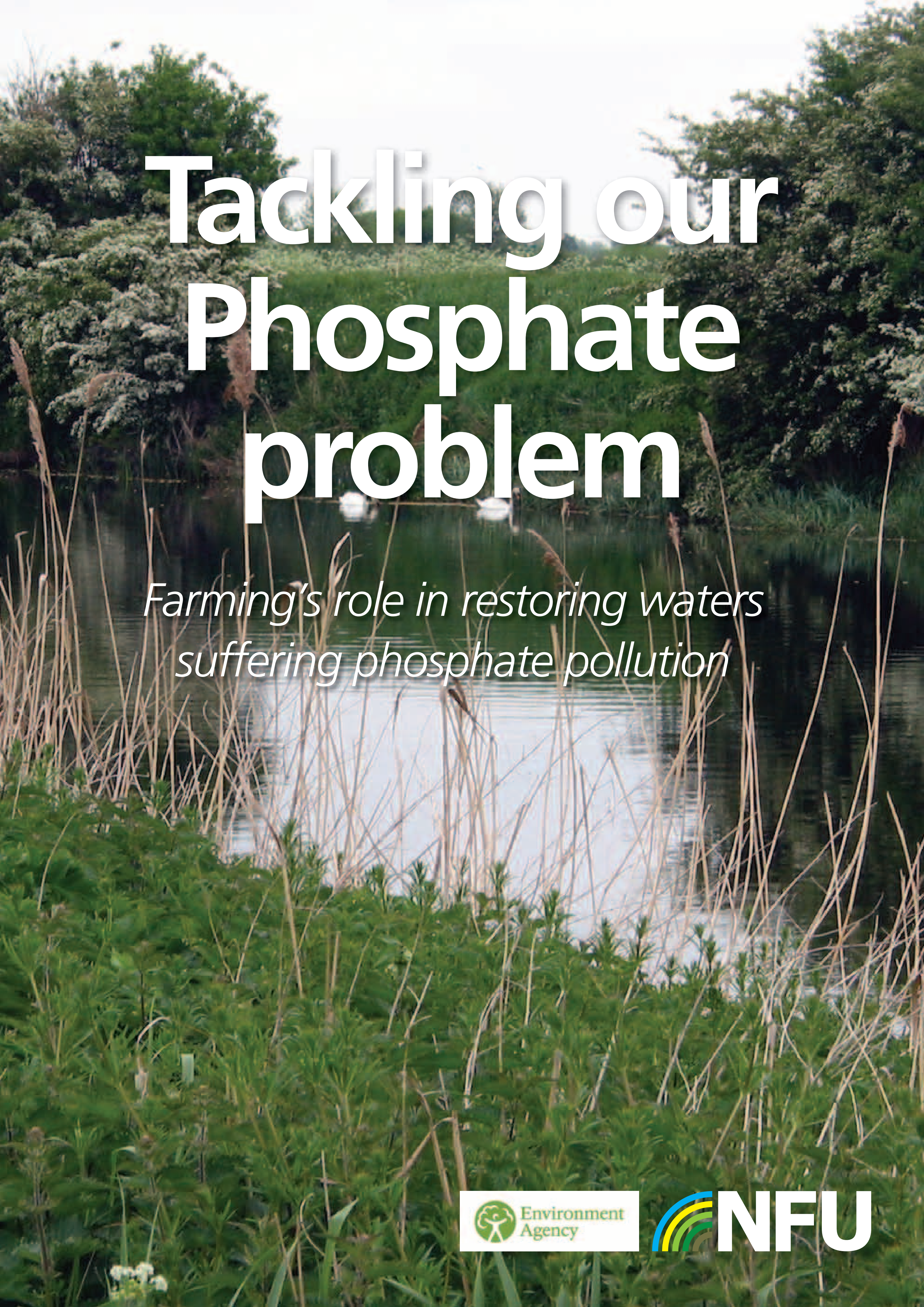
Tackling our Phosphate problem

Farming's role in restoring waters suffering phosphate pollution



Environment Agency

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Introduction

The role of farming in restoring waters suffering from phosphate restoration

The health and well-being of England's streams, rivers, and ground waters has always been a core business concern for its farmers and growers as well as an environmental one. Good quality water is a vital resource which farming has a responsibility to protect, both in its own interests and on behalf of society generally.

