Indicator: Combined Sewer Overflow Controls in Southeast Michigan

Background

Most large, older cities in the Great Lakes basin were located on the banks of rivers or lakes to meet the needs for transportation and commerce. Detroit was no exception. During the 1700s and 1800s, the streets were primarily dirt or gravel and they frequently remained muddy after rainfall. Citizens of Detroit and similar cities grew tired of muddy streets and urged the government to do something about this inconvenience.

The immediate solution was to build sewers to drain storm water off the streets during wet weather so that they would not remain muddy for long periods of time. These sewers were either open ditches or pipes buried underground. As communities grew, these sewers needed to be quite substantial in size to carry away the storm water. Remember, of course, that the vehicles on these roads were horses and carriages, and that the horses left behind more than footprints. At that time, domestic water use was relatively low, but the domestic wastewater was simply dumped in the gutter where it would be flushed away during the next rain. During these rains, both domestic wastewater and manure from the streets were flushed into the sewers, where they were transported directly to the nearest waterway. This created both odor problems and pollution of waterways.

A new kind of sewer, called an interceptor sewer, was built to address these problems. They were primarily built parallel to waterways to carry wastewater further downstream. It was common and acceptable up to the late 1800s and early 1900s to move this wastewater further downstream where there were fewer or no people to complain. In the early 1900s, domestic use of water increased rapidly with human population growth and resulted in increased domestic wastewater discharges. Since the sewers at that time were originally designed to carry away storm water, the increased domestic wastewater from the growing population could exceed sewer capacity during heavy rains and snow melt. However, because of budget constraints, the sewers at that time were sized to intercept only the domestic waste during dry weather conditions. Therefore, one of two things had to happen during a rainstorm. Either the sewers would exceed their capacity and flood the streets or there needed to be a relief discharge directly into a waterway near these populated areas. Structures, called regulators, were constructed to provide this relief. They operate when the flow rises above the height of the overflow weir, allowing the combined storm and sanitary sewer flow to overflow into the receiving waterway – thus causing what has come to be called a combined sewer overflow (CSO).

As time went by, the idea of building sewers that handled both the sanitary wastewater and the storm water gave way to the concept of building a separate system just for sanitary wastes. These separate sewers came to be called sanitary sewers and the original type of sewer came to be called combined sewers. Today, these combined sewers are

found only in older, larger cities where combined storm water and wastewater are treated during dry weather, but it overflows directly into rivers during and after wet weather events. When many of these combined sewers were constructed, they were simply called "sewers." Later on, in the 1930s and 1940s, the distinction between storm sewers, sanitary sewers, and combined sewers became well accepted.

Status and Trends

In 1972, the U.S. Congress passed the Clean Water Act which launched a major effort to control pollution from industrial and municipal sources. The law required each state to issue discharge permits to regulate the quantity and concentration of pollutants from municipal and industrial treatment facilities to meet state water quality standards.

By the mid-1980s virtually all of the over 400 municipal wastewater treatment plants in Michigan had achieved compliance with the Clean Water Act requirement to provide secondary treatment of all flows. Michigan's treatment plants were also required to disinfect the wastewater prior to discharge and reduce phosphorus loadings to control nutrient impacts in the Great Lakes basin.

As the discharges from wastewater treatment plants came under control, attention began to focus on water quality problems attributable to intermittent wet weather discharges from combined sewer systems. CSO discharges can be a significant source of pollution to receiving waters since they consist of a diluted mixture of untreated sanitary wastewater and storm water runoff. Water quality problems attributable to uncontrolled CSOs include public health threats from bacteria contamination and pathogenic organisms, dissolved oxygen depletion, aesthetic problems, and residues from sanitary trash and floatable materials.

CSOs are a particularly significant problem in southeast Michigan because of the high population and the fact that CSO discharges were impacting small urban waterways such as the Rouge River and its tributaries. Within the service area of the Detroit wastewater treatment plant, more than 25% of the service area utilizes combined sewer systems. Within the city of Detroit there are 35,924 hectares (88,770 acres) served by combined sewers and an additional 24,186 hectares (59,764 acres) in suburban communities in Wayne, Oakland and Macomb counties (Figure 1). Uncontrolled CSO discharges were identified as a major source of pollution throughout much of the Rouge River basin, the Clinton River basin, and portions of the Lake St. Clair and Detroit River shoreline.

