Broads Authority
The Broads - a member of the National Park family

Issues Affecting Lakes and SSSI condition

Appendix 1

Broads Lake Restoration Strategy

Flooding at Postwick - Mike Page

Issue - Phosphorus

A report investigating the flows and phosphorus fluxes relevant to the Habitats Directive Review of Consents in tidally-influenced Broadland rivers (Halcrow, 2004), presented modelled predictions that demonstrated the proportional amounts of phosphorus load derived from sewage treatment works and diffuse sources, largely agriculture and unconnected properties. The results show that the river valley and indeed the point within the river valley has different proportions of phosphorus from the various modelled sources, for example are shown in Table 1.

Area	Consented discharges	Diffuse (largely agriculture and properties without mains sewage disposal)
Horsey Mere Area	21%	79%
Hickling and Heigham Area	69%	31%
Geldeston Meadows catchment	39%	61%
Sprats Water and Marshes catchment	35%	65%
Ant Broads and Marshes catchment	50%	50%
Yare Broads and Marshes Tidal Yare/Chet catchment	67%	33%
Upstream Yare and Tas catchment	73%	27%
Bure Broads and Marshes catchment	25%	75%

Table 1. Main sources of phosphorus for key wildlife sites in the Broads. Source Environment Agency

Overall, national studies show that around 60-70% of phosphorus in surface waters comes from sewage treatment works, with around 18% of this originating from phosphate-base cleaning products (Defra, 2008).

However the retention of phosphorus from sewage is dependant on the treatment, individual package treatment retain less within the plant than larger sewage treatment works (STW), and STWs without nutrient stripping retains up to 35%, whereas a STW with nutrient stripping retains up to 90% and septic tanks tend to retain around 35% depending on the proximity to water courses and maintenance (EA data).

Other sources of phosphorus input have been considered, such as inputs from birds and the marine environment, however these were considered to be fairly local and minor (Halcrow, 2004)

The combined influence on the overall in-stream phosphorus concentrations of the inputs derived from agriculture, natural background loads, atmospheric deposition, upstream loads, septic tanks and minor point sources, on average account for 80% of the total load at the thirteen SSSIs studied (Halcrow, 2004).

Issue - Ochre

Ochre is produced from certain iron-rich soils within the Broads catchment. The rate of production is increased by land drainage. Ochre in water results in acidification, high levels of soluble iron as well as turbid water. The associated problems include

smothering of plants and animals, low light climate and toxic effects on invertebrates (such as dragonflies), fish and aquatic plants. In addition ochre in water looks unsightly, and can impact poorly on visitor experience.

Issue - Nitrogen

Nitrogen is present in all land, and is required by plants to grow. Agricultural systems use additional nitrogen fertilisers as well as phosphorus and potassium to promote crop growth. Some nitrogen may end up in ground or surface waters. Losses of nitrogen to water from agricultural systems are often mainly in the form of nitrate as it is extremely water soluble. It is estimated that about 60% of nitrate in waters in England originate from agricultural land, (Defra NVZ consultation 2007). There are no figures available on the contribution within the Broads or associated catchments from different sectors but projects (Upper Thurne catchment mass balance UEA PhD.) are underway to model these inputs.

To date, under the EU Nitrates Directive, England has designated certain Nitrate Vulnerable Zones (NVZ), which includes some of the Bure catchment, and a large area around the Thurne, the Trinities, the Yare and the Waveney. The areas designated as NVZs are likely to be expanded (in 2008) to include virtually all the Broads. The current NVZ regulations include a limit on the amount of nitrogen fertiliser that can be applied across a farm and a requirement that nitrogen fertiliser is applied only up to that required by the crop. There are also ‘closed periods’ where certain fertilisers cannot be applied to certain areas and various other restrictions on how and where nitrogen fertilisers are spread.

Nitrate pollution can also originate from a number of non-agricultural sources including sewage treatment works, industry and various diffuse sources (e.g. transport and urban drainage systems). However, significant investment by water companies in recent years has led to reductions in pollution from sewage treatment works particularly through the Urban Waste Water treatment Directive. One sewage treatment works in the Broads catchment affected by this directive is Diss which treats sewage from more than10,000 population and discharges into the River Waveney, designated as a nitrate sensitive area in 1997. Diss Works had to optimise the nitrate removal through the treatment process and give a minimum reduction of 53% total nitrogen as an annual average.

The quantity of nitrogen derived from sewage in the rivers is fairly constant throughout the year. In contrast, nitrate is lost from land mainly during winter and early spring – because this is when land is fully wetted, and drains flow. During the early part of the winter, nitrate concentrations in water draining from agricultural land are relatively high. The early winter period is the time when nitrate concentrations in surface waters are most likely to exceed 50 mg/l, and it is at this time of year that water from land dominates river flow. Defra have been identifying further appropriate mechanisms to tackle non-agricultural diffuse water pollution.

