King County

Department of Natural Resources and Parks

Wastewater Treatment Division

Contract P00208P16
Professional Services for Evaluation of Inflow and Infiltration Reduction Concepts

Phase 1: Evaluation of Concepts

Task 520
Outline for a Standardized Regional Inspection Training Program

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Project 150258

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Revision History

Date	Revision	Reason for Revision

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1.0 Background and Purpose

This introductory section presents the background and purpose for this Task 520, Outline for a Standardized Regional Inspection Training Program technical memorandum (TM).

Background

Inflow and infiltration (I/I) is rainwater, surface water, and groundwater that flows directly and indirectly into sanitary sewers. Although sewer design guidelines include a reasonable allowance for I/I, excessive rates of I/I in a sanitary sewer system can lead to basement backups, sanitary sewer overflows, and unnecessary conveyance and treatment costs. Excessive I/I flows in King County's (KC's) regional separate sanitary sewer system impact both capital and operational costs.

KC Wastewater Treatment Division's (WTD) Conveyance System Improvement (CSI) Program assesses the hydraulic capacity of the regional wastewater system with measured 20-year peak flows. This information is used to plan and size future capacity-related improvement projects.

Findings from CSI Program analysis show that about 70 percent of the peak flow in the separate sanitary sewer system is rain-derived inflow and infiltration. An estimated 27 percent of the annual wastewater system volume treated by KC's wastewater treatment plants (WWTPs) can be attributed to I/I.

This I/I results in higher capital program costs by accelerating the need and scale of capacity improvement projects. Operational costs are increased because of the need to transport and treat higher rates of flow. The additional capital costs associated with increasing the capacity of the collection system, pump station, and WWTP to handle excessive I/I flows are currently spread across all customers through WTD's sewer rates.

WTD implemented an I/I Control Program in 1999 as part of the Regional Wastewater Services Plan. Currently, the I/I Control Program efforts are focused on portions of the sanitary sewer system experiencing flow capacity shortages. Specifically, the I/I Control Program has developed data to assess where pursuing I/I reduction might be more cost-effective than increasing pipe and/or pump station capacity. Thus far, the I/I Control Program has been effective in reducing I/I experienced in some areas of the regional wastewater system; however, no comprehensive program is currently in place to address I/I throughout the regional wastewater system.

The Phase 1: Evaluation of Inflow and Infiltration (I/I) Reduction Concepts project has been developed to assist KC WTD and Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC) member agencies in the exploration of new elements for the Regional I/I Control Program. This project will build on the work that WTD has done previously and explore more comprehensive and system-wide I/I reduction. WTD selected Brown and Caldwell (Consultant) per the P00208P16 Professional Services Contract to assist with this project. The Consultant has been tasked with the following:

- Collect and share existing I/I Control Program information with MWPAAC
- Review sewer and side sewer standards, assess existing local agency standards compared to best management practices (BMPs), and develop an approach to achieve common standards in the region
- Evaluate current city and utility district inspection programs for sewers and side sewers to identify BMPs and develop an outline for a regional inspection training program
- Identify the types of private side sewer programs in common use nationally, and evaluate private side sewer programs within the KC service areas for side sewer inspection and certification, grants or loans, and regional I/I support
- Develop a framework for implementing private side sewer programs within the KC service areas, specifically for side sewer inspection and certification, grants or loans, and regional I/I support

Purpose

An overview of the regional data for inspectors and inspection programs across the region was provided in the Task 510, Evaluation of Current Inspection Programs at Cities and Sewer Districts TM. While the local agencies generally employ experienced construction inspectors, most have reported that training is obtained on the job and there is currently no regional standardization for inspection practices. Regional standardization of inspector training and inspection practices would provide a basic level of assurance that sewer infrastructure is constructed and repaired at a consistent level of quality across the regional service area.

