

## 11 Appendices

## Appendix A: Possible Dwelling Scenarios

**Table 11-1: Norwich Policy Area Possible Dwelling Scenarios to 2026**

Broadland District Council							
NPA1	North East Sector (inside the NNDR <sup>[1]</sup> )	0	1,000	5,000	10,000	15,000	20,000
NPA2	North East (outside the NNDR, vicinity of Rackheath)	0	1,000	5,000	10,000	15,000	20,000
NPA3	East Sector (outside the NNDR)	0	1,000	5,000	10,000	15,000	20,000
NPA4	North East and East Combination	0	1,000	5,000	10,000	15,000	20,000
NPA9	North West Sector (A067 – NNDR)	0	1,000	5,000	10,000	15,000	20,000
NPA10	North Sector (North of Airport)	0	1,000	5,000	10,000	15,000	20,000
South Norfolk District Council							
NPA5	South East Sector	0	1,000	5,000		15,000	20,000
NPA6	South Sector (A11-A140 outside A47)	0	1,000	5,000		15,000	20,000
NPA7	South West Sector (A11-B1108)	0	1,000	5,000		15,000	20,000
NPA8	West Sector (River Yare to River Wensum)	0	1,000	5,000		15,000	20,000
Norwich City Council							
CITY	Norwich City	0	1,000	5,000	10,000	15,000	20,000

**Table 11-2: Rural Policy Area Possible Dwelling Scenarios to 2026**

Broadland District Council							
RPA1	Reepham	0	100	500	1,000	2,000	
RPA2	Aylsham	0	100	500	1,000	2,000	
RPA3	Wroxham	0	100	500	1,000	2,000	
RPA4	Acle	0	100	500	1,000	2,000	
South Norfolk District Council							
RPA5	Hingham	0	100	500	1,000	2,000	
RPA6	Diss	0	100	500	1,000	2,000	
RPA7	Harleston	0	100	500	1,000	2,000	
RPA8	Loddon	0	100	500	1,000	2,000	

## Appendix B Flood Risk and Hydrology Data

---

## Appendix C: Water Treatment, Water Resources and Wastewater Data

## Appendix D: Major Public Supply Abstraction Licences

	Source Name	Licence No.	NGR	Daily Quantity (m3/day)	Annual Quantity (m3/year)	Aggregates	Long term annual average returns (%)
Norwich Aggregate	Bixley	7/34/14/*G/0133	TG 2410 0605 and TG 2409 0603	10,000	3,000,000	no more than 1,715,200 cubic metres per month and 10,500,000 cubic metres per year.	84.5
	Colney	7/34/13/*G/0229	TG 1815 0816 and TG 1816 0822	6,600	2,000,000		84.3
	Bowthorpe (Bland Road)	7/34/13/*G/0186	TG 1858 0877 and TG 1862 0877	6,000	1,462,000		84.5
	Caister St Edmunds	7/34/14/*G/0090	TG 2392 0458, TG 2394 0457 and TG 2393 0450	10,000	2,600,000		84.5
	Thorpe St Andrew (Abstraction Point A only)	7/34/15/*G/0177	TG 2530 0840	22,730	5,000,000		65
	Barford	7/34/13/*G/0296	TG 1112 0698	3,000	730,000		No return data available
River Yare Licences	Barford	7/34/13/*G/0296	TG 1112 0698	3,000	730,000		No return data available
	Colney	7/34/13/*G/0229	TG 1815 0816 and TG 1816 0822	6,600	2,000,000		84.3
	High Oak	7/34/13/*G/0163	TG 074 009, TG 077 011, TG 078 010 & TG 0745 0099	10,910	2,727,600		84.47
	Mattishall	7/34/13/*G/0230	TG 054 097	2,350	850,000		84.7
	Marlingford - NB. Not yet licensed. Once it is it will be included within an aggregate with the other River Yare Licences of 7,536,000 cubic metres per year and be licensed under 7/34/13/*G/0296. This will change the annual quantity under this licence.						
Other	Costessey Borehole (Chalk)	7/34/11/*G/0486	TG 163 132	20,000	944,444		84
	Costessey Surface water supply	7/34/11/*S/0399	TG 1622 1345	240,000	17,000,000		85.9

NB. There is no known borehole at Mousehold, however there is a storage reservoir/holding tank.  
NB. There will be no abstraction from Strumpshaw after 31 March 2008

Yellow boxes indicate figures calculated from data taken in the Broadland Rivers CAMS. These take into account any aggregates on the licences which prevent them from abstracting their full licensed quantity.

