Operating Experience with Large CSO Control Facilities

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1. ABSTRACT

Nine facilities for storing and treating combined sewer overflows (CSO) are in operation on the Rouge River in metropolitan Detroit. These facilities provide screening, chlorination and storage of CSO, and they have a total peak flow capacity of 3,600 cfs and a storage volume of 60 million gallons. The facilities are being monitored to assess their performance and water quality benefits for future phases of CSO control in the Rouge. In the meantime, the operating data collected since June 1997 provide important information on design. This paper discusses several aspects of CSO facility operations:

- Staff Training
- Overall O&M Costs
- Use of SCADA and Mobile Staffing
- Pacing and Control of Hypochlorite Dosage
- Solids Flushing Procedures
- Dealing with Low Influent Flow Rates
- Exploring Potential New Operating Practices

The nine CSO facilities include three operated by the City of Detroit Water and Sewerage Department, three operated by the Oakland County Drain Commissioner, and three operated by the Wayne County Department of Environment. All of these facilities have been constructed as part of watershed restoration efforts on the Rouge River. These other efforts include illicit discharge elimination, storm water management, abandoned dump remediation, and habitat and recreational improvements.

Overall, the operating experience with the Rouge River CSO control facilities is providing valuable information for designing future phases of CSO control on the Rouge and for communities engaged in CSO control in other watersheds. It is also helpful in identifying opportunities to enhance operational practices for CSO control.

2. KEYWORDS

Combined sewer overflow, operation and maintenance, chlorination, effluent limits, performance evaluations, NPDES

3. INTRODUCTION

Nine facilities for storing and treating combined sewer overflows (CSO) are in operation on the Rouge River in metropolitan Detroit. These facilities provide screening, chlorination and storage of CSO, and they have a total peak flow capacity of 3,600 cfs and a storage volume of 60 million gallons. The facilities are being monitored to assess their performance and water quality benefits for future phases of CSO control in the Rouge. In the meantime, the operating data collected since June 1997 provide important information on design for future facilities. This paper covers several aspects of operation and maintenance:

- Staff Training
- Overall O&M Costs
- Use of SCADA and Mobile Staffing
- Pacing and Control of Hypochlorite Dosage
- Solids Flushing Procedures
- Dealing with Low Influent Flow Rates
- Exploring Potential New Operating Practices

The nine CSO facilities include three operated by the City of Detroit Water and Sewerage Department, three operated by the Oakland County Drain Commissioner, and three operated by the Wayne County Department of Environment. The basins were constructed starting in 1994, and they were completed between 1997 and 1998. The basins operated by Wayne County are owned by three communities in the county: the City of Dearborn Heights, the Charter Township of Redford, and the City of Inkster. Similarly, the basins operated by Oakland County include the Village of Beverly Hills, Bloomfield Township, City of Bloomfield Hills and the City of Birmingham. The names of the CSO basins as used in this paper, and the respective operating agencies of the basins, are as follows:

Wayne County Department of Environment
Dearborn Heights, Inkster, and Redford
Oakland County Drain Commissioner
Acacia Park, Birmingham, and Bloomfield Village
Detroit Water and Sewerage Department
Puritan-Fenkell, Seven Mile, and Hubbell-Southfield

The Wayne County and Oakland County basins have completed a two-year evaluation period, and reports have been prepared in March 2000 on the performance. The Detroit basins began performance monitoring in November 1999, and the performance period is scheduled to end in July 2002.

The following paper looks at the operational issues of the CSO facilities from the program management perspective. Of particular interest is the relationship between capital expenditures and ongoing operation and maintenance expenditures, the water quality benefits of certain design features and operational practices, and finding the optimal balance for staff resources between the dry weather and wet weather job functions.

4. METHODS

4.1. Design Criteria for the Facilities

The demonstration basins were designed to provide public health protection and to eliminate raw sewage discharges to the Rouge River. The NPDES permits prohibited discharges from the CSO outfalls after basin construction. This required that all of the existing outfalls be bulkheaded following completion of the CSO basins. Consequently, the CSO basin headworks were sized to receive the ultimate flows from the tributary areas without bypass.