The purpose of this TM is to recommend improvements to inspection practices, and provide options for a regional inspector training program that could be used by the MWPAAC members. The TM addresses new construction and rehabilitation/repair inspection for three components of the sewer system: sewer main, lateral, and private side sewer. Figure 1 identifies these three components.

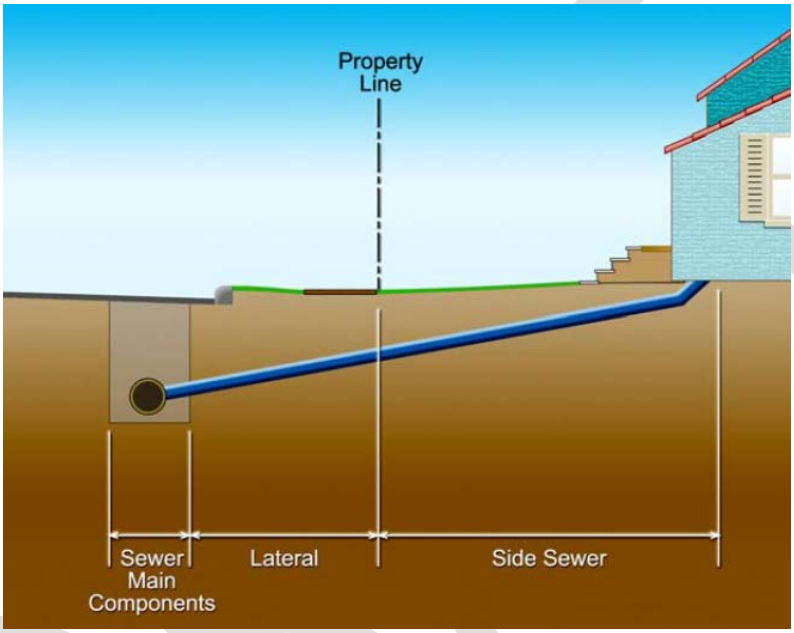

Figure 1. Components of the sanitary sewer system

2.0 Improvements to Regional Inspection Practices

Based on the interviews conducted, it was determined that local agencies inspect newly constructed sewer mains, laterals, and side sewers in a consistent manner, meeting KC requirements. Sewer mains are usually tested with a compressed-air test, manholes are tested with a vacuum test, and laterals/side sewers are tested with a water exfiltration test. Materials and methods are reviewed and compared to agency standards. Lastly, sewers are internally inspected via traditional closed-circuit television (CCTV) inspection equipment.

Inspection practices were less consistent for repairs or modifications of private side sewers, including new home construction within a sewered area (fill-ins or teardowns). Most local agencies inspect only the location of the spot repair on the side sewer after repairs are made. For teardowns or significant remodels, sometimes only the private property side sewer is inspected. Some local agency inspections are purely visual, looking down into the trench, others require an internal inspection, and others require some type of air or water test.

The local agencies generally reported having experienced inspectors and a low turnover rate for inspector positions. However, training was typically obtained on the job, making it difficult to determine the consistency of training across the region. One agency reported having a formal training program, and another requires National Association of Sewer Service Companies (NASSCO)

Pipeline Assessment and Certification Program (PACP) certification for inspectors. Formalized training would increase assurances that inspections were being conducted consistently across the KC wastewater service area. In addition, having minimum or more advanced inspection options for modifications/repairs of existing side sewers and laterals would further enhance the region's ability to gradually reduce I/I.

Minimum Inspection Option for Consideration

An option is to formalize minimum inspection requirements for the repair/modification of side sewers and laterals. A possible minimum inspection option is that private side sewer repairs/modifications should have a more detailed inspection consisting of a water exfiltration test or air pressure test, internal inspection, and confirmation that all parts and methods are per standards for the section of modified pipe.

