

Session 7: Identify Data Gaps Develop Monitoring Plan

In This Training Session

- Introduction
- Examine the data you have
- Read and understand MPCA/EPA protocols
- Determine whether you have quality data
- Determine whether you have enough data
- Data gaps
- Coordinate with other agencies
- Complete the monitoring plan Worksheet #7-1
- Complete monitoring plan Worksheet #7-2
- Develop a monitoring plan
 - Determining the appropriate level of rigor
 - Consider the timing and frequency of field sampling
 - When to begin Citizen Monitoring activities
 - Contents of a monitoring plan
 - Create action steps for data gathering
 - Monitoring is an iterative and comprehensive process
 - Planning your field work
 - The importance of using certified laboratories
 - Data submission and storage
- MPCA Project Manager responsibilities
- Project Sponsor responsibilities

Acronyms

DNR - Department of Natural Resources
EPA - Environmental Protection Agency
MP - Monitoring Plan
MPCA - Minnesota Pollution Control Agency
PM - Project Manager
QAPP - Quality Assurance Performance Plan
TMDL - Total Maximum Daily Load
USGS - United States Geological Survey

Introduction

“You cannot manage what you do not understand - and you cannot understand what you do not measure.”

-Dr. Joe Magner, MPCA

Good information should provide the foundation for all public policy decisions. Unfortunately, when we attempt to address a legitimate water quality problem, in the majority of cases, good quality data and information are hard to come by. As you worked to complete Worksheets 6-1 and 6-2, this may have become apparent. You may already recognize the need to collect more data to complete your Total Maximum Daily Load (TMDL) study.

Session 7: Identify Data Gaps Develop Monitoring Plan

Water quality monitoring is one way to provide important additional data for your TMDL study. However, water quality data, if not collected with a specific purpose in mind, has little value. Similarly, incomplete or poor data sets will provide no more information than a hunch.

Take the time now to carefully consider what information you still need in order to complete your TMDL study and, more importantly, to restore the impaired waterbody. Then create a plan that can help you collect it.

In the past, water quality monitoring typically focused only on the collection of **water chemistry data**. TMDL studies typically require significantly more information than water chemistry data alone can provide. The data you already have and what you plan to collect should allow you to understand the **chemical, physical, biological, geomorphological and flow conditions** of the impaired waterbody. Integrating multiple data sets will allow your technical team to develop a better diagnosis of the impairment(s). Ultimately, you will need to gather enough data and information so that you can successfully complete the TMDL allocation formula and devise effective management strategies for restoring water quality.

Land use/land cover information can also be very important to the development of a TMDL. If this information is not currently available to you, consider collecting basic land use/land cover data for the watershed, then using GIS software to display it. Then, supplement that with your own observations. If possible, canoe or walk the stream with your technical team. Stop along the way, talk to citizens and document probable sources of the impairment with photographs and notes.

Good quality data, photographs, visual observations and professional expertise together can help you tell a compelling story about the watershed and allow you to build greater support for the TMDL project.

The worksheets presented in this chapter are intended to help you analyze existing data and information and to determine critical data gaps. By completing them, you will be developing the core of your monitoring plan.

Session 7: Identify Data Gaps Develop Monitoring Plan

Examine the Data You Have

By this point, you will have spent considerable time and energy pulling together all available existing data related to your impaired waterbody. You have also completed worksheets 6-1 and 6-2. You have given thought to whether or not you have the data you need to complete the TMDL study.

Remember, good quality data should allow you to **validate (confirm)** or **eliminate** specific causes and sources of impairment.

Where data is limited, you may be able to determine that there is enough evidence (**strength of evidence**) to link causes and sources of pollution to the impairment.

However, if the data gaps are determined to be significant, they must be addressed before moving further ahead. By reading and working through this chapter, you will be better able to identify gaps in your data and develop a plan for filling those voids.

Read and Understand MPCA/EPA TMDL Protocols

EPA and MPCA have developed several monitoring protocols for specific impairments. To date, the following protocols have been developed:

- **Dissolved Oxygen**
- **Fecal Coliform**
- **Excess Nutrients in Lakes**
- **Turbidity**

If your waterbody has one of these impairments, you should carefully examine the relevant protocol before gathering additional data. These protocols provide a general overview of monitoring requirements for each parameter. This training module and the MPCA/EPA Protocols are meant to be used in tandem as you develop a monitoring plan for your project.

The Project Manager, in conjunction with MPCA technical staff will need to decide whether these protocols will be followed closely or adapted to meet the needs of your project. You and your technical team should document in writing why you have chosen to follow or *not* to follow those protocols.

