

‘Did Farmer Giles do it?’ – Determining sources of phosphorus input to rivers using load apportionment modelling



Dr Mike Bowes
Centre for Ecology and Hydrology
Wallingford, Oxfordshire

Reducing P concentrations in rivers

- Focus on reducing phosphorus loadings in UK rivers, to reduce the risk of eutrophication.
 - Phosphorus removal from sewage effluent
 - Farming controls / land use changes
- Where is the phosphorus coming from?
 - Sewage
 - Agriculture

Traditional methods of phosphorus source apportionment

Based on –

- Land use
- Fertiliser application rates
- Number and size of sewage treatment works
- Soil type
- Topography
- Infrequent (monthly?) water sampling

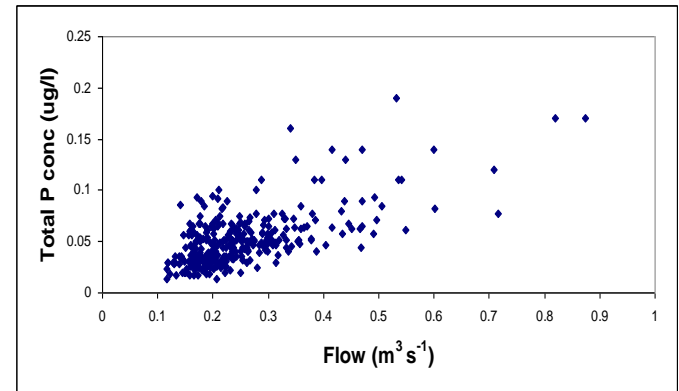
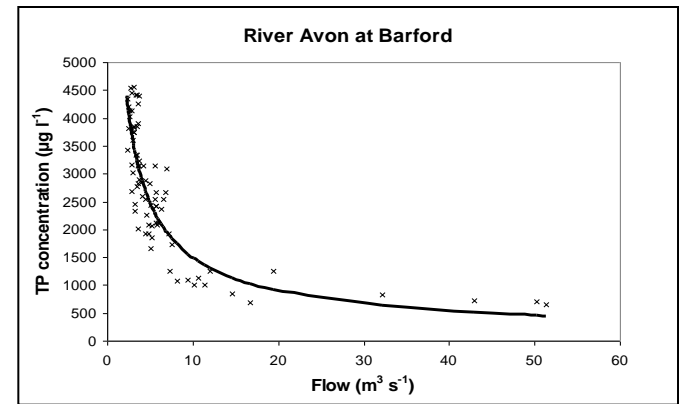
Give annual loads from sewage treatment works and agriculture