The waterways of Broadland show a strong seasonal pattern in nitrate concentrations with peaks in the winter months. Apart from the River Waveney, nitrate concentrations are below the Nitrate Directive limit of 50 mg/l NO_3 for the majority of the time (with occasional exceedences occurring in the winter). Over the past 25 years, nitrate concentrations have remained at similar levels at most sampling sites in the Broads with no obvious increase or decrease in concentration.

Issue - Contaminants

The main water pollutants recorded Environment Agency pollution incidents within the Broads catchment are sewage (46% from 2002-6 inclusive) and oil (27%).

Sewage pollution can arise from illegal septic tank discharges, sewage works producing inadequately treated sewage, wrong domestic pipework connections, consented intermittent overflows from combined sewers (where the foul system contains surface water during wet weather), or consented emergency sewer overflows from pumping stations.

Oil is a highly visible pollutant that affects the water environment in a number of ways. It can reduce levels of dissolved oxygen and taint drinking water supplies at very low concentrations, making them unsuitable for use.

From 2002 to 2006 inclusive (5 years) the Environment Agency became aware of 373 reported oil pollution incidents within the Broads' river whole catchments. 64% of these affected water. There are requirements under various regulations for many oil tanks to be protected, providing secondary containment to contain spillages. There are also industry standards, voluntary operating agreements and supply chain initiatives.

Contamination also has been recorded in the Broads from historic emissions that have left legacy issues for sediment quality in several areas. Most notable are the presence of mercury in the River Yare sediments downstream of Norwich derived from a chemical plant and the now banned antifoulant tributyltin (TBT) which is present predominantly in boatyard sediments and lakes close to boatyards. The environmental persistence of these pollutants has meant that they are still detectable but generally remain buried in undisturbed sediments. Depending on the level of contamination, and the subsequent usage of sediment dredged from these areas, these contaminants pose ongoing sediment management and disposal issues. Both contaminants have been found within Broads aquatic organisms and are known to be highly toxic. The residual risk posed to organisms from these compounds is unclear and further research into TBT is currently taking place.

Recent research into contamination issues in the Broads has included the presence of copper and organic biocides released from antifoulant paints used on boats and polycyclic aromatic hydrocarbons (PAH's) found in sediments. The latter are principally derived from the combustion of fossil fuels, such as in motor engines, as well as from oil and fuel spillages and historic power station sites. There appears to be wide variation in the distribution of PAH's in sediment across the Broads, the River Yare downstream of Norwich appears to be particularly affected most likely resulting from a power station, with some boatyards also relatively contaminated. The boatyards are also the main hotspots for the antifoulant contaminants, as expected from the density of boats in these areas.

Under the Water Framework Directive, priority and priority hazardous substances have been identified (such as mercury, PAH's and tributyltin) which have been shown to be of major concern for European Waters. Article 16(1) of the WFD requires that member states shall put in place measures to effect "the cessation or phasing-out of discharges, emissions and losses" of these priority hazardous substances. Preventing further inputs to the environment is particularly relevant for PAH's in the Broads as emissions from road traffic residues and boat engines are current. The EU approach to priority hazardous substances being lost to overlying water from contaminated sediments is as yet unclear, as specific Environmental Quality Standards (EQS) for sediment-bound contaminants are yet to be agreed.

Issue - Sediment

It is estimated that the Broads receive around 24,000 cubic metres of sediment, with the majority originating from headwaters (mainly agricultural land) and bank erosion, with the balance varying across time and space. (Wakelin and Kelly, 2007). Sediment

is also formed from algae and plants as they die and settle out. Consequently nutrient enrichment also exacerbates sediment accumulation. Algal inputs can locally and seasonally make up between 20-70% of the total sedimentation as recorded in the middle reaches of the Bure (Gray, 2006), where sediment accumulation rates have been recorded at 10-15mm per year within the lakes (Rose et al, 2005).

Sediment inputs can also carry high phosphorus which can provide a source or sink of nutrients in lakes (particularly when it comes from agricultural land), in addition to smothering open water habitats where it is deposited. In the Broads sediment input creates a serious nuisance and cost to boaters.

Issue - Flow problems

The Broads area has both surface water and groundwater resources. The main groundwater resource comes from the Chalk, which underlies most of the area, and the Crag which has a less extensive coverage. These major aquifers are overlain by varying thicknesses of sands and gravels, providing local water supplies. With over 800 abstraction licences the licensing and review process is carefully considered to ensure the needs of people, wildlife and recreation are met.

Within the Broads catchment the different river systems and associated groundwater units have been assigned low flow resource availability status's through the Broadland Rivers Catchment Abstraction Management Strategy (CAMS). There are various water availability status categories within this area;

- Over Abstracted (meaning that existing abstraction is causing unacceptable damage to the environment at low flows) catchments include Spixworth Beck, River Tas, River Dove, and the Upper and Lower Waveney.

