OR/14/047 Design of monitoring network

Farr, G, and Hall J. 2014. Atmospheric deposition and groundwater dependent wetlands: implications for effective catchment management and future Water Framework Directive groundwater classification in England and Wales. *British Geological Survey Internal Report*, OR/14/047.

Partnership working

The monitoring program should be designed and implemented with full consultation of all partners, including, but not limited to: Environment Agency, Natural England, Natural Resources Wales, British Geological Survey, Centre for Ecology and Hydrology, PLINK network and SEPA.

Potential research hypothesis

The following are key questions that we aim to answer:

- **How successfully can a nitrogen budget and source apportionment (including both atmospheric and terrestrial sources) be defined for any given wetland?**

how will this help both our understanding of nutrient sources and pathways, management of wetlands in unfavourable condition and subsequent WFD classification and program of measures?

- **Is it possible to quantify the input of atmospheric deposition to any given habitat, both directly and as an indirect contribution via groundwater and surface water inputs?**

how will this help our understanding of nutrient pathways for atmospherically derived nutrients, management of wetlands that exceed their critical load and subsequent WFD classification and program of measures?

- **At a site level is it possible to identify the main pressure contributing towards unfavourable condition between atmospheric deposition, terrestrial nitrate and poor site management?**

what are the implications for the Water Framework Directive classification process and future site management to achieve favourable condition?

Existing data

As a minimum the following data should be obtained as part of a desk top study before any new studies are undertaken:

Ecological

- NVC mapping
- CSM data, ideally botanical quadrat data to inform calculation of plant-based damage metrics
- Expert local knowledge, both ecological and hydrological

Hydrological

- Hydrogeological conceptual model and/or water balance
- Surface water and groundwater quality
- Surface water and groundwater levels
- Rainfall and rainwater quality
- Expert local knowledge

Atmospheric

- Data from existing atmospheric deposition monitoring networks
- Modeled atmospheric deposition data
- Expert local knowledge

Equipment

The following is a list of equipment, suppliers and costs (correct at time of writing) for analysis and sample equipment that may be required for site investigation. Where one of the potential partners already owns the equipment then this has been noted as sharing between partner organisations will help to reduce costs of the overall monitoring program.

Parameter/equipment	Use	Supplier	Est Cost (£)
Inorganic water samples	Characterization of water types and N and P in groundwater and surface water/Ensure the lowest detection limits (or LOD) for N and P are used	EA/NRW	~£50 per sample
Field water quality parameters	Collection of pH, DO, EC, temperature and redox in the field	YSI/In situ	Loan from EA/NRW/BGS
Pump	Portable groundwater pump to collect water samples from dipwells and boreholes	WASP	Loan from EA/NRW/BGS
Rainwater quality	Characterization of rain water quality	~£50 per sample	
Nitrogen and Oxygen stable Isotopes	Source attribution of nitrogen using 15N/14N + $^{18}O/^{16}O$ isotopes in groundwater and surface water	BGS	£30–44 per sample (UEA) £140 per sample (NERC Labs)
CFC and SF_6	Age dating of young waters	BGS	£230 per sample
Diffusion tubes	Collection and analysis of atmospheric deposition data	Enviro Technologies/Gradko (NO_2), CEH Edinburgh (NH_3 badge samplers)	NO_2 tube and analysis £7.90 (needed in quadruplicate per month per site) NH_3 badge sampler and analysis £25 (needed in triplicate per month per site)
Dipwell casing	Installation of new monitoring points to sample groundwater	MGS Geotechnical	<£200
Groundwater levels	Characterization of groundwater levels using a vented or non vented pressure transducer	Solinst/Diver/Hobo	Loan from EA/NRW/BGS
Surface water gauges and flow	Estimation of flow into or out of a wetland from any surface water feature. e.g ditch, spring or stream, using manual flow meter or automated data logger	BGS	Loan from EA/NRW/BGS
Survey equipment	Accurate survey of location and elevation of all monitoring equipment. Using Leica Smartrover	BGS	Loan from BGS

Risks

The following risks are considered for any future work, namely onsite investigations and source apportionment work, following on from recommendations made within this report:

- **Project Management:** a project group should be assembled early on to review and comment on proposals and to select and agree upon the sites for the future study. A single project manager should take charge of the project.
- **Unrepresentative site selection:** It will be important to consider the types, locations and pressures of any sites included in future work.
- **Inconclusive results:** It is highly possible that even after collecting data sets at various sites that the results are ambiguous or inconclusive (*see* Research needs).
- **Funding:** funding or time in kind should be sort from all partners including, but not limited to Environment Agency, Natural Resources Wales, Natural England, British Geological Survey (NERC) and the Center for Ecology and Hydrology (NERC).

Category:

- OR/14/047 Atmospheric deposition at groundwater dependent wetlands: implications for effective catchment management and Water Framework Directive groundwater classification in England and Wales

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