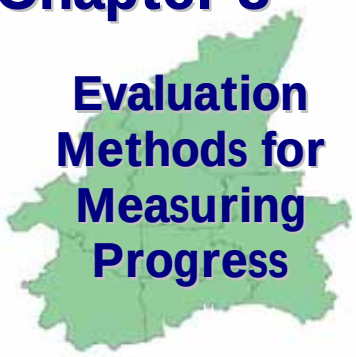
Chapter 8

Evaluation Methods for Measuring Progress



Introduction

The goals established to protect and restore water uses of the river are ambitious and may take several decades to accomplish. However, significant progress has been made over the past 10-15 years and will continue to be made as actions are implemented. Chapter 6 focused on the overall Rouge River Watershed action plan that included management strategies ranging from small-scale site tree plantings to large-scale construction projects such as the concrete channel modifications along the Main Branch of the Rouge River.

Measurements and evaluation are important parts of planning because they can indicate whether or not efforts are successful and provide feedback for improving project implementation as new information is gathered. In continuing to work collaboratively toward goals for the watershed, the ARC and associated communities recognize the importance of long-term environmental monitoring (i.e. water quality, quantity and biological monitoring) and performance monitoring programs that will occur by maintaining active subwatershed advisory groups, ARC committees and collaborative reporting. This monitoring approach will facilitate effective evaluation in order to determine where the ARC and communities should focus resources as they progress toward meeting the goals and objectives.

By evaluating the effectiveness of proposed programs, communities and agencies will be better informed about public response and success of the programs, how to improve the programs and which programs to continue. Although these methods of measuring progress are not directly tied to measurements in the river, it is assumed that the success of these actions/programs, collectively and over time, will have a positive impact on the in-stream conditions.

Monitoring and measuring progress in the watershed is two-tiered including both ARC collaborative approaches and community-specific approaches. First of all, the ARC has established a series of committees that are responsible for facilitating and overseeing priority projects on an annual basis. For example, the Public Involvement and Education (PIE) Committee identifies the ARC priorities for public involvement and education. The committee then oversees development and implementation of various public education initiatives and materials for use by ARC members. These materials have ranged from presentations at public meetings to posters that highlight progress made in improving watershed conditions. Initiatives include a green infrastructure program, tree giveaway and rain barrel sales. In addition, the Technical Committee is responsible for overseeing development and implementation of a quantitative program that monitors progress and effectiveness on a watershed and subwatershed level. This is done in order to assess the ecological effects of the actions taken in accordance with this watershed management plan.

The second-tier approach will include community-specific monitoring of respective activities and programs. This type of monitoring is qualitative in nature and may include successes through implementation of site-specific projects.

This chapter outlines the ARC's five-year monitoring plan that will be implemented to demonstrate ongoing progress in Rouge River Watershed restoration. It includes the following information:

- Description of the historical five-year monitoring plan;
- Description of the recently updated five-year monitoring plan;

Quantitative Evaluation - Involves the use of numerical measurement and data analysis based on statistical methods

- Description of the parameters monitored and entities collecting the data, and
- Description of the Michigan Department of Environmental Quality (MDEQ) five-year watershed basin cycle monitoring activities.

Watershed Historical Five-Year Monitoring Plan (2004 – 2008)

The original Rouge River Watershed five-year monitoring plan was developed and implemented as part of the multi-year, multi-million dollar Rouge River National Wet Weather Demonstration Project (Rouge Project). It was developed after the completion of the seven original subwatershed management plans in an effort to implement a long-term monitoring plan that would define and demonstrate progress towards meeting the goals and objectives outlined in the subwatershed management plans as well as the Rouge Project. Implementation of the monitoring plan cost approximately $1.5 million from 2004-08.

