EVALUATION OF IN-STREAM IMPACTS OF CSO CONTROL FACILITIES

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ABSTRACT

Is the discharge from a combined sewer overflow (CSO) control facility clean enough to meet water quality standards? What in-stream impacts should be measured? How can the in-stream impacts of CSO be evaluated when there are other sources of wet weather pollution in the watershed? When is there enough data to make decisions?

These are the questions being answered by the Rouge River National Wet Weather Demonstration Project in metropolitan Detroit. Nine new facilities for storing and treating CSO discharges have been constructed and placed into operation along the Rouge River since 1997. A detailed evaluation is underway to examine the performance of the facilities and the water quality impacts of their discharges. This paper focuses on the in-stream evaluation of four criteria:

- The water quality standard for dissolved oxygen
- The physical characteristics standard
- The total residual chlorine standard
- The health of the biological community (as a surrogate for toxic materials)

The evaluation is being performed in the context of a number 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. In the Rouge Watershed, CSO discharges are being controlled in three phases:

- Phase 1 – public health protection for approximately 30 percent of the combined sewer area
- Phase 2 – public health protection for the remaining combined sewer area
- Phase 3 – meet water quality standards in the river (not necessarily in the whole effluent) for all combined sewer overflows

The nine facilities being evaluated are part of Phase 1. The evaluation of the Phase 1 facilities will lead to the basis of design for Phase 2 and Phase 3. The answers will determine the level of additional investment required for completion of CSO control in Phase 2 and Phase 3.

KEYWORDS

CSO, water quality standards, effluent limitations, dissolved oxygen, fecal coliform, total residual chlorine, floatables, oil and grease, biological impacts

INTRODUCTION

The Rouge River National Wet Weather Demonstration Project (Rouge Project) was initiated in 1992 to develop approaches to implementing federal and state wet weather water quality programs. The Rouge Watershed is a 438 square mile area and includes portions of three counties, Wayne, Oakland and Washtenaw, and 48 municipalities. It includes a large portion of Detroit, a large suburban area, and a small rural fringe. A significant portion of the urbanized area is served by combined sewers.

Wayne County performs the Rouge Project in cooperation with other counties, local units of government, the Michigan Department of Environmental Quality (MDEQ) and other governmental agencies, academic institutions and non-governmental organizations. The County has a dedicated staff for the project and has consulting staff, which are collectively known as the Rouge Program Office (RPO).

The Rouge Project addresses watershed management issues, CSOs, stormwater, illicit discharges, habitat restoration, non-point sources. This paper focuses on the CSO control objectives of the project. In the Rouge Watershed, CSOs are being controlled in a three-phase program. The objective of Phase 1 is to provide public health protection for approximately 30 percent of the combined sewer area. The objective of Phase 2 is to provide public health protection for the remaining combined sewer area. The objective of Phase 3 is to meet water quality standards for overflows in the river (not necessarily in the whole effluent) throughout the entire combined service area.

It was known at the start of the project that CSO control was needed to meet the water quality standards. What was not known was the optimal level of control, and how the optimal level would vary in different parts of the river depending on the assimilative capacity of the stream at each location where treated CSO is discharged.

The nine CSO facilities all include influent or effluent screens, skimming baffles, influent pumping (one facility), storage and settling basins that can capture small events or work in a flow-through mode for large events, and disinfection using sodium hypochlorite. The nine facilities were designed using a range of size from a 1-year design storm to a 10-year design storm in order to evaluate the respective ability of the size to meet public health and water quality standards. The nine facilities also include a variety of technologies: swirl concentrator, first flush tanks, basins in parallel, basins in series, decanter outlets and a shunt channel. The evaluation will also demonstrate the benefits of these features.

Unfortunately, due to construction difficulties, not all facilities came into operation at the same time. Data for six basins is currently available for at least a 2-year period. Design characteristics of the six facilities with monitoring data are shown in Table 1. Operational information for the evaluation period from June 1997 to December 2000, is shown on Table 2.

The general locations of the six facilities that were monitored are shown on Figure 1.

