

Habitats Directive: Form for recording likely significant effect (Stage 2)



Environment
Agency

For consultation

The following text highlighted in yellow has been added as a result of discussions between Natural England and the Environment Agency since the Appendix 11 was last updated in November 2012.

Concerns raised by Natural England on 24 April 2013 and further clarified in their email dated 21 June 2013 are provided in Annex 4 of this document. These have been addressed by a report available in Annex 5 and have been incorporated into the conclusions of this paper.

NOTE! Please note that this consultation document considers two proposed renewal applications submitted by the same applicant.

Part A

Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)

Type of permission/activity:	Abstraction Licence (Renewal on same terms)
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Environment Agency reference no(s):	Plumsgate Road: NPS/WR/007223 (Licence AN/034/0009/008) Ludham Road: NPS/WR/007224 (Licence AN/034/0009/009)
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National grid reference:	Plumsgate Road – TG 382 223 Ludham Road – TG 386 206
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Site description:	Crag boreholes at Ludham and Plumsgate Roads, Catfield, Norfolk
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<p>Brief description of proposal:</p>	<p>These applications are to renew 2 abstraction licences to abstract water from crag boreholes for the purpose of spray irrigation between April and October inclusive;</p> <p><u>PLUMSGATE ROAD: Renewal of full licence</u> AN/034/0009/008 - Borehole at Plumsgate Road, Catfield at quantities of 1,090 cubic metres per day and 68,000 cubic metres per year at an instantaneous rate of 15 litres per second.</p> <p><u>LUDHAM ROAD: Renewal of full licence</u> AN/034/0009/009 - Borehole at Ludham Road, Catfield at quantities of 45 cubic metres per hour, 800 cubic metres per day and 22,700 cubic metres per year at an instantaneous rate of 12.5 litres per second.</p> <p>The locations of both abstraction boreholes, and their proximity to European conservation sites is shown in Figure 1, Annex 1.</p> <p>The existing licences for both Plumsgate and Ludham Roads contain monitoring addendums linked to measuring water levels in various piezometers. A copy of the addendums are shown in Annex 2. Retention of existing monitoring requirements in the proposed renewals will be based upon the outcome of the habitats regulations assessment for both renewals. It is possible that monitoring conditions will be removed or amended to reflect the outcome of this assessment. This will also apply to any time limits that could be applied to the proposed renewals which will be fully considered within the later appropriate assessment as appropriate.</p> <p>Both licences expired on 31 March 2012 – Please be aware that in accordance with Section 46A of the Water Resources Act 1991 (as amended by the Water Act 2003) licences AN/034/0009/008 (Plumsgate Road abstraction) and AN/034/0009/009 (Ludham Road abstraction) have met the criteria for limited extended validity. This means that while we are determining the applications, licences AN/034/0009/008 and AN/034/0009/009 remain in force until such time as we grant new ones, or if we refuse the applications until such time as any appeal is determined (or if there is no appeal, the time limit for bringing the appeal).</p> <p>The applicant is therefore entitled to abstract water under the terms of licences AN/034/0009/008 and AN/034/00039/009; the periods of abstraction are April to October inclusive.</p> <p>At this stage, the assessment of likely significant effect is being considered based on both licences being renewed at the same quantities.</p>
<p>European site names and status:</p>	<p>Broadland Ramsar Broadland SPA The Broads SAC</p> <p>Broadland SPA/Ramsar and The Broads SAC is an archipelago site made up of 26 (covering an area of 5,485.85 hectares) and 28 (covering an area of 5865.6 hectares) separate SSSIs respectively. Out of these SSSIs there are 2 that we are most concerned about in relation to the renewal applications. These are the Upper Thurne Broads & Marshes SSSI and the Ant Broads & Marshes SSSI which will be the focus of this assessment.</p>

<p>List of interest features (relevant to this type of permission):</p>	<p><u>Broadland Ramsar</u> 1.1 Fens & wet habitats (not sensitive to acidification) (Alkaline Fens, Residual alluvial forests (Priority Feature) 1.2 Bogs & wet habitats (sensitive to acidification) (Calcareous fens with Cladium mariscus and Carex davalliana (Priority Feature) 2.2 Vascular plants lower plants and invertebrates of wet habitats (Desmoulins whorl snail, Fen orchid 2.9 Mammals of riverine habitats (Otter 3.4 Birds of lowland wet grasslands (Bewicks swan (3.4), Greylag goose (3.4), Pink-footed goose (3.4) 3.6 Birds of lowland freshwaters and their margins (Bewicks swan (3.6), Gadwall (3.6), Greylag goose (3.6), Pink-footed goose (3.6), Shoveler (3.6), Wigeon (3.6) 3.7 Birds of farmland (Bewicks swan (3.7), Greylag goose (3.7), Pink-footed goose (3.7), Wigeon (3.7) 3.8 Birds of coastal habitats (Bewicks Swan (3.8), Pink-footed goose (3.8), Wigeon (3.8) 3.9 Birds of estuarine habitats (Pink-footed goose (3.9), Shoveler (3.9), Wigeon (3.9))</p> <p><u>Broadland SPA</u> 3.3 Birds of lowland heaths and brecks (Hen harrier (3.3) 3.4 Birds of lowland wet grasslands (Bewicks swan (3.4), Hen Harrier (3.4), Ruff (3.4), Whooper swan (3.4) 3.6 Birds of lowland freshwaters and their margins (Bewicks swan (3.6), Bittern (3.6), Gadwall (3.6), Hen Harrier (3.6), Marsh harrier (3.6), Ruff (3.6), Shoveler (3.6), Whooper swan (3.6), Wigeon (3.6) 3.7 Birds of farmland (Bewicks swan (3.7), Marsh harrier (3.7), Whooper swan (3.7), Wigeon (3.7))</p> <p><u>The Broads SAC</u> 1.1 Fens & wet habitats (not sensitive to acidification) (Alkaline Fens, Molinia meadows on chalk and clay, Residual alluvial forests (Priority Feature) 1.2 Bogs & wet habitats (sensitive to acidification) (Calcareous fens with Cladium mariscus and Carex davalliana (Priority Feature), Transition mires and quaking bogs 1.4 Standing Waters (sensitive to acidification) (Oligotrophic waters containing very few minerals of Atlantic sandy plains with amphibious vegetation: Lobelia, Littorella and Isoetes 1.5 Standing waters (not sensitive to acidification) (Natural eutrophic lakes with Magnopotamion or Hydrocharition type vegetation 2.2 Vascular plants lower plants and invertebrates of wet habitats (Desmoulins whorl snail, Fen orchid, Ramshorn snail 2.9 Mammals of riverine habitats (Otter)</p>							
<p>Is this application necessary to manage the site for nature conservation?</p>	<p>No</p>							
<p>What potential hazards are likely to affect the interest features (relevant to this type of permission?</p> <table border="1" data-bbox="260 1861 1422 1989"> <thead> <tr> <th data-bbox="260 1861 735 1989">Sensitive interest feature:</th> <th data-bbox="735 1861 1077 1989">Potential hazard:</th> <th data-bbox="1077 1861 1422 1989">Potential exposure to hazard and mechanism of effect/impact if known:</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>			Sensitive interest feature:	Potential hazard:	Potential exposure to hazard and mechanism of effect/impact if known:			
Sensitive interest feature:	Potential hazard:	Potential exposure to hazard and mechanism of effect/impact if known:						

Broadland Ramsar - Exposure to hazard is applicable for both licences.

Ant Broads & Marshes SSSI: 0.65km from the Ludham Road abstraction, 0.9km from Plumsgate Road abstraction.

Upper Thurne Broads & Marshes SSSI: 1.5km from the Ludham Road abstraction, 1.8km from Plumsgate Road abstraction.

1.1 Fens & wet habitats (not sensitive to acidification) (Alkaline Fens, Residual alluvial forests (Priority Feature))	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in freshwater flow to estuary	No likely significant effect
	Change in salinity regime	No impact anticipated
	Change in surface flooding	No likely significant effect
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect
1.2 Bogs & wet habitats (sensitive to acidification) (Calcareous fens with Cladium mariscus and Carex davalliana (Priority Feature))	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in surface flooding	No likely significant effect
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect
2.2 Vascular plants lower plants and invertebrates of wet habitats (Desmoulins whorl snail, Fen orchid)	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in surface flooding	No likely significant effect
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect

2.9 Mammals of riverine habitats (Otter)	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in surface flooding	No likely significant effect
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Entrapment	No likely significant effect
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect
3.4 Birds of lowland wet grasslands (Bewicks swan (3.4), Greylag goose (3.4), Pink-footed goose (3.4))	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in surface flooding	No likely significant effect
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect
3.6 Birds of lowland freshwaters and their margins (Bewicks swan (3.6), Gadwall (3.6), Greylag goose (3.6), Pink-footed goose (3.6), Shoveler (3.6), Wigeon (3.6))	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in surface flooding	No likely significant effect
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect
3.7 Birds of farmland (Bewicks swan (3.7), Greylag goose (3.7), Pink-footed goose (3.7), Wigeon (3.7))	Change in surface flooding	No likely significant effect
3.8 Birds of coastal habitats (Bewicks Swan (3.8), Pink-footed goose (3.8), Wigeon (3.8))	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in salinity regime	No likely significant effect
	Change in surface flooding	No likely significant effect
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect
3.9 Birds of estuarine habitats (Pink-footed goose (3.9), Shoveler (3.9), Wigeon (3.9))	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in freshwater flow to estuary	No likely significant effect
	Change in salinity regime	No likely significant effect
	Change in surface flooding	No likely significant effect
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect

Broadland SPA - Exposure to hazard is applicable for both licences.

Ant Broad & Marshes SSSI: 0.65km from the Ludham Road abstraction, 0.9km from Plumsgate Road abstraction.

Upper Thurne Broad & Marshes SSSI: 1.5km from the Ludham Road abstraction, 1.8km from Plumsgate Road abstraction.

3.3 Birds of lowland heaths and brecks (Hen harrier (3.3))	Habitat Loss	Likely significant effect - please see conclusions
3.4 Birds of lowland wet grasslands (Bewicks swan (3.4), Hen Harrier (3.4), Ruff (3.4), Whooper swan (3.4))	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in surface flooding	No likely significant effect
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect
3.6 Birds of lowland freshwaters and their margins (Bewicks swan (3.6), Bittern (3.6), Gadwall (3.6), Hen Harrier (3.6), Marsh harrier (3.6), Ruff (3.6), Shoveler (3.6), Whooper swan (3.6), Wigeon (3.6))	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in surface flooding	No likely significant effect
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect
3.7 Birds of farmland (Bewicks swan (3.7), Marsh harrier (3.7), Whooper swan (3.7), Wigeon (3.7))	Change in surface flooding	No likely significant effect

The Broad & Marshes SAC - Exposure to hazard is applicable for both licences.

Ant Broad & Marshes SSSI: 0.65km from the Ludham Road abstraction, 0.9km from Plumsgate Road abstraction.

Upper Thurne Broad & Marshes SSSI: 1.5km from the Ludham Road abstraction, 1.8km from Plumsgate Road abstraction.

1.1 Fens & wet habitats (not sensitive to acidification) (Alkaline Fens, Molinia meadows on chalk and clay, Residual alluvial forests (Priority Feature))	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in freshwater flow to estuary	No likely significant effect
	Change in salinity regime	No likely significant effect
	Change in surface flooding	No likely significant effect
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect

1.2 Bogs & wet habitats (sensitive to acidification) (Calcareous fens with <i>Cladium mariscus</i> and <i>Carex davalliana</i> (Priority Feature), Transition mires and quaking bogs)	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in surface flooding	No likely significant effect
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect
1.4 Standing Waters (sensitive to acidification) (Oligotrophic waters containing very few minerals of Atlantic sandy plains with amphibious vegetation: <i>Lobelia</i> , <i>Littorella</i> and <i>Isoetes</i>)	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect
1.5 Standing waters (not sensitive to acidification) (Natural eutrophic lakes with <i>Magnopotamion</i> or <i>Hydrocharition</i> type vegetation)	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect
2.2 Vascular plants lower plants and invertebrates of wet habitats (<i>Desmoulins</i> whorl snail, Fen orchid, Ramshorn snail)	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in surface flooding	No likely significant effect
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect
2.9 Mammals of riverine habitats (Otter)	Change in flow or velocity regime	Likely significant effect - please see conclusions
	Change in surface flooding	No likely significant effect
	Changed water chemistry	Likely significant effect - please see conclusions
	Changes in water levels or table	Likely significant effect - please see conclusions
	Entrapment	No likely significant effect
	Habitat Loss	Likely significant effect - please see conclusions
	Reduced dilution capacity	No likely significant effect

Is the potential scale or magnitude of any effect likely to be significant?

Alone?

