

DEVELOPMENT OF A MONITORING PROGRAM TO SUPPORT THE ROUGE RIVER WATERSHED MANAGEMENT PLAN

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ABSTRACT

The watershed management approach being applied to the Rouge River in southeast Michigan under the Rouge River National Wet Weather Demonstration Project (Rouge Project) includes an integrated monitoring program. The monitoring program will be applied during the implementation phase of the management plan. The development of the monitoring plan involves a multi-step process to ensure the program will satisfy three criteria: (1) capable of monitoring the health of the Rouge River Watershed; (2) responsive to community/watershed management needs; and (3) cost-effective to implement. This development process includes defining: (1) monitoring objectives; (2) indicators; (3) data needs; (4) individual sampling programs; and (5) estimated costs.

Monitoring will not be based on water chemistry sampling results alone. The overall approach to indicate the effectiveness of the management program uses both environmental indicators that focus on field conditions and performance indicators that document progress on implementation of selected controls and management activities.

The field programs needed to collect data for the environmental indicators will be comprised of monitoring at numerous locations throughout the 467 square mile watershed. Documentation to show compliance with a new general permit for the watershed will be used to compile information for the performance indicators. All programs will be implemented using staff from the participating municipalities, local universities, and private consultants, as well as, a large volunteer effort. The annual operating budget for monitoring has been targeted at between \$300,000 and \$500,000.

KEYWORDS

monitoring, watershed management, indicators, planning

INTRODUCTION

A watershed management plan is being developed and implemented for the Rouge River in southeast Michigan under the Rouge Project. The Management Plan includes an integrated monitoring program as the means to track the progress of the Plan. This paper presents an overview of the planning of this watershed monitoring program.

Monitoring is recognized as a critical element in watershed management. Two national studies have recently been completed that identify the key role monitoring plays. The Intergovernmental Task Force on Monitoring Water Quality (ITFM) prepared the report, "The Strategy for Improving Water Quality Monitoring in the United States" (ITFM, 1995). In the report, the ITFM recommends adopting the use of goal-oriented monitoring and indicators as the means "to support sound water-quality decision-making." The Urban Wet Weather Flows Federal Advisory Committee (UWWFAC) agrees with the ITFM report and in their own report, "Draft Recommendations on Monitoring Requirements for Watershed Management Programs" (Murray, et. al, 1996), discusses how watershed-based monitoring plays an integral part by tracking progress towards watershed objectives, while collecting more environmentally relevant data than traditional compliance monitoring.

The Rouge River, a tributary to the Detroit River in southeast Michigan, has been designated as a significant source of pollution to the Great Lakes system. (See Figure 1) The Rouge River Watershed is largely urbanized, spanning 467 square miles, and is home to 1.5 million people in 48 communities and three counties. Sources of pollution to the river include combined sewer overflows (CSOs), storm water runoff, resuspension of contaminated sediment, inflow from abandoned dumps, and limited industrial and municipal point sources.

The Rouge Project is a United States Environmental Protection Agency (USEPA) sponsored program to manage wet weather pollution as the means for restoring the Rouge River. It is designed to identify the most efficient and cost effective controls of wet weather pollution, while assuring maximum use of the resource. Controls for the CSOs that are being investigated include retention treatment basins and sewer separation. Innovative storm water control technologies are also being evaluated, including various best management practices (BMPs) and the development of a general permit which will offer: discharge options; focus on hydrologic boundaries; and define management activities. The results of the CSO and storm water control projects are being incorporated into the detailed management plan for the Rouge River Watershed.

METHODOLOGY

Planning the monitoring program to support the watershed management plan for the Rouge River involved establishing several elements. This planning process was derived from both the ITFM and UWWFAC reports, as well as, strategies for the development of monitoring plans that are presented in the USEPA's guidance document entitled, "Guidance for the Data Quality Objectives Process" (USEPA, 1994) and in "Design of Networks for Monitoring Water Quality" (Sanders, et.al, 1990). These five elements included:

- (1) monitoring objectives;
- (2) indicators to measure progress;
- (3) data needs;
- (4) individual sampling programs; and
- (5) estimated costs.

The first step in developing the monitoring program for the Rouge River Watershed management plan was to formulate an overall direction for the program. This direction was expressed in terms of monitoring objectives and planning criteria. The objectives were formulated in terms of the information requirements necessary for measuring the effectiveness of the management plan. The criteria established the overall approach of the monitoring program based on the objectives.

