Wensum evidence:

Drawn from the 2010 site action plan:

B2.4 Flows required for "in-channel" features of the River Wensum SAC

The generic Environmental Outcomes supplied by Natural England for the in-channel features of the River Wensum SAC require that flow throughout the whole of the SAC river is above the Habitats Directive Ecological River Flow (HDERF) objective and that the hydrological regime reflects the natural flow regime for the river for all time periods (e.g. seasonally and diurnally).

B2.4.1 Consideration of alternative flow objectives

It is not considered ideal to determine RoC outcomes solely on the basis of the HDERF objective alone. Site-specific objectives supported by good hydro-ecological information are preferred upon which to determine more appropriate RoC outcomes. In the case of the River Wensum, however, it has not been possible to develop site-specific flow objectives for the principal features of interest.

During discussions with Natural England it was agreed that *Ranunculus* habitats should be used as the main, in-river habitat feature indicative of desirable hydrological conditions for the Wensum SAC, and that white-clawed crayfish, brook lamprey and bullhead would not need separate targets set as these will be adequately covered by the targets for *Ranunculus* vegetation.

Velocity and flow regime (quantity, volume and depth and timing of changes of water supply) are considered to be the most important factors governing the condition and extent of *Ranunculus* vegetation. (Grieve and Newman, 2002). Water quantity is also important for the dilution of nutrient inputs and for flushing channels sufficiently strongly to maintain channels in a silt-free condition. However, the precise flow requirements of *Ranunculus* vegetation are not fully understood, and there have been no site-specific studies on the River Wensum which establish the historical and/or existing flow regimes within the river sections where *Ranunculus* has been recorded.

Should additional information come to light which improves the understanding of flow requirements for the features of European interest within the River Wensum before any RoC solution is fully implemented, due consideration will be given to this new information, including appropriate revision of any part of the RoC solution yet to be implemented, should it be required.

B2.4.2 Revised flow impact scenarios using the Yare & North Norfolk Regional Groundwater Model.

Natural England has indicated in the Conservation Objectives for the River Wensum SAC that the whole 71 km of the river should be capable of supporting the 'Watercourses of plain to montane levels with the *Ranunculion fluitans* and *Callitricho-Batrachion* vegetation' feature.

The model-based hydrological criteria for deciding acceptable levels of abstraction in Stage 4 [of the RSA process] are the same as those used in Stage 3 [of the RSA

process], however the impacts of abstraction have been re-assessed using the updated and improved Yare and North Norfolk Regional Groundwater Model to revise the predicted flow impacts at three assessment points along the river.

As in Stage 3, three individual assessment cells in the regional groundwater model have been selected to which correspond with three Assessment Points (APs) adopted in the Broadland Rivers Catchment Abstraction Management Strategy[1] (CAMS). These APs represent the River Wensum from source down to Fakenham (CAMS AP5 – Fakenham Gauging Station), between Fakenham and Swanton Morley (CAMS AP7 – Swanton Morley Gauging Station) and between Swanton Morley and the downstream end of the River Wensum SSSI/ SAC at Hellesdon Mill (CAMS AP8 – Hellesdon Mill).

In Stage 4, Flow Duration Curves (FDCs) have been produced for each of the three Assessment Points based on the historical time series of gauged river flows. The gauged historical time series has then been used to derive FDCs for the naturalised and Real Fully Licensed flow scenarios, based on the modelled impacts of abstraction predicted by the Yare and North Norfolk regional groundwater model. Full details of the

Study of the daily time series plots for both the observed and modelled historic flow regimes at Hellesdon Mill has shown a distinct difference between the period pre-1988 and the period post-1988 (further details provided in Section 3.6 of the Stage 4 Options Appraisal Report, Entec 2010). This difference is due to the relocation of the Costessey PWS surface water abstraction intakes (licence no. 7/34/11/*S/0399) from the River Wensum at Heigham and Norwich (downstream of Hellesdon Mill and the SSSI / SAC limit) to Costessey (upstream of Hellesdon Mill and Costessey GS, within the SAC boundary) in 1988.

In order for the most recent historical abstraction scenario to be represented without mixing the impacts of the two different flow regimes in the FDC (and hence also in the abstraction scenario appraisal), FDCs in the River Wensum at Hellesdon have been derived for the 1988-2005 period only for all model scenarios. FDCs for Fakenham GS and Swanton Morley GS have been derived for the full 1970-2005 model period.

The FDCs derived for gauged historic and modelled naturalised flows at Fakenham, Swanton Morley, and Hellesdon Mill appear within Figures B2.1, B2.2 and B2.3 respectively.