ARC Watershed Monitoring Plan (2009 – 2013)

The ARC Technical Committee revised the goals for the five-year monitoring plan based on the reality that grant funding would not be available to continue the extensive monitoring program initiated under the Rouge Project. These goals are as follows:

- Reduce monitoring costs;
- Increase usefulness of volunteer data and verify MDEQ will accept volunteer data;
- Maintain USGS monitoring stations;
- Make data readily available on website;
- Satisfy the watershed management plan monitoring requirements;
- Ensure a mechanism to coordinate staff and volunteers efforts, and
- Ensure the monitoring program supports the alternative IDEP approach and permit requirements.

The proposed monitoring plan is summarized in Table 8-1 and depicted in Figure 8-1 with additional detail in the text that follows. Table 8-1 includes specific in-stream monitoring as well as activities designed to meet the intent of the watershed plan for demonstrating progress into the future. Although the availability of funds for ecosystem monitoring beyond 2013 is unknown, it is anticipated that some level of monitoring will continue in the future.

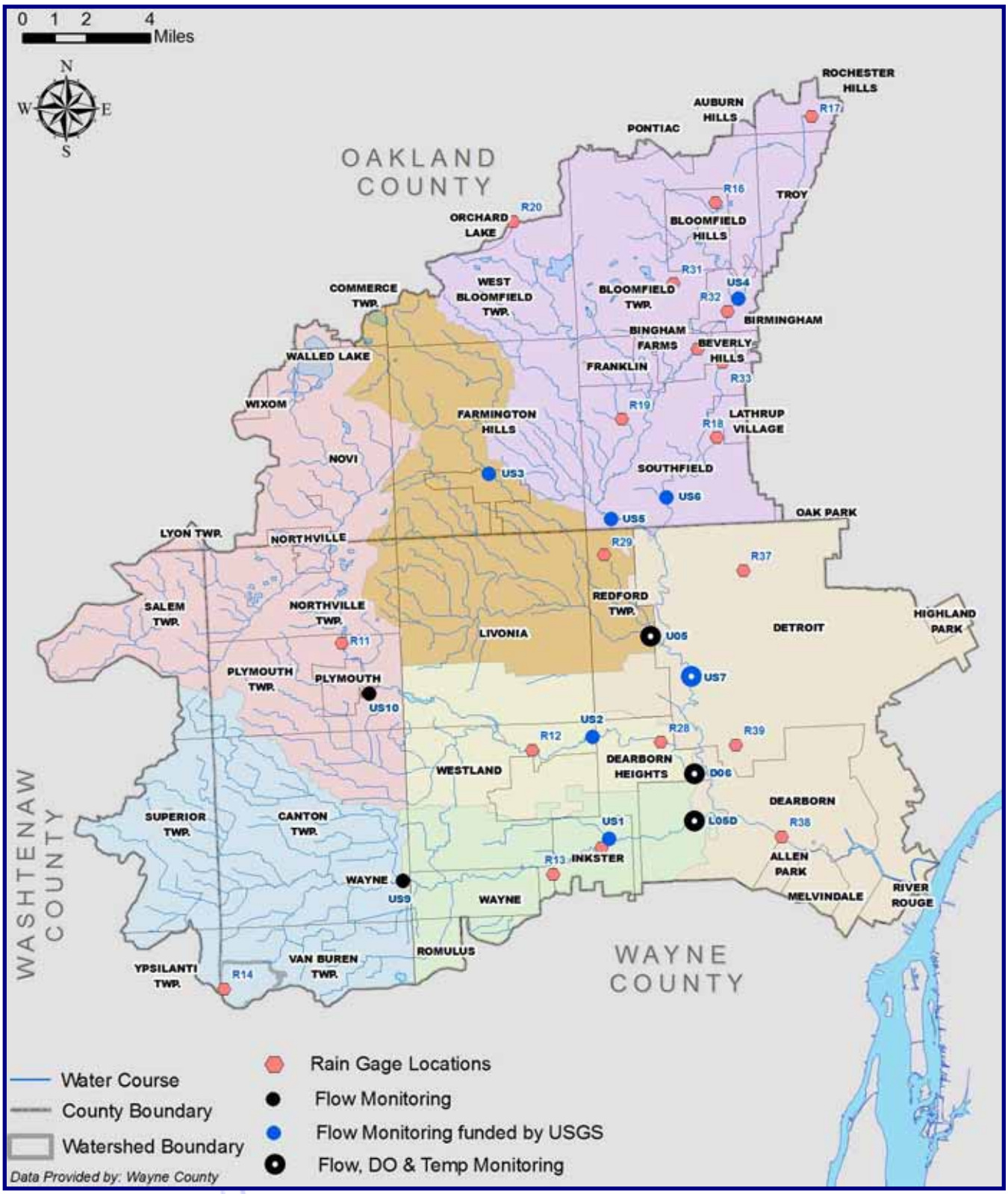
Table 8-1: ARC 5-Year Monitoring Plan

Element	Monitoring Locations	O = Non-Alliance Services (no charge to ARC) 2009	2010	2011	2012	2013
Planning & Reporting by ARC						
Monitoring Plan Annual Review	Not Applicable	X	X	X	X	X
Data Handling, Data Management & Analysis	Not Applicable	X	X	X	X	X
Monitoring Report	Not Applicable	X	X	X	X	X
Brochure	Not Applicable			X		X
Press Release	Not Applicable	As warranted				
Physical Monitoring						
Geomorphology/Stream Classification	WCDPS_WQMD/FOTR	O	X	X	X	X
Precipitation	Apr-Nov at 21 sites (15 min totals)	O	O	O	O	O
Continuous Stream Flow (15 min data) by ARC & USGS*		Year round				
Main 1/2	3 sites annually (*US4,US5,US6*)	X	X	X	X	X
