Progress and Challenges in Wastewater Treatment in the United States With Focus on the Ohio Valley and the Ohio River

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1. Introduction

As a highly developed and industrialized nation, the United States has accomplished great strides in the abatement of water pollution resulting from the installation of facilities to capture and process municipal and industrial wastewater flows. However, the U.S.'s efforts did not substantively begin until after major industrial development, which occurred in the late 19th century/early 20th century. Thus, driving initial national efforts was the poor state of water quality in many areas and its associated impacts on public health, as well as the recognition that restoration of water quality was necessary for the public's well being and for continuing economic development.

2. The beginnings – 1948 to 1972

As a national commitment to the development of sewage treatment works, the origin United States' effort can be considered the passage of the Federal Water Pollution Control Act of 1948. In that legislation, the United States Congress did not call for a regulatory approach, but encouraged the states to improve water quality, largely through grants or loans for the construction of facilities. Through a series of amendments to the 1948 legislation, the last being enacted in 1970, provisions were added that expanded the federal government's statutory authority, including adding federal enforcement authority in certain situations (e.g. navigable waters) and conditioning receipt of federal monies on the states setting water quality standards.

In the 1950's and 1960's, while progress in establishing water quality objectives and installation of municipal and industrial wastewater treatment was less than was desired by Congress, there occurred however some notable programs. In the Ohio Valley Region, and under the leadership of the Ohio River Valley Water Sanitation Commission (ORSANCO), intensive studies were undertaken to determine appropriate criteria for key water quality pollutants (e.g. fecal Coliform), best available treatment technologies were determined for categories of waste discharging industries, and municipalities were provided technical assistance to facilitate construction of facilities. This "Clean Streams Campaign" resulted in ORSANCO being awarded the American Society of Civil Engineer's *Outstanding Civil Engineering Achievement Award* in 1963 for "the most effective large-scale water pollution abatement program ever undertaken in the Western Hemisphere."(1) By that time, over $1 Billion had been dedicated towards wastewater treatment, with the population along the Ohio River with at least primary treatment either in place or under construction rising from less than one percent to 98.5 percent. Correspondingly, 86% of industries had installed facilities. (2)

3. The 1972 Clean Water Act and Amendments – Providing the Requirements and Funding for Secondary Treatment for Municipalities and Requiring Best Available Technology Treatment for Industry

Responding to growing public concern with the condition of the nations waters, combined with a general dissatisfaction with the pace of construction of facilities, the U.S Congress enacted the 1972 Clean Water Act and set new baselines for treatment of point sources of wastewater. Aided by federal grants totaling over $61 Billion which provided for up to 75 % of the cost for installation of municipal publicly owned treatment works (POTWs), at a minimum level of secondary treatment, the population served and number of installed facilities providing that level of treatment or greater grew rapidly as illustrated by the following statistics for 1968 and 1998:

1968 – U. S. population served by less than secondary treatment – 39%
U. S. population receiving greater than secondary treatment – 0.3 million
14,051 POTWs; serving 140 million people; 73% providing at least secondary treatment

1996 – U. S. population served by less than secondary treatment – 9%
U. S. population receiving greater than secondary treatment – 164 million
16, 024 POTWs; serving 190 million people; 86% providing at least secondary treatment (3)

USEPA's pending latest survey shows the number of POTWs as 15,583 (4)

Over the 1968-1996 period, effluent BOD(5) releases were reduced by 45% while influent levels almost doubled. Correspondingly, water quality across the U.S. improved dramatically, particularly in the Eastern region, which, in turn has spurred growth in recreation and revitalization of urban waterfronts.

Along the Ohio River, comparative levels of dissolved oxygen under drought conditions have increased and biological surveys such as has been conducted by ORSANCO have documented the return of some pollution intolerant species, such as Sauger, and shown a steady increase in numerical indices, such as the Modified Index of Well Being.