In 1985, work began on the development of Remedial Action Plans for these watersheds to define alternatives for improving water quality and protecting public health. The Rouge River Remedial Action Plan was adopted in 1988 and called for substantial investment in facilities to control CSOs in Detroit, Wayne County and Oakland County. Similar control efforts were initiated along the Clinton River and Red Run Drain basin, and the shoreline areas of Lake St. Clair and the Detroit River.

The recommendations of the Remedial Action Plans were the basis for new permit requirements to eliminate or adequately treat CSO discharges throughout southeast Michigan. The southeast Michigan CSO control program received support from the federal government when Congress approved the Rouge River National Wet Weather Demonstration Project in 1992. Under this program, municipalities in the Rouge

River watershed served as a pilot program to demonstrate the effectiveness of various CSO control measures. The program also instituted a variety of other pollution control activities related to storm water discharges, streambank erosion control, wetland preservation, public education, and other measures.

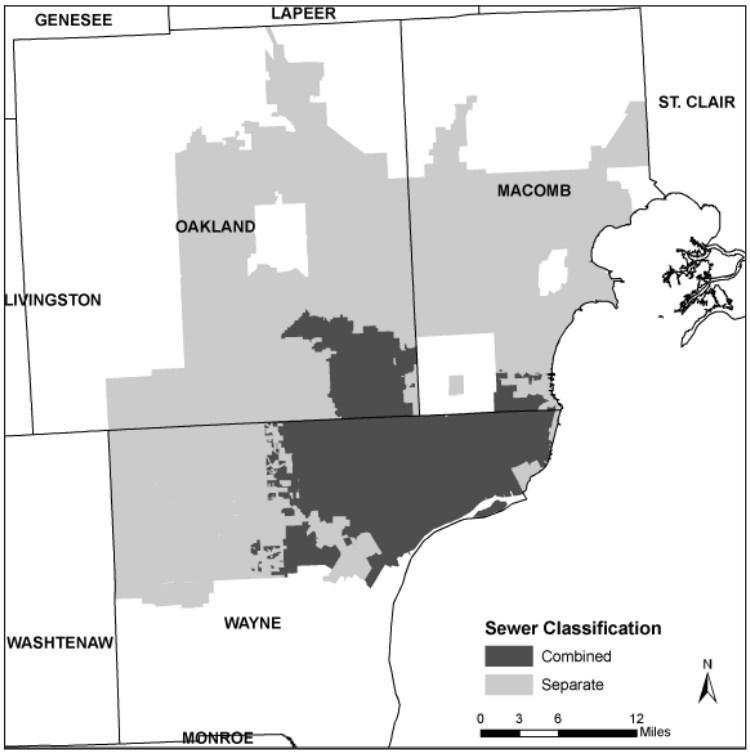

Figure 1. Areas of Wayne, Oakland, and Macomb counties that have combined and separate sewer systems.

Prior to 1990, there were more than 170 uncontrolled CSOs in existence in 35 municipalities in southeast Michigan. The quantity of untreated combined sewage discharged annually at that time is estimated at more than 119 billion liters per year (over 31 billion gallons per year), although the actual quantity of the discharge varies in response to climatic conditions and rainfall patterns. CSO discharges typically occurred about 50 times per year throughout the region and the pollutant load from these discharges was significant. Numerous water quality studies in the area documented serious impairments and water quality standards violations during and after wet weather events when CSO discharges occurred. Dissolved oxygen levels in some areas were depleted, making it difficult for the watersheds to support aquatic life and fish.

In response to the regulatory initiative to control CSOs, southeast Michigan communities in the Detroit Water and Sewerage Department service area have committed to the construction of projects totaling nearly $2.2 billion to eliminate, capture, or treat combined sewage. A list of the CSO control projects is included in Table 1. The debt obligation to pay for these capital improvements has had a significant impact on local sewer rates, even though many facilities were financed with low interest loan assistance from the State Revolving Loan Fund, and the initial projects received grant support through the National Wet Weather Demonstration Project.

Table 1. CSO investment of southeast Michigan as of May 2007 [a]. DWSD = Detroit Water and Sewerage Department.

