



# **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 510**

**Evaluation of Current Inspection Programs at Cities and Sewer  
Districts**

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**Project 150258**

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## Revision History

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# 1.0 Background and Purpose

This introductory section presents the background and purpose for this Task 510 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 treatment costs. Excessive I/I flows in King County's (KC's) regional separate sanitary sewer system impact both capital and operational costs.

KC Water Treatment Division's (WTD) Conveyance System Improvement (CSI) Program assesses the hydraulic capacity of the regional wastewater system with projected 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 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 wastewater treatment plant 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 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 the Metropolitan Water Pollution Abatement Advisory Committee (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, insurance, maintenance, and grants or loans
- Develop a framework for implementing private side sewer programs within the KC service areas, specifically for side sewer inspection and certification, insurance, maintenance, and grants or loans

## **Purpose**

The purpose of this TM is to document the review of current sewer inspection programs of agencies discharging to WTD sanitary sewers. The Consultant conducted online research of the MWPAAC agencies and conducted in-person interviews with 32 of the 34 agencies to obtain information on their respective sanitary sewer standards and practices. Because of their geographic separation from the main WTD service area, the City of Carnation and Vashon Island were not included in this evaluation.

The MWPAAC agency standards are compared with identified industry best practices, and recommendations for modifications are included. Statistical information on inspections is tabulated and presented. MWPAAC agencies are supposed to submit inspection data, such as air and vacuum test results of new sanitary sewers, to WTD. A review of how WTD reviews and manages these data is also included. An overview of each agency's inspection practices is included in Appendix A.

## **2.0 Summary of MWPAAC Inspection Practices**

This section presents a summary of MWPAAC inspection practices for new construction of side sewers, repairs/modifications to existing side sewers, and main sewer lines.

All of the agencies interviewed require some type of inspection on mainline sewers and private side sewers. The inspections vary depending on what type of construction is being implemented (new construction, repairs, replacements, or extensions) and what is happening on the private property (renovation, teardowns, or repairs).

### **New Construction of Side Sewers**

For new construction in the public right-of-way (ROW), all agencies inspect the sewers in a consistent fashion. Inspection work for developer-funded extensions and agency-funded sewer work is generally performed by contracted inspectors or the agency's engineering department. Manholes are vacuum-tested and mainlines (including side sewers up to the property line) are air pressure-tested, meeting the requirements of Washington State Department of Transportation (WSDOT) specification 7-17.3(2). Very few failed inspections were reported during the interview process. Areas that fail the vacuum/pressure test are required to be corrected and undergo the test again and pass, prior to acceptance by the agency. While not verified during the interview process, it is assumed that the inspectors are reviewing the materials to make sure that they meet the agency's and project specifications.

The inspection practices were also the same across the board for new building construction connecting to new sewers. Once the entire side sewer pipe is in the ground (from the building to the connection point at the property line) and prior to backfilling, the pipe is visually inspected and then water- or air-tested. Corrective action is required until the pipe passes the selected test. The inspectors for this type of work vary greatly from agency to agency. Inspectors were used from the building, sewer, or other departments, depending on who was qualified and available.

### **Repairs/Modifications to Existing Side Sewers**

Across the service area, there is wide variation in the inspection of private side sewer repairs and the process for teardowns and renovations. The limits for inspections depend upon what part of the side sewer pipe is designated as public versus private. The limits of ownership are not consistent across the service area. Figure 2-1 shows a breakdown of lateral ownership by category.<sup>1</sup>

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<sup>1</sup> One district owns the entire length of pipe from the building to the main and for one city ownership varies depending upon date of construction.



