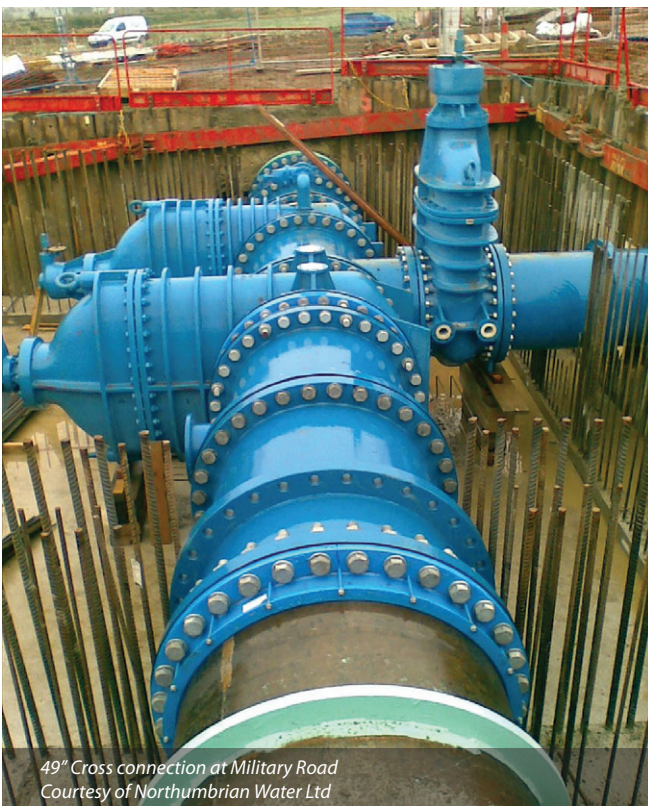


# Trunk Mains Cleaning Programme

## Northumbrian Water's £30 million project to clean and refurbish 157km of trunk mains in Tyneside and South East Northumberland

by Richard Johnston

Northumbrian Water Ltd (NWL) is committed to ensuring the drinking water supplied to customers is of excellent quality. The trunk mains cleaning AMP4 Acceptability of Water (AOW) programme is part of Northumbrian Water's strategic directive statement (2004) to reduce customer contacts relating to discolouration, from 14,000 to 5,000 a year. In 2007, Northumbrian Water launched a £30 million scheme to clean 157km of trunk water mains in the north of Newcastle, North Tyneside and South East Northumberland. The scheme comprised a £19.5m suite of contracts to clean or renew pipes, and improve water quality to hundreds of thousands of customers. The project demonstrates a commitment to set water industry benchmark performance in new technology and innovation, and also reinforces the NWL's aspiration to be the national leader in drinking water quality and customer service.



49" Cross connection at Military Road  
Courtesy of Northumbrian Water Ltd



(Kilbride) Hydrascan cleaning  
Courtesy of Northumbrian Water Ltd

### Background

Since 2000, extensive water quality improvement schemes have been carried out at both treatment works and within the distribution network. In 2006, NWL launched a study in to the creation of a 'Trunk Mains Investigation Model' to enable the monitoring of customer contacts to assess, evaluate and prioritise improvement work in various drinking water distribution system zones.

The model categorised the highest priority as System Zone 07 (SZ07), which consists of approximately 157km of trunk mains in the north of Newcastle, North Tyneside and South East Northumberland. This system zone supplies drinking water to 500,000 people. NWL identified the need to carry out this cleaning work on a 'source to tap' principle. It was acknowledged that a scheme of this nature has never been attempted by the company.

Some of the trunk mains planned to be worked on had been in use for over 100 years. They had never been isolated and varied in condition, material and size. It was evident that some sections of pipe could not be isolated without loss of supply to customers and,

as a result, new pipe would need to be laid.

### Investigation and feasibility

A feasibility study to clean the System Zone 07 trunk mains network was launched in February 2007. The study concluded that extensive enabling work would be required to allow us to decommission trunk mains, on an individual basis, with minimal impact to customer supplies. Thought also had to be given to ensure there was operational flexibility within the section of network that was being cleaned and upgraded.