## Appendix E: Environmental Data

## Appendix F: Designated Sites

### River Wensum SAC

The Wensum was designated as a European site for its:

- Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation - Although the river is extensively regulated by weirs *Ranunculus* vegetation occurs sporadically throughout much of the river's length. Stream water-crowfoot *R. penicillatus* ssp. *pseudofluitans* is the dominant *Ranunculus* species but thread-leaved water-crowfoot *R. trichophyllus* and fan-leaved water-crowfoot *R. circinatus* also occur.
- White-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes* - The Wensum is a chalk-fed river in eastern England, and is an eastern example of riverine white-clawed crayfish *Austropotamobius pallipes* populations. As with most of the remaining crayfish populations in the south and east of England, the threats from non-native crayfish species and crayfish plague are severe. Designation of the river as a SAC provides as much protection as can be afforded to such vulnerable populations.
- Desmoulin's whorl snail *Vertigo moulinsiana*;
- Brook lamprey *Lampetra planeri*; and
- Bullhead *Cottus gobio*.

### Issues

Under current discharge conditions phosphate standards are substantially exceeded throughout the river, as described in Section 3.3.3. STW's that already exceed thresholds will be addressed by the Environment Agency's own Review of Consents process. However, any substantial further discharges will only add to the phosphate loading of the watercourse, such that the WCS would fail its assessment unless measures are built in to control the additional phosphates input into the River Wensum.

In addition, the Broadland Rivers CAMS (March 2006) identifies that the River Wensum as being over-licensed with no water available at low flows. In other words, current actual abstraction is such that no water is available at low flows, and if licences were utilised to their full limits damage to the environmental features of the river would result. This watercourse is therefore unlikely to be available for further licensing at low flows. However, the converse of this is that water may be available for abstraction at periods of high flow. Given the Environment Agency restrictions that will be placed on any abstraction from this watercourse (including on the timing of abstraction), it is concluded that the water cycle study is unlikely to have a significant adverse effect on the River Wensum SAC through excessive abstraction, as existing regulatory mechanisms will not permit such damaging levels to be reached<sup>18</sup>.

<sup>18</sup> If it were determined during later stages of the Study development that insufficient water was available to meet housing needs without resorting to damaging levels of abstraction from the Wensum, the assessment would need to be revisited.



## Broads SAC / Broadland SPA

The Broads Special Area of Conservation was designated as a European site for its:

- Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. - The Broads is the richest area for charophytes in Britain. Twenty species have been recorded, which represents over 65% of the British flora.
- Natural eutrophic lakes with *Magnopotamion* or Hydrocharition-type vegetation - Although artificial, having arisen from peat digging in medieval times, these lakes and the ditches in areas of fen and drained marshlands support relict vegetation of the original Fenland flora, and collectively this site contains one of the richest assemblages of rare and local aquatic species in the UK.
- Transition mires and quaking bogs - The Broads contain examples of transition mire in a floodplain in the south-eastern part of the UK, where the habitat is rare.
- Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* - This floodplain mire site has the largest example of calcareous fens in the UK and possibly the largest occurrence in the EU outside Sweden.
- Alkaline fens - The Broads is one of two sites selected for Alkaline fens in East Anglia, in eastern England, where a main concentration of lowland fen occurs.
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) - The complex of sites in the Broads contains the largest blocks of alder *Alnus glutinosa* wood in England. Within the complex complete successional sequences occur from open water through reedswamp to alder woodland, which has developed on fen peat. There is a correspondingly wide range of flora, including a number of uncommon species such as marsh fern *Thelypteris palustris*.
- Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)
- Desmoulin's whorl snail *Vertigo moulinsiana* - The Broads is the main stronghold of Desmoulin's whorl snail in East Anglia. Several large populations are known, associated with standing and flowing water and ditch systems. This is a very important area for wetland invertebrate fauna, and many Red Data Book and Nationally Scarce species occur here.
- Fen orchid *Liparis loeselii* - The Broads in eastern England provide representation of the Fenland form of fen orchid *Liparis loeselii* in the eastern part of its UK range. Three small populations of var. *loeselii* are known to occur on this site, and 242 plants were found in 1996; and
- Otter *Lutra lutra*.

