Ohio River Combined Sewer Overflows

A publication of the Ohio River Valley Water Sanitation Commission

What are Combined Sewer Overflows (CSOs)?

In many of our nation's older cities and towns, storm water drains were built to provide relief from street flooding, and waste water disposal was typically through backyard privies or cesspools. Eventually, it became apparent that remedies were needed to deal with the odor and health problems caused by this disposal of sewage. The simplest solution was to send waste water to rivers and streams through the storm water drains. Hence, the origin of the **combined sewer**.

At that time, it was thought that rivers and streams would provide enough dilution to take care of the problem. Public awareness and concern about pollution caused by untreated sewage gradually increased.

After a time, "interceptor sewers" were built to intercept sewage before it reached the waterway and transport it to newly constructed waste water treatment plants. While interceptor sewers generally had no problem carrying the waste to the treatment plant during dry weather, additional water flowing into the system during "wet weather" (snow melt or rainfall) often exceeded the capacity of the pipes. Excess flow would be discharged at relief points along the sewer line. These discharges were called **combined sewer overflows (CSOs)**. This type of sewer system is still present in many cities and towns today.

Since 1972, discharges to rivers and streams have been managed by a permit system known as the National Pollutant Discharge Elimination System (NPDES). Each discharger must apply to its state water quality control agency for a permit, and through this system, the amount of pollutants entering the nation's waterways is controlled. To protect water quality in the Ohio River, ORSANCO reviews and comments on NPDES permits issued by its member states before they are approved.

With more than 1,300 identified CSOs along the main stem of the Ohio River, a potentially serious problem exists, especially in large urban areas where most of these older combined sewer systems are located. When these systems overload, they release large amounts of bacteria and other contaminants to the waterways. Water quality control agencies monitor certain forms of bacteria because their presence in the water can indicate the presence of more harmful bacteria called pathogens—disease-carrying bacteria which can cause ear, eye and throat infections and gastrointestinal illnesses in humans having contact with the water during recreational activities such as swimming or skiing. Historically, bacteria have been a problem in the Ohio River, and today, several larger cities along the main stem post daily or weekly bacterial advisories.

ORSANCO's Role in Ohio River CSO Abatement

To address this problem, in 1992 ORSANCO established a work group to determine the Commission's role in reduction of pollution from CSOs. The work group identified eight activities which ORSANCO should do to support efforts by states and municipalities that were working to reduce pollution from these discharges.

ORSANCO's Eight-Point Action Plan

Review state CSO strategies and identify any conflicts.

Provide a way for states to report to each other.

Coordinate impact studies by commenting on proposed studies; conduct studies on a contract basis.

Review results of CSO impact studies, integrate results from both sides of the Ohio River.

Participate in the national dialogue on CSO control.

Develop recommendations for monitoring impacts.

Identify areas where CSOs are especially harmful.

Hold regional meetings on CSOs.

Developing a Strategy for Monitoring CSO Impacts

ORSANCO's role in reducing Ohio River pollution from CSOs focuses on monitoring their impacts and coordinating state abatement programs. In large urban areas along the River, CSOs are generally located on both sides of the Ohio River and their pollution has the potential to affect more than one state. In 1993, the Commission, as an interstate agency, developed a strategy to provide a consistent approach among the states for monitoring the impacts of CSOs.

Because there is little information available which pinpoints what water quality problems, if any, come directly from CSOs, ORSANCO's strategy emphasizes continuous sharing of monitoring results among dischargers, the states and the Commission.

Primary Objectives of ORSANCO's CSO Monitoring Strategy

- **Identify successful ways to test and evaluate pollution from wet weather discharges** by using data from ORSANCO, CSO dischargers, state agencies, health department and others conducting monitoring on the Ohio River and other large rivers.

- **Define the water quality impacts from CSOs on the Ohio River** by conducting special studies in areas where large amounts of CSOs are located. Results of these studies will be combined with data from CSO dischargers.

- **Determine whether specific controls, called "nine minimum controls," recommended by U.S. EPA are adequate to meet water quality standards on the Ohio River and its tributaries.** Many CSO dischargers have overflows to both the main stem and certain tributaries. It is assumed that pollution effects in the tributaries will most likely be greater.

- **Provide data on water quality improvements resulting from CSO controls.** Given the potential expense of CSO control, it is important that data be available to show water quality improvements. This will be accomplished by comparing existing monitoring data with that collected once controls have been implemented.

Specific responsibilities for dischargers, state agencies, and the Commission are defined in the strategy. Short-term goals focus on gathering information on the locations of all CSOs and "plans of action" for their control. This information includes frequency and volume of the discharge, and types and quantities of pollution released. Data are received from dischargers monitoring CSOs which are listed as "priorities" due to their potential to pollute. The short-term phase, which has a target date of January 1997, will conclude when a CSO discharger has achieved the nine minimum controls.

