

# Observatory monitoring framework – indicator data sheet

## Environmental impact: Water

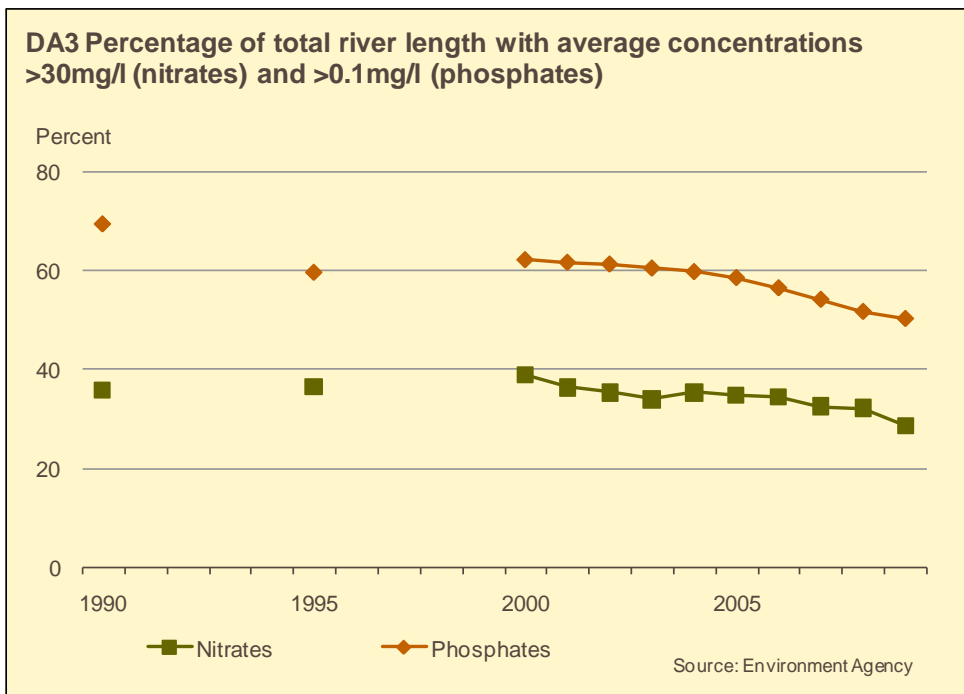
### Indicator DA3: Nitrate and phosphate levels in rivers

The EU Water Framework Directive has resulted in the need to change the way in which surface water quality is monitored and reported. It is not currently possible to produce an indicator of water quality that is consistent across the countries of the UK or provides a long-term indicator of change. Defra, the Environment Agency for England and Wales, the Scottish Environment Protection Agency and the Department of the Environment for Northern Ireland are considering reporting options and methodologies. This indicator will be updated once a new methodology has been established. Further details can be found on the accompanying fact sheet.

This indicator shows the levels of phosphate (as phosphorus, P) and nitrate ( $\text{NO}_3$ ), from all sources, in river water in England. 59% of nitrates and 26% of phosphates in English waters are of agricultural origin. Changes in cropping practices or livestock types, numbers or management as a result of CAP reform could impact on nutrients leaching to water although the impact of other initiatives (eg Nitrate Vulnerable Zones, Water Framework Directive) also needs to be taken into account.

Chart DA3 shows the lengths of rivers with nitrate levels over 30 mg  $\text{NO}_3$  per litre, and phosphate (as phosphorus) levels over 0.1 mg P per litre. The nitrate limit very roughly corresponds with a 95 percentile limit of 50mg/l used in the EC Nitrates Directive and the EC Drinking Water Directive. Government guidance recommends that rivers should not exceed annual mean phosphate concentrations of 0.1mg per litre.

The General Quality Assessment (GQA) reporting for river water quality ended in 2009.