Next, a series of indicators were developed as the means to quantify the progress of the management plan toward reaching the overall goals of the watershed. This derivation was performed by taking each individual monitoring objective and breaking it down into a series of issues to be addressed. Parameters of interest were then identified under each issue. These parameters were either very specific such as flow rates and dissolved oxygen levels, or a further breakdown of a particular issue such as "downward" trends under identifying areas with problems and septic systems under minimum controls of the general permit. For each parameter, potential indicators were identified. Indicators were features that could be easily measured and could be used to quantify whether or not a specific objective or a goal has been achieved. The environmental indicators developed by the USEPA for water quality in the United States were used as a starting point (USEPA, 1996).

The third element was to identify the data requirements. These requirements were expressed in terms of the data needed to support the suggested indicators. Estimates of the data needs were made by identifying the database required to properly conduct an analysis of a given indicator and then evaluating the usability of the current database for the Rouge River.

Based on the data requirements, individual sampling and monitoring programs were identified to collect the data. A wide range of sampling programs were required for all the diverse data, such as water chemistry, habitat status, and recreational usage.

The final element to establish in the planning process was an estimate of the costs. Costs were developed for each of the identified sampling programs. The costs for labor, laboratory analyses, equipment, travel, and reporting were all included in the estimates. Costs of the monitoring program that had been conducted in support of the Rouge Project over the last four years were used to estimate costs for these future programs.

After the initial cost estimates had been completed, total annual costs for the entire watershed-based program were calculated. The distribution of costs was defined amongst the various sampling programs. The distribution was then evaluated in terms of the importance or priority of the information generated by each sampling program. Adjustments and trade-offs were made if information considered less important had a relatively higher cost to perform the required sampling. Based on these analyses, options to the monitoring plan were developed and submitted for further consideration.

RESULTS

The goals established for the Rouge River Watershed and the management plan can be summarized in the following statements:

- provide a safe and healthy recreational river resource for present and future generations;
- re-establish a healthy and diverse ecosystem within the Rouge River Watershed;
- protect downriver water resources such as the Detroit River and Lake Erie; and
- help ensure compliance with federal, state, and local environmental laws which protect human health and the environment.

The goals for the Rouge River Watershed were originally established in a remedial action plan (RAP) for the Rouge River, developed in 1989 and updated in 1994 (MDNR, 1994). These goals have been refined through the Rouge Project with the help of community leaders and citizens, federal and state regulators, and local and national technical advisors. The focus of the management plan for the Rouge River is to achieve these goals.

Based on the goals of the watershed, the objectives developed for the monitoring program are to:

- characterize river and ecosystem health trends;
- identify problem areas to be addressed & priority areas to protect;
- provide information for watershed management and assess progress towards achieving watershed goals;
- document compliance with and progress of general permit minimum controls; and
- encourage public stewardship and compliance with a highly visible and comprehensive program.

These objectives are considered necessary for the program to successfully support the implementation of the management plan for the Rouge River Watershed. They are also consistent with objectives for monitoring and sampling programs identified by the UWWFAC study.

The criteria used to plan the monitoring program includes:

- capable of monitoring the health of the Rouge River Watershed;
- responsive to community/watershed management needs; and
- cost-effective to implement.

The five monitoring objectives were broken down into specific issues that would be addressed by the monitoring program. These issues are presented in the second column of Table 1. In turn, specific parameters were identified for each issue. The third column of the table presents the potential parameters that were considered. The final column in Table 1 provides several examples of the types of indicators that were identified for the various parameters to track the progress toward meeting the goals of the watershed. The approach was adopted that both environmental and performance indicators would be applied to quantify the progress. The environmental indicators would focus on field conditions for characterizing trends and identifying problems. Whereas, the performance indicators would document progress on implementation of the general permit and

management plan activities, or increasing the level of public interest. Several indicators have been identified for each parameter but are not shown in the table.

A wide range of data would be required based on the range of suggested indicators. The types data to support all the suggested environmental indicators would need to include flow, dissolved oxygen, water chemistry, bacteria levels, aesthetics, sediment chemistry, habitat quality, and populations of fish, macroinvertebrates, algae, amphibians, birds, animals, and plants. The performance-based indicators would also need a range of data including related government ordinances, standards, permits; stormwater and wastewater control and inspection programs; and the number of attendants or participants involved with recreational activities and public education programs. The amount of data required also varied. Parameters such as flow, DO, water chemistry and bacteria were found to be highly variable in the Rouge River and required a large database to accurately establish baseline conditions and identify trends. Whereas, the amount of data required to characterize the aesthetics, sediments, and habitat was significantly smaller because these parameters were found to be relatively stable. The same was true for the performance indicators. An annual accounting of the various programs, activities, or participants was considered to be sufficient. The existing database for the Rouge River was found to be sufficient for establishing baseline conditions.