Upper	*US3* annually + U05 in 2010	X	X	X	X	X
Middle 1	1 site at outlet (US10)			X		
Middle 3	*US2* annually + D06 in 2011	X	X	X	X	X
Lower 1	1 site at outlet (US9)				X	
Lower 2	*US1* annually + L05D in 2012	X	X	X	X	X
Main 3/4	1 site annually (*US7*)	X	X	X	X	X
Water Quality Monitoring						
Continuous DO and Temperature (15 min) by ARC		May-Oct				
Main 1/2						
Upper	1 site at outlet (U05)		X			
Middle 1						
Middle 3	1 site at outlet (D06)			X		
Lower 1						
Lower 2	1 site at outlet (L05D)				X	
Main 3/4	1 site (US7)					X
Grab Sampling by MDEQ**						
E. coli	TBD					
Total Phosphorus (TP)	TBD					
Total Suspended Solids (TSS)	TBD					
Biological Health Monitoring						
Fish, Macroinvertebrates, Habitat by MDEQ	TBD		O			
Macroinvertebrates by ARC via FOTR & by WCDOE	Multiple (35+)	X	X	X	X	X
Stoneflies by ARC via FOTR & by WCDOE	Multiple (20+)	X	X	X	X	X
Green Infrastructure (Land Cover) Monitoring by WCDOE	Across ARC	O	O	O	O	O
Public Education/Involvement by ARC						
Public Survey	Across ARC			X		
Volunteer Restoration Efforts	Across ARC	O	O	O	O	O
Pollution Prevention by ARC & local communities						
Illicit Discharges Identified & Eliminated	Across ARC	O	O	O	O	O

*Stream gages operated by USGS are italicized.

**Grab sampling based on MDEQ 5 year water quality monitoring cycle.

Figure 8-1: Flow and Water Quality Monitoring Locations



Planning and Reporting

Monitoring Plan Annual Review

The Technical Committee is responsible for review of the five-year monitoring plan on an annual basis and for preparation of recommendations for the upcoming calendar year monitoring events. This review will be completed in cooperation with the PIE Committee in order to identify those annual components that require implementation and oversight by the PIE committee. The recommendations from these committees are reviewed and approved by the ARC Executive Committee and the full ARC for budgeting purposes.