However, as of 2000, 39%, 45% and 51% respectively of the rivers, lakes and estuaries in the U.S are considered still polluted. Among the leading causes of impairment are bacteria, nutrients, metals (primarily mercury) and siltation, with sewage treatment plants as one primary source. (5)

4. Reduction in Federal Funding Support and the Current Infrastructure Gap

Beginning in the mid 1980's the federal government began implementation of a policy shift to reduce its direct financial commitment to development of wastewater infrastructure. Most notably, the program of grants was phased out and, in its place, capitalization grants have been provided to State loan agencies which are supplemented with state derived funds to provide reduced interest loans to public agencies. Over $20 Billion has thus far been made available to States but the amounts appropriate annually

by Congress has going down, with the most recent allocation being $0.9 Billion (Fiscal year 2006). Comparatively, if the amount of Federal funding in the several years following enactment of the 1072 Clean Water were expressed in today's dollars, the amount would be upwards of $25 Billion!

While estimates differ, a mid-point of the estimates prepared by the U.S. Congressional Budget Office sets wastewater capital needs at $340 Billion over the next 20 years. Among the needs for funding is the correction of combined sewer overflows, replacement refurbishment or expansion of facilities constructed in the 1970's and installation of technologies to address such issues as excess nutrients in receiving waters. Thus, a monumental challenge is presented for new sources of funding and employment of strategies to prolong the life of existing assets.

5. Today's Wastewater Utility Agenda; Some Key Challenges

With the exception of some rural areas, installation of wastewater treatment in the U.S. has been accomplished to achieve pollutant removal levels of at least 85%. Severe pollution conditions in waterways no longer occur, but problems remain that pose significant challenges, particularly to municipal utilities. Most notably, it is estimated that over $50 Billion will be needed for the correction of discharges from combined sewer overflows (CSOs). Many facilities, constructed in the 1970s and 1980s are reaching their design life and capacities and must be expanded or modernized. However, without federal assistance funding, revenue from users must be significantly increased. This is a particular problem in older cities which have lost population, industry, and the tax base which comes with it. In the metropolitan area of Cincinnati, Ohio, a metroplex of just over 1 million population, the cost to correct CSO will approach $3Billion and result of increases in user fees estimated to be 300% over the coming two decades..

Wastewater utilities are now and in the future will likely be receiving requirements for reducing the presence of nutrients in their discharges. In some areas, such as in the Chesapeake Bay Watershed, very stringent limits are being applied, but other regions of the country can expect to be eventually subject to similar requirements (e.g. Mississippi River Basin). In other areas, wastewater utilities will be required to address such pollutants as mercury and dioxin. These pollutants have resulted in fish consumption advisories and sources will be assigned limits on loadings designed to achieve water quality requirements.

These and other challenges are causing employment of new planning, management and operational techniques to extend the life of physical facilities and achieve more efficient operation. These initiatives include "asset management", "environmental systems approaches" and "capacity, management, operations and maintenance" (CMOM) programs.

Also emerging in the U.S. is the use of trading programs to achieve, on a watershed basis, prescribed overall loadings of a given pollutant. Among the trading programs that have been/are being established are those to meet reductions in nutrient loadings to the Long

Island Sound and the Chesapeake Bay. Participation in these programs will impact the construction of wastewater facilities.

Wastewater utilities in the U.S. are also being impacted by implementation of watershed-based approaches for achieving water quality objectives. Among specific developments are use of "watershed discharge permits" where facilities are bundled and authorized to discharge under a single issued permit. Also, wastewater utilities are actively cooperating with other interests in the watershed to forge partnerships or address common interests. Examples are working with sources of non-point pollution to develop cooperative initiatives and water supply utilities to assure protection of their source waters.

Finally, resulting from the events of September 11, 2001, security issues have come to the forefront. As many POTWs employ the use of chlorine as a disinfectant, some have abandoned use of Chlorine in favor of less dangerous chemicals, such as sodium hypochlorite, and facility perimeter barriers have been strengthened. This will be a continued trend.