During the feasibility stage, Northumbrian Water carried out physical investigations of pipe lengths, and more than 40 sediment analysis points were installed throughout the System Zone 07 network. In addition, water quality sampling and tests on 'cut out' sections of pipe took place.

Inspection data was gathered and analysed and it indicated that the sediment (residue material) contained predominately Iron (Fe), Manganese (Mn) and Aluminium (Al).



  
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Fastflow cleaning head first pass entering 24" epoxy lined pipe  
Courtesy of Northumbrian Water Ltd 12/01/2009

The findings were that the 'residue material' was 'attracted' to the pipe wall. This 'residue material' was particularly susceptible to fluctuations in flow and velocity changes, and under normal operating conditions the network was very difficult to operate in its current condition. There was a high risk of this resulting in discoloured water.

#### Hydraulic investigation

The feasibility study also considered hydraulic performance within the network. The outcome was that the majority of pipes could be isolated, but only with the installation of enabling works. The enabling works included installing additional in-line valves and construction of new cross connections.

The exception was a 16.6km section of 49" pipe, which runs from Horsley WTW to the district meter area at Gosforth in Newcastle. To isolate and clean this section of trunk main, NWL had to duplicate it and install a new 16.6km pipeline. The enabling work will also allow flexibility within this section of the trunk mains cleaning network when future cleaning and maintenance work is carried out.

The study also considered the impact on production outputs. Two water treatment works at Horsley and Warkworth are the main sources within System Zone 07. The operational regimes would vary significantly at times over the programme of cleaning work. This was factored into the proposed sequencing and isolation programme. For example, Horsley WTW needed to sustain 130MI/d (million litres per day), which is more than 30% of the normal water production output, over a four month period. At the other end of the spectrum, Warkworth WTW would be required to operate at minimal to zero flows over similar periods of time.

To allow this variance in water production to take place, a number of supporting projects and testing was required, including the upgrade of the raw water river intake. Treatment processes, delivery pumps and surge vessels were also upgraded or replaced at both the Horsley and Warkworth WTWs.

#### Cleaning trials

As Northumbrian Water had never attempted any cleaning work like this before, the company had to ensure that the aims and expectations of the programme were achievable. In 2008, a 5km section of 36" steel diameter bitumen lined pipeline was made available for full scale field trials, and evaluation of cleaning technologies.

Contractors, designers and technology developers were invited to participate in the trials with the aim of evaluating the performance, effectiveness and efficiency of the processes.

Criteria assessed included:

- *Minimal use of water* - the use of excessive water was discouraged from an environmental point of view and consideration was also given to the safe removal and disposal of waste material and wash water;
- *Cleaning lengths* - it was a requirement to reduce and mitigate the number of excavations required to access pipe and it was an aspiration to be able to clean lengths in excess of 500 metres;
- *Aggressiveness of cleaning technique* - the pipes had existing linings and the development of non-aggressive cleaning techniques, which would not unduly damage the existing lining and achieve a 'clean' pipe, was an important requirement;
- *Capabilities pre and post CCTV inspection surveys.*

At the same time as determining the parameters for the trials, NWL needed to understand how to determine if a pipe was clean and what the acceptable standard would be, after cleaning. It was acknowledged that many cleaning processes on the market relied

on the number of 'passes' (of the cleaning equipment) to declare that the pipe had been cleaned.

Northumbrian Water aspired to be able to demonstrate more evidential, auditable and qualitative criteria, so set out to establish an achievable cleaning specification. The initial target was to set out to maintain the same water quality standards as when water leaves a water treatment works. The targets agreed were:

- Iron <math><50 \mu\text{g/l}</math>
- Aluminium <math><50 \mu\text{g/l}</math>
- Manganese <math><10 \mu\text{g/l}</math>

#### **Trials**

Specialist water pressure jetting companies participated in the trials. Kilbride Industrial Solutions further developed their existing jetting capabilities and designed new cleaning heads (UKSTT innovation award winner 2009). Fastflow Pipeline Services developed a completely new cleaning system based on the water jetting principle (UKSTT innovation award winner 2008).

Trials on the 5km section of pipeline was completed successfully with minimal use of water and the criteria to clean long lengths of pipe were met. CCTV surveys indicated that the required water quality standards were achievable.

