

What is Infiltration and Inflow (I&I)?

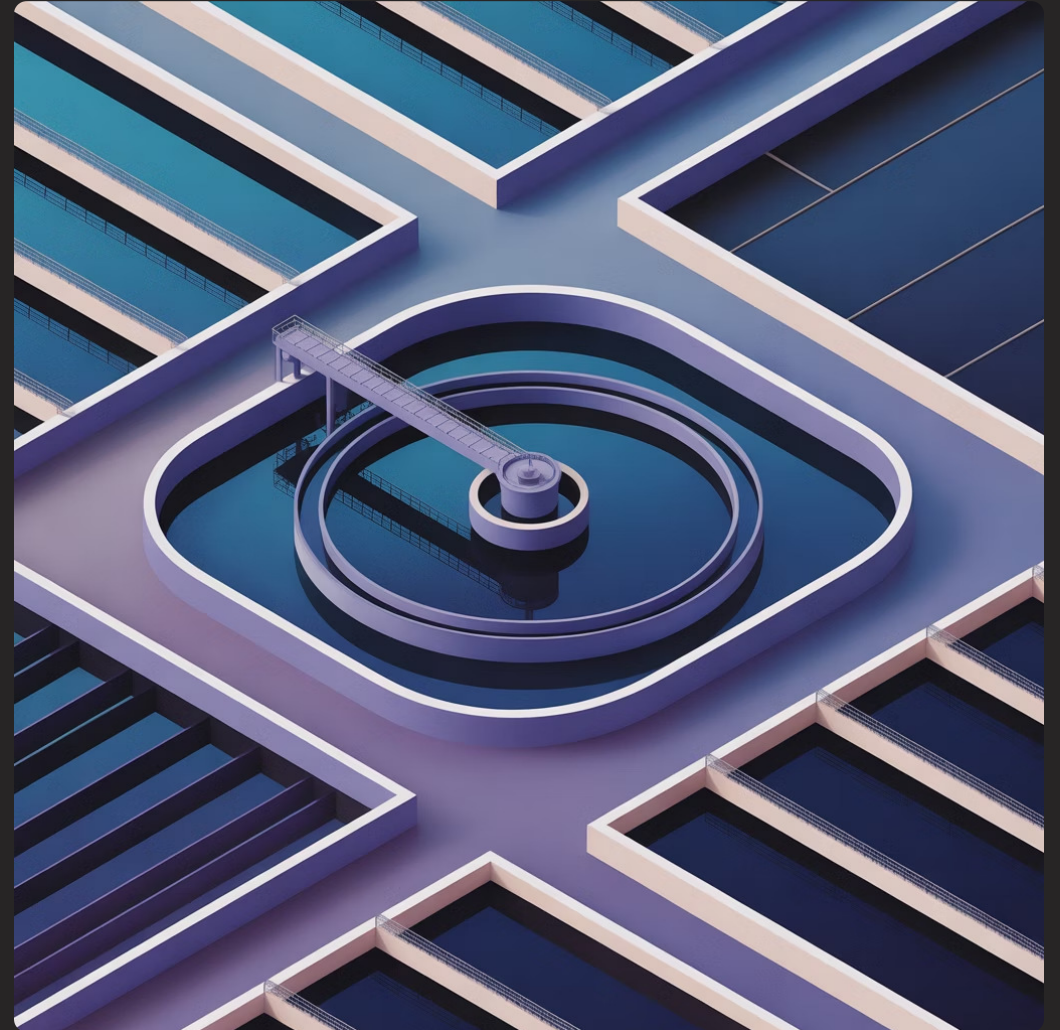
Understanding how unwanted water enters our wastewater systems and why it matters for communities everywhere.



Understanding I&I: The Basics

Infiltration and inflow (I&I) refer to groundwater and stormwater entering sanitary sewer systems through unintended pathways. This water is not domestic wastewater but dilutes sewage, causing treatment inefficiencies and system overloads.

When clean water mixes with sewage, it creates a cascade of problems for treatment facilities and taxpayers alike.



Infiltration vs. Inflow: What's the Difference?

Infiltration

Groundwater seeps into sewer pipes through cracks, broken joints, or defective manholes.

- Occurs continuously
- Slow, steady flow
- Underground sources

Inflow

Stormwater enters through direct connections like sump pumps, roof drains, or uncapped cleanouts.

- Event-driven spikes
- Rapid, high volume
- Surface water sources

Both increase sewer flow dramatically but have different sources, flow patterns, and detection methods.

How I&I Enters Sewer Systems



Infiltration Pathways

Cracked pipes, offset joints, damaged manholes, and deteriorated cleanouts



Direct Connections

Sump pumps and roof drains illegally tied to sanitary sewers



Stormwater Intrusion

Yard drains and downspouts channeling rainfall into the system





Why Does I&I Matter?

Treatment Inefficiency

Excess I&I dilutes sewage, reducing biological treatment effectiveness as pollutant concentrations drop below critical levels needed for proper breakdown.

