

The Thirlmere Aqueduct

inspection & refurbishment as part of major programme

by
Alan Spray BSc, CEng, MICE, FCIWEM

Thirlmere Aqueduct has been a source of water for the North West of England since 1894, taking water from Thirlmere in the Lake District down to Manchester and the surrounding area. It is made up of a number of single-line tunnel sections linked by multiple pipe, inverted syphons at road, rail and valley crossings. The tunnel sections have an internal height and width of around 2.1m, with the internal surface being mainly in concrete together with some areas of brickwork and occasional exposed rock soffits. The aqueduct took nine years to build employing some 3,000 men at the peak of activity. A great testament to its Victorian designers is that the flow is entirely by gravity, taking just over a day to reach Manchester. Between 2006 and 2014, as part of its regulatory investment programme, United Utilities is carrying out a major inspection, cleaning and repair programme for its large diameter trunk mains and aqueducts. The £350 million programme is the largest of its kind in Europe and, when completed, more than 800km of the North West's biggest water mains will have been improved, safeguarding water quality for a generation for more than five million people. This article describes the inspection work recently carried out on the Thirlmere Aqueduct as part of this programme.



Thirlmere: Aqueduct: An example of an exposed rock soffit

photo courtesy Hyder Consulting

The 2006 inspection

Following the first inspection of a short section of the aqueduct by PMP in 2005, repair work was carried out by Daniel Contractors and specialists Stonbury.

In October 2006, Hyder Consulting, working with contractor AMCO Donelon, under the overall control of MWH, carried out the first major inspection over a 50km length between Kendal and Bolton.

The inspection was carried out by three teams, each made up of a Hyder structural engineer and two AMCO staff who carried out

various supporting tasks such as setting up surface communications, overseeing safety and carrying out air quality monitoring. Prior to the inspection a considerable amount of preparation was carried out by United Utilities to arrange alternative water supplies for consumers, securely lock-off all supply valves and drain down the aqueduct.

Not surprisingly, the aqueduct was classed as a 'confined' space and all personnel entering it were trained and certified to traverse standard, with the longest traverse between access points being approximately 1.6km. In addition, it was anticipated that naturally



Inspection Team Setting Up Prior to Entering the Aqueduct, with Ventilation Ducts Shown

photo courtesy Hyder Consulting

occurring radon gas would be present in some sections of the tunnel and thus all inspection personnel were required to wear radon dose badges to record their level of exposure.

At the start of each day, AMCO set up forced ventilation systems and ran these for approximately one hour before entry and continuously during the inspection itself. Gas monitoring was carried out prior to entry and during inspections to check for low oxygen levels and the presence of methane gas, the latter being a potential risk within some sections of the tunnel.

In addition to the ventilation system, a hard-wired inductive radio communication system was set up each day to provide continuous contact with the surface teams. A verbal/klaxon back-up communication system was also put in place to ensure a rapid response from the rescue teams should an incident occur.

The inspection was carried out by the team slowly walking along the tunnel and, with the aid of powerful torches, logging any features, defects and water ingress as well as taking cross-section measurements. Digital photographs were taken extensively, both as a general record and at all items of interest.

Control and safe keeping of the large amount of data acquired was of paramount importance, particularly as the work was being carried out to a tight programme in a one-off shutdown of the aqueduct. Each evening the Hyder team reviewed and backed-up the digital photographs and scanned and saved all paper records onto CD's. Duplicate copies of all this information were regularly picked up from the overnight accommodation and stored securely off site.

In addition to the inspection, the project also entailed AMCO taking concrete core samples and water samples, fixing chainage markers and checking and refurbishing drain valves.

The inspection schedule was severely constrained by external factors which meant that each day's work was planned and carried out with military precision.

Findings

Although relatively straightforward in concept, the aqueduct incorporates a number of interesting features, including overflows, washouts, pressure relief valves, manhole accesses and chambers as well as different types of construction, all of which were recorded and photographed.

The inspection resulted in around 5,500 records being prepared and these, along with the test results from the samples, were compiled into a fully interactive electronic report which was completed early in 2007. In general, the condition was found to be very good with only a few areas of minor concern. The report detail is now being used by United Utilities to assess the extent of any required remedial works.

The inspection was completed ahead of the original four week programme and entirely without any health or safety incidents. The joint working with AMCO and United Utilities was exemplary and all parties agreed that the outcome of what was thought to be the longest internal aqueduct inspection ever carried out in Europe was highly successful. ■

Note: The Editor & Publishers wish to thank the author Alan Spray, a Technical Director at Hyder Consulting's Warrington office, for preparing the above article for publication. Contributions are gratefully acknowledged from, United Utilities, AMCO Donelon and Les Frankland, Hyder Consulting's Project Manager.



View Into an Access Chamber from the Tunnel Conduit

photo courtesy Hyder Consulting



Operating throughout the UK and Ireland, Laser Special Projects is a leading multi-sector specialist contractor. Our expert knowledge of legislative requirements, innovative technologies and proven systems ensures a comprehensive service from consultation, assessment and specification, through to delivery of the finished project.



Laser Special Projects

Specialists in Water Engineering



Laser Special Projects

Henwick Mill, Martley Road, Lower Broadheath, Worcestershire, WR2 6RG

T 01905 742750 | E gemma.gunter@laser-group.co.uk | www.laser-group.co.uk