Summary

Wastewater treatment in the U.S., substantially developed in the final three decades of the last century, has resulted in major water quality improvements. However widespread and significant water quality problems remain for which wastewater utilities will bear a heavy cost burden to address.

New management techniques are being deployed to improve planning and efficiency of operation, but many facilities have reached their design life and/or capacity.

Among the most significant current/emerging issues are reduction of impacts of sewer overflows and control of nutrients. Creative approached are being developed, including use of trading programs.

However, wastewater utilities are one component in the context of watershed-based water quality management. As such, the future of wastewater treatment in the U.S. will involve cooperation and partnerships with other interests to achieve water quality goals.

Reference

(1) Statement of William Wisely, Executive Secretary, American Society of Civil Engineers, May, 1963
(2) Annual Report for 1963, Ohio River Valley Water Sanitation Commission
(3) "Progress in Water Quality" An Evaluation of the National Investment in Municipal Wastewater Treatment, USEPA, June 2000
(4) Mr. Bob Bastian, USEPA, Email Communication, November 6, 2006
(5) National Water Quality Inventory, 2000, USEPA

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Japan-U.S. Joint Conference on Drinking Water Quality Management and Wastewater Control
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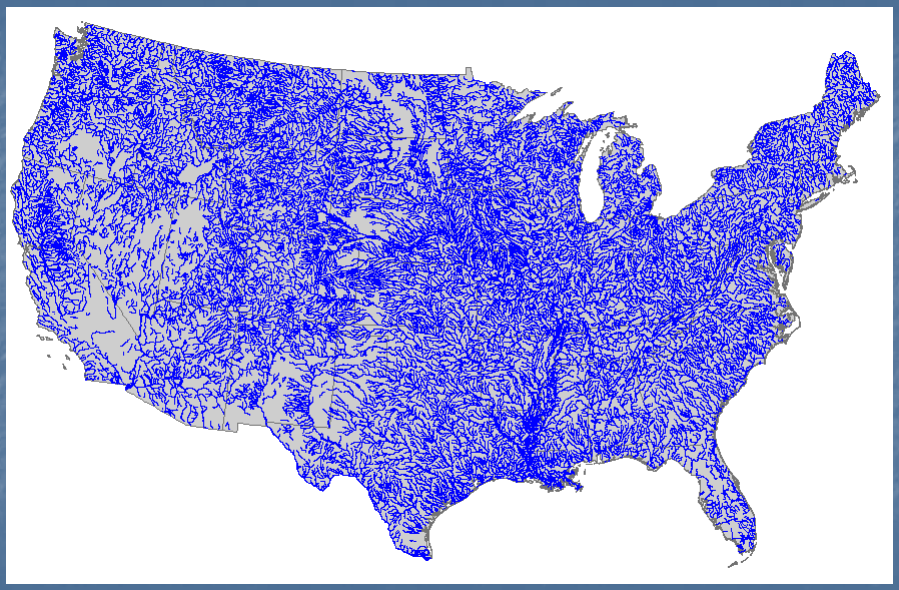


Water Pollution Control Act of 1948

- An “encouragement” to construct wastewater treatment facilities
- Water quality objectives based
- Grants provided
- Act amended numerous times which resulted in strengthened federal control
- Nationally, results not as hoped by Congress

