

# Trunk Mains Cleaning Programme

£33m AMP5 project to clean and refurbish 218km of trunk mains in Gateshead, Newcastle, North Tyneside and Northumberland

by Stuart Tilley & Richard Johnston

The trunk mains cleaning AMP4 and AMP5 Acceptability of Water (AoW) programmes are part of Northumbrian Water's (NW) strategic directive statement (2004) to reduce customer contacts relating to discolouration from 14,000 to 5,000 a year. During AMP4, NW successfully cleaned and upgraded 157km of trunk water mains in the north of Newcastle, North Tyneside and south-east Northumberland. As part of the AMP5 undertaking, Northumbrian Water has embarked upon the delivery of a further 218km of trunk mains cleaning within Tyneside system zone six (SZ06). These programmes demonstrate NW's commitment to ensuring the drinking water supplied is of excellent quality as well as commitment to set water industry performance benchmarks in new technology and innovation and reinforce the company's aspiration to be the national leader in drinking water quality and customer service. This paper is a continuation of the AMP4 Trunk Mains Cleaning programme and achievements case study published in UK Water Projects 2011.



Valve installation - Courtesy of Northumbrian Water

## AMP4 mains cleaning programme

The £30m programme to clean and upgrade 157km of trunk mains during the AMP4 period consisted of three contracts to improve water quality to approximately 500,000 customers completed in June 2011. A number of contractors were involved in the completion of this scheme of works including Balfour Beatty Utility Solutions Ltd, Fastflow Pipeline Services, Lumsden & Carroll Construction Ltd, Kilbride Industrial Services Ltd and Hydrascan.

NW achieved a reduction in the number of customer complaints in line with the strategic directive statement. The settlement and measurement of success period ran between June 2012 and June 2013. Within the 12 month rolling programme, NW experienced three consecutive months of customer contacts below 5,000 and as a result of this, the DWI signed off the undertaking as complete in June 2013.

## Programme background

Since 2000, extensive water quality improvement schemes have been carried out at both treatment works and within the distribution network. In 2006, NW launched a project to create a Trunk Mains Investigation Model to monitor customer contacts to assess, evaluate and prioritise improvement work in various drinking water distribution system zones.

Prior to the AMP5 period, a similar exercise to that of AMP4 was carried out where the model categorised the next highest priority as system zone six (SZ06). This area consists of approximately 218km of trunk mains, which are supplied from two of NW's largest water treatment works; Whittle Dene WTW and Horsley WTW. These pipes transfer in excess of 100ML/D into the Tyneside Low Service Network and supply around 500,000 customers in the lower Tyne Valley and Tyneside conurbations.

As with AMP4, NW identified the need to carry out this cleaning programme on a 'source to tap' principle to make sure the drinking water provided to customers is of excellent quality.

Some of the trunk mains that required work had been in use for over 100 years. Similar to the network worked on in AMP4, they had never been isolated and were of varied condition, material and size.

#### Investigation and feasibility

A feasibility study to clean the SZ06 trunk mains network was launched in March 2010. The study concluded that enabling works would be required to allow us to decommission trunk mains, on an individual basis.

This work would allow the trunk mains network to be operated with minimal impact to customer supplies. Operational flexibility also had to be taken into account within the section of network that was being cleaned and upgraded.

During the feasibility stage, NW carried out physical investigations of pipe lengths and a number of sediment (residue material) analysis points were installed throughout the SZ06 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 contained predominately Iron (Fe), Manganese (Mn) and Aluminium (Al).

The findings identified that the sediment was attracted to the pipe wall and was particularly susceptible to fluctuations in flow and velocity changes. Under normal operating conditions the network was very difficult to operate in its current condition as there was a high risk of discoloured water if any changes were made in the network.

#### Quality assurance

A NW specific water quality standard is required to be achieved in each section of cleaning by a combination of pre and post CCTV, visual inspection and water quality sampling.