Load apportionment modelling

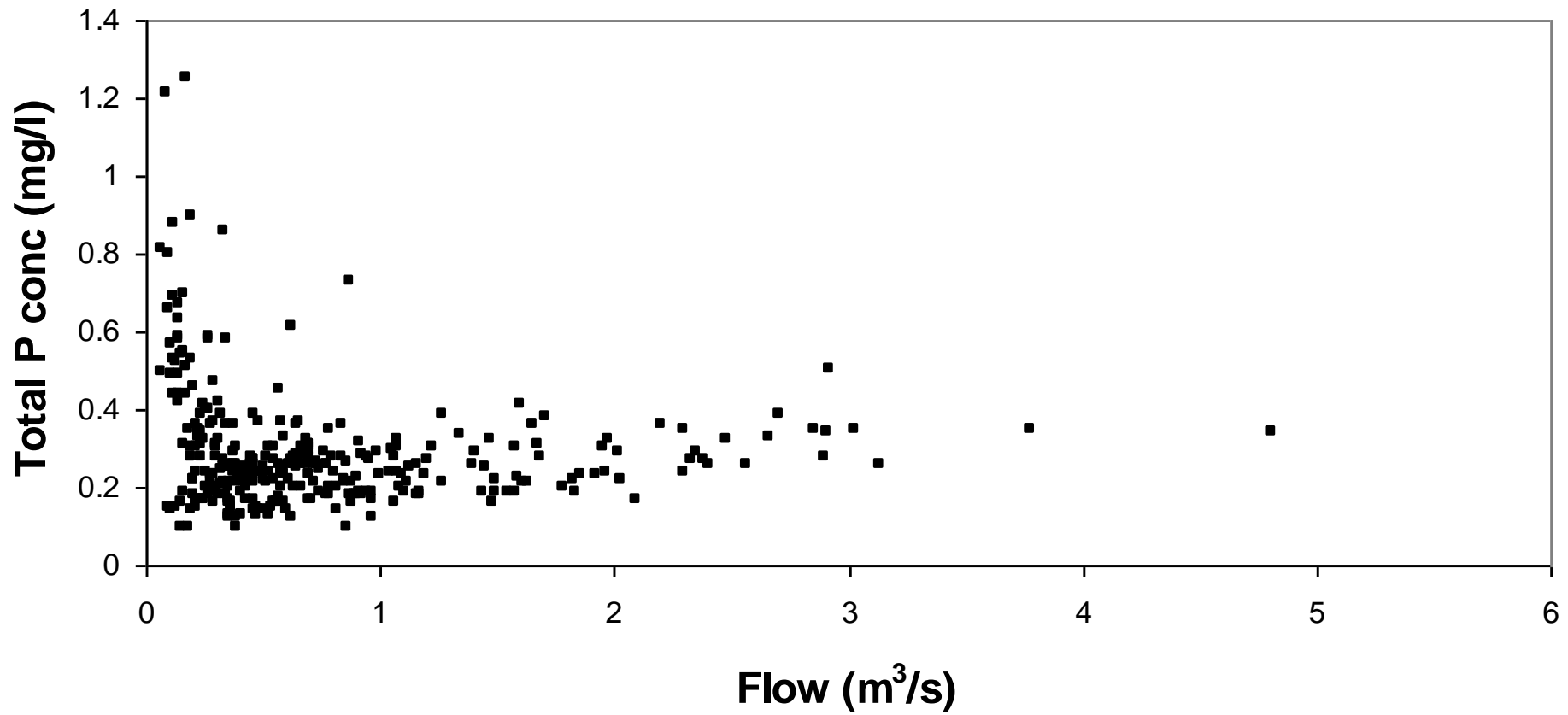
- Sewage treatment works P input is relatively constant, and independent of flow.