- Over Licensed (meaning that if existing abstraction licences were used to their full allocation they could cause unacceptable environmental damage at low flows) catchments include the River Wensum, River Blackwater, Upper River Bure, River Tiffey and River Yare.

- No Water Available (meaning that no water is available for further licensing at low flows) catchments of Rievr Ant and Lower River Bure

- Water Available (meaning water is likely to be available at all flows including low flows) catchments of the River Chet and Confined Chalk.

It should be noted that for all these resource status's there may still be water available at high flows with appropriate restrictions.

The Broadland Rivers CAMS, published in March 2006, states that by implementing the CAMS strategy there will no Over Abstracted water resource management units by 2016. For further information on the Broadland Rivers CAMS and the licensing management strategies please see http://www.environment-agency.gov.uk/regions/anglian/1274735/314104/?version=1&lang=_e

As a competent authority, the Environment Agency must assess the possible effects of all permissions, including abstraction licences and discharge consents, on European Habitat Sites. They must also review the potential impacts of all existing permissions issued prior to the requirement for appropriate assessments by the Habitat Regulations (1994). This review covers all existing permissions and is known as the Review of Consents (RoC). European sites include Special Protection Areas

(SPAs) which are designated for their important bird populations and Special Areas of Conservation (SACs) designated for their habitats and other species.

Before any decisions on abstraction licences are made under the Habitat Regulations the Environment Agency will consult with licence holders to identify all options available that ensure these European sites are not adversely affected by permissions. The Environment Agency will then pursue the solutions which achieve the required environmental outcome but which are the least onerous on licence holders. Any solutions which require modifications to licences will be pursued through the Environment Agency's Restoring Sustainable Abstraction (RSA) programme. These modifications must be implemented as soon as practicable.

Issue – Invasive Non-native Species

Invasive non-native species are recognised as one of the most significant threats to biodiversity, and freshwater habitats such as the Broads, are particularly susceptible. Species such as Australian swamp stonecrop (*Crassula helmsii*), Himalyam Balsam (*Impatiens glandulifera*), Turkish crayfish (*Astacus leptodactylus*), Asian Clam (*Corbicula fluminea*) are becoming widespread in many parts of the Broads. In contrast, other species such as floating pennywort (*Hydrocotyle ranunculoides*) have been introduced more recently and further spread of these species is being considered as preventable in the early stages of infestation.

The impacts of invasive species depend on the species and the severity of the infestation and the sensitivity of the habitats or species affected. Australian swamp stonecrop, of example, may out-compete all native vegetation in certain ponds, but may exist with other vegetation in other situations. Zebra mussels (*Dreissena polymorpha*) may provide a useful function of filtering algae within lakes and providing food for wildfowl and fish, however they also alter substrates, out-compete native mussels and have the potential to alter foodwebs.

Experience in controlling invasions of problem species has indicated that eradication is difficult and that there is a risk of re-infestation from neighbouring sites or upstream sections if a strategic approach is not adopted. A Non-Native Species Management Forum for Norfolk, the first of two pilots in the UK, is being established to demonstrate the potential of such approaches and to serve as best practice examples. The Forum will initially coordinate awareness, eradication and surveillance of freshwater and riparian non-native species.

Issue - Physical Modifications

There are relatively few direct physical modifications to the majority of lakes, with the exception of routine sediment removal activity. However Broadland rivers and their floodplain have been hugely altered to constrain flooding, improve drainage and navigation. These modifications are necessary to protect life and livelihoods in the Broads. It is certain that ecological processes and species have, over time, adapted and changed as a result of these physical alterations. For example as rivers have become disconnected from flood plains the siltation budgets, fish habitat availability, saline incursion have all been altered.

It may not be desirable or possible to reverse physical modifications to the rivers and their banks, however as we continue to develop the Broads waterways, consideration of the impact of modifications on the water environment and the species it supports is required, alongside plans to mitigate any existing negative impact on the ecology need consideration.

An example of assessment and mitigation of impacts undertaken in the Broads includes that undertaken for the Broads Flood Alleviation Project. A hydrological

model helps to ensure that there is no negative impacts on water levels a result of the implementation of the Project which is undertaking essential work to maintain and set-back flood banks.

Issue – Climate Change and Saline Incursion
The combined effects of the sinking coastline, along-side predicted increased sea levels as temperatures increase in the Broads, is likely to result in further penetration of saline water into the Broads during surge tide events. Broads that are further downstream, and not protected by flood defences, such as Oulton, South Walsham, Malthouse and Ranworth are likely to be increasingly effected by more regular inundation of saline water.

