

# Water Quality Studies

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**Water Quality** presents special problems to environmental managers who have to control rivers, lakes, groundwaters and wetlands to meet both environmental standards and water supply standards. For example, the new EU Water Framework Directive is having a major impact on the control of water quality and ecology as the new standards are set and applied at the catchment scale. New techniques on modelling catchments are required in order to cope with the increasing complexity of water quality issues.

**Water Resource Associates** have developed a range of water quality models for modelling river systems and catchments. These include the HERMES and INCA software packages. HERMES simulates the transport of pollution events down river systems and this model simulates flow, Dissolved Oxygen, Biochemical Oxygen demand, Ammonia, E Coli and any conservative or nominally unreactive pollutant.

**In association with research at Reading University**, Water Resource Associates has also developed a suite of catchment-based models collectively known as the INCA (Integrated Catchment) models. These take into account the land surface and land use and route the water and associated quality into the river network. Current versions of the software include INCA-N for flow, nitrate and ammonia, INCA-P for phosphorus, sediments, macrophytes, epiphytes and phytoplankton, INCA-SED for a sediments and INCA-Metals for a range of metals as well as a carbon model for DOC or water colour problems. All the models are process based, dynamic, daily and generate fluxes estimates and concentrations of all the variables at key locations along river systems.



## Experience as a company and directors

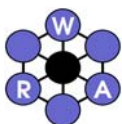
### Eurolimpacs Project

The directors of the company are currently managing the modelling work package of the EU 6<sup>th</sup> Framework Project Eurolimpacs ([www.eurolimpacs.ucl](http://www.eurolimpacs.ucl)). This is a major project to assess the impacts of climatic change on flow and water quality across Europe. New models are being developed based on scientific experiments to be conducted across the EU. The project involves 38 partners and many end-users and stakeholders such as the UK Environment agency.

### UK Project to assess the Impact of Climate Change on Water Quality

A report has recently been completed for the Environment Agency, demonstrating the potential impact of climate change on water quality in selected pilot catchments. Versions of INCA for phosphorus, sediment and nitrogen have been used to assess the potential impact on flow and water quality in the Rivers, Lambourn, Kennet, Tamar, Tweed and Lugg [Wye]. The UKCIP02 scenarios have been used to drive the models and the outputs have been analyzed for the 2010s, 2020s and the 2050s.

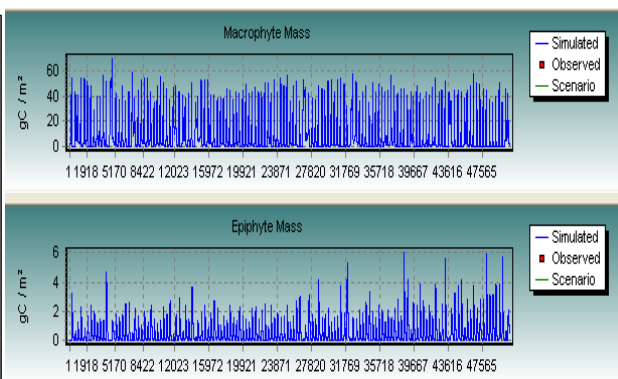
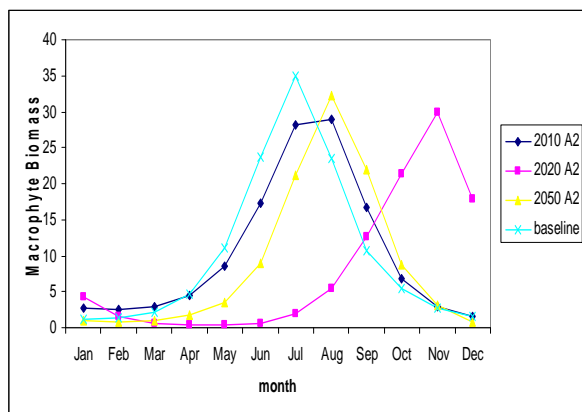
Further work has been carried out on six British rivers for the Environment Agency. In the River Lambourn, declining concentrations of soluble reactive phosphorus [SRP] were predicted for winter months and increasing concentrations during summer and autumn months, caused by lower flows and reduced dilution. Such change, combined with change in temperature and flow, affects the ecology, particularly macrophyte growth in summer months. The urbanized midlands rivers show similar increased SRP levels in summer, but higher increases in winter due to diffuse urban runoff. In the western and rural River Lugg, the SRP is predicted to decrease in winter but increase in summer months.