The Broads SAC, Broadland SPA and Ramsar overlie each other, and are comprised of several component areas of land, which correspond with specific SSSI sites. The component areas of the European sites which have the potential to be impacted by the proposals are Upper Thurne Broads & Marshes SSSI and Ant Broads & Marshes SSSI (See Figures 2 and 3 in Annex 1 below for location plan of component SSSIs within the SAC/SPA and Ramsar sites).

An assessment of likely significant effect has been completed using the SSSI names associated with each of the SAC/SPA/Ramsar component areas.

**Upper Thurne Broads & Marshes SSSI component site:
Plumsgate Road -No
Ludham Road - No**

Change in water levels or table, habitat loss, change in flow or velocity regime and changed water chemistry

Although these licences were not considered per se within the Review of Consents (RoC) for the European sites they were included within the background groundwater modelling at the same quantities as the now expired licences.

Abstraction was considered to be an issue for the Upper Thurne Broads & Marshes component site and an Options Appraisal was undertaken to change 2 non time-limited abstraction licences.

Due to the relatively small size of these renewal applications and their distance from the component site (1.5km from the Ludham Road abstraction, 1.8km from Plumsgate Road abstraction) neither were highlighted as having an alone impact on the site. Further, when the abstractions are considered against the post RoC fully licensed quantity (once the 2 non time licences have been changed) the Ludham Road abstraction represents 3.4% and Plumsgate Road represents 10% of the in-combination fully licensed post RoC levels of abstraction which when considered alone is a negligible impact.

We have received some new information about the ecology of the site and in particular the Mrs Myhill's Marsh component of the SSSI (via the Fen Ecological Survey in 2010) which provides evidence of scrubbing up, similar to other areas in the Broadland fens. This could be due to a range of factors, however Natural England have confirmed that abstraction by these 2 applications is not having a significant contribution to this.

As we are not aware of any other new information since the completion of the RoC that abstraction, other than from the 2 licences requiring changes, are having an impact we are able to conclude that neither of the renewal applications are having a significant alone impact on this component site.

Ant Broads & Marshes SSSI component site:
Plumsgate Road - Yes
Ludham Road - Yes

The Review of Consents Site Action Plan for the Ant Broads and Marshes SSSI site (dated January 2010) concluded that there is only a low risk that the environmental outcomes for the site will not be achieved under Real Fully Licensed (i.e. when all licences are abstracting at their maximum licensed quantity) abstraction conditions.

Throughout the groundwater modelling work undertaken for the Review of Consents, the abstractions considered for these renewals were represented at the same quantities proposed for the renewals.

Since these licences were last renewed in March 2010 new information has been provided by Natural England in January 2011 which suggests a long-term trend (which has been shown to have accelerated since the 1980s) of drying of Catfield Fen which forms part of the Ant Broads & Marshes SSSI (Units 3, 11 and 35) as shown in Figure 4 within Annex 1. This includes on-site evidence of vegetation change consistent with drying of a wetland habitat (A compendium of ecological and eco-hydrological evidence from Catfield Fen, Norfolk at 31 January 2011).

Whilst both the compendium (Dated 31 January 2011) and the recent report by Amec (Catfield Fen Investigation – Final report, August 2012) suggest there is a high level of uncertainty regarding the cause of the drying at Catfield Fen, abstraction cannot be ruled out as having a significant impact when considered alone. It is concluded therefore that at this stage the renewal of the abstraction licences on the same terms has the potential to have a likely significant effect on the water levels or table, habitat loss, water chemistry and flow or velocity regime of the Ant Broads & Marshes component site and an appropriate assessment will be required – please refer to scoping in Part B of this proforma.

Despite the small size, the proximity of these renewal applications and their distance from the component site (0.65km from the Ludham Road abstraction, 0.9km from Plumsgate Road abstraction) means that we are unable to conclude no likely significant effect when considered alone.

In addition to Catfield Fen, there are a number of other hydrological sub units of the SSSI which may need consideration as a result of this assessment. These are as follows and are shown in Figure 4 of Annex 1;

- Reedham Marshes
- Cromes Broad
- Sharp Street
- Hall Fen
- Barton Broad
- Barton Fen
- Sutton Broad
- Sutton Fen

As a likely significant effect alone cannot be ruled out for all the component units of the European site scoping for an appropriate assessment can be found in Part B of this document.

<p>In combination with other Environment Agency permissions, plans or projects?</p>	<p>The following existing abstractions have been considered for their in-combination impacts at the relevant SSSIs that form part of the European site.</p> <p>An assessment of the proposed abstraction licences in-combination with each other: AN/034/0009/008 – Alston Plumsgate Road AN/034/0009/009 – Alston Ludham Road</p> <p>Other abstractions that these renewals may act in combination with; 7/34/09/*G/0091 – Ludham Road source (Public water supply licence) - Referred to later as Licence 1. 7/34/10/*G/0111 – Borehole at Catfield (Summer irrigation licence) - Referred to later as Licence 2. 7/34/09/*G/0058 – Well at Catfield (General and domestic farming licence) 7/34/09/*S/0084 – Abstraction from Catfield Broad & ditches (Summer irrigation licence)</p> <p>The above licences will be considered further in the appropriate assessment – please see scoping in Part B of this document. If during this assessment other licences are considered to be relevant to the site they will be included at that stage.</p> <p>Note: A Restoring Sustainable Abstraction (RSA) investigation for Catfield Fen is ongoing with the public water supply licence being included as part of future AMP work.</p>
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**Upper Thurne Broads & Marshes SSSI component site :
Plumsgate Road - No
Ludham Road – No**

Change in water levels or table, habitat loss, change in flow or velocity regime
and changed water chemistry

During the Review of Consents (RoC), abstraction was considered to be an issue for one part of the SSSI component site - Mrs Myhill's Marsh, part of the Hickling Broad hydrological sub unit of the SSSI, shown in Figure 5 of Annex 1, and an Options Appraisal was undertaken **using the Yare & North Norfolk groundwater model**. As already stated within the "Alone" section of this proforma, the abstractions being renewed were both included within the background groundwater modelling at the same quantities as the now expired licences.

Early in the Review of Consents (RoC) process Mrs Myhill's Marsh was recorded as being in unfavourable declining condition, however this condition was not reported as being due to abstraction. Reasons given for the unfavourable condition at the time were: inadequate water levels related to IDB drainage, ochre production through land drainage, excessive salinity, scrub invasion and disturbance of SPA refuge areas.

Since the RoC was completed, Natural England's website ([link](#)) confirms that SSSI Unit 20, representing Mrs Myhill's Marsh, is in favourable condition (as assessed on 24 December 2010).

During the RoC, to establish a baseline for the current ecological condition Natural England confirmed that the condition of the ecology for the Mrs Myhill's Marsh was acceptable in non drought years.

We have received some new information about the ecology of the site and in particular Mrs Myhill's Marsh component of the SSSI (via the Fen Ecological Survey in 2010) which provides evidence of scrubbing up, similar to other areas in the Broadland fens. This could be due to a range of factors including build up of material due to lack of management, change in scrub clearance practices and changes to the general hydrology. Natural England have confirmed in their email dated 24 April 2013 that abstraction by these 2 applications is not having a significant in-combination contribution to scrubbing up (and therefore not likely to be significant in relation to habitat loss).

As no further new information has come to light, other than potential habitat loss i.e. scrubbing up, we consider that hydrological functioning (including water chemistry, water table/levels and flow) and by association that historical abstraction pre RoC was also acceptable. This formed our baseline for assessment.

The SAC community found on Mrs Myhill's Marsh is an NVC community M5 – a transition mire community. This community is potentially sensitive to groundwater inputs – in particular the balance of Crag groundwater and rainwater within a mixing zone. There are no specific water chemistry requirements set out in the environmental outcomes or in the favourable condition table for this community, and as the community is dependent upon the relative contribution of Crag groundwater and rainwater we consider that protecting the hydrological functioning of the site will protect the water chemistry required to support this community.

As there may be a time lag between abstraction occurring and changes in ecology we also looked at whether the quantities of water abstracted were increasing, steady or decreasing. This showed that abstraction had been steady since the early 1990s (and will now decrease with the licence changes described below) allowing us to take the view that lagged, as yet unseen effects on the ecology of the sites were not present.

	<p>For Mrs Myhill's Marsh it was established and agreed with Natural England in 2009 that pre RoC levels of fully licensed abstraction were acceptable in non drought years. The RoC solution focused on reducing the impact to acceptable levels in drought years. The 2 Alston licences were identified as having the potential to impact on Mrs Myhill's Marsh at Stage 3 of the RoC, however groundwater model scenario runs carried out for the Options Appraisal confirmed that abstraction from Licences 1 and 2, locations shown in Figure 5 of Annex 1, contributed more than 50% of the total impact from the pre RoC fully licensed abstraction. These licences therefore were highlighted as requiring changes.</p> <p>By making changes to Licences 1 and 2, this reduced the modelled impacts to an acceptable level. This will be further enhanced by the fact that a recent renewal of a variation to Licence 2 went beyond the changes recommended by the RoC and applied a straight 25% reduction in the annual quantity, rather than the recommended reduction in drought years only.</p> <p>Table 1 within the report in Annex 5 provides a comparison of the pre and post RoC fully licensed levels with the historical uptakes for 1993 and 2011. With the changes to Licences 1 and 2, this reduces the fully licensed quantity by 186,200 m³/year and brings it more in-line with the historical levels of abstraction.</p> <p>Based on technical appraisal, the Site Action Plan concluded that by changing these 2 non time-limited licences within the vicinity of Mrs Myhill's Marsh, it would reduce drawdown at the SSSI to a level which would reduce the risk of failing to achieve the environmental outcomes for this SSSI from medium to low. As the historical ecological condition was considered acceptable there is the presumption that historically the hydrological (in terms of flow and water level/table) and hydrochemical functioning has been acceptable. Given that the post RoC 'in combination' abstraction (once changes to Licences 1 and 2 are made) is similar to historical no significant change is expected in either the hydrological or hydrochemical functioning. Based on this as the post RoC fully licensed level of abstraction a conclusion of no adverse effect was reached under the RoC and in terms of these renewal applications a conclusion of no likely significant effect can be made when considered in combination.</p> <p><u>Note:</u> The changes required to meet the RoC environmental outcomes for Mrs Myhill's Marsh have been made to the abstraction labelled "Licence 1" in Figure 5, however the changes have not yet been made to Licence 2. We have received an application to renew a time-limited variation to Licence 2 which has been determined, and the RoC changes have been applied to the variation for Licence 2 only. For information the RoC concluded that a 25% reduction in annual quantities was required for drought years only. Following discussion with the Licence Holder they requested that the 25% be applied to all years to enable them to plan their business. The change to the variation therefore went beyond that required from the RoC. The base, non time-limited, portion of Licence 2 will be changed as part of Restoring Sustainable Abstraction, the timescales of which are unknown at present but likely to be by the end of December 2013. Using the RoC assessment we consider that the environmental outcomes were met by changing the two licences as detailed above we therefore do not consider it necessary to modify the two Alston licences in terms of hydrological function of site to allow a conclusion of no likely significant effect to be reached.</p> <p>Based on current new information provided we still consider that the solution provided under the RoC to protect the site under drought conditions allows us to conclude no likely significant effect in combination from these licences.</p>
	<p>Ant Broad & Marshes SSSI component site : Plumsgate Road - Yes Ludham Road - Yes Please refer to the reasons stated above (in 'Alone' section).</p>

<p>In combination with permissions, plans or projects with competent authorities?</p>	<p>As a result of this risk assessment, the Environment Agency can conclude that there is the potential of a Likely Significant Effect in relation to the Ant Broads & Marshes SSSI component of the European site. This application could act in combination with permissions and/or plans/projects of other competent authorities and consultation has been undertaken with North Norfolk District Council and The Broads Authority. These permissions, plans and projects will be considered further in the Appropriate Assessment - please see Part B scoping at the end of this document.</p> <p>Table 1 overleaf shows all the permissions that have been granted within the Catfield area by North Norfolk District Council and Broads Authority. As of 02/10/2012 for the district council and 03/10/2012 for the Broads Authority, neither had any relevant decisions pending. For the North Norfolk District Council some of the permissions have been marked as having potential implications for water resources as it is currently unknown how the dwellings will be supplied with water however the council have confirmed that they expect all will be supplied by mains water unless situated in remote locations. The district council have since confirmed that there are no further details held on file.</p>
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Table 1 containing all granted permissions from North Norfolk District Council (as of 02/10/2012) and Broads Authority (as of 03/10/2012)