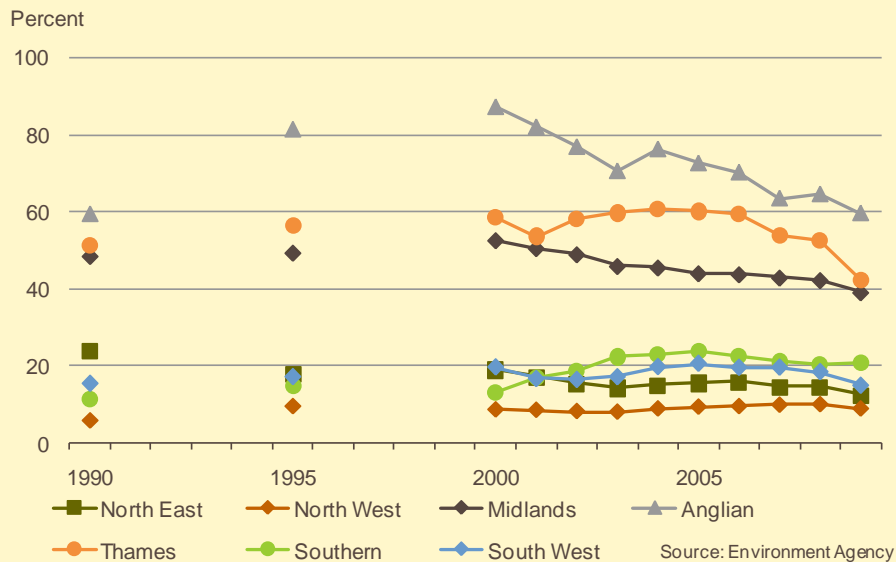
- Since 2000 nitrate levels have gradually fallen from 39% of river lengths exceeded 30 mg  $\text{NO}_3$  per litre to 29% in 2009.
- Since 2000 phosphate levels have gradually fallen from 62% of river lengths exceeding 0.1 mg P per litre to 50% in 2009.

## Regional data

The proportions of rivers exceeding aforementioned levels in rivers within English Environment Agency regions can be seen in Charts DA3a and DA3b.

Different natural conditions exist in different parts of England. For example, nutrient concentrations are naturally greater in East Anglia than in the uplands.

**DA3a Percentage of total river length with average nitrate concentrations >30mg/l**



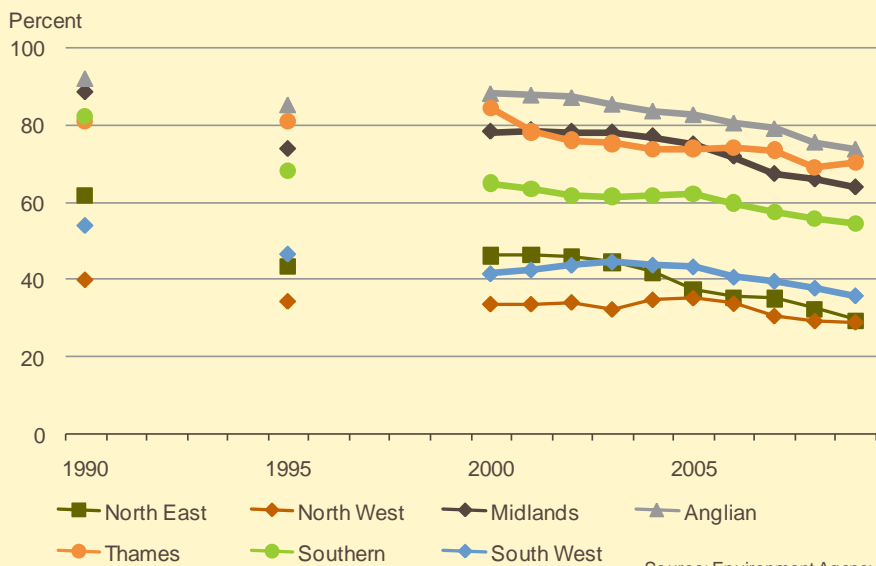
Since 2000, there have been overall reductions in most regions. However, in the Southern region the proportion of river length exceeding 30mg/l of nitrates increased somewhat between 2000 and 2005. Although this has since reduced the proportion remains above 2000 levels.

