

INFLOW & INFILTRATION CORRECTION VIA LATERAL LINE DITCH LEAK REPAIRS

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Project Location and Description

The project is in the northeast quadrant of the City of Houston, Texas. ♦ Located in the Fresh Water Supply District (FWSD) #23 and Red Gully Service Areas. ♦ The service areas are situated east of State Highway 59 (Eastex Freeway) and North of Ley Road. ♦ The primary commercial boulevards within the service areas include Tidwell, North Wayside, and Mesa Drive. ♦ The service areas are composed predominantly of single-family residential development. ♦

The City of Houston (CITY) operates one wastewater treatment plant, also named FWSD #23, to service both areas. ♦ In addition, one wet-weather facility was constructed in 1997 to provide relief to the sanitary sewer collection system during peak wet-weather events. ♦ FWSD #23 and Red Gully Service Areas were two of the four service areas evaluated as part of the first phase of the Greater Houston Wastewater Program for overflow control, as a result of significant rain-induced inflow/infiltration (I/I) into the sewer system(s).

Project Background

From 1989 to 1992, the CITY performed comprehensive physical inspection tests to identify I/I in the FWSD #23 and Red Gully Service Areas collection system. ♦ Only sanitary sewer I/I sources discovered by the CITY during the 1989 to 1992 physical inspections were retested. ♦ Three techniques were utilized to confirm the presence of I/I sources: smoke testing, dye-water flood testing, and dye-water flood testing in conjunction with CCTV inspection. ♦ The first step, smoke testing, was used to confirm and document reported I/I sources. ♦ If the I/I source was classified as ditch type leaks, then these leaks were dye-water flood tested. ♦ Once an I/I source was confirmed by smoke testing and dye-water flood testing, the mainline sewer was cleaned, and the dye-water flood test repeated while the sanitary sewer main was simultaneously inspected (CCTV). ♦ From the CCTV inspection, the exact location(s) of the entry of I/I into the sanitary main was determined. ♦ Field tests began in 1997 and were completed in 1999. ♦ These tests identified ♦ 500 I/I leaks for the FWSD #23 and Red Gully Service Areas.

EPA Mandated Repairs

In 1995, the CITY was issued National Pollutant Discharge Elimination System (NPDES) Permit for the Bretshire Wet-Weather Facility (WWF). ♦ This WWF was built in the vicinity of the FWSD #23 and Red Gully Service Areas. ♦ A requirement of this NPDES permit was to eliminate all known inflow sources by 31 December 2000. ♦ All reported inflow sources have been corrected. ♦

In total, 33 inflow sources were reported to the U.S. Environmental Protection Agency (EPA) under the 1995 NPDES permit. ♦ Due to the immediacy of the 31 December 2000 deadline, the CITY authorized WESTON to prepare construction work orders to correct all inflow sources promptly. ♦

WESTON reviewed all data collected for these service areas. As a result of this review, WESTON identified 37 Inflow leaks and confirmed them in the field. Due to the urgency and timing to correct these leaks, WESTON coordinated and accelerated the repair options with Public Works and Engineering and Utility Maintenance. Since sufficient time was not available to bid and award a conventional construction package for these inflow corrections, it was agreed that work orders would be created to allow Utility Maintenance to make these repairs.

Some repairs were performed by CITY crews while others were performed by contractors. The contractors were already under contract with the CITY on annual service contracts. CITY crews and annual service contractors completed most of these repairs within 2 to 3 weeks. All 37 inflow sources were confirmed complete on 21 December 2000, ahead of the deadline.

Scope of Engineering Services

WESTON was originally selected to generate construction bid documents for the correction of approximately 500 I/I leaks reported in the FWSD #23 and Red Gully Service Areas. The scope of Engineering Design Services is as follows:

1. Correct 465 in-drainage channel leaks (infiltration)
2. Correct 2 Surface drains (inflow)
3. Correct 3 open-ended pipes (inflow)
4. Correct 6 clean out plug defects (inflow)
5. Correct 2 broken clean outs (inflow)
6. Correct 20 manhole wall/cone defects (inflow)
7. Correct 2 indirect storm sewer cross-connects with sanitary sewers on one sanitary sewer mainline section (infiltration)

Description of Existing Problems/Deficiencies

The major sources of infiltration reported under were:

1. 465 Type 'A' Leaks (in-drainage channel defects).
2. 2 Type 'Q' Leaks (storm sewer connect, non-isolated).

The in-drainage channel defects allow water from road side drainage ditches to enter the sanitary sewer system through defects in the sewer laterals, which cross or parallel these ditches. "Nonisolated" storm sewer connect defects allow stormwater to enter the sanitary sewer system indirectly by infiltration through cracks and defective joints in sewer pipes.

Evaluation of infiltration Correction Base Solutions

The base solutions offered by the City of Houston Wastewater Program were evaluated based on the information provided and the additional information obtained during the preliminary design phase. The following is a discussion of WESTON's findings for each type of leak.

