2 Water Cycle Study

2.1 Objective of the Water Cycle Study

The objective of Water Cycle Studies are to provide an integrated approach to managing flood risk, water supply, and wastewater infrastructure in the Study Area, mindful of the environmental constraints. They intend to address the following key issues:

- Location of development in relation to key water and wastewater infrastructure;
- Capacity of existing infrastructure;
- Additional impact on existing infrastructure; and
- Major constraints.

Water Cycle Studies are generally divided into two stages - this report representing the first stage. These stages are:

2.1.1 Stage 1 – Strategy Outline

Stage 1 intends to identify the areas that have been proposed for significant development, and to provide a first approximation of the situation of these with respect to the existing infrastructure, flood risk and environmental considerations. It also identifies the infrastructure required to meet the demands for growth in the area. Furthermore, methods for developer contributions to the capital costs of the proposed schemes should be identified. Stage 1 includes the preliminary data collection, collation and strategy inception.

2.1.2 Stage 2 - Strategy Development

Once the principles outlined in Stage 1 have been agreed by the stakeholders and identified as potential options, Stage 2 intends to build upon this. It will entail a development of the strategy and provide supporting evidence for the proposed development works and confirm the capital and operating costs associated with these. Furthermore, it will provide an in-depth assessment of developer contributions.

2.2 Potential Growth Areas

The RSS has set out the growth of development in the Greater Norwich area. The area has been sub-divided into two Policy Areas that have been outlined below and in Appendix A, and shown in Figure 1-2.

2.2.1 Norwich Policy Area

The Norwich Policy Area (NPA) is defined in the Structure Plan as an area including the urban area, first ring of surrounding villages and Wymondham (the Structure Plan definition also includes Long Stratton but the precise boundary is subject to confirmation in the JCS[3]).

2.2.2 Rural Policy Area

The Rural Policy Area (RPA) comprises of the remainder of the South Norfolk and Broadland District Council areas, outside of the NPA.

Consultation of the JCS and the Water Cycle Study Development Scenarios, as well as discussions with Norwich City Council[4] have identified a number of Potential Growth Areas within the three Local Authority areas. These are summarised in Table 2-1 below and shown in.

Table 2-1: Identified of Potential Growth Areas

Norwich Policy Area		Rural Policy Area	
NPA1	North East Sector (inside the NNDR)	RPA1	Reepham
NPA2	North East Sector (outside the NNDR)	RPA2	Aylsham
NPA3	East Sector (outside the NNDR)	RPA3	Wroxham
NPA4	North East and East Combination	RPA4	Acle
NPA5	South East Sector	RPA5	Hingham
NPA6	South Sector (A11-A140 outside A47)	RPA6	Diss
NPA7	South West Sector (A11-B1108)	RPA7	Harleston
NPA8	West Sector (River Yare to River Wensum)	RPA8	Loddon
NPA9	North West Sector (A1067 - NNDR)		
NPA10	North Sector (North of Airport)		
NPA11	Wymondham		
CITY	Norwich City		

2.3 Possible Dwelling Scenarios

Each of these Potential Growth Areas have been assigned Possible Dwelling Scenarios, with a minimum and maximum number for each Policy Area within which they sit. These Possible Dwelling Scenarios are outlined in Appendix A and they are intended solely as a means of testing water infrastructure capacity on a site by site basis. Smaller Possible Dwelling Scenarios are investigated for the Rural Policy Area.

[3] JCS for Broadland, Norwich and South Norfolk
[4] Mike Burrell – Senior Planner

2.4 Approach to Water Cycle Study

2.4.1 Introduction

The Water Cycle Study intends to test the suitability of the proposed allocation sites taking into account flood risk and existing water infrastructure, whilst considering the impacts of proposed growth to the receiving environment. As outlined in Section 2.2 there are a number of growth areas that have been proposed.

The overall approach to the Water Cycle Study is outlined below:

- Identify the catchment characteristics within the Study Area;
- In consultation with stakeholders identify the potential constraints for development within the Study Area;
- Identify the individual disciplines that will input into the Water Cycle Study including Environmental, Flood Risk and Water Infrastructure;
- Identify each of the constraints for each of the disciplines in terms of their potential impacts on development;
- Identify each of the Potential Growth Areas for the Norwich Policy Area (NPA) and Rural Policy Area (RPA), using the Possible Dwelling Scenarios provided by the Local Authorities;
- For each specific constraint, assign an appropriate level of impact of the potential development risk for each of the Potential Growth Areas;
- For each of the potential growth sites, a catalogue of the traffic lights of constraints will be compiled to provide an overall constraint assessment. This will be undertaken using a matrix for visual and comparative purposes;
- From this matrix, preferential Potential Growth Areas based on water issues will be identified;
- The developer contribution for each of the options will be analysed and options for the provision of capital towards the scheme provided, and;
- Identify sustainable development techniques to maximise efficient development will be outlined.