For the environmental indicators, over 20 different monitoring programs were identified for collecting the data. The programs included rainfall, flow, water and sediment quality, aquatic life, terrestrial conditions, public health, and recreation. Costs for each of the programs were estimated and various program options were developed for the watershed. Table 2 presents one such option that was developed. This program was developed to maximize the diversity of the data while working with an annual operating budget of \$300,000. Most of the programs listed in the table were continuations of current monitoring programs being conducted under the Rouge Project. Therefore, the units costs do not include start-up. Other options focused on the biological indicators, different annual costs, and longer durations for the sampling season.

No specific monitoring program has been developed for the performance indicators at this time. The majority of the data will be collected as part of the requirements of the general permit that is being developed for the Rouge River Watershed. The permit requires each community to implement plans to eliminate illicit connections and promote public education and participation in management activities. The management plan being developed and implemented for the entire Rouge River Watershed is also part of the general permit. Compliance with the permit will be based on documentation of completed activities. This documentation is anticipated to supply the required data for the performance indicators.

DISCUSSION

The Rouge Project is fortunate to have four years of monitoring experience on a watershed basis to aide in the development of its "long-term" program. Although the final program has not been completed, the basic components have been identified. Further screening and prioritization of the indicators are currently being performed.

Environmental monitoring will use a combination of permanent and roving stations to provide flexibility and improve coverage. Rainfall, flow, water column, and bacteria monitoring will be performed on an annual basis at both permanent and roving (temporary) stations. Assessment of the sediment and the biological elements (aquatic and terrestrial) will be performed every three to five years. (Table 2 indicates these programs will be performed on an annual basis as a means to estimate annual costs for comparison with other options.) Two-thirds of the costs of the program presented in Table 2 are under the rainfall, flow, and water column programs even though particular attention was paid to control this portion of the program. Studies with smaller budgets may want to consider less emphasis on this type of information.

All programs will be implemented using staff from the participating communities, local universities, and private consultants, as well as, a large volunteer effort. The volunteer effort will initially focus on monitoring aesthetics, habitat, amphibians, as well as, the performance indicators for public education and participation in recreational activities. The annual operating budget for monitoring has been targeted at between \$300,000 and \$500,000.

These funds will come from local communities as part of the general permit and, possibly, through federal grants.

CONCLUSION

Managing a natural resource on a watershed basis requires a comprehensive understanding of the natural systems and the impacts of human activities. Monitoring must be integrated into watershed management because it is a source of information that can provide answers to the complex questions that come with trying to understand the problems and solutions associated with watersheds.

A monitoring program designed in support of a watershed management plan must provide a broad range of information. Monitoring several chemical parameters for compliance with site-specific standards or criteria will not provide all the required information. For the Rouge River Watershed management plan, this information included both environmental and performance indicators.

Planning a watershed-based monitoring program is very important. Without proper planning, the range of desired information will lead to a very large and expensive program with little focus. Using a goal- or objective-oriented approach has helped the Rouge Project to stay focused on the important issues. But objectives cannot be used alone; they must be broken down into specific indicators. Only indicators are able to quantify results and define what specific information needs to be collected. The planning process should also screen and prioritize the indicators to determine the most important ones. Without this information, the limited resources for implementing the monitoring program cannot be effectively applied.