Table 1 presents a summary of the basis of design for the nine facilities currently in operation. Note that some facilities were sized for a presumptive criteria of a 10-year, 1-hour design storm, while others were sized for a demonstration approach with a 1-year, 1-hour design storm.

TABLE 1
KEY BASIN INFORMATION AND MONITORING DURATION

Basin Name & Location	Compartmental Volumes (MG)	Basin Configuration	Combined Drainage Area (acre)	Basin Dimensions	Design Storm	Detention Time (min)
Redford, MI	2 parallel compartments each – 0.9 MG Total = 1.9 MG	2 parallel compartments preceded by one swirl concentrator	669	180' x 66' x 11.2 each compartment	one year-one hour storm	20
Inkster, MI	1st flush Compartment – 11MG 2 detention Compartments each=1 MG Total = 3.1 MG	1 first flush tank followed by 2 detention tanks operating in parallel	515	186' x 60' x 11.75 each detention tank	one year-one hour storm	20
Dearborn Heights, MI	3 compartments, each – 0.9 MG Total = 2.7 MG	3 detention tanks in parallel with the capability of using the 1st tank for a 1st flush capture	360	175' x 60' x 11.6 each compartment	ten year-one hour storm	30
Acacia Park	2 compartments **Total volume = 4 MG**	2 compartments in series	816	160' x 80' x 20' each compartment	one year-one hour storm	30
Bloomfield Village	3 compartments **Total volume = 10 MG**	3 compartments filling in series through different elevation weirs	1735	157.5' x 128.5' x 20' each compartment	one year-one hour storm	30
Birmingham	2 compartments **Total volume = 5.5 MG**	2 compartments in series with 11' tunnel	1185	140' x 120'20' each compartment	one year-one hour storm	30
Hubbell-Southfield	1st basin – 10 MG 2nd basin – 12 MG Total = 22 MG	2 tanks in series with the capability of running the 1st basin as a 1st flush capture tank	14400	900' x 240' x 16.5 overall basin	Built within site constraints	
Puritan Fenkell	2 compartments each = 1.4 MG Total = 2.8 MG	2 tanks operating in parallel	649	236' x 99.5' x 8' each compartment	one year-one hour storm	20
Seven Mile	2 compartments each = 1.1 MG Total = 2.2 MG	2 tanks operating in parallel	463	200' x 91.5' x 8' each compartment	one year-one hour storm	30

4.2. Major Features of the Facilities

The basins provide screening, storage, settling, skimming and chlorination. The Redford facility includes a vortex separator of 35-foot diameter. Tables 2, 3 and 4 describe the screening, settling and skimming features of each basin.

TABLE 2
SCREENING METHODS

Basin	Bar Spacing	Screen Location
Inkster	0.75"	Wet well prior to pumps
Redford	0.75"	Wet well prior to pumps
Dearborn Heights	0.75"	Wet well prior to pumps
Acacia Park	0.75"	Effluent
Birmingham	0.75"	Effluent
Bloomfield Village	0.75"	Effluent
Seven Mile	0.5"	Effluent
Hubbell – Southfield	1.5"	Effluent
Puritan/ Fenkell	0.5"	Influent

TABLE 3
SKIMMING METHODS

Basin	Feet of Weir/Baffle	Location of Weir/Baffle
Inkster	427’	Prior to effluent weir
Redford	528’	Prior to effluent weir
Dearborn Heights	450’	Prior to effluent weir
Acacia Park	1942’	• After the influent weir • Before the intermediate weir • After the intermediate weir • Before the effluent weir troughs
Birmingham	1908’	• After the influent weir • Before the intermediate weir • After the intermediate weir • Before the effluent weir troughs
Bloomfield Village	2495’	• After the influent weir • Before the intermediate weir • After the intermediate weir • Before the effluent weir troughs
Seven Mile	558’	• Prior to effluent weir
Hubbell – Southfield	1156’	• Prior to effluent weir
Puritan/ Fenkell	576’	• Prior to effluent weir