Determine Whether You Have Quality Data

Data used for the TMDL study should be of sufficient quality such that decisions are scientifically and legally defensible and able to withstand public scrutiny. Using data of unknown quality and completeness will make it difficult to defend the decisions you make and may ultimately lead to poor or ineffective solutions.

Session 7: Identify Data Gaps Develop Monitoring Plan

While MPCA has strict quality assurance and quality control protocols, some errors in data collection inevitably occur. Absolute certainty and perfection is not affordable and is seldom achieved in most watershed projects. Consequently, it is helpful to define a certain tolerance level for error.

Begin by determining whether the quality of the existing data is acceptable. Consider these two important issues:

1) Data Needs – Was there a clear purpose for the monitoring activity, the types of data collected, the methods used and the conditions under which the data were collected?

Were the goals of a previous monitoring activity consistent with your goals? Would they help you to determine cause and effect relationships within the watershed?

For example, data on stream macroinvertebrate health are only useful if you have data which describes the physical habitat conditions as well. Or, a month of water quality data may not be adequate to provide acceptable estimates of phosphorus loading when calculating the TMDL allocation formula.

Be clear on the questions you need to answer, and think carefully about whether the data you have on hand will help you to get at the root cause of the impairment(s) in the watershed.

2) Data Quality – Consider data characteristics like accuracy, precision, sensitivity, and detection limits.

Data quality is a critical factor when conducting a TMDL study. Monitoring data become the basis for determining load allocations for a watershed. Load allocations can have regulatory implications in many cases, so being accurate is important.

Ask yourself these questions before accepting the data available to you:

- Was a certified laboratory used to analyze the samples?
- Were the detection limits of the laboratory's analytical equipment at or lower than the present standard?
- If using citizen monitoring data, does it meet acceptable measurement criteria?
- Was there a Quality Assurance Project Plan (QAPP) associated with the data?
- What was the measurement quality of the flow data?
- Are the data so old that it is difficult to compare to present day data?
- Are the data in an accessible electronic form?

Session 7: Identify Data Gaps Develop Monitoring Plan

Determine Whether You Have Enough Data

Document your answers in worksheet 7-1.

Review and analyze all existing data and ask yourself these basic questions:

- Will the data we have allow us to identify the causes and sources of impairment?
- Can we effectively integrate this data to create a clear picture of the ways in which physical, chemical and biological systems are being affected? If not, what more do we need?
- What analysis tools could be used to help us understand the data?
- Is this information adequate to allow the calculation of pollutant loads (TMDL, Waste Load Allocations, and Load Allocations)?
- Is the information adequate to inform the selection and design of pollution control measures?

Again, summarize your answers in Worksheet 7-1. It is perfectly acceptable to answer “No” to these questions. In most cases, you will not have enough data to clearly identify the causes and sources of impairment in the watershed and to develop pollutant load allocations.

Data Gaps

There are three major types of data gaps:

- 1) **Informational**
- 2) **Temporal**
- 3) **Spatial**

Informational- A given type of information is not available. For example, your waterbody has a turbidity impairment and you lack important information about stream bank erosion, you may need to fill these data gaps.

Temporal – If information has been gathered for your waterbody, but was collected long ago when watershed conditions were different, you may need to collect new information. Or data may have not been collected in the season or hydrologic conditions of interest to you, for example, during spring snowmelt or after crop harvest when the ground is bare. Climate conditions vary. As a result, you will want to have data that represents this variability over several years.

Spatial – If information was collected at the correct times, but not at the locations or with the spatial distribution you require to conduct a good quality analysis, you may need additional data. At the stream level, data gaps can confound a number of investigations. Data may implicate a specific tributary of a river as a pollution source, but not provide the information needed to identify the exact source of that pollution.

Session 7: Identify Data Gaps Develop Monitoring Plan

At a watershed or basin scale, poor spatial coverage of important tributaries can make it difficult to describe simple relationships between landscape characteristics, physical stream conditions (e.g. habitat quality, water chemistry, etc.) and biological communities. In addition, inadequate spatial coverage within a watershed or basin can cause certain land areas to be underrepresented in the data sets, which can ultimately bias the analyses (EPA, 2005).

Before designing a monitoring plan to fill data gaps, be certain to work with MPCA technical staff to identify the water quality model that will be used to calculate your pollutant load allocations. The model you select will, to a great extent, drive the kinds and quantity of water quality samples you will need.

The model may be as simple as a spreadsheet or as intensive as complex computer models.