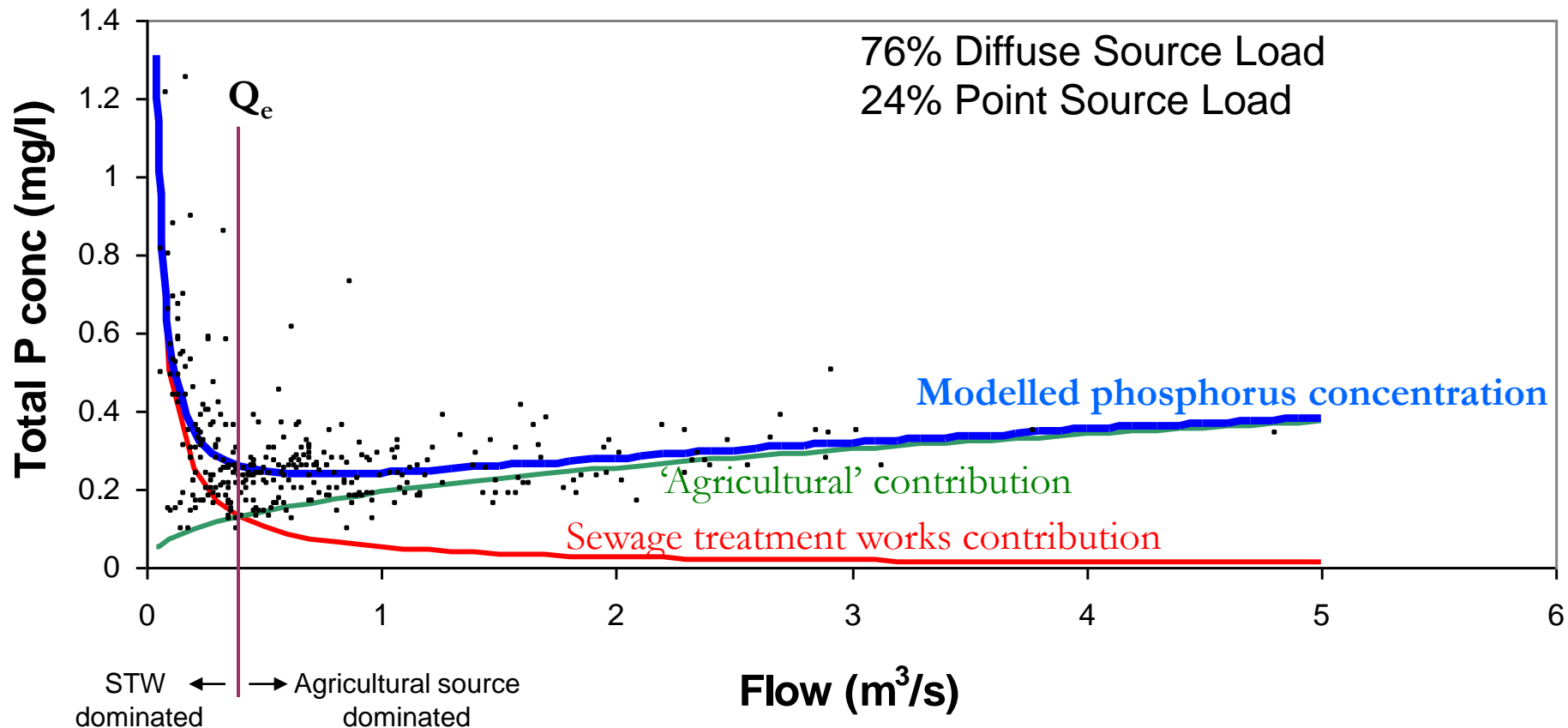
- Diffuse P inputs (agriculture, septic tanks) are usually rainfall dependant (and therefore related to river flow)