The Ohio River Basin

The “Clean Streams Program” for the Ohio Valley

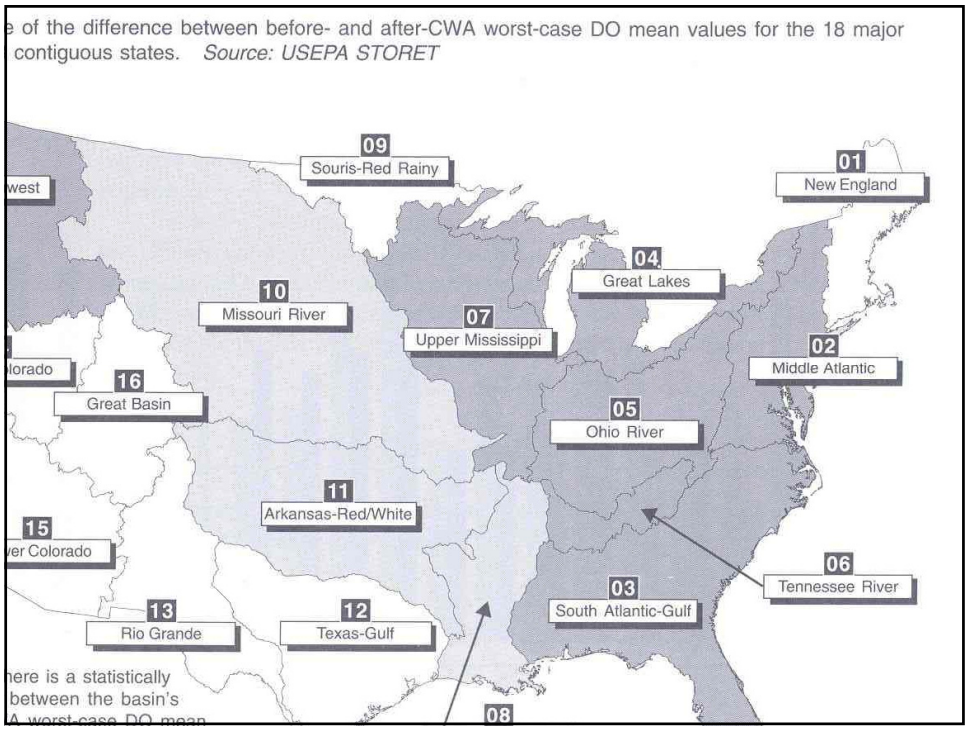
- Spearheaded by the Ohio River Valley Water Sanitation Commission (ORSANCO)
- A public awareness effort
- ORSANCO developed stream quality objectives
- By 1963, along the Ohio River, 98.5% of population had at least primary treatment and 86% of industries had installed facilities