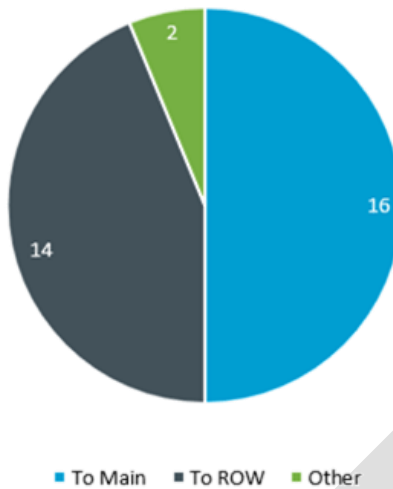


Figure 2-1. Limits of side sewer ownership, from building

All sewer agencies except one require that the property owner obtain a side sewer permit for modifications to existing side sewers. Once a permit is in place, it triggers inspection of the repair. This inspection varies across the agencies. Most inspect only the part of the pipe that was opened for repair or replacement. The inspection for this is generally just a visual confirmation of the joints prior to backfilling. One jurisdiction requires that the side sewer be fully replaced to the property line for all teardowns. For lines that are fully replaced, a water or air test and visual inspection is usually completed prior to backfilling. **Two of the agencies requiring side sewer permits stated that they do not inspect these repairs, and the one agency that did not require permits also does not perform inspections.**

Inspections of new and rehabilitated side sewers can be completed throughout the construction process (inspector present full time or comes periodically) or occurs only upon completion of the work, prior to backfilling. A breakdown of inspection timing is presented in Figure 2-2.

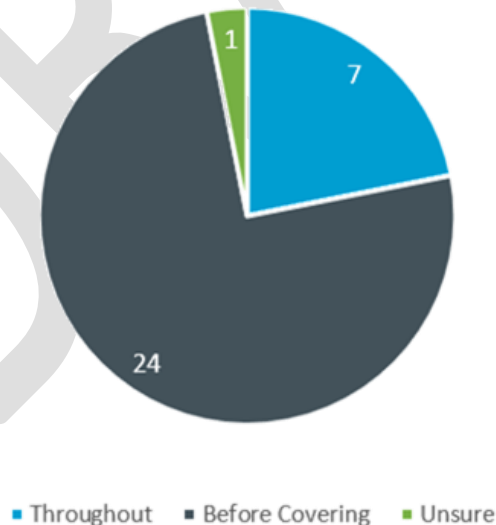


Figure 2-2. When inspections occur

## Mainline Inspections

The conversations during the interview process were more focused on side sewers than on agency-owned assets. However, it became apparent that the agencies have a wide range of ongoing mainline and manhole inspection programs. Some agencies own multiple closed-circuit television (CCTV) trucks and are out inspecting pipe every day. Others have contracted out the work and have completed one inspection of their system. Visual inspections during ongoing cleaning and maintenance programs were another common method used to gather condition data on agency mainlines. Others have spotty information of their system gathered as problems arise, with no comprehensive assessment. Agencies that do not own CCTV trucks or have active inspection programs acknowledged that this was a shortcoming. Most of these respondents indicated an interest in collecting CCTV data, but many lacked the staffing and budgetary resources or approval to begin one. All inspections were reported to follow the National Association of Sewer Service Companies' (NASSCO's) Pipeline Assessment and Certification Program (PACP) format.

Figure 2-3 shows the number of agencies that reported having an active CCTV program. The average frequency of complete system inspection was 5 years across 11 agencies with a range of 3 to 10 years.