Coordinate with Other Agencies

Once you have identified the data gaps, you will need to take the next steps to address them. Before writing a monitoring plan, be certain to inquire whether MPCA, DNR, USGS or other agencies and organizations are planning to or are already conducting biological or other kinds of monitoring activities in your area. Some agencies plan their monitoring activities several years in advance. By coordinating your efforts with other agencies, significant efficiencies could be achieved. Data collected by other federal or state agencies may be useful to your project and may be available to you at little to no cost.

STOP – Complete Worksheets 7-2 and 7-3

Worksheets 7-2 and 7-3 will help you to flesh out data gaps and areas of uncertainty and identify what kinds of new monitoring data need to be collected. Once completed, these worksheets will supply the core elements of a monitoring plan.

Develop a Monitoring Plan

When developing a monitoring plan, it is important to coordinate your efforts with MPCA's monitoring coordinators so that sampling protocols are consistent, reliable and comparable with other statewide monitoring efforts. In addition, try to convene a multi-disciplinary team to help you write the plan. Consider whatever plan you write to be a "work in progress". Be willing to change sampling design as more information becomes available.

Session 7: Identify Data Gaps Develop Monitoring Plan

Before you begin to write the plan, be certain to consider using all of these potential information collection and assessment techniques:

- **Visual Assessment** - Walk, drive or boat through the watershed, and document potential sources and stream conditions with a camera.
- **Physical Characterization** – Identify the stream and riparian conditions that can affect water quality. For example, if a stream is surrounded by urban development, the stream is likely to show signs of stress from increased runoff and increased water temperature.
- **Geomorphic Assessment** – Describe channel shape, slope, channel stability, and pattern, and stream alterations over time due to natural events and human activities.
- **Hydrological Assessments** – Measure stream flow (from surface and groundwater contributions). USGS is often the best existing source for this information. If there is a USGS stream gauging station in your watershed, you will have access to historical and current flow data to help estimate pollutant loads.

If there is no station near your waterbody, you may be able to estimate flow from adjacent, similar watersheds for a simple TMDL or where less scientific rigor is required (EPA, 2005). However, it is likely that you will still need to collect some flow data.

Nonpoint source pollution is driven by both climate and watershed hydrology. Measuring stream flow provides critical information about nonpoint source loadings to rivers, streams and lakes. Consequently, river stage data should be collected and flow measurements incorporated into nearly all TMDL monitoring plans.

- **Water Quality Assessment** – Monitor chemical health of a waterbody and track flow measurements.
- **Biological Monitoring** – Measure the health of biological communities in the aquatic environment.
- **Remote Sensing** – Provide information about lake or stream clarity, wetland plant diversity and land use pattern.

Session 7: Identify Data Gaps Develop Monitoring Plan

Determining the Appropriate Level of Rigor

The issue of scientific rigor is important to any TMDL study in several ways. First, your TMDL study must be of sufficient rigor such that it provides a strong foundation for any policy or regulatory decisions that may be needed to restore beneficial uses to the impaired waterbody.

For example, if you ultimately determine that you must impose strict new requirements on permitted facilities within the watershed that may be costly to meet; you will want to have a high level of confidence in the design and execution of your data collection efforts.

Secondly, the TMDL study should be of sufficient scientific rigor such that it can withstand public scrutiny and potential legal challenges in court. Your data collection procedures and the analytical tools you chose to use to analyze that data must be supported in the scientific literature and be well-documented in your public record.

Application of a high level of scientific rigor requires that you have significant staff, resources and time at your disposal. For some complex, controversial projects, this approach may be a necessity. For simpler impairments, a lesser degree of rigor may be justifiable. Before developing a monitoring plan, carefully consider what is an acceptable level of rigor for your particular project.

All watersheds are unique with regard to scale, hydrology, land use, number and sources of pollution, and social conditions. The final approach must balance the complexity of the watershed, the potential for controversy, and available staff and financial resources.

Required Outline for a Monitoring Plan

A monitoring plan organizes the “answers” you provided in the monitoring plan worksheets into the proper format that your technical team should review for completeness and accuracy.

Because of the site-specific nature of water quality impairments, monitoring plans have to be developed for the unique conditions present in each watershed. MPCA staff will often take the lead in designing a monitoring plan that will provide the information you need to complete the TMDL study.

