EPA United States Environmental Protection Agency
Office of Water

OFFICE OF WASTEWATER MANAGEMENT

Sanitary Sewer Overflows

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What are they and how can we reduce them?

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What are Sanitary Sewer Overflows?

A sanitary sewer overflow can spill raw sewage into basements or out of manholes and onto city streets, playgrounds and into streams, before it can reach a treatment facility.

Why are SSOs a problem?

EPA has found that Sanitary Sewer Overflows (SSOs) caused by poor sewer collection system management pose a substantial health and environmental challenge in some parts of our nation. The response to this challenge varies considerably from state to state. Many municipalities have asked for national consistency in the way permits are considered for wastewater discharges, including SSOs, and in enforcement of the law prohibiting unpermitted discharges.

In response, EPA has convened representatives of states, municipalities, health agencies, and environmental advocacy groups to advise the Agency on how to best meet this challenge. This *Federal Advisory Subcommittee* examines the need for national consistency in permitting and enforcement, effective sewer operation and maintenance principles, public notification for SSOs with potential health or environmental dangers, and other public policy issues.

EPA carefully considers the Subcommittee recommendations for regulatory and nonregulatory actions to reduce SSOs nationally.

Why Do Sewers Overflow

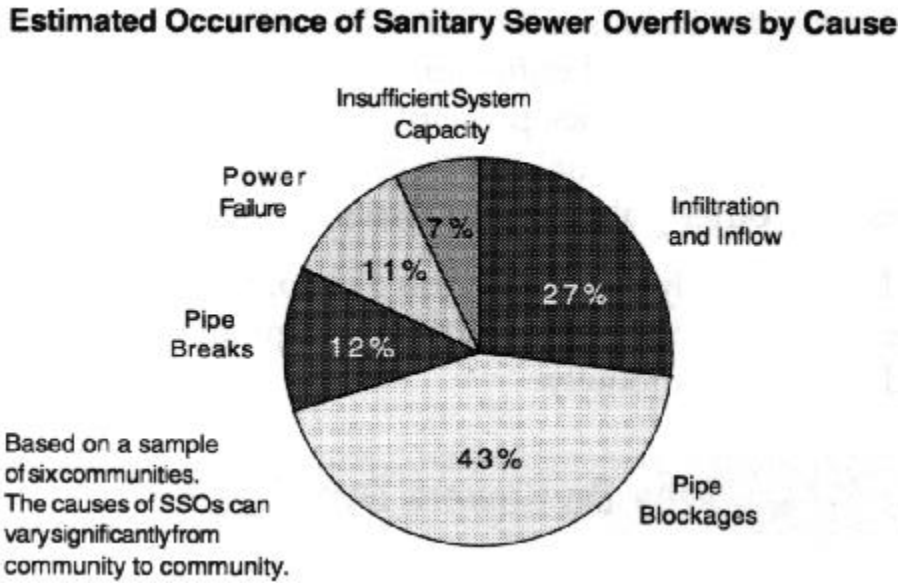
SSOs occasionally occur in almost every sewer system even though systems are intended to collect and contain all the sewage that flows into them. When SSOs happen frequently, however, it means something is wrong with the system.

Problems that can cause chronic SSOs include:

- Too much rainfall or snowmelt **infiltrating** through the ground into leaky sanitary sewers,

which are not intended to hold rainfall or to drain property. Excess water can also **inflow** through roof drains connected to sewers and broken or badly connected sewer service lines

- Sewers and pumps too small to carry sewage from newly-developed subdivisions or commercial areas
- Blocked, broken or cracked pipes and other equipment or power failures that keep the system from doing its job. Tree roots can grow into the sewer. Sections of pipe can settle or shift so that pipe joints no longer match. Sediment and other material can build up and cause pipes to break or collapse. This can also happen to sewer service connections to houses and other buildings. Some cities estimate that as much as 60 percent of the water over-filling their sewer systems comes from service lines. The chat below shows major types of problems that cause SSOs most frequently.
- A deteriorating sewer system. When sewers are not properly installed or maintained, widespread problems that can be expensive to fix develop over time. Some municipalities have found severe problems, necessitating billion-dollar correction programs. Often, communities have had to curtail new development until problems are corrected or system capacity is increased.



What Health Risks Do SSOs Present

Because SSOs contain raw sewage they can carry bacteria, viruses, protozoa (parasitic organisms), helminths (intestinal worms), and borroughs (inhaled molds and fungi). The diseases they may cause are shown in the table below and range in severity from mild gastroenteritis (causing stomach cramps and diarrhea) to life-threatening ailments such as cholera, dysentery, infections hepatitis, and severe gastroenteritis.

