What part are the Demonstration Test Catchments playing in addressing water pollution?

The Demonstration Test Catchments have been set up to evaluate whether water pollution can be reduced through farming practice and agricultural land measures while maintaining farming productivity and profitability.

Photo by Sim Reaney, Durham University

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Demonstration Test Catchments (DTC) is a UK government-funded project designed to provide robust evidence regarding how diffuse pollution can be cost-effectively controlled to improve and maintain water quality in rural river catchment areas.

The Eden catchment

The river Eden rises in the limestone fells of the north Pennines and flows across Cumbria, bordered by the Pennines and the fells of the Lake District, to more lowland pastures around Carlisle. It joins with other rivers to form the Solway Firth estuary and reaches the open sea 90 miles (145 km) from its source.

In the Eden catchment:

- Parts of the Lake District and Yorkshire Dales National Parks, the North Pennines, Solway Coast Area of Outstanding Natural Beauty, and Hadrian's Wall World Heritage Site are all to be found.
- There is a Site of Special Scientific Interest and Special Area of Conservation which have legal protection.
- Species and habitats of conservation interest include water crowfoot, lamprey, white clawed crayfish, otters, bullheads, Atlantic salmon and swamp alder woodlands.
- The river and its catchment are of strategic importance for water supply in the north west of England.
- Agriculture and food production form an important part of the social, environmental and economic landscape of the catchment.
- Upland areas are mainly given over to livestock farming with more intensive mixed and livestock farms on the fertile lower Eden valley.
- Intensive livestock farming has increased over recent years.
- Pollution from animal manure and slurry and sediment from eroded farmland soil are particular problems.
- Rain and extreme weather events exacerbate the problem in this particularly wet part of the country.
- Potentially toxic algal blooms and reduced biodiversity may result from the pollution.

How do pollutants reach waterways in the Eden catchment?

Pathways in the Eden catchment are complex and difficult to predict or to track.

- Pollutants are easily mobilised in water but because of the high rainfall and runoff they are likely to be somewhat diluted.
- There is a wide variety of rock types in the catchment which affects the routes taken by pollutants and the time taken to reach the river.
- In parts of the catchment, where the soil or surface geology has low permeability (e.g. clay), pollutants can travel rapidly over or close to the surface, but where rocks and soils are more permeable, water and pollutants will soak below ground, following much slower flow routes and taking longer to reach the river.
- In other places underground pathways can be much faster, for example in fractured limestones, where underground flow can emerge at specific points as springs or upwellings in the stream bed.
- The subsurface flow routes through aquifers can be further complicated where the catchment is covered in glacial deposits. These are typically clayey, but since they often also contain permeable sands and gravels, a complicated mixture of surface and shallow subsurface water flow routes results.

The Avon catchment

The Avon originates in Wiltshire as two separate rivers which merge at Upavon, flowing south across the Salisbury Plain. The Bourne, Wylye, Nadder, Ebble and Nine Mile river join the Avon at Salisbury before flowing south, through the New Forest at Fordingbridge and Ringwood, and meeting the river Stour at Christchurch where it flows into Christchurch Harbour, reaching the English Channel at Mudeford, Dorset.

In the Avon catchment:

- There is a Special Area of Conservation, Sites of Special Scientific Interest, and a wetland system protected for its importance for birdlife. The western tributaries rise within the Cranborne Chase and West Wiltshire Downs Area of Outstanding Natural Beauty.
- Species of conservation interest are water crowfoot, Atlantic salmon, brook lamprey, sea lamprey, bullhead, Desmoulin's whorl snail, gadwall duck and Bewick's swan.
- The mixed farming economy includes livestock and crops.
- Organic nitrogen and phosphorus, inorganic nitrate and sediment from road, track and field surface runoff are all important sources of pollution.
- Heavy rain and extreme weather lead to surface runoff of water which washes sediment and nutrients into watercourses.
- Researchers are investigating physical interventions which aim both to reduce sources of pollution and to intercept pollution after it has been mobilised and is being transported to water courses. These measures are associated with both Catchment Sensitive Farming and Entry Level Stewardship agri-environment schemes.

How do pollutants reach waterways in the Avon catchment?

The catchment is underlain by a variety of materials ranging from clay with very low permeability to highly permeable sands and fractured Chalk.

- In the parts of the catchment underlain by clay, surface runoff predominates and water moves rapidly from the land surface to watercourses.
- In the areas underlain by the Chalk and other aquifers, slow subsurface flow is important and flow pathways from the land surface to the river are mainly via groundwater routes. In some Avon sub-catchments a large proportion of the water in the river is derived from groundwater.
- Different aquifers may have either separate or linked groundwater flow systems, leading to complex flow patterns in certain parts of the catchment.
- The interaction between surface water and groundwater can also be complicated, with some sections of rivers gaining flow from underlying aquifers, and other sections losing flow to groundwater.