The Anglian region continues to have the greatest proportion of river length exceeding 30mg/l of nitrates.

The proportion of rivers exceeding 0.1mg/l of phosphorus has declined in all regions between 2000 and 2009.

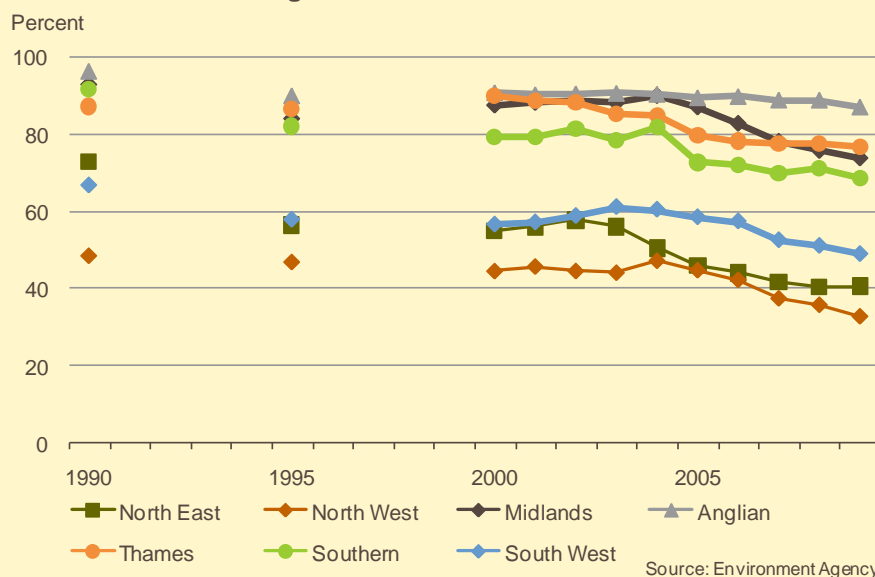
The greatest reductions have been in the North East, Midland, Anglian and Thames regions.

**DA3b Percentage of total river length with average phosphate concentrations >0.1mg/l**



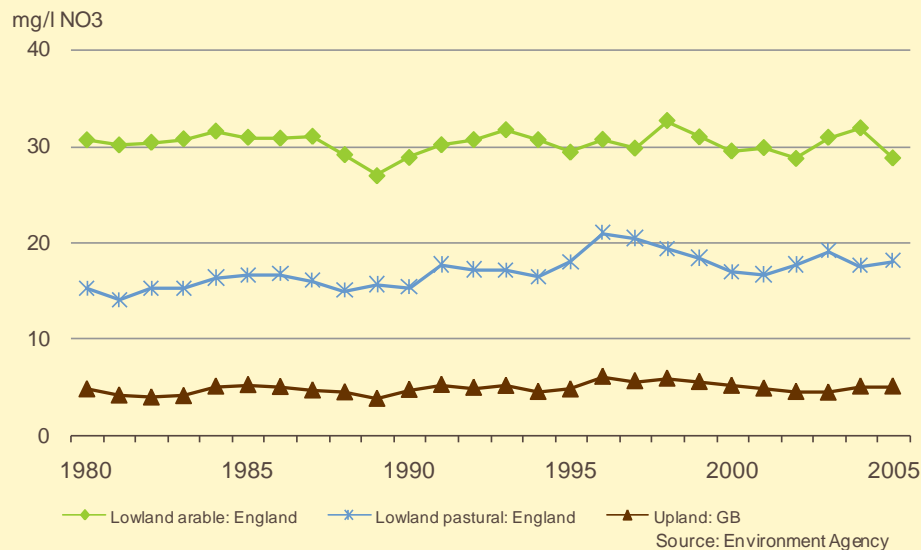
The picture changes very slightly if we consider the lower limit of 0.06 mg/l.