1) Fakenham AP

RFL abstraction would breach the HDERF at Q74 i.e. some deficit is predicted for approx. 26% of the time. (this equates to a total of 3,415 days over the 36 year model period 1970 – 2005, or an average of about 95 days per year).

RFL deficit at Q95 would be 1.5 Ml/d i.e. this deficit predicted for approximately 5% of the time, which equates to an average of about 18 days per year).

[1] Published by the Environment Agency in 2006

Maximum RFL deficit of 2.6 Ml/d occurs at Q99.5 i.e. this deficit is predicted for approx. 0.5% of the time, which equates to an average of about 2 days per year).

Q95 flows

The comparison of FDCs for the various abstraction scenarios provides the following information for flows at Q95 (i.e. low flows, or flows being exceeded 95% of the time):

The difference between **HDERF** and **RFL** would be -**1.5 Ml/d** (ie. deficit that would need to be recovered from licensed abstraction). RFL flow would achieve 92**%** of the HDERF.

The difference between **HDERF** and **historical** has been +**1.3 Ml/d** (ie. historical flows have been above the HDERF). Historical flow has exceeded the HDERF by more than 1**%**.

2) Swanton Morley AP

RFL abstraction would breach the HDERF at Q999 (i.e. some deficit is predicted for approximately 1% of the time, which equates to a total of 131 days over the 36 year period 1970 – 2005, or an average of about 3.5 days per year).

At Q95, the predicted RFL flow would be above the HDERF (i.e. surplus).

Maximum RFL deficit of 2.1 Ml/d occurs at Q99.5 (ie. this deficit is predicted for approx. 0.5% of the time, which equates to an average of about 2 days per year).

Q95 flows

The comparison of FDCs for the various abstraction scenarios provides the following information for flows at Q95 (i.e. low flows, or flows being exceeded 95% of the time):

The difference between **HDERF** and **RFL** would be **+2.6 Ml/d** (ie. RFL flows would be above the HDERF). RFL flow would exceed the HDERF by 3.8**%**.

The difference between **HDERF** and **historical** has been **+9.5 Ml/d** (i.e. historical flows were above the HDERF). Historical flow has exceeded the HDERF by more than 13.8**%**.

3) Hellesdon Mill AP

The following predictions do not take into account the existing Minimum Residual Flow (MRF) licence condition on the AWS Costessey abstraction – this is considered separately below.

RFL would breach the HDERF at Q47 (ie. some deficit is predicted for approximately 53% of the time, or approx. 193 days per year, if averaged over the 18 year period).

RFL deficit at Q95 would be 48.2 Ml/d (i.e. deficit predicted for approximately 5% of the time).

Maximum RFL deficit of 54.2 Ml/d occurs at Q99.5 (i.e. this deficit is predicted for approximately 0.5% of the time, which equates to a total of 33 days over the 18 year climatic period 1988-2005, or an average of about 2 days per year).

Q95 flows

The comparison of FDCs for the various abstraction scenarios provides the following information for flows at Q95 (i.e. low flows, or flows being exceeded 95% of the time):

The difference between **HDERF** and **RFL** would be **-48.2 Ml/d** (i.e. deficit that would need to be recovered from licensed abstraction). RFL flow would achieve just **56%** of the HDERF.

The difference between **HDERF** and **historical** has been **-27.3 Ml/d** (i.e. deficit that would need to be recovered compared to historical actual abstraction). Historical flow has achieved **75%** of the HDERF.

Figure B2.1 Flow Duration Curve ; Fakenham (CAMS AP 5)

