

The Klipspruit basin sewer upgrades within the city of Johannesburg – an application of trenchless technologies

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Introduction

The mission of Johannesburg Water (Pty) Ltd is to provide all residents and visitors of the City of Johannesburg with access to high-quality water and sanitation services, by delivering a sustainable, affordable and cost-effective service, whilst ensuring protection of the environment, which contributes to the economic growth of the country. The use of economically-viable advanced technologies continues to assist utilities worldwide to achieve this objective.

Ensuring delivery of a sustainable service that does not harm the environment requires that the utility constantly reviews the condition and capacity of its water and sanitation storage and conveyance systems and where and when required to perform proactive upgrading and rehabilitation activities. In 2006 Johannesburg Water initiated various projects to rehabilitate and upgrade sewer pipes within its catchment area, where capacity shortcomings, water and root ingress and structural deterioration had been identified.

The rehabilitation and upgrading of sections of the bulk and link sewers in the Klipspruit Sewer Drainage Basin formed part of this group of projects.

Description

The project works consisted of the rehabilitation and upgrading of 2,3 km of sewers, with diameters greater than 150 mm, primarily by means of trenchless technology, due to the location of the pipes.

Location

The Klipspruit Sewer Drainage Basin stretches from Braamfontein in the north to Devland in the south, with a total length of sewers of 560 km.

The works were implemented in three locations within the basin as presented in fig 1 on the next page.

The technical team

Client Johannesburg Water (Pty) Ltd

Consultant Vela VKE Consulting Engineers (Pty) Ltd

Contractor Trenchless Technologies cc.

Approach

In 2006 the preliminary scope of the work was based on previous close-circuit television (CCTV) camera surveys, but the need for a pre-implementation CCTV camera survey was identified and included as part of the contractor's scope of work. Thus, on appointment the contractor was allowed to continue with all upgrading and localised point-repair work, ie where existing pipes had to be enlarged by pipe bursting and localised point repairs by conventional open trenching.



Fig 1: Location of the works

This approach allowed for:

- pre-implementation CCTV camera surveys to obtain updated data on the internal condition of pipes identified for rehabilitation by cured-in place pipe (CIPP)
- topographic surveying for new pipes that were to be installed by means of horizontal drilling.

The final design of the project was concluded within the first months of implementation with minor alterations during the implementation period. This design was significantly different from the preliminary design, including:

- eliminating the rehabilitation of a 250 m section of 450 - 750 mm diameter sewer by CIPP lining, due to the existing sewer being found to have been inaccurately surveyed originally
- eliminating the replacement of 65 m of 450 mm diameter sewers, due to the pipe having been structurally graded incorrectly because of a 4 m localised collapse
- rehabilitating 1 518 m of 200 mm diameter clay and concrete sewers originally earmarked to be surveyed only.

Reasons for trenchless methods

The locality of the work was the primary reason for the application of trenchless technologies, namely:

- at the Oriental Plaza, the upgraded sewers were located within the plaza parking area and the surrounding streets. As the plaza receives approximately 28 000 visitors per day, minimal disruption was crucial
- in Rosettenville, the rehabilitated sewer was located in a major arterial road and crossed underneath a railway line. Hence limited disruption was required.



Fig 2a: Oriental Plaza

Fig 2b: Rosettenville

CCTV camera surveys

The pre-implementation CCTV camera surveys assisted to identify the following general problems:

- corroded pipes
- water infiltration
- cracked pipes
- broken pipes, and
- root intrusion.

The following is an overview of the problems identified by the pre-implementation CCTV camera survey at the various localities.



Fig. 3a: Water Infiltration

Fig. 3b: Broken Pipe



Fig. 3c: Corroded Pipe

Fig. 3d: Corroded Pipe

Joubert Park

A collapsed section of pipe which required repair was identified; but the remainder of the pipe did not require any immediate rehabilitation.

Oriental Plaza

The existing 250 mm clay sewer in Bree Street situated next to the Oriental Plaza was experiencing water infiltration (suspected to be from the super-imposed stormwater conduit) and was shown by network modelling to be under-sized.

The locality of the sewer, 500 mm below the existing stormwater conduit, negated the potential of increasing the capacity by means of pipe bursting, which would also have eliminated the water infiltration. Thus, a new pipe had to be installed parallel to the existing sewer on the opposite side of the road by means of horizontal directional drilling, whilst the existing sewer was CIPP-lined.

Rosettenville

The survey revealed that the greatest part of the existing sewer had water infiltration, major cracks and major corrosion of the concrete sections. 90 % of the sewer was rehabilitated by means of pipe bursting.

The remaining 10 % of the sewer was found to be concrete-encased where it crossed underneath the railway line and a section of the road. This section was rehabilitated by installing a CIPP liner.

