

WFD – Taking the next step forward in joined up thinking

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Introduction

The River Don is the main river in South Yorkshire - rising in the Pennines, and flowing eastwards for 70 miles, through the major conurbation of Sheffield. In the late 1980's, the Don was one of the most polluted rivers in Europe – mainly as a result of discharges from sewage treatment works and the sewerage system, the many steel foundries in the area and the coal mining and processing industries.

Over the last 25 years, the Don has been transformed into a largely clean river that supports a thriving fish population. There are even occasional sightings of salmon in the lower reaches of the river. And yet, the river remains fragile. In July 2006, following a summer thunderstorm after a hot dry spell, there was a major fish kill on the river. Questions were asked in Parliament as a result. The Environment Agency is still recording episodes of poor water quality downstream of the main Sheffield sewage works.

To understand why there is still occasional poor water quality in the river Don, including the root causes of the fish kill, and what might be done to prevent a repetition, Yorkshire Water is carrying out a comprehensive study of the River Don. This will include significant fieldwork - allied to comprehensive modelling of the sewerage network, sewage treatment works and the river system in an integrated and detailed manner. At the same time, it is important to engage with key external stakeholders on the study; not just the Environment Agency, but other key bodies, such as the Don Catchment Rivers Trust. And, as if that were not enough, everything has to be completed before the end of 2012.

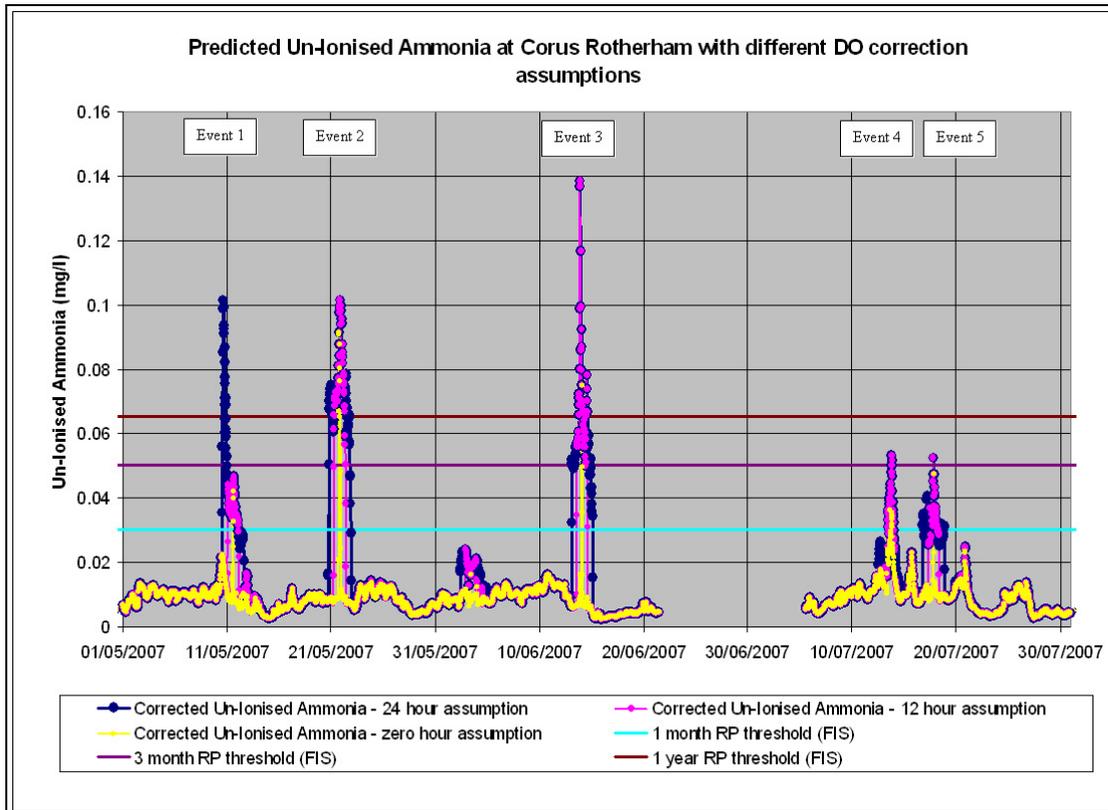
Background to the fish kill

In early July 2007, the Don catchment had experienced a prolonged period of high river temperatures of over 20°C and low river flows. On 2nd July, a series of severe thunderstorms occurred over the majority of Sheffield, increasing the river flows from 2 to 35 cumecs in little over an hour. The dissolved oxygen in the river dropped sharply to under 2mg/l at locations downstream of the main Sheffield (Blackburn Meadows) WwTW. There was also a significant rise in the amount of BOD and ammonia within the system with, for example, values of over 20mg/l BOD being recorded. As a consequence, several thousand fish died, with the incident being classed as category one by the Environment Agency - the most severe form of event.

Initial reactions were that this was obviously due to the treatment works. Further investigation, however, has come up with some contrary indicators. The main Don Valley interceptor sewer was not discharging at the time of the event and the storm tanks at the works only filled after the event. Other anecdotal evidence also indicated other phenomenon taking place, such as algal mats being washed down the river.

Following the event, the Environment Agency installed a number of continuous dissolved oxygen and ammonia monitors downstream of the works to gain more understanding of what was happening to the river. These revealed the variable quality of the River Don, including other episodes of low dissolved oxygen and high ammonia - but not to the same extent as those that occurred during the fish kill. Analysis of the data showed that some of the events were severe enough to breach the Urban Pollution Management (UPM) Fundamental Intermittent Standards, which have been

specifically set up to protect fish life. The analysis showed events travelling down the catchment, sometimes from the works and sometimes from upstream. What also stood out was that some of the events were not happening in wet weather.

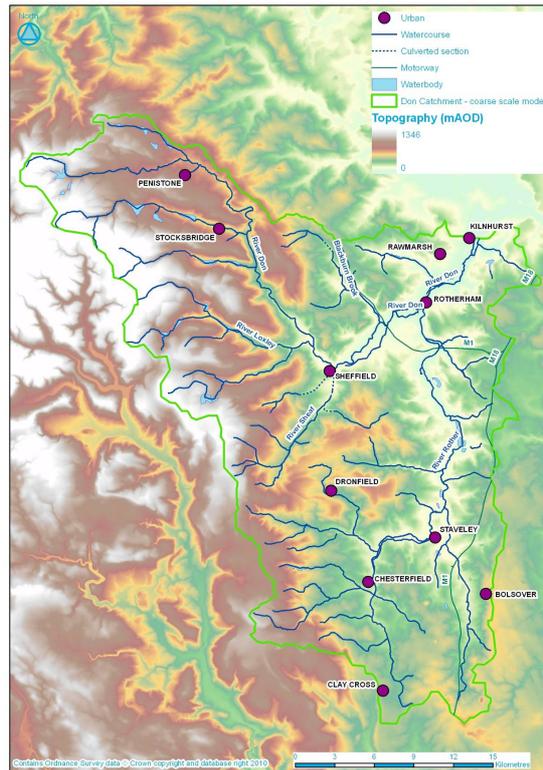


The approach

To help fully understand the reasons for the fish kill and the UPM FIS failures, Yorkshire Water is about to carry out a comprehensive study of the catchment, involving river monitoring and modelling, in conjunction with sewer models of the key study area.

The study will have a detail area that covers the River Don downstream of the M1 to Kilnhurst - with the River Rother also being studied in detail from Woodhouse Mill to the Don confluence. Within this area, the water quality will be monitored continuously for a year using water quality sondes, which will provide dissolved oxygen, ammonia, temperature and pH information. To augment the sondes, water quality auto samplers will be used to take a series of spot samples for parameters that cannot be analysed by the sondes, such as BOD. The auto sampling will be carried out for a series of storm events and also dry periods. For river flow information, the study is well served, with permanent Environment Agency flow gauges on the Don adjacent to the M1 and on the Rother at Woodhouse Mill. There are also a number of Agency level gauges in the catchment and temporary ratings will be established for those sites. There are also a number of permanent rain gauges within the study area and these will be significantly augmented for the sewer modelling studies.

For the river modelling, a model of the detailed area will be built in MIKE 11. To provide the upstream flow and water quality information, the entire upstream Don and Rother catchments will be mapped in MIKE BASIN and will extend down to below the detailed study area with, in effect, the detailed model sitting on top of the coarse scale model. Within the coarse scale model, general representations of the functioning of the sewerage system will be included. The extent of the coarse scale model is shown below.



In addition to the modelling of the river system, full Infoworks modelling of the sewerage system affecting the study reach will be included in the modelling. As the main interceptor sewer is a key feature of the system, then this will also involve building a macro model of the whole of the upstream Sheffield system, so that this feature can be represented correctly. For the treatment works, this will be modelled using BioWin software. The need for modelling the treatment works is further emphasised by the fact that the Blackburn Meadows works is being rebuilt during AMP5 to meet the requirements of the Freshwater Fish Directive.

Monitoring of the water quality of the system is important for several reasons. Firstly, it allows a direct comparison to be made with the UPM FIS standards, something that had previously only been achieved through modelling. Secondly, it also allows the boundary conditions for the fine scale model to be determined in detail and thirdly they provide an insight into the dynamics of what is happening within the key study area.

The approach means that the river flow, water quality and sewer models can be integrated and layered to provide appropriate levels of detail where required, without requiring undue detail in other areas. Initially, the coarse scale models will primarily be validated to provide accurate river flows and qualities at the boundaries of the detail model, but will still provide information within catchments in the upstream models. When carrying out simulations, both river and sewer systems will be driven by the same input rainfall so that any synchronisation between sewer and river discharges can be properly accounted for. In addition, when the fish kill event is simulated, it is important that a good calibration has been established, to allow conclusions to be made with confidence.

As a spin-off from the study, a comparison will be undertaken between the time series approach using the coarse scale MIKE BASIN models and the SIMCAT Monte Carlo modelling tools traditionally used by the Agency for water quality planning purposes. This is ultimately likely to lead to other areas of integration within modelling approaches, such as the incorporation of energy information, the ability to operate works differently

according to season and the ability to interplay between water quality and water resources.

Progress to date

The team of consultants, contractors and YW personnel have been working on this project since April. In that time, much of the scope of the work has been defined and agreed, although a few details remain. Fieldwork, particularly for water quality has commenced, with vagaries of land access agreements leading to some delays along the way. At the same time, processing of data is also taking place; this has revealed questions to be taken up with the contractor along with new information on the performance of the works and on water quality upstream of the study area. The team are now in the midst of defining data requirements and managing the task of data acquisition and transfer between the various organisations. On the sewer side, monitoring and modelling has now also commenced.

Outcomes

As an outcome from the study, the team are looking to understand the reasons for both the FFD failures and the root causes of the fish kill. It is vital though that this is not done in isolation as there are many other people involved as well, including:-

- Interest groups, such as the Don Catchment Rivers Trust
- Local councils
- Interested landowners, and
- Academics

To deliver a successful outcome from the project, it is important that all these groups are effectively engaged. To achieve this, we will be looking to templates we have recently used elsewhere in the region, particularly on the coast.

Once the reasons for failure are understood, it is likely that the answers to success will not only lie in traditional civil engineering and the way we operate existing assets - though opportunities to look differently at what we do with the works and interceptor sewer will be considered, with particular consideration being given to carbon and sustainability aspects of any decision. Moreover, there is the distinct possibility for interplay between clean and waste assets within the Don catchment which is worth exploring. There are also different approaches entirely that could be considered, such as the use of oxygenation equipment in critical low flow / high temperature periods. There may even need to be consideration of ecological approaches to mitigating the impact of extreme conditions as opposed to traditional engineering. Whatever the eventual outcome, what is certain is that the Don study will be based on the concept of sound science for sound decision making.

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