Research Experience Placement (REP) Scheme 2025

Supervisor Project Proforma

Project title:	**Evaluating the role of algal blooms in carbon flux at Rutland Water Nature Reserve**
Host Institution:	**Loughborough University**
Project supervisor (name, department):	Savannah Worne, Geography and Environment
Project enquiries (supervisor email):	s.worne@lboro.ac.uk
Co-Supervisor, if any (name, department):	Tom Denning, Geography and Environment
Proposed start date and weekly hours: (please note project must be of 6 weeks duration)	30th June 2025

Please provide a short paragraph or couple of sentences summarising the project to encourage potential applicants to apply (max 75 words)**:**

Investigate how climate change and sewage-driven algal blooms impact water quality and carbon cycling at Rutland Water, a major UK reservoir and nature reserve. This project involves field sampling and lab analysis, contributing vital data for conservation and water management. You'll gain hands-on experience with water sampling and laboratory techniques, including nutrient analysis, chlorophyll-a, and dissolved carbon using a state-of-the-art TOC-TN analyser, skills widely used by environmental researchers, managers and consultants in water quality monitoring.

Project description (max 700 words, 1-2 figures may be included):
Proposed projects must:

- Have a clearly defined objective.
- Be within the science remit of NERC.
- Be feasible for a student to complete within the timescale of the placement.
- Include more than purely a computer/modelling component i.e., some element of fieldwork, data collection, activity to give an understanding of the wider context including participation in lab/team meetings, networking, and training etc.
- Give scope for thought and initiative on the part of the student and should not use the student as a general assistant.
- Be based at an eligible UK research organisation (remote placements are also an option for enabling inclusivity).

Climate change and algal blooms pose a serious threat to the sustainability of water resources and natural habitats by degrading water quality and disrupting the function, structure, and unique biodiversity of aquatic ecosystems. This issue is especially pronounced in standing water bodies, which have slower flushing rates and are more prone to nutrient accumulation that promotes algal growth.

Algal blooms consume large amounts of carbon, meaning their increased frequency and duration could enhance CO_2 drawdown; however, this potential benefit is uncertain, as blooms can also promote conditions that lead to increased methane (CH_4) release—a far more potent greenhouse gas—potentially offsetting any gains in carbon sequestration. As climate change is expected to

intensify these blooms, it is crucial to deepen our understanding of their role in carbon cycling, to assess whether the potential benefits of carbon sequestration outweigh the broader ecological consequences.

This study will be focused on Rutland Water (RW), which is one of the UK's largest drinking water reservoirs. This reservoir provides an essential regional water supply and supports the adjacent Rutland Water Nature Reserve (RWNR) which is composed of 8 connected shallow water lagoons. RW hosts >25,000 birds annually, including 10 internationally protected species, granting it multiple designations as an internationally protected site. However, Oakham Sewage Treatment Works (STW, now Water Recycling Centre) discharges treated effluent directly into one of the lagoons (Lagoon 3; Fig. 1), which is hydraulically connected to the main reservoir via a managed pipe system.

As nutrient levels increase, lake system shifts from clear water dominated by submerged macrophytes to more turbid conditions dominated by algal blooms. This transition reduces the availability of food and habitat for important bird species. Therefore, it is essential to assess the intensity and spatial extent of cyanobacterial blooms at this site, particularly in the context of aquatic carbon cycling, to gain a clearer understanding of their impact.

Figure 1) Map of central sector of Rutland Water Nature Reserve.

Preliminary ecological data identified a significantly higher abundance of harmful cyanobacteria in Lagoon 3, compared to the main reservoir and lagoons which are not affected by the sewage inflow. However, this data was qualitative and did not include measurements of dissolved organic carbon (DOC). By analysing chlorophyll-a (an indicator of overall productivity) and DOC levels from samples collected between May 2023 and July 2025, this project will represent the first quantitative assessment of biological productivity across the site. By comparing productivity and DOC results between lagoons and with the main reservoir, the project will evaluate the extent to which algal blooms impact carbon flux, and hence the impact that sewage has had on carbon cycling. This will be addressed through the following aims and objectives:

1) In collaboration with Leicestershire and Rutland Wildlife Trust, we will undertake field sampling to collect waters for chlorophyll-a and DOC analysis (currently scheduled 14th July).
2) Analysis of previously collected samples from May 23 to June 25, as well as those collected in July 2025 as part of this placement, for chlorophyll-a (using colorimetric UV-vis spectrometry) and DOC concentrations (using a state-of-the-art Shimadzu TOC-TN analyser).
3) Comparison of data between seasons across multiple years will evaluate the progression of phytoplankton growth and carbon flux, in conjunction with collected nutrient data (e.g. phosphorus and nitrogen).

The research undertaken by the student in this project will contribute to a wider body of research at RWNR undertaken by the Dr. Worne, which is evaluating the spatial variability in water and ecological quality. Data from this study will be used to provide evidence to the Leicestershire and Rutland Wildlife Trust, and Anglian Water, who co-manage the site, about the nature of algal blooms at the site, and be used to inform further study around water quality management practices**.** The results from this placement are expected to contribute to an upcoming publication, with the student invited to participate as a co-author and contribute to the writing process, subject to performance and interest.

Project timeline:

Week 1: Health and Safety briefing, lab induction, familiarisation with lab methods and reading around project.

Weeks 2-5: Laboratory analysis of water samples (for DOC) and filter papers (chlorophyll-a).

Week 3 (14-15th July):
- 14th July – Water sampling of Rutland Water.
- 15th July – shadowing/assisting with nutrient analysis of waters using colorimetric methods.

Week 6: Write-up and analysis of data in report form, presenting key findings associated with algal bloom impacts on carbon cycling.

Candidate requirements:

Essential:
- Interest in working in laboratory environments.
- Be willing to undertake repetitive tasks.
- Ability to work in Loughborough for the duration of the project.
- Ability to work out of core work hours for fieldwork days (14-15th July; due to time-sensitive nature of laboratory analysis).
- Interest in aquatic environmental science/water management.

Desirable:

- Experience working in a laboratory environment.
- Experience with data analysis/GIS
- Experience working in/near water.

Background reading and references:

Anthropogenic alteration of nutrient supply increases the global freshwater carbon sink | Science Advances

Phytoplankton Carbon Utilization Strategies and Effects on Carbon Fixation

Effects of phytoplankton blooms on fluxes and emissions of greenhouse gases in a eutrophic lake - ScienceDirect