System Overload

Causes sewer pipes and treatment plants to exceed design capacity, leading to backups, overflows, and environmental contamination.

Rising Costs

Treatment costs rise significantly due to pumping, processing, and disinfecting unnecessary stormwater that should never enter the system.

Real-World Impact: Sanitary Sewer Overflows



The Overflow Crisis

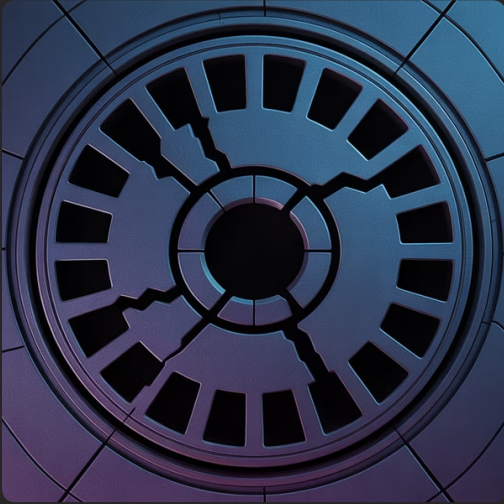
Heavy rains cause inflow spikes that can overwhelm even well-maintained systems within hours. The results are devastating:

- SSOs release untreated sewage into streets, parks, and waterways
- Disease-causing pathogens spread through affected communities
- Aquatic ecosystems suffer from toxic pollution loads
- Beach closures and fishing bans hurt local economies



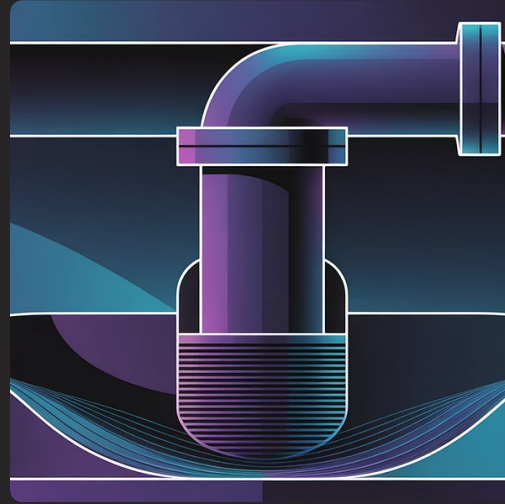
Example: Many municipalities report 60-80% of SSOs are directly linked to I&I during storm events.

Common I&I Entry Points in Communities



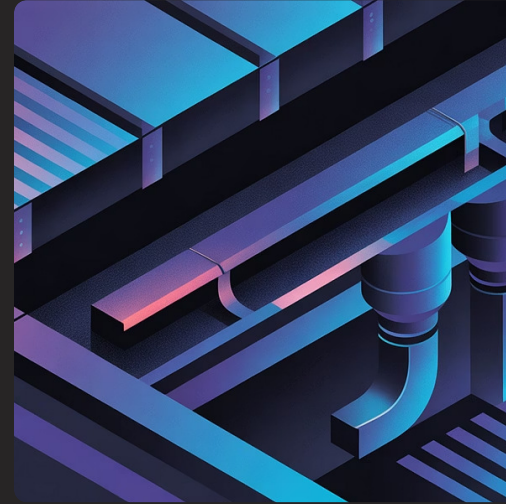
Deteriorated Manholes

Loose covers and cracked walls allow massive stormwater intrusion



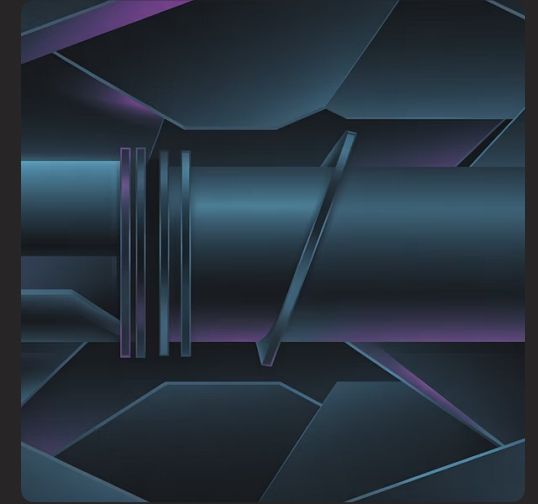
Illegal Sump Pumps

Groundwater pumped directly into sanitary sewers during wet weather



Roof Drain Connections

Downspouts tied to sanitary lines instead of storm drains



Aging Infrastructure

Offset joints and broken pipes in systems past their service life

Urban features like gravel bedding and permeable soils can channel groundwater toward damaged pipes, multiplying infiltration problems.

