

Keeping Rivers Cool

Clients: Atkins – Canal and Rivers Trust – Southern Water – Environment Agency

Fluvial Ecosystems

Southern UK is blessed with chalk river systems which are designated as SSSI and SAC. These important ecosystems include Ranunculus communities, southern blue damselfly, white-clawed crayfish, bullhead and brook lamprey among others. Some of these chalk streams such as the Itchen include extensive water meadows and water cress beds. Rivers such as the Itchen and Test support very important Atlantic salmon and trout fisheries. Not all



Salmonids are temperature sensitive

SSSI & SAC are in good condition partly due to climate change but also due to inappropriate water level management. In some rivers the



Damselfly do not like dense riparian foliage

pressure to abstract greater quantities of water may stress the ecosystems even further. Many fluvial

ecosystems are close to their limiting thermal tolerance and any additional stress due to abstraction, reduced flows or radical changes to the riparian configuration is to be avoided.

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It is important to ensure that rivers do not suffer severe temperature changes from well-intentioned management actions or changed abstraction.

An example is the restoration of water meadow carriers in the Itchen with suitable foliage at the margins. These are shallow and slow flowing so there is a danger that these small streams could carry warm water back to the main stream.

The selection of appropriate foliage is not straightforward. Heavy shading would not suit the damselfly, but in opposition to that heavy shading would ensure the streams are kept cool in the day. Ground nesting wading birds require large expanses of open shrub and tree free meadows. These conflicting requirements demand an accurate analysis of the thermal situation in order to generate an optimal plan.

In a similar vein the demand for increased abstraction can impact the temperature regime in a chalk stream. The River Test is a very important salmonid river but is also subject to abstraction for human consumption. This river has a tributary known as the Black River which is very shaded. Perhaps counterintuitively the Test would be slightly cooled by an increase in abstraction owing to the resulting changed mixing ratio. TechnoEconomica applied a model to simulate how this would occur for numerous scenarios covering variations in climate, season, flow regime and abstraction.

Convincing the Regulator

Quite rightly the regulator will require a robust and accurate analysis to show the long-term detailed variation of temperature throughout the water body. The models we apply are always calibrated and we have achieved calibration accuracies of

fractions of 1°C which enables decision making to proceed with confidence.

Modelling Systems

The modelling system developed by TechnoEconomica simulates the long-term thermal evolution of rivers and streams with hydrodynamics solved using our MOL solution of the St Venant equations. The system accounts for every aspect of heat exchange, including solar, atmospheric, ground and the influence of foliage and buildings on dynamic heat balance. Seasonal changes in the foliage are included as is the distribution of wind velocity at the water surface.

Where boundary data is absent, we use a calibrated virtual lake approach to provide long term boundary data which is driven by hourly meteorological data. We have applied this model to rivers and canals to investigate the impacts of:

- Abstraction changes
- Foliage type including trees and shrubs
- Buildings
- Stream orientation
- Confluence of streams and side channels
- Climate change
- Riparian management

Services Provided

- Specification and analysis of thermal and hydrographic surveys
- 1D Modelling of fluvial thermal profiles
- Studies on the impact of abstraction
- Studies on the effect of different riparian foliage

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