That is why, through the NFU, farmers and growers have been working with the Environment Agency on a project in the Anglian region to cut the levels of one particularly damaging pollutant going into watercourses – phosphate – a significant proportion of which comes from farmland.

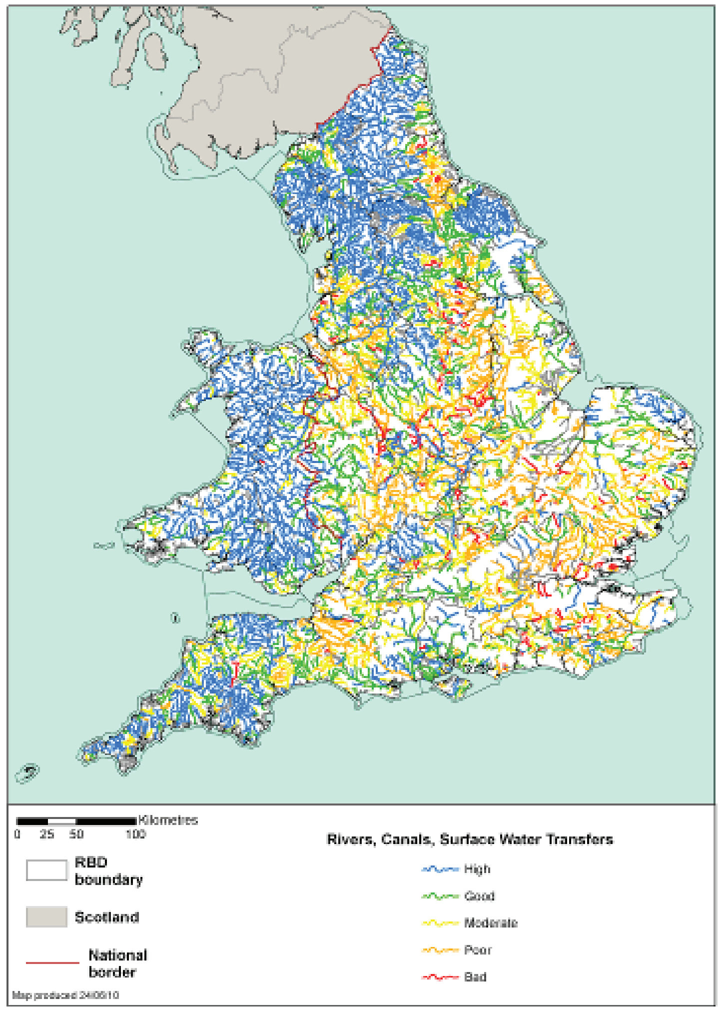
Raised levels of phosphate going into lakes and rivers can trigger the growth of algae and larger plants in a process called 'eutrophication'. This can lead to severe drops in dissolved oxygen levels with major impacts on fish and other wildlife, and damages the biodiversity of our streams, rivers and lakes.

Although phosphate levels in our streams and rivers are improving, there is a long way to go. In 1990 about 70% of all English rivers (by length) had a 'high' (greater than 0.10mg per litre) phosphate concentration; by 2008 this figure had reduced to 50% (*see Figure 1 State of rivers*).

It's a legal requirement

To achieve phosphate levels needed to meet new European legislation, which comes into force in 2015, it is vital that that we introduce more effective measures to control all sources of phosphate reaching our rivers and streams.

This is why the Environment Agency and the NFU have agreed to take new steps, working in partnership, to understand and reduce phosphate coming from farming operations.



We use the term 'phosphate' in this report to mean all forms of phosphorus (the chemical) which is found in manures, slurries and fertilisers.

Figure 1 - Phosphate Pollution in Rivers

So what is the Anglian River Basin Phosphate Project?

The project is a joint initiative between the Environment Agency and the NFU, to develop a more effective, voluntary framework for farmers to reduce phosphate emissions alongside reductions from other sources, like sewage treatment works and septic tanks. Our organisations have done this by establishing and agreeing the evidence for the sources, effects, and control measures for phosphate pollution from agricultural sources and starting action with farmers and advisers in two carefully-selected pilot catchment areas within the Anglian region.

From a farmer's perspective, a hands-on approach to this project from its inception is vital to establish practical, proportionate and cost-effective farm management solutions.

The project's findings will not only provide the evidence for phosphate sources, effects, and control measures for the pilot catchment areas and the wider Anglian River Basin District, but will also be fed into future national voluntary control measures for farmers.