**DA3bi Percentage of total river length with average phosphate concentrations >0.06mg/l**



The charts below show average concentrations of N and P in watercourses flowing through different landscape types. Data for lowland arable and pastoral landscapes are available for England but are only available for upland landscapes for Great Britain. Values for lowland England were considerably higher than for Great Britain as a whole for both types of landscape for both N and P. The data can be found in the accompanying datasheet.

**DA3ci Annual average concentrations of nitrates by landscape type**

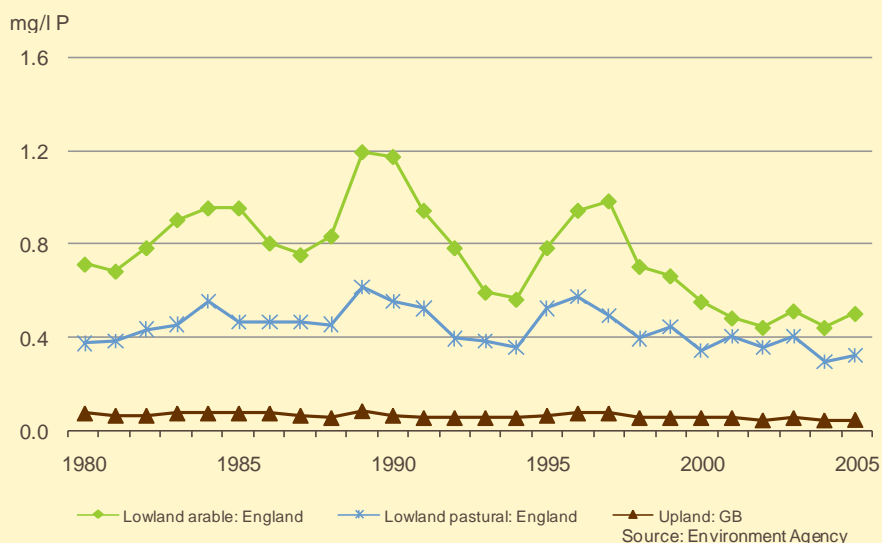


- Average nitrate levels in watercourses in English arable landscapes were around twice those in pastoral landscapes.
- Levels of nitrate loss from the uplands are much lower than from the lowlands and concentrations have remained consistently at around 5mg/l.

Nitrate remaining in the soil or arising from decomposition of crop residues is lost from arable fields in autumn and winter when rainfall is high and crops are absent or growing slowly and unable to take up surplus nitrogen. In fields under grassland, more of the nitrogen is retained in organic matter, but leaching still occurs where soil N levels are high.

- Levels of phosphate in water have fluctuated much more than nitrates in lowland landscapes. However the general trend has been downwards.
- In English lowland pastoral landscapes, average concentrations declined.
- In upland areas in GB average concentrations remained level.

**DA3cii Annual average concentrations of orthophosphates by landscape type**



This indicator was updated in September 2010. This indicator will be updated once a new methodology has been established.

#### *Further information and contact*

Background information can be found in the accompanying fact sheet.

This is also a Biodiversity Strategy indicator.

For further queries or information on this indicator contact Defra's Observatory team on +44 (0) 1904 455229 or email [Observatory@defra.gsi.gov.uk](mailto:Observatory@defra.gsi.gov.uk)