Data Handling, Data Management & Analysis

Management of both quantitative and qualitative data collected is generally completed by those entities identified as the data collectors listed in Table 8-1. For example, macroinvertebrate data collected by Wayne County is managed and analyzed by Wayne County staff. In some cases, the ARC will also contract with outside entities for data collection efforts. This includes benthic monitoring through Friends of the Rouge which is described further below.

Monitoring Report/Brochure/Press Release

The Technical Committee will also oversee development of a complete monitoring report that summarizes the data collection efforts and monitoring results. The timing is intended to coincide with progress monitoring reports required through the NPDES Phase II permit program.

Physical Monitoring

Geomorphology/Stream Classification

Streambank erosion is a natural process but it is also drastically accelerated by excessive storm water runoff. The excessive volume of water as well as the change in sediment transported into and in the stream will dramatically alter the stream's natural channel stability. Natural stream channel stability is the ability of a stream over time to transport sediment and flows produced by the watershed, in the present climate, in such a manner that the dimension, pattern, and profile are maintained without aggregation or degradation of the stream bed (Rosgen, D., 1996).

Streambank erosion has long been identified as a major problem within the Rouge River Watershed but until recently there has not been a science-based (quantitative) approach for assessing if the problem is getting better or worsening. Using stream channel geomorphology field measurement techniques (per Harrelson, et al. 1994), the Reference Reach Spreadsheet© (developed by Mecklenberg, Ohio EPA) as adapted by J. Rathbun, MDNRE, WCDOE and FOTR volunteers will monitor and assess stream channel stability across the watershed. This will be done to both geospatially assess channel stability as well as assess stabilizing or destabilizing trends over time.

Precipitation

Twenty-six rain gages are operated continuously by the local communities and counties in the watershed. The gages are located throughout the watershed, but there is sparse coverage in Wayne County. The operation and maintenance of these gages are currently done at no direct cost to the ARC. Precipitation data helps direct community-specific efforts including: retention basin operation, combined sewer overflow reporting, illicit discharge elimination investigations, water quality monitoring and modeling. Therefore, precipitation monitoring should continue at its current level of effort.

Continuous Stream Flow

Stream flow data coupled with water quality data (measured or historical) is used in pollutant modeling and pollutant loading calculations to determine areas where storm water pollution remediation efforts need to be undertaken. In addition, the stream flow data is also used to evaluate the frequency of bankfull events in order to evaluate long term reductions in storm water runoff volume. Both flow and volume also impact stream habitat for aquatic organisms. Therefore, this type of monitoring should continue in each subwatershed until the targets are met and until stable aquatic life communities are established and maintained.

Seven stream gages (US1 - US7) are operated continuously in the watershed. These gages are currently operated and maintained by the USGS each year. The operation and maintenance of the USGS gages is done at no direct cost to the ARC. Five additional stream gages should be operated for one year each to evaluate flow conditions at the outlet of each subwatershed. Two of the additional gages (US9 and US10) is to provide discharge data in two unmonitored subwatersheds (Lower 1 and Middle 1). The purpose of the other three gages (U05, D06 and L05D) is to provide discharge data near the outlets of the Upper, Middle 3 and Lower 2 subwatersheds.

Water Quality Monitoring

Dissolved Oxygen and Temperature

Continuous dissolved oxygen (DO) and temperature data are used as indicators of the overall health of the river at various locations. Since this data is collected continuously, it is very useful in determining spatial and temporal water quality trends. In general, DO and temperature water quality standards are met on a routine basis throughout the watershed. In addition, DO and temperature levels have remained fairly stable at most locations. Therefore, continuous DO and temperature monitoring should be limited to the downstream end of each subwatershed for a total of four locations (U05, D06, L05D and US7).

Grab Sampling

From 2003 to 2007, wet weather grab sampling was performed at nine locations, while dry weather grab sampling was performed at 21 locations. Water quality has improved significantly since the CSO basins have been built, however, there are still clearly identified drainage areas that are not meeting water quality standards.

