

PIPE REHABILITATION

Restoring a corroded sewer

Robert Kelly & James Smolik describe the use of CCCP techniques to renew a concrete sewer that had suffered extensive hydrogen sulphide corrosion

WESTLAKE City, a suburb of Cleveland, Ohio, is primarily a residential community with light industrial and retail areas. It has a population of about 34,000, which doubles during the daytime. The city has its own engineering department, responsible for design, bidding, construction management and inspection.

In 2007, Westlake had a condition assessment performed of its primary sanitary interceptor sewer – a 6,400m pipe comprising part reinforced concrete and part poured-in-place concrete. Flowing to the regional wastewater-treatment plant, the 1960s constructed pipe conveys the city's entire sewage along the northern corporation boundaries.

Sewer projects are funded through bills collected at a flat rate of US\$30.25 per quarter for residential dwellings, while that for commercial and industrial properties is usage-based. With diameters varying between 915-1,525mm, the sanitary interceptor has an average dry weather flow of 22.7ML/d and covers a sewer tributary area of 227km, which is owned and maintained by Westlake.

The condition assessment was performed after a sanitary interceptor failure at a neighbouring community in 2006, during which many basements were flooded with raw sewage. Only 18 years old, this interceptor was a reinforced-concrete pipe, similar to the one in Westlake. As a result of the calamity, which also involved a fatality, residents filed multiple lawsuits exceeding US\$560,000, the majority of which have now been settled.

As no comprehensive assessment of the Westlake interceptor had been undertaken since its construction, the municipality hired URS Corp of Cleveland, Ohio, to perform an appraisal.

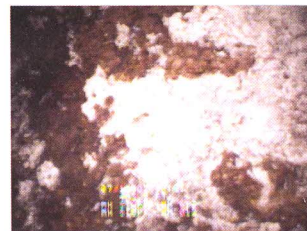
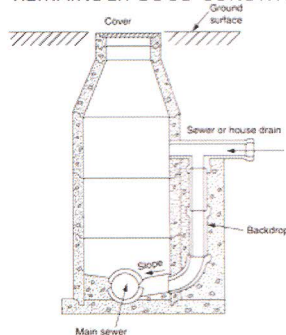
CONDITION ASSESSMENT

URS performed the CCTV inspection of the entire interceptor with ADS Environmental Services of Earth City, Missouri. This was accomplished with a crawler camera and a camera mounted on a pontoon boat for downstream locations with heavy flows. In addition, all 64 sanitary manholes along the interceptor were inspected.

The CCTV inspection was analysed by URS, and the condition assessment generated and organised in the following order:

- **HYDROGEN SULFIDE CORROSION WAS SEEN AT ALL MAJOR TRUNK LINES (6) DUE TO DROP MANHOLES**

- 50' +/- MANHOLE
- REMAINDER GOOD CONDITION



CLAGUE ROAD



COLUMBIA ROAD

Typical manhole (left) with typical effects of corrosion (right)

“Due to budgetary constraints, rehabilitating the entire pipe from manhole to manhole was not an option since some sections were as long as 167m”

- Operation and maintenance Issues (O&M)
 - a. Leaking joints contributing to infiltration;
 - b. Capacity-reducing obstructions; and
 - c. In-pipe debris.
- Structural defects
 - a. Cracks and fractures;
 - b. Microbiologically-induced corrosion (MIC); and
 - c. Open joints.
- Manhole inspection
 - a. Infiltration/inflow (i/i); and
 - b. Structural defects.

Assessments to prioritise defects relative to the pipe runs between manholes were carried out. This classified each run of pipe with respect to operational and maintenance issues, and structural defects. The locations of all defects were displayed in a GIS environment. Each pipe length, from manhole to manhole, was ranked for operation and maintenance, and structural condition. The system-ranking methodology allows for the values of each segment to be prioritised relative to the entire system's defects.

From the condition assessment in 2008, the greatest area of concern was microbiologically induced corrosion from hydrogen sulphide, which was prevalent throughout the entire system and concentrated at critical locations. These were at the connection points of the various trunk lines (458-610mm diameter) discharging into the sanitary interceptor.

At those connection points, drop manholes were located with at least a 3m vertical difference between the inverts of both pipes. Also, the downstream section of the interceptor had a large concentration of corrosion due to the proximity of the wastewater-treatment plant.

MICROBIOLOGICALLY INDUCED

Vertical-drop manholes of trunk lines cause severe turbulence in the interceptor, releasing large amounts of hydrogen sulphide gas, produced from anaerobic bacteria in the sewage. Over time, the effects of carbon dioxide and hydrogen sulphide lower the concrete pipe's surface pH to below seven, thereby providing an ideal environment for *Thiobacillus*