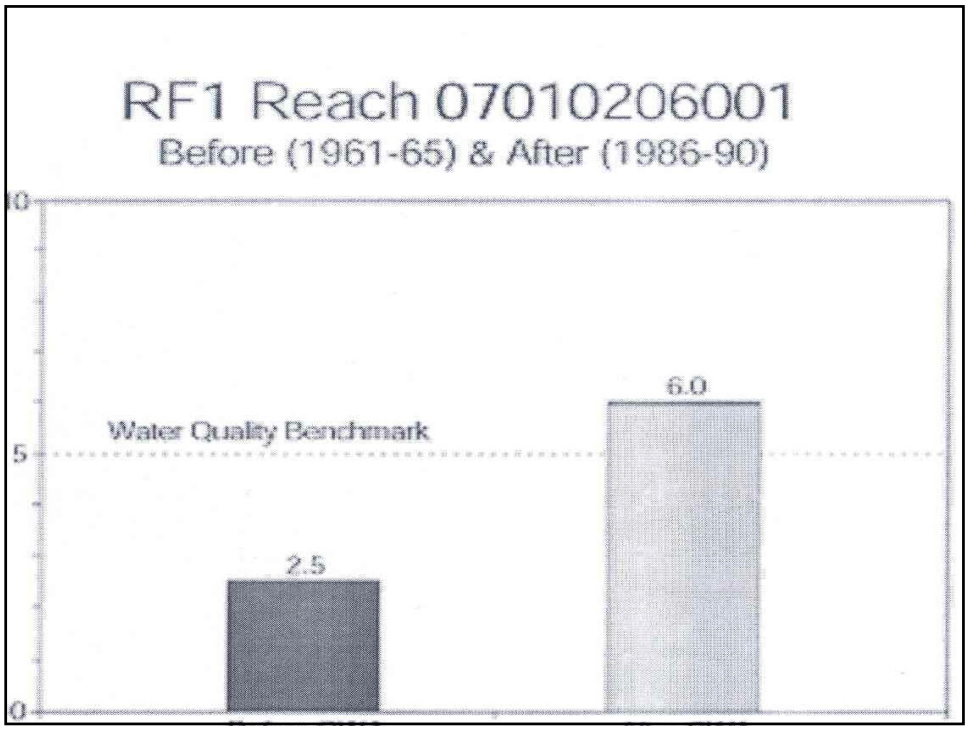
1972 Clean Water Act

- Change of philosophy; requires a minimum of secondary treatment across the land (i.e. technology based requirement)
- From water quality perspective, requires restoration of chemical, physical and biological integrity
- Requires permits to discharge
- Places federal government in ultimate control
- Federal funding assistance up to 75% for planning/design/construction

Development of Sewage Works in the U.S.

	1968	1996
• Population served by less than secondary treatment	39%	9%
• Population receiving greater than secondary treatment	0.3 million	164 million
POTWs		
Number	14,051	16,024
Population served	140 million	190 million
Providing minimum secondary	73%	86%

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Before (1961-65) & After (1986-90)
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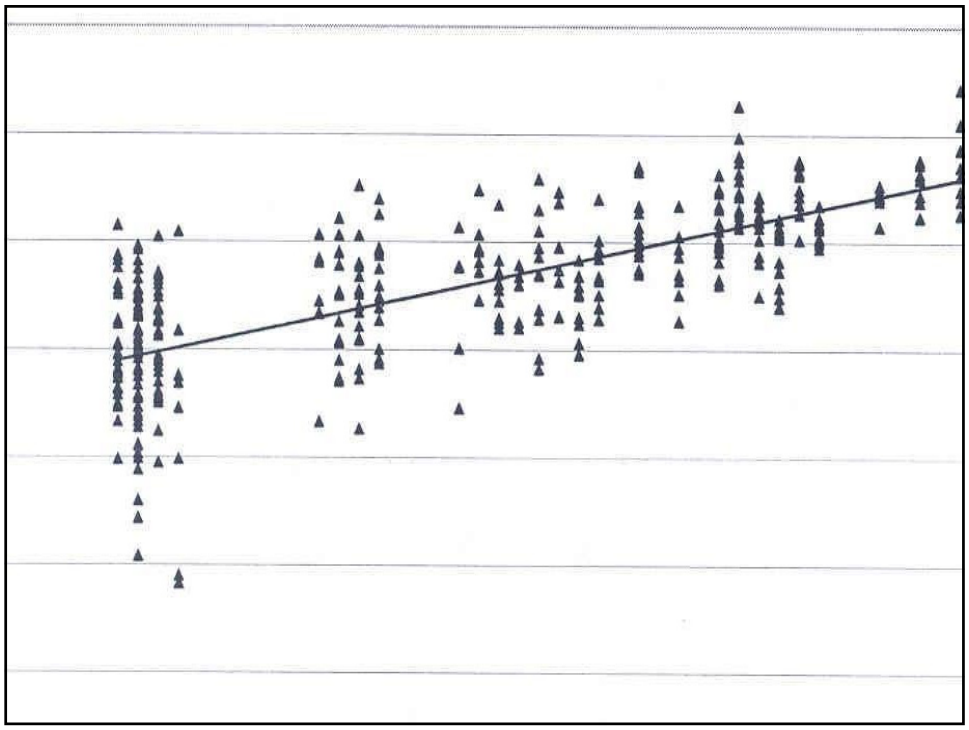
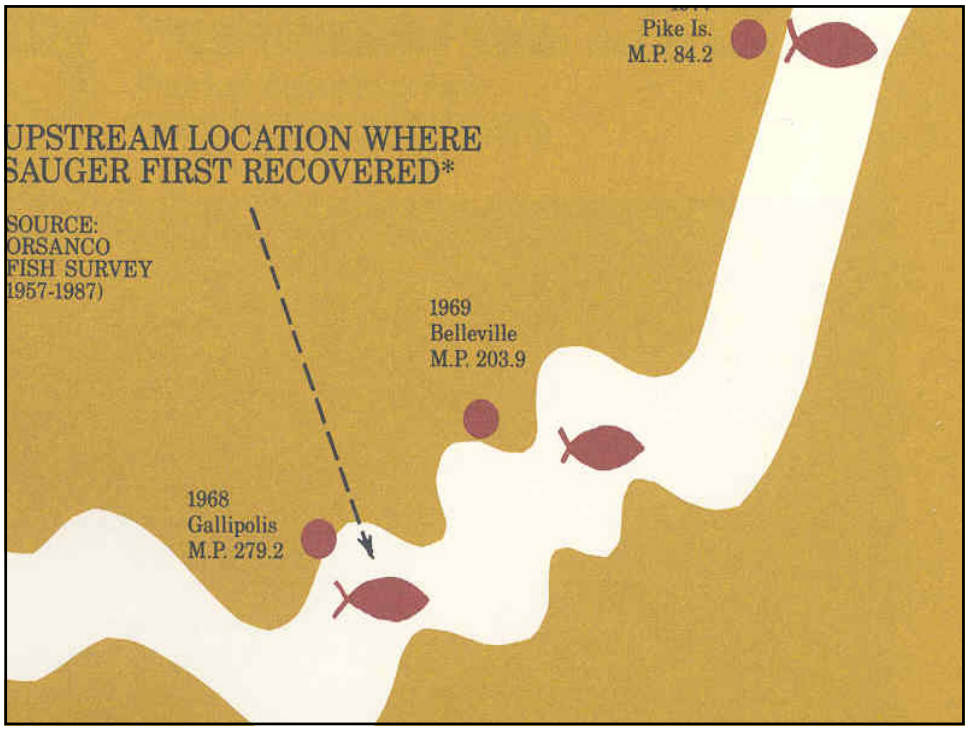
Water Quality Benchmark
2.5
6.0