Controlling Phosphate – farming measures at a glance

1. Manage your nutrients by planning fertiliser and manure applications and applying only what the crop needs in the right conditions
2. Manage your soils by testing soils every 3-5years for pH and nutrients, avoid soil compaction during and after harvest and take steps to reduce run-off.
3. Only spread industrial wastes or sewage sludge where it is beneficial to soils.
4. Manage your livestock: minimise access to watercourses by providing alternative water supplies and adjust stocking levels to reduce the risk of run-off to watercourses.
5. Use buffer strips to intercept run-off alongside watercourses

Why focus on Anglian Region?

The Anglian River Basin was chosen because groundwater in the region shows some of the highest phosphate concentrations in the UK – above 0.12 mg per litre in some areas. Indeed phosphate is a reason for half the failures to achieve WFD 'Good' status in the region's rivers (381 out of a total of 757).

This can be partly attributed to the productivity of arable farming in the region as well as population pressure and low rainfall. The impact of phosphate from all sources, including agricultural land, on river concentrations is highly dependent on the amount of rainfall and its dilution potential.

The Environment Agency and NFU needed to agree on the precise role agriculture plays in eutrophication – and, in the first phase of the project, have published a report[1] reviewing all the available evidence on sources of phosphate, how it gets into rivers and streams, the resulting ecological impacts and the likely cost-effectiveness of control measures.

The next phase and the cornerstone of the initiative is to enlist the help of farmers within two catchment areas of the Anglian River Basin – **Harpers Brook** in Northamptonshire and **Bourn Brook** in Cambridgeshire. The evidence gathered in the first phase of the project has been used to identify the nature of the phosphate pollution on a farm-by-farm basis in these catchments and so help the farmers modify current management practices to deliver improvements in river phosphate concentrations. The project is also monitoring – over a four or five year period – any corresponding movements in phosphate levels, so farmers and advisers in the pilot areas can receive 'real time' feedback.

Where's the phosphate coming from?

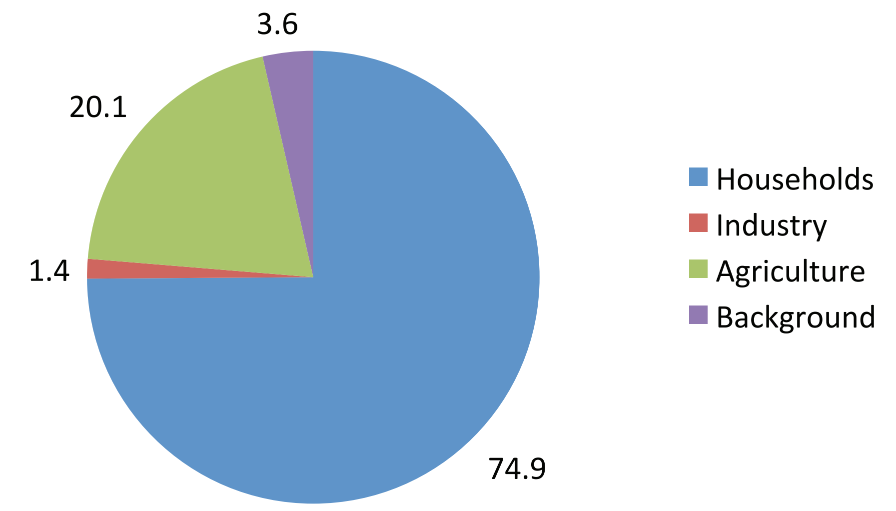
The study has shown that there is a low natural 'background' level of P being released from natural sources (less than around 5% of the total) which is caused by atmospheric deposition, soil weathering, river bank erosion, riparian vegetation and migratory fish returning to spawning grounds.

But the bulk of phosphate going into our rivers and streams nowadays is a direct result of human activity. The pie charts illustrate farming's relative contribution and provides a breakdown between farming activities.