	Reference	Location	Approximate National Grid Reference	Type of activity/permission	Water Resource discussion
Broads Authority	BA/2008/0249/FU L	Comp 4, Left Bank Of River Ant Clayrack Marshes How Hill Norfolk	TG 37003 19533	Flood bank strengthening	No known implications
	BA/2009/0300/FU L	Comp 6a, Hickling, Horsey And Heigham Norfolk	TG 42124 22618	Flood defence improvements	No known implications
	BA/2011/0194/FU L	Longmoor, Wood Street, Catfield, NR29 5DF	TG 37247 22938	To create 20 shallow scrapes and 5 turf ponds on lowland fen wetland habitat, for the purposes of ecological gain.	Assuming that the ponds are not discharging and no abstraction above 20 cubic metres per day is taking place from the ponds there are no water resource implications. There are no current applications received to NPS for these applications.
	BA/2011/0300/FU L	Longmoor Farm, Wood Street, Catfield, NR29 5DF	TG 37247 22938	Dig 4 pond complexes	
	BA/2007/0165/FU L	Hunsett Mill, Chapel Field, Stalham	TG 36377 23925	The building of a new clay flood bank	No known implications
	BA/2011/0020/FU L	Norfolk Wildlife Trust, Hickling Nature Reserve, Near Stubb Mill And Whiteslea Lodge	TG 42124 22618	Flood defence improvements	No known implications
North Norfolk District Council	20071664	Land off, New Road, Catfield	TG 38790 22007	Change of use from industrial to warehousing (Non residential change of use only)	The assumption is that no additional water will be required by this change of use.
	20051911	Summerhouse Farm, Coach House & Barns, Catfield	TG 38064 20225	Conversion of non residential barns to two dwellings	The district council have no further information about how the new dwellings will be supplied with water, however they assume it will be via mains water. Therefore they are no likely to result in any additional impact on water resources.
	20080500	Stone Cottage, New Road, Catfield	TG 38770 21857	Erection of 4 dwellings and garages	
	20090638	Galloway House, The Street, Catfield	TG 38697 21762	Change of use of annexe to residential dwelling	
	20090941	Land at rear, Brumstead House, New Road, Catfield	TG 38788 21799	Erection of 4 dwellings	

North Norfolk District Council	PF/10/0959	White House Farm, Limes Road, Catfield, NR29 5DG	TG 38983 21537	Erection of livestock building (Non residential new build)	The district council have no further information about how the new dwellings will be supplied with water, however they assume it will be via mains water. Therefore they are no likely to result in any additional impact on water resources.
	PF/11/0484	Crown Inn, The Street, Catfield, Great Yarmouth, NR29 5AA	TG 38667 21980	Conversion of storage building into bedroom accommodation for bed and breakfast use	
	PF/11/1484	Walton Hall Farm, Gipsies Lane, Ludham, Great Yarmouth, NR29 5PW	TG 39061 19843	Erection of pig handling building (Non residential new build)	
	20091009	Broads Business Park, The Street, Catfield	TG 38795 22006	Erection of rear extension, formation of storage compound and installation of front & side windows (Non residential extension).	Assume no additional water required
	PF/11/1353	Unit 1, Tradebase, The Street, Catfield, Great Yarmouth, NR29 5AZ	TG 38693 21669	Change of use from D2 (Leisure) to B2 (vehicle repairs/MOT bay) and part raising of roof height (Non residential change of use only)	Assume no additional water required
	N/A	Land off Lea Road	TG 38870 21709	Proposal to construct 15 dwellings on a 1ha site	This is listed within the Site Allocations Development Plan Document - Service Villages (dated February 2011). Within this document it is stated that Anglian Water has indicated that the levels of development in the Service Villages should not cause concern in relation to water supply. This assumes they will be supplied by mains water.
	N/A	Vacant Mushroom Factory, Catfield	TG 38654 21988	Currently vacant but has potential for redevelopment	There are no current plans to develop this site, however this may change in the future. If it is developed it is assumed that the dwellings will be supplied by mains water.

Conclusion: Is there likely to be a significant effect 'alone and/or in combination' on a European site?	<p>The Broadland SPA/Ramsar and The Broads SAC is an archipelago site made up of 26 (covering an area of 5,485.85 hectares) and 28 (covering an area of 5865.6 hectares) separate SSSIs respectively. Out of these SSSIs there are 2 that we are most concerned about in relation to the renewal applications. These are the Upper Thurne Broads & Marshes SSSI and the Ant Broads & Marshes SSSI which will be the focus of this assessment.</p> <p>For the Upper Thurne Broads & Marshes SSSI we are able to conclude no likely significant effect based on the outcome of the RoC, however for the Ant Broads & Marshes SSSI we are unable to conclude no likely significant affect either alone or in-combination at this stage and will progress to an appropriate assessment – please refer to the scoping brief in Part B of this proforma.</p>	
EA Officer:	Hannah Hawkins	Date: 24/10/2012 Updated following comments from Natural England on 26/11/2012 and 24/07/2013
Natural England/CCW comment on assessment:		
Natural England/CCW Officer:		Date:

If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).

Part B Suggested scope of the EA appropriate assessment:

The appropriate assessments for the proposed renewals at Plumsgate and Ludham Roads will consider the likely impact on sensitive features of **Ant Broads and Marshes SSSI**, component of The Broads SAC, Broadlands SPA and Ramsar. The assessments will consider the current state of the component SSSI, its integrity within the EU site as a whole and the conservation objectives for the SAC, SPA and Ramsar. A separate appropriate assessment will be completed for each application.

- An assessment of the proposed abstraction renewals alone:
- An assessment of the proposed abstraction renewals in-combination with each other:
- An assessment of the proposed abstraction renewals in combination with other licensed abstractions as listed in 'In-combination' sections of this appendix.
- An assessment of the proposed abstraction renewals in combination with permissions, plans or projects with competent authorities. **In order for us to complete a full in-combination assessment could you please confirm whether you have granted any permissions that we should be aware of for our assessment?**
- The assessment will focus on the 4 hazards of; change in water levels or table; habitat loss; change in flow or velocity regime; and changed water chemistry.
- Consideration of monitoring conditions and limits placed on the proposed renewals. It is possible that current monitoring as requested through the important notes section of the licences will be removed or amended to reflect the outcome of the habitats regulations assessment.
- Characterise the site in relation to the qualifying features and their conservation objectives;
 - existing information
 - additional surveys
 - management/unauthorised impacts

See Annex 3 for what the EA proposal of qualifying features. We would appreciate Natural England's comments on whether this information is correct or needs further amendment.

- Assess each likely impact on the interest features;
 - compare with historical data
 - predict impacts
 - compare with impact from management/unauthorised activities
- Determine the extent to which each possible impact can be avoided.

Natural England/CCW comment on scope of EA appropriate assessment:

Note: Please refer specifically (but not solely) to the EA appropriate assessment scoping in Part B.

Natural England/CCW Officer:

Date:

Annex 1: Figures

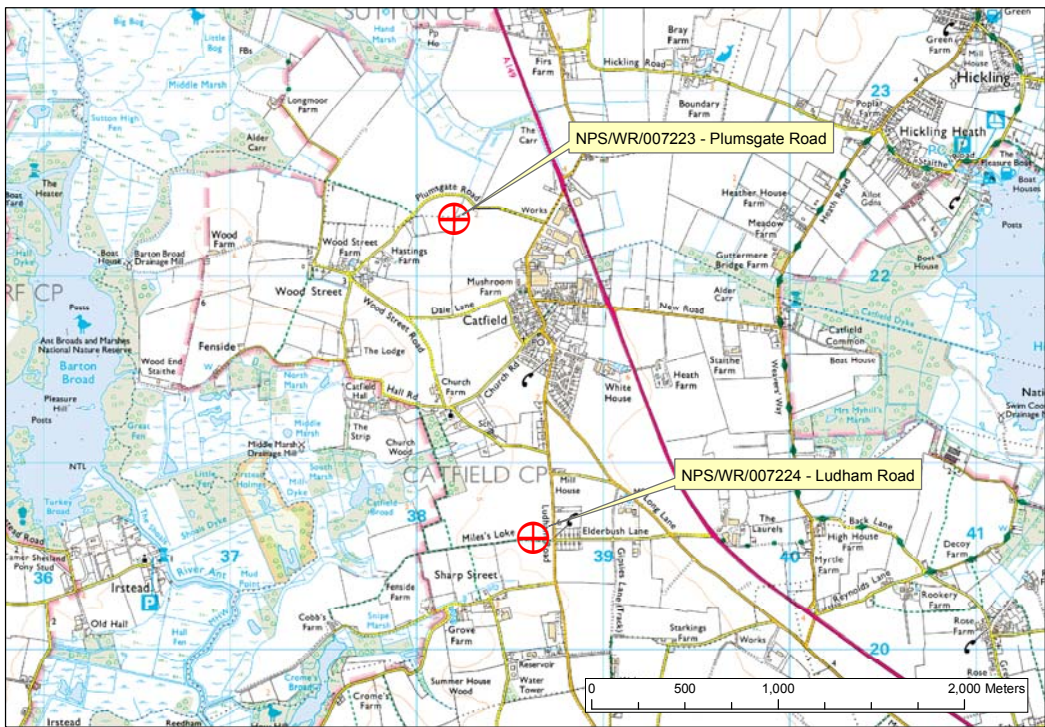


Figure 1: Map indicating locations of both abstraction NPS/WR/007223 (Plumsgate Road) & NPS/WR/007224 (Ludham Road)

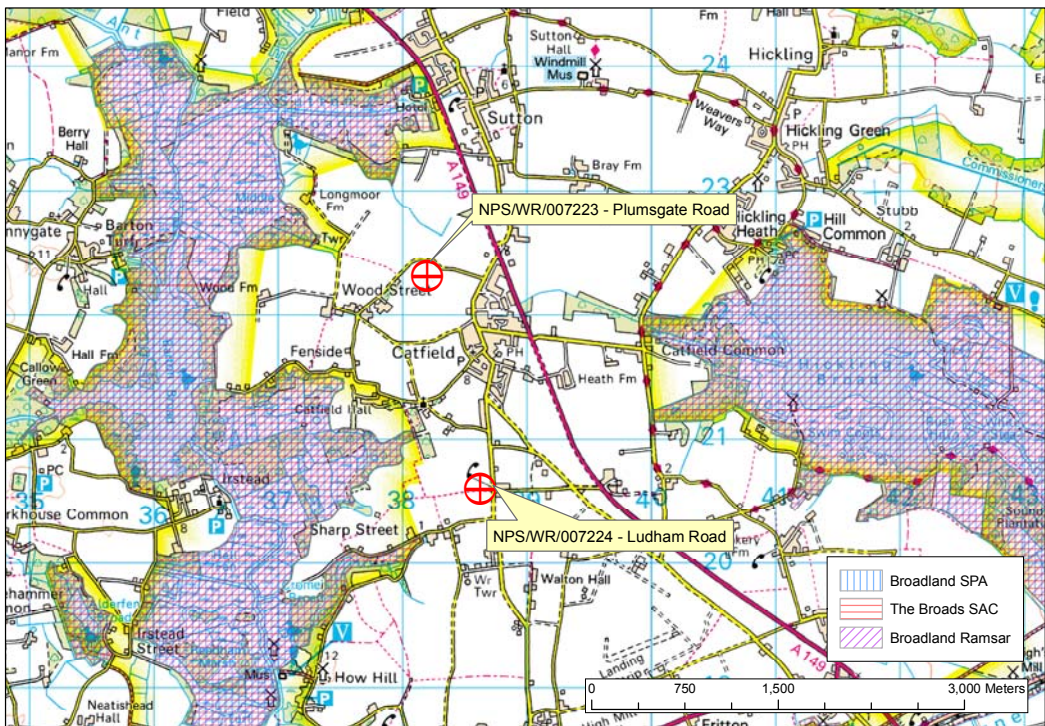


Figure 2: Map outlining the extent of The Broads SAC, Broadland SPA and Broadland Ramsar in relation to the abstraction applications

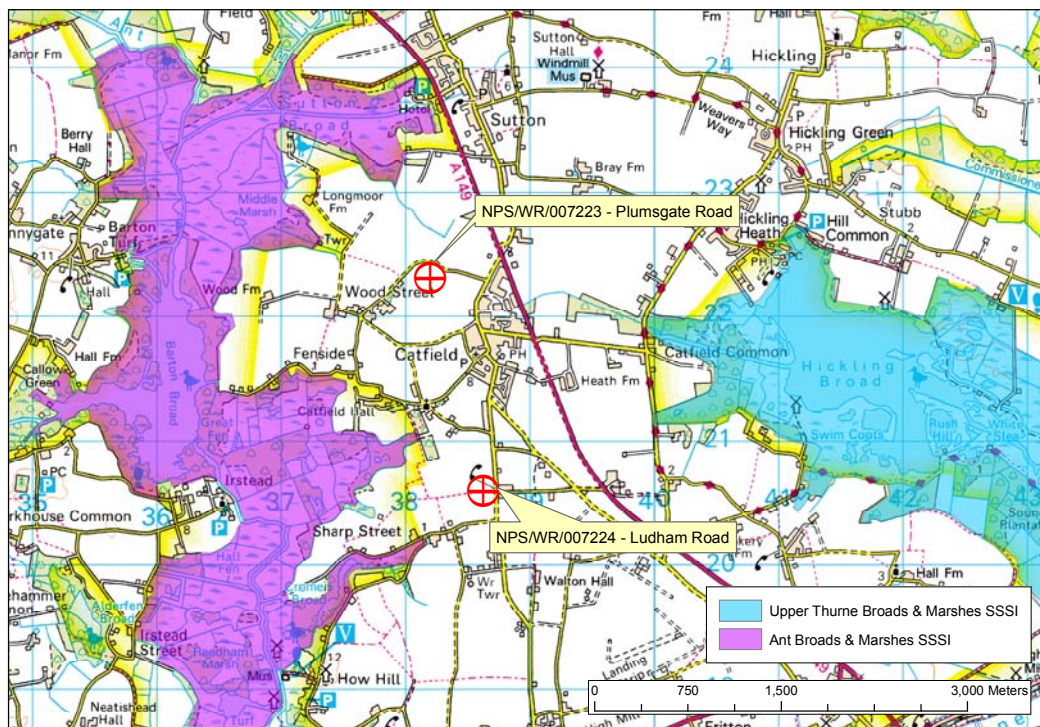


Figure 3: Map outlining location of SSSI components Upper Thurne Broads & Marshes, and Ant Broads & Marshes, which are overlain by the European nature conservation sites shown in Figure 2, in relation to the abstraction applications.