FIGURE 1
ROUGE RIVER WATERSHED AND CSO BASINS

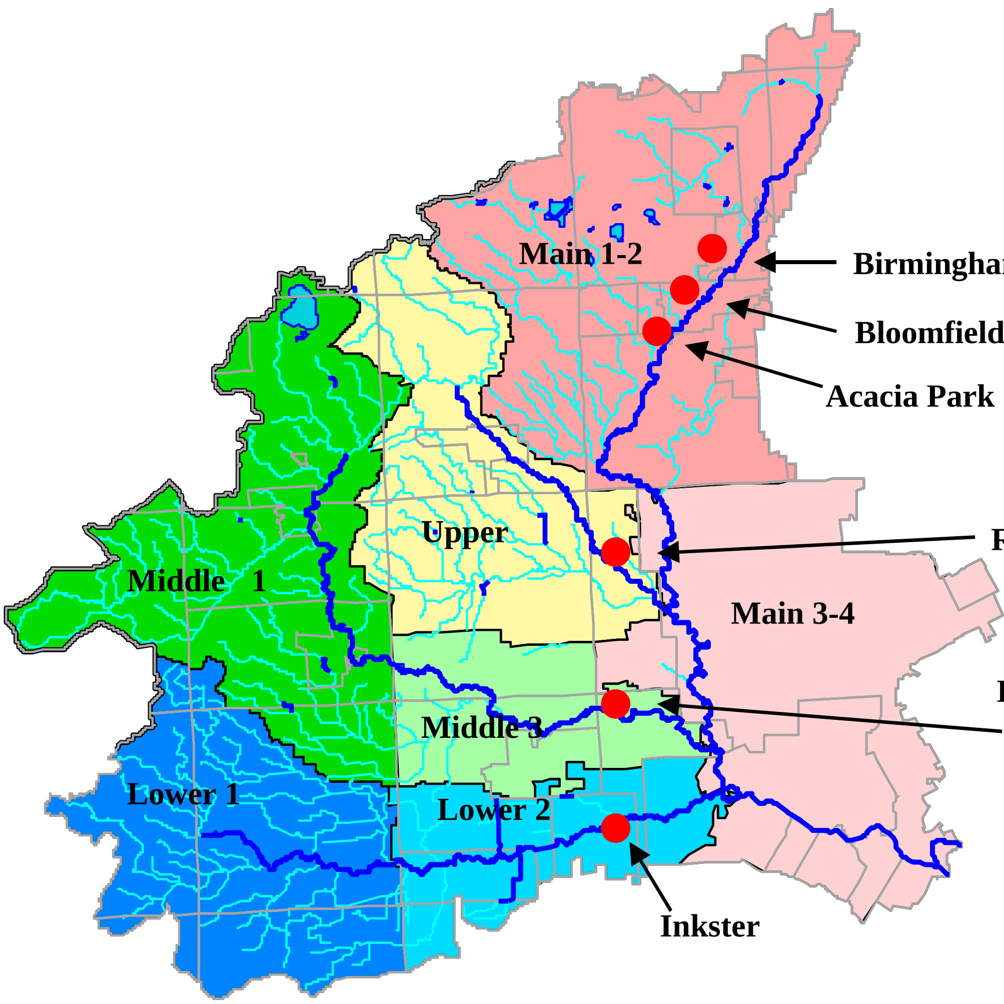


TABLE 1
ROUGE RIVER PROJECT
CSO BASIN DESIGN INFORMATION

Basin	Combined/ Storm Drainage Area (acres)	Separate Sanitary Drainage Area (acres)	Basin Volume (MG)	Basin Volume (Inches of Runoff)	Sizing Criteria	Design Detention Time (Minutes)	Design Storm
Inkster	838	548	3.1	0.14	Demonstration	20	1 year, 1 hour (1 in)
Redford	669	1622	1.9	0.10	Demonstration	20	1 year, 1 hour (1 in)
Acacia Park	816	0	4.0	0.18	Demonstration	30	1 year, 1 hour (1 in)
Birmingham	1185	0	5.5	0.17	Demonstration	30	1 year, 1 hour (1 in)
Bloomfield Village	1735	590	10.0	0.21	Demonstration	30	1 year, 1 hour (1 in)
Dearborn Heights	360	0	2.7	0.28	Portion of MDEQ Guidance*	30	10 year, 1 hour (1.75 in)

* MDEQ's Adequate Treatment Guidance is sizing a basin to capture the 1-year, 1-hour storm event *and* provide a minimum of 30 minutes of detention for the 10-year, 1-hour storm event. The Dearborn Heights basin was designed *only* to provide 30 minutes of detention for the 10-year, 1-hour storm.

TABLE 2
ROUGE RIVER PROJECT CSO BASIN OPERATING INFORMATION
(JUNE 1997 – DECEMBER 1999)

	Events Monitored			**No. of Months Monitored**			**Computed Average Events per Season**		
Basin	May – Oct	Nov – Apr	Total	May – Oct	Nov – Apr	Total	May – Oct	Nov – Apr	Total
Inkster	11	7	18	17	13	30	3.9	3.2	7.1
Redford	9	6	15	17	15	32	3.2	2.4	5.6
Acacia Park	5	4	9	12	12	24	2.5	2.0	4.5
Birmingham	1	2	3	12	9	21	0.5	1.3	1.8
Bloomfield Village	2	3	5	12	13	25	1.0	1.4	2.4
Dearborn Heights	4	5	9	14	14	28	1.7	2.1	3.9

The evaluation period to date has seen rainfall generally consistent with long term trends. The largest storm events were in February 1998 and August 1998. The February event resulted in a relatively uniform 2.1 to 2.7 inches of depth over the watershed, and it included some snow melt and rain. The August event totaled 2 inches to 4.4 inches of rain over the watershed.

The evaluation of the CSO impacts on the Rouge River considers the seasonal differences in wet weather events. For example, the summer events, with lower stream flows, warmer temperatures, and greater amounts of rain are critical for dissolved oxygen in the river. On the other hand, the winter events, which can have larger and longer duration overflows of treated CSO, can be critical for the physical standards criteria.

Initially, the work group has tried to keep the analysis as simple as possible and to use existing water quality standards that have not been specifically modified to deal with transient wet weather conditions.

METHODOLOGY

The methodology for examining the in-stream impacts of CSOs was developed by MDEQ as part of its work on the Rouge Project. MDEQ developed a framework for the methodology in August 1998 based on the NPDES permit condition that reads, in part:

> "Conduct a Retention Basin Evaluation of the effectiveness in meeting Phase II goals of the elimination of raw sewage discharges and the protection of public health, and in meeting the Phase III goals of the elimination or adequate treatment of combined sewage discharges to comply with Water Quality Standards at times of discharge. The evaluation shall be coordinated with other Retention Basin Evaluations being undertaken by other permittees in the Rouge River Basin.