1 Review of phosphorus pollution in the Anglian River Basin District **http://publications.environment-agency.gov.uk/PDF/SCHO0512BUWF-E-E.pdf**

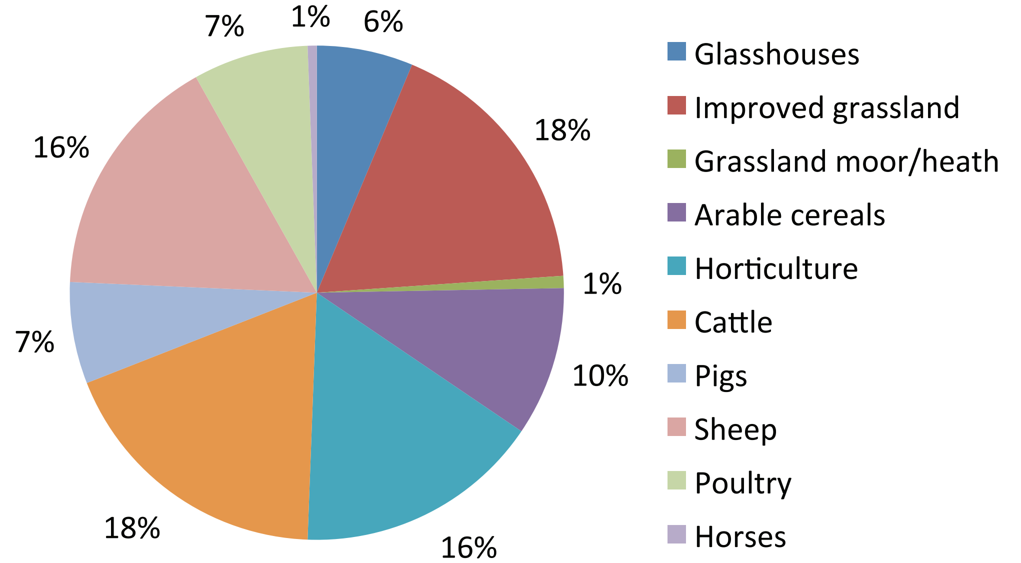
Where's the phosphate coming from?

Total Phosphorus loads from agricultural, household, industrial and background sources to the waters of England and Wales



White, P.J. and Hammond, J.P. 2009. The sources of phosphorus in the waters of Great Britain. Journal of Environmental Quality, 38, 13-26.

Percentages of total phosphorus loads in England & Wales from agricultural sources