TMDL Monitoring Plan Outline

- **Introduction**
- **Background** (reference worksheets)
- **Data collection goals**
- **Data collection objectives**
- **Field sampling plan** (What sampled? How many? What sites? What seasons? What frequency? Number of flow samples collected? etc.)
- **Equipment needs and availability**
- **Parameters analyzed** (ex. DO, turbidity, fecal coliform, etc.)
- **Laboratory analysis plan**
- **Budget for monitoring and lab analysis**
- **Timeline**
- **Roles and responsibilities**
- **Data management plan**
- **Quality Assurance Performance Plan (QAPP)**

NOTE: If EPA or MPCA funds are used to fund the collection of data, a QAPP will be required and must be approved by the EPA before any water sampling can occur. MPCA typically develops a QAPP for each watershed project, with assistance from the project sponsor.

Monitoring is an Iterative and a Comprehensive Process

The most important thing to remember about water quality monitoring is that it should be an **iterative process**. Developing a monitoring plan once is not enough. Circumstances will change, knowledge will increase, temporal and spatial adjustments may be needed. Be open to changing the sampling design and changing your working hypothesis. During, and at the end of the monitoring activities, be willing to question your initial assumptions and to change course as needed. Document any changes that have been made along the way. You will likely find yourself collecting water quality data several times over a period of time. Typically, data gathering will become increasingly refined as time goes on.

MPCA recommends conducting preliminary monitoring as a first step to assist you in locating permanent monitoring stations. MPCA suggests that you take preliminary samples for applicable field parameters, followed by grab analytical parameters, using maps and known identified sources to guide your efforts. This information can help you to define the project area and to reduce monitoring stations to the minimum number needed to attain an accurate picture of pollutant loads and sources.

Session 7: Identify Data Gaps Develop Monitoring Plan

Monitoring should also be a **comprehensive process**. When computing a pollutant load, you must have more than pollutant concentration data. You must also have stream flow that is representative of the water quality monitoring period of record.

If time constraints make collecting extensive data impossible, recognize the limitations of your period of record. You may need to address data limitations by increasing the margin of safety when calculating pollutant load allocations.

Conduct Field Work

With careful and thoughtful planning completed, you are ready to begin collecting new data. The length of time spent monitoring will depend on a number of factors, including the number of impairments you are addressing, the size of the watershed or basin you are attempting to characterize, the parameters you need to analyze, etc.

The Project Manager may need to invest significant time in organizing and coordinating the water quality monitoring effort, especially if more than one agency or organization will be involved in collecting samples.

The Importance of Using Certified Laboratories

Water samples collected for any TMDL study must be sent to a laboratory that has been certified by the Minnesota Department of Health. That laboratory must be certified specifically for the parameter for which you are having the sample analyzed. Be certain to check with the laboratory before you collect samples so they can be routed to the appropriate location and within the required holding times. For more information on lab certification, contact Roger Fischer at the MPCA.

Data submission and storage

Your Monitoring Plan should follow the strict data submission and entry protocols for both the HYDSTRA and STORET databases.

All water quality monitoring data collected as part of the TMDL project must be sent to the MPCA STORET team. If the MPCA does not receive all data by the date specified in the TMDL contract, MPCA will withhold 10% of final reimbursements from the project sponsor for work completed until such time as all data is submitted.

All stage data and field notes must be submitted to MPCA to be entered into HYDSTRA, the MPCA/DNR flow management data base. For further details contact MPCA's Regional Monitoring Coordinators.

Session 7: Identify Data Gaps Develop Monitoring Plan

MPCA Project Manager Responsibilities for the Monitoring Plan

The Project Manager should:

- Work closely with the project sponsor and the technical team when developing a monitoring plan, and QAPP.
- Ensure that the grantee follows contract requirements related to the submittal of data.
- Review data submitted to the STORET team for quality and completeness.
- Ensure MPCA staff enters time series data into HYDSTRA.
- Assist project sponsor when needed.

Project Sponsor Responsibilities

As a project sponsor, you will be responsible for following activities related to monitoring:

- Complete worksheet 7-1 and 7-2 with your technical team.
- Develop draft and final monitoring plans
- Collect water samples when specified by MPCA
- Follow requirements for data collection and submission
- Maintain communication with Project Manager, Technical and Stakeholder Advisory Committees and your STORET Team.

MPCA Resources

MPCA Monitoring Coordinators

Pat Baskfield (southern MN) 507-389-1648
Mark Evenson (northern MN) 218-828-6074

Water Quality QA/QC STORET Database (MPCA)

Roger Fisher 651-296-7387
Lynda Nelson 651-296-7232
Nancy Flandrick 651-296-8385
Jean Garvin 651-296-9455

Citizen Monitoring

Minnesota Waters 218-824-5565
Laurie Sovell, (Streams) MPCA 651-296-7187

References

Minnesota Waters 2005 Designing Your Monitoring Plan, p. 5-19.