MDEQ designed the methodology in close consultation with the communities and agencies that are responsible for the combined sewer systems. An organizational structure of "work groups" was established to evaluate the in-stream impacts for dissolved oxygen, physical characteristics, total residual chlorine, and biological impacts. For each of these impacts, the work groups established a set of measurements and analytical methods to perform the evaluation.

There are three sets of work groups, and they all work on a decision-by-consensus basis:

Retention Basin Committees
There are three of Retention Basin Committees – one for each group of Retention Treatment Basins (RTBs) as follows:

- Oakland County RTB Committee
- Detroit RTB Committee
- Wayne County RTB Committee

The RTB Committees review discharge data in relation to the Phase II criteria for success. Each RTB Committee includes MDEQ, an RPO representative, the facility operators or other representatives of each community, and representatives of the communities' design consultants. When finished analyzing the discharge data on a particular RTB group, the RTB Committee will report in writing to the CSO Work Group indicating its conclusions of whether the individual RTB is achieving the Phase II criteria for success.

Stream Data Committee
The committee analyzes in-stream data in relation to the Phase III criteria for success. The Committee consists of four persons from MDEQ, three persons from RPO, one person from Oakland County, one person from Detroit and one person from Wayne County. The Committee will report in writing to the CSO Work Group indicating its conclusions of whether the receiving water downstream from each individual RTB is achieving the Phase III criteria for success and, if not, to what extent the RTB discharge is contributing to the problem. Some conclusions and recommendations may be the result of predictive modeling, considering all sources of pollutant loading. The committee may provide comments regarding the importance of pollutant sources other than CSO's based on predictive modeling work.

CSO Work Group
The CSO Work Group will compile information on success of the individual RTBs in meeting the Phase II and Phase III criteria for success and to propose what level of treatment should be considered adequate. Work Group members will include five from the MDEQ, two from the RPO, and one representative from each jurisdiction which has a RTB. The Work Group will develop recommended levels of treatment considered "adequate" to achieve the Phase II criteria for success, and the Phase III criteria for success. The recommendations will be reported in writing to the entities represented on the CSO Work Group, to the EPA and the Federal Court, and to other appropriate entities, such as the Rouge River Remedial Action Council and the Rouge River Steering Committee.

An earlier paper presented at WEFTEC 1999 and titled: "Can a Watershed Be Managed? Leading the Efforts of Public Agencies and Local Communities in the Rouge River Watershed" [(1)] described the importance of this type of collaborative, consensus-based group, inclusive of all stakeholder interests, and focusing on well-defined technical issues.

Table 3 summarizes the methodology outlined by MDEQ.

TABLE 3
METHODOLOGY FOR EVALUATING CSO BASINS IN THE ROUGE WATERSHED

Goal	General Process to Evaluate Goal
1. Ability to compare data from all basins	Estimate actual detention times at design storms for each facility, and compare basins on a common basis.
2. Meet Phase II	a. Determine if basin protects public health (effluent disinfection), and b. Determine if basin eliminates raw sewage, by evaluating ability to remove sanitary trash and identifiable sanitary solids (floating, sinking, or vertically stationary)
3. Meet Phase III (achieving state WQS in the receiving stream at times of discharge)	Success in achieving the goals of Phase III will eventually be demonstrated using measurements of the receiving waters (whereas, success in achieving the goals of Phase II will be demonstrated using measurements of effluents, as explained above). The criteria for success in Phase III are as follows: a) The dissolved oxygen standard (R 323.1064). b) The physical characteristics standard (R 323.1050). c) The total residual chlorine standard (final acute value under R 323.1082). d) The health of the biological community, as a surrogate for toxic materials (R 323.1057) and other pollutants. This is recommended because of the intermittent nature of the wet weather problems in the Rouge Watershed. The biota integrate the intermittent effects, and using this biological criterion will greatly simplify the monitoring for numerous other pollutants. There may be a need to consider individual toxic materials on a case-by-case basis where the biota are inadequate surrogates – for example, where fish tissue analyses indicate the presence of bioaccumulative toxicants. Note that the microorganism standard is not included here because it is included in the requirements of Phase II for the CSO discharges. An overall evaluation of whether water quality standards are met, considering all sources, will need to consider the microorganism standard for E. *coli* (R 323.1062).

The physical characteristics are being evaluated by measuring oil and grease and total suspended solids, and by periodic visual observations of the effluent plumes. Also, effluent nets on the CSO discharges are used to determine if any sanitary trash or identifiable sanitary solids are present in the effluent. All of the facilities provide screening, chlorination, storage and settling of CSO. Some facilities include other features such as swirl concentrators, first flush tanks, and shunt channels. Effluent monitoring is performed to measure compliance with the fecal coliform standard of 400/100 ml (geometric mean).

The dissolved oxygen standard is being evaluated by continuous water quality monitoring stations and predictive modeling to determine the magnitude and location of transitory dissolved oxygen sags caused by effluent from the facilities. The model uses field measurements for effluent BOD (biochemical oxygen demand), in-stream BOD decay rate and temperature, and effluent dissolved oxygen. Also, sediment oxygen demand is being measured to determine if the rates are decreasing compared to pre-CSO control conditions.

Total residual chlorine (TRC) is being evaluated by measuring TRC in the effluent plume, upstream chlorine demand, and the prediction of mixing zone limits with respect to the Michigan standard of 0.038 mg/l of chlorine.