Table 4
Sedimentation Basin Characteristics

Basin	Design Flowrate (cfs)	Surface Area (Sq. ft.)	Effluent Weir Length (Ft.)	Surface Overflow Rate (Gpd/sq. ft)
Inkster	228	22,300	472	6600
Redford	190	23,760	528	5180
Dearborn Heights	204	31,500	450	4200
Acacia Park	290	25,600	1120	7500
Birmingham	330	33,600	1200	7856
Bloomfield Village	700	70,980	1760	6760
Seven Mile	230	36,800	558	4040
Hubbell – Southfield	2200	193,300	1156’	7460
Puritan/ Fenkell	320	47,670	576’	4400

4.3. Staffing Approach and Training

The Wayne County and Detroit basins have no full-time staff, while the Oakland basins have only one-full time staff person per basin. All basins rely on mobile crews and they have SCADA technology for operational control. (The use of SCADA is discussed later in Section 6.1). The staffing approach has proved successful.

At the start of operations, staff persons with pump station and wastewater sampling experience were selected to form the core group of CSO basin operating, sampling and maintenance group. Training started prior to the formal turnover of the facilities to the operational agencies. The initial phase of training, which provided the staff with basic operating knowledge of all equipment and dry weather procedures, was generally completed in about two months.

A second phase of training entailed the operation of the facility in wet weather. When the facilities first became operational, there was a 3- to 6-month period when baseline sampling was required to meet routine NPDES requirements. During this period, an evaluation sampling protocol was finalized between the DWD, Wayne County, Oakland County Drain Commissioner, Michigan Department of Environmental Quality and the Rouge Program Office. The evaluation program started following the completion of the protocol, with training updates conducted every six months. The training updates were designed to communicate any changes in sampling parameters and preliminary results of the CSO basin performance. Generally, wet weather procedures were refined over this second 3- to 6-month period, with the length of time being dependent on particular conditions and the number of wet weather events at each basin.

Each operating agency has a somewhat different staffing plan. The basins operated by Wayne County use a 3-person team per basin, and each team is mobile. Home base for these teams is the Wayne County Henry Ruff Maintenance Yard located within 4 miles of the closest facility and within 13-miles of the farthest facility. The basins operated by the Oakland County Drain Commissioner have a mobile supervisor plus one person stationed full-time day shift at each basin. The supervisor has a home base location that is within 10 miles of the three basins. The Detroit Water and Sewerage Department facilities use a 3-person team per basin, and each team is mobile. Home base for these teams is the Detroit Wastewater Treatment Plant, which is within 7 miles of all the basins. The staff at the Detroit basins regularly include job categories of senior wastewater technicians and chemists, plus other specialties as needed. The staff at the Wayne County basins regularly include job categories of operators, mechanics, and electricians.

4.4. Development of the Evaluation Monitoring Program

As mentioned above, detailed plan for performance monitoring was developed by the owners of the facilities, the Michigan Department of Environmental Quality and representatives of the Rouge River project. The purpose of the monitoring plan was to assess the relative effectiveness of the different basin sizes and the different storage and treatment technologies used in the facilities. The evaluation program was complex, and it was a significant factor in the operation and maintenance requirements for the basins in the first two years of operation.

The details of the evaluation program were developed over a two-year period starting before the completion of the construction of the basins. Following the design of the CSO basins, but before construction completion, the RPO implemented a "surrogate" CSO basin monitoring program. Protocols were developed to be used in a sampling program at the City of Saginaw CSO basins. This program was intended to yield some preliminary data as well as experience that could be useful in developing the evaluation program for the CSO basins. The standard operating procedures and experiences from the surrogate program was instrumental in finalizing the sampling protocol for the rest of the program.

The program was initially designed to provide information to meet the NPDES Permit requirements. Subsequent meetings with the MDEQ changed the emphasis to collecting enough samples to demonstrate whether there was a "first-flush effect" in the quality of CSO basin influent. In addition, there was the need to collect information that could be used in predictive water quality modeling of the Rouge River. Overall, the goals included:

- Quantification of all loads which are captured in the basin;
- Quantificaton of all effluent loads from the basin;
- Intermediate point sampling for multi-cell basins;
- Pollutant concentration variability data; and
- Flow and volume data.

