



EPA New England Water Infrastructure Outreach provides tools, examples, and technical assistance for water infrastructure operators and managers, local officials, and other decision-makers for more effective and sustainable water infrastructure management. For more information see <http://www.epa.gov/region1/sso/toolbox.html>

Quick Guide for Estimating Infiltration and Inflow For Region 1 NPDES Annual Reporting

June 2014

Addressing Permit Requirements to:

Submit a calculation of the annual infiltration and inflow (I&I), maximum daily, weekly, and monthly infiltration and the maximum daily, weekly, and monthly inflow for the reporting year. For further details on Infiltration and Inflow, see '[Guide for Estimating Infiltration and Inflow](#)'.

Definitions

Infiltration

Groundwater that infiltrates a sewer system through defective pipes, pipe joints, connections, or manholes. Infiltration does not include, and is distinguished from inflow. Infiltration is generally measured during seasonally high ground water conditions, during a dry period.

Inflow

Water other than sanitary flow that enters a sewer system from sources which include, but are not limited to, roof leaders, cellar drains, yard drains, area drains, drains from wet areas, cross connections between storm sewers and sanitary sewers, catch basins, cooling towers, stormwater, surface runoff (including leaking manhole covers), street wash-water, or drainage. Inflow does not include, and is distinguished from infiltration. Inflow is generally measured during wet weather.

Estimations for reporting:

Term	Definition or How to Calculate
Average Dry Weather (ADW) flow	Use highest 7 to 14 day average per day flow without precipitation and during high seasonal groundwater. Includes domestic wastewater and infiltration.
Groundwater Infiltration (GWI)	During ADW flow period, average the low nighttime flows (midnight to 6am) per day for the same time period, minus significant industrial or commercial flows.
Groundwater Infiltration (GWI)	Subtract GWI from ADW flow.
Maximum Daily Infiltration	Subtract BSF from highest daily flow after a dry period of three days or more during high seasonal groundwater.
Maximum Weekly Infiltration	Subtract BSF from highest 7 day average flow after a dry period of three days or more during high seasonal groundwater.
Maximum Monthly Infiltration	Subtract BSF from highest monthly flow during dry or minimal rain period during high seasonal groundwater.

Maximum Daily Inflow	Measured during wet weather. Determine infiltration rate for dry period preceding rain event. Subtract BSF plus infiltration rate from the highest daily flow during the event.
Maximum Weekly Inflow (includes delayed inflow)	Determine infiltration rate for dry period preceding rain event(s). Subtract BSF plus infiltration from the highest 7 day average wet weather flow.
Maximum Monthly Inflow	Determine infiltration rate for dry period preceding rain event(s). Subtract BSF plus infiltration rate from the highest monthly average flow.
Maximum Monthly Infiltration and Inflow	Subtract BSF from highest monthly average flow.
Average Annual Flow	The total annual volume divided by 365 days. The average annual flow can also be calculated by averaging the monthly average flows.
Average Annual Infiltration and Inflow	Subtract the BSF rate from the average annual flow.
Average Annual Infiltration	Average of the monthly minimum flows.
Average Annual Inflow	Subtract the BSF and average annual infiltration from the average annual flow.
Average Wet Weather Flow (Average WWF)	The average daily flow during a period of significant rainfall (excludes significant commercial and industrial flow).
Peak Hourly Wet Weather Flow (Peak WWF)	The highest one hour flow rate during a significant rain event.

Notes:

If your system experiences SSOs or backups, you may have excessive inflow, although infiltration also contributes to the problem. Even where a system is not suffering from SSOs, systems experiencing surcharging should be evaluating their I&I, as should systems where new growth is expected and existing collection system infrastructure may be inadequate or marginal for handling new customers.

Other calculations used by state agencies to determine whether infiltration and/or inflow are excessive include:

Is your Infiltration Rate Excessive?

Some states have an excessive infiltration criterion based on gallons per person per day (gppd) and other states use a criterion of gallons per day per inch of diameter per mile of pipe (gpd/idm).

To determine gppd, divide the ADW flow by the population served. If the ADW flow exceeds 120 gppd, your state agency may consider the infiltration excessive.

To determine gpd/idm, first determine your total inch diameter-miles of pipe (idm). As an example, for a sewer system that has 36 miles of 4 inch diameter laterals, 36 miles of 8 inch diameter, 6 miles of 10 inch diameter, and 6 miles of 12 inch diameter gravity sewers, the total number of inch – miles is:

$36 \times 4 + 36 \times 8 + 6 \times 10 + 6 \times 12 = 564$ inch diameter miles

To determine gpd/idm, divide the dry weather infiltration rate during seasonal high groundwater (GWI from B above) by the total inch miles. In this example, if the GWI is 2 mgd, with 564 inch diameter-miles of pipe, then the gpd/idm would be:

$2 \text{ mgd divide by } 564 \text{ idm} = 3546 \text{ gpd/idm}$

Metcalf & Eddy's text "*Wastewater Engineering: Collection and Pumping of Wastewater*", suggests that infiltration rates for whole collection systems (including service connections) that are lower than 1500 gpd/idm are not usually excessive. The Massachusetts Department of Environmental Protection document "*Guidelines for Performing I/I Analyses*" recommends (as a rule-of-thumb) sewer subsystems of about 20,000 linear feet that exhibit infiltration rates above 4000 gpd/idm be investigated for contributing potentially excessive infiltration. For more information on design standards consult the Technical Report, "*Guidelines for the Design of Wastewater Treatment Works, New England Interstate Water Pollution Control Commission TR-16*".

Is your inflow excessive?

Divide the Average WWF by the population served to determine the gallons per person per day (gppd). If the Average WWF exceeds 275 gppd your state agency may consider the inflow excessive. This calculation should exclude major industrial or commercial flows.

A calculation for gpd/idm can also be determined for wet weather.

Estimating your cost to treat Infiltration and Inflow

Wastewater collection and treatment cost can range from \$2 to \$5 per thousand gallons. An annual I&I volume of 150 million gallons would cost between \$300,000 and \$750,000 per year to transport and treat. For many older collection systems infiltration can be quite substantial, and has been calculated as high as fifty percent of the flow.

If your treatment facility is at or near capacity and an upgrade will be necessary, the cost of reducing I&I to free up capacity at the existing treatment facility should be measured against the cost of building additional treatment capacity.