The contractor is required to achieve the following standards:

Iron (Fe):	<50 µg/l
Manganese (Mn):	<50 µg/l
Aluminium (Al):	<10 µg/l
Turbidity:	<1.0 NTU

#### Hydraulic investigation

The feasibility study considered hydraulic performance within the network as well as the impact on the SZ06 production outputs; Whittle Dene and Horsley WTWs being the main water sources within the zone. The operational regimes would vary significantly at times over the programme of cleaning work and this was factored into the proposed sequencing and isolation programme.

To allow this variance in water production to take place, a number of supporting projects and testing were required. This will involve the advance construction and installation of 3 (No.) strategically placed electrically operated control valves (EOVs) and the installation of a number of flow meters within the trunk mains network.

The outcome of the feasibility study was that the majority of pipes could be isolated, but only with the installation of the aforementioned enabling works.

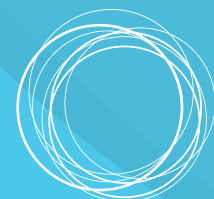
#### Implementation of cleaning work

Procurement of the mains cleaning and enabling works contracts commenced in 2011. In total five cleaning contracts would be competitively tendered to clean a total of 218km of pipe. At the time of writing (July 2013) the first three contracts had been awarded.



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**Contract one**

*Awarded to:* Seymour Civil Engineering Contractors  
*Specialist cleaning contractor:* Kilbride/Hydrascan  
*Length:* 69km of trunk mains (ranging in size: 8" - 42" diameter)  
*Network improvements:* Construction of 4 (No.) EOVs  
*Value:* £5.2m  
*Commenced:* February 2012

**Contract two**

*Awarded to:* Seymour Civil Engineering Contractors  
*Specialist cleaning contractor:* Kilbride/Hydrascan  
*Length:* 22km of trunk mains (ranging in size: 8" - 30" diameter)  
*Value:* £3.1m  
*Commenced:* February 2013

**Contract three**

*Awarded to:* Morrison Utility Services  
*Specialist cleaning contractor:* Kilbride/Hydrascan and Aqualogy  
*Length:* 44km of trunk mains (ranging in size: 8" - 42" diameter)  
*Value:* £4.1m  
*Commenced:* September 2013

**Contract four**

*Awarded to:* Currently being tendered  
*Specialist cleaning contractor:* TBC  
*Length:* 56km of trunk mains (ranging in size: 8" - 42" diameter)  
*Value:* £TBC  
*Commenced:* TBC

**Contract five**

*Awarded to:* Awaiting tender  
*Specialist cleaning contractor:* TBC  
*Length:* 20km of trunk mains (ranging in size: 8" - 30" diameter)  
*Value:* £TBC  
*Commenced:* TBC

**Customer and stakeholder communication strategy**

It was vital that a strategy was put in place to ensure communication with customers and stakeholders is consistent and timely. As the AMP5 programme is taking place in a much more urban environment, a branding identity, *The Main Event*, was created to aid in raising awareness of the programme.

Prior to beginning any cleaning work, NW used various means of communication to contact those expected to be affected. A more modern and innovative approach has been used alongside the more traditional method of notifying by letter.

By using radio, outdoor and bus advertising, social media, information campaigns, community engagement and a dedicated website accessible via a QR code, Northumbrian Water believes a more diverse and wider range of customers and stakeholders can be reached. Where necessary and appropriate, customer information sessions were also arranged where customers could come along to ask questions.

Regular updates have been issued to the media and political and business stakeholders. Within the defined cleaning area, three local highway authorities are affected by the work. Each one is actively engaged with NW and has assisted, advised and cooperated with us and our contractors during the course of the work.

**Coordination planning**

Similar to the AMP4 programme, the 218km of trunk mains to be cleaned was broken down into individual sections and split between the five main contracts. Each section presented the customer team with challenges. They needed to ensure that high standards of customer service were maintained in line with the regulatory Service Incentive Mechanism (SIM).

To enable each section of pipe to be de-commissioned and re-commissioned without impact or major disruption to the trunk mains distribution network, the dedicated NW coordination planning team was carried over from AMP4. The team consisted of colleagues from water quality, network analysis, distribution operations, investment delivery, contractors, planners, communications and the NW customer team.