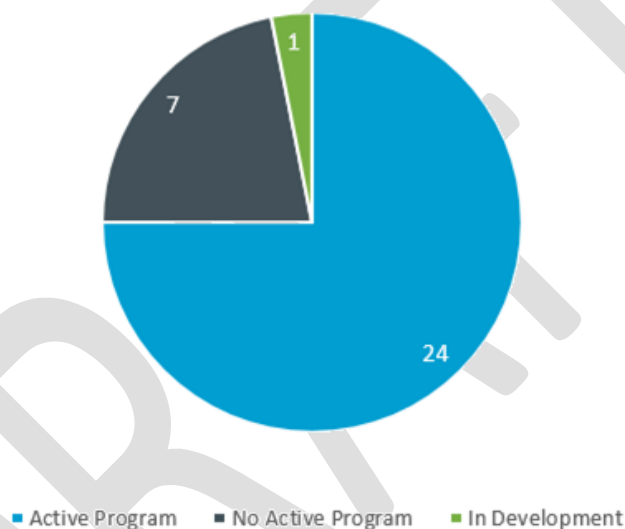


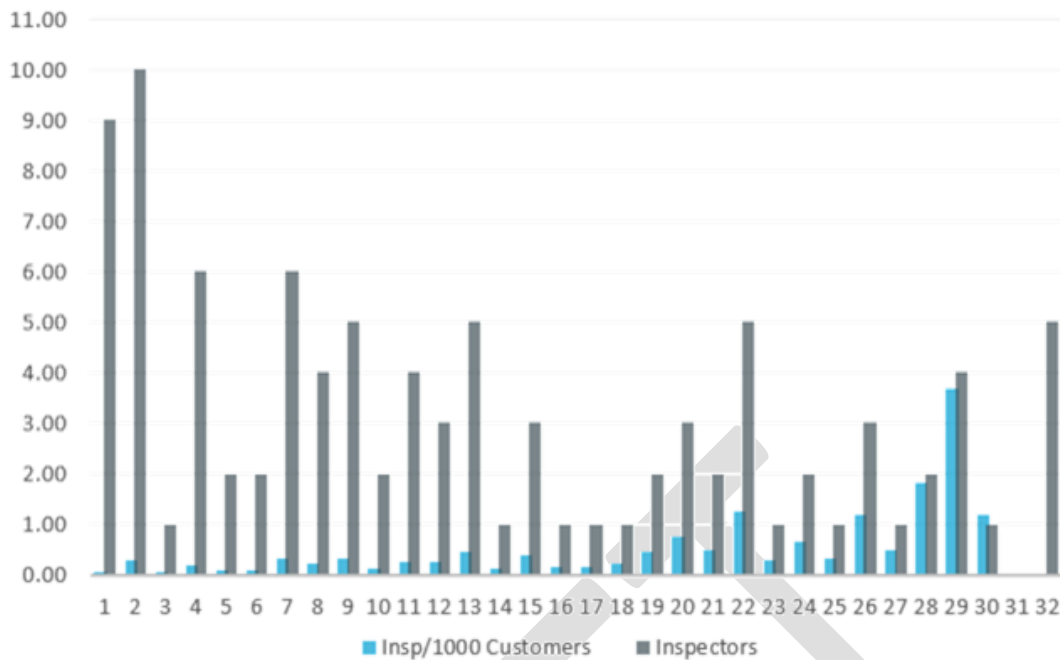
Figure 2-3. CCTV inspection programs

## 3.0 Inspectors

This section presents an overview of the inspectors at each local agency.

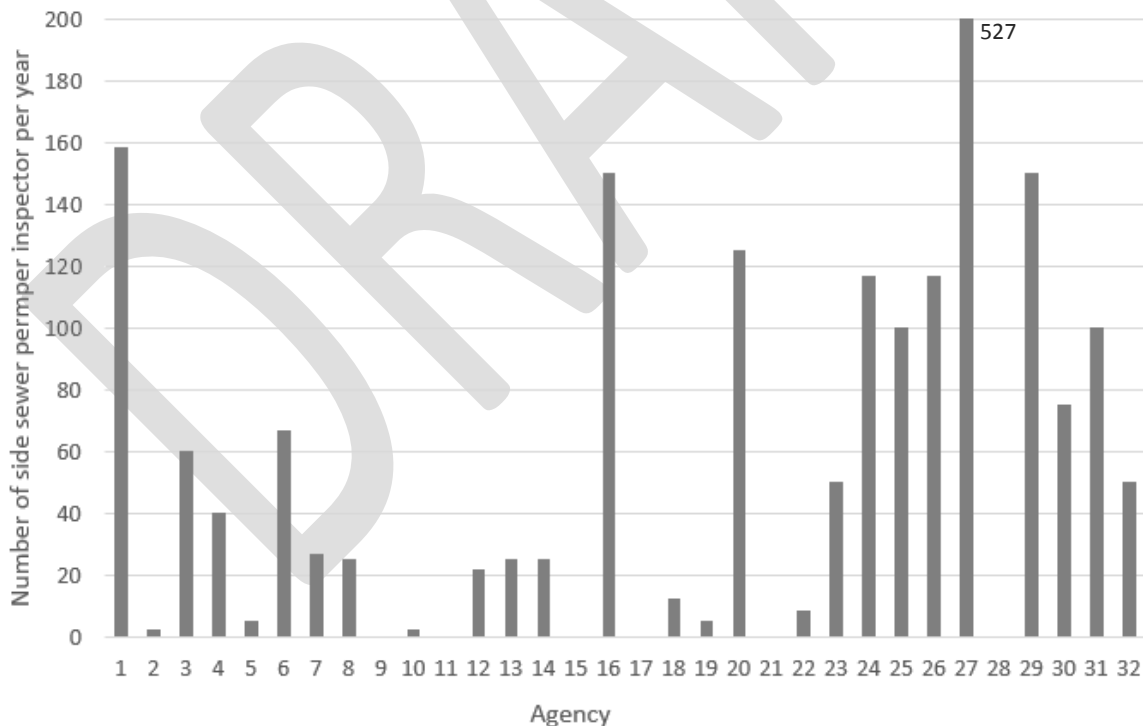
Inspectors are the front line in ensuring that the agency is receiving a quality product, built to its specifications and needs. The number of inspectors that an agency has varies with the size of the service area and whether it is a city or district sewer provider. Cities have the opportunity of leveraging other departments, such as building inspectors, to have more oversight and knowledge of sewer modifications versus districts. Districts are limited to just their staff. City agencies averaged 4.0 inspectors, while utilities averaged 2.5 inspectors. Many of the district and smaller city inspectors are not full-time inspectors and are balancing additional responsibilities. Based on WTD mapping, 64 percent of the service area is composed of cities and 36 percent of the service area is composed of districts. This is shown in Appendix B.