Advanced Inspection Options for Consideration

There are several more advanced options to consider in requirements for inspection practices. The list below is not comprehensive and should be discussed, modified, and added to pending each agency's desire to enhance inspection practices:

1. Fully inspect the entire side sewer (rather than just the modified section as outlined under the minimum recommendation) using a push or lateral launch camera and test it (water) to ensure that it is adequately repaired and that there are no other concerns. Agencies would have to confirm that it has the legal authority to inspect the entire side sewer, and determine the agency's mechanisms for correction of defects.
2. Guidelines on easy-to perform testing of side sewer repairs/modifications. Simpler methods could be used to approve laterals and side sewers. Currently, most agencies follow Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction inspection standards for testing sewers. The WSDOT standard for water exfiltration tests requires the use of a formula that accounts for pipe diameter, length of pipe, and test head, that is compared to an allowable leakage rate of 0.28 gallon per hour per 100 feet. The low-pressure air test similarly needs calculations to determine a pass or fail. Alternately, simpler methods could be used to approve laterals and side sewers. For example, East Bay Municipal Utility District in the greater San Francisco area simply requires that for exfiltration tests, regardless of pipe length, the test head be 5 feet and that there can be zero exfiltration in 5 minutes. KC should review and provide consistent recommendations on easy-to-perform testing on repairs/modifications to existing side sewers.
3. Inspect the property for possible inflow sources while the construction inspector is on site. The inspector should identify where roof drains and any area drains discharge. The inspector should also inquire about sump pumps and foundation drains. Noted illicit inflow sources should be documented for future disconnection and/or redirection. Each agency would have to confirm that it has the legal authority to inspect private property, and determine the agency's mechanisms for correction of illicit connections.
4. Inspect side sewers during mainline sewer inspections. Many agencies and almost all sewer inspection providers have side launch sewer inspection cameras. While crews are inspecting mainlines, they should inspect as much of the side sewer as possible. Most agencies already have inspection rights to side sewers; therefore, no additional right-of-entry or permissions may be required. However, each agency should confirm this prior to proceeding. Adding inspections of side sewers with a side launch camera takes additional time, so inspection goals may need to be modified to include this length of extra pipe and setup time.

3.0 Outline for a Standardized Regional Inspection Training Program

As noted in Section 2.0, there is generally no formalized inspector training. Standardization of inspection practices would provide a basic level of assurance that sewer infrastructure is constructed and maintained at a consistent level of quality across the regional wastewater service area. Having a regionally sponsored training program would help lead to improved consistency.

This section details suggested training content, facilitation, funding, and evaluation methods for a standardized inspector program.

Minimum Requirements for Inspectors

Prior to attending a training program, the inspector should have a minimum understanding of sewer construction and inspection standards. In order to establish a baseline for when personnel would start the formalized training a typical job classification/description that includes skills, knowledge, and abilities for sewer inspectors should be developed. This may include the following:

- Knowledge of appropriate methods, technologies, and materials used in sewer installation and maintenance
- Knowledge of sewer codes regulating installation and maintenance of sewers
- Ability to read and interpret plans and specifications of sewer lines and systems
- Individual physical capabilities commensurate with the demands of the job

Methods and Content for Inspector Training

There are many possible ways to conduct inspector training: classroom, online, or hands-on training, to name a few. At the September 7, 2017, MWPAAC Engineering and Planning (E&P) subcommittee meeting, the consensus was that hands-on training would be best. It is recommended to establish a live, in-person training that has both classroom and hands-on components. Content for the trainings can vary from session to session and will need to be updated for alignment with changing regulations and BMPs. Initial possible content for regional training courses includes the following elements:

- Module 1: Introduction to the Regional Inspection Certification Program
  - This module would provide an overview of the inspection certification process and outline what is required for each agency to submit to WTD for new sewers. Topics could include:
    - Regional inspector training: what is the purpose and benefit of this program
    - Inspection results reporting requirements to WTD
- Module 2: Inspection Methods and Standards
  - This module would outline the method the inspector should use to complete the inspection process. Topics could include:
    - Reviewing construction methods and materials
    - Completing internal inspections
    - What to look for when inspecting a spot repair or lateral/side sewer modification
    - Construction defect assessment: severity levels and what level of defect requires additional repair
    - Other items to inspect on site: possible inflow sources
    - How to identify tricks and shortcuts by contractors that may increase I/I risk

