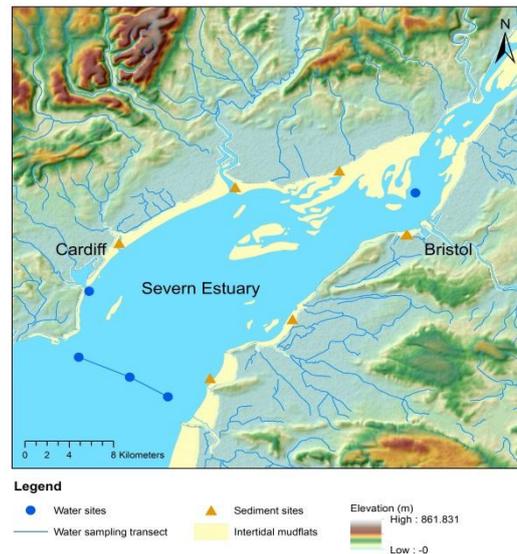


**NERC Great Western Four+ Doctoral Training Partnership (GW4+ DTP)**  
**Project Pro Forma for 2015 intake**

<p><b>1. Project title:</b> <b>Feeding the oceans: biological mediation of estuarine silica flux</b></p>
<p><b>2. Research theme:</b> <b>Biogeochemical Cycles: Tracing and modelling the flow of chemical elements and compounds between living organisms and the physical environment.</b></p>
<p><b>3. Hosting institution:</b> <b>University of Bristol 60%, Cardiff University 40%</b></p>
<p><b>4. Duration of project (default is 3.5 years unless of special circumstances):</b> <b>3.5 years</b></p>
<p><b>5. Start date of project (default is September 2015):</b> <b>Sept 2015</b></p>
<p><b>6. Names and affiliations of supervisors:</b> Main supervisor: Katharine Hendry, University of Bristol Co-supervisor: Rupert Perkins, Cardiff University Supervisory Team: Catherine Wilson, Cardiff University; Melanie Leng (NIGL)</p>
<p><b>7. Description of project (max. 400 words and up to two references. Pictures may be included):</b></p> <p>The biogeochemical cycling of silicon (Si) is a crucial component of the Earth's climate system. Silicon is an essential nutrient to many organisms - including diatoms, photosynthetic algae that form their frustules from amorphous biogenic silica - and contribute to a significant proportion of organic carbon production in aquatic and marine systems. Whilst there have been many studies carried out to quantify the terrestrial and marine silicon cycles, there have been relatively few studies of the coastal transition zone.</p> <p>The Severn Estuary is one of the most important hypertidal regions in Europe and plays a key role in fisheries, transportation, conservation and – potentially - tidal energy production. With predictions of precipitation and temperature changes, and inevitable land-use changes resulting from a growing population, it is essential to understand how this important interface between the terrestrial and marine Si cycles will be impacted into the 21<sup>st</sup> century. The overall research aim of this project is to use cutting-edge techniques to investigate estuarine ecosystems and the role they play in the biogeochemical cycling of Si, by quantifying the silicon budget of the Severn Estuary, and assessing diatom primary production and isotopic mass balance.</p> <p>The PhD studentship will involve a dedicated field campaign in the Severn Estuary over two years</p>

**NERC Great Western Four+ Doctoral Training Partnership (GW4+ DTP)**  
**Project Pro Forma for 2015 intake**

(Figure 1). The candidate will gather water, suspended particulate, sediment and biofilm samples, in order to address the project aim. Estuaries are heterogeneous environments and so the student will design their field sampling to take into consideration a range of spatial and temporal scales.



*Figure 1: Map of the Severn Estuary and sampling sites*

Field studies will involve sampling from a number of sites in the Severn Estuary for biofilms at low tide. The student will measure *in situ* i) sediment stability and erosion rates using a Gust Mesocosm chamber; ii) phytoplankton productivity using a Water PAM EDF/B fluorometer and light curve methodology (Perkins et al., 2010); and would take samples for laboratory analysis for: i) chlorophyll; ii) porefluid nutrients; and iii) biogenic silica content and Si isotope composition. Water samples will be taken at high tide for: i) temperature/salinity; ii) pH; iii) dissolved oxygen; iv) nutrients; and v) particulate loading and composition. The student will learn skills in isotopic measurements and nutrient analyses, to be carried out at Bristol; and calculation of photosynthetic parameters and chlorophyll *a* extractions will be carried out at Cardiff. The biogenic silica concentration and isotope data will be used in mass balance calculations to assess the Si budget of the estuary system (Cardinal et al., 2010).