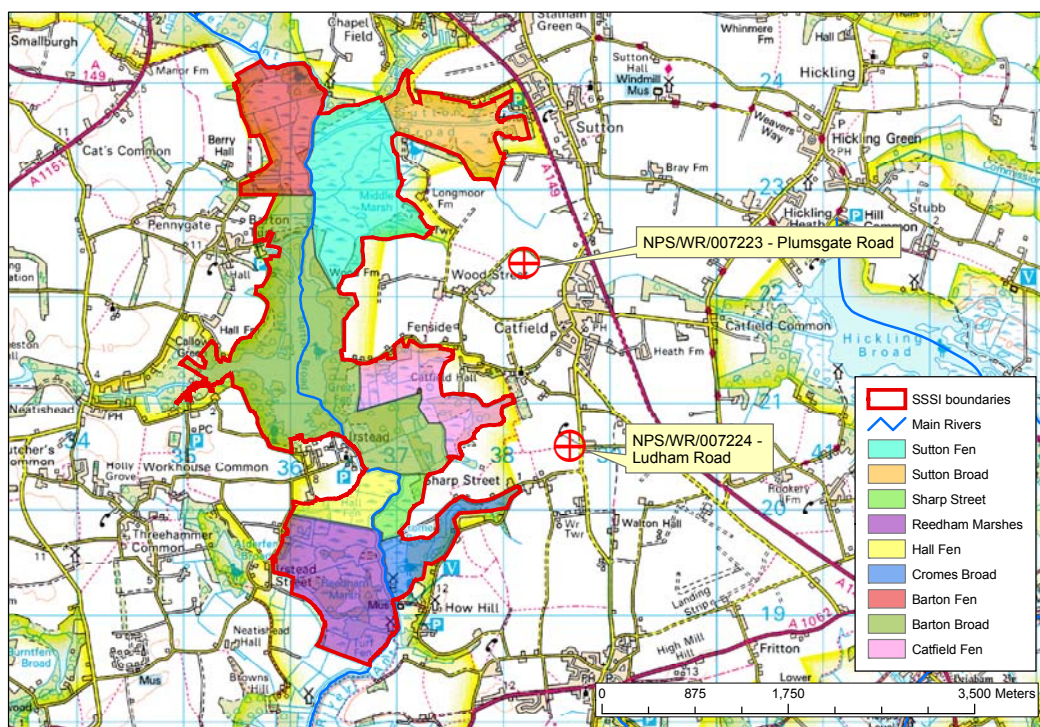


Figure 4: Map outlining the boundary of the Ant Broads & Marshes SSSI and the 9 hydrological sub units associated with the SSSI.

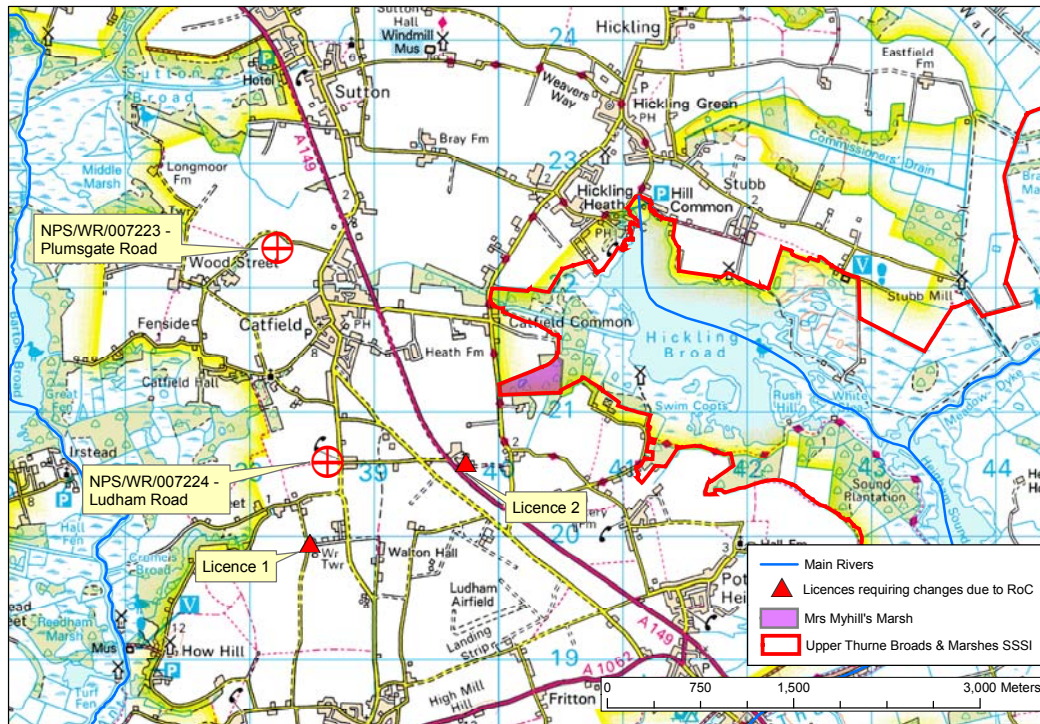


Figure 5: Map showing the location of Mrs Myhill's Marsh, part of the Hickling Broad hydrological sub unit of the Upper Thurne Broads & Marshes SSSI in relation to the Alston renewal applications and Licence 1 and 2 identified for changes under RoC.

Annex 2 – Current licence addendums

PLUMSGATE ROAD: Renewal of full licence AN/034/0009/008

Water Level Monitoring

Water level monitoring shall be carried out as specified below unless otherwise agreed with the Agency:

(i) The licence holder shall maintain in good condition the following existing piezometers:

- 15 metre deep piezometer at TG 3831 2262
- 3 metre deep piezometer at TG 3831 2262
- Agency piezometer No. 5 at TG 3825 2240 (Reference TG32/815D)

(ii) The licence holder shall monitor water levels in the Agency piezometer No 5 by means of a datalogger set to record at hourly intervals. The logger shall be checked, and recalibrated if necessary, at not less than monthly intervals.

(iii) The licence holder shall measure and record water levels in the 15 metre and 3 metre piezometers at not less than twice-weekly intervals between April and October inclusive in any year and at monthly intervals between November and March.

Drainage pump monitoring

The licence holder shall ensure that the volume pumped by the Sutton IDB pump is measured at not less than fortnightly intervals.

Pump test

The licence holder may be required to undertake a pump test if the monitoring carried out under operational pumping is inconclusive.

LUDHAM ROAD: Renewal of full licence AN/034/0009/009

Water Level Monitoring

Water level monitoring shall be carried out as specified below unless otherwise agreed with the Agency:

(i) The licence holder shall maintain to the satisfaction of the Agency the existing three piezometers at National Grid References TG 3850 2059 (Reference TG32/805), TG 3813 2078 (Reference TG32/801) and TG 3821 2029.

(ii) The Licence Holder shall measure and record the water levels in the piezometers before the initiation of pumping each day during the abstraction season and at weekly intervals for the rest of the year. The Licence Holder shall also record the date and time at which the water level in each borehole is measured.

(iii) Certified copies of the levels recorded shall be submitted to the Agency within 28 days of the end of November in any year.

Annex 3.

The following tables show the features for the different site designations and their distribution across the Ant Broads & Marshes SSSI units based on the best information we have available.

FOR NATURAL ENGLAND: Could you please confirm whether this information and our assumptions are correct and whether there is anything additional that should be considered within the appropriate assessment.

*Although Fen Orchid is not officially recorded as being in Unit 3, it is listed within the ecological compendium as being present and therefore has been included within the above table.

	Ant Broads & Marshes SSSI units								
	Catfield Fen (Units 3 & 11)	Sharp Street (Units 4 & 6)	Sutton Fen (Units 8, 10, 23 & 24)	Sutton Broad (Units 10 & 30)	Cromes Broad (Units 4, 5 & 36)	Barton Broad (Units 2, 6, 8, 12, 13, 16, 18, 20, 21, 25, 26, 27, 32 & 33)	Barton Fen (Units 1, 2, 9, 17, 23, 26, 29 & 31)	Reedham Marshes (Units 5, 7, 16 & 37)	Hall Farm (Unit 22)
Broads SAC features									
Calcareous Fens (A Rare Type Of Chalk Rich Fen Dominated By Great Fen Sedge)	Yes (both units)	Yes	Yes for units 8, 10 & 24	Unit 10 only	Unit 5 only	Yes for units 6, 8, 12, 13, 16, 18, 25, 26 & 27	Yes for units 1, 2, 17 and 31	Unit 16 only	Yes
Lutra Lutra (Otter)	Yes (both units)	Yes	Yes	Unit 10 only	Yes	Yes except unit 32	Yes	Yes	Yes
Liparis Loeselii (Fen Orchid)	Unit 3 only*	Unit 6 only	Unit 10 only	Unit 10 only	No	Unit 6 only	No	No	No
Molinia Meadows On Calcareous, Peat Or Clay-Silt Soil (Purple Moor Grass Meadows)	Yes (both units)**	No	Unit 10 only	Unit 10 only	No	No	Unit 1 only	No	No
Natural Eutrophic Lakes With Magnopotamion Or Hydrocharition (Naturally Nutrient Rich Lakes Often Dominated By Pond Weed)	Yes (both units)	Yes	Yes	Unit 10 only	Unit 5 only	Yes except units 2 & 33	Yes for units 1, 2, 23, 26 & 31	Units 7 & 16 only	Yes
Vertigo Moulinsiana (Snail)	Yes (both units)	Yes	Yes	Unit 10 only	Yes for units 4 & 5	Yes except units 32 & 33	Yes except unit 31	Yes except unit 37	Yes
Alder Woodland On Floodplains Or Alongside Water Bodies	Yes (both units)	Unit 6 only	Yes for units 8 & 10	Unit 10 only	Unit 5 only	Yes for units 8, 21, 25 & 28	Yes for units 2, 9, 23, 26 and 31	Unit 16 only	No
Transition Mires And Quaking Bogs	Unit 11 only	No	Unit 10 only	Unit 10 only	No	Units 16 & 18 only	No	Unit 16 only	Yes
Hard Oligo-Mesotrophic Waters With Benthic Veg Of Chara Spp. (Calcium-Rich Nutrient-Poor Lakes, Lochs And Pools)	No	No	No	No	No	No	Unit 2 only	No	No

**Although Purple Moor Grass is not officially recorded as being in Units 3 & 11, it is listed within the ecological compendium as being present and therefore has been included within the above table.