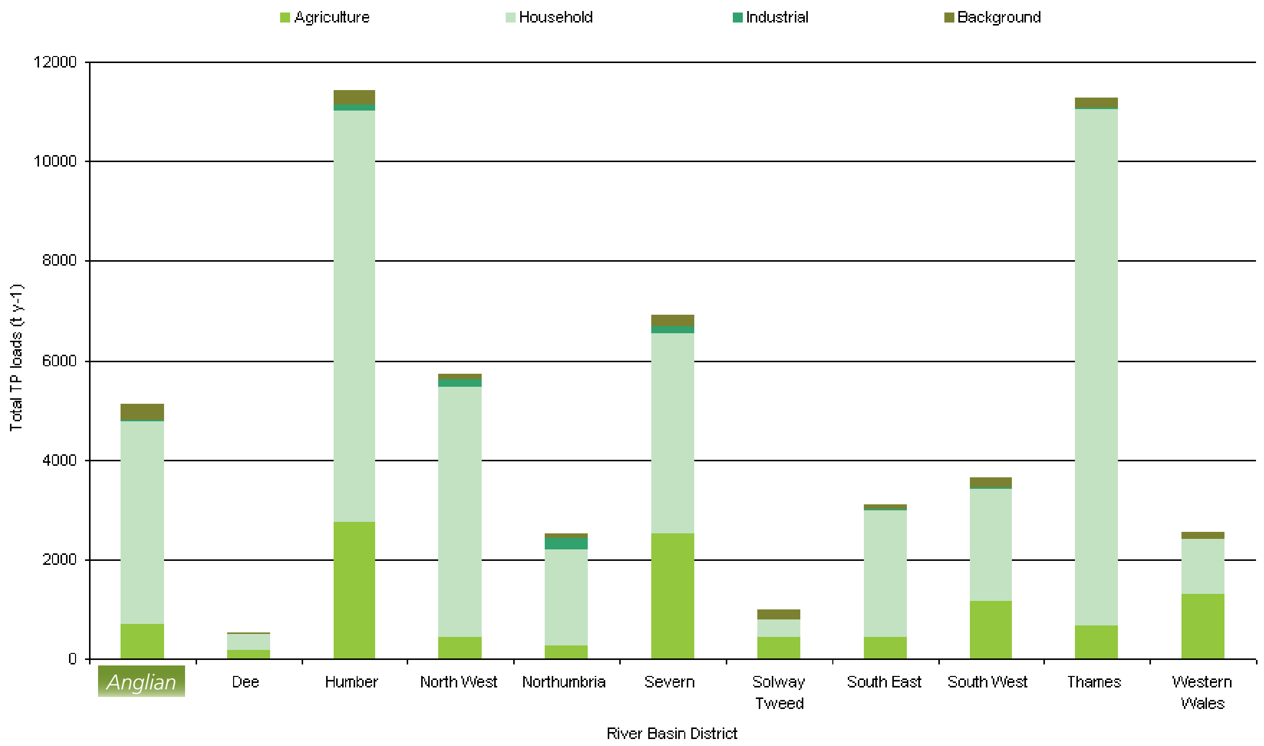


White, P.J. and Hammond, J.P. 2009. The sources of phosphorus in the waters of Great Britain. Journal of Environmental Quality, 38, 13-26.

A key source of phosphate in our rivers and streams is Sewage Treatment Works (STW). The UK water industry treats 40 million tonnes of domestic sewage every year. This contains around 45,000 tonnes of phosphate sourced 70% from human wastes, food additives and food wastes, 16% from detergents and 6% from tap water dosing, plus other minor contributions. And with population growth seen during the last decade we have seen an extra 173 tonnes of phosphate in sewage every year.

Nationally industrial and household sources contribute the bulk of the phosphate going into our rivers and streams – between 65-76% of phosphate in rivers in England and Wales – consequently Water Companies are investing billions over the next decade to reduce these levels. But farming's contribution can be regionally significant *(see chart below).*

Total Phosphate loads from agricultural, household, industrial and background sources to the River Basin Districts of England and Wales



White, P.J. and Hammond, J.P. 2009. The sources of Phosphorus in the waters of Great Britain. Journal of Environmental Quality, 38, 13-26

So why the focus on farming?

There is strong scientific evidence, confirmed in this project's survey of all relevant studies, that agriculture is also a significant source of the phosphate loading in rivers, groundwaters and streams. Estimates suggest that up to a quarter of the phosphate load to surface waters comes from farming sources.

The size and impact of phosphate emissions from farming into our watercourses is complex, and variable from place to place. They are influenced by a range of factors such as climate, topography, soil type, inputs, stores, land management as well as the longer term structural changes in farming since the Second World War.

Farming's precise phosphate contribution is being studied. Scientists continue to debate the relative contribution of 'point' sources and 'diffuse' sources of phosphate to the amount of phosphate getting into our rivers. This is an important debate because, it determines the amount of phosphate which can be directly attributable to farms and farming activities, and therefore the scale of activity needed to address it.

'Point' sources include direct discharges such as those from Sewage Treatment Works, whereas agricultural and other rural sources such as septic tanks are termed 'diffuse' as they are spread widely throughout the catchment area.

There is a general scientific consensus that phosphate in sewage effluent (where phosphate reduction is not in place) poses a greater risk to eutrophication than agricultural sources because more of the phosphate is in a soluble form easily taken up by plants. Phosphate from farms and farmland is generally less soluble – attached to soil particles – and thereby not readily available to aquatic plants.

However, phosphate from farming is largely delivered to watercourses during rainfall events, and is often flushed out of the river system, or lost at times of the year when there is little plant growth.

The Phosphate surplus

Long term structural changes in farming in order to meet the food needs of a growing population have left a surplus of phosphate in our soil. This is a result of a combination of factors *(see table 1 below).*

Table 1 -Building the phosphate surplus
A move away from mixed farming to specialised arable and livestock systems which are geographically separated.
A reliance on substantial inputs of water soluble phosphate fertilisers and concentrated feeds as farming systems have intensified.
A switch to continuous cultivation on vulnerable soils (including marginal land) and introduction of tramlines
The removal of hedgerows which increase the length of slope for soil erosion
Increased stocking densities and adoption of slurry-based manure recycling
The expansion of field underdrainage to remove soil waterlogging.

The scale of an annual phosphate 'surplus' on farmland is very important because it can present an increased risk of run-off that can be lost into watercourses – literally the higher the concentration of phosphate in soil the more 'leaky' that soil becomes.

The second factor is the interplay between any 'surplus' and land-use patterns and farming practices that increase the vulnerability of land to runoff, erosion and enrichment of runoff with recently-applied or deposited phosphate. In other words, a small surplus managed badly may lead to a much greater pollution problem than a large surplus managed well.

