

Case study

DGT phosphorus programme in the River Kent catchment



Placing a basket to deploy DGT sampler devices at a fixed location

When

2024-2025

Where

The River Kent and Tributaries SSSI

Background

Despite the River Kent being a SSSI and SAC, recent laboratory analyses of the water quality within the site has been relatively limited, restricted to limited grab samples. These samples only give a snapshot of the conditions at the time of collection, so allow little opportunity for interpretation of the data to better understand the sources and impact.

The River Kent catchment is one of England's most important river systems, supporting internationally significant populations of freshwater pearl mussel, white-clawed crayfish, salmon and a range of other protected species. As part of the LIFE R4ever Kent project, understanding and improving water quality is a key priority, particularly in relation to phosphorus, one of the main pressures affecting freshwater ecosystems.

Traditionally, phosphorus monitoring in water relies on grab sampling, where a single water sample is collected at a specific location and point in time. While effective, grab samples only provide a snapshot of river conditions and can be influenced by short-term changes caused by rainfall, runoff,

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land use activity or wastewater inputs, that might not be an accurate representation of the site in general.

Freshwater pearl mussels need exceptionally clean, nutrient-poor water, and the phosphorus concentrations associated with favourable conditions can be so low that they are difficult to measure reliably using conventional grab samples. DGT samplers help overcome this challenge by sitting in the river for weeks at a time and continuously absorbing dissolved phosphorus from the water. This approach effectively amplifies very low concentrations, giving a much lower limit of detection than a single bottle sample collected on one day. As a result, DGTs provide a clearer picture of whether rivers are truly achieving the ultra-low phosphorus levels needed to support freshwater pearl mussels and can detect subtle differences in water quality that may otherwise go unnoticed.

To build a more complete picture of phosphorus across the catchment, the project trialled Diffusive Gradients in Thin-films (DGT) technology alongside conventional sampling. DGTs are passive samplers that remain in the river for several weeks and continuously accumulate phosphorus, allowing researchers to calculate a time-weighted average concentration over the deployment period. We monitored dissolved and biologically available forms of phosphorus across the catchment. Excess phosphorus can drive algal growth and degrade the clean, nutrient-poor habitats needed by species such as freshwater pearl mussel.

What we did

LIFE R4ever Kent commissioned Lancaster Environment Centre at Lancaster University to undertake the design, analyses and reporting of the monitoring programme, with support from the project's Catchment Management Advisors. The Catchment Management Advisors were responsible for liaising with partner organisations and landowners in identifying and securing access to sample locations across the catchment, and undertook the field deployment and sample collection.



Scoping suitable sample sites

Between July 2024 and July 2025, phosphorus monitoring was undertaken across 12 locations within the River Kent catchment, including the Rivers Kent, Sprint, Mint and Gowan, alongside key tributaries such as Flodder Beck, Lambrigg Beck and Thursgill Beck.

Samplers were deployed attached to gabion baskets filled with stones to keep them in place in the river channel, and early visits involved some learning on flow rates and best position within the river,

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with some sites water levels dropping leaving the devices out of the water. These teething problems were quickly resolved and a standard operating procedure then continued for the rest of the year.

Every three weeks, project staff working in pairs:

- Collected grab water samples for laboratory analysis.
- Exchanged DGT devices deployed at each monitoring location.
- Recorded field conditions and maintained monitoring equipment throughout the year.



A DGT sampler changeover

The monitoring network was designed to cover a broad range of catchment types, from relatively unimpacted headwaters to areas where previous modelling had suggested elevated phosphorus concentrations. DGTs remained in the river for approximately 329 days across the study period, providing vastly greater temporal coverage than the 18 individual grab-sampling visits undertaken.

At the end of the study the baskets were emptied by hand and removed. In initial deployment and final collection one of the project team with a licence to translocate White-clawed crayfish was on hand to move any of the protected species who had made the rocks their home.

Outcomes and learning

Grab samples were analysed for Soluble Reactive Phosphorus (SRP), which is commonly used as an indicator of phosphate in rivers. DGT devices measured a time-weighted concentration of dissolved, bioavailable phosphorus, broadly comparable to SRP but likely excluding some colloidal, organic and complexed phosphorus forms that may be included in grab sample analysis. The report therefore discusses phosphorus (P) throughout, but the measurements are not of total phosphorus. They are primarily assessing the dissolved and biologically available fraction of phosphorus in the water.

The monitoring programme provided a detailed picture of phosphorus distribution across the River Kent catchment and identified several clear patterns.



Checking for White-clawed crayfish during dismantling

Areas with consistently good water quality

The River Sprint, upper River Kent and upper reaches of the River Gowan generally showed very low phosphorus concentrations, often below 5 µg P/L. These levels are below current targets and are consistent with conditions required to support freshwater pearl mussels.

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Priority areas identified

The River Mint sub-catchment recorded the highest phosphorus concentrations in the programme. In particular:

- Lambrigg Beck showed the highest phosphorus concentrations recorded across all monitoring sites.
- Flodder Beck also displayed elevated phosphorus levels.
- Evidence suggests a combination of inputs are influencing water quality in this part of the catchment.
- Better understanding of phosphorus sources – previously the pathway from different becks within the sub-catchment had not been investigated.

The data highlighted the locations of different phosphate pressures across the catchment, revealing important insights into p sources. Where phosphate concentrations rose with rainfall, this indicated an influence from diffuse sources such as land runoff or the combined effect of septic tanks. In contrast, where elevated concentrations do not correlate strongly with rainfall, this suggests that phosphate enters the water more through a mix of diffuse inputs or from point source inputs such as treatment works.

Supporting future conservation efforts

The evidence generated through the programme will help guide future freshwater pearl mussel restoration work, identify areas where targeted catchment interventions are needed, and support engagement with landowners, farmers and infrastructure providers to reduce phosphorus inputs.

Increasing the use of new technology

The study is helping to familiarise practitioners with the potential of the DGT samplers in phosphorous monitoring, especially over long time periods or at low limits of detection. It should support DGT to become recognised as an effective and accurate p monitoring mechanism.

A final lesson learnt on the study is when undertaking sampling that involves working low to the water level a buoyancy aid is recommended over an automatic lifejacket.



Lesson learnt

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