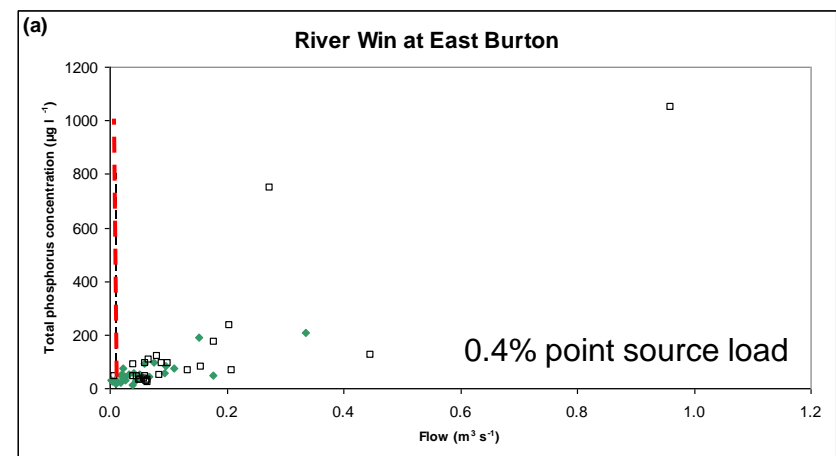
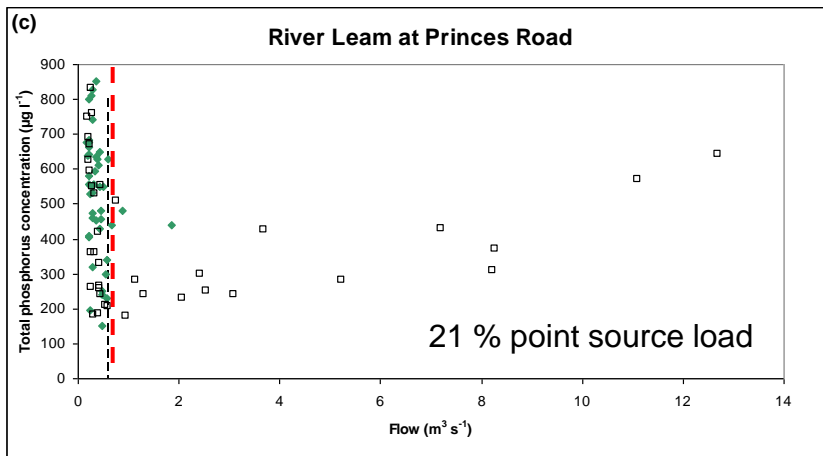
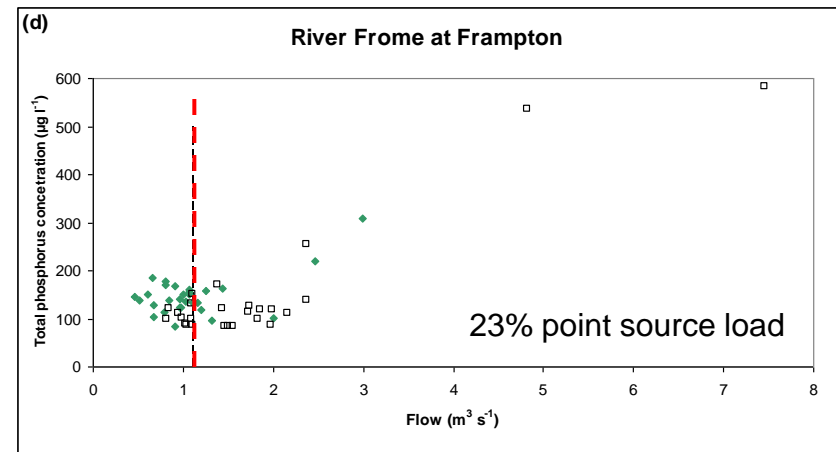
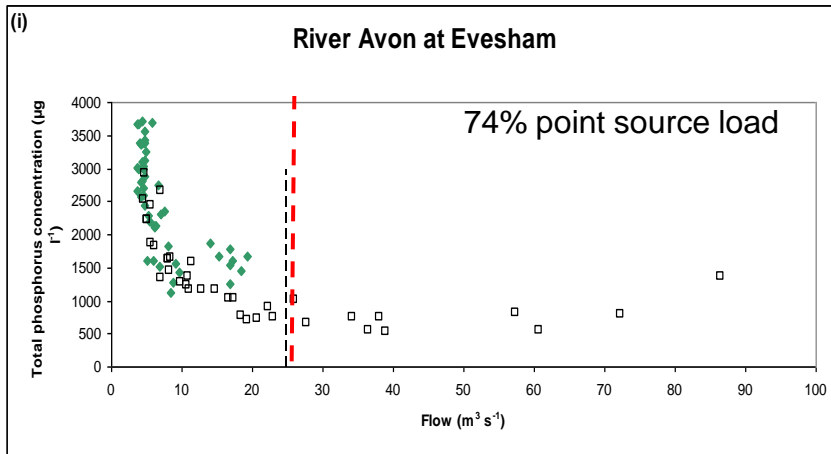
Load Apportionment Modelling