Cardinal, D., et al. (2010). "Contrasting silicon isotope signatures in rivers from the Congo Basin and the specific behaviour of organic-rich waters." *Geophysical Research Letters* **37**(12).

Perkins, R., et al. (2010). The application of variable chlorophyll fluorescence to microphytobenthic biofilms. *Chlorophyll a Fluorescence in Aquatic Sciences: Methods and Applications*, Springer: 237-275.

**8. Training opportunities (please also include facilities required and interdisciplinary aspects):**

The student will receive training in:

1. Fieldwork (including safety training and fieldwork planning, as well as sampling procedures and *in situ* measurements);
2. Isotope geochemistry (multi-collector inductively coupled plasma mass spectrometry (MC-ICP-MS) at Bristol);

**NERC Great Western Four+ Doctoral Training Partnership (GW4+ DTP)**  
**Project Pro Forma for 2015 intake**

3. Chemical oceanography methods including nutrient and oxygen analysis (using Winkler titration, photospectrometry and IC at Bristol), and chlorophyll assays (using cold methanol extraction and pigment analysis at Cardiff);
4. Manipulation of data to calculate photosynthetic parameters, and mass balance calculations (using statistical software and other programs at both Bristol and Cardiff);
5. Personal development training in research and transferable skills at both Bristol and Cardiff.

**9. Please outline the approximate cost of research and source of additional funding if costs exceed the stated RTSG:**

i) Travel including fieldwork:

- £800 per day for chartered boat for high tide water sampling; 8 days over two years (£6400)
- £100 car hire per day for low tide sampling of biofilms; 12 days over two years (£1200)

ii) Lab costs:

- 5 days @ £500 per day for multi-collector inductively coupled plasma mass spectrometry (Bristol) (£2500)
- £900 consumables for both Bristol and Cardiff

**Total = £11k**

iii) Other (e.g. conferences):

The student would apply for travel grants to attend conferences (e.g. Geochemistry Group of the Geological Society, British Phycological Society (BPS). The student would attend the BPS Summer Meetings (2/3<sup>rd</sup> years) and Association for the Sciences of Limnology and Oceanography Meeting (3<sup>rd</sup> year)

iv) Source(s) of additional funding:

We would aim to apply for additional funding for additional field equipment (ADCPs, spectroradiometry, rugged laptop) to expand the project via the Royal Society Early Career Research Grants (Hendry as PI).

We will be able to fund the essential isotope work through the studentship. Further isotope work will be carried out in collaboration with the NERC Isotope Geosciences Laboratory, Keyworth, funded through NERC Isotope Geochemistry Facility Steering Committee grants. We have contacted Professor Melanie Leng and have her full support, and she is willing to act as an external supervisor.

**NERC Great Western Four+ Doctoral Training Partnership (GW4+ DTP)  
Project Pro Forma for 2015 intake**

**10. Supervisory team:**

For the two main supervisors, please specify:

	Supervisor I		Supervisor II	
	Current number of NERC PhD students supervised	Current number of other PhD students supervised	Current number of NERC PhD students supervised	Current number of other PhD students supervised
Year 1	0	1	0	0
Year 2	1	1	0	0
Year 3	0	0	1	0
Year 4	0	0	0	2

- Number of previous NERC students who have submitted theses within 4 years:  
Supervisor I: N/A

Supervisor II: 1

**11. Added value:**

*Please identify if your project has additional value. This can include (i) whether the project is cross institutional within the GW4+ DTP; (ii) has other external collaborators (e.g. CASE partners); (iii) you already have an offer of partial funding (e.g. 50% funding available from another source).*

This project represents a cross institutional collaboration between GW4+DTP members, Bristol and Cardiff Universities.