2.5 Identification of Constraints

After reviewing the information provided, a number of generic potential constraints could be applied to all of the sites. The intention of this was to enable the comparison of the Potential Growth Areas with each other in terms of the constraints, so that the most appropriate sites for development could be identified. The constraints were divided into the following generic fields:

2.5.1 Flood Risk and Hydrology

The risk of flooding can be ascertained by applying known or estimated flood levels to the ground levels for a range of return periods. Typically, fluvial flood risk is assessed in terms of a 1 in 100 year return period, or a 1% annual probability of flooding; and tidal flood risk in terms of a 1 in 200 year return period, or 0.5% annual probability. The functional floodplain of a river has been defined in PPS25 (Development and Flood Risk) as the 1 in 20 year return period (or as agreed with between the LPA and the Environment Agency). Flood risk has been compared to the Potential Growth Areas and is shown in Appendix B.

2.5.2 Water Resources and Supply

The water resources constraint was considered in terms of the proximity of the potential growth area to the most appropriate Water Treatment Works (WTW), as well as from information obtained from AWS in terms of the available water supply. The water treatment works are identified in Appendix C. Implications of potential contamination to the groundwater resources were also considered.

In general, development sites within a similar geographical area e.g. NE and E or S and SE, are likely to be supplied from the same WTW. In deriving an overall score for water resource issues, we have also taken account of the following factors:

- Spare water resources available based on the Catchment Abstraction Management Strategy (CAMS), this is the method whereby the EA manages water abstraction within a given catchment;
- Groundwater Vulnerability Classification and
- Presence of a Groundwater Source Protection Zone 1/2/3 and proximity to major Public Water Supply borehole sources (PWS).

The implications of potential contamination to groundwater resources are seen as an important consideration in apportioning allocations. For example, given two development sites supplied from the same the works, one close by a PWS source and one further away, then of these two sites, development of the later site (away from the PWS) would be a more preferable option.

2.5.3 Wastewater Drainage and Treatment

The wastewater constraint was determined in terms of the proximity of the potential growth area to a Sewage Treatment Works (STW) as well as the headroom and consents within each of the sites. A distance of 3km was assumed. The STW are identified in Appendix C.

The assessment of the Potential Growth Areas is based on the assumption that STW will be operating under fully consented conditions (phosphorous and flow) based on information provided by the Environment Agency and AWS. The baseline figures are those applying to the consented period of 2006 and the calculated Dry Weather Flow (DWF) and Population Equivalent (PE) headroom as calculated by AWS.

Stand alone developments have been assumed to contribute new flows based on information extracted from the Office of Water Services (OFWAT) Security of Supply, Leakage and Water

Efficiency Report which assumes an average water consumption of 130 l/c/d (litres per capita per day) and an average household occupancy of 2.1 with a 90% return to drain. It must be noted though that AWS calculated headroom in two ways:

- Based on Calculated DWF and
- Based on Treated Sewage Flow Recorder.

The assessment undertaken in this report is based on calculated headroom. It is assumed that at each and every STW there is some overflow facility to the environment typically through a Combined Sewer Overflow (CSO) or via storm tanks. PE headroom based on Treated Sewage Flow Recorders (TSFRs) are higher compared to those from calculated DWF PE headroom. As such, this discrepancy will need to be treated with caution at this stage and verified during Stage 2 of the Water Cycle Study as it does show that in some areas more properties than those proposed below can be developed.

The capacity of the receiving watercourse is a crucial factor in the treatment and disposal of wastewater. For example, a large, tidal watercourse has the ability to receive greater concentrations of pollutants than a small watercourse due to greater volumes of water available to diffuse the pollution, along with regular washing as a result of tidal inflows and outflows.

2.5.4 Environment

The environmental constraints that were assessed were consistent with those considered within the Appropriate Assessment (see Section 4) and included Ramsar Sites, Special Protection Areas (SPA) and Special Areas of Conservation (SAC) – constituting areas of European designation or higher. Sites of Special Scientific Interest (SSSI), which have national designation status, were also considered. The impact of the potential development on these sites was considered in terms of their proximity to the site and a distance of 3km was set. It is noted that there may be wider influences of development on environmentally sensitive sites further than 3km, particularly in the Broads, and this will be assessed in a review of the wider context. The environmental designated sites are identified in Appendix E.