Name of the Facility	Ownership	Status	Storage Volume: million liters (million gallons)	Construction Cost [b]
Detention Basins				
Belle Isle	DWSD	In Construction	1.14 (0.30)	Est. $13,866,000
Conner Creek	DWSD	Operational	119.24 (31.50)	$186,512,000
Hubbell-Southfield	DWSD	Operational	83.28 (22.00)	$54,884,000
Oakwood Pump Station	DWSD	In Construction	34.07 (9.00)	Est. $131,437,000
Puritan – Fenkell	DWSD	Operational	15.52 (4.10)	$18,194,000
Seven Mile	DWSD	Operational	11.73 (3.10)	$29,948,000
Acacia Park	Oakland County	Operational	15.14 (4.00)	$10,681,000
Bloomfield Village	Oakland County	Operational	37.85 (10.00)	$21,994,000
Birmingham	Oakland County	Operational	20.82 (5.50)	$26,252,000
GWK	Oakland County	Operational	350.91 (92.70)	$165,068,000
Chapaton	Macomb County	Operational	105.99 (28.00)	$25,817,000
Martin	Macomb County	Operational	32.55 (8.60)	$7,471,000
Milk River	Wayne County	Operational	71.92 (19.00)	$31,200,000
Dearborn Heights	Dearborn Heights	Operational	10.22 (2.70)	$18,678,000
Inkster	Inkster	Operational	11.73 (3.10)	$18,592,000
Redford Township	Redford	Operational	7.19 (1.90)	$14,300,000
SUBTOTAL			929.32 (245.50)	$774,894,000
Treatment/Capture Shafts				
Capture Shaft 013	Dearborn	In Construction	27.25 (7.20)	$28,895,000
Capture Shaft 014	Dearborn	In Construction	38.23 (10.10)	$33,097,000
Disinfection Facility for Capture Shaft 013 and 014	Dearborn	In Construction	Included Above	$4,397,000
Capture Shaft 015	Dearborn	In Construction	9.08 (2.40)	$10,528,000
Original CSO Shafts	Dearborn	Constructed	Included Above	$26,000,000
Treatment Shafts 1 – 5	Dearborn	In Design	98.80 (26.1)	$170,000,000
Treatment Shaft 016	Dearborn	In Construction	12.49 (3.30)	$25,997,000
Treatment Shaft 017	Dearborn	In Construction	24.61 (6.50)	$36,791,000
SUBTOTAL			210.47 (55.60)	$335,705,000
Screening & Disinfection Facilities				
Baby Creek (Including VR-7)	DWSD	Operational	115.08 (30.4)	$73,107,000
Leib	DWSD	Operational	31.42 (8.3)	$31,438,000
St. Aubin	DWSD	Operational	9.20 (2.43)	$19,821,000
SUBTOTAL			155.69 (41.13)	$124,366,000
Tunnels				
Upper Rouge Tunnels	DWSD	In Design	760.87 (201.00)	$640,000,000
SUBTOTAL			760.87 (201.00)	$640,000,000