As part of the long-term goals, monitoring information will be evaluated when a discharger achieves the EPA's nine minimum controls. This review will determine if water quality standards are being met. If standards are not being met, ORSANCO, the appropriate state agencies, and the discharger will decide what course of action is needed to help reach water quality objectives.

ORSANCO CSO Studies

Demonstration Studies

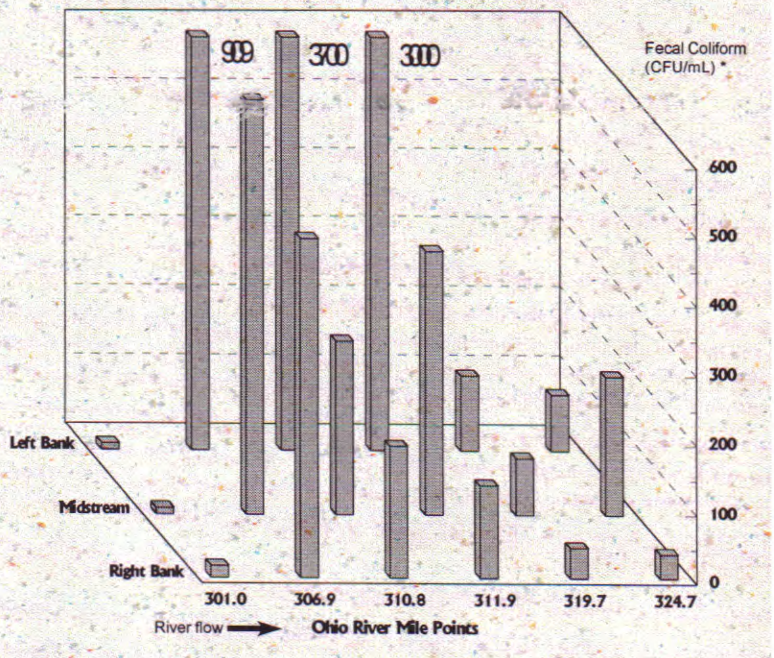
In 1994, as part of a demonstration study on monitoring CSO impacts, the Commission investigated the Ohio River near Wheeling, West Virginia and in the Greenup Pool near Huntington, West Virginia.

Greenup Pool Survey

The Commission conducted a bacteria survey on a 40-mile segment of the Ohio River to determine the magnitude and extent of wet weather impacts on water quality. Dry weather and wet weather surveys were conducted, using a cross-sectional and longitudinal approach. The cross-sectional sampling involved collecting samples at five points across the River at 10 locations within the study area. During the longitudinal survey, a single sample was collected at each of the 10 designated locations. The longitudinal sampling was conducted without stopping the boat using special equipment.

ORSANCO examined several physical water quality conditions, such as pH, temperature, dissolved oxygen and conductivity, and measured fecal coliform bacteria levels.

Cross-Section - Wet Weather Event - 10/19/94



* CFU is a unit of measurement for quantifying bacteria in a sample.

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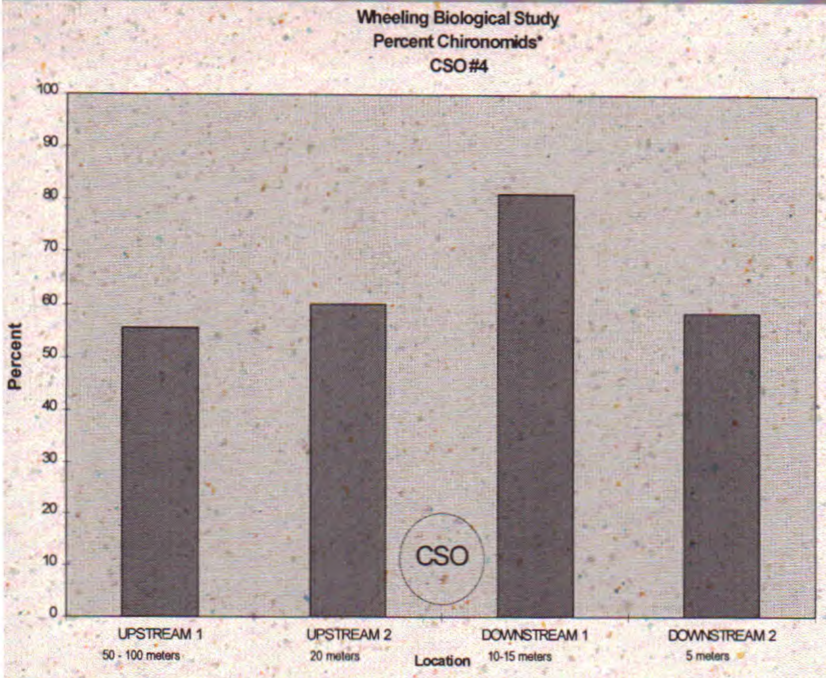


*Species that thrive in sewage enriched area

It is generally expected to find more pollution-tolerant macroinvertebrates immediately below the CSO discharge. Collection at the first site downstream, five meters from this CSO, showed an increase in the percent of chironomids, a species that thrives in sewage enriched areas.