Across the agencies, there was an average of 0.64 inspector per 1,000 customers. Figure 3-1 shows the number of reported inspectors for each agency and the number of inspectors per 1,000 sewer accounts.



**Figure 3-1. Total number of inspectors and inspectors per 1,000 customers**

Another metric to assess the workload of inspectors is to look at the number of side sewer permits issued per agency per year per inspector. This breakdown is shown in Figure 3-2.



**Figure 3-2. Side sewer permits per year per inspector**

During the interview process, it was found that only one agency has a formal training program for inspectors. One other agency reported that its inspectors are required to receive NASSCO PACP certification. All agencies reported that their inspectors receive on-the-job training and have had several years of experience in sanitary sewer operations and maintenance prior to becoming inspectors.

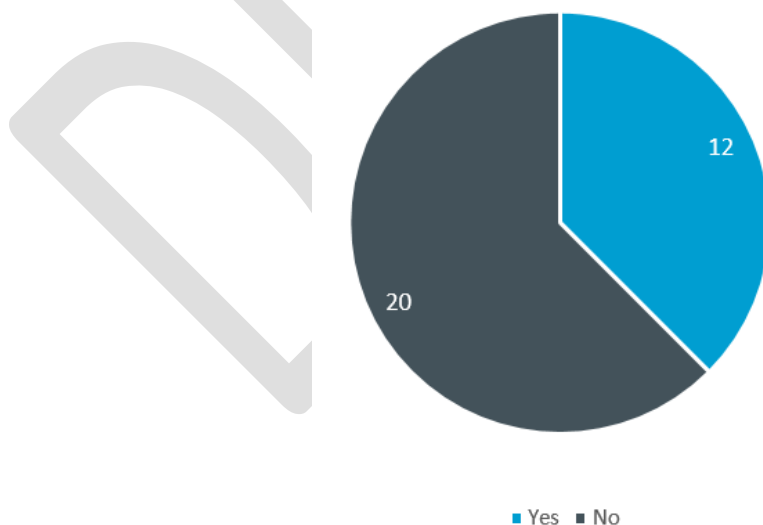
Inspector experience across agencies varied greatly. Many of the agencies did not know the exact experience ranges of their inspectors. Of those that provided numbers, 18 of the agencies reported that they have inspectors with more than 10 years of inspection experience. Others reported that generally they have newer inspectors teamed with more senior inspectors. One agency reported that its inspectors had only 2 years and 5 years of experience, but had on-the-job training with an inspector who had 30 years of experience prior to his retirement. Generally, it was found that across the agencies, inspectors have had several years of sewer operations and maintenance experience prior to becoming inspectors. The junior inspectors were always teamed with more senior inspectors to learn on the job the ins and outs of the inspection process and turnover in the inspections department is low.

## 4.0 Permitting

This section presents an overview of the side sewer permitting practices for each local agency.

It is important for agencies to know when any work occurs on a side sewer. This provides an opportunity to inspect an otherwise seldom-inspected asset. All agencies but one require a permit for any owner-driven side sewer repairs. Despite this requirement, a common response was that permits were not always requested for private side sewer work. Smaller agencies reported chance enforcement of these as discovered by staff, but larger agencies were less likely to report any adequate enforcement.