Michigan Department of Environmental Quality

Monitoring and assessment of surface waters in Michigan is primarily the responsibility of the Michigan Department of Environmental Quality (MDEQ) Water Resources Division (Draheim S. and R. Eberhardt, 2006). In 1997, MDEQ developed the "Strategic Environmental Quality Monitoring Program for Michigan's Surface Waters" (MDEQ, 1997). This strategy was updated in 2005 (MDEQ, 2005) to reflect current monitoring efforts in the state.

The MDEQ collects data in watersheds on a five-year rotating cycle that includes water quality, macroinvertebrates and fish diversity. The program recognizes goals that include assessment of current conditions, determination of whether water quality standards are met, identifying water quality trends, and recognizing emerging water quality problems.

E. coli

Monitoring the watershed program's effectiveness towards reducing levels of pathogens in the waters of the state includes the following three (3) main components:

1. The TMDL for *E. coli* has been approved (MDEQ, 2007). Progress will continue to be monitored through the MDEQ five-year cycle with the next Rouge Watershed cycle in 2015.
2. In 2009, the ARC will develop an IDEP and *E. coli* TMDL implementation plan that will include cost-effective watershed-wide approaches to reducing pathogens in the river. The plan will compile existing activities and strategies already in place into one document to demonstrate the success of the current and ongoing cost-effective programs. In addition, monitoring will also be incorporated into this plan through further analyses, dye testing and/or field investigations of known *E. coli* "hot spot" areas based on existing sampling data results. The goal is to further isolate these problem areas and identify the potential sources.
3. Finally, implementation of the green infrastructure strategy described throughout this plan will document load reductions in bacteria from non-point source storm water runoff.

Total Phosphorus and Total Suspended Solids

Similar to *E. coli* grab sampling, the ARC will also rely on the MDEQ to continue to implement the watershed monitoring program by analyzing grab samples for both total phosphorus and total suspended solids. The ARC Technical Committee will coordinate with MDEQ staff to identify priority sampling locations across the watershed. In addition, the green infrastructure strategy described further in this chapter will also be utilized to estimate load reductions as there is conversion from gray-to-green infrastructure across the watershed and as additional BMPs are constructed and/or retrofitted.

Biological Health Monitoring

Fish, Benthics & Habitat (MDEQ)

The MDEQ watershed monitoring program generally includes some level of monitoring for biological health. The Rouge River Watershed biota TMDL is based on biological data collected by MDEQ and other supplemental data. In addition to the water quality sampling anticipated to be conducted by the MDEQ in 2010, monitoring fish populations is also expected. Locations will be selected by the MDEQ, however, the recent report outlining delisting targets for fish and wildlife habitat and population beneficial use impairments provides potential monitoring locations (ECT, 2008). The ARC will rely on this monitoring program to continue to monitoring improvements in biological conditions as funding is available through the MDEQ.

New caddisfly (Predacious caddisly) found

Benthic Monitoring (FOTR & WCDPS-WMD)

While some level of MDEQ monitoring is expected, the ARC will continue a benthic monitoring program as a measure of restoration success. Macroinvertebrate density and diversity data are used as indicators for stream habitat and water quality. Data collection efforts have historically occurred three times a year (spring and fall for macroinvertebrates and winter for stoneflies) by volunteers, who are organized by Friends of the Rouge (FOTR). This sampling occurs at more than 20 sites by FOTR volunteers and at 15-20 additional sites by Wayne County staff. Although gathered by volunteers, the data is collected under a quality assurance plan approved by the MDEQ. This data collection not only provides historical water and habitat quality conditions based on the presence of certain aquatic organisms, but also provides opportunities for public involvement. Macroinvertebrate sampling will provide stakeholders an overall assessment of conditions at multiple locations within each subwatershed (more than can be assessed by the continuous water quality monitoring).