Name of the Facility	Ownership	Status	Storage Volume: million liters (million gallons)	Construction Cost
In-System Storage Facilities (Dams and Gates)				
Conner Creek Influent Storage Gates	DWSD	Operational	152.93 (40.40)	$4,392,000
Wyoming Relief (ISD001)	DWSD	Operational	23.24 (6.14)	$26,469,000
Weatherby (ISD002)	DWSD	Operational	11.92 (3.15)	
Upper Livernois Relief (ISD003)	DWSD	Operational	9.24 (2.44)	
Joy (ISD004)	DWSD	Operational	13.55 (3.58)	
Clark Summit (ISD005)	DWSD	Operational	15.06 (3.98)	
First Hamilton (ISD006)	DWSD	Operational	34.14 (9.02)	
First Hamilton (ISD007)	DWSD	Operational	16.77 (4.43)	
First Hamilton (ISD008)	DWSD	Operational	14.99 (3.96)	
First Hamilton (ISD009)	DWSD	Operational	16.20 (4.28)	
First Hamilton (ISD010)	DWSD	Operational	5.38 (1.42)	
Conant Mt. Elliott (ISD011)	DWSD	Operational	34.18 (9.03)	
Six Mile Rd. (ISD012)	DWSD	Operational	8.86 (2.34)	
Seven Mile Rd. (ISD013)	DWSD	Operational	13.51 (3.57)	
6 Mile & 6 Mile Relief Outfall Gates	DWSD	Operational	26.12 (6.90)	$7,708,000
Puritan Outfall Gates	DWSD	Operational	1.14 (.30)	
Lyndon Outfall Gates	DWSD	Operational	6.44 (1.7)	
Lahser Outfall Gates	DWSD	Operational	5.30 (1.4)	
W. Chicago Outfall Gates	DWSD	Operational	19.68 (5.2)	
Tireman Outfall Gates	DWSD	Operational	21.58 (5.7)	
Bloomfield Hills, Birmingham, Acacia Park	Oakland County	Operational	18.17 (4.8)	$1,552,000
GWK Influent Weir Storage	Oakland County	Operational	124.92 (33.00)	Included w/GWK Basin
Frisbee Sewer	City of Detroit	Operational	7.19 (1.9)	$2,043,000
SUBTOTAL			600.52 (158.64)	$42,164,000
Equalization Basins (as part of CSO Elimination Program)				
Farmington	Farmington	Operational	12.11 (3.20)	$5,000,000
City of Wayne	Wayne County	Operational	8.71 (2.30)	$3,827,000
Livonia	Livonia	Operational	8.33 (2.20)	$1,029,000
SUBTOTAL			29.15 (7.70)	$9,856,000
Sewer Separations/Relief Sewers and Collection System Upgrades				
Area 25	City of Wayne	Operational		$221,000
Areas 19, 20, 23	City of Wayne	Operational		$2,454,000
Area 18	City of Wayne	Operational		$82,000
Farmington	Farmington	Operational		$9,000,000
Midtown West	Garden City	Operational		$9,727,000
Midtown East	Garden City	Operational		$6,435,000
South Venoy	Garden City	Operational		$1,228,000
Merriman	Garden City	Operational		$459,000

Name of the Facility	Ownership	Status	Storage Volume: million liters (million gallons)	Construction Cost
Sewer Separations/Relief Sewers and Collection System Upgrades				
Perrin & Middlebelt	Garden City	Operational		$10,848,000
Robinson Subdivision	Plymouth Township	Operational		$557,000
Districts 30, 31, & 32	Plymouth Township	Operational		$341,000
Area 42	Westland	Operational		$346,000
Area 38	Westland	Operational		$1,364,000
Area 10 (Contract 1 & 2)	Westland	Operational		$4,010,000
Area 10 (Contract 3)	Westland	Operational		$1,874,000
Area 10 (Contract 4)	Westland	Operational		$768,000
Grosse Pointe Farms	Grosse Pointe Farms	Operational		$10,000,000
Grosse Pointe Park	Grosse Pointe Park	Operational		$18,600,000
Eastpointe Roseville Separation	Macomb County	Operational		$4,184,000
So. Macomb Relief Sewers	Macomb County	Operational		$15,269,000
So. Macomb Pump Station/Bypass Structure	Macomb County	Operational		$22,827,000
Area Tributary to CSO 016	Dearborn	In Construction		$6,380,000
Miller Rd. Pump Station Renovation	Dearborn	Operational		$8,000,000
SUBTOTAL				$134,974,000
Operational Elements				
Fairview Pump Station	DWSD	Operational		$6,072,000
VR-15 (Conant Mt. Elliott)	DWSD	Operational		$6,902,000
VR-17 (Shiawassee Gate)	DWSD	Operational		$198,000
VR-8 (Hubbell-Southfield)	DWSD	Operational		$202,000
SUBTOTAL				$13,374,000
Detroit WWTP				
Primary Clarifiers No. 17, 18	DWSD	Operational		$89,018,000
PS-2A (Additional Pump)	DWSD	Operational		$2,048,000
SUBTOTAL				$91,066,000
TOTAL EXPENDITURE				$2,166,399,000

[a] Listing does not include facilities to control sanitary sewer overflows (SSOs) from separated sewer systems except for equalization basins which were built to retain excess wet weather flows in newly separated combined sewer systems.

[b] Construction cost reflects the cost to build the facility (as-bid contractor's cost plus or minus change orders) and has not been adjusted to account for inflation since the project was built. Costs do not include engineering, administrative, land acquisition or legal expenses.