Finally, the biological assessment uses Michigan protocols for rating macroinvertebrate populations and habitats upstream and downstream of the CSO control facilities.

Base Stream Flow for Evaluation

The base stream condition for evaluating compliance with the standards is a wet weather base flow. Earlier consideration was given to comparison to a 7-day, 10-year low flow or some other dry weather flow. Having evaluation data allowed the work groups to look at what conditions really occur during actual events, rather than based on a theoretical scenario of a combination or worst case conditions. The evaluation process is examining what wet weather event yields the critical design storm for a particular water quality standard. For example, the critical storm for the dissolved oxygen standard may be 0.5 to 0.75 inches of rain. This rainfall is enough to cause an overflow from the basin, but river flows are not extremely high. Smaller rainfall events may cause no overflow, while larger rainfalls can cause stream flooding and provide substantial dilution of the treated CSO basin effluent.

RESULTS

A paper presented at WEFTEC 1999, entitled: "What Performance Monitoring Tells Us About How to Improve the Design of CSO Storage/Treatment Basins" [(2)] provided a description the data collection protocols. Details of the data collected have been published in six reports (one for each CSO basin) presented to MDEQ in March 2000, and these reports are listed in the references. Table 4 summarizes representative data that have been collected.

TABLE 4
SUMMARY OF REPRESENTIVIVE
CSO BASIN EFFLUENT DATA *

Basins	CBOD Mg/l	TSS Mg/l	NH_3 Mg/l	Total P Mg/l
Inkster	4.5 - 25.4	50 - 164	0.14 - 3.9	0.58 - 5.7
Redford	4.5 - 28.3	24 - 183	1.01 - 4.60	0.67 - 5.92
Dearborn Heights	4.6 – 43.2	44.4 – 82.7	0.26 – 4.47	0.66 – 1.26

* Results represent event-mean concentrations

DISCUSSION

Physical Standards

Excerpts from the water quality standards for physical standards in Michigan are:

R 323.1050: "The waters of the state shall not have any of the following unnatural physical properties in quantities which are, or may become injurious to any designated use:

(a) Turbidity
(b) Color
(c) Oil films
(d) Floating solids
(e) Foams
(f) Settleable solids
(g) Suspended solids
(h) Deposits"

Applicable designated uses in the Rouge River include:

(i) industrial, agricultural, public water supply
(ii) recreation
(iii) warmwater and coldwater fisheries, other aquatic life, and wildlife
(iv) navigation

The MDEQ chose four parameters from this list for CSO evaluation to consider: suspended solids, oil films, turbidity, and sediment/sludge deposits. Results for each parameter are described below.

Suspended Solids. Total Suspended Solids (TSS) sample results were selected as the means for evaluating the suspended solids parameters. Discrete effluent TSS samples have been obtained for as long as a two-year period for each demonstration basin overflow event. Sampling is continuing at some basins where the requisite two-year period or 10 storm events have not yet been achieved. During overflow events in the months of May through October, discrete in-stream TSS samples have also been obtained at locations upstream and downstream of basins with complete CSO control. Some samples were also taken upstream and downstream of the Inkster basin in 1997, even though there is not complete CSO control upstream. In general, TSS concentrations in basin effluent are lower than in-stream values as shown in Figure 2. Note that TSS concentrations are naturally high in the Rouge River as a result of clay soils.