The good news on managing phosphate is that, thanks to advances in fertilising practice which has reduced phosphate fertiliser use on arable and managed grassland in recent years, annual surpluses are now lower than in 1935. That is a result of a number of factors – notably the rise in farmer and adviser awareness of the environmental and business benefits of more targeted fertiliser application. However the phosphate which has built up in the soil – the stored or cumulative surplus – is still 12 million tonnes and will continue to increase while a phosphate surplus exists.

Farmers can make a difference

Working with farmers in the Anglian region, the EA/NFU's Phosphate Project is aiming to demonstrate that voluntary farm management changes will deliver the necessary reduction in phosphate losses from farms.

The prospects for a positive outcome from farm management changes are good. The results of the Catchment Sensitive Farming delivery project (CSF) have shown that improvements in management practices will result in significant reductions in pollutant losses - generally between five and ten per cent, but reductions of up to 36% in some areas.

During the project farmers in each of the catchments will work with local advisers from FWAG East and their own professional agronomists to adopt actions that are known to reduce phosphate run-off, such as those identified by a comparative study carried out by Anthony (2009) which reviewed the reductions from different types of farm management changes across England and Wales *(see table 2 below).*

Method	Tackling phosphate source, pathway or receiving water	Per cent reduction
Avoid slurry spreading in high risk periods	Source	4.0
Balancing fertiliser and manure nutrient supply	Source	2.9
Use fertiliser recommendation system	Source	2.9
Reduce tillage	Pathway	2.1
Avoid spreading fertiliser in high risk periods	Pathway	0.9
Use improved genetic resources in livestock	Source	0.7
All methods used simultaneously		**12.9**

Table 2 Calculated percentage reduction in national phosphate losses from implementation of selected mitigation methods (after Anthony 2009)

Farmers in the catchment will also undertake soil sampling and use handheld meters to measure phosphate concentrations in drainage water leaving their land and in drainage ditches.

The lesson from this study is that small changes to farm management can cut the amount of phosphate runoff from the farm – and at minimal cost or, indeed, cost savings, for the farmer. And a number of these measures running concurrently can cut the phosphate emissions substantially.

How were the Pilot Catchments chosen?

The Environment Agency working with the NFU regional offices in Uppingham and Newmarket used a two-stage screening process to select the two pilot catchment areas from within the Anglian region. Firstly catchments were selected if they:

- were not included in existing measures to tackle diffuse phosphorus pollution, for example Catchment Sensitive Farming.
- failed to achieve WFD 'Good' status only for phosphorus.

That process produced a total of 75 water bodies. These were then filtered through another range of requirements – including the need for contrasting soil types and farm systems. And in order to engage farmers, the EA were looking for areas where there was deemed to be a relatively high P input into rivers from agricultural sources. Eventually, the Harpers Brook and Bourn Brook catchments were chosen.

Harpers Brook is located in the River Nene catchment in the northern area of the Anglian River Basin and the catchment is characterised under the Water Framework Directive as being small, low lying and calcareous (lime-rich), with high alkalinity. It is in a Nitrate Vulnerable Zone.

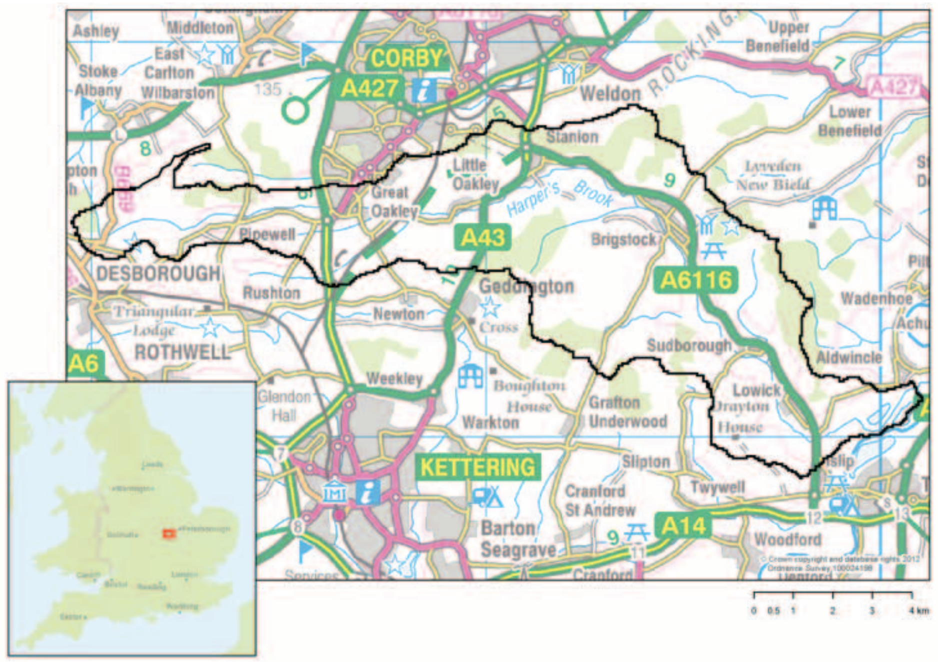
The soils in the catchment are dominated by clay with an area of deep loam in the centre of the catchment. Soil P levels are not high. The geology is a complex mixture of mudstone at the head and bottom of the catchment with limestone dominating the centre alongside small amounts of sandstone and clay.