Broad's SSSI features	Ant Broad's & Marshes SSSI units								
	Catfield Fen (Units 3 & 11)	Sharp Street (Units 4 & 6)	Sutton Fen (Units 8, 10, 23 & 24)	Sutton Broad (Units 10 & 30)	Cromes Broad (Units 4, 5 & 36)	Barton Broad (Units 2, 6, 8, 12, 13, 16, 18, 20, 21, 25, 26, 27, 32 & 33)	Barton Fen (Units 1, 2, 9, 17, 23, 26, 29 & 31)	Reedham Marshes (Units 5, 7, 16 & 37)	Hall Farm (Unit 22)
Standing open water and canals (Ditches)	Yes (both units)	Yes	Yes for units 8 & 10	Unit 10 only	Unit 4 only	Yes for units 2, 6, 8 & 12	Yes for units 1, 2 & 31	No	Yes
Standing open water and canals (Eutrophic lakes)	No	No	No	No	Unit 36 only	Unit 33 only	No	Unit 37 only	No
Fen, marsh and swamp (Floodplain fen (lowland))	Yes (both units)	Yes	Yes	Unit 10 only	Unit 4 only	Yes for units 2, 6, 8, 12, 13, 16, 18, 21, 25, 26 & 27	Yes	Units 7 & 16 only	Yes
Vascular plants (Fen Orchid)	Unit 3 only*	Unit 6 only**	Unit 10 only	Unit 10 only	No	Unit 6 only**	No	No	No
Lowland Mire Grassland And Rush Pasture	No	No	Unit 10 only	Unit 10 only	No	Yes for units 2, 6, 16 & 18	Yes for units 1 & 2	Unit 16 only	Yes
Lowland open waters and their margins	Yes (both units)	Yes	Yes	Unit 10 only	Unit 36 only	Yes except for units 20, 21 & 32	Yes for units 1, 2, 17, 23, 26, & 31	Units 16 & 37 only	Yes
Mineral marsh and Open Water: Open Water On Disturbed Sediments	Yes (both units)	Unit 4 only	Yes for units 8 & 10	Unit 10 only	Units 4 and 36	Yes for units 2, 8 & 12	Yes for units 1, 2 & 31	Unit 37 only	Yes
Permanent Wet Mire: Mesotrophic Fen	Unit 3 only	Yes	Unit 10 only	Unit 10 only	Unit 4 only	Unit 6 only	No	No	No
Permanent Wet Mire: Rich Fen	Unit 3 only	Yes	Unit 10 only	Unit 10 only	Unit 4 only	Unit 6 only	Unit 31 only	No	No
Standing open water and canals (Ponds)	Yes (both units)	Unit 4 only	Yes	Unit 10 only	Unit 4 only	Yes for units 8, 12, 12, 13, 16 & 18	Yes for units 17 & 31	Unit 16 only	Yes
Vascular Plant Assemblage	Yes (both units)	Yes	Yes except unit 23	Unit 10 only	Unit 4 only	Yes for units 2, 6, 8, 12, 13, 16, 18, 25, 26 & 27	Yes for units 1, 2, 17, 26 & 31	Unit 16 only	Yes
Wet Woodland	Yes (both units)	Yes	Yes	Yes	Unit 4 only	Yes for units 6, 8, 12, 16, 18, 20, 21, 26 & 32	Yes for units 9, 17, 23, 26, 29 & 31	Unit 16 only	No

*Although Fen Orchid is not recorded as being in Unit 3, it is listed within the ecological compendium as being present and therefore has been included within the above table.

**Fen Orchid was listed as being present in Unit 6 for the SAC features, however this was not included as being present for the SSSI features. It has been included in the above SSSI table for completeness.

Broadland SPA features:**Habitat requirements:**

Bewicks swan	Roost on open water, feed on arable fields
Bittern	Linked to open water and fen habitat
Gadwall	Open water
Hen harrier	Not particularly relevant to Ant system (Adrian Gardiner pers. com)
Ruff	Open water margins, wet grassland
Shoveler	Open water primarily
Whooper swan	Open water/fen/ arable fields
Wigeon	Open water/grazing marsh

Following Natural England's response dated 16 November 2012 the features of greylag goose and pink footed goose have been removed from this list and the following addition has been made;

Marsh harrier	Reed beds/wet grazing marshes/arable fields
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The Broadland Ramsar features are:

Alkaline Fens
Calcareous Fens
Desmoulin's whorl snail
Fen Orchid
Gadwall
Otter
Greylag goose
Pink-footed goose
Residual alluvial forests
Shoveler
Wigeon

Of this list there are two (Greylag goose & Pink-footed goose) that are not already included as features in either the SPA or SAC.

Assumptions for SPA & Ramsar features:

Based more specifically on the feature descriptions at Ant Broads & Marshes SSSI units 3, 4, 5, 10 & 11 they all have open water and fen habitats and so theoretically could support all/any of the birds as do most of the other units in the Ant. It is therefore difficult to make an assessment of the relative importance of these units as compared to the SSSI/SPA/Ramsar as a whole.

The Site Action Plan for Ant Broads and Marshes, Alderfen Broad and Broad Fen (dated 31.01.2010) states that for the SPA features there is no hydrological target set and it was assumed that they would be adequately covered by SAC features and their targets. This assumption will also be applied to the Ramsar features.

Annex 4

Concerns raised by Natural England on 24 April 2013 and further clarified in their email dated 21 June 2013.

Email dated 24 April 2013:

Natural England would like to raise two issues:

1. Since the RoC the Fen Ecological Survey in 2010 has provided evidence that Mrs Myhill's Marsh is scrubbing up similar to other areas in the Broadland Fens. Scrub encroachment may be the result of a number of causes working alone or together. It may be as a result of: inadequate management which leads to an accumulation of dead vegetation material and build up of the fen surface above the fen water table; lack of follow up management in areas where there was previous scrub clearance; changes to general hydrology as a consequence of other pressures which may include abstraction.

From this perspective NE does not believe that there is persuasive evidence the two licence renewals would make a significant contribution to scrub encroachment.

2. The most sensitive part of Upper Thurne Broads and Marshes SSSI is Mrs Myhill's Marsh which includes M5, a very rare transition mire community, which is highly sensitive to ground water inputs and therefore very sensitive to impacts from groundwater abstraction. In particular the sensitivity is related to a complex balance of acid rich crag ground water and the more base rich water. If the abstraction results in a change to this balance, then a change in the vegetation communities found on this unit may result.

Are the EA able to indicate whether such small changes in water table levels are likely to have an impact on the balance in the base status of the water feeding site?

Additional clarification questions emailed dated 21/06/2013;

Groundwater data questions:

- 1) Are the EA able to identify the significance of the groundwater to the site?
- 2) Can the EA provide information in the assessment to show ground water levels under naturalised conditions and then with the individual licences added and finally with all the licences in combination.
- 3) Can the EA provide data to show the residual impact from the Overton licence and the AWS licence with the 25% reduction in place?
- 4) Are the EA able to consider likely consequences alone and in combination of the license on transition mire? The key issue is that transition mire is a mire type which is in the process of change. Our concerns revolve around implications of water level and hydro-chemistry on rate and nature of change.

Water Chemistry Questions

- 5) What is the significance of the groundwater input in relation to the water chemistry?
- 6) Has the assessment taken into account the fact that the M5 transition mire is on solid peat and not floating? (the connection with groundwater is more important here than with a floating transition mire)
- 7) The assessment will need to provide evidence of the mixing zone of water inputs to the site. How deep is it? Where is it?

Annex 5

Answers to Questions Posed by Natural England Regarding The Impacts of the Alston Licences on Upper Thurne Broads and Marshes – Mrs Myhill's Marsh

INTRODUCTORY INFORMATION

Background

Mr Alston is seeking to renew his Ludham Road and Plumsgate Road abstraction licenses. Concern has been expressed about what impact the fully licensed rate of these abstractions might have on the hydrochemical regime and therefore the potential to negatively affect the Transition Mire feature located at Mrs Myhill's Marsh.

This note assesses whether the Alston Licenses, abstracting at the fully licensed level could adversely affect the Transition Mire.

Mrs Myhill's Marsh is similar to Catfield Fen, it is a similar environment, with similar hydrological functioning and we suggest similar hydrochemical functioning, so reference is also made to data associated with Catfield Fen.

Geology and Aquifer Framework

Reference to the Site Option Plan for the Upper Thurne Broads and Marshes, Entec 12th February 2008 (The SOP) Figure 3.38 illustrates the fact that the geological sequence immediately underlying the site consists of peat underlain by Breydon Formation (containing clays), which is underlain by Corton Formation (with basal clay) and the Upper, Intermediate and Lower Crag Formations. The Crag overlays the London Clay which effectively represents the base of the aquifer system. This stratigraphy is similar to Catfield Fen.

The aquifer system is continuous through the Crag, through the Breydon Formation and into the peat. There are clays present which could be expected to restrict the upward flow to the marsh.

Water Level Monitoring

Monitoring of both groundwater and surface water levels in the Upper Thurne Broads and Marshes are detailed in the SOP as Figures 3.23 (monitoring locations) and Figure 3.24 Groundwater Levels Adjacent to Mrs Myhill's Marsh and Figure 3.25 Groundwater and Surface Water Levels at Mrs Myhill's Marsh. Note has also been taken of the significant amount of water level monitoring data for Catfield Fen contained within Appendix E of the Catfield Fen Investigation Final Report, August 2012 (The Mason Report).

Hydrochemical Data

Hydrochemical information pertaining to Mrs Myhill's Marsh is available; the character of Crag groundwater is indicated by analyses for the 3 piezometers TG42/010/010a and 010b (SOP Figure 3.35) together with that of surface water in the immediate area represented by analyses for sampling points UT1 and UT3 (SOP Figure 3.34).

Since the acid/alkali (pH) balance is important a Whisker diagram (Figure 4) derived from the Mason Report is presented. This illustrates the range of values which can be assigned to the various water types in the 'Area of Interest', including in the vicinity of Catfield Fen and Mrs Myhill's Marsh. Table 1 provides a summary of water chemistry analyses which are subdivided into different chemical groupings (water types). Table 1 is also derived from the Mason Report and is important when considering the location of a potential mixing zone.

Ecological Status

The ecological features to be found on Mrs Myhill's marsh consist of Alluvial Woodland (W2, W5 and W6) and Transition Mire (M5). The feature of concern is the Transition Mire (M5). Early in the Review of Consents (RoC) process the feature was recorded as in unfavourable declining condition, however this condition was not reported as being due to abstraction. Reasons given for the unfavourable condition at the time, at a number of sites including Mrs Myhill's Marsh were: inadequate water levels related to IDB drainage, ochre production through land drainage, excessive salinity, scrub invasion and disturbance of SPA refuge areas.

However since December 2010, SSSI Unit 20, representing Mrs Myhill's Marsh, has been assessed as being in favourable condition.

Ecological Functioning of the Transition Mire

The Ecohydrological Guidelines (Wheeler et al., 2010) indicate that M5 represents the first phase acidification of a more base-rich fen. In optimal situations the water table is typically close to the surface year round. The summer water table recorded from a number of stands of M5 had a mean of -4cm bgl, with a max of 10cm agl and a min of -45 bgl. M5 is typically found in moderately base-poor and fertile conditions but it can occupy a wide range of conditions. The water pH recorded from a number of M5 stands had a mean of 5.0, with a max of 6.1 and min of 3.8.

Hydrological and Hydrochemical Functioning

Hydrological

In order to illustrate the hydrological situation as it pertains to the Transition Mire feature located in Mrs Myhill's Marsh a process schematic diagram has been developed and included as Figure 1. This is in an effort to facilitate conceptual understanding of the site. For the future it is useful to be aware that this diagram can also be applied to aid understanding of the processes acting at Catfield Fen.

The active geological formations as indicated in the Geology and Aquifer Framework description above are represented in Figure 1 together with the relevant surface features including a stylised representation of the ditches (dykes). The summer and winter water levels are illustrated by the solid and dashed convex lines respectively which link with the ditches and provide an indication of the summer and winter ditch water levels. Idealised locations for dipwells and piezometers are included as are the relevant indicative water levels for comparison with both the summer and winter water table levels and the ditch levels.

These levels indicate that the potential for upward flow from the Crag into the Breydon Formation and thence to the Peat exists. However precipitation occurring at surface is largely responsible for the convex nature of the water table and flow is indicated towards the ditches. Vertical drainage and the upward groundwater gradient will find a balancing level (representative of the mixing zone) shown as the blue chain dotted concave line linking the ditches. This represents the zone where more acidic rainfall recharge is meeting upwelling of relatively base rich Crag groundwater. Crag groundwater will accrete to the ditches and mix with the surface water/shallow groundwater drainage.

Figures 2 and 3 present the actual water level relationships for Mrs Myhill's Marsh. The measured water level information depicted is consistent with that expected and illustrated in the schematic process diagram and indicates that an upward gradient does indeed exist in the Crag, through the Peat and towards the ditches.

Sections generated by site topographic survey are provided in the SOP Figure 3.14 for cross section D-D' and 3.15 for cross section E-E' at Mrs Myhill's Marsh. This information together with water level, flow and the artificial influence data has been used in the Yare and North Norfolk regional numerical model to identify water balance components at critical assessment cells. Assessment Cell A presents this information for winter and summer periods at Mrs Myhill's Marsh in SOP Figure 5.16, and the relevant Zone Budget will be found in SOP Appendix G.