Early in the program, within six months of the start of sampling efforts, parts of the protocol were changed to reflect experience gained in sampling. For example, effluent samples could not be collected at the strict 15-minute and 30-minute intervals for CSO basins with influent pump stations. The sampling interval was changed to coincide with the collection of about three samples per pump cycle.

During the evaluation program, samples were required every fifteen minutes for the first hour, then every 30 minutes for the next 2 hours. In addition to discrete samples, composite samples were also required on the influent and effluent flows. Grab samples were also required every hour for fecal coliform, dissolved oxygen, temperature, pH etc.

Table 5 presents a summary of the periods of monitoring performed on each basin. Monitoring for the three basins owned by the Detroit Water and Sewerage Department began in November 1999.

Table 5
Basin Information and Monitoring Durations

Basin	Combined Drainage Area (acres)	Basin Volume (MG)	Basin Volume (in)	Months Monitored*		
				May – Oct.	Nov – April	Total
Inkster	515	3.1	0.14	17	13	30
Redford	669	1.9	0.1	17	15	32
Dearborn Heights	360	2.7	0.28	14	14	28
Acacia Park	816	4	0.18	12	12	24
Birmingham	1185	5.5	0.17	12	9	21
Bloomfield Village	1735	10	0.21	12	13	25
Seven Mile	463	2.2	0.2	-	6*	-
Hubbell – Southfield	14400	22	0.06	-	6*	-
Puritan/ Fenkell	649	2.8	0.18	-	6*	-

- Monitoring began in November 1999 and will extend to 2002.

5. RESULTS

5.1. Operation and Maintenance Cost Summary

Operation and maintenance costs are averaging about $35,000 to $70,000 per year per million gallons of storage capacity, or about 1 to 2 percent of the construction cost. These are preliminary numbers – reflecting the first one or two years of start-up, testing, and performance evaluation. In some situations there was continuing construction that affected downstream or upstream wastewater transmission components, and this construction contributed to more activations or extended wet weather conditions at some facilities. Consequently, the average operating costs in the first two years may not represent design operating conditions.

TABLE 6. ANNUAL OPERATING COSTS

Basin	Labor	Energy & Utilities	Chemicals & Supplies	Laboratory & Services	Total
Bloomfield Village	$133,600	$42,100	$61,000	$24,200	$260,900
Birmingham	$61,200	$36,000	$55,900	$10,900	$164,000
Acacia Park	$58,600	$24,800	$25,900	$10,500	$119,800
Dearborn Heights	$132,900	$71,600	$22,000	$15,000	$241,500
Inkster	$133,000	$85,300	$23,100	$20,000	$261,400
Redford	$107,900	Not Available	$22,600	$25,000	$155,000

Not included above are the costs of wastewater treatment for the CSO that is stored in the basin. The treatment cost is approximately $8 per 1,000 cubic feet, and this cost is $100,000 to $250,000 per facility, depending on the actual volume captured.

It should be noted that administrative costs are not included in Table 6. Wayne County has administrative costs associated with the contract operations for the three basins that it operates, and the Oakland County Drain Commission does not account for administrative costs in the categories of costs shown in Table 6.

5.2. Operating Statistics

The facilities are activated on the average once or twice per month. The Hubbell-Southfield facility is activated most frequently, because the overflow point that it serves has the largest drainage area and smallest relative capacity for transmission of wet weather flows. The CSO basins have exceeded their storage capacity and dewatering capacities only 2 to 7 times per year. When storage capacity is exceeded the basins provide settling, screening, and chlorination.

Average annual overflow frequency for six of the basins are shown below for the period June 1997 to March 2000.

Basin	Average Discharges November to April	Average Discharges May to October

Inkster	3.2	3.9
Redford	2.4	3.2
Acacia Park	2.0	2.5
Birmingham	1.3	0.5
Bloomfield Village	1.4	1.0
Dearborn Heights	2.1	1.7

Tables 7 to 9 present representative effluent data of the monitoring period to date.