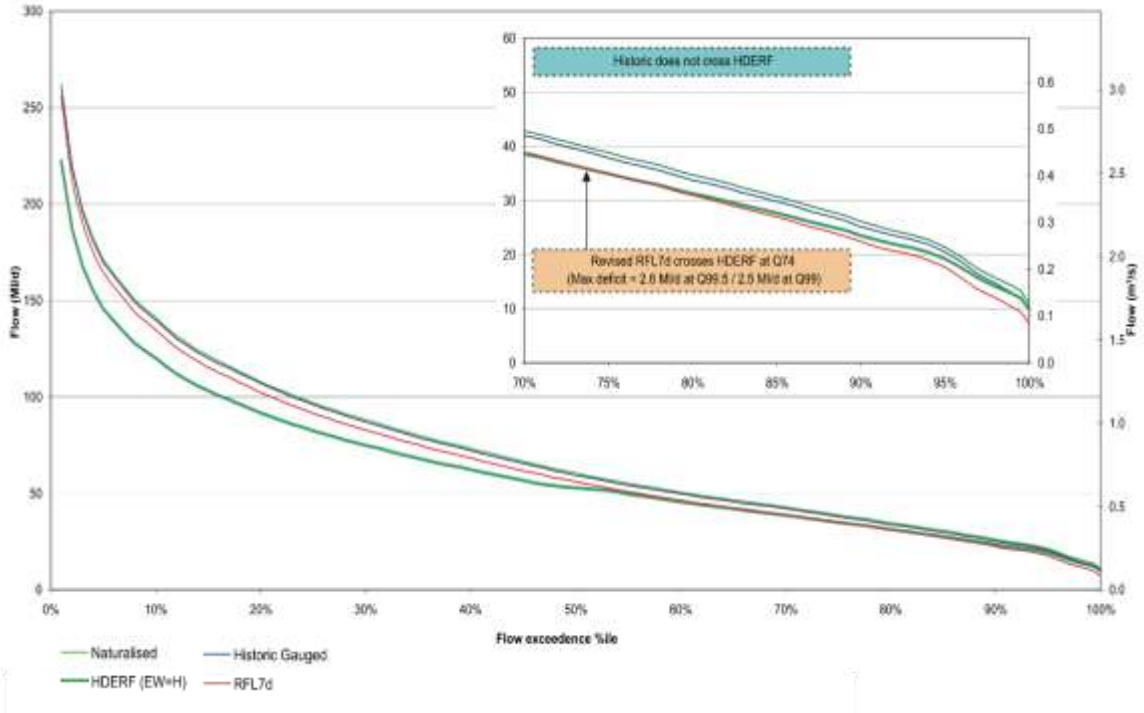


Figure B2.2 Flow Duration Curve ; Swanton Morley (CAMS AP 7)

