Inflow and Infiltration: How to Reduce I&I in Sanitary Sewer Systems

Municipal sanitary sewer systems are designed to collect and treat wastewater from homes and businesses. However, if manholes, pipes and other structures are damaged or deteriorate, excess stormwater or groundwater can enter the sanitary sewer system, leading to higher treatment costs as well as potential health and environmental impacts.

Reducing this excess water flow—otherwise known as inflow and infiltration—by addressing vulnerabilities in the sanitary sewer system is essential for municipalities to lower wastewater costs, protect overflow from seeping into the environment and reduce the risk of flooding.

What Is Inflow and Infiltration?

Inflow and infiltration (I&I) refers to the clear, excess water that flows into a sanitary sewer system from groundwater or stormwater sources. When groundwater seeps into the system through cracks, holes or weak connections, or as stormwater flows into the system through holes in manhole covers or foundation drains, the resulting overflow is called inflow and infiltration.

The Difference Between Inflow and Infiltration

Inflow describes stormwater that flows into the sanitary sewer system as a result of stormwater runoff, heavy rainfall, snowfall or snowmelt runoff taking the path of least resistance—such as through sump pumps, chimney sections, storm drain cross-connections or manhole covers.

Infiltration occurs when groundwater gets into the sanitary sewer system through cracks, holes, leaks, failures or faulty connections in the system. After prolonged precipitation or a large storm, these vulnerabilities allow groundwater to infiltrate the system.

Regardless of the source, I&I stresses municipal sanitary sewer systems and wastewater treatment facilities.

Why Is Inflow and Infiltration in Sanitary Sewer Systems a Problem?

The unintended excess water caused by inflow and infiltration can have serious consequences for both the infrastructure and operational costs of municipal sanitary sewer systems and wastewater management.

Possible Damage to Sewer Collection Systems

A primary concern is that the increased flow from I&I can overwhelm the sewer collection system. These systems are designed to handle specific volumes of sewage, and when they are forced to manage more flow than they can handle, the excessive flow can lead to pipe failures and other structural issues.

For instance, infiltration can cause erosion of soil around pipes, weakening their support and potentially leading to failure or collapse.

Strain on Wastewater Treatment Facilities

The added water flow also increases the burden on wastewater treatment facilities.

Treatment plants must process all water that enters the system, including the extraneous stormwater and groundwater introduced by I&I. This extra volume can lead to the discharge of untreated wastewater into the environment if the system's capacity is exceeded.

Potential Environmental and Health Impacts

Most municipal sanitary sewer systems are not equipped to handle significant volumes of stormwater. During heavy rain events, the additional flow from I&I can cause the system to reach or exceed its capacity, resulting in sewer backups into homes and buildings as well as overflows into rivers and lakes, which can have severe environmental impacts and public health implications.

Financial Implications

The financial impact of I&I is also significant. Increased flow leads to higher operational costs for pumping and treating water that should not be in the system. The need to treat groundwater and stormwater unnecessarily adds to the treatment plant's energy usage and operational expenses.

Risks to Infrastructure and Property

The structural integrity of sanitary sewer systems is at risk due to I&I. Excessive groundwater infiltration and stormwater inflow can lead to the deterioration of sewage pipe structures and manholes.

Residential homes and businesses may also suffer from sump pump backups caused by overwhelmed sewer systems, causing potential property damage.

5 Potential Sources of Inflow and Infiltration

I&I can have many—or multiple—sources. If you suspect inflow and infiltration is occurring, you will need to inspect all aspects of a sanitary sewer collection system to find the source(s) of the problem, which could include any of the following.

1. Aging Infrastructure

As infrastructure ages, it becomes more vulnerable to leaks, cracks and holes, any of which can allow groundwater to enter into the sanitary sewer system.

2. Improper Connections

Improper connections between stormwater handling systems and the sanitary sewer system are a significant cause of I&I. Examples include gutters, foundation drains and sump pumps that are designed to guide flow toward the sanitary sewer system.