Permits are also consistently required for new construction, teardowns, and significant remodels. For city agencies, the sewer permit is usually tied to the building permit. However, for sewer districts, there is no tie-in to a building permit. These are handled by two separate organizations. A meaningful breakdown of the number of building permits issued per year was not obtained because of the differences between a district and a city. A breakdown of sewer permits tied to building permits is shown in Figure 4-1.



**Figure 4-1. Side sewer permit tied to building permit**

Tracking the annual number of side sewer permits issued helps the agencies help plan staffing levels and indicates the number of side sewers that could potentially be inspected, repaired, or replaced each year as part of a side sewer program. The number of side sewer permits reported by agencies for the past year varies between 0 and 950 and is shown in Figure 4-2.

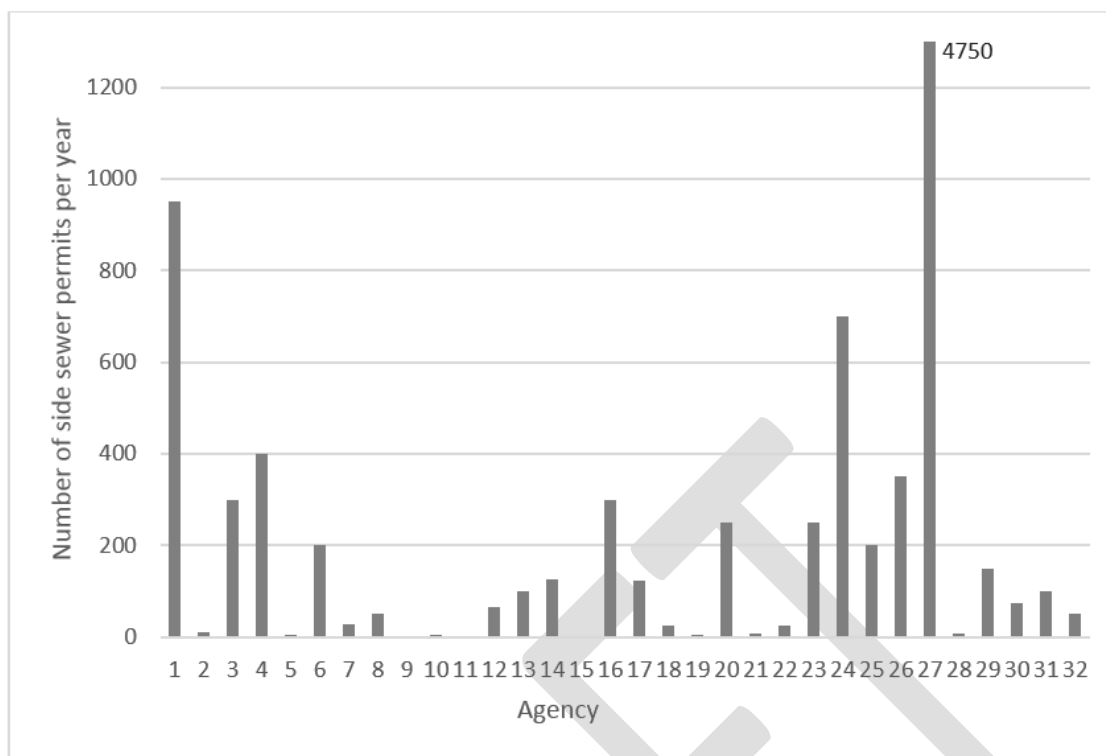


Figure 4-2. Side sewer permit per year

The number of permits is not known for agencies 9, 15, 17, 23, 27, and 28. Not including the missing values, almost 4,400 side sewer permits are issued in a typical year by WTD's local service providers.

## 5.0 National Inspection Best Practices and Standards

This section presents a summary of the national best practices and standards for both general side sewer inspections and I/I specific inspections.

### General Inspection Best Practice

Several agencies are noted for having industry best practice level inspection programs. The City of Santa Barbara's Sewer Line Inspection Certification Program (SLIP) is one of these programs. The City's program has been underway for more than 10 years with continued demonstrated success, and has been used as a model by many utilities in California. Because the residential SLIP effort was so successful, the City expanded its scope to laterals serving multi-unit residential/commercial entities. Clean Water Services' in Oregon offers a step-by-step process for inspections that can be considered a best practice.