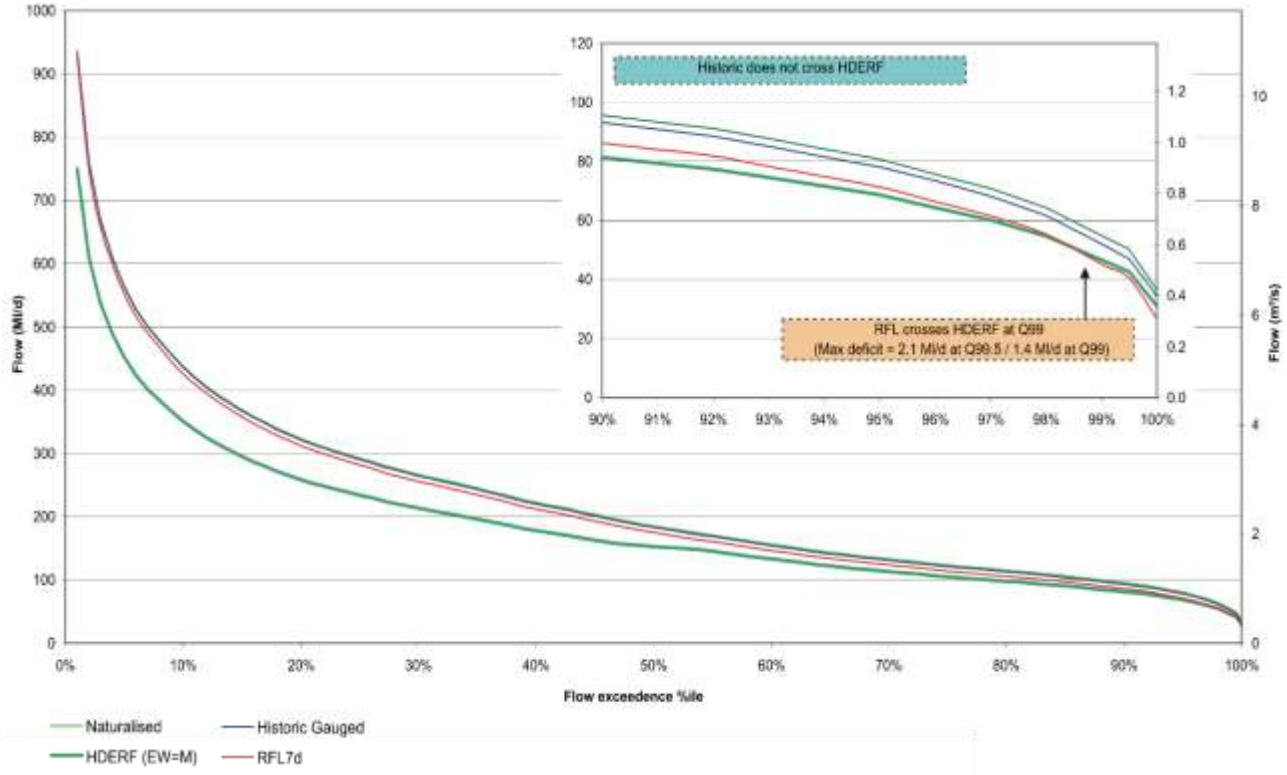
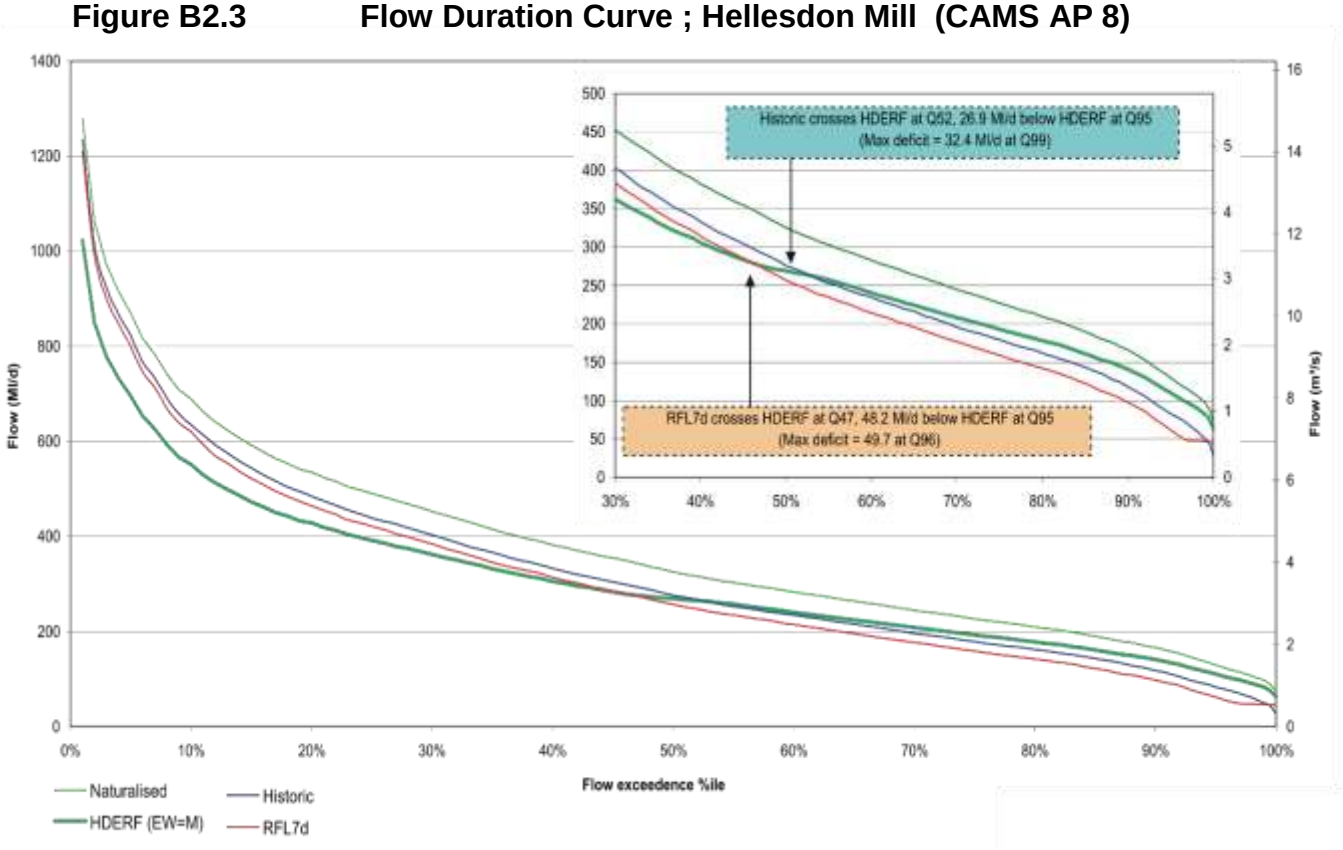


Figure B2.3 Flow Duration Curve ; Hellesdon Mill (CAMS AP 8)



Bear in mind:

These flow duration curves represent the river as of 2010, before any license changes had been made. Several licenses have been changed since then, so the actual situation will be improved from what is depicted here.

We have worked to these 2010 standards in deciding which licenses to change and by how much. The situation will be reviewed in 2024, and further changes may be made at that point if the standards current at the time have not been met.

The main license change on the Wensum will not be complete and start to show effects until 2019. The license in question involves major engineering works to implement in its new form, which are currently being undertaken. Environmental issues may be seen in the river up to that point, which we believe will be solved by the changes already underway.

Nicola Wood, 26/02/2018.