The key water balance components are:

- 1) Lateral groundwater flow in the Crag;
- 2) Lateral groundwater flow in the Drift (Breydon Formation);
- 3) Vertical groundwater flow between Crag and Drift;
- 4) Recharge to saturated zone;
- 5) Groundwater discharge to streams (positive or negative)

Referring to the December 1993 winter time step shown in SOP Figure 5.16, it can be seen that the vertical groundwater flow from the Crag to the Drift is upward. The diagram gives a flow of 0 MI/day which is due to rounding up to the MI/day units. The actual upward flow for December 1993 is in fact 24 m³/day (SOP Appendix G).

With the aid of the field data and the groundwater model, the hydrological functioning of Mrs Myhill's Marsh has been characterised and quantified. The model indicates a flow regime consistent with the data and the conceptual understanding, and indicates that a small upward flow from the Crag meets a downward flow from rainfall recharge leading to the potential for a mixing zone. The level of abstraction from the 4 main sources across the 'Area of Interest' – AWS Ludham, Overton, Alston Plumsgate Road and Ludham Road for 1993 was 592.8 TCMA.

Hydrochemical

Reference to Table 2 of this document provides a summary of water chemistry analyses, with subdivision into different chemical groupings (water types) derived from the Catfield Fen Investigation – Final report, August 2012 (the Mason Report); together with a Whisker diagram derived from these data. This is presented to illustrate the range of values which can be assigned to the various water types near to the Upper Thurne Broads and Marshes.

With regard to Mrs Myhill's Marsh, groundwater analyses are depicted in SOP Figure 3.35 for TG42/010/010a and 010b which are taken from piezometers tapping deep, intermediate and relatively shallow Crag water respectively. The analyses yield a Ca Mg SO₄ water which would be expected of mixed shallow and deeper crag water, for which the pH range is 7.59 to 7.89 similar to AWS Ludham.

Similarly surface water analyses are shown in SOP Figure 3.34 for samples taken from UT1 through to UT14 by Holman in 1994. Sample locations UT1 and UT3 are located in dykes close to Mrs Myhill's Marsh.

Analysis of sample UT1 can be characterised as Ca HCO₃ which is representative of a mixed river and broads/shallow groundwater. Sample UT3 is indicative of Na Cl which is characteristic of a peat source but may also indicate a potential tidal connection. The pH values for UT1 and UT3 are 6.5 and 7.7 respectively.

In summary we can identify three hydrochemical water types;

- Mixed intermediate and deeper Crag groundwater (Ca Mg SO₄) pH 7.59 – 7.89;
- Mixed river and Broads/shallow groundwater (Ca HCO₃) pH 7.9;
- Peat (Na Cl) pH 5.8.

The hydrochemical character of the water types identified for which analyses are available for Mrs Myhill's Marsh are consistent with the process and conceptual diagrams provided as figure 1, 2 and 3 respectively. The hydrochemical functioning of the site based on the hydrological functioning has facilitated the conditions which support the development of transition mire as indicated in the Ecological Guidelines.

Changes to the Hydrological and Hydrochemical Functioning with Alston Ludham Road and Plumsgate Road Sources at Fully Licensed Abstraction

In quantitative terms Table 1 illustrates fully licensed and historical rates of abstraction for the main licenses affecting Upper Thurne Broads & Marshes – Mrs Myhill's Marsh and these are illustrated in Figures 6 and 7.

It will be noted that the fully licensed, in combination rate of abstraction prior to the RoC was 843.4 TCMA. For the 'RoC Solution' the AWS Ludham fully licensed quantity is reduced by 25% together with a reduction of the same percentage for the Overton Licence under drought conditions. A total reduction of 186.2 TCMA. This gives the post RoC fully licensed quantity of 657.2 TCMA, a reduction of 186.2 TCMA.

It is instructive to note that the post RoC reduction in abstraction of 186.2 TCMA is 8 times the fully licensed rate of the Alston Ludham Road abstraction 22.7 TCMA.

Table 1 Fully licensed and historical rates of abstraction for the main licenses in the vicinity of Mrs Myhill's Marsh

Source	Pre RoC FL TCMA	1993 Hist TCMA	2011 Hist TCMA	Post RoC FL TCMA
Alston Ludham Rd	22.7	11.7	21.9	22.7
Alston Plumsgate Rd	68.0	11.7	65.7	68.0
Overton	72.7	0.0	12.8	54.5
AWS Ludham	680	569.4	540.2	512
In Comb	843.4	592.8	640.6	657.2

In relation to the hydrological functioning of the site:

Historically

- Historical (1993) 592.8 TCMA
- Recent Actual (2011) 640.6 TCMA – abstraction has been fairly steady since 1993. Agency understands feature of concern has remained in acceptable condition

RoC Changes

- Pre RoC Fully Licensed 843.4 TCMA
- Post RoC Fully Licensed 657.2 TCMA

So:

- 'In combination' fully licensed abstraction levels are now in line with the historical level of abstraction;
- The Alston Ludham Road abstraction is included at the fully licensed rate, so the alone impact from Alston Ludham Road will have negligible impact and the hydrological functioning will be essentially unchanged;
- The hydrochemistry will therefore remain essentially unchanged.

From the foregoing discussion the Environment Agency is confident that the 'in combination' fully licensed level of abstraction will not lead to an adverse effect on the integrity of the site. It is further anticipated that changes to the fully licensed abstraction quantities resulting from implementation of the RoC solution

will result in minimal change to the hydrological functioning and since there is no suggestion of any significant shift it is unlikely that the hydrochemistry will be impacted at all.

Conclusions

- This Technical Note has assessed the potential impacts of abstraction in the vicinity of Mrs Myhill's Marsh on the hydrological and hydrochemical functioning;
- The hydrological and hydrochemical functioning has been presented based on data and modelling;
- Historical ecological condition was considered acceptable so the presumption is that historically the hydrological and hydrochemical functioning has been acceptable;
- The post RoC 'in combination' abstraction is similar to historical so no change is expected in either the hydrological or hydrochemical functioning;
- The agency is confident that there will be no adverse effect on the integrity of the site due to the post RoC fully licensed 'in combination' levels of abstraction;
- The Alston Ludham Road and Plumsgate Road fully licensed rate is 90.7 TCMA which is 13.8% of the 'in combination' fully licensed rate of 657.2 TCMA.
- Assuming the entire potential abstraction quantity accrues to an impact at Mrs Myhill's Marsh, they represent a minor component of the overall 'fully licensed' rate and alone are unlikely to significantly impact either the hydrological or hydrochemical functioning of the site.

The following questions were posed by Natural England:

Groundwater Data Questions:

- 1) *Are the EA able to identify the significance of the groundwater to the site?*

Answer: Refer to foregoing note which explains the hydrological functioning of the site. At the cell A location, the Yare and North Norfolk model shows that the rainfall recharge in December 1993 was 93 m³/day and the upward flow from Crag to Drift was 24 m³/day. The site is predominantly rainfall fed but upward flow represents 25% of the flow into the Peat layer and the upward head gradient effectively impedes drainage of the recharge.

- 2) *Can the EA provide information in the assessment to show ground water levels under naturalised conditions and then with the individual licences added and finally with all the licences in combination.*

Answer: Refer to the foregoing note which explains that the hydrochemical functioning is mainly based on groundwater flows and the hydrological functioning.

For information:

Modelled groundwater levels under naturalised conditions for the assessment cell are shown on SOP Figure 5.2.1.

Adding all the licences in combination is demonstrated by the equivalent Options Appraisal (OA) figures 7.9 and 7.10 in Chapter 7

- 3) *Can the EA provide data to show the residual impact from the Overton licence and the AWS licence with the 25% reduction in place?*

Answer: Refer to foregoing note.

For information:

The RoC preferred option figure 5 (OA7, Run 345) includes the reductions in the Overton and AWS Ludham licences and therefore gives the in-combination Fully Licensed drawdown at Mrs Myhill's Marsh for the 'new' FL situation. This essentially includes the residual impact from the Overton and Ludham PWS licences.

- 4) *Are the EA able to consider likely consequences alone and in combination of the license on transition mire. The key issue is that transition mire is a mire type which is in the process of*

change. Our concerns revolve around implications of water level and hydro-chemistry on rate and nature of change.

Answer: Refer to the explanation in the foregoing note. Under the post RoC fully licensed abstraction the hydrological and hydrochemical regime will essentially remain unchanged.

Water Chemistry Questions

5) *What is the significance of the groundwater input in relation to the water chemistry?*

Answer: Refer to foregoing note. The hydrological functioning including the rainwater recharge/groundwater input balance is the most important factor controlling the water chemistry.

6) *Has the assessment taken into account the fact that the M5 transition mire is on solid peat and not floating? (the connection with groundwater is more important here than with a floating transition mire)*

Answer:

The Broads Environmental Outcomes contains the text below – and as a result targets were set for Cell A containing the M5.

‘Transition Mires and Quaking Bogs

The transition mire community M5 occurs on the fen surface (not floating) and is thus potentially sensitive to water level fluctuations. Water levels should not fluctuate more than 30 cm annually.’

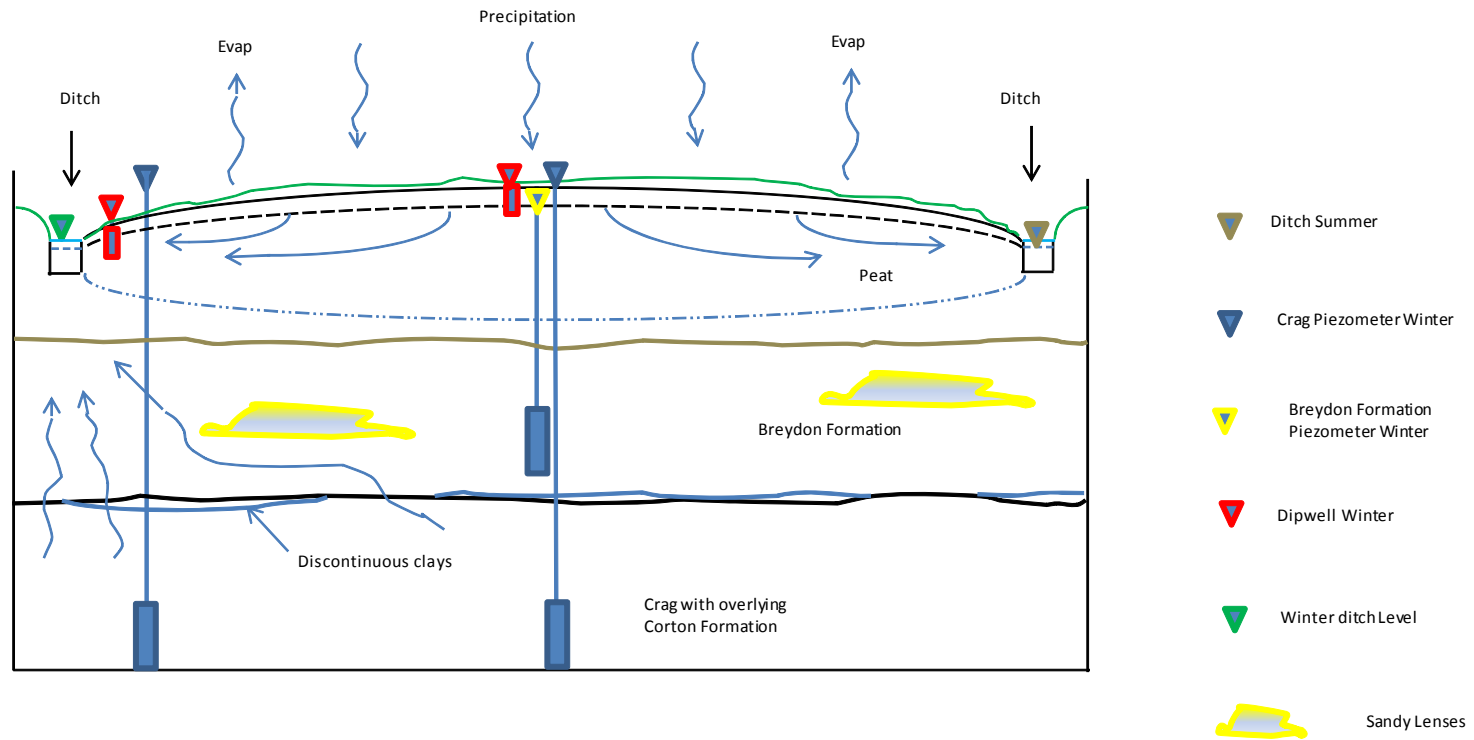
The targets were the same as we used for M13.

Therefore, the assessment has taken into account the fact that the M5 transition mire is on solid peat and not floating.

7) *The assessment will need to provide evidence of the mixing zone of water inputs to the site. How deep is it? where is it?*

Answer: Refer to foregoing note. The potential mixing zone is schematically identified on Figure 1. The depth to a ‘mixing zone’ will depend on how it is defined in hydrochemical terms. It is likely that the mixed ‘river and Broads/shallow groundwater’ type extends somewhat deeper than the depth of the ditches.

