

Enterprise

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Case Study: Eccup Raw Water Main Refurbishment – Subline Technique

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AWARDS 2003

For Trenchless and Minimum Dig Technology

Initial Situation

The past decade has seen considerable development in the techniques available to utilities for the trenchless rehabilitation of pipelines. Much of this development has been in direct response to the demand by utilities for cost-effective solutions to the wide range of problems faced with an ageing infrastructure. Increasing awareness of the social cost of pipeline replacement using traditional open-cut methods and ever tighter regulatory requirements has added new impetus to the search for new innovative solutions.

This paper details an innovative use of the well established Subline deformed close fit PE liner system to renovate a large diameter raw water trunk main. It describes how, by using a flexible approach to programme planning, management and construction the system was applied to resolve many and varied on site issues and problems to effect a successful rehabilitation delivered; on time and within budget, with zero impact on road users and with minimal effect on both the users of a park and its ecology.

Subterra

Enterprise plc
Lancaster House
Centurion Way
Leyland
Lancashire
PR26 6TX
Tel: +44(0)1772 8190 00
Fax: +44(0)1772 819 001
www.enterprise.plc.uk

Key Customer Requirement

As part of their AMP3 capital programme Yorkshire Water constructed a new water treatment plant at Headingley nr Leeds during 2001/2002.



One of the main feeder pipes to the plant was a 42inch diameter ferro-concrete pipeline carrying raw water from Eccup reservoir. It was identified that 860 metres of the main suffered from leaking joints and significant root ingress and was in need of renovation.

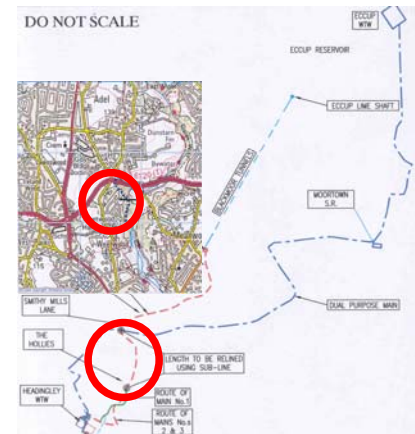
It was a pre-requisite that any renovation method would have to have minimal effect on highways, the public and environment, and because of the strategic importance of the main a short installation time. Restricted access and environmental concerns made new lay an unlikely option so Earth Tech-Morrison as designers and constructors approached Subterra to find a solution.

Our Response

Subterra's Subline method was used to successfully install 827m of 1050mm SDR58 MDPE liner without disruption to footpaths, roads and with minimal disruption to the environment all within the stipulated 13 week possession time.

The location and route of the main presented many varied and interesting challenges to the construction team. The pipeline route as shown starts at the upstream end adjacent to an

access road to a major local cricket ground and training pitch for Yorkshire County Cricket Club.



Via a series of 11¼° and 22½° bends the pipeline then crosses under the busy northern section of the Leeds A6120 ring road and is then joined by two adjacent large diameter aqueducts. The three pipelines, in very close proximity then follow a route up to 4.5 metres deep in places, below a narrow track weaving its way through a major public park containing mature trees supporting a vast array of wildlife. The park is used extensively by the public as a recreation area. Vehicular access to the park is by a narrow, twisting access track gained via an ornate stone gateway severely restricting height and width.

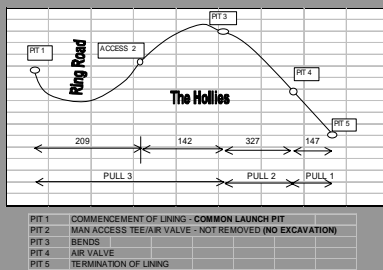
Improvements Achieved

The welding site was located in a field some 200 metres upstream from the launch pit. This location was connected by a narrow access road used by residents to houses overlooking the site. The liner, in 14.5 metre lengths, was delivered to site by lorry and off-loaded in the access to the cricket ground and then taken in individual lengths to the welding site. Prior to delivery, consultation took place with the local authority and Police to determine the most appropriate time for deliveries to avoid rush hour traffic

Our Response summary

The solution was to utilise the access pit at the upstream end as a common single insertion pit in which to winch all of the Sublined liner. However, the weight of 860 metres of PE liner coupled with the quantity and alignment of bends would produce installation forces too high to allow the liner to be inserted in one length.

The liner was therefore installed in three sections, each length being determined by the location of fittings to be renewed:



- **Pull 1 : 147m from the downstream end to the second air valve**
- **Pull 2 : 327m from the second air valve to the second set of bends, and**
- **Pull 3: 351m from the second set of bends, through the first air valve and washout to the insertion pit.**

Without the need to insert from within the park only small pits were needed at these intersection locations to provide access for final connection pipework. Reconnection of the liner ends, replacing the washout and one of the air valves required further innovative thinking.

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Fax: +44(0)1772 819 001
www.enterprise.plc.uk

Improvements Achieved cont..

Four excavations were dug to access the main (see figure 4): at the termination point (where the pipe material changed from ferro-concrete to cast iron), the second air valve, the middle section of bends and the upstream end adjacent to the cricket ground. The installation team, specially trained to work in confined spaces, carried out a complete end-to-end internal inspection to confirm alignment, condition and number of fittings. The main was then cleaned using heavy-duty brushes following removal by manual cutting of root masses intruding through the joints. The internal condition of the concrete main was generally good with little in the way of debris or blistering.

Improvements to: Liner Installation

The Subline machine was positioned near to the launch pit on the edge of the access road. The first 147 metre length weighing approximately 9 tonnes was moved from the welding site to the subline machine, deformed into the characteristic "C" shape, banded and connected to the winch rope. It was then pulled through the main 860 metres until it finally reached its correct position. The second and third lengths, weighing 20 and 22 tonnes respectively, were installed in the same way later the same week.

Improvements to: Liner Reversion

The liner ends were mechanically re-rounded to enable fitting of mechanical end couplings. Blank flange plates were fitted and the liner reverted, by water pressure, into its original circular shape.

Improvements Connections to:

The concrete pipe prevented the use of conventional mechanical transition couplings to 'piece in' at intervention points.

This was resolved by terminating the liner 300mm short of the host pipe-end, anchoring it to the concrete with specially made steel retaining bands and affecting a hydraulically seal using an Amex-10 seal. Bespoke mechanical couplings completed the seal between the ferro-concrete pipe and the new ductile iron pipe and fittings bridging the gap between the host pipe ends at access pits. Replacement air valves could then be used in conjunction with these standard ductile iron fittings.

Past experience had proved this liner-end termination method suitable for use "in-pipe" supported by trained 'confined space' personnel. With this in mind the liner near the washout was cut immediately each side of the outlet branch taking care not to expose the joints – ensured by careful measurements taken prior to liner installation. The liner ends at these points were then terminated and sealed using the Amex-10 seals leaving only the branch exposed with the joints between tee and pipeline securely covered by the liner. This element of the work was carried out beneath the road and the park without any of the road users being aware, and experiencing no disruption. The air valve at the man access tee was similarly renovated from within the main avoiding any excavation in this particularly sensitive location.

Conclusion

The works detailed represent the largest diameter Subline project completed in the UK to date. The innovative use of a well developed 'No-dig' technology resulted in construction being completed "on time and within budget". Critical success was also measured by the zero impact on road users and the minimal effect on both the users of the park and its ecology.