Locally, the City of Skyway's inspection program is comprehensive and well organized and could be a model for other WTD city and sewer districts.

### I/I Inspection Best Practice

Several source documents summarize what are recognized as widely accepted standards for I/I inspection practices and standards. One excellent source of information is the 2016 Water Environment Federation (WEF) special publication, titled *Private Property Infiltration and Inflow*

*Control.* This document provides guidance on a wide range of topics concerning identifying private I/I sources, including:

- Measuring I/I from the private sector
- Private I/I source identification
- Establishing I/I source flow rates
- Private sector I/I source data management

In addition to such material, the publication provides helpful guidance on application of standards, in that best practice application starts with defining an I/I control program scope and vision. This definition will ultimately drive what standards are followed, where they are followed, and to what extent they are followed.

An additional source to reference is *WEF Manual of Practice FD-6, Third Edition, Existing Sewer Evaluation and Rehabilitation*, 2009. Chapter 5, Infiltration and Inflow Source Detection, covers topics including the purpose and need for I/I source identification, specific approaches to performing source detection, legal considerations for performing testing on private property, and quality assurance/quality control considerations.

## **6.0 Proposed Improvements to MWPAAC Standards**

This section presents proposed improvements to MWPAAC standards including testing and inspection procedures.

It appears that all agencies are following inspection best practices and measures for new construction. No recommendations for modifications are needed, as long as the agencies are strictly following these protocols in the field. Suggestions for existing infrastructure inspection are presented below.

### **Simple Testing Procedures**

A possible modification to the testing procedures is to provide a simpler method to determine passing or failing results. The WSDOT references for air/vacuum/water testing provide detailed equations to determine what is acceptable. East Bay Municipal Utility District (EBMUD) provides simple passing criteria for inspections of side sewers, which may be easier for inspectors to follow. For the various testing methods, it is a simple: it cannot drop more than a specified amount for a given period rather than entering data into a formula.

### **Inspect Full Length of Side Sewer**

For inspection of repairs, there is room for improvement. As stated in Section 2, some agencies do not require side sewer permits and one agency does not complete inspections on repairs. It is recommended that all repairs require permits and be fully inspected. The level of inspection is different among agencies. It is recommended that the full length of the side sewer be internally inspected, not just an external visual confirmation of the spot repair in the open trench. An additional requirement to air- or water-test the entire repaired line would result in more consistent quality between new and repaired side sewers.

### **Pressure Test Side Sewer**

If an inspector is already on site for an inspection of the spot repair, adding additional inspection measures will not add a lot of time to the inspection process. EBMUD has a side sewer certification process (which is discussed in the 610 TM) that requires air or water tests of side sewers at defined periods. This inspection equipment is required to be set up prior to the arrival of the inspector. The test requires only 5 minutes to complete, which would add very little time to the inspection process if setup is completed before the inspector's arrival.

## **Inflow Source Inspection**

It would also be beneficial for inspectors to check for clear water connections to the sanitary sewer while on site. This would include items such as roof drains, area drains, and sump pumps. These items may contribute significant amounts of flow and are illegal to have connected to a sanitary system. It would be advantageous for the inspector to quickly assess the property while on site. Johnsons County, Kansas, implemented a large inspection program dedicated to inspecting every structure connected to the sanitary sewer system for identifying clear water connections.

## **Active CCTV Program**

The agencies have a wide range of ongoing inspections for the publicly owned assets in the ROW. Some have active ongoing inspections, and others have very limited data. It is recommended that all agencies have an active inspection program that inspects everything on a periodic basis. General industry guidelines suggest inspecting assets every 5 to 7 years. The actual inspection frequency should be modified based on asset management principles and the criticality of the asset. The more critical the asset is, the more frequently an inspection should occur and vice versa. The de facto standard for sewer inspections is to follow NASSCO PACP/Lateral Assessment and Certification Program (LACP)/Manhole Assessment and Certification Program (MACP) standards.

## **7.0 WTD Review of Submitted Data**

As part of our review, we interviewed WTD staff on the review and management of local agency data. This section summarizes the WTD review process.

According to WTD standards, member agencies are required to submit inspection data to WTD for review, approval, and cataloging. Per WTD, it has 15 days to reply to agencies when given data for review. If the agency receives no reply within 15 days, it is considered to be accepted.