Figure 1 Upper Thurne Broads & Marshes – Mrs Myhill’s Marsh Conceptual Process Schematic



Date 04/07/2013

Figure 2 Upper Thurne broads & Marshes Conceptualisation Based on SOP Section D-D'

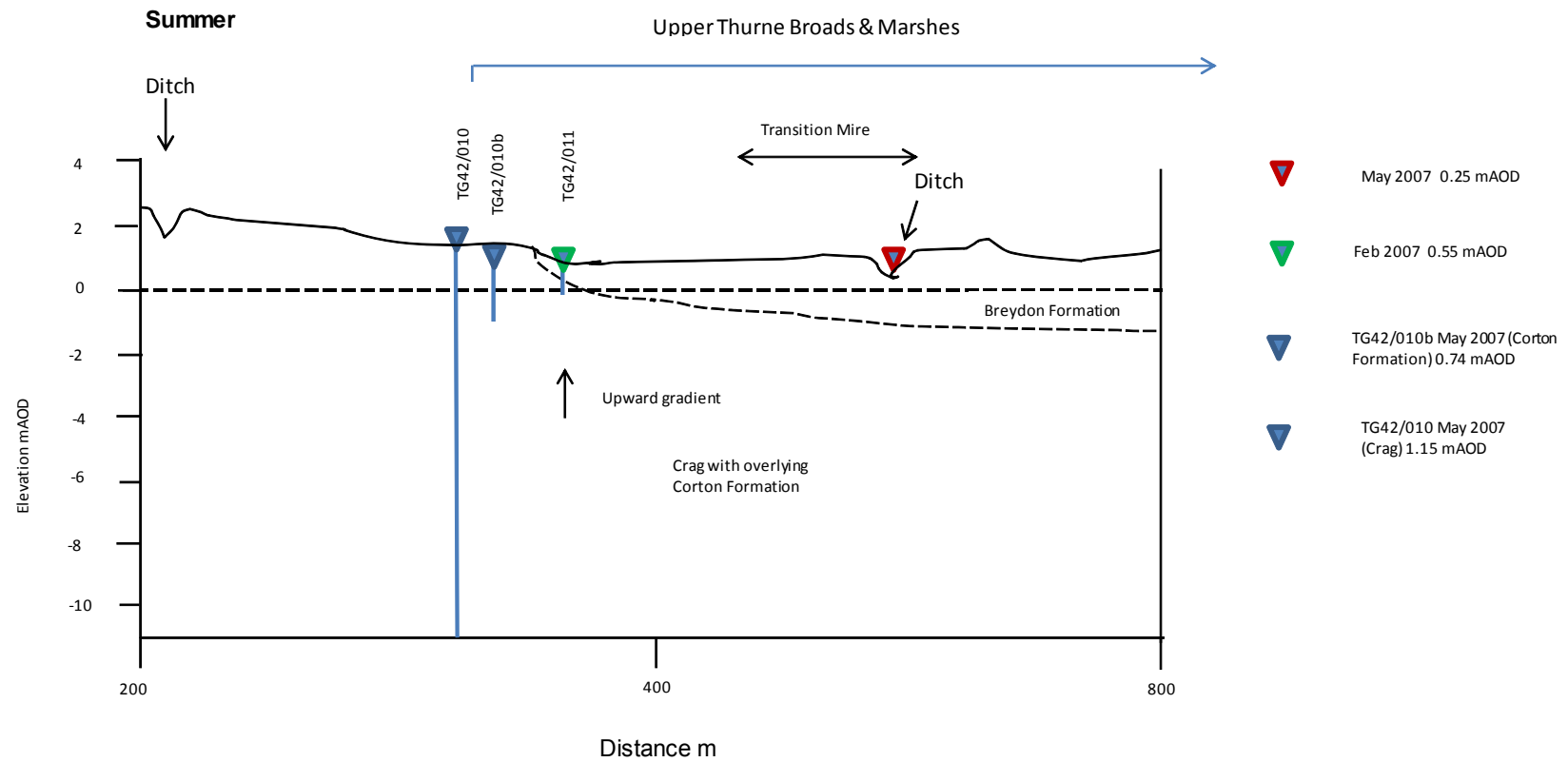


Figure 3 Upper Thurne Broads & Marshes Conceptualisation Based on SOP Section D-D'

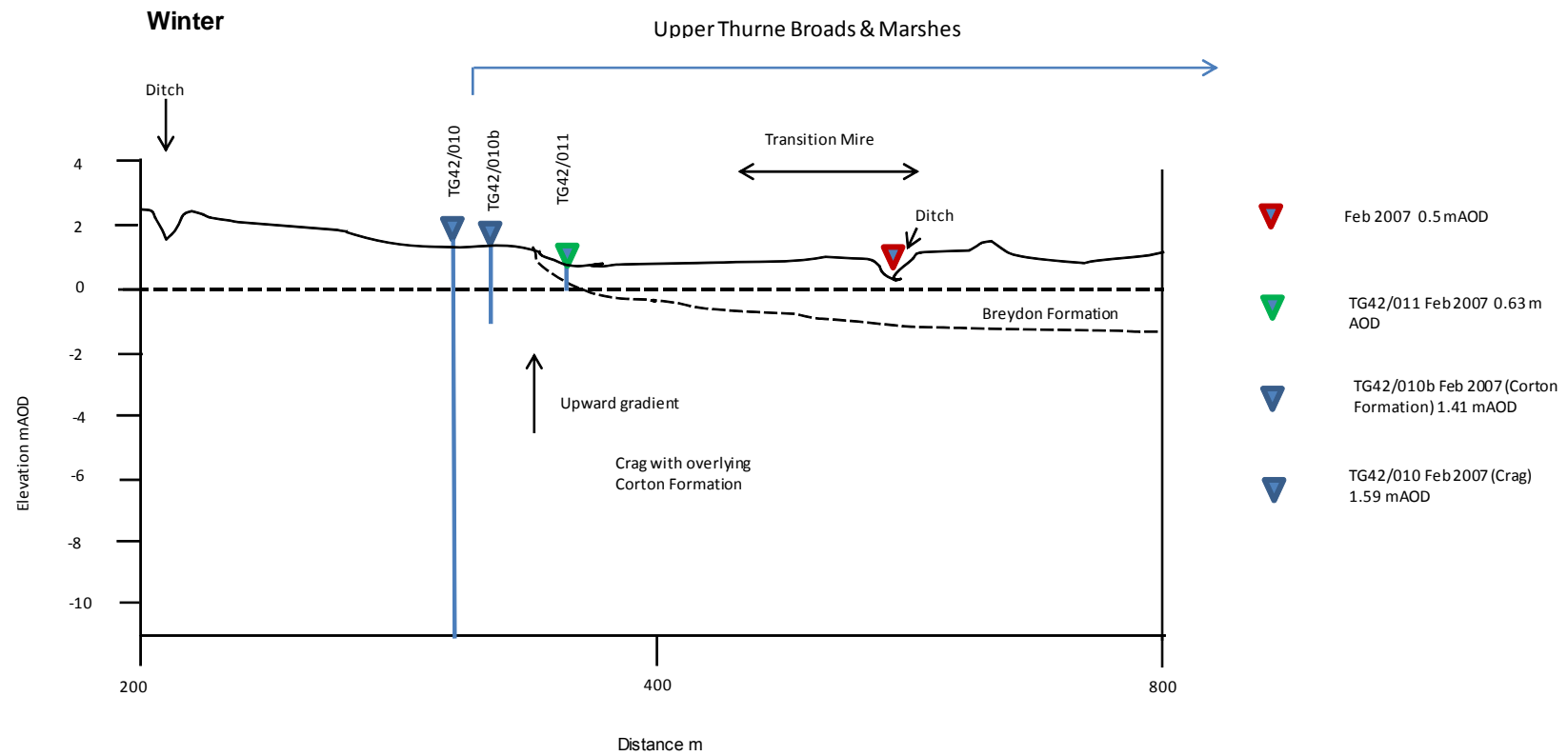
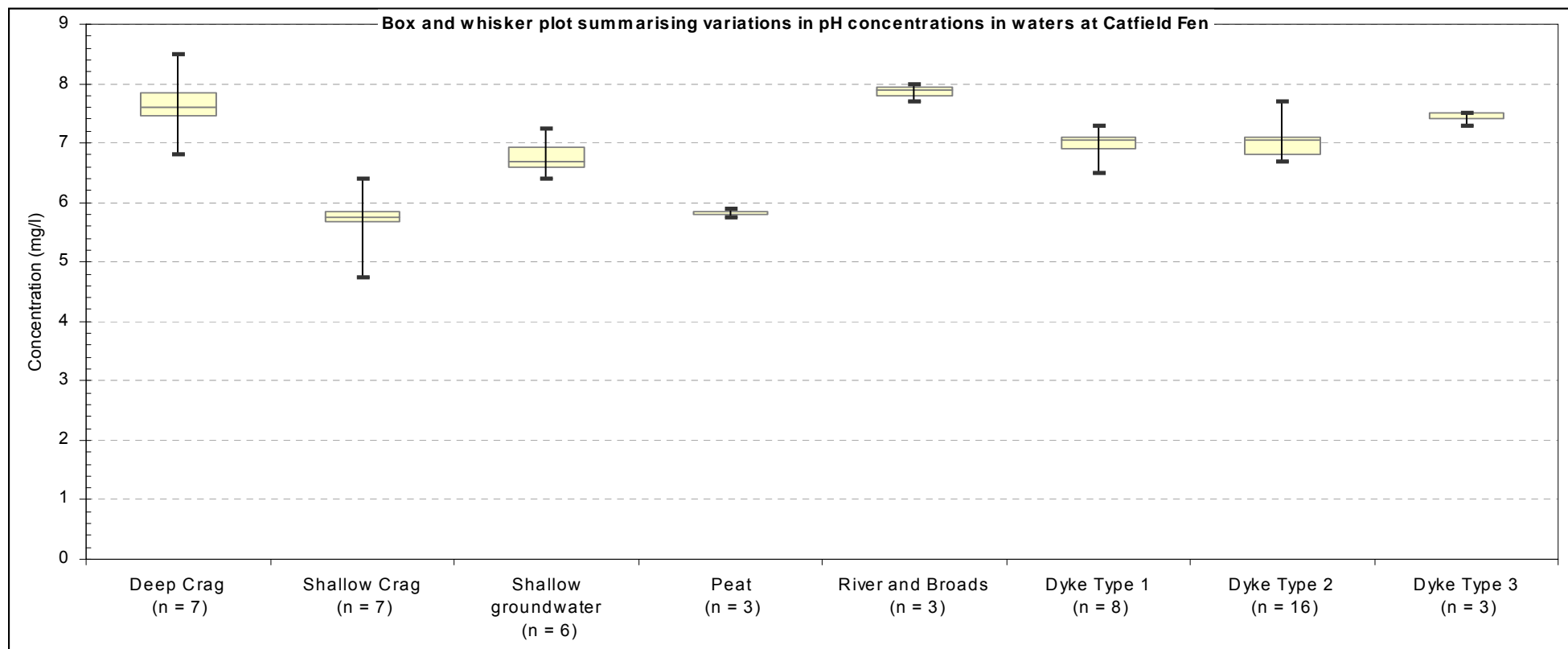


Figure 4 Box and whisker plot summarising variations in pH concentrations in waters at and near Catfield Fen – Figure F21 Appendix F the Mason Report



Note: Box and Whisker diagrams show the median value within the box with the upper and lower box boundaries representing 25 percentile values. The observed range is shown by the “whisker” bar.