The planning team considered each of the 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.

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 NW contingency planning considered other on-going work within the trunk mains distribution network, and assisted with coordination.

**Innovation - Ice Pigging**

Between December 2012 and January 2013, NW embarked upon a trial of an innovative cleaning method known as Ice Pigging as an alternative cleaning technique. This technique uses a semi-solid ice slurry to remove particulate deposits from the internal walls of water mains and has numerous advantages that bring benefits to Northumbrian Water's on-going Acceptability of Water (AoW) Trunk Mains Cleaning programme.

NW Research and Development produced an Ice Pigging Technical Evaluation to highlight the objectives of the trial, which were to assess the cleaning effectiveness of the technique, in comparison to the current method of pressure jetting. This evaluation also documented observations and findings from the trial. The post-trial



### The efficient, rapid and environmentally friendly way to clean pipes

Ice Pigging is a patented process for cleaning the inside of pipes using slush ice. It was developed in the UK but is now widely adopted as the most cost-effective method of pipe cleaning in many countries around the world. Ice Pigging:

- Uses **50% less water**.
- Is up to **1000 times more effective** at removing sediment and biofilm.
- **Flows through all diameters**, fittings and bends of pipes.
- Significantly **reduces customer disruption**.
- **Takes half the time** than other techniques.
- Generally requires **no excavations**.
- **Lowest cost option** when considering volume of sediment removed.
- **Exceptionally low risk**.
- Produces **quantifiable results**.
- Ice is **harmless** to public health.



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assessment outlined a recommended Ice Pigging implementation and quality assurance procedure to ensure cleaning is in accordance with current NW cleaning standards.

### Ice Pigging trials

The Ice Pigging trial was carried out on four sections of trunk mains, ranging from 8" to 400mm in diameter, located in north east Northumberland and Tyneside, Morpeth, Pegswood and North Shields. The total length of trunk mains cleaned in this trial was 5.72km.

The trial assessment was based on pre and post-clean inspections to determine the level of cleaning effectiveness achieved by Ice Pigging. The inspections included extraction of cut out pipe samples, under pressure CCTV surveys carried out through hydrants and traditional CCTV surveys carried out whilst the main was isolated and drained down.

The trial has proved that Ice Pigging is very effective at removing particulate deposits from water mains and meets NW water quality cleaning specifications. However, on pipes with cementitious linings, the ice slurry seems to leave sand deposits in the main. It would appear that fine particles from the lining are picked up by the ice slurry and deposited within the main during Ice Pigging. This issue can be overcome by carrying out a second cleaning pass to remove the residual sand deposits and by varying the fraction of the ice particles.

Compared to the current method of pressure jetting, Ice Pigging offers many benefits in terms of reduced enabling works, a significantly reduced cleaning duration and reduced customer, operations, stakeholder and environmental impact. To realise these benefits, the Ice Pigging process must be carried out 'live' without draining down pipework.

To ensure Ice Pigging consistently achieves satisfactory levels of cleaning, the recommended implementation and quality assurance procedure was revised and incorporated into the NW quality assurance document for Ice Pigging. This details five stages of works, which will document the pre and post-clean condition of the main.

NW is also the first water company in the UK to carry out the most comprehensive trial of Ice Pigging to clean large water pipes with Aqualogy Environment Ltd (Ice Pigging Cleaning Services).

As a result of this successful trial, Northumbrian Water has added Ice Pigging to the suite of approved techniques for trunk mains cleaning and has incorporated it into the AMP5 Trunk Mains Cleaning Programme.

During this programme NW expects to clean around 75km with the Ice Pigging technique.

### Summary

Northumbrian Water continues to lead the way in seeking new and innovative ways of working in the trunk mains cleaning field. The trunk mains cleaning team carried over the valuable lessons learnt in the AMP4 period into the AMP5 Trunk Mains Cleaning Programme and at the time of writing (July 2013), over 50km of cleaning works have been completed during the AMP5 period.

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