The site is also designated as an SPA for:

During the breeding season

- Bittern *Botaurus stellaris*, 3 individuals representing up to 15.0% of the breeding population in Great Britain (Count as at 1998)
- Marsh Harrier *Circus aeruginosus*, 21 pairs representing up to 13.1% of the breeding population in Great Britain (Count as at 1995)

#### Over winter

- Bewick's Swan *Cygnus columbianus bewickii*, 320 individuals representing up to 4.6% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)
- Bittern *Botaurus stellaris*, 6 individuals representing up to 6.0% of the wintering population in Great Britain
- Hen Harrier *Circus cyaneus*, 22 individuals representing up to 2.9% of the wintering population in Great Britain (5 year peak mean 1987/8-1991/2)
- Ruff *Philomachus pugnax*, 96 individuals representing up to 13.7% of the wintering population in Great Britain (5 yr peak mean 87/8-91/2)
- Whooper Swan *Cygnus cygnus*, 133 individuals representing up to 2.4% of the wintering population in Great Britain (5 yr peak mean 93/4-97/8)

The site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:

- Gadwall *Anas strepera*, 605 individuals representing up to 2.0% of the wintering Northwestern Europe population (RSPB: Count 99/00)
- Pink-footed Goose *Anser brachyrhynchus*, 3,290 individuals representing up to 1.5% of the wintering Eastern Greenland/Iceland/UK population (5 yr peak mean 94/5-98/9)
- Shoveler *Anas clypeata*, 401 individuals representing up to 1.0% of the wintering Northwestern/Central Europe population (RSPB: Count 99/00)

The area qualifies under Article 4.2 of the Directive (79/409/EEC) by regularly supporting 22,603 individual waterfowl.

Sections above in appendix.

#### Issues

The same phosphate enrichment problem exists for the River Yare, which in turn affects the Yare Broads and Marshes SSSI (part of Broadlands SAC) as a result of discharges from:

- Whitlingham STW
- Dereham STW
- Reepham STW

- Wymondham STW
- Long Stratton STW

Under current discharge conditions the phosphate standards are substantially exceeded in the River Yare, being more than twice the relevant standard. Modelling has indicated that despite having phosphate stripping in place, Whitlingham STW contributes 41% of phosphate loads to the Yare Broads and Marshes site.

In addition, as with the River Wensum, the Broadland Rivers CAMS (March 2006) identifies the River Yare as being over-licensed with no water available at low flows. Given the Environment Agency restrictions that will be placed on any abstraction from this watercourse, it is concluded that the development is unlikely to have a significant adverse effect on the Broadlands SAC and Broads SAC through excessive abstraction, as existing regulatory mechanisms will not permit such damaging levels to be reached<sup>19</sup>.

---

<sup>19</sup> If it were determined during later stages of the study development that insufficient water was available to meet housing needs without resorting to damaging levels of abstraction from the Wensum, the assessment would need to be revisited.

## Appendix G Constraints Matrix Questions with Appropriate response

Constraint Question	Traffic Light		
	No	Partially	Yes
Is the site within 1 in 100 (fluvial) floodplain**	No	Partially	Yes
Is the site within 1 in 100 (fluvial) floodplain including Climate Change	No	Partially	Yes
Is the site defended from flood risk	Yes	Unknown	No
What is the condition of the existing flood defence infrastructure	Good	Unknown	Poor
What is the Standard of Protection provided?	>100	30-100	<30
Is there potential for large scale flood storage /SUDS	Yes	Maybe	No
Are there any flooding issues from land drainage	No	Unknown	Yes
Are there known surface water drainage issues (SfA6)	No	Unknown	Yes
Are there any groundwater flooding issues	No	Unknown	Yes
Are there known or recorded flood events	No	Unknown	Yes
Is there capacity in the receiving watercourse?***	Yes	Unknown	No
Will increased discharge have significant impacts on third parties?***	No	Unknown	Yes
Is there an existing raw water source with spare licence quantity available?	Yes	Unknown	No
Is there spare water resource available based on CAMS Methodology Classification?	Yes	Unknown	No
What is the groundwater vulnerability classification for the location?	Low LP	Medium LP	High LP
Is there a groundwater source protection zone 1/2/3 local to the area?	No	Unknown	Yes
What is the river quality classification for the surface water?			
Is there an SPA/SSSI/SAC/Ramsar site within 3km of the site	No	Unsure	Yes
Is there a perceived threat to a designated site?***	No	Unknown	Yes
Are there any significant adverse impacts on the WFD?***	No	Unknown	Yes
Is there an existing STW nearby?	Yes	Unsure	No
Is there headroom in the Volumetric consent of the STW?***	Yes	Unsure	No
Is the current treatment plant at capacity (physical constraint)?***	No	Unknown	Yes
Is there capacity in the existing sewer infrastructure?***	Yes	Unsure	No
Is there capacity in the existing sewer infrastructure with Climate Change Impacts?	Yes	Unsure	No