Green Infrastructure (Land Cover) Monitoring

As previously described, the ARC members have begun to embrace Green infrastructure/grow zone projects that have included such examples as rain gardens, riparian buffer expansions and bioswales. Many ARC members have tree preservation ordinances (i.e., Bloomfield Township, Farmington Hills, Auburn Hills and Troy), that promote installation and preservation of urban trees and forests.

In 2009, The ARC contracted with a consultant to process existing aerial imagery to create the green infrastructure and the impervious surfaces GIS data coverage for the Rouge River Watershed. A report will be generated using CITYgreen© software and the green infrastructure data. The CITYgreen© software will track land cover area converted to green infrastructure while also estimating load reductions of pollutants, including fecal coliform, total phosphorus and total suspended solids. The ARC and individual communities will be able to evaluate and assess benefits and impacts from potential projects as well as prioritize areas for retrofits in reducing impervious cover.

Bennett Arboretum before grow zone construction in Northville Township

This method of evaluating progress across the watershed provides a number of benefits, including the following: (1) quantifies and communicates the economic and environmental benefits of existing green infrastructure in the Rouge River Watershed; (2) provides the means to evaluate the impacts of future development and/or grow zone projects; and (3) establishes the baseline green infrastructure and updates the impervious surface GIS data coverage for use in evaluating the long-term success/impacts of watershed protection and restoration activities. Over the long-term if the Action Plan described in Chapter 6 is successful the percentages of "green" land cover types should increase with a corresponding decrease in the percent of "gray" land cover.

The ARC Public Involvement and Education (PIE) Committee will also publicize the ongoing successes with green infrastructure implementation. A workshop, coordinated through the PIE Committee, will promote and instruct ARC members in the use of the green infrastructure analysis system.

Bennett Arboretum after grow zone construction in Northville Township

Public Education/Involvement

Public Survey

The Rouge River Watershed communities have regularly conducted public opinion surveys to gage the public's knowledge of watershed-related issues and concerns. Surveys were conducted in 1992 and 1999 by the Subwatershed Demonstration Project and in 2004 by SEMCOG. It is anticipated that a future survey will be conducted and will include questions related to the effectiveness of the monitoring program, such as asking respondents to rate the quality of water in their local rivers, lakes and streams; asking respondents if they visit their local waterway and what activities they engage in, and asking respondents if they engage in activities such as household hazardous waste disposal or reduce fertilizer use to prevent storm water pollution.

Targets for Measuring Progress

Although achievement of Michigan's water quality standards is a goal for the Rouge River, it is not practical to expect that they can be achieved in the near term, if at all, in an urbanized area. Therefore, several interim targets have been established, in order to determine whether or not the implemented restoration activities are improving the Rouge River Watershed ecosystem. These targets are

grouped into three categories, water quality, ecological, and volume-based, and have been developed for each subwatershed.

The anticipated timeline for achieving each of the targets is 2015. At that time, this plan will be evaluated to determine if the watershed has met the targets outlined below and if modifications to the plan are necessary to improve environmental conditions.

The water quality targets are based on water temperature, concentrations of dissolved oxygen, total phosphorus, total suspended solids and *E. coli*. The current conditions of each subwatershed were established by evaluating the most recent parameter concentrations at the most downstream monitoring site based on the Rouge River Water Quality Ranking System (Chapter 3, Table 3-3 on Page 3.13). Generally the target for each parameter was determined by improving the site specific ranking by one level (e.g.: from Fair to Good) within the next five years. For the situations where the current conditions were already considered Good, the target was to maintain that Good ranking. The targets and current conditions for the water quality parameters are presented in Table 8-2.

Due to funding limitations and past success, there are currently no plans for continuous DO and temperature monitoring in the Lower 1, Main 1-2 or Middle 1 subwatersheds. However, targets are still established in the event funding becomes available. If these sites are not monitored, then these subwatersheds will be assessed based on the results of DO and temperature monitoring at the downstream sites in the Lower 2, Main 3-4 and Middle 3 subwatersheds, respectively.