Harpers Brook itself only fails to meet P standards by a small margin, and models suggest an agricultural P input of 37% of the total.

Agricultural land use in the catchment is dominated by arable farming with mostly cereal crops, oilseed rape and beans. There are only a few livestock farms in the catchment. Dairy farming has been extensive in the past. Only small amounts of manure are recycled.

Most fields in the river corridor are cultivated with tramlines running both across the slope and down the slope. Minimal cultivation is widely practised. Riparian buffer strips varying from 2-20m wide are widespread – although they are mostly 6 metres wide.

Walkovers revealed that the dominant pathway of phosphate loss from fields in the catchment was via land drains – especially during heavy rains in the autumn. Agriculture is not considered to be the main source of phosphate to the brook although the field walk revealed some 'high risk' farming activity.



Charles farms 1200 acres at Manor Farm, Little Oakley as part of a joint venture/machinery sharing enterprise. His arable cropping is on a wheat/rape/spring beans rotation. He farms 100 sheep and 100 beef cattle.

Corby farmer Charles Frost is convinced that local farmers can make a real difference to the amount of phosphate getting into the Nene tributary, the Harpers Brook, which is the catchment chosen in the west of the Anglian River Basin project area.

As his farm is in the centre of the catchment, and he is chairman of the East Northants local branch of the NFU, Charles feels a responsibility to get a good response from the farming community.

> “ 'I think that this phosphate problem is something we as an industry all need to be seriously looking at. I'm very happy to be taking part in the project, and encouraging others to join in, because I feel that if we don't act ourselves we will eventually have more legislation imposed on us.
> 'It's early days yet for the project– we haven't been told what sort of measures we need to introduce to try and control phosphate levels. I have a FWAG adviser coming to see me soon to develop a strategy for our farm.' ”

He says local farmers are already showing a lot of interest in the scheme and what it is trying to achieve.

'But I think it's pretty important, from a farm business point of view, that the changes we make to our management have no cost attached. I think that if we can achieve something with this voluntary cost-conscious approach, more farmers will be encouraged to adopt the measures as a matter of course.

'I already consider myself to be very environmentally conscious in the way I farm – particularly in relation to the watercourses. I'm in the Entry Level stewardship scheme - so we already have six to 10 metre buffer strips next to the brook – and we adhere to the LERAP scheme to protect watercourses when we spray.