The Tamar catchment

The river Tamar, which forms most of the Devon/Cornwall border, has also been adopted as a satellite of the Avon Demonstration Test Catchment.

In the Tamar catchment:

- The Tamar-Tavy estuary is a protected Site of Special Scientific Interest because of the habitat and wildlife found there. Water is abstracted for the public water supply and species include Atlantic salmon and otter.
- Pressures include nutrients and sediment from farming.
- Researchers are monitoring the water quality and freshwater responses to mitigation strategies funded by South West Water via Upstream Thinking, a Payment for Ecosystem Services scheme being implemented by the Westcountry Rivers Trust. For further details see www.upstreamthinking.org

The Wensum catchment:

The river Wensum rises between the villages of Colkirk and Whissonsett in Norfolk, flows through Fakenham and the Pensthorpe nature reserve, and on through Norwich, towards its confluence with the river Yare at Whitlingham where it becomes a Broadland river, draining an area of international importance for biodiversity.

In the Wensum catchment:

- 71 km is designated a Site of Special Scientific Interest and the whole river is a Special Area of Conservation. Diffuse pollution is having serious effects on these designated areas.
- Animals and plants that require conservation include water crowfoot, white clawed crayfish, Desmoulin's whorl snail, brook lamprey, brown trout and bullhead.
- The river is recognised as one of the most important lowland Chalk river habitats in the east of England.
- Intensive arable cultivation of combinable crops is the predominant land use.
- Rainfall allows fertilisers, manures and soil particles to be transported to nearby streams. The timing of ploughing, fertiliser application and harvesting in relation to rainfall will have an impact on how much is carried to the stream.
- Researchers are working mainly with arable farmers, on land that has been farmed over many years and has often lost organic carbon content. They are experimenting with cultivation measures that are designed to reduce soil disturbance and their vulnerability to mobilisation and nutrient leaching following heavy rainfall.

How do pollutants reach waterways in the Wensum catchment?

Pathways from sources of pollution to the receptor waterways are complex and occur via a mixture of surface and subsurface routes.

- The Wensum catchment is underlain by the Chalk, which is overlain in the east of the catchment by the Crag. These two formations act as a single aquifer system. But there are places, including the Blackwater subcatchment, where this aquifer system is not connected with shallow groundwater flow in the overlying superficial deposits.
- The main control on pollutant movement is the complex sequence of overlying deposits. Groundwater moves through, and is stored in, the glacial and fluvial sands and gravels, with limited flow through the various layers of clay-rich sediment.
- In the parts of the catchment where the uppermost glacial deposits have low permeability, surface runoff predominates and water moves rapidly from the land surface into watercourses, often via field drains.
- In the parts of the catchment underlain by more permeable sands and gravels, pollutants generally reach the watercourses more slowly, but owing to the complexity of the geology, with a mixture of extensive and more limited aquifers, the flow paths and flow timescales are variable.

Teams in the Eden catchment in Cumbria, the Avon catchment in Hampshire and the Wensum catchment in Norfolk, have assessed the causes, risks and impacts of diffuse pollution in these three different areas. The catchments were chosen because they are representative of a range of farming types and because of previous research there. The aim is to build on existing knowledge and to transfer findings across the country.

What are the sources of pollution in the catchments?

Pollution originates from a range of sources in the three catchments, including:

- Inorganic nitrogen and phosphorus from fertiliser.
- Pathogens, nitrogen, phosphorus and ammonium from animal manure; or sometimes from septic tanks and urban sewage works.
- Livestock accessing riverbanks causing poaching and soil erosion, leading to increased sediment in the water. They may also deposit urine and faeces directly into the stream.
- Sediments eroded from bare farmland soil, in-stream channel banks and road verges.

What problems does it cause?

Pollutants are washed from slurry, manure or other sources, over or through the soil, and sooner or later will reach watercourses. This process is often called "mobilisation". Once mobilised the pollutants take different "delivery" pathways, depending on the local circumstances. Rain and extreme weather events also play a part. This can result in:

- Unsightly algal blooms which are sometimes toxic.
- Pollutants that may favour nuisance species and reduce the biodiversity of waters.
- Reductions in lower life forms cascading through the food web and affecting fish and mammal populations.
- Silting of channels with detrimental effect on habitats.
- Negative impacts on Sites of Special Scientific Interest and other protected areas.
- Implications for meeting European standards for conservation and water quality and increased costs for water companies.

What are the potential solutions?