The majority of the broads are largely freshwater, with the exception of the Upper Thurne Broads, which are made brackish by the penetration of salt water that is drawn in from the coastal aquifer in land drainage water. Repeated incursion of saline water can be damaging to freshwater plants, fish and invertebrates, however saline surges generally occur in the winter month when water plants are dormant as seed or vegetative material, thus recovery during the summer months is possible as freshwater conditions resume.

In addition, climate change is likely to result in more fluvial flooding events, warmer temperatures and periods of drought. These will have a variety of impacts on aquatic life, and it important to minimise any additional impacts and to help develop resilient ecosystems that can cope with these extreme events.

CONDITION ASSESSMENT OF SSSI BROADS

Waterbody name	Main habitat	Unit ID	Unit area (ha)	Condition	Latest assessment
Blackfleet Broad	Fen, marsh and swamp	1020161	1.56*	Favourable	31/05/2001
Buckenham	Standing open water and canals	1028706	2.23	Favourable	08/07/2004
Irstead Holmes	Standing open water and canals	1028679	0.44	Favourable	17/09/2004
Martham North	Standing open water and canals	1028699	8.56	Favourable	09/07/2004
Martham South	Standing open water and canals	1028700	8.27	Favourable	09/07/2004
Ranworth Flood	Standing open water and canals	1028688	3.72	Favourable	12/01/2006
Reedham Water	Standing open water and canals	1028682	4.04	Favourable	17/09/2004
Upton Great	Standing open water and canals	1028701	5.17	Favourable	08/07/2004
Alderfen	Standing open water and canals	1028677	5.37	Unfavourable recovering	08/07/2004
Catfield Broad	Standing open water and canals	1028680	1.25	Unfavourable recovering	17/09/2004
Cockshoot	Standing open water and canals	1028687	5.38	Unfavourable recovering	08/07/2004
Ormesby	Standing open water and canals	1028693	52.25	Unfavourable recovering	08/07/2004
Strumpshaw	Standing open water and canals	1028705	3.69	Unfavourable recovering	08/07/2004
Bargate	Standing open water and canals	1028703	5.18	Unfavourable no change	09/07/2004
Barnby Broad	Standing open water and canals	1009614	1.97	Unfavourable no change	29/07/2003
Barton	Standing open water and canals	1028678	71.26	Unfavourable no change	15/12/2005
Calthorpe Broad	Fen, marsh and swamp	1020045	1.01	Unfavourable no change	05/07/2006
Cromes	Standing open water and canals	1028681	4.22	Unfavourable no change	20/09/2006
Decoy	Standing open water and canals	1028683	9.07	Unfavourable no change	08/07/2004
Hassingham	Standing open water and canals	1028707	1.61	Unfavourable no change	22/03/2005
Heigham Sound	Standing open water and canals	1028696	33.18	Unfavourable no change	26/09/2006
Horsey	Standing open water and canals	1028698	36.32	Unfavourable no change	09/07/2004
Hoveton Great	Standing open water and canals	1028684	32.01	Unfavourable no change	08/07/2004
Hudson's Bay	Standing open water and canals	1028685	4.5	Unfavourable no change	08/07/2004
Lily	Standing open water and canals	1028692	8.2	Unfavourable no change	08/07/2004
Little Broad	Standing open water and canals	1028689	1.3	Unfavourable no change	08/07/2004
Ormesby Little & Filby	Standing open water and canals	1028694	77.95	Unfavourable no change	08/07/2004
Ranworth	Standing open water and canals	1028686	28.74	Unfavourable no change	10/03/2005
Rockland	Standing open water and canals	1004699	21.18	Unfavourable no change	31/08/2000
Rollesby	Standing open water and canals	1028695	26.25	Unfavourable no change	08/07/2004
Round Water	Standing open water and canals	1028708	0.09	Unfavourable no change	30/03/2005
Sprat's Water	Standing open water and canals	1028709	0.24	Unfavourable no change	30/03/2005
Surlingham Broad	Fen, marsh and swamp	1020403	5.24*	Unfavourable no change	26/09/2006
Upton Little	Standing open water and canals	1028702	1.17	Unfavourable no change	08/07/2004
Wheatfen	Standing open water and canals	1028704	3.99	Unfavourable no change	08/07/2004
Woolner's Carr	Standing open water and canals	1028710	0.1	Unfavourable no change	30/03/2005
Hardley Flood	Standing open water and canals	1028690	26.65	Unfavourable declining	08/07/2004
Hickling	Standing open water and canals	1028697	127.72	Unfavourable declining	12/01/2006

Total waterbody area (ha) = 631.08

* BA digitised area used as NE unit area includes surrounding swamp

Data extracted from the Natural England website on 30/11/07
http://www.english-nature.org.uk/Special/sssi/report.cfm?category=C,CF