PATHOGENS IN RAW SEWAGE(6)

ORGANISMS	DISEASES AND SYMPTOMS
Bacteria	Chlorea, salmonellosis (food poisoning),

	typhoid fever, bacillary dysentery, gastroenteritis (including diarrhea and abdominal pain)
Viruses	Hepatitis, meningitis, pneumonia, fever, common colds, paralysis, encephalitis, gastroenteritis, diarrhea, respiratory infections
Protozoa	Gastroenteritis, acute enteritis, giardiasis (including diarrhea, abdominal cramps, and weight loss), dysentery, toxoplasmosis, crypotosporidiosis
Helminths	Digestive and nutritional disturbances, abdominal pain, vomiting, restlessness, coughing, chest pain, fever, abdominal pain, diarrhea, anemia, weight loss, fever, muscle aches, nervousness, insomnia, anorexia, hookworm disease, taeniasis
Bioaerosols	Allergic reactions (such as asthma), Legionnaire's disease

People can be exposed through:

- Sewage in drinking water sources.
- Direct contact in areas of high public access such as basements, lawns or streets, or to waters used for recreation. At least one study has estimated a direct relationship between gastrointestinal illness contracted while swimming and bacteria levels in the water(1).
- Shellfish harvested from areas contaminated by raw sewage. One study indicates that an average of nearly 700 cases of illness per year were reported in the 1980s from eating shellfish contaminated by sewage and other sources. The number of unreported cases is estimated to be 20 times that(2).

Some cases of disease contracted through inhalation and skin absorption have also been documented (3).

What Other Damage Can SSOs Do?

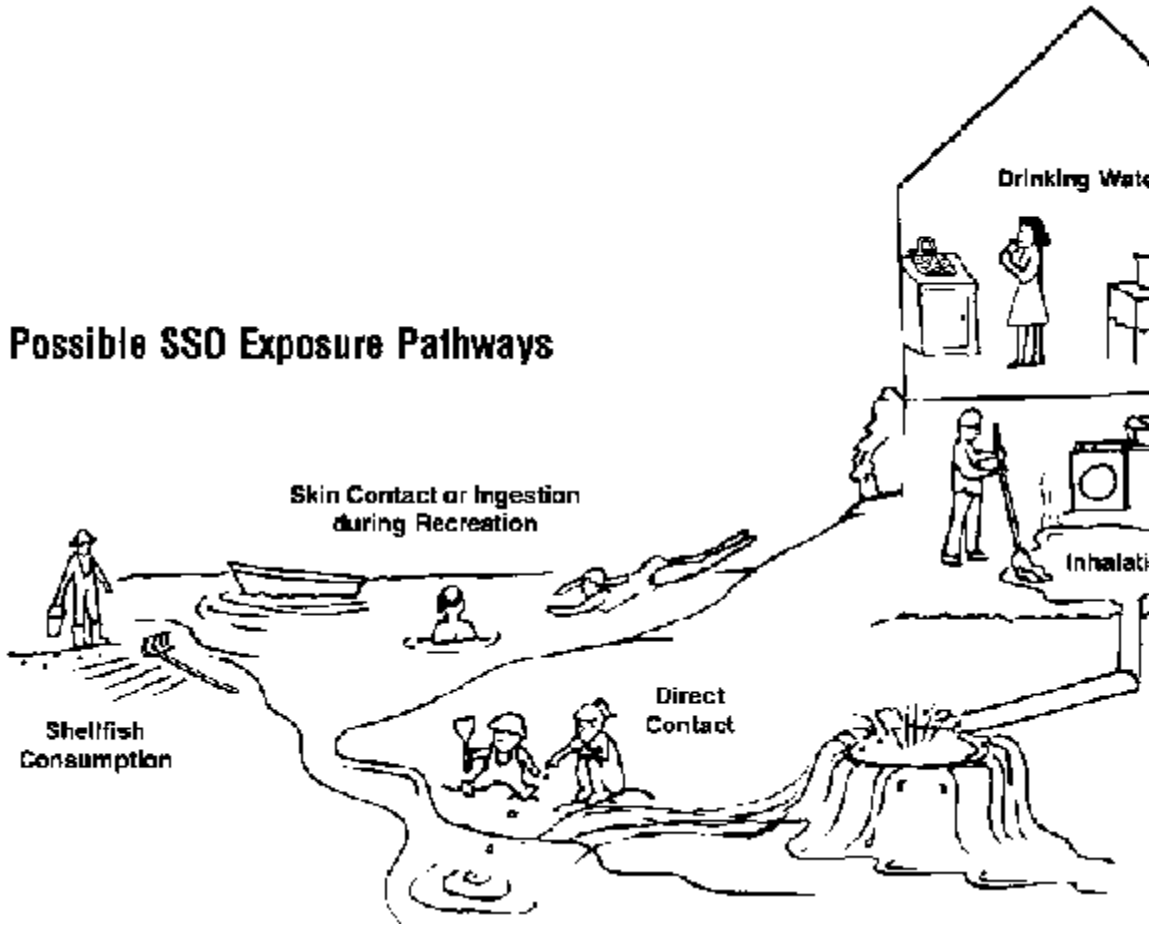
SSOs also damage property and the environment. When basements flood, the damaged area must be thoroughly cleaned and disinfected to reduce the risk of disease. Cleanup can be expensive for homeowners, and municipalities. Rugs, curtains, flooring, wallboard panels, and upholstered furniture usually must be replaced.