Implementation

Suburb	Condition assessment	Application	Work
Joubert Park	Localised pipe collapse	Point repair, by open trenching	The replacement of 4 m of 450 mm diameter clay pipe with 450 mm outside diameter HDPE PN10 PE100 pipe and the construction of a manhole to facilitate joining the HDPE and clay pipes
Oriental Plaza	Pipe under capacity (assessed by means of network modeling) Water infiltration and root ingress Pipe under capacity (assessed by means of network modeling)	Pipe bursting CIPP lining Horizontal directional drilling	The up-sizing of 394 m of 250 mm diameter clay pipe to 355mm HDPE PN10 PE100 pipe The installation of 170 m <i>Berolina lightspeed</i> liner in an existing 250 mm diameter clay pipe The installation of 175 m of new 250 mm diameter HDPE PN10 PE100 pipe
Rosettenville	Pipe corrosion and various localised structural collapses Water infiltration	Pipe bursting CIPP lining	The up-sizing of 1 518 m of 160-200 mm diameter clay and concrete pipe to 225 mm HDPE PN10 PE100 pipe The installation of 86 m <i>Berolina lightspeed</i> liner in an existing concrete encased 200 mm diameter clay pipe

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Fig 4a: Horizontal drilling equipment (Oriental Plaza)



Fig 4b: Pipe Bursting (Oriental Plaza)



Fig 4c: Cured in place liner (Rosettenville)

Cost and time

The project was done with a R 7,7 million budget (fees and construction excluding VAT) over an 8-month construction period.

A cost comparison between conventional trenching and trenchless construction was not done for this project, but it is noted that the largest cost savings were of an economical, social and environmental nature.

Benefits of trenchless methods

- Reduced excavation costs
- Less long-term damage to road surfaces
- Minimal disruption to vehicle and pedestrian traffic
- Limited environmental impact (no full environmental impact assessment required)
- Reduced service congestion in developed cities, and hence more available space for development of other services.

Comments and recommendations

During the initial stages of the project it was noted that there were no standard specifications relating to the application of trenchless methodologies under southern African conditions.

Recommendation

The Southern African Society for Trenchless Technology in association with the South African Bureau of Standards should develop a specification that will ensure the quality of products and work.

A significant amount of Johannesburg Water's sewers are clay pipes, which are no longer manufactured in South Africa, making localised repairs difficult (proper connection) or expensive (replacement of total pipe length between existing manholes or construction of new manholes) where other types of materials are used. In the case of this project, HDPE pipe was utilised for a 4 m point repair and a manhole constructed to join the two types of pipes effectively.

Recommendation

Manufacturers should be encouraged to design and manufacture suitable couplings or international manufacturers should be encouraged to obtain South African approval of their couplings.

Recommendation

Data generated by CCTV camera surveys should be used at the three stages of any trenchless rehabilitation project, ie:-

- prior to the start of the project, viz data originating from routine maintenance-programme surveys where defects are first identified, but should not be older than 6 months
- at the works hand-over stage, before issue of the certificate of completion
- at the end of the defects-and-liability period in order to confirm that the up-sized and rehabilitated sewers are still operating effectively and efficiently. In particular, the liners should be assessed for any defects and their effectiveness over the long term.

This information can be applied when deciding on the applications to be used in future projects.

In fact, the latter two stages are recommended for both trenchless and conventionally-implemented water and sanitation projects.

Conclusion

Delivering medium to major construction projects with minimal interruptions to the residential and business communities, whilst not harming the environment, continues to be of great importance.

Johannesburg Water:-

- supports the use of economically viable and appropriate trenchless methodologies, supported by limited conventional methods, for installing new or rehabilitating old sewer pipes in busy and congested areas, such as central business districts
- endorses the development of standards that will assure the quality of the final product.

Who and what is the ISTT?

Introduction

Founded in 1986, the International Society for Trenchless Technology (ISTT) is the original society for the promotion of trenchless technology. It was initially based in the UK, but these days it doesn't have a formal office anymore. The officers of the society work online from home or from their places of employment, on their computers.

When the society started out, anybody in the world who wanted to join became a member of the ISTT. Pretty soon, however, national societies were established and only members living in countries which did not have a national society became members of the ISTT itself. All others were required to become members of their national societies and became affiliated to the ISTT through their national societies.

What are the benefits of affiliation to the ISTT?

Obviously the benefits are particularly significant for companies, ie the corporate members of the national societies.

Affiliated corporate members are more likely to send executives or employees to international events such as the *International No-Dig* conferences and exhibitions. They benefit from the discounts on the registration fees.

Also, corporate members can publish details of their business on the ISTT's Technical Resource Centre, the TRC for short, which is in fact a vehicle for free, online, international advertising. Several corporate members of SASTT have already availed themselves of this opportunity.

Who are the Southern African affiliated corporate members of the ISTT?

The following corporate members are affiliated to the ISTT:

- City of Tshwane Metropolitan Municipality
- Corrocoat SA (Pty) Ltd
- Cycad Pipelines (Pty) Ltd
- Esor Ltd
- Infrasat
- Insitu Pipelines (Pty) Ltd
- Jacked Pipelines, a division of WK Construction (Pty) Ltd
- Johannesburg Water (Pty) Ltd
- Malani Padayachee & Associates (Pty) Ltd
- Mbombela Roads Water & Sanitation cc
- Navigational Drilling Systems (Pty) Ltd
- Nyeleti Consulting (Pty) Ltd
- Petzetakis Africa (Pty) Ltd
- Pipeline Erectors (Pty) Ltd
- Rare Chemical
- Reef Trenchless Technology SA (Pty) Ltd
- Rescue Rod (Pty) Ltd
- Sight Lines Pipe Survey Services
- Trenchless Technologies cc
- TT Innovations (Pty) Ltd
- Vela VKE Consulting Engineers (Pty) Ltd

Vermeer Equipment Suppliers (Pty) Ltd

If you wish to contact any of these members, you can find their contact details, as well as particulars of their trenchless business, at <http://www.sastt.org.za/memcorp.html>

Alternatively, you can contact Joop van Wamelen, the honorary director of SASTT.