- Module 3: Testing Standards
  - This module would cover how the inspector is to properly complete/oversee testing of the various sanitary sewer components. Topics could include:
    - How to properly complete a vacuum test
    - How to properly complete an air pressure test
    - How to properly complete a water leakage test
    - How to properly complete an internal visual inspection (NASSCO PACP/Lateral Assessment and Certification Program [LACP] standards)
- Module 4: Construction Best Management Practices
  - This module would discuss various construction and repair methods for inspectors to be fully aware of the limitations of each method. Topics could include:
    - Cured-in-place pipe (CIPP) lining BMPs (mainline, laterals, and side sewer)
    - Pipe-bursting BMPs
    - Grouting BMPs
    - Spot repair BMPs
    - Lateral and side sewer repair BMPs
    - Adapting to recent changes to other industry BMPs and regulations
    - Lateral sewer connection BMPs
- Module 5: Communication Methods
  - This module would discuss means and methods in communicating with contractors, other utilities, private property owners, and the general public. Topics could include:
    - Confrontation training: what to do when a contractor pushes back
    - Cross bores: how to address situations where gas lines, fiber-optic lines, and other utilities have bored through sewer mains, laterals, and/or side sewers
    - Effective communication: how to deal with property owners and the general public

It is also recommended that inspectors receive a certificate of completion of the course to indicate their training level and help local agencies track who has received training. This should also help to incentivize attending the training sessions. A master list of who has received training should be maintained.

Considerations for a KC Regional Sewer Construction Inspection Program

KC currently requires that agencies provide inspection test results for new construction. Consideration could be given to requiring that inspection documentation be submitted to KC whenever sewer systems are repaired or modified in the service area. With such documentation, KC can better determine in the future whether the certification process is being followed and if it is meeting the goal of reducing I/I.

Entities Responsible for Inspector Training

It is anticipated that a third-party consultant would be required to assist with training development. Once the program approach is better defined, it is also recommended to reach out to other local sewer-related organizations, such as the Pacific Northwest Clean Water Association (PNCWA), Washington Wastewater Collection Personnel Association (WWCPA), or even nationally to NASSCO for possible inclusion in its programs. Including national organizations would help to broaden the resource base for information to be included in training programs.

Once the training program is established, agencies would be responsible for identifying and sending their staff to the training. At the September 7, 2017, MWPAAC E&P subcommittee meeting, a desire was expressed to move the training locations around the region to make it easier for staff to attend. It is recommended to alternate the training (frequency to be determined) between the northern and southern ends of the KC wastewater service area. In addition to having hands-on, formalized training, the developed training materials could be posted on WTD's and agency websites for access.

Requirements to Complete Training

It is recommended that training attendance start out as voluntary. It is also recommended that each agency have at least one regionally certified sanitary sewer inspector. Certifications should be renewed every 3 to 5 years so that inspectors can apply the latest information in their inspection practices. Training programs should be one-half to a full day in duration based on content to be provided.

Funding Sources for Inspector Training

The funding for developing, implementing, and managing the regional inspector training program needs to be determined. It is anticipated that the local agencies will cover the cost of staff attending training sessions.

Methods for Assessing Effectiveness of Training Program to Reduce I/I

A gradual reduction of I/I sources is anticipated over a period of many years where inspections occur. It is not possible to estimate the magnitude of the decrease or the potential decline in the rate of I/I increase that could be attributed to improved inspections. KC's decennial flow monitoring, hydraulic modeling, and measured flows at the WWTPs are sources of data that may be used to evaluate effectiveness of any programs adopted to address I/I in the years to come.