A key concern with SSOs which enter rivers, lakes, streams, or brackish waters is their effect on water quality. When bodies of water cannot be used for drinking water, fishing, or recreation, society experiences an economic loss. Tourism and water front home values may fall. Fishing and shellfish harvesting may be restricted or halted. SSOs can also close beaches. One 1994 study claims that SSOs closed beaches across the nation that year for more than 300 days(4).

How Big Is The Problem?

The total number of SSOs that occur nationwide each year is not known. In some areas, they might not be reported or are underreported to EPA and state environmental agencies. Two surveys, however, hep to define the size of the problem:

- In a 1994 survey of 79 members of the Association of Metropolitan Sewerage Agencies, 65 percent of the respondents reported wet weather SSOs(5). They reported that between 15 and 35 percent of their sewers were filled above capacity and/or overflowed during wet weather. However, municipal respondents with SSOs had only limited information about them. Only 60 percent had estimated the annual number. half of those had estimated the amount of sewerage discharged, and 17 percent had determined what pollutants were in their overflows.
- A 1981 survey conducted by the National Urban Institute indicated an average of 827 backups and 143 breaks per 1,000 miles of sewer pipe *(about 1,000 miles of sewer pipe are needed to serve 250,000 people.)* per year. Breaks occurred most often in the young, growing cities of the South and West. The report authors suggested that cities with the most collection system problems were doing the least to correct them---even cleaning pipes at a very low rate.



How Can SSOs Be Reduced Or Eliminated

Many avoidable SSOs are caused by inadequate or negligent operation or maintenance, inadequate system capacity, and improper system design and construction. These SSOs can be reduced or eliminated by:

- Sewer system cleaning and maintenance
- Reducing infiltration and inflow through system rehabilitation and repairing broken or leaking service lines.
- Enlarging or upgrading sewer, pump station, or sewage treatment plant capacity and/or reliability.
- Construction wet weather storage and treatment facilities to treat excess flows.

Communities also should address SSOs during sewer system master planning and facilities planning, or while extending the sewer system into previously unsewered areas.

A few SSOs may be unavoidable. Unavoidable SSOs include those occurring from unpreventable vandalism, some types of blockages, extreme rainstorms, and acts of nature such as earthquakes or floods.

What Costs Are Involved?

Sanitary sewer collection systems are a valuable part of the nation's infrastructure. EPA estimates

that our nation's sewers are worth a total of more than $1 trillion. The collection system of a single large municipality is an asset worth billions of dollars, and that of a smaller city could cost many millions to replace. Sewer rehabilitation to reduce or eliminate SSOs can be expensive, but the cost must be weighed against the value of the collection system asset and the added costs of this asset is allowed to further deteriorate. Ongoing maintenance and rehabilitation adds value to the original investment by maintaining the system's capacity and extending its life.

The costs of rehabilitation and other measures to correct SSOs can vary widely by community size and sewer system type. Those being equal, however, costs will be highest and ratepayers will pay more in communities that have not put together regular preventive maintenance or asset protection programs in place.

Assistance is available through the Clean Water Act State Revolving Fund for capital projects to control SSOs. State Revolving Funds in each state and Puerto can help arrange low-interest loans. For the name of your State Revolving Fund contact, please call the EPA Office of Water Resource Center, (202)260-7786.

Identifying SSO Problems and Finding Solutions

Cabool, Missouri(7)

In 1990 the sewer system for this city of 5,000 exceeded its capacity, causing overflows and backups at several locations. Breaks in drinking water mains lowered the water pressure, allowing contamination from nearby SSOs to enter the drinking water system.

Researchers linked these overflows with a pathogenic strain of *Escherichia coli* which killed 4 people, hospitalized 32 and caused diarrhea and other problems in 243 people.

Ocoee, Florida(8)

Sewage overflows from November 1988 to April 1989 periodically flooded a mobile home park during heavy rains and caused occasional outbreaks of disease.

Thirty nine cases of hepatitis A were identified among residents. In addition, four infected food handlers living in the park were linked to 100 cases of hepatitis A in Ft. Lauderdale where they worked. Hepatitis A is a chronic liver disease that can lead to permanent health injury and shorten life expectancy. Using a special health analysis scale, health damages were measured at up to 20 years' lost life expectancy. Diarrhea and other symptoms continued for 2 years.