\*\* Questions identified as most important

## Appendix H: Request for Information.

Data to be provided in hard copy, and electronic format for inclusion into GIS. Please ensure that you have attached all of the relevant files in electronic format to ensure that the file is compatible and geo-referenced where possible.

### General (LA)

- Distribution and total number of existing Residential Properties in Study Area
- Projected Growth (33 000 properties 2021 Horizon). Master Plan Layout Drawing to enable identification of wastewater drainage and water supply areas
- OS Base Mapping
- Remote Topographic Data (LiDAR and/or SAR data)
- Topographic data (river surveys, beach surveys etc)
- Aerial Photography
- All current approved planning applications above 10 dwellings
- District boundaries

### Flood Risk

#### Hydrology (Environment Agency)

- Existing Hydraulic Models
- Existing Hydrometric Monitoring
- Identification of Main River, Critical Ordinary Watercourses
- Gauged fluvial data sets
- General Quality Assessment (GQA) data – water quality

#### Flood Defence, Warning and Management Strategies (Environment Agency)

- Design standards
- Condition of existing defences
- Details of Improvements Programme
- Other unofficial defences e.g. railway embankments
- Areas benefiting from flood warning procedures and management strategies
- Wave height analysis

#### Environment Agency Fluvial Flood Levels (Environment Agency)

- Design Standard 1:100 year Fluvial Flood
- Design Standard 1:1000 year Extreme Flood
- Functional Floodplain Outlines for all modelled watercourse
- Historic Flood Levels information

#### Environment Agency Tidal Flood Levels (Environment Agency)

- Design Standard 1:200 year Fluvial Flood

- Design Standard 1:1000 year Extreme Flood

#### Flood Risk Assessments (LAs / Environment Agency)

- Within the area of interest
- Planning briefs for proposed developments

#### Environment Agency Flood Zone Maps (Environment Agency)

- Extent of Flood Zone 3
- Extent of Flood Zone 2

#### Local Authority Information (LAs)

- Local Development Frameworks
- Local Plans
- Development Plan Documents
- Other relevant documentation relating to development, policies and flood issues within the local and surrounding area (draft Regional Spatial Strategy etc)
- Areas of important biodiversity

#### Drainage Standards (LAs / Environment Agency)

- Problem areas
- Areas of Non Fluvial Drainage
- Improvement Plans / Asset Management Plans

#### Water Infrastructure

##### Industrial/Commercial (NCC)

- Location and total number of existing Industrial/Commercial Properties
- Anticipated growth, and identification of major water users (alternatively consumption figures can be obtained through interviews)

##### Institutional (NCC)

- Location, and total number of existing Institutions (Not critical just for completeness)

#### Water Supply (AWS)

- Existing Water Volumes being supplied (i.e. current and also projected), including:
  - Water Consumption per capita/property or per property/day
  - Treatment works current and projected outputs (capacities), location (layout drawings and location maps), treatment levels (chemical, power consumptions, etc rough cost of treatment/m3)
  - Distribution Network layout, (trunk mains, pipe diameters and capacities)

- Bulk meter readings (from/to service reservoirs, within system, and location of same)
- Domestic, Institutional, Industrial and Commercial consumer meter readings, (if any)
- Bulk Supplies, including locations of service reservoirs
- Raw Water Abstraction License and limits including Locations
  - Pumping Stations, including duties of pumps and hours run
  - Unaccounted for water (whatever information available)
  - Total number of connections by category (if information available)
  - Existing water consumption control measures

#### **Wastewater Collection, Treatment and Disposal (AWS)**

- Treatment works current and projected capacities
- Treatment levels, (Statutory limits)
- Location, (layout drawings and location maps)
- Process units, e.g. preliminary, primary, secondary and tertiary, (current capacities and plant design horizon)
- Existing Sludge treatment and disposal, (current capacities and plant design horizon)
- Existing Effluent Disposal quantities and statutory limits,
- Sewerage Network layout, pipe diameter, capacities and CSOs, (Combined Sewer Overflows)
- Pumping Stations, including duties of pumps and hours run
- Discharge consent locations