**Water Resource Associates**

*A specialist consultancy in water resources, hydrology, hydraulics, hydrogeology & water quality*

## Impact of Climate Change on Water Quality – WRA Expertise

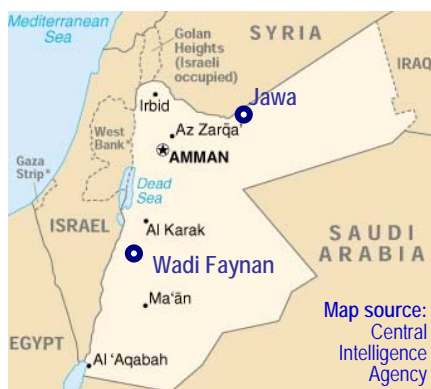


Lambourn macrophyte biomass  $g\ C/m^2$  monthly statistics over a range of time periods for the A2 long-term scenario

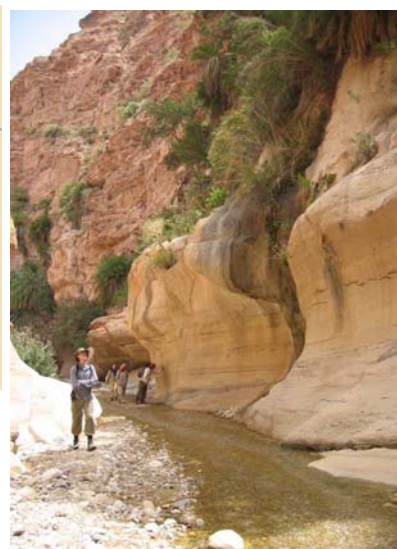
Nitrate levels in the northern Tweed show increased winter levels in upland headwaters as organic nitrogen is released and decreased levels in summer months. Although the lower Tweed also shows increased nitrates in winter, the highest increases are in summer, due to change in land use and point source discharges. Nitrate levels in the Tamar have a similar response to the Tweed. Full details of the project are given in the report, Potential Impacts of Climate Change on River Water Quality by Whitehead et al, 2008, Science Report SC070043/SR1. [//publications.environment-agency.gov.uk/pdf/scho0508bocw-e-e.pdf](http://publications.environment-agency.gov.uk/pdf/scho0508bocw-e-e.pdf).

### Jordan

WRA provided past and future climate modeling expertise to a 3-year project funded by the Leverhulme Trust. Both HYSIM and INCA models were developed to represent and predict past and future flow and water quality in the Jordan River. This project investigated the impacts of climate change in the region.



Travertine deposits were sampled in Wadi Ghuwayr during April/May 2007, to help determine the relative wetness of the climate at key times during the Holocene. The samples were analysed at the University of Reading. >>>>



**Australia** - The water quality river model HERMES has been applied to the Murrumbidgee River system to evaluate the impacts of effluent discharges from Canberra prior to the installation of tertiary treatment.

**Thailand** - Water quality models were developed for the Sonkla Lakes in Southern Thailand to evaluate the rates of siltation and nutrient build up in the lake systems.

### New Dispersion model

A new model of dispersion has been developed by Steve Chapra and Paul Whitehead to simulate the impact of pollutant discharges on river systems. The model accounts for the main processes operating in rivers as well as the dilution from incoming tributaries and first order kinetic decay processes. The model is dynamic and simulates hourly behaviour of flow and pollutants along river systems.

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