#### **Post cleaning trials**

It was concluded that the techniques and technology needed were available and that water pressure jetting was most favoured.

#### **Implementation of cleaning work**

In 2008 Northumbrian Water commenced procurement of the trunk mains cleaning contracts. This involved putting three separate cleaning contracts in place to clean a total of 157km of pipe.

#### **Contract one**

*Awarded to:* Balfour Beatty Utility Solutions Ltd  
*Cleaning method:* water jetting 7km of 49" steel bitumen lined pipe and link mains  
*Value:* £2.2 million  
*Commenced:* July 2009 - *Completed:* January 2010

#### **Contract two**

*Awarded to:* Fastflow Pipeline Services  
*Cleaning method:* water jetting 84km of trunk mains, (ranging from 8" to 36") with existing linings and 9km of PU lining/pipe replacement  
*Value:* £6 million  
*Commenced:* October 2008 - *Completion due:* June 2011

#### **Contract three**

*Awarded to:* Lumsden & Carroll Construction Ltd (cleaning works sub contractor Kilbride/Hydrascan, PU Lining works Needham Specialist Machines)  
*Cleaning method:* water jetting 52km of trunk mains with existing linings (range 12" to 36") and 5km of PU lining  
*Commenced:* April 2009 - *Completion due:* June 2011

#### **Customer and stakeholder communication strategy**

It was vital that a strategy was put in place to ensure consistent and timely communication with customers and various stakeholders. Before the enabling work began, NWL communicated with all those affected. Customers who would be affected by the four-year scheme were informed of the work with an initial letter and detailed information leaflet. This was followed by localised letter and leaflet drops and, where necessary and appropriate, customer information sessions were arranged where customers could come along to ask questions, and NWL had the opportunity to update them on the progress of the work.

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To date, NWL have mailed somewhere in the region of 650,000 information letters and/or leaflets, and have also issued regular updates to the media and political and business stakeholders. Within the defined cleaning area, three local highway authorities were affected by the work. Each one actively engaged with Northumbrian Water and assisted, advised and cooperated with both NWL and our contractors during the course of the work.

**Coordination planning**

The 157km of trunk mains to be cleaned was broken down into 85 individual sections, split between the two main contracts. Each section presented our customer team with challenges. They needed to ensure that the high standards of customer service were maintained.

To enable each section of pipe to be de-commissioned and re-commissioned without impact or major disruption to the trunk mains distribution system, a dedicated coordination planning team was formed. It consists of colleagues from water quality, network analysis, distribution operations, contractors, planners, communications, the customer team and investment delivery.

The planning team has considered each of the 85 sections on an individual basis, taking into account the sensitivity of the trunk mains system. Network modellers explored hydraulic performance, potential impact on customers and we also built in the installation of local mitigation and enabling works where appropriate.

The distribution operations team compiled de-commissioning and re-commissioning valve schedules and, network monitoring requirements, for when sections of pipe were isolated. Joint contractor and Northumbrian Water contingency planning considered other on-going work, within the trunk mains distribution network, and assisted with coordination.

**Innovation**

The trunk mains cleaning team actively encouraged innovation. For example, spray chlorination was available within the current market but lacked the ability to cover long lengths of pipe. Northumbrian Water, along with Fastflow Pipeline Services, carried out a research and development project where extensive non-live and live trials were carried out.

Results were compared to conventional chlorination and were found to give comparable post cleaning bacteriological and metal sample results. There were clear environmental benefits as less water used. This was more economically viable and saved time too. The process was subsequently approved, and adopted into Northumbrian Water's disinfection code of practice, in 2010. It has also been approved into the current trunk mains cleaning contracts.

**Summary**

Overall, to date (May 2011), 95% of cleaning work has been completed successfully. The trunk mains cleaning team have managed to carry out this relatively new type of work through some difficult periods. The severe winters in 2008/09 and 2009/10, made working conditions and access very difficult at times.

Isolation of some sections of pipe was particularly problematic. The team has learned some valuable lessons which will be taken into the AMP5 trunk mains cleaning programme - when in the region of 200km of large diameter trunk water mains will be cleaned.

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