Results of these surveys indicated that while there were generally no significant changes in the physical properties, bacteria concentrations consistently increased after wet weather events.

The most significant bacteria changes were not on the Ohio River main stem, but were on the Guyandotte River, a major tributary in this zone. The study also showed that samples collected at the most upstream site consistently had low levels of fecal coliform during both wet and dry weather. This suggests that bacteria loadings to the Ohio River were associated with the urban area in the zone and were not the result of high levels from upstream flowing into the sample area.

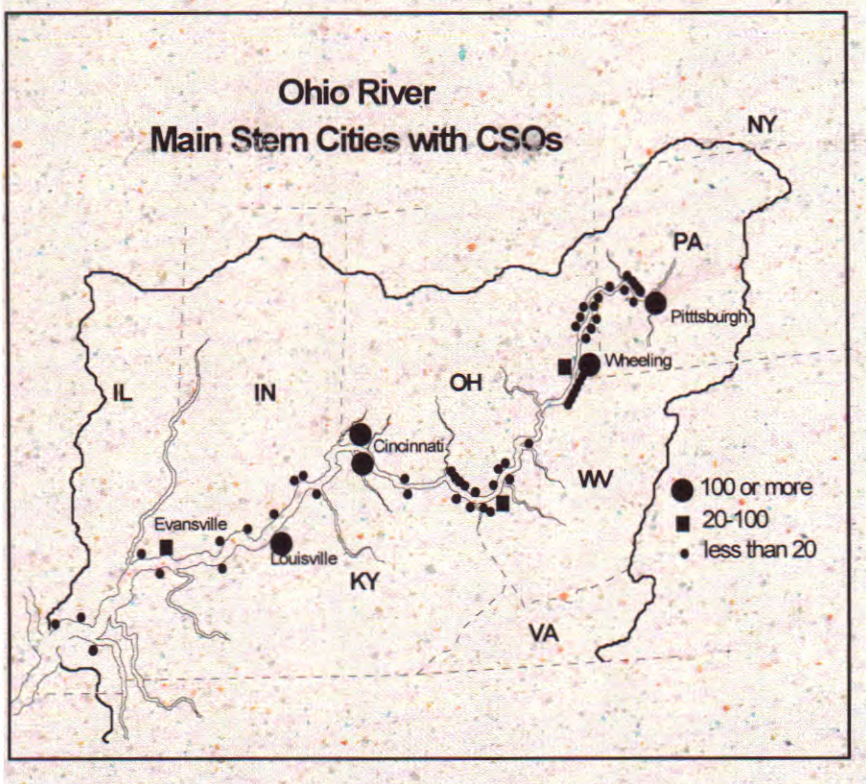
Wheeling Study

To determine which biological community would be most useful for studying CSO impacts, ORSANCO investigated two types of macroinvertebrates—small aquatic insects, crayfish, worms and mollusks—and periphyton (algae) in a five-mile section of the Ohio River in this urban area. Macroinvertebrates (those living in the water column) and benthic macroinvertebrates (those living in the bottom sediment), were studied because they require generally good water quality to survive, and unlike fish, they are somewhat stationary.

Three rounds of sampling were conducted over an 18-week period. Results indicated that of the biological communities studied, macroinvertebrates appeared to be the most useful in detecting impacts from the intermittent discharges of CSOs. However, before impacts can be attributed to wet weather, further study is needed.

(Studies continued on back page)

An Inventory of Ohio River CSOs



There are 68 permitted sewer systems along the Ohio River with a total of 1144 CSOs. In addition, there are an estimated 272 unpermitted overflows from several municipalities. This results in approximately 1366 CSOs along the Ohio River. Five areas—Pittsburgh, Wheeling, Cincinnati, Northern Kentucky, and Louisville—have more than 100 CSOs each, collectively they account for 73 percent of all Ohio River CSOs.

ORSANCO has retrieved latitude/longitude information for 57 municipalities and 1225 CSOs.

Thirty-three municipalities have completed and submitted CSO minimization plans to their respective states. Of these, 13 have been approved by the appropriate state agency. The submittal dates for eight facilities have passed, and their plans are now overdue.