FIGURE 2

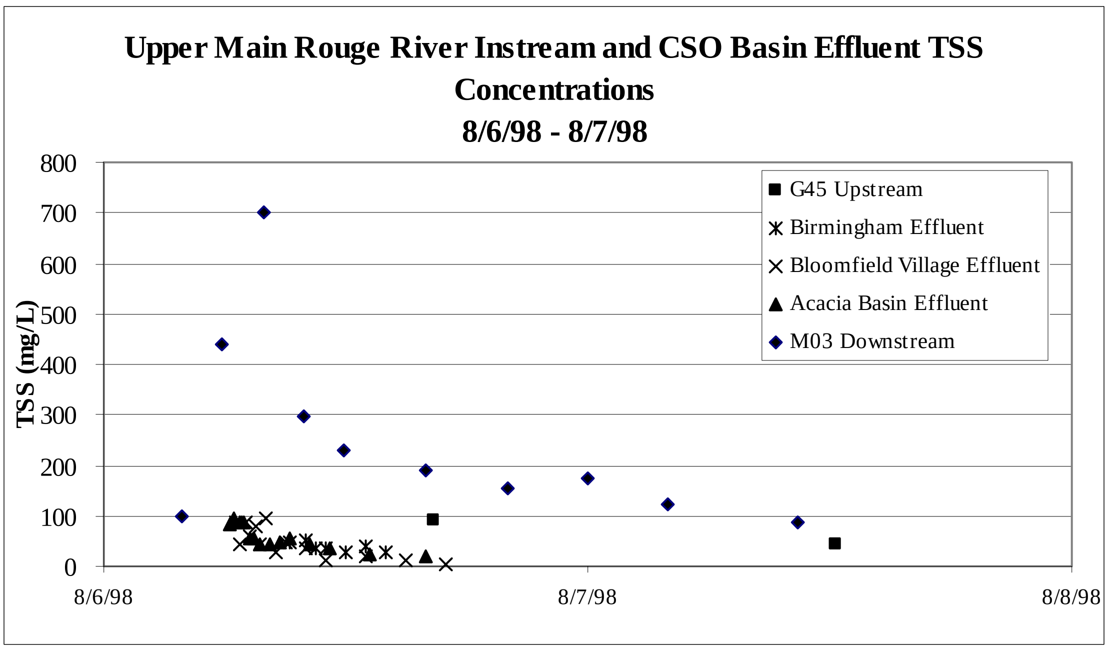
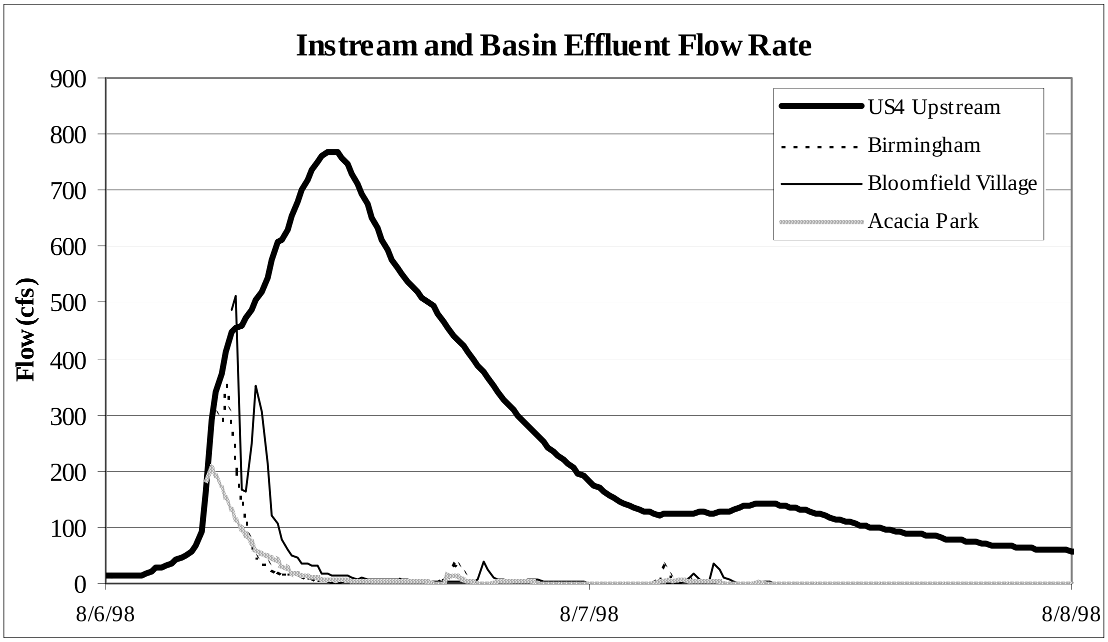
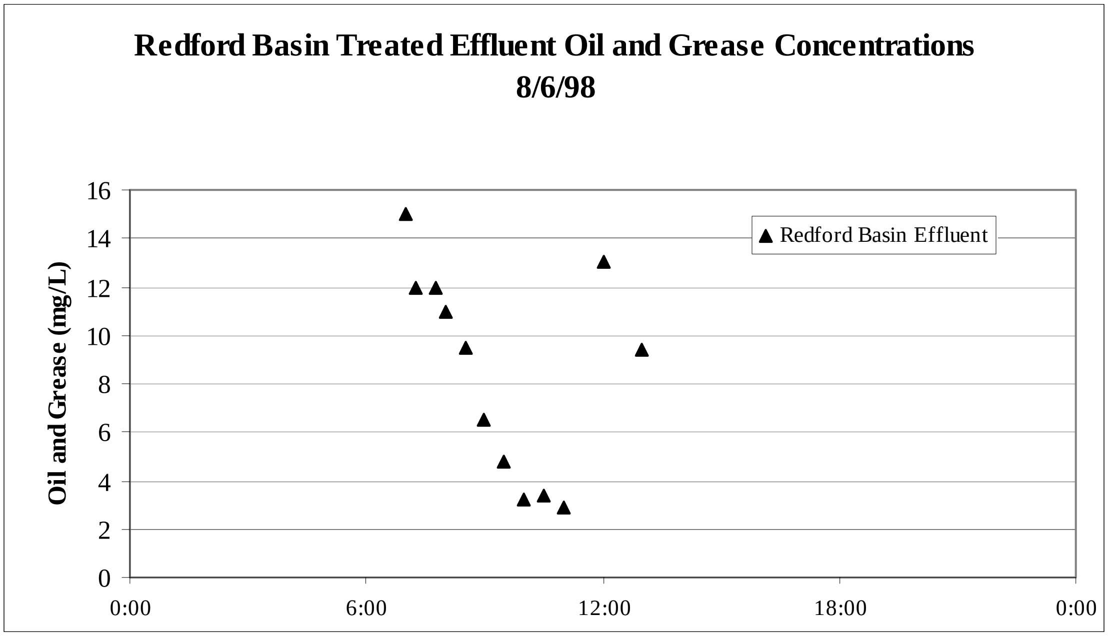