## Observatory monitoring framework – indicator fact sheet

### Environmental impact: Water

#### Indicator DA3: Nitrate and phosphate levels in rivers

<i>Indicator</i>	Nitrate (NO <sub>3</sub> ) and phosphate (as phosphorus, P) levels in river water
<i>Data</i>	<p>% of rivers with NO<sub>3</sub> levels greater than 30mg/l and P levels greater than 0.1 mg/l. (General Quality Assessment)</p> <p>Annual average concentrations of nitrates and orthophosphates by landscape type. (Harmonised monitoring scheme)</p>
<i>Geographic coverage</i>	<p>England (General Quality Assessment)</p> <p>England and GB (Harmonised monitoring scheme)</p>
<i>Years</i>	<p>1990, 1995 and 2000-2009 (NO<sub>3</sub> &amp; P) (General Quality Assessment)</p> <p>1980-2005 (Harmonised monitoring scheme)</p>
<i>Source</i>	Environment Agency
<i>Origin of data</i>	Environment Agency, Defra eDigest of Environmental Statistics
<i>Updates</i>	This indicator will be updated each year. This indicator will be updated once a new methodology has been established.
<i>Background</i>	<p>Emissions to water come from a number of sources. However, 59% of nitrates (ADAS, 2007) and 26% of phosphates (White and Hammond, 2006) in English waters are of agricultural origin. Sewage treatment works are also a source of phosphates, although improvements have reduced pollution from this source in recent years. Nitrates are highly soluble, and can be lost to water through runoff and leaching. The major source of nitrates in water is organic nitrogen, rather than directly from nitrogen applied as inorganic fertilisers. Phosphates are less soluble, but can enter watercourses bound to soil particles lost through soil erosion.</p> <p>An increase in nutrient (particularly phosphorus) concentrations can result in vigorous and excessive growth of algae which can reduce light penetration below the water's surface and lead to the death of submerged plants. The decomposition of this dead material can, in turn, reduce the oxygen concentration and ultimately the river can become unsuitable for species that require ample daylight and oxygenated water, such as dragonflies and fish. This process is known as eutrophication.</p> <p>Nitrate levels are also a concern in both surface and ground waters used to supply drinking water, because of possible effects on human health. The General Quality Assessment (GQA) adopts an average of 30mg/l to indicate "high" nitrate concentrations to allow for a better comparison of regional differences and monitoring of trends. This limit very roughly corresponds with a 95 percentile limit of 50mg/l used in the EC Nitrates Directive and the EC Drinking Water Directive. However, lowland rivers can support diverse wildlife that is tolerant of natural concentrations of 10-40mg/l.</p> <p>Government guidance recommends that rivers should not exceed annual mean phosphate concentrations of 0.1mg per litre. The thresholds used in this indicator provide a general indication of water quality with respect to nutrients. However, this</p>

phosphate concentration does not offer protection to oligotrophic (low nutrient and high dissolved oxygen concentrations) or mesotrophic (medium concentration of nutrients) rivers, where 0.02-0.06 mg/l is proposed by Natural England.

Data on the proportions of rivers averaging various levels of nitrates and phosphates (both above and below those used here) can be found on the Environment Agency website. A link can be found below.

Changes in cropping practices or livestock types, numbers or management as a result of CAP reform could impact on nutrients leaching to water, although the impact of other initiatives also needs to be taken into account. The 1991 Nitrates Directive aims to protect surface and ground waters against pollution caused by nitrates from agricultural sources. From 1 January 2009, the areas covered by Nitrate Vulnerable Zones (NVZs) were increased to approximately 70% of England. The Directive requires that within NVZs, farmers must follow 'Action Programmes' to decrease nitrate loss to waters within those zones. NVZs are one of the measures currently in place for tackling diffuse water pollution.

The Water Framework Directive (WFD) is a vital piece of European legislation designed to integrate the way we manage water bodies across Europe. The WFD aims to protect and enhance our water environment, promote sustainable water consumption, reduce water pollution and lessen the effects of floods and droughts. The WFD updates all existing European legislation and promotes a new approach to water management through river basin planning.

*Statistical &  
methodological  
information*

General Quality Assessment

The data collected over three years are used to determine average nutrient concentrations. All the results collected over the three years are included. No extreme data values are excluded. To avoid bias, only results from routine, pre-planned sampling programmes are included. Extra data collected for special surveys or in response to pollution incidents are not included.