TABLE 7
REDFORD – TREATED EFFLUENT CONCENTRATION FOR OVERFLOW EVENTS

		Total Volume (MG)		Average Treated Effluent Concentration (mg/L)			
Date	Rainfall (in)	Influent	Effluent	CBOD5	TSS	NH3	Total P
16-Jun-97	0.63	2.29	0.10	**NO SAMPLES**			
02-Jul-97	1.75	11.45	8.58	21.4	189	4.60	0.85
26-Jul-97	0.82	2.43	0.16	**NO SAMPLES**			
10-Sep-97	1.71	3.54	0.99	20.4	54	2.02	1.21
7/8-Jan-98	0.21	2.82	0.79	19.6	24	4.70	0.67
17/21-Feb-98	2.42	25.85	23.42	26.3	93	1.83	0.88
9/10-Mar-98	1.05	6.43	3.48	14.2	75	2.69	0.76
9/10-Apr-98	1.21	3.57	0.90	17.5	71	2.40	0.95
06-Aug-98	3.42	8.76	5.92	13.5	110	1.01	1.09
07-Oct-98	1.86	2.35	0.42	23.2	123	2.2	5.92
22-Jan-99	1.06	2.95	0.23	4.5	145	3.5	1.75
22/26-Apr-99	1.23	11.45	4.86	14.2	69	2.94	1.08
12-Jun-99	2.46	3.30	2.07	**NO SAMPLES**			
27-Jun-99	2.01	3.29	0.50	34	61	2.5	1.15
28/29-Jun-99	0.70	1.75	0.06	**NO SAMPLES**			

TABLE 8
INKSTER – TREATED EFFLUENT CONCENTRATION FOR OVERFLOW EVENTS

		Total Volume (MG)		Average Treated Effluent Concentration (mg/L)			
Date	Rainfall (in)	Influent	Effluent	CBOD5	TSS	NH3	Total P
21-Jun-97	0.73	6.42	2.67	25.3	152	3.9	0.76
2-Jul-97	1.75	5.08	2.10	12.8	164	2.8	1.1
10-Sep-97	1.51	6.93	2.88	<10	71	0.22	0.51
7/8-Jan-98	0.21	5.62	1.73	14.5	55	0.82	0.58
17/20-Feb-98	2.56	44.04	40.00	18.4	144.8	0.53	0.66
9/10-Mar-98	1.23	17.86	13.71	4.5	103.6	0.22	0.58
9/10-Apr-98	1.32	9.44	4.92	25.4	99.4	0.86	0.69
26-Apr-98	1.40	6.32	1.02	30	50	0.78	0.58
31-May-98	1.07	4.16	0.06	**NO SAMPLES**			
7/8-Jul-98	1.11	4.65	0.43	**NO SAMPLES**			
6-Aug-98	2.18	8.23	4.29	22.6	117	0.36	0.65
22/24-Jan-99	1.20	14.35	1.73	17.5	108	1.35	1.41
22/24-Apr-99	1.06	10.82	3.99	15.2	65.8	1.44	0.87
12/13-Jun-99	2.14	7.52	3.72	**NO SAMPLES**			
13/14-Jun-99	0.97	5.18	1.96	**NO SAMPLES**			
24/25-Jun-99	0.99	4.24	0.89	**NO SAMPLES**			
27/30-Jun-99	3.98	24.66	13.89	21.8	125	0.66	0.79
23/24-Jul-99	1.89	6.92	2.07	29	151	0.14	5.7

TABLE 9
DEARBORN HEIGHTS – TREATED EFFLUENT CONCENTRATION FOR OVERFLOW EVENTS

		Total Volume (MG)		Average Treated Effluent Concentration (mg/L)			
Date	Rainfall (in)	Influent	Effluent	CBOD5	TSS	NH3	Total P
08-Jan-98	0.23	7.47	3.84	**43.2**	**71.7**	**4.47**	**1.01**
17/20-Feb-98	2.66	33.61	30.21	20.6	71.1	2.22	0.68
9/10-Mar-98	1.11	10.63	7.05	12.6	48	2.33	1.26
9/10-Apr-98	1.41	5.04	1.57	**NO SAMPLES**			
6/7-Aug-98	2.20	12.00	7.00	23.8	82.7	2.21	0.66
22/25-Apr-99	1.33	17.53	4.70	4.6	53.3	2.26	0.92
12/13-Jun-99	2.98	7.67	3.93	5.7	86.25	1.15	1.13
20/29-Jun-99	2.75	12.14	9.84	**5.29**	**44.4**	**0.26**	**0.57**
23/24-Jul-99	1.93	5.79	1.80	NO SAMPLES			

