental capacity of receiving waters with regard to housing growth which may present a potential constraint on growth at the inland works with low dilution and Downham Market WwTW where dilution may be limited in the summer when flows are low.

Impacts of the discharge from Heacham sewage works and the urban drainage system in Hunstanton and Heacham on the Bathing Water at Heacham are a potential constraint on housing growth although Anglian Water are addressing this issue through a series of investigations in AMP5. If available, information from these investigations should be considered in more detail in Phase 2 to determine whether water infrastructure is required to mitigate the impacts which may place timing constraints on the housing developments. Treatment solutions are available at these sewage works (e.g. UV disinfection) to overcome any potential constraints on growth.

Even where the capacity of the existing wastewater infrastructure (sewerage network and WwTWs) is sufficient to meet the proposed increase in residential properties, growth would tend to erode some of the capacity of the WwTW and sewerage network. This may eventually lead to problems such as localised sewer flooding, more frequent CSO operation, undersized pumping stations and WwTW inlet works and insufficient storm tank capacity although these issues are being addressed by AWS in their AMP and long-term planning. It is recommended that AWS continue their proactive approach to growth planning and update their asset management planning to achieve consistency with the population growth projections (as provided by the Borough of King's Lynn and West Norfolk). These issues should be considered in more detail in Phase 2 of the WCS when housing locations become more clearly defined.

The completion of the Hayfields development will bring residential properties to within 10m of the Downham Markey WwTW boundary which may constrain any modifications to the hydraulic and treatment capacity of the works and, therefore, place a constraint on growth in the sewerage catchment.

Recommendations

1. Assess options for achieving Water Framework Directive targets in water courses in the Borough, particularly in relation to nutrients, taking into account impacts of housing growth and water management in upstream catchments;
2. Carry out further analysis on the impacts of planned growth at the wastewater treatment works exceeding their current consented DWF and how this may be mitigated by proposed changes to the consents on receiving waters.



3. Carry out further analysis on the impacts of the wastewater treatment works exceeding their current consented DWF and proposed changes to the consents on receiving waters increases in wastewater flow at Downham market sewage works on the Flood Relief Channel;
4. Review output of Anglian Water sewerage modelling on impacts of CSOs;
5. Review Anglian Water investigations on Bathing Water compliance, particularly in relation to Heacham Beach;
6. Identify key infrastructure for the provision wastewater services to the housing developments and timescales for provision of these services;
7. Potential physical constraints on improvements to WwTWs needs to be considered further. This includes physical constraints at Downham Market WwTW that may result from recent housing developments.
8. Internal Drainage Board Consenting requirements at WwTWs discharging to land drains should be identified in discussion with the Internal Drainage Boards.