A grade from 1 to 6 is allocated for both phosphate and nitrate. These are not combined into a single nutrients grade. In this respect it differs from the chemical and aesthetic classifications which combine factors into a single grade. This cannot be done for nutrients. There are no set 'good' or 'bad' concentrations for nutrients in rivers in the way that chemical and biological quality are described. Rivers in different parts of the country have naturally different concentrations of nutrients. 'Very low' nutrient concentrations, for example, are not necessarily good or bad; the classifications merely states that concentrations in this river are very low relative to other rivers.

Measures of water quality have been reviewed as part of the implementation of the EU Water Framework Directive (WFD). New monitoring procedures ( a 'river basin' monitoring approach) were implemented in 2008; the results are significantly different from the GQA results presented here.

The main differences are:

Under the WFD river basin monitoring approach, the way in which the sample of rivers used is selected has changed, since the sample needs to ensure adequate representation across all river basin districts. Further analysis is required to establish whether robust estimates can be made for Government Office Regions – however, if this is the case, at the same time it should improve our ability to report results by river basin district.

The actual monitoring process has also changed, with the separating out of what will be called "surveillance" monitoring and "operational" monitoring. The former will effectively be the ongoing monitoring at agreed sites, and it will be this which will form the basis of the reported results. In addition, "operational" monitoring will be carried out at sites

identified as warranting closer and more frequent monitoring.

The assessment used under the WFD is called “Good Ecological Status” (GES). GES monitoring is risk based and focuses on where there is likely to be a problem, meaning that the figure is derived from the poorest sites. The classification also operates on a „one out all out” principle, where the poorest of the many elements measured drives the overall result. This stringent approach is designed to look at the impact of all pressures, deal with the biggest issues, and drive progress towards GES for all rivers.

The GES results are significantly different from the GQA results presented here and comparisons between the two should be treated with caution. WFD monitoring is risk based and focuses on where there is likely to be a problem, meaning that the figure is derived from the poorest sites. The classification also operates on a „one out all out” principle, where the poorest of the many elements measured drives the overall result. This stringent approach is designed to look at the impact of all pressures, deal with the biggest issues, and drive progress towards GES for all rivers.

The Observatory indicator has a different focus. It is a long-term measure of river water quality, and uses a consistent set of representative monitoring sites and measurements to ensure changes over time are accurately reflected.

It is intended that a common indicator will be developed for the UK, incorporating the new WFD monitoring network and allowing an aggregated UK comparison. This will likely focus on a subset of water quality parameters that have been monitored historically and will continue to be in the future, and will use a consistent pool of monitoring sites (known as “surveillance” sites). This will ensure that a consistent, long-term picture of river water quality is retained.

#### Harmonised monitoring scheme

The Harmonised Monitoring Scheme (HMS) was established to provide an archive of water quality data for Great Britain. It is used to provide information for international obligations, including the long-term trends of some determinands and the estimation of riverborne input of selected determinands to the sea. The HMS commenced in 1974 and has been administrated and maintained by the Environment Agency since 1998. The sampling network includes 230 sites, which are mainly located at the tidal limits of major rivers or at the points of confluence of significant tributaries.

The data show the annual averages of the site means for each landscape type, with each site given equal weight irrespective of the number of samples taken - an average of all the samples would give a greater weight to the sites at which samples are most frequently taken.

#### *Further information*

ADAS report to Defra 2007 (Nitrates in water)

<http://archive.defra.gov.uk/environment/quality/water/waterquality/diffuse/nitrate/documents/consultation-supportdocs/d1-nitrateswater.pdf>

White and Hammond report to Defra 2006 (phosphates in UK water):

<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=13635>

Information on National Statistics for River Water Quality can be found at:

<http://www.defra.gov.uk/statistics/files/exp-note-changes.pdf> and  
<http://www.defra.gov.uk/statistics/files/rwq-ind-sus-2009-resultsv2.pdf>