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Figure 1
Rouge Watershed

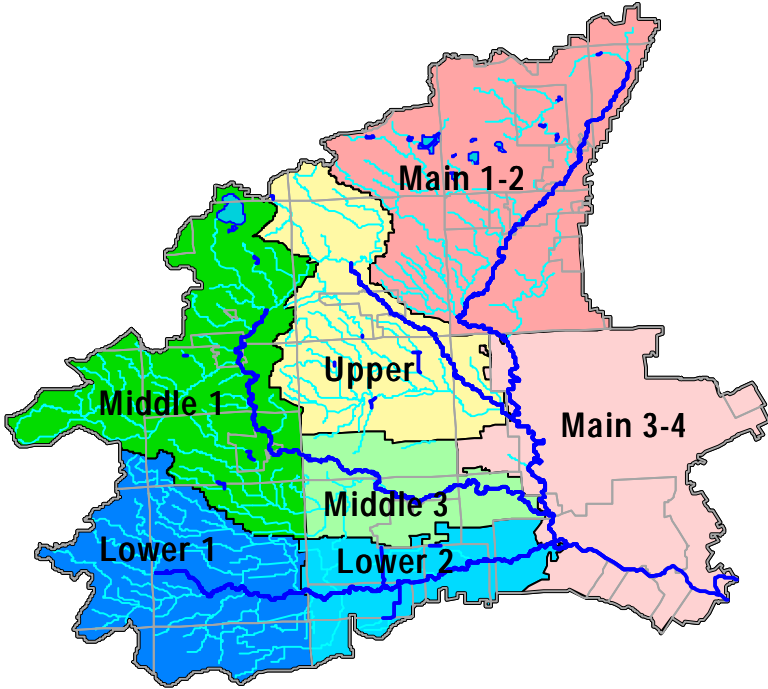


Table 1
Breakdown of Monitoring Objectives into Indicators

Objective	Issues to be Address	Parameters	Examples of Indicators
Characterize Trends	Impacts from Upstream Controls and Development	flow rate, dissolved oxygen levels, water chemistry, bacteria levels, aesthetics, river channel stability, land use, sediment quality	dry and wet weather averages, concentrations, loading/acreage, time > WQSS, sites w/ conc. > criteria, RPO indices, erosion, distribution of land use types
	Habitat Quality	aquatic, riparian, terrestrial	flow, DO, temperature, IBI and GLEAS51 scores, habitat acreage, amphibian and bird species
	Recreational Uses	fishing, canoeing, swimming/wading	fishing advisories, total designated miles
Identify Areas of Concern	Problems	WQS exceeded, "poor" rating using RPO indices, "downward" trends	% of time exceeding WQS, IBI fish score < 20, lower populations or number of species
	Priority Areas	headwaters, wetlands, prime habitat	acreage, remaining habitat
Assist with Watershed Management		progress in achieving the other four objectives will direct management activities	
General Permit	Minimum Controls	illicit connections, septic systems, public education, local controls, development/redevelopment, sewer construction, erosion	number of inspections, number of Rouge friendly businesses, new local ordinances or standards, training certifications
	Local Priorities	recreation, habitat	available areas, fishing results, conservation easements, streambank rehab projects
Public Involvement	Recreation	park usage, canoeing/boating, fishing, birding	number of programs, attendance, participants
	Stewardship	programs	number of new programs, participants
	Perception	knowledge of watershed	kiosk usage, inquiries, media coverage

**Table 2
Program Option for Environmental Monitoring**

Programs	Cost Rate	Units	No. Of Stations	Duratin	Total Cost
Rainfall					
Wayne Co	\$800.00	site/month	5	4	\$16.00
Oakland Co./Detroit	\$400.00	site/month	5	4	\$8,000.00
Flow/Stage					\$
Permanant (stage + Q)	\$1,200.00	site/month	2	4	\$9,600.00
Permanant (stage only)	\$1,000.00	site/month	2	4	\$8,000.00
Temporary (stage + Q)	\$2,700.00	site/month	2	3	\$16,200.00
USGS	\$400.00	site/month	7	4	\$11,200.00
Water Column					
continuous	\$3,500.00	site/month	5	4	\$70,000.00
Cont. Temporary	\$4,000.00	site/month	2	3	\$24,000.00
Chemistry					
- dry grab	\$400.00	grab/site	30		\$12,000.00
- wet event	\$2,400.00	event/site	10		\$24,000.00
- toxics	\$700.00	grab/site	3		\$2,100.00
Sediment Chemistry					
Toxics	\$700.00	grab/site	5		
Aquatic					
Habitat	\$2,000.00	site/month	15		
Benthic	\$350.00	site/month	15		
Algal	\$350.00	site/month	15		
Fish	\$600.00	site/month	15		
Toxicity	\$1,000.00	grab/site	3		
Terrestrial					

Table 2
Program Option for Environmental Monitoring

Programs	Cost Rate	Units	No. Of Stations	Duratin	Total Cost
Amphibian	\$10,000.00	year	1		
Birds	\$8,000.00	year	1		
Public Health					
E. Coli Bacteria	\$100.00	3 grabs/survey	120		
Fish Tissue	\$1,000.00	sample/site	3		
Recreation					
Aesthetics	\$8,000.00	year	1		
			ANNUAL TOTAL		\$298,100.00