Detecting and Reducing I&I

01

Identify Problem Areas

Flow monitoring pinpoints sewer sections with abnormal wet-weather increases

02

Conduct Field Testing

Smoke testing reveals illegal inflow connections; dye testing traces specific sources

03

Inspect Infrastructure

CCTV camera inspections locate pipe defects, cracks, and structural failures

04

Execute Repairs

Seal cracks, replace damaged sections, cap cleanouts, disconnect stormwater drains

05

Engage Property Owners

Private sewer lateral maintenance programs prevent I&I at the source

The Cost of Ignoring I&I

40%

Higher Operating Costs

Increased treatment plant energy use and chemical consumption

\$1M+

Environmental Fines

EPA penalties for permit violations and sewage spills

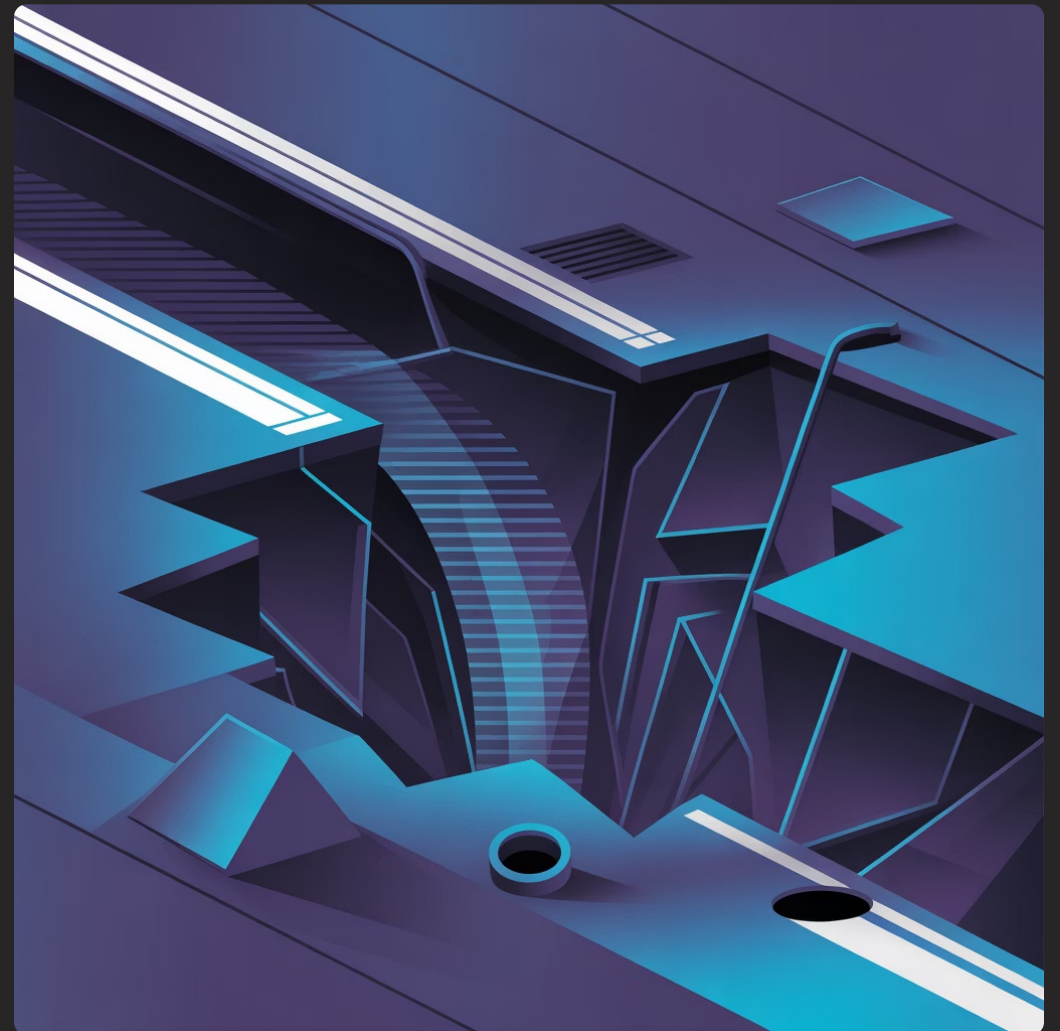
30%

Rate Increases

Ratepayers bear higher utility bills treating clean stormwater

Infrastructure Consequences

- Soil erosion around pipes leading to sinkholes and collapses
- Accelerated pipe deterioration from hydraulic overload
- Reduced treatment plant lifespan and premature equipment failure
- Public health risks from sewage backups into homes



Managing I&I Protects Communities



System Integrity

Understanding infiltration and inflow is critical to maintaining sewer system reliability and preventing catastrophic failures



Environmental Protection

Proactive detection and repair reduce overflows, protect water quality, and preserve aquatic ecosystems



Cost Savings

Preventing I&I saves communities millions in treatment costs and infrastructure repairs



Shared Responsibility

Everyone—from utilities to homeowners—has a role in controlling I&I for a healthier environment

By prioritizing I&I management, communities invest in sustainable infrastructure, protect public health, and ensure clean water for future generations.