FIGURE 2 CONTINUED

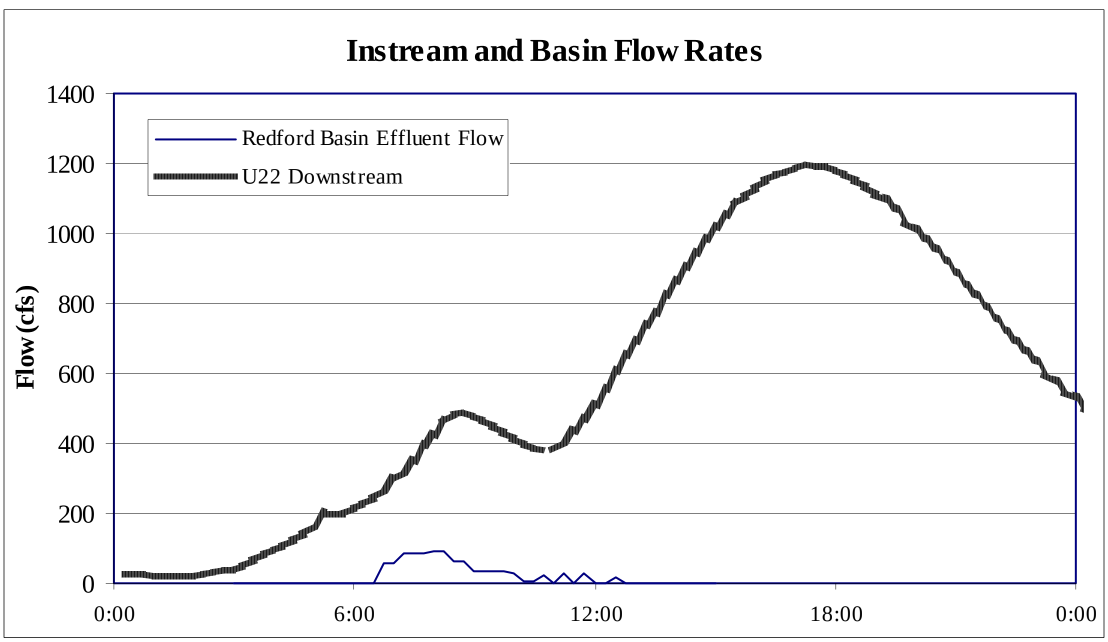


Oil Films. The presence of oil films is being evaluated based on oil and grease sample analysis and visual observations. Discrete samples of effluent oil and grease samples are being obtained for each overflow event. Effluents are skimmed by baffle walls before discharge. This technique for oil and grease control is proving to be effective. Fifty percent of effluent oil and grease samples have been below the detection limit of 5 mg/l, and 95 percent have been below 15 mg/l. Data for one event are shown in Figure 3. In-stream sampling for oil and grease is not being performed, but visual inspections of the stream and CSO effluent plumes are recorded.

FIGURE 3



Redford Basin Treated Effluent Oil and Grease Concentrations
8/6/98
Redford Basin Effluent
Oil and Grease (mg/L)
16
14
12
10
8
6
4
2
0
0:00
6:00
12:00
18:00
0:00



Instream and Basin Flow Rates
Redford Basin Effluent Flow
U22 Downstream
Flow (cfs)
1400
1200
1000
800
600
400
200
0
0:00
6:00
12:00
18:00
0:00

Turbidity. Visual observations of effluent and in-stream turbidity are being recorded by sampling crews using a standardized "Aesthetic Observation Sheet" developed for use throughout the Rouge River Project.

These observations are performed for all wet weather events from May through October of each year. Oakland County has reported that on some occasions the Acacia basin effluent plume can be identified as significantly clearer than the river. There is no direct measurement of turbidity via a probe or lab analysis. However, it is expected that turbidity would correlate well to TSS.

Sediment/Sludge Deposits on the Stream Bed Downstream of CSO Basins. No new sludge deposits downstream of the basins are being observed following the construction of the CSO basins. The Stream Data Committee has examined the potential for sediment/sludge deposits and has concluded, based on the following facts, that the settling within the basins will preclude the formation of any sediment/sludge deposits.

- Average velocities in the detention basins range from 0.005 to 0.1 feet/second. The shortest detention times to date are about ½ hour, but several hours is more typical.
- Average in-stream velocities during wet weather events are typically 1 to 3 feet/second.

<u>Dissolved Oxygen Standard</u>

The water quality standard for dissolved oxygen applicable to the Rouge River is as follows:

R 323.1064: "…In all other waters, except for inland lakes as prescribed by R 323.1035, a minimum of 5 milligrams per liter of dissolved oxygen shall be maintained."

The examination of compliance with the dissolved oxygen standard is being performed using a combination of continuous water quality monitoring, data analysis, and modeling as described below. The first river reach being evaluated is in Oakland County, where the Acacia Park, Birmingham and Bloomfield Village CSO basins have resulted in complete CSO control. Evaluation of river reaches downstream of other facilities will follow using a similar approach.

Continuous Water Quality Monitoring. Continuous monitoring of in-stream dissolved oxygen has been conducted from May through October at two locations downstream of the Oakland County CSO basins. In 1998, less than one percent of the in-stream DO readings were below the 5 mg/l standard, and none of the exceedances were attributable to discharges from the Oakland County CSO basins. In 1999, there were no violations of the DO standard. While the monitoring results are promising, further analysis and modeling are deemed necessary by the Stream Data Committee to examine other river locations which were not monitored and to determine if the DO standard would be met for a "critical" design storm.