A variety of changes in farm and land management are being trialled in the Demonstration Test Catchments to reduce the impacts of diffuse pollution on surface water and groundwater. These are being delivered through advice and support on soil and nutrient management, tailored to the specific geography and types of farm practice. Researchers and advisers are working with farmers to identify flow pathways, specific problems and "hotspots" such as foul water drains, vulnerable fields and hard standings. Interventions being tested include:

- Development of nutrient management plans targeting dirty water, slurry, manure and fertiliser spreading.
- Working with land managers to deliver large scale investment in farm infrastructure such as slurry and silage storage and manure management processes.
- Installing new guttering, drains, ponds, lagoons and soakaways where these are required.
- Improvement of livestock and machinery tracks to prevent erosion and rapid transfer of pollutants to watercourses.
- Establishing riparian buffer strips and stream-bank fencing to exclude livestock. Fencing may be coupled with some carefully targeted additional options such as constructed wetlands, swales and settling ponds for sediment and associated nutrient removal.
- Reduced cultivation methods such as strip tillage and the use of cover crops to reduce bare soil after harvest and to take up residual nitrogen.
- Biobeds to reduce pesticide pollution from sprayers. The sprayers are washed down on a hard standing and the polluted water broken down in a bed of straw, soil and peat.

What about the rest of the country?

These kinds of problems affect the whole of the country.

- In England and Wales, only 27% of water bodies are currently estimated to be at good status as defined by the EU Water Framework Directive.
- The Environment Agency estimates that 33% of the known failures in England and Wales are due to agriculture.
- Approximately 55% of nitrates, 20% of phosphorus and 75% of sediments polluting UK water bodies are estimated to come from farming.
- The problems are different everywhere but the three Demonstration Test Catchment case studies show the types of problems occurring across the UK.

Useful resources:

There is information available about all the Demonstration Test Catchments on these websites:

www.edendtc.org.uk
www.avondtc.org.uk
www.wensumalliance.org.uk
www.demonstratingcatchmentmanagement.net
http://ccmhub.net

Contact
Bob Harris, DTC Secretariat
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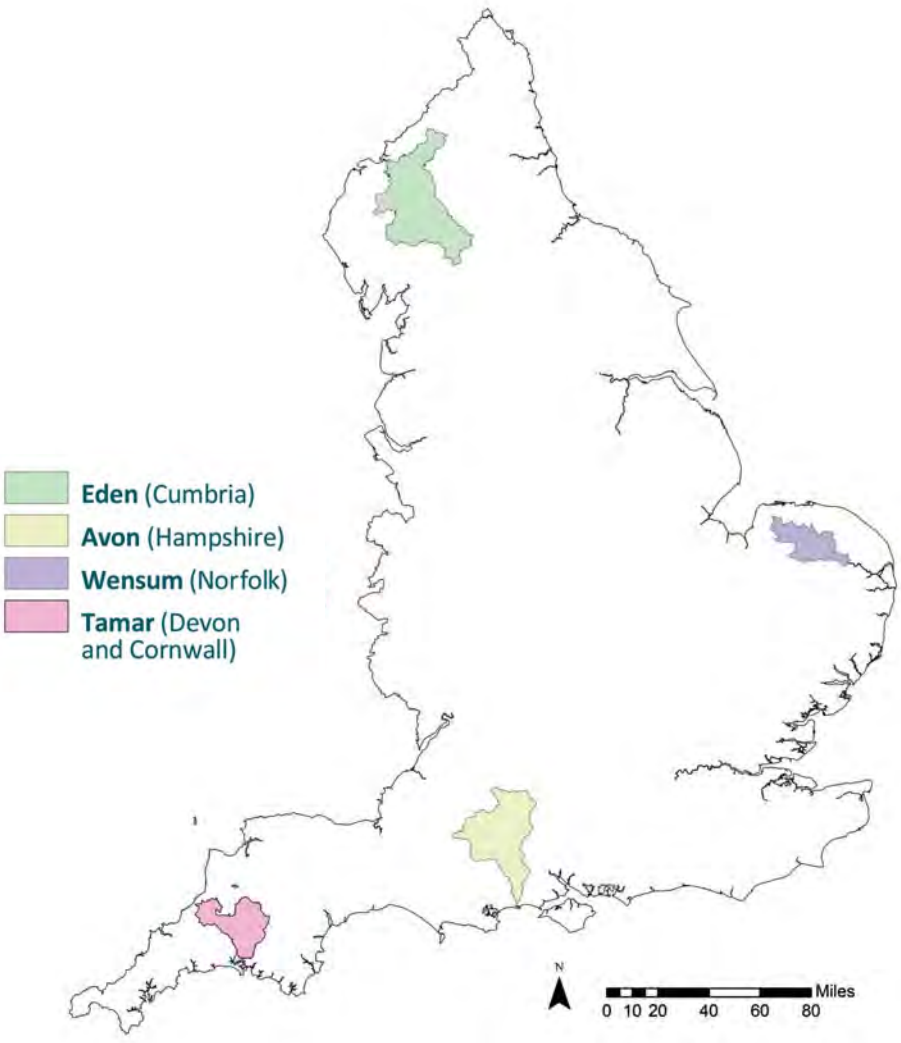
Location of the Demonstration Test Catchments



Demonstration Test Catchments

CATCHMENT CHANGE NETWORK

Catchment Change Management Hub