#### **Environment Designated Sites (NE)**

- Ramsar sites
- Special Areas of Conservation
- Special Protection Areas
- Sites of Special Scientific Interest

#### **Water Quality (Environment Agency)**

- Water Quality Data
- Water quality targets

## Appendix I: Strategic Flood Risk Assessment

The Department of Communities and Local Government's Document - A Practice Guide Companion to PPS25 'Living Draft' outlines the outputs of a Level 1 and Level 2 Strategic Flood Risk Assessment. Below highlights the expected outputs, in accordance with PPS25, which it is anticipated will be assessed with reference to the Water Cycle Study in Stage 2.

### Level 1

The key outputs from a Level 1 Strategic Flood Risk Assessment are as follows:

- Plans showing the LPA area, Main Rivers, ordinary watercourses and flood zones, including the functional floodplain where appropriate, across the local authority area as defined in Table D1 of PPS25, as well as all allocated development sites
- An assessment of the implications of climate change for flood risk at allocated development sites over an appropriate time period, if this has not been factored into the plans above
- Areas at risk of flooding from sources other than rivers and the sea
- The location of any flood risk management measures, including both infrastructure and the coverage of flood warning systems
- Locations where additional development may significantly increase flood risk elsewhere
- Guidance on the preparation of FRAs for allocated development sites
- Guidance on the likely applicability of different sustainable drainage systems (SUDS) techniques for managing surface water run-off at key development sites.

### Level 2

The Strategic Flood Risk Assessment should consider the variation of risk within flood zones which are protected by flood defence infrastructure, draw appropriate conclusions and make recommendations for each allocated development site. A Level 2 Strategic Flood Risk Assessment should contain:

- An appraisal of the current condition of flood defence infrastructure and of likely future policy with regard to its maintenance and upgrade
- An appraisal of the probability and consequences of overtopping or failure of flood risk management infrastructure, including an appropriate allowance for climate change
- Maps showing the distribution of flood risk across flood zones
- Guidance on appropriate policies for the making sites which satisfy parts a) and b) of the Exception Test, and requirements to consider at the planning application stage to pass part c) of the Exception Test.
- Guidance on the preparation of FRAs for sites of varying risk across the flood zone.



## Compensatory Flood Storage/Conveyance

### Undefended areas

Where development is proposed in undefended areas of floodplain, which lie outside of the functional floodplain, the implications of ground raising operations for flood risk elsewhere needs to be carefully considered and appropriate guidance provided to developers within the Strategic Flood Risk Assessment.

In undefended tidal areas, raising the ground is unlikely to impact on maximum tidal levels and provision of compensatory storage should not be necessary. There are few circumstances where provision of compensatory flood storage or conveyance will not be required for undefended fluvial floodplain areas. This is because, whilst single developments may have a minimal impact, the cumulative impact of many such developments can be significant.

### Defended areas

When proposing new development behind flood defences, the impact on residual flood risk to other properties should be considered. New development behind flood defences can increase the residual flood risk, should these defences breach or overtop, by disrupting conveyance routes (flow paths) and/or by displacing floodwater. If conveyance routes that allow flood water to pass back into a river or the sea following failure of a flood defence are blocked, this will potentially increase flood risk to existing properties. If there is a finite volume of water able to pass into a defended area following a failure of the defences, then a new development, by displacing some of the floodwater, will increase the risk to existing properties. Policy and practice for managing these risks as part of the spatial planning process should be included in the Strategic Flood Risk Assessment.

It is recommended that, should any land allocation be proposed in a defended flood area, the potential cumulative impact of loss of storage at the allocation sites on flood risk elsewhere within the flood cell should be considered. Such assessment should be appropriate to the scale and nature of the proposed development and flood risk. If the potential impact is unacceptable, mitigation should be provided.

## Run-Off Rates and Volumes From New Development

Strategic Flood Risk Assessments should provide guidance to developers on how surface water should be managed and on the potential for using sustainable drainage measures. The starting point for this guidance should be the policies stated in Annex F of PPS25. These policies state that both the rates and volumes of run-off from new developments should be 'no greater than the rates prior to the proposed development, unless specific off-site arrangements are made which result in the same net effect'. This may have significant implications for new developments, which developers will need to factor into the earliest stages of their site assessments.