6. DISCUSSION

<u>6.1. Use of SCADA</u>

All of the facilities rely on SCADA and mobile crews for maintenance and operations. The SCADA capabilities and the use of mobile crews dispatched during wet weather events has proved to be successful. Standard operating procedures have been developed for arrival times at facilities after influent is detected, inspection at facilities during storm events, and post-event dewatering and clean-up.

The Oakland County basins use SCADA capabilities and a comprehensive dewatering plan to maximize the available storage in their RTB facilities. The RTBs are part of the Evergreen-Farmington Interceptor Sewer System (EFSDS) which has a contract capacity to discharge a peak flow of 160 cfs in the interceptor system that carries flow to the Detroit wastewater treatment plant. The SCADA system allows Oakland County to monitor the flow in the interceptor and the flows being received in each of its three CSO basins. If one or more of the three basins starts to receive CSO while there is still capacity in the interceptor system, then dewatering pumps are activated in the basin (or basins) to put flow back into the interceptor. When the interceptor nears its discharge capacity, the dewatering pumps are put-off and CSO is stored in the RTB until flow subsides and the facility overflows.

The Detroit Water and Sewerage Department has an existing limited SCADA system to monitor their CSO facilities. Levels within major trunk interceptors are monitored at the wastewater treatment plant. During wet weather conditions, operating staff is dispatched to the facilities when high interceptor levels indicate the facility may begin receiving flow. Each CSO facility is locally controlled. It is the intent of the Detroit Water and Sewerage Department to implement a system-wide SCADA system within the next five years where data from all remote facilities will be transmitted to a central monitoring location.

The Wayne County SCADA system is set up to allow the operation of any one basin from any of three basins, and interceptor capacity is balanced with CSO basin capacity and dewatering capacity.

The SCADA systems have been used successfully to monitor interceptor capacity and allow the basins to be dewatered during storm events to maximize the wet weather flow sent to the interceptor system

6.2. Pacing and Control of Hypochlorite Dosage

All facilities are designed to meet NPDES effluent limits for fecal coliform of 400 per 100 ml and an effluent goal for total residual chlorine (TRC) of 1 mg/l. Operational control is based on monitoring the influent flow and effluent TRC.

Chlorination is achieved using liquid sodium hypochlorite. The hypochlorite is purchased and stored at a 5 to 6 percent solution. The facilities were designed to dilute the stored hypochlorite and feed it at a strength of 6 percent strength. Hypochlorite is paced by influent flow meters. Some of the facilities have pumped influent, while others have gravity influent. All of the facilities use multi-path transit time flow meters to measure the in plant flow rate. The Wayne County basins feed hypochlorite at the discharge of the influent pumps, and this practice has worked well for mixing ahead of the detention basins.

There are a number of operational problems that have arisen with the chlorination systems.
First, there has been more rapid degradation of the strength of the stored sodium hypochlorite strength between storm events than anticipated. At some times, the stored hypochlorite would be at only half of its stored strength. The systems for diluting the hypochlorite before feeding it to the flow did not have sufficient flexibility, therefore there were events when the feed strength was less than half of its design feed concentration. Some of the sodium hypochlorite feed controls have been retrofitted to provide more flexibility in adding dilution water.

Second, there is the tendency for the flow meters to under-record flow rates at low flows as the water level is rising. As a result, this causes too little hypochlorite to be applied.
Third, accurate measurements of effluent TRC have been a problem.

Other CSO facilities under design for the Rouge River and nearby Detroit River are benefiting from the experience with the existing facilities, and they are making improvements to the technology of the chlorination systems.

Overall, the two years of experience shows that the facilities can be operated to achieve the bacteria standard in the effluent and to meet a TRC of less than or equal to 2 mg/l TRC at the end of the pipe. In order to meet a TRC goal of 1 mg/l at the end of the pipe, a more sophisticated or flexible chlorine feed and control system may me needed. Receiving water quality studies continue to determine the chlorine demand in the receiving waters and to determine the extent of treated CSO plumes where TRC might exceed 1 mg/l.