Load Apportionment Modelling



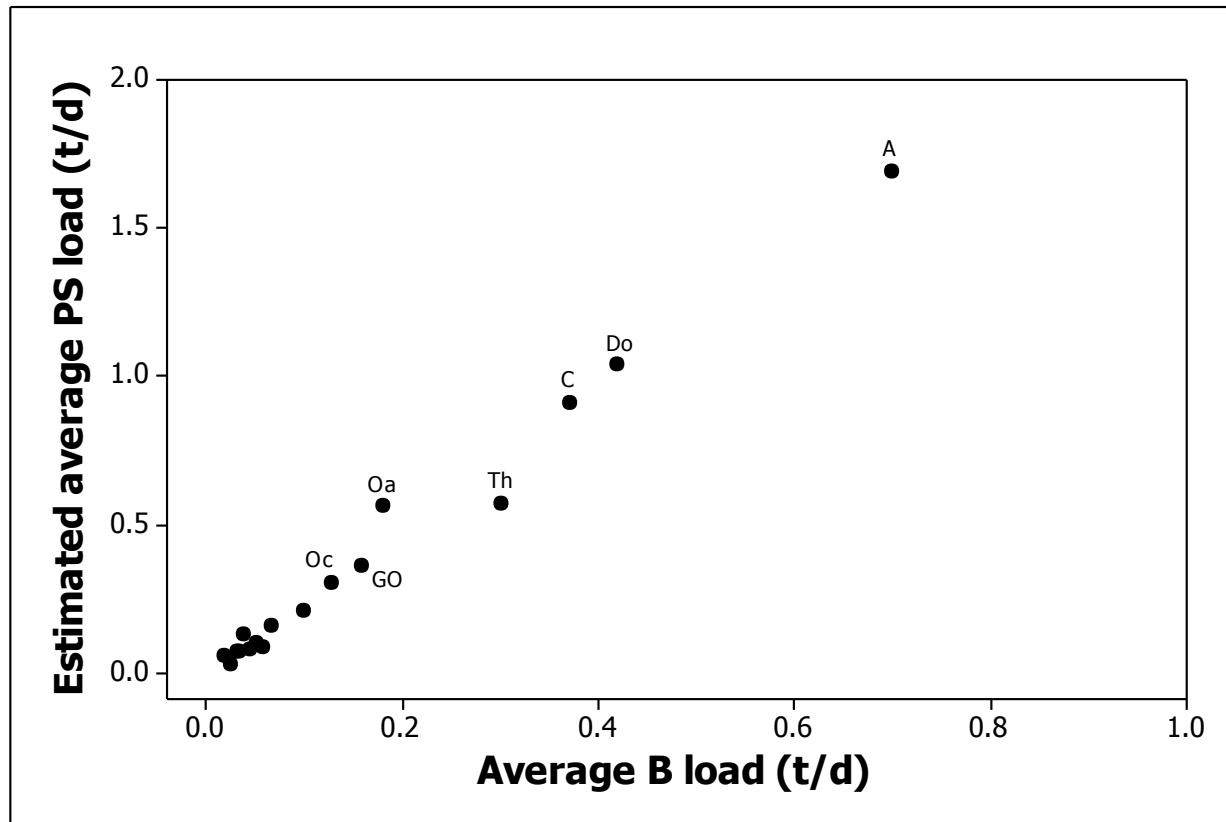
Load Apportionment Modelling



□ Oct - Mar
■ Apr - Sept

Does it work?

Load Apportionment model applied to wide range of UK rivers



Defra PARIS project

(Phosphorus from Agriculture: Riverine Impacts Study)

- Study based on small headwater streams in low population density areas.
- No sewage works.
- Intensive agriculture.
- All P pollution from farming?



Defra PARIS project

(Phosphorus from Agriculture: Riverine Impacts Study)

- LAM detected significant 'point source' input
 - Major source during summer low-flows
- High concentrations of boron (sewage tracer).



Conclusions from PARIS project

- Sewage input from septic tanks very important in headwater catchments.
- Much of the 'agricultural' pollution signal due to rural inhabitants, rather than farming.
- Best management options?
 - Septic tank misconnections
 - Improve septic tank maintenance