Agencies are providing WTD with their data in the allotted time frame. However, in the last few years, with the increase in growth, WTD has not been able to keep up with the review of all the submitted data and the agency will often not receive a reply within the 15 days and consider its data accepted.

## **Appendix A      Agency Summary Sheets**

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## **Appendix B      Service Area Map**

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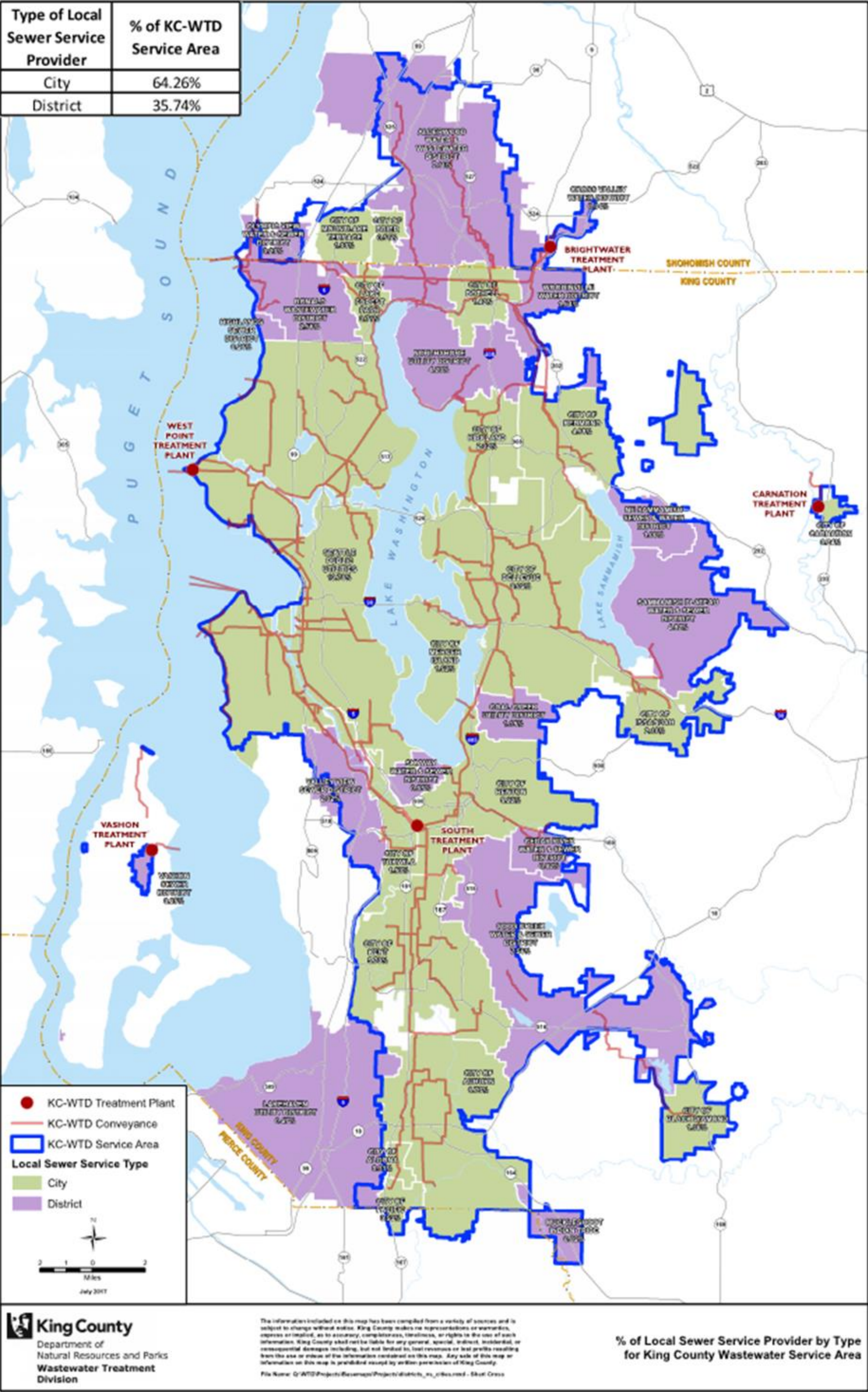


Figure B-1. Service area map