Table 8-2: Interim Water Quality Targets

Subwatershed	Lower 1		Lower 2		Main 1-2		Main 3-4		Middle 1		Middle 3		Upper	
Site	US9		L05D		US5		US7		US10		D06		U05	
Parameter	Current	Target	Current	Target	Current	Target	Current	Target	Current	Target	Current	Target	Current	Target
Water Temperature		X				X				X				
Dissolved Oxygen (DO)		X				X				X				
Total Phosphorus (TP)													*	
Total Suspended Solids (TSS)													*	
E. coli													*	

* Measured at G71.
X= Target established, but no plans to monitor in the ARC 2009-2013 Monitoring Plan.
Current conditions and targets based on Rouge River Water Quality Ranking System:
Good Fair Poor

Ecological targets were also established for each subwatershed to evaluate restoration efforts. These targets were based on the quality of fish communities, stream habitat, and benthic macroinvertebrates, the abundance of stoneflies and

the abundance of frogs and toads. Generally, 2007 data was used to determine current conditions. Target conditions for each parameter were established by improving the quality score for the current conditions by one level, by increasing the number of sites ranked within a category or by improving a specific score by 10%. Since so few stoneflies are found in the watershed, they were evaluated by absence/presence, with a target of finding them within each subwatershed. The targets and current conditions for the ecosystem parameters are presented in Table 8-3.

Table 8-3: Interim Ecological Targets

Subwatershed	Lower 1		Lower 2		Main 1-2		Man 3-4		Middle 1		Middle 3		Upper	
Parameter	**Current**	**Target**	**Current**	**Target**	**Current**	**Target**	**Current**	**Target**	**Current**	**Target**	**Current**	**Target**	**Current**	**Target**
Fish Quality[1]														
Stream Habitat Quality[2]	2 (100%)	All	2 (66%)	All	7 (88%)	All	1 (50%) site	All sites	10 (71%)	>80%	1 (17%)	>20%	5 (56%)	>60%
Benthic Macroinvertebrates[3]	33	36	18	20	28	31	14	15	36	40	22	24	29	32
Stonefly Abundance[4]	P	P	NS	P	A	P	A	P	P	P	NS	P	P	P
Frog and Toad Abundance[5]	67%	74%	30%	33%	47%	51%	20%	22%	74%	81%	32%	35%	49%	54%

P = Present A = Absent NS = Not Sampled

[1]Based on MDEQ's 2005 Fish Rating, except the Lower 2 which is based on MDEQ's 2000 Fish Rating and the Main 3-4 which is based on MDNR's 1995 IBI Index (Catalfio, et al., 2007)

Acceptable Poor

[2]Number of sites based on MDEQ's 2005 Habitat Rating (Catalfio, et al., 2007)

Good Marginal (2005 scale)

[3]Average 2007 quality score for all sites (both Spring and Fall) based on the FOTR benthic ranking system (Catalfio, et al., 2007)

Excellent Good Fair Poor

[4] Based on 2007 FOTR data

[5] 3 year average frequency (by blocks surveyed) of Spring Peepers identified in the FOTR Frog and Toad Survey (2005-2007) (Catalfio, et al., 2007)

As described in Chapter 3, a reduction of the stream volume associated with the 30-day storm event is desired to improve the conditions of each subwatershed. As furthur discussed in Chapter 6, a 1% reduction in the 30-day storm volume has been established as a short-term target for each subwatershed to be achieved by 2015. The targets for stream volume reduction by subwatershed are presented in Table 8-4.

Table 8-4: Interim Stream Volume Reduction Targets

Subwatershed (site)	Lower 1 (L06)*	Lower 2 (US1)	Main 1-2 (US5)	Main 3-4 (US7)	Middle 1 (US2)	Middle 3 (D06)	Upper (US3)
30 Day Storm Volume Reduction Target (cf)	**52,280**	**21,970**	**87,060**	**44,350**	**40,450**	**16,250**	**47,060**

*Will be evaluated based on data collected at site US9.