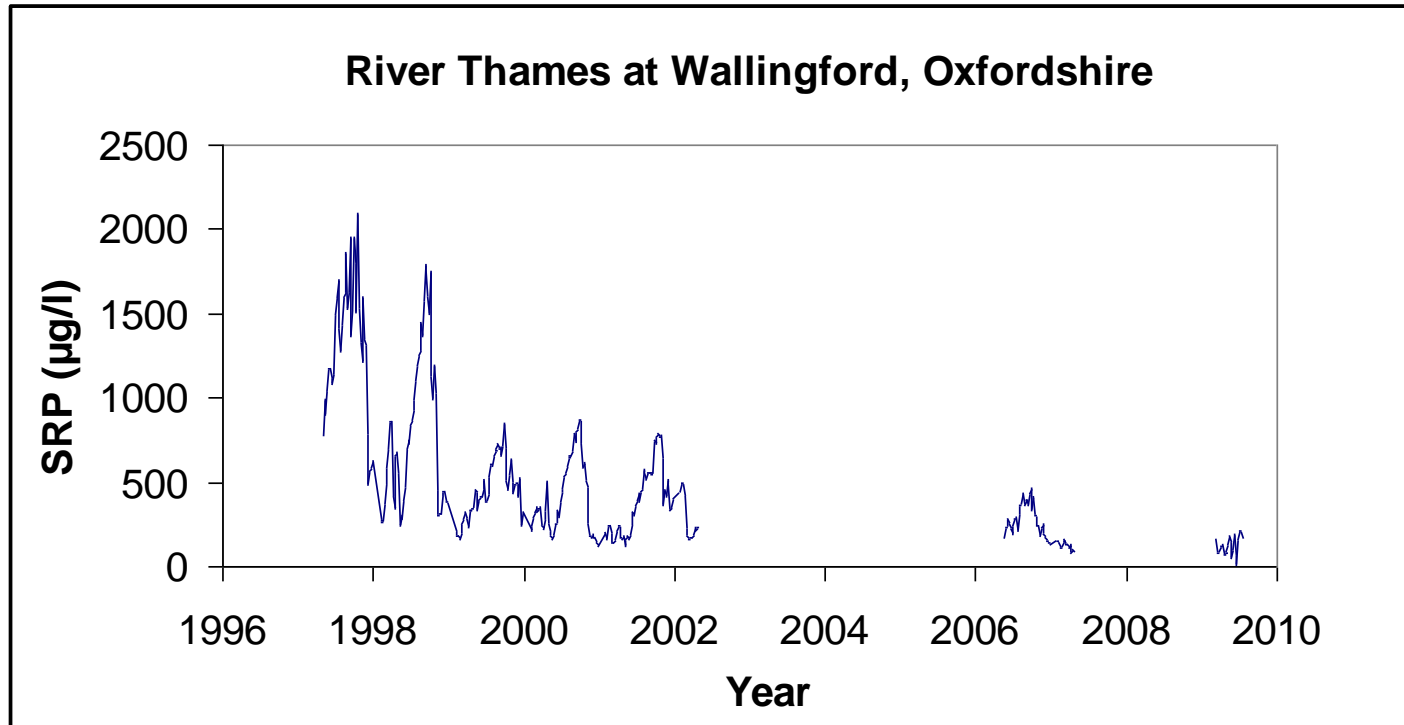
Need to focus on sewage inputs

- Importance of agricultural inputs have been greatly overestimated using traditional source apportionment approaches.
- Sewage inputs provide greatest source contribution during algal growing period.
- Sewage inputs are in bioavailable form.