Water quality has improved, however, as of 2000, 39% of U.S. rivers, 45% of U.S lakes and 51% of U.S. estuaries are still considered polluted

And, The U.S. Government , beginning in the 1980s, began a trend of disinvestment in sewerage infrastructure

75% support funding was terminated

Funds are now being provided to States to capitalize revolving Funds to provide low interest loans

Current Estimate of Wastewater Capital Needs

$340 Billion

Today's Wastewater Utility Challenges

- Correction of combined sewer overflows (CSOs) - $50 Billion
- Refurbishment/expansion/replacement of plants built in the 1970s
- Affordability in cities that have lost population and industry

Today's Challenges (continued)

- Reduction of Nutrients, PCBs, Dioxin and Mercury in Effluent
- Better Internal Management
  - Asset Management
  - Environmental Systems Approaches
  - Capacity, Management , Operations and Maintenance (CMOM)

Today's Challenges (continued)

- More proactive engagement outside the fence line as watershed management approaches needed to achieve water quality goals.
  - Trading to address nutrients
  - Protection of "source water" of drinking water utilities.
  - Public education on risk vs. cost

Wastewater Treatment in the U.S. Summary

- Great progress in wastewater services provided and receiving water quality
- Federal support made it happen but utilities are now on their own
- MAJOR capitol needs exist for many utilities to control CSOs.
- Awareness and concern rising regarding failure to attend to infrastructure needs
- There is a "New World" for wastewater utilities

If, in the U.S., There is not Continued (Accelerated?) Investment in Water Pollution Control, the Gains in Water Quality Achieved Over the Past 35 Years Could Be Lost

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