6.3. Dewatering and Solids Flushing Procedures

The nine basins feature a variety of basin sizes and configurations, including first flush tanks, shunt channels, and sequential and parallel storage basins. The largest facility, Hubbell Southfield, uses spray nozzles for flushing solids that might settle in its shunt channel. All of the other facilities use tipping buckets for flushing solids. The tipping bucket systems have proven to be adequate. More time is needed to assess the spray nozzle system.

The basins require 8 hours to over 120 hours for dewatering, and the time for dewatering depends on the volume stored and the interceptor capacity available. Design dewatering rates for full-basin conditions are shown below:

Basin Name	Design Dewatering Rate
Dearborn Heights	12-18 hours
Redford	12-18 hours
Inkster	12-18 hours
Hubbell-Southfield	24 hours
Seven Mile	12-24 hours
Puritan Fenkell	12-24 hours
Acacia Park	87 hours
Birmingham	69 hours
Bloomfield Village	127 hours

6.4. Dealing with Low Influent Flow Rates

Based on the two years of experience, it is clear that more design attention should be paid to how the basins can be operated in low flow conditions. Low flows account for over 80 percent of the events.

Much of the design effort for any CSO control facility focuses on performance under peak flow conditions. However, there are usually dozens of events each year that are smaller events with low flows. SCADA and weather radar information is critical to monitoring flows and storms to know how to initially respond to small events and low flow rates. Also special operating procedures are required to accurately monitor flow. The multi-path ultrasonic meters that are used at the facilities are good for high flows, but they have not proven to be accurate under low flow collection conditions as the water level within the collection system/CSO basin rises. At low flows, it is particularly difficult to accurately determine the proper rate of chlorine addition. Continuing operating experience is required to establish standard operating procedures for low flow conditions.

6.6. Exploring Potential New Operating Practices

The different design features and capacities of the Rouge River CSO basins provide a comparison of the respective operating performance of the different components and difference basis of sizing. As more operating experience is gained, the benefits of first flush tanks, tanks in series versus tanks in parallel, and shunt channels will be known.

At this time, additional investigation is underway to “stress test” the vortex separator in the Redford CSO facility and to determine the performance of this unit separate from the detention basins that are also part of the facility. These tests will improve operating protocols for determining how the vortex separator should be used in conjunction with the basins.

Decanting of stored and treated CSO is another potential procedure that is being considered. Decanting refers to the practice of screening, chlorinating, and settling CSO in the basin, then releasing the treated effluent to the receiving water. Tests are being performed and submitted to the Michigan Department of Environmental Quality for review. In one test in January 1999, the treated effluent had CBOD and TSS less than 20 mg/l, and the bacteria and TRC standards were also met. This practice has the advantage of enhancing flows in the river and avoiding the cost of treating the flow again at the wastewater treatment plant.

7. CONCLUSIONS

1. The two-years of monitoring and evaluation have shown that the basins are meeting their public health goal within anticipated operation and maintenance costs.

2. Standard O&M procedures are keeping the basins meeting effluent limits and keeping the basins as good neighbors to surrounding land uses, which include nature centers, golf course, and recreational facilities.

3. Start-up and testing of any CSO basin will likely take at least two years to fine tune, given the low frequency of overflow events. Because most overflows from the combined sewer system are contained in the basins, there are only a very few events (e.g., 2 to 4) each year through which operators can develop experience with the flow-through operation of the facility.

4. Design should consider operations during low flow conditions, because the vast majority of events will produce flows that are only a small fraction of the peak design flows. The use of a variety of influent pump capacities, installing flow meters to handle low flow regimes, smaller and larger screen channels, and multiple basins appear to be ways of providing the flexibility to handle low flows.

Overall, the operating experience with the Rouge River CSO control facilities is providing valuable information for designing future phases of CSO control on the Rouge and for communities engaged in CSO control in other watersheds. It is also helpful in identifying operational problems and strategies for dealing with them.

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