Figure 5 Groundwater Heads Historic, Real fully Licensed and Options Appraisal Cell A Mrs Myhill's Marsh

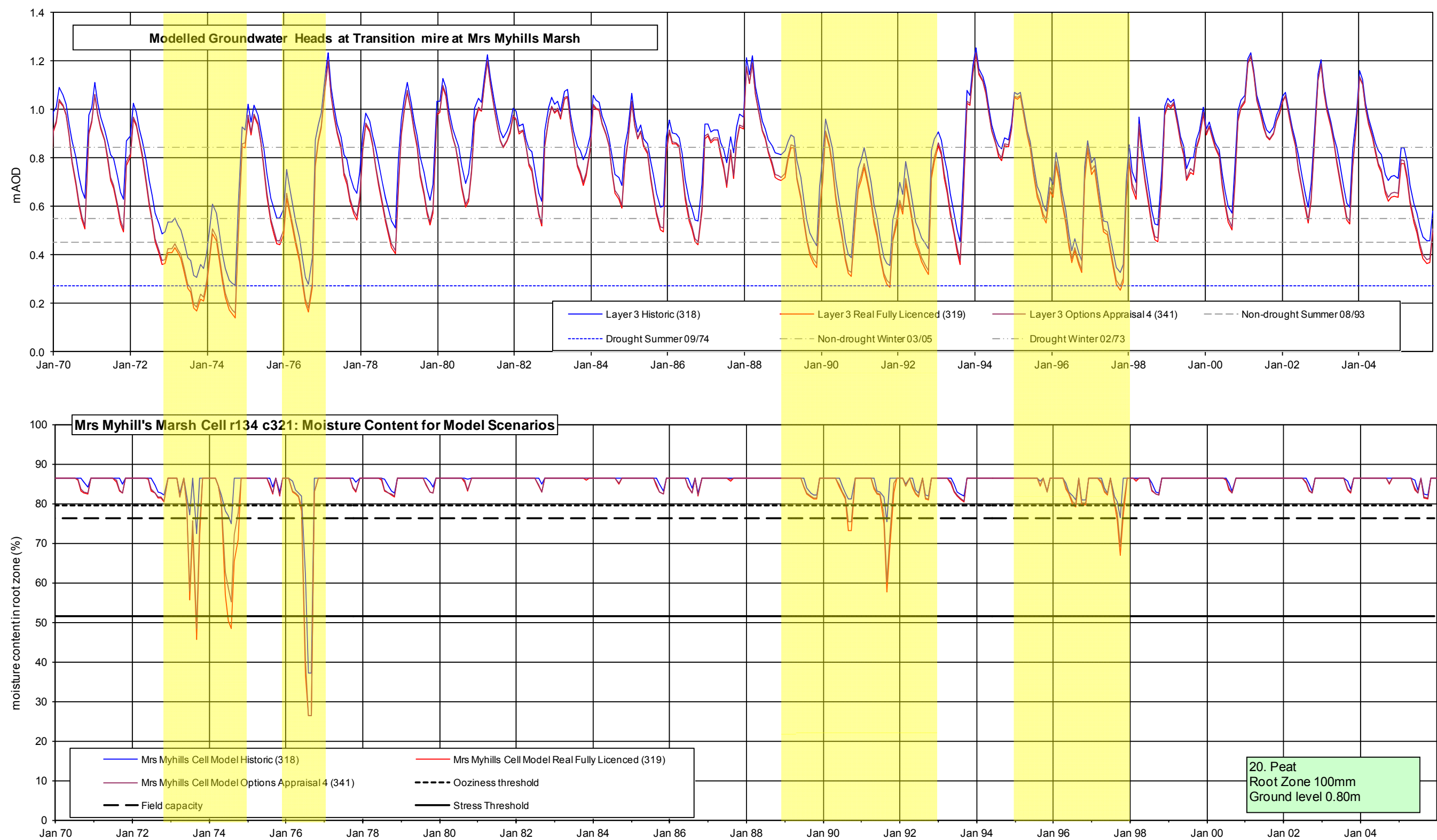


Table 2 Reproduced from Table F4 – Summary of water chemistry analyses, with subdivision into different chemical groupings – The Mason report

Group	General description	n	Parameter median (values in square brackets are the observed range)										Typical Equivalent Ratios		Calcite saturation index (median)
			Ca mg/l	Na mg/l	K mg/l	Mg mg/l	Cl mg/l	SO ₄ mg/l	HCO ₃ mg/l	Fe mg/L	Nitrate as N mg/L	pH	Ca/Mg	Na/Cl	
River and Broads	Ca-HCO3 water type from rivers / broads surrounding the site. Higher pH than other surface waters; calcite saturated.	3	88 [84 - 100]	51 [36 - 58]	6.2 [4.5 - 8.7]	19.5 [14 - 29.3]	95 [66 - 122]	94 [76 - 111]	194 [188 - 235]	0.05 [0.04 - 0.3]	2.9 [0.3 - 3.9]	7.9 [7.7 - 8]	2.71	0.82	0.5
Dyke Type 1	Dilute water type from surface waters. Low concentrations of Ca, Mg, HCO3 and SO4.	8	35 [14 - 42]	43 [22 - 65]	4.3 [0.3 - 7.3]	9.3 [5 - 28]	87 [33 - 140]	11 [6 - 54]	107 [49 - 158]	0.11 [0.01 - 0.26]	0.7 [0 - 2.7]	7.1 [6.5 - 7.3]	2.23	0.77	-0.8
Dyke Type 2	Surface waters with ionic compositions intermediate between Type 1 and Type 3. Understaturated wrt Calcite.	25	73 [50 - 108]	42 [28 - 75]	4.4 [1.3 - 18]	14.1 [7.5 - 29.6]	82 [14 - 131]	51 [5 - 97]	220 [129 - 391]	0.17 [0.01 - 11.1]	1.0 [0 - 11.5]	7.1 [6.7 - 7.7]	3.11	0.78	-0.4
Dyke Type 3	Ca-Mg-HCO3-SO4 water type from surface waters. High Ca and HCO3; saturated wrt calcite; occasionally high nitrate.	8	124 [115 - 135]	43 [33 - 54]	5.1 [0.8 - 13]	21.8 [14.2 - 28]	81 [39 - 104]	88 [22 - 129]	340 [243 - 427]	0.17 [0.03 - 0.61]	0.4 [0 - 22.8]	7.5 [7.3 - 7.5]	3.41	0.81	0.1
Dyke Type 4	Dyke waters showing evidence of pollution (elevated nitrate, SO4, Mg, and K).	2	110 [110 - 110]	45 [38 - 52]	29.0 [7.4 - 50.6]	56.9 [32 - 81.7]	110 [95 - 125]	85 [21 - 149]	458 [351 - 565]	1.44 [0.01 - 2.86]	5.9 [5.6 - 6.2]	7.3 [7.1 - 7.4]	1.16	0.63	-0.3
Deep Crag	Ca-HCO3 water type from Deep Crag boreholes. High Ca/Mg ratio, moderate Fe concentration, very low nitrate.	9	91 [75 - 116]	33 [29 - 40]	2.9 [2 - 4.5]	6.4 [5.8 - 9.4]	47 [39 - 64]	50 [26 - 80]	246 [221 - 283]	1.60 [0.19 - 3.72]	0.2 [0 - 0.6]	7.6 [6.8 - 8.5]	8.64	1.10	0.3
Shallow Crag	Ca-Mg-SO4 water type from Shallow Crag boreholes. High Mg, SO4, Fe and nitrate concentrations. Low HCO3 and pH.	7	73 [62 - 101]	45 [33 - 74]	5.9 [2.8 - 8.6]	31.2 [23.2 - 61.5]	91 [78 - 162]	131 [105 - 230]	61 [18 - 157]	2.02 [0.12 - 67.6]	17.7 [13.8 - 46.7]	5.7 [4.8 - 6.4]	1.41	0.75	-2.3
Crag: Ludham PS P5	Deep Crag source exhibiting characteristics of both Deep Crag and Shallow Crag groups.	4	87 [62 - 125]	34 [31 - 43]	3.4 [2 - 3.6]	10.8 [2.5 - 32]	75 [39 - 107]	116 [57 - 127]	114 [53 - 280]	1.49 [0.03 - 23]	4.2 [0 - 14.3]	9.0 [7.4 - 12.4]	4.83	0.69	-0.3
Other Crag	Ca-HCO3-SO4 type from shallow / mid depth Crag boreholes. Composition between Shallow and Deep Crag Groups.	5	122 [68 - 178]	52 [17 - 98]	11.7 [1 - 38]	13.0 [2.4 - 21.5]	72 [40 - 87]	165 [80 - 176]	257 [21 - 381]	1.50 [0.02 - 5.07]	10.2 [0.1 - 12.1]	6.9 [6.6 - 9.8]	5.63	1.12	-0.1
Shallow groundwater	Ca-HCO3 water type from superficial deposits. High nitrate concentrations, very high K at one location, low SO4.	6	78 [55 - 102]	25 [16 - 84]	46.7 [6.7 - 57.3]	11.7 [7.5 - 50.8]	51 [16 - 308]	30 [4 - 39]	250 [211 - 305]	1.15 [0.01 - 37.5]	2.7 [0.3 - 12]	6.7 [6.4 - 7.2]	3.99	0.77	-0.7
Peat	Na-Cl type groundwater from a single peat observation borehole (NTG3261P3). High Na and Cl concentrations suggest limited flushing of salt, probably from saline incursions sourced from the sea	3	74 [65 - 76]	186 [178 - 199]	4.0 [0.8 - 7]	36.1 [33.2 - 36.8]	377 [356 - 387]	4 [3 - 4]	200 [189 - 218]	4.40 [2.76 - 5.8]	0.1 [0 - 0.2]	5.8 [5.8 - 5.9]	1.22	0.76	-1.6
Rainwater	[mean]	2	1.4 [0.5 - 2.3]	2.5 [1.3 - 3.8]	0.29 [0.21 - 0.36]	0.59 [0.37 - 0.81]	4.2 [1.7 - 6.6]	5.6 [4.5 - 6.8]	-	-	-	-	1.42	0.94	

Figure 6 Actual annual abstraction from some licensed sources in the Thurne Broads & Marshes area

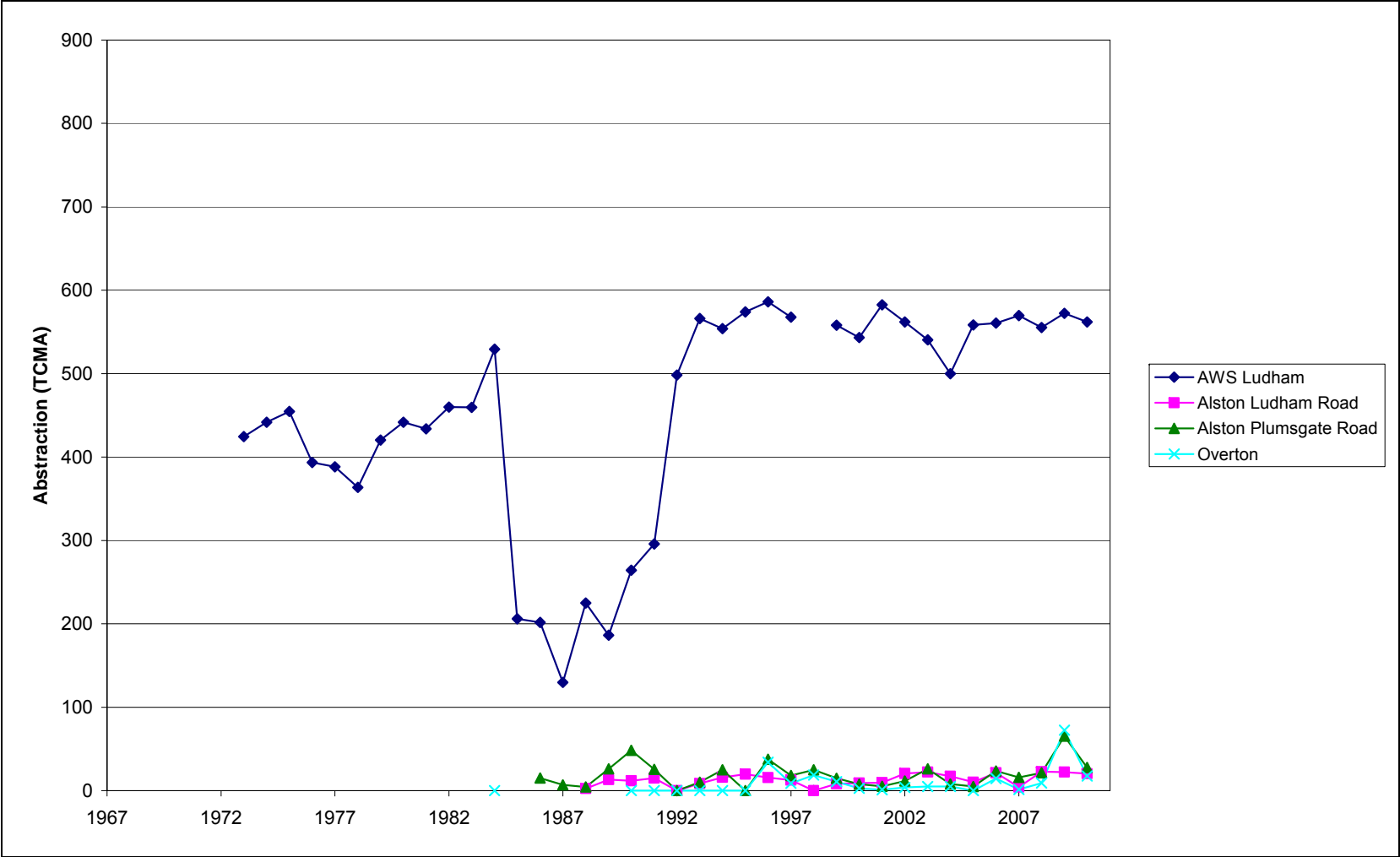


Figure 7 Annual licensed abstraction quantities for some licensed sources in the Thurne Broads & Marshes area