The benefits of this massive CSO expenditure have become apparent as water quality throughout southeast Michigan continues to improve. The volume of uncontrolled CSOs has decreased substantially, and further improvements will be achieved as projects currently in design and construction are completed and placed into service. As shown in Figure 2, the quantity of uncontrolled CSO discharges will be reduced by 85% when all of the facilities are completed and placed in service.

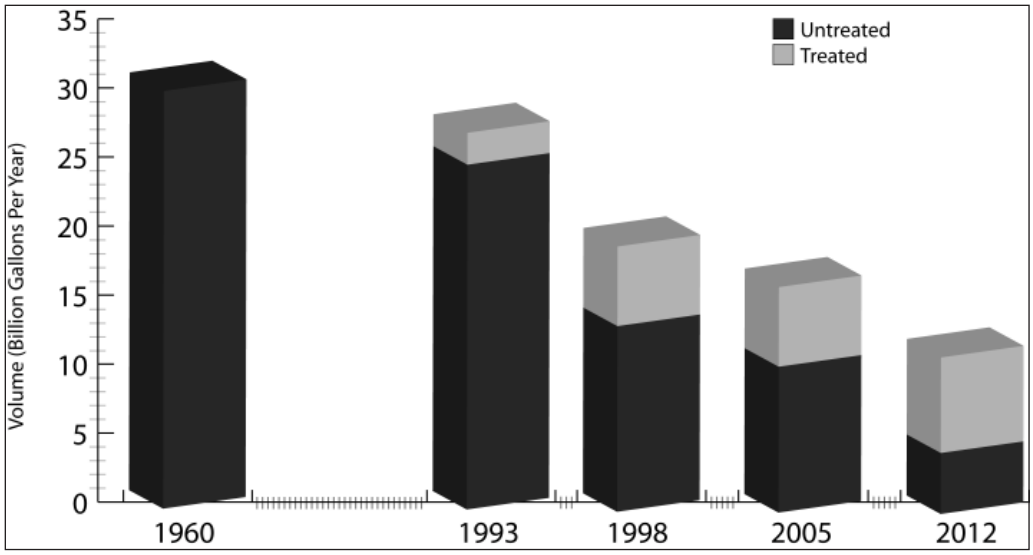

Figure 2. Historical and projected effects of Detroit Water and Sewerage Department's and customers' efforts to reduce and treat CSOs.

Dissolved oxygen levels in receiving waters throughout southeast Michigan have shown steady improvement, and fish and aquatic life surveys document that area waterways are markedly improved. Because the CSO control projects typically include disinfection to control bacteria, recreational users benefit from improved public health protection practices, and beach closures in response to wet weather events have become increasingly infrequent.

While the effort to control wet weather pollution from CSOs is not yet complete, the progress achieved to date demonstrates that significant water quality improvements are achievable in urban areas when CSO controls are constructed. The overall health of the watersheds in southeast Michigan is continuing to improve, and in large measure this is a result of the work by local government to control pollution from combined sewer systems throughout the area.

Management Next Steps

Key management actions for southeastern Michigan watersheds include:

- Complete Phase 2 CSO control projects (planned CSO controls on all remaining combined sewer areas);
- Continue sanitary sewer capacity improvements;
- Promote the economic importance of the region's "Green" (plants) and "Blue" (waters) infrastructure to encourage adequate public investment in continued restoration and protection efforts;

- Ensure sufficient collaboration among all watershed communities, all watershed counties, Michigan Department of Environmental Quality, and the U.S. Environmental Protection Agency to secure adequate funding to sustain and expand a collaborative illicit discharge elimination effort and a public education and watershed monitoring program; and
- Expand the voluntary storm water permit efforts of the Rouge River to all southeastern Michigan watersheds, consistent with Michigan's Watershed-Based Storm Water Permit (MIG619000).

Research/Monitoring Needs

Monitoring is essential for proper watershed management. Priority must be given to ensuring sufficient monitoring to be able to adequately evaluate effectiveness of programs and to make midcourse corrections. Further, research is needed on innovative funding mechanisms for storm water, CSOs, and watershed management in order to maintain the momentum for restoration and protection efforts.

Links for More Information

Detroit Water and Sewerage Department
www.dwsd.org

Rouge River National Wet Weather Demonstration Project
www.rougeriver.com

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