Washington Suburban Sanitary Commission, Maryland(9)

From 1990 to 1994 the number of SSO-related basement backups ranged from 484 to 659 per year, for a total of 2,960. Basement cleanups cost an average of $700 each, including removal and disposal of sewage; removal and cleaning or disposal of carpet, wallpaper, wallboard, insulation, and other materials; disinfection; and drying.

Overflows at sewage pumping stations and treatment plants occurred from 11 to 50 times per year.

The costs of upgrades to reduce the level of overflows in the system (which serves 1.4 million people and handles 180 million gallons of wastewater a day) include:

- Upgrades at pumping stations and sewage treatment plants: $38 million
- Collection System improvements: $22 million
- Sewer reconstruction: $6 million (annual)
- Maintenance program: $10 million (annual)

These upgrades costs system users about $50 per household per year.

Lynn, Massachusetts(10)

SSOs caused street flooding, basement flooding, and sewer house connection backups in low locations. Some homeowners had to install pumps to reduce basement flooding.

Some of the SSO problems were attributed to badly cracked pipes, blocked, damaged manholes, leaky pipe joints, and large debris in some sewer sections.

The city has undertaken sewer separation and rehabilitation projects that have reduced the number and frequency of SSOs at a cost of $2.6 million. Additional work will further reduce overflows. Costs are estimated at about $10 per household per year.

Louisville/Jefferson County, KY(11)

From 1989 to 1994, 165 overflows were reported in 80 different locations, 70 percent caused by wet weather infiltration and inflow.

The county began corrective actions to reduce the number and frequency of SSOs through sewer rehabilitation and preventive maintenance. Further work was planned to remove private infiltration and inflow source connections such as sump pumps, foundation drains, and other connections. Future SSO reduction projects were investigated.

The long-term budget plan for corrective actions totaled $14.6 million. This program costs each household about $40 per year.

Office of Wastewater Management

For more information about EPA's work to help reduce sanitary sewer overflows please write to:

SSO Program Manager
U.S. EPA Office of Waste Water Management
401 M Street, SW (4201)
Washington, DC 20460

For publications about U.S. EPA Office of Wastewater Management programs and policies, please consult these sources:

Office of Water Resources Center

RC- 4100 - 2615 OWM
401 M Street, SW
Washington, DC 20460
(202)260-7786
Fax: (202)260-0386
(U.S. EPA Office of Water publications including information about storm water and combined sewer overflows. Also available is a list of commonly-used technical references for managing sanitary sewer overflows.)

Center for Environmental Research Information (CERI)
26 West Martin Luther King
Cincinnati, OH 45268
(513)569-7566
(Technical information about all U.S. EPA regulatory programs.)

Education Resource Information Center
Clearinghouse for Science, Mathematics and Environmental Education (ERIC/CSMEE)
1929 Kenny Road
Columbus, OH 43210-1080
(800)276-0462 or (614)292-6717
Fax: (614)292-0263
(Comprehensive information about environmental education. Charge applies.)

U.S. Dept. of Commerce
National Technical Information (NTIS)
5285 Port Royal Road
Springfield,, VA 22161
(800)553-6847 (rush orders) or (703)487-4650
Fax: (703)321-8547
(Many U.S. government agency publications. Charge applies)

National Small Flows Clearinghouse
West Virginia University
P.O Box 6064
Morgantown, WV 26506-6064
(800)624-8301
Fax: (304)293-3161
(Small communities technical assistance and information. Charge applies.)

Also see the U.S. EPA Office of Water Internet Home Page at http://www.epa.gov/OW

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6) U.S. EPA, 1992, *Technical Support Document for Reduction of Pathogens and Vector Attraction in Sewage Sludge*. Office of Water, Office of Science and Technology. EPA/822/R-93-021.

7) Geldreich et al., 1992, Searching for a water supply connection in the Cabool, Missouri, outbreak of *escherichia coli* 0157:H7. *Water Resources* 26(8):1127-1137; Swerdlow et al., 1992, A waterborne outbreak in Missouri of *Escherichia coli* 0157:H7 associated with bloody diarrhea and death. *Annals of Internal Medicine* 117(10):812-819.

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9) Washington Suburban Sanitary Commission, MD, 1995, *Separate Sanitary Sewer Overflows: Report to the U.S. Environmental Protection Agency.*

10) Lynn, MA, 1988 and 1989, *Combined Sewer Overflow Facilities Plan*.

11) Fort Worth, TX, 1995, *Sanitary Sewer Main 161 and 221 Drainage Areas Inflow/Infiltration Evaluation Study*.