Leak Type A (Open Ditch Leak)

A total of 466 type A leaks were confirmed during the preliminary design and all of them are located in the public right-of-way (ROW).

Evaluation: From field inspection and review of the CCTV Inspection video tapes, it was evident that more than one pipe joint in a service lateral was found contributing to rainfall dependent I/I. It was also found that the majority of the service laterals are unreinforced concrete lines 4 to 6 inches in diameter. These lateral lines are approximately 50 years old or older and have several structural defects. The average length of a service lateral in this project is 30 linear feet (LF). The average length of a point repair on a service lateral under a drainage ditch is 10 linear feet. In view of these observations, it is recommended that all ditch leaks be corrected by replacing the service connection at the main and the entire service lateral from the sanitary sewer main to the ROW line.

Leak Type Q (Storm/Sanitary Indirect Cross Connect)

Two type Q leaks were confirmed during the preliminary design phase, and all of them are in the public ROW.

Evaluation: For Type Q leaks, the CITY provided confirmatory information by smoke testing and dye-water flood testing with concurrent CCTV Inspection for sanitary sewers. CCTV Inspection of the storm sewers confirmed that in excess of 80% of the storm sewer pipe had some kind of structural defect(s) requiring removal and replacement. CCTV Inspection video tapes of sanitary sewers were also reviewed for condition assessment.

A Brief Description of Alternatives Considered During the Development of Proposed Project

The rehabilitation methods proposed in this project will occur within the CITY's right-of-way. Proposed improvements will be limited to the existing sewer alignment and adjacent disturbed areas. Three (3) types of lateral sewer rehabilitation construction methods are considered suitable for this project. No grouting is proposed. The methods to consider are cured-in-place pipe, point repair and removal and replacement.

Alternative 1

Under alternative 1, WESTON recommends that all sewer laterals be rehabilitated by R/R. This will total approximately 12,670 linear feet of sewer laterals. Approximately 323 service connections will also be replaced. In selecting R/R as the rehabilitation method, approximately 3,050 yd² of roadway will be excavated in the process. The repair of these roadways will also be included in alternative 1. Table-1 presents rehabilitation quantities for this alternative.

Table -1

Alternative 1 Rehabilitation Quantities

Item Description	Quantity
Service Laterals (each)	399

Service Laterals (LF)	12,670
Service Reconnections (each)	323
Roadway Repair (yd ²)	8,000

The estimated construction cost for alternative 1, including mainline repairs, is \$2,860,200.

Alternative 2

Under alternative 2, WESTON recommends that all sewer laterals be rehabilitated by both R/R and CIPP. The rehabilitation method will be R/R when the sewer lateral alignment does not cross beneath roadway pavement. The rehabilitation method will be CIPP when the sewer lateral alignment crosses beneath a roadway or is greater than 10 feet deep. In this alternative, no roadways will be excavated and therefore no roadways will need repair. Approximately 2,935 linear feet of sewer laterals will be rehabilitated by R/R, while approximately 9,735 linear feet of sewer laterals can be rehabilitated by CIPP. Only those sewer laterals replaced by R/R will have service connections replaced. The CIPP rehabilitation method includes the rehabilitation of all service connections associated with the rehabilitated service lateral. Table-2 presents rehabilitation quantities for this alternative.

Table -2

Alternative 2 Rehabilitation Quantities

Item Description	Quantity
Service Laterals (each)	399
Service Lateral R/R (LF)	2,935
Service Lateral CIPP (LF)	9,735
Service Reconnections (each)	145
Roadway Repair (yd ²)	2,700

Sanitary Sewer Rehabilitation Design Criteria

Design guidelines for the evaluation of existing sanitary sewers and the selection of the preferred rehabilitation techniques are based on criteria established by the Department of Public Works and Engineering, City of Houston. The condition of the existing sanitary sewer is assessed to determine the relative degree of deterioration of the pipeline due to structural defects and/or corrosion. The degree of deterioration of the sewer will greatly influence the selection of the rehabilitation method that is most economical and/or feasible. In general, rehabilitation for sewers classified light deterioration will not require rehab at this time, but will be subject to re-evaluation in 5 years. Sewers classified moderate or heavy deterioration will require rehabilitation with trenchless-in-place or conventional technology, depending upon the amount of significant future growth and hydraulic analysis in the sub-basin.

recommendation

The concept of rehabilitation of the lateral line by the cured-in-place process has not previously been performed in the City of Houston. ♦ This rehabilitation process may need to be evaluated by the CITY Standard Products Committee. ♦ If this method of repair is deemed acceptable, WESTON would add verbiage to the bid form that would allow the contracting community to bid an ADD or Deductive Alternate for use of lateral line repairs for the correction of lateral lines through a cured-in-place repair method.

If you have any questions, please contact [Dr. C.Vipulanandan](#)
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