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 modeled 20-year peak flows. This information is used to plan and size future capacity-related improvement projects.

Findings from a flow monitoring study estimated that about 50–70 percent of the peak flow in a separate sanitary sewer system is rain-derived I/I[1]. An estimated 25 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 at a local or project scale 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 regional program is currently in place to address I/I throughout the entire regional wastewater system.

The Phase 1: Evaluation of Inflow and Infiltration (I/I) Reduction Concepts project was 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.

[1] King County Infiltration & Inflow National Survey + Pages 11-13, Control of Infiltration and Inflow in Private Building Sewer Connection, Dillard, Wayne, Chair, the Sanitary Sewer Overflow Cooperative Agreement Workgroup of the Water Environment Federation, 1999.

- Develop a framework for implementing private side sewer programs within KC service areas, specifically for side sewer inspection and certification, grants or loans, and regional I/I support.

Purpose

The purpose of this TM is to recommend improvements to inspection practices and provide options for a regional inspector training program that can be implemented by MWPAAC members. The TM addresses the impact of non-standardized inspection practices on new construction and rehabilitation/repairs for three key components of the sanitary sewer system: mains, laterals, and private side sewers. Figure 1 illustrates the three components.

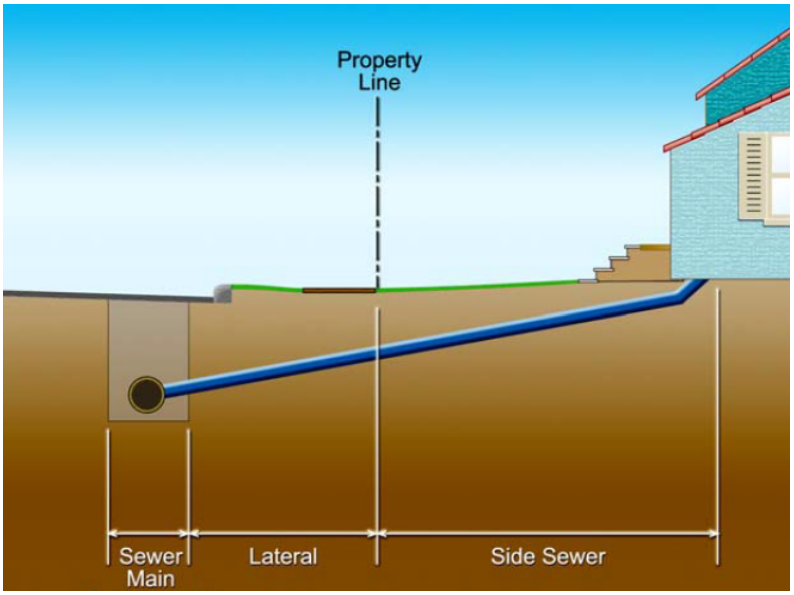

Figure 1. Components of the sanitary sewer system

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.

2.0 Improvements to Regional Inspection Practices

Based on interviews conducted with local agencies, it was determined that newly constructed sewer mains, laterals, and side sewers are inspected 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. Finally, sewers are inspected internally via traditional closed-circuit television (CCTV) inspection equipment.

However, 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, i.e., by looking down into the trench. Others require an internal inspection, and still 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, while another requires National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) certification for inspectors.

Formalized inspector training would increase the likelihood that inspections were being conducted consistently across KC's wastewater service area. In addition, having minimum or more advanced inspection options for use when inspecting modifications/repairs of existing side sewers and laterals would further enhance the region's ability to gradually reduce I/I.

The following describes potential options for improving the consistency and practices of sewer inspections.

- Minimum Inspection Option. 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. Beyond minimum inspection requirements, 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 amended pending each agency's desire to enhance inspection practices:
  - *Fully inspect the entire side sewer (versus just the modified section as outlined above).* Use a push or lateral launch camera and test it (water) to ensure that it is adequately repaired and that there are no other concerns. Each local agency 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.
  - *Establish easy-to-perform testing guidelines for side sewer repairs/modifications.* Simpler tests could be used to approve laterals and side sewers. Currently, most local 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 also needs calculations to determine a pass or fail. Simpler methods could be used to approve laterals and side sewers. For example, the 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 could consider adopting this straightforward approach.
  - *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.
  - *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 used by local agencies. Standardization of inspection practices would provide a basic level of assurance that all newly constructed or repaired sewer infrastructure is constructed and maintained at a consistent level of quality across the regional wastewater service area. A regionally sponsored training program would support standardization and lead to improved consistency.