(As of 10/96)

Cincinnati/Northern Kentucky Wet Weather Study

In 1995, with funding from U.S. EPA, Metropolitan Sewer District of Greater Cincinnati, Sanitation District #1 (Northern Kentucky), and Cincinnati Water Works, ORSANCO began a two-year $2 million wet weather study of water quality in the Cincinnati/Northern Kentucky area. One goal of the study is to develop methods for monitoring wet weather impacts on the Ohio River, and at the same time to develop a predictive model that other communities nationwide could use to evaluate water quality problems and effectiveness of controls in large river systems.

During the study, CSOs and nonpoint sources of pollution were investigated under both dry and wet weather conditions in a 70-mile stretch of the Ohio River, which includes the City of Cincinnati to the north and more than 30 cities and communities known collectively as "Northern Kentucky" on the southern side of the River.

Land use in the study varies from highly urbanized and heavily residential to mainly agricultural. Approximately 330 CSOs discharge in the upstream segment of the study area, and three major tributaries and smaller creeks, such as the Mill Creek, empty into the Ohio River in the study area. Many of these streams are also affected by CSOs.

Monitoring included cross-sectional and longitudinal sampling of the Ohio River, sampling of the lower sections of the tributaries in the study area, and CSO end-of-pipe monitoring. Both dry and wet weather surveys were conducted. In addition to chemical investigations, ORSANCO monitored the biological community. Biological assessments included both fish population and macroinvertebrate surveys.

Results of the first year indicated that fecal coliform bacteria is the single most significant water quality parameter of concern associated with wet weather pollution. Although exceedances of water quality criteria for bacteria occurred in the Ohio River during local rainfall, the highest bacteria densities were present on the tributaries, with the greatest density measured in the Mill Creek. Bacteria densities on the Great Miami River were greater than anticipated. Two tributaries demonstrated surprisingly high densities of fecal coliform bacteria during the dry weather sampling.

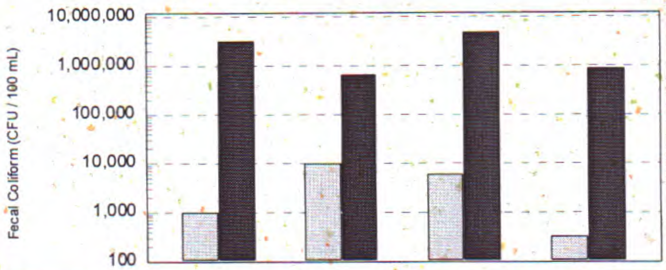
Investigations of the biological community revealed normal expectations for macroinvertebrate populations—the total number of macroinvertebrates was highest upstream of the urban area, decreased moving downstream through the cities, and increased further downstream as pollution loadings lessened. Fish populations remained constant throughout the survey area.

The second year of the study will focus on supplementing information generated during the first year, including verifying accuracy of the data. This will be done through intensive monitoring of both wet and dry weather conditions. Water quality models which were developed during the first year will be fine tuned and will be used to simulate the impact of pollution events in the study area.

Wet Weather Demonstration Study

Tributary Surveys - Peak Fecal Coliform Densities

Dry Weather vs. Wet Weather



Survey Type	Little Miami	Licking	Mill	Great Miami
Dry Weather	1,000	10,000	> 6,000	320
Wet Weather	> 3,000,000	640,000	4,750,000	860,000

Notes
Single Point Grab Samples
Based on data collected from 3 dry weather and 4 wet weather events

Glossary of Terms

CSO discharge - includes partially-treated or untreated sewage, industrial wastes, runoff from parking lots and streets, rain, and melted snow that is released to waterways through overflow structures that are designed to divert this waste from a treatment facility.

Nine Minimum Controls - As part of the EPA's National CSO Strategy, these low-cost, short-term controls would help CSO dischargers achieve acceptable water quality and reduce pollution impacts to human and aquatic life.

Nonpoint source pollution - chemicals, toxins, silt, animal waste, and other substances that are washed into waterways from land. This type of pollution is generally a result of human activities such as mining, homeowner chemical control of weeds and unwanted vegetation, construction, urban activities, forestry, and agriculture. Since it does not come from a specific source, such as a pipe, it is the most difficult to locate.

Waste water - any mixture of sewage or "used" water from residential households, municipalities, or industries. It can contain both solids and liquids.

The Ohio River Valley Water Sanitation Commission (ORSANCO). ORSANCO is an interstate water pollution control agency, created in 1948 by the signing of a compact among the states of Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia, with approval of the United States Congress. A primary goal of the Commission is to control existing and future pollution in the Ohio River Valley. The Commission consists of 27 members: three representing each state, appointed by the respective governor, and three representing the federal government, appointed by the President.

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