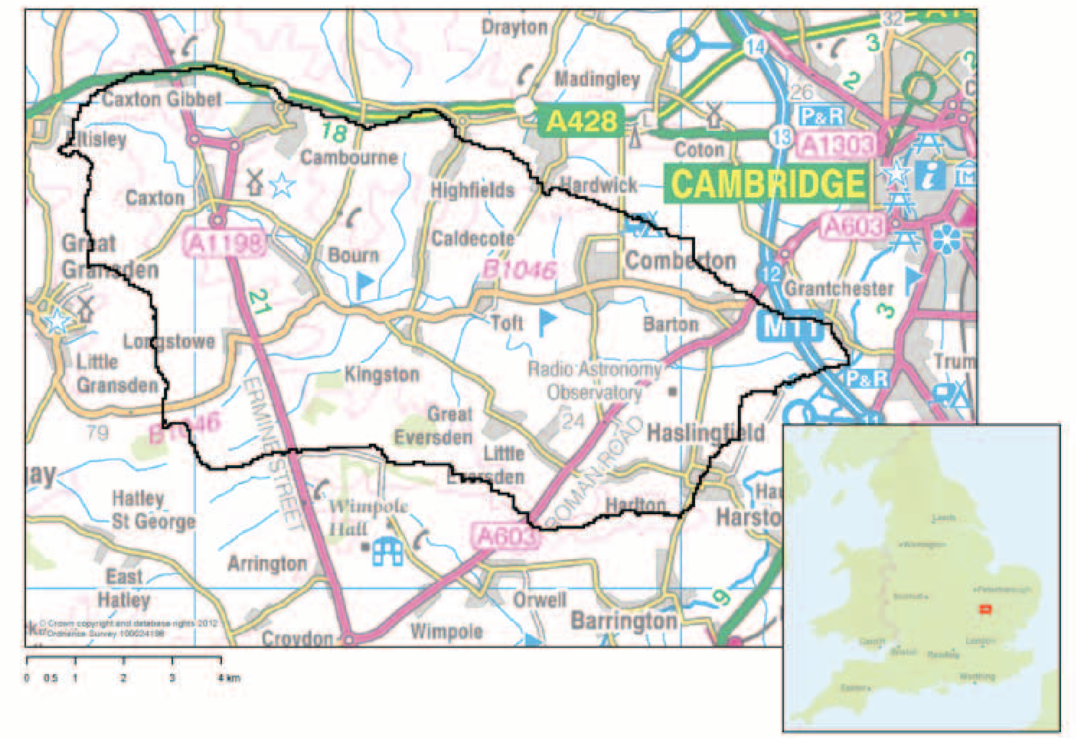
As part of the project, Charles has already joined ten other farmers in the catchment who are monitoring the water running from his field drains to assess the P levels. They will be doing this sampling for ten weeks.

Bourn Brook is located in the Cam and Ely Ouse catchment in the central area of the Anglian River Basin. It flows into the River Cam and like Harpers Brook is a hydrologically discrete headwater body which has high alkalinity and defined as 'small, low-lying and calcareous'.

Soils in the catchment are predominantly clay, with some small areas of shallow silt and with some suggestions of sand outcrops. The catchment is underlain by clay bedrock, with some areas of sandstone in the upper Bourn, and some chalk in the Lower Bourn.

Phosphate levels in the river are significantly higher than the required WFD standard – and with a third of the P estimated to be coming from agricultural sources. The catchment is within a Nitrate Vulnerable Zone and designated as a protected area under the Freshwater Fish Directive. Land use in the Upper Bourn catchment has historically been dominated by arable production, mostly cereal crops, set-aside land and permanent grass, with some small areas of other crops such as beans and potatoes. There is little livestock farming, although there are some pig units in the upper part of the catchment.

Walkovers revealed that the majority of fields were minimally cultivated, tramlines occurred both across slope and down slope, and with 6-metre riparian strips. Most P fertiliser in the area was incorporated before drilling rather than being top-dressed.



Tim farms 700 acres in a crop rotation of winter crops - wheat, barley rape and linseed -together with spring barley and wheat. He is a tenant of The Countryside Restoration Trust, which owns the land fronting Bourn Brook.Tim Scott is no new convert to the concept of environmentally-sensitive farming.

'As a tenant of the Countryside Restoration Trust, I've always been a bit of a 'green' when it comes to farming' he says. 'Our whole farming focus for the past twenty years has been on maintaining a margin by forcing down the inputs rather than going for the maximum output approach. It's just so much better for the environment.'

Part of that strategy is the farm's focus on spring crops. This not only ensures the improvement of soil structure through reduced autumn work on the land but also less inputs.

Tim's farm has more than three miles of Bourn Brook frontage and he intends to be closely involved in the pilot catchment project – although his farm is just downstream of the P monitoring area.

Tim thinks his frontage to the brook is already reasonably well protected. It has been a long term farm policy to gradually reinstate water meadows – permanent pasture – alongside the brook.

“This works as a natural sponge. So while we are already working with reduced inputs, there is also a good chance that a good percentage of what we do put on the land is retained in the water meadows rather than going into the brook.

As Cambridge NFU local branch chairman, Tim is convinced that local farmers will rise to the challenge.

'I think there's a lot we can do, and with little actual cost, to get this agricultural P problem sorted out – and in the ways that can fit in with our farming systems without too much upheaval and cost. This pilot project is a very important piece of work for all of us.”