This section describes a suggested approach and discusses possible content, facilitation, funding, and evaluation methods for a standardized inspector training program.

Development of Inspector Training Program

It is anticipated that third-party consultants would be required to assist with training development. The consultants would help guide WTD and MWPAAC on establishing inspection criteria, such as standard checklists, inspection methods, and development of thresholds for defects that require repair. They would also assist in development of educational materials. During the program development phase, it is 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 training programs. Including national organizations would help to broaden the resource base for information, trainers, and coordination/hosting capacity to support the training program.

Entities Responsible for Inspector Training

Once the training program is established, local agencies would be responsible for identifying and sending their staff for training. Any third-party contract inspectors used by agencies would be responsible for receiving training as well. It is anticipated that WTD would play a role in hosting and/or coordinating trainings in the region, as well as in tracking inspector certification. It is not anticipated that WTD staff would act as trainers.

At the September 7, 2017, MWPAAC Engineering and Planning (E&P) subcommittee meeting, a desire was expressed to move the training locations around the region to make it easier for staff to attend. Alternating the training (frequency to be determined) between the northern and southern ends of the KC wastewater service area is recommended.

Methods for Inspector Training

There are many ways to conduct inspector training including classroom, online, or hands-on training, to name a few. The E&P subcommittee stated a preference for, and belief that, hands-on training would be best. Establishing in-person sessions that have both classroom and hands-on training components is recommended. Training programs should be one-half to a full day in duration, based on content provided. In addition to having hands-on, formalized training, any training materials developed could be posted on WTD's and agency websites.

Requirements to Complete Training

Requirements to complete training should include defining voluntary or mandatory completion, number of certified sanitary sewer inspectors per agency or in the region, and timing for certification renewal. Certifications should be renewed every 3–5 years so that inspectors can apply the latest information in their inspection practices. The E&P subcommittee stated interest in a testing-out option and/or a list of alternate, equivalent certification.

Certification/Recertification

It is 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. A list of alternate, equivalent certifications should also be maintained.

Funding Sources for Inspector Training

The funding for developing, implementing, and managing the regional inspector training program needs to be determined. Program development may be supported, in part, by the Regional I/I Control Program funds. It is anticipated that the local agencies will cover the cost of staff attending training sessions.

Methods for Assessing the Effectiveness of the 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.

Considerations for a KC Regional Sewer Construction Inspection Program

Consideration could be given to ways to assess the effectiveness of the training program itself through post-training evaluation questionnaire, tracking the number of certifications per year, or other methods.

Minimum Requirements for Inspectors

Prior to attending a training program, the inspector should have a minimum understanding of sewer construction and inspection standards. A typical job classification/description that includes the skills, knowledge, and abilities for sewer inspectors should be developed in order to establish a baseline for when personnel would start the formalized training. 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 abilities commensurate with the demands of the job

Content for Inspector Training

It is recommended that content for the trainings vary from session to session. At a minimum, content will need to be updated periodically to align with changes in 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 training program and certification process. Topics could include:
    - Regional inspector training: What is the purpose and benefit of this program?
    - Certification process
- 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/or shortcuts by contractors that may increase I/I risk
    - Inspection results reporting requirements
- 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 correctly complete a vacuum test
    - How to correctly complete an air pressure test
    - How to correctly complete a water leakage test
    - How to correctly complete an internal visual inspection (NASSCO PACP/Lateral Assessment and Certification Program [LACP] standards)
- Module 4: Construction BMPs
  - This module would discuss BMPs for various construction and repair methods to inform inspectors about the limitations of each method. Topics could include:
    - Cured-in-place pipe (CIPP) lining (mainline, laterals, and side sewer)
    - Pipe-bursting
    - Grouting
    - Spot repair
    - Lateral and side sewer repair
    - Lateral sewer connection
    - Adapting to recent changes to other industry BMPs and regulations
- 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

Implementation Schedule

It is estimated that setting up an inspection training program without any constraints could take 18–24 months. This time frame includes coordination with member agencies, contract inspectors, and other industry associations, contracting with third-party content developers, setting up training tracking software, and developing training modules. An ultimate implementation schedule will be developed during further evaluation.