3. Manholes

During heavy storms, snowmelt or floods, excess water can get into the holes in manhole covers as well as through any leaks or cracks in the manhole structure.

4. Laterals

Laterals, which are the pipes connecting residential and commercial buildings to the municipal sanitary sewer system, can crack or break due to age, allowing groundwater to enter the system. Additionally, tree roots near laterals can cause damage that contributes to I&I.

5. Sewer Mains

Damage to sewer mains, including cracks, leaky joints or deterioration, can make the pipe vulnerable to groundwater seepage.

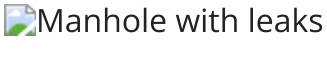

Image A

Image B

Image A shows a brick manhole that is compromised with cracks and allows for infiltration.

Image B shows a newly relined manhole that has a Sherwin-Williams protective lining. to seal off any cracks and prevents infiltration.

Inflow and Infiltration Calculation Methods

Accurately calculating I&I requires careful quantitative and visual monitoring.

One way of measuring inflow and infiltration is through flow monitoring. Flow monitoring involves measuring wastewater flow in the collections system and comparing it against a baseline flow estimate from before I&I. If the flow is higher than expected, it indicates there is an I&I issue at some junction of the sanitary sewer system. At this point, visual inspections can help determine the location and severity of the I&I.

Another method of calculating inflow and infiltration is the FELL-41 system, which involves using an electrical current to measure the amount of electrical leakage in a section of the sewer pipe or manhole structure, indicating water leakage.

If measurements reveal I&I, it's essential to take steps to reduce inflow and infiltration in order to minimize the impact on the entire municipal sanitary sewer system and wastewater treatment facility.

Inflow and Infiltration Solutions: 6 Strategies to Reduce I&I

Reducing inflow and infiltration requires a strategic approach that combines preventative maintenance with timely intervention. Here are five ways to tackle I&I and improve the integrity of a municipal sanitary sewer system.

1. Proactive Maintenance and Prompt Repairs

A proactive maintenance regime is the foundation of preventing and mitigating I&I.

Regular inspections and swift repairs are essential to addressing issues before they escalate. Routine maintenance helps in identifying potential problem areas, such as deteriorating manholes and pipes, and ensures that repairs are carried out quickly. **Structural rehabilitation of manholes** and other key components can also significantly reduce I&I, helping to maintain the sanitary sewer system's overall functionality.

2. Replace Existing Structures

Replacing failing pipes is a straightforward method to reduce inflow and infiltration. However, while effective, this approach is often costly and disruptive, impacting road traffic and residential areas. Traditional pipe replacement involves excavation, which can be labor-intensive and inconvenient.

As a result, municipalities often prefer less invasive methods to minimize disruptions while achieving similar outcomes.

3. Sliplining a Pipe

Sliplining is a popular trenchless technology used to rehabilitate aging pipelines. This method involves inserting a new, smaller-diameter pipe into the existing one. The space between the old and new pipes is filled with grout to prevent leaks and provide additional structural support.

4. Inserting Deform/Reform Pipe Lining

Deform/reform pipe lining offers another effective solution for reducing I&I. A flexible liner is inserted into the damaged pipe and then heated using hot water or steam, which causes the liner to expand and conform to the interior surface of the old pipe. The result is a new, seamless barrier against inflow and infiltration.

5. Spray a Protective Lining

Spray lining involves applying an epoxy compound to the interior walls of a cleaned pipe or manhole structure. The compound is sprayed in place and held by continuous airflow until it cures, creating an impermeable, durable and long-lasting protective coating that seals cracks and prevents I&I.

6. Inject Resin or Grout into Cracks

Injection methods can be used to address specific defects. By pressure-injecting resin or chemical grout into cracks, joints and gaps, it seals off leaks and stabilizes the surrounding soil.

Resin injections are commonly performed using a packer device, which is inflated to seal defects before the resin or grout is applied.

Reduce Inflow and Infiltration with Industry-Leading Wastewater Coatings and Linings at Sherwin-Williams (h2)

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