Dilution Analysis. The dilution analysis approach looks at the overall capability of the stream to assimilate oxygen demand from the CSO basin effluent. At the Acacia Park CSO basin, the *river flow:basin effluent flow* dilution was determined for all overflow events occurring in the most critical months for DO, May through October. While the dilution immediately downstream of the basins was as little as 1:1 at the moment basin overflow began, the dilution always increased to 20:1 within 1 to 4 hours due to decreasing facility flows and increasing river flows. The highest $CBOD_5$ recorded in the Acacia Park effluent was 72 mg/l, while the median value is around 30 mg/l. Based on the highest $CBOD_5$ recorded, the 20:1 dilution equates to an in-stream concentration of less than 4 mg/l, with further dilution provided from other storm water inputs a short distance downstream.

Steady State Model Analysis. A steady state DO model was developed as a conservative "first cut" modeling approach. The model is based on basin effluent and river conditions at the onset of overflow, when dilution is at a minimum. After initial simulations, it was agreed that this "first cut" approach was too conservative and that a dynamic, wet weather modeling approach would be required. However, a sensitivity analysis performed with the steady state model provided the following insights.

- The river's DO response to a CSO basin overflow is most sensitive to river flow at the time of discharge.
- Other than river flow, the three most sensitive variables are the basin effluent $CBOD_5$ concentration, the river temperature and the BOD decay rate.
- The least sensitive variables are the basin effluent DO concentration, the background $CBOD_5$ concentrations from other sources, sediment oxygen demand, and the reaeration rate.

It was agreed the sensitivity analysis should be repeated with the dynamic, wet weather model in the future.

Dynamic Modeling Analysis. A dynamic modeling analysis is currently underway at this writing. The basis of the dynamic modeling analysis is as follows:

- Develop a dynamic wet weather DO model of the 8/6/98 event. This is not necessarily believed to be the "critical" event but it is the only event to date in which all three Oakland County CSO basins discharged, and some instream sampling was also conducted during the event.
- Conduct initial model runs and a sensitivity analysis with the 8/6/98 event before deciding our next steps, including whether to analyze another actual event or to define a critical design event.
- Agreed to use the previously developed SWMM/WASP model for the Rouge Project, initially ignoring the impacts of other non-CSO sources.
- Calibrated the quantity model for the 8/6/98 event using stream gages and measured effluent flow from each CSO basin. Agreed the calibrated model is suitable to support the 8/6/98 event DO model, but that it is not suitable as a predictive model for other events without making additional adjustments.

- Agreed to overall DO modeling approach as follows:
  - Assign measured DO and $CBOD_5$ concentrations to the Oakland County CSO basins
  - Initially assign a constant DO of 6 mg/l and $CBOD_5$ of 1 mg/l to all other pre-event dry weather flows entering the model and all storm water runoff entering the model.
  - Conduct a sensitivity analysis before refining modeling approach any further.

Total Residual Chlorine

The MDEQ has established the maximum concentration of total residual chlorine in-stream to be 0.038 mg/l. The approach being used is to examine in-stream values of TRC. It has been concluded that effluent TRC must be 1 mg/l to assure adequate reduction of pathogens. At the same time the in-stream standard for TRC is 0.038 mg/l. Sampling crews have been on-call since June 1999 to perform in-stream sampling during an overflow event to define the limits of the TRC plume at one or more basins. To date, there have not been any rain events that have produced basin overflows, and in general, discharges have become quite rare with control facilities in place. Therefore, it is not clear whether there is a significant environmental impact caused by chlorine residuals, even if the stream standard is not always met.

Biological Impacts

The MDEQ have established aquatic health standards for various species under R 323.1057. These standards cover macroinvertebrates as well as fish and various plants. The macroinvertebrate protocol involves the collection of 100 organisms; identification to family; and calculation of scores for nine metrics. The metrics express macroinvertebrate community health at several ecological scales; organism diversity, community composition, etc. The scores of the nine metrics are summed to produce a total score for each station and the total score is compared to scores from MDEQ established reference streams to evaluate similarity to recognized "health" communities.

In the late summer of 1999, RPO staff collected macroinvertebrate samples from the vicinity of the CSO basins in Redford (Upper Branch) and Oakland County (Main Branch, to investigate the compliance of these basins with Phase 3 Criteria for Success: Health of the Biological Community. Sampling locations were agreed to over several Stream Data Committee meetings. Organisms were collected and community scores calculated as per the GLEAS #51 protocol. Guidelines for interpreting the data were agreed to prior to sampling: the basin discharges would be judged to not be impacting the macroinvertebrate community if either: (a) the communities immediately downstream of the basin outfalls scored as "Excellent" or "Tending towards excellent," or (b) GLEAS scores for the communities downstream of the outfalls were not significantly lower than scores at locations upstream of the outfalls, regardless of the absolute scores (e.g., "Poor" scores both upstream and downstream of the outfalls would be interpreted as "no effect").

- Macroinvertebrate communities at all stations scored in the “acceptable” range (+4 to –4), although eight locations had “tending towards poor” scores, indicating degradation, and three had “neutral, with not tendency toward excellent or poor” scores. These neutral to low scores were due primarily to low diversity of taxa overall, and of mayflies, caddisflies, and stoneflies. These results are quite comparable to previous MDEQ and MDNR surveys from these general locations.

- The GLEAS scores from stations downstream of both the Redford and the Oakland County CSO outfalls are not significantly lower than scores from locations upstream to the outfalls. Some station-to-station variation was observed (total scores ranged from 0 to –4), but it does not follow a pattern indicative of macroinvertebrate community degradation due to the basin discharges.

- Organisms collected by hand, from stream sediments, instream structures (logs, stones, leaf packs), etc.

- ≥ 100 organisms are identified to family in field or in the laboratory.