2.6 Constraints Matrix

2.6.1 Traffic Light Coding

Within each of the constraints categories identified in Section 2.5, a series of questions were formulated to identify for each of the Potential Growth Areas the relevant important constraints associated, given the present situation and infrastructure provision. These are listed along with the possible responses in Appendix G. For the purpose of the constraints matrices these were amalgamated and put into generic categories outlined in Table 2-2 below. Stage 2 of the study will identify how and whether these constraints can be overcome.

Table 2-2: Generalised Constraint Traffic Lights

Flood Risk	Water Resources	Wastewater	Environment
There is little or no perceived risk of flooding to the policy area.	There is existing raw water source nearby with spare licence capacity. There is water available based on CAMS Methodology Classification. The Groundwater Vulnerability Classification - Low LP. The site is in Zone 3 groundwater source protection zone. There river quality classification is Good - A/B/C.	Where housing option can be accommodated within existing available headroom at STW and in sewers.	No environmental constraints were identified or when housing levels were considered sufficiently small that they were unlikely to materially increase impacts on European sites.
There is a perceived medium risk of flooding to the policy area. Floodplain intersects portions of existing development and or is likely to intersect possible extension areas.	There is an existing raw water source nearby with but with no spare capacity. There is no water available based on CAMS Methodology Classification. The Groundwater Vulnerability Classification - Intermediate LP. The river quality classification is The site is in Zone 2 groundwater source protection zone.	Where STW has capacity to accommodate the Possible Dwelling Scenario but the sewers are unlikely to have capacity and therefore may need upgrading. Preliminary assessment suggests that minor upgrade of existing STW will suffice to accommodate housing option.	Medium risk of significant adverse effects as housing levels increase. Coding determined by lower level as a result of greater proximity to sensitive features (such as hydrologically sensitive sites) or a greater degree of dependence upon sewage treatment works that are currently contributing to excessive phosphate loading.[5]
There is a perceived high risk of flooding to the policy area.	There is no existing raw water source nearby. There is an over abstracted/ over License based on CAMS Methodology Classification. The Groundwater Vulnerability Classification - High LP. The site is in Zone 1 groundwater source protection zone.	Where major/significant upgrade of STW and or Sewers is required to accommodate the Possible Dwelling Scenario. Cases where pumping of waste water (for distances over 3 km) is required to transfer it to a STW with spare capacity have also generally been allocated this colour.	High risk of significant adverse effects as housing levels increase. Coding determined by higher level as a result of greater proximity to sensitive features (such as hydrologically sensitive sites) or a greater degree of dependence upon sewage treatment works that are currently contributing to excessive phosphate loading.*

[5] It is not possible at this stage to accurately determine the level of housing that would lead to significant adverse effects on European sites. This would require further investigation at Phase 2 into (for example) likely degrees of increase in phosphate loading associated with levels of additional housing.

2.6.2 Constraints Matrix

The resultant outcome was the formulation of a constraints matrix for each of the Potential Growth Areas. This has been completed for each of the housing options within each of the Potential Growth Areas, and forms the background behind the identification of the preferred potential growth sites. These are contained with the Potential Growth Areas summarised in Section 5. The matrix has been designed so that the amount of subjective interpretation of the questions is minimised, and hence the traffic lights allocated are based on factual and quantitative data.

The number of dwellings which have been identified in the matrices have been based on an interpretation of the existing flood risk, wastewater headroom, water resource availability and perceived environmental impacts.

2.6.3 Use of the Matrix

The matrix is intended to provide a visual comparison of the appropriateness of development within each of the Potential Growth Areas, with respect to the housing scenarios provided in Appendix A. For each of the scenarios, a traffic light is applied, and the total number of “green” traffic lights can be directly compared to the total number of “red” traffic lights. Sites with a majority of “green” boxes would be preferred. It is important to note that the matrix is a broad brush summary, and that a detailed assessment should be used to provide more detailed analysis.

It should be noted that depending on the anticipated growth, the matrix have been classed into number of Possible Dwellings Scenarios (eg 100-500; 1,000-5,000)

2.6.4 Summary Matrix

A summary matrix is provided in Section 8.2. This shows the limiting number of dwellings or each of the disciplines within each of the Potential Growth Areas. The final limiting number will be the lowest value of these and represents the development figure for each of these areas without significant implications.

2.6.5 Constraints of the Matrix

Although the identification of the preferred Potential Growth Areas can be undertaken through a visual comparison of the traffic light systems, it should be recognised that a “red” light in one of the constraints may in effect over-ride all other traffic lights. Particularly important question are highlighted in Appendix G (**). This is particularly applicable if any of the following questions are assigned a “red” light: