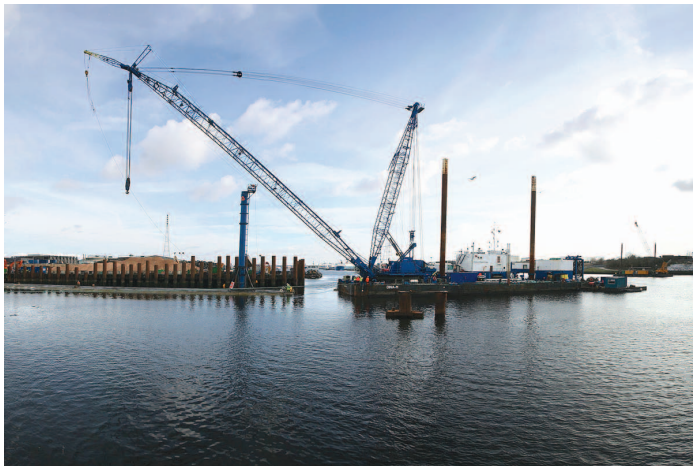
River Quality Protected during Tyne Tunnel Construction Project

Five buoy-mounted automatic water quality monitors (AWQMs) have been installed by YSI Hydrodata engineers at the new Tyne Tunnel project to ensure that construction operations do not significantly affect river water quality. Unusually, the contractors have not taken ownership of the instrumentation, preferring instead to simply purchase the data and alarms.

Background: Traffic Tunnel

In 1967 a two-lane toll vehicular tunnel was built under the River Tyne in the North East of England, a few miles east of Newcastle upon Tyne. Originally designed for a daily traffic throughput of 24,000 vehicles, it now carries 38,000 customers per day.

In July 2005, approval was given to the Tyne & Wear Passenger Transport Authority (now the Tyne and Wear Integrated Transport Authority or TWITA) for a new tunnel and construction began in Spring 2008.



Continuous water quality monitoring upstream and downstream of dredging in the Port of Tyne protected migrating salmon

The tunnel has been constructed utilising a hybrid method– immersed tubes form the river section and a cut-and-cover method has been deployed on the land. The river section involved the construction of four, 90 m long, 15 m wide and 8.5 m high concrete units in the nearby Walker dry dock that were subsequently floated down river and dropped into position.

The riverbed location for the concrete cylinders that would form the tunnel was formed by a 'cutter suction dredger' capable of pumping up to 7000 m^3 of sediment/water slurry per hour. In total, the dredger removed 400,000 m^3 of sediment over a 5 week period during December 2009.

YSI Hydrodata was contracted to provide continuous monitoring data from five locations in the river. They did this by setting up a website accessible to the key stakeholders –Newcastle University, Newcastle City Council, the contractor Bouygues Travaux Publics, the dredging company Jan De Nul, Port of Tyne and the Environment Agency (EA)–to which the data were transmitted in real time.

Dredging the Trench

Originally, the plan was to employ a grab dredger to create the trench, with sediment removal by barge and disposal by landfill. However, the possibility arose of using the dredged material to infill Port of Tyne's redundant Tyne Dock, thereby reclaiming 13 acres of land for use by Port of Tyne. The cutter suction dredger removed material with a solids content of approximately 20% so a sheet pile wall was erected in the dock to optimise settlement of the solids. Furthermore, silt curtains were employed to limit the level of solids in the overflow to the river. One of the AWQMs was sited close to the overflow point to ensure that this did not adversely affect water quality.

Environmental Protection

The EA reached a legal agreement with TWITA that included water quality standards to ensure the protection of the environment and particularly migrating salmon on their way to breed in the upper Tyne catchment. The agreement also required AWQMs to demonstrate that these standards were met and to trigger corrective action if they were breached.

As recently as 1959, no salmon were caught in the Tyne, but they have returned as water quality recovered from domestic and industrial pollution. For the last ten years the River Tyne has arguably been the finest salmon river in England and Wales, with over 3000 salmon caught each year.

The AWQMs were installed around 12 months prior to the commencement of dredging operations so that 'normal' water quality conditions could be established. The standards were based on differences between measurements of water quality upstream and downstream (depending on the tide) of the dredging operations. This allowed the impact of the dredging operation to be distinguished from background variations.

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Roger Inverarity is a water quality planner with the EA. He says, "Having access to continuous live water quality data via a web site gave all stakeholders information about what was happening in the river, day or night. It enabled the dredger to respond to any deterioration and us, the regulator, to check that they were doing so."

Each of the YSI AWQMs is fitted with highly accurate sensors that are designed to operate in challenging environments. These continuously measure dissolved oxygen, turbidity and temperature in addition to velocity. The turbidity measurement is particularly important because it is a surrogate for both suspended sediments and any contaminants that are associated with them.

The AWQMS raised alarms on a small number of occasions, largely as a result of high turbidity in the overflow from the dock. When alarm conditions arose, an email was automatically generated and sent to a mobile phone on the dredger, whereupon dredging ceased until water quality had returned to acceptable levels.

YSI Hydrodata's Andy Burton was responsible for the installation and maintenance of the AWQMs. He is delighted that the data provided by his company's instruments have contributed to the success of the project: "Monitoring water quality in a tidal estuary close to the North Sea in all weathers has been a significant challenge and the reliability of our data is testament to the ruggedness of the instruments. Our anti-fouling technology proved to be a particular benefit in these aggressive conditions."

Autonomous water quality monitoring buoy in the River Tyne; dissolved oxygen, turbidity, and temperature sensors on a YSI sonde attached to the buoy

Meeting Water Quality Goals

Looking back, Roger Inverarity says, "From an environmental regulator's perspective, the overall objective was to protect the estuarine system during the course of the project. The AWQMs was a key part of the agreed controls to enable achievement of this goal. It is good that we could ensure and demonstrate that water quality has not been significantly affected by the works."

Nicolas Caille, Project Managing Director for Bouygues Travaux Publics UK, says, "We were very pleased with the outcome of the dredging works. The water quality monitoring demonstrated that we delivered this sensitive aspect of the works with the highest regard for environmental protection. The choice of monitoring equipment was important because we had to satisfy environmental stakeholders in terms of reliability, sensitivity, and accuracy. The technology we opted for provided great reassurance to all parties."

This project was unusual. Firstly, the environmental monitoring took place for a considerable length of time–both during the project and for 12 months beforehand. Secondly, the environmental conditions were occasionally severe and thirdly, the contractor decided that data would be purchased instead of instruments. This placed the responsibility for installation, ongoing calibration and maintenance with YSI Hydrodata.

Commenting on the benefits of purchasing data, YSI's Regional Director Darren Hanson says, "When monitoring is only required for a specific period of time, it often makes sense not to take ownership of the assets. This is not just because of instrument redundancy at the end of the project, but also because the maintenance of the equipment is effectively transferred to YSI Hydrodata staff who possess an intimate knowledge of the equipment, so they are in a good position to ensure that it performs to its best ability."

YSI has completed a number of projects in which the company has been contracted to supply monitoring data and Hanson says, "This is a growing trend because we have invested in the resources necessary to effectively fulfill contracts of this nature and because recent advances in communications and internet technology have enabled us to transfer live data to customers' desktops with far greater speed than has ever been possible in the past."

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