- The data set is used to calculate scores for each of 9 metrics, by comparing the sample data to values from “reference” streams, believed to be minimally impacted by human activities. This results in scores of –1, 0, or +1 for each metric.

- A “total score” for the station is calculated by summing the scores for each of the nine individual metrics. The total score can range from –9 to +9.

Table 5 summarizes the findings of the macroinvertebrate sampling.

TABLE 5
1999 CSO BASIN MACROINVERTEBRATE STUDY SCORES

Metric #	Metric Description	Main Branch Sites									Upper Branch Sites					
		B6	B5	Birmingham CSO Basin	B4	Bloomfield Village CSO Basin	B1	Acacia Park CSO Basin	B2	B3	C5	C4	Redford CSO Basin	C1	C2	C3
1	Total Number of Taxa	-1	-1		-1		-1		-1	-1	-1	-1		-1	-1	-1
2	Total Number of Mayfly Taxa	0	-1		0		0		0	0	-1	0		0	0	0
3	Total Number of Caddisfly Taxa	-1	-1		-1		-1		-1	-1	-1	-1		-1	-1	-1
4	Total Number of Stonefly Taxa	-1	-1		-1		-1		-1	-1	-1	-1		-1	-1	-1
5	Percent Mayfly Composition	1	1		1		-1		1	1	1	1		1	1	1
6	Percent Caddisfly Composition	0	0		1		1		1	1	1	1		1	-1	1
7	Percent Contribution of the Dominant Taxon	-1	-1		-1		-1		-1	-1	-1	-1		-1	-1	-1
8	Percent Isopods, Snails, and Leeches	-1	1		1		-1		0	0	1	1		0	-1	1
9	Percent Surface Dependent	1	1		1		1		1	1	1	1		1	1	1
	Totals	**-3**	**-2**		**0**		**-4**		**-1**	**-1**	**-1**	**0**		**-1**	**-4**	**0**

Key for Individual Metric Scores:

+ 1	= Community performing better than the average condition found at the excellent sites.
0	= Community performing between the average condition and (minus) 2 standard deviations from the average condition found at the excellent sites.
- 1	= Community performing outside of (minus) 2 standard deviations from the average condition found at the excellent sites.

Key for Total Scores:

> + 4	= Excellent.
+4 to +4	= Acceptable
+ 1 to + 4	= Tending toward excellent.
0	= Exactly neutral (no tendancy towards excellent or poor).
- 1 to - 4	= Tending towards poor.
< - 4	= Poor.

CONCLUSIONS

1. The process for evaluating the impacts of the basins is leading to constructive decisions. Working with a large group trying to achieve consensus is taking more time, but is well worth the effort. MDEQ agreed that implementation of further controls is dependent on this evaluation. The next phase of CSO control will begin upon completion of this evaluation.

2. The frequency and magnitude of discharges has been considerably reduced. Therefore, the basins only discharge treated effluent in large events when assimilative capacity of the river is the greatest.

3. Other sources are significant, but the evaluation of CSO impacts can be reasonably isolated from other non-point source pollution impacts to draw conclusions on the effectiveness of the CSO basins in achieving the water quality standards.

4. A two-year time frame for monitoring and/or 10 overflow events at each facility is generally sufficient. In some cases for the Rouge River Project, an additional 3 to 6 months of study is being performed to further examine some issues specific to certain basins.

5. Treated effluent from the CSO control facilities studied so far seems to be relatively good quality. Detailed evaluations are ongoing to determine if water quality standards are expected to be met, particularly for DO.

6. Since wet weather control is so expensive, having good data and analysis to determine appropriate sizes is important. Much of the experience in the Rouge Project is expected to be transferable to other watersheds.

7. Overall, the evaluation of the Phase 1 CSO control facilities is providing valuable technical information for future phases of CSO control on the Rouge and for communities embarking on CSO control in other watersheds. The evaluation process also provides a innovative forum for stakeholders to establish objectives for CSO control within the goals of urban watershed restoration.

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REFERENCES

1. Johnson, Carl and V. Kaunelis, (1999). “Can a Watershed Be Managed? Leading the Efforts of Public Agencies and Local Communities in the Rouge River Watershed”.

2. “Hufnagel, Carol, V. Kaunelis, E. Kluitenberg, and J. Niebert, (1999). What Performance Monitoring Tells Us About How to Improve the Design of CSO Storage/Treatment Basins”.

3. Hubbell, Roth & Clark, Inc. (2000). Acacia Basin Report, “Retention Basin Evaluation for the Acacia Park CSO RTB”.

4. Hubbell, Roth & Clark, Inc. (2000). Bloomfield Village Basin Report, “Retention Basin Evaluation for the Bloomfield Village CSO RTB”.

5. Wade-Trim/Associates, (2000). Inc Birmingham Basin Report, “Retention Basin Evaluation for the Birmingham CSO RTB”.

6. Hubbell, Roth & Clark, Inc. (2000). Inkster Basin Report, “CSO Basin Evaluation Report Interim Final Inkster CSO Retention Basin”.

7. Hubbell, Roth & Clark, Inc. (2000). Redford Basin Report, “CSO Basin Evaluation Report Interim Final Redford Township CSO Retention Basin”.

8. Hubbell, Roth & Clark, Inc. (2000). Dearborn Heights Basin Report, “CSO Basin Evaluation Report Interim Final City of Dearborn Heights CSO Retention Basin”.