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inputs

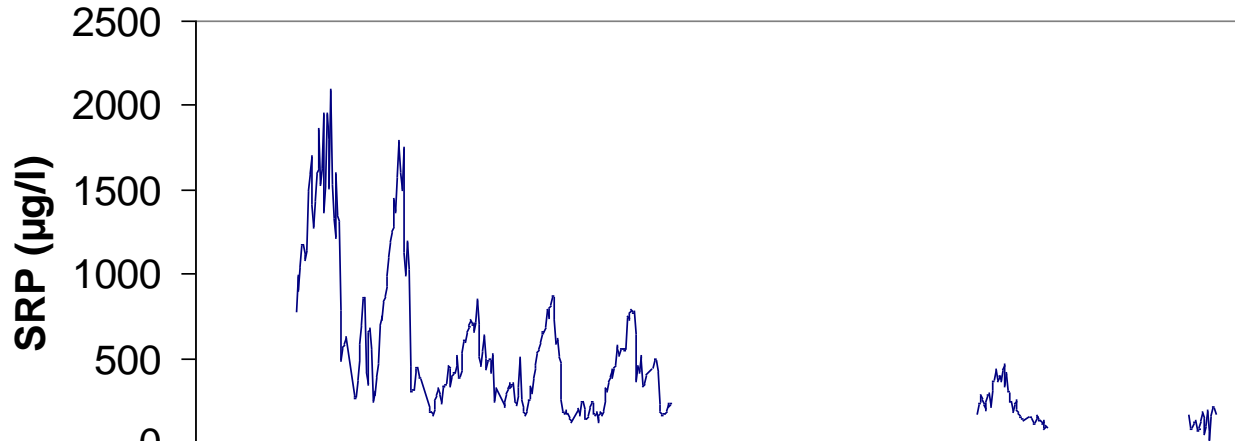


Additional source

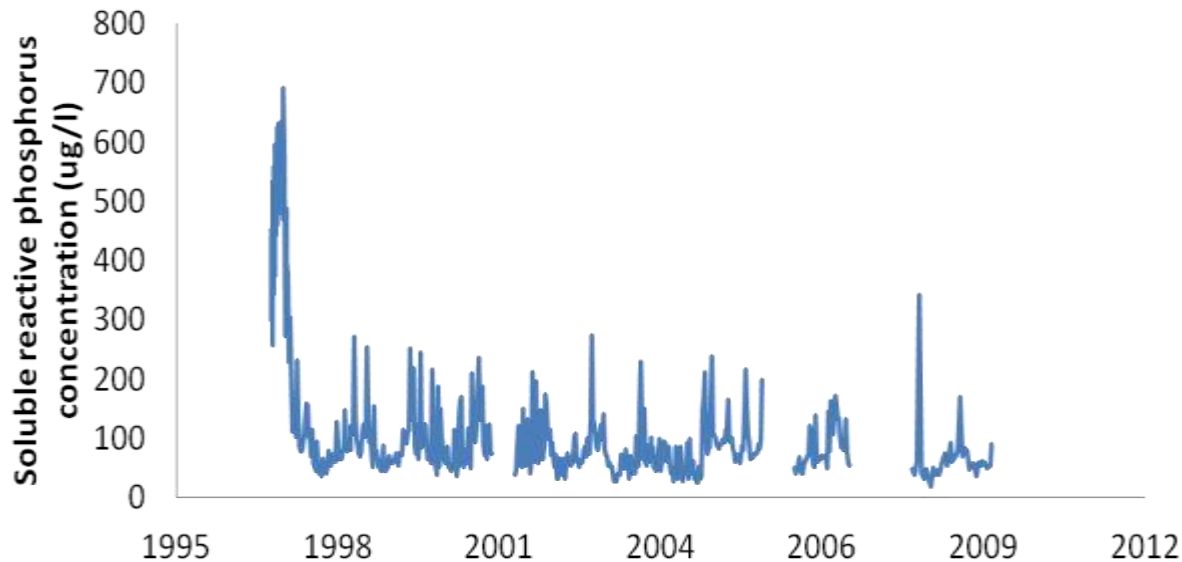
Legal growing

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River Thames at Wallingford, Oxfordshire



River Kennet at Mildenhall



inputs

Additional source

Legal growing

10

at P concentration
often have no

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- Sewage inputs are in bioavailable form.
- STW improvements result in immediate and significant P concentration reductions in rivers.
- Changes to agricultural land use often have no observable effect on water quality.
- Septic tank inputs acting as multiple point sources.
 - Significant P source in rural areas

Acknowledgements

Jim Smith (University of Portsmouth)

Helen Jarvie (CEH)

Paul Withers (ADAS / Bangor University)

Liz Palmer Felgate (CEH)

Colin Neal (CEH)