US EPA 2006 Handbook for Developing Watershed Plans to Restore and Protect Our Waters, pp. 6-2-6-5.

US EPA 2006 Handbook for Developing Watershed Plans to Restore and Protect Our Waters, pp. 6-11-6-13.

US EPA 2006 Handbook for Developing Watershed Plans to Restore and Protect Our Waters, 6-18-6-24.

Data Inventory Worksheet 7-1

Fill out this worksheet after the Data Inventory is completed

Before moving forward to gather additional water quality or other kinds of information, work with your Project Manager and Technical Team to complete the following Monitoring Plan Worksheet

When completing this worksheet, remember that it is perfectly acceptable to respond with “I do not know” or “I am not sure”. Uncertainty in your response may simply point to a deficiency in data which should be addressed.

For each question, document how you arrived at the answer and the sources of information you used to respond to it.

Keep in mind that you will want to revisit this worksheet from time to time as you gain more data, information and knowledge about the watershed.

1. Describe the waterbody and watershed

1a) Name the drainage basin in which your impaired water body is located

1b) List attached maps

1c) Name the major watershed in which it is located. What is its size in square miles?

1d) Name the other sub-watersheds within the watershed.

1e) Name the tributaries that may affect it and downstream waters that it may affect.

1f) What are the major aquifers in the project area?

1g) What is the underlying geology of the watershed?

1h) What are the predominant glacial and geologic systems?

1i) What do you know about the ground water system that may be influencing the river?

1j) Where does streamflow come from under baseflow conditions?

1k) Briefly describe what you know about each of the following pathways by which water moves through the watershed: streams, surface ditches, subsurface tile intakes, gullies, surficial aquifers, precipitation

(See www.dnr.state.mn.us/waters/groundwater_section/climatology/index.html)

1l) Describe what the system would be like under natural conditions? (expected levels of turbidity, DO, biological communities, etc.)

1m) Map the locations of all NPDES permitted discharges in the watershed. Attach map. Have you contacted MPCA point source staff to coordinate your activities?

1n) List all DNR Appropriation Permits within the project area.

2. Field Reconnaissance Trip 1 -- Notes

Date:

Note: This type of reconnaissance trip is easy to complete when streams are 10 or less square miles. If your watershed is 11-50 square miles, double the time needed to complete this task. If the watershed is larger, break the trips down into manageable pieces.

Conduct a Field Reconnaissance Trip (document findings below). Take along the Project Manager, Geomorphology expert, Biologist, Local Government staff, Basin Manager, others as needed.

2a) Look at the terrain of the watershed during a windshield survey. What are your observations?

2b) Observe and describe flow conditions.

2c) Did you find good locations for measuring flow? For conducting water quality monitoring? Biomonitoring? Consider pros and cons of each location. Take photos of each possible site.

■ **Where are they?**

2d) Look carefully at the channel's condition. Describe conditions briefly.

Field Reconnaissance Trip II -- Notes

Date:

Revisit the waterbody by boating or walking the stream or river. Observe the entire stream or river (if possible).

2e) Describe riparian areas.

2f) Describe the channel in more detail.

2g) Did you find any surprises? Document them here.

2h) Other notes?

3. Overview of the problem

3a) What are the waterbody's known or perceived impairments? Examples: High water temperatures, low dissolved oxygen, muddy water, eutrophic conditions, etc.

3b) Describe land uses within the watershed, using feedlot inventories, agricultural statistics, state/county/city land use data bases, etc...

3c) What general land uses (agriculture, urban, industrial, etc.) likely contribute to the impairment? What specifically might be contributing to the impairment? Examples: (non-conforming sewer systems, WWTFs, soil erosion, small businesses, feedlots, ISTSs, etc.)

3d) Have the potential causes and sources of impairment been previously identified? If so, with what certainty? Examples: feedlots, urban runoff, inadequate wastewater treatment, ISTSs, etc.

4. Describe existing studies and implementation activities

4a) Has any new information been gathered from stakeholders and the public about the impairment(s)? Briefly describe information.

4b) Conduct an internet search on your waterbody. What information is already available, and what analyses have been performed to support development of a TMDL? Examples: Previous studies, Clean Water Partnership reports, GIS mapping, etc.

4c) Have any previous studies been done that *quantify* the causes of source inputs? And if so, with what certainty? Have specific portions of the watershed been identified as delivering more pollutant load than others?

4d) List/describe any historical or ongoing management efforts aimed at controlling the problem pollutants or stressors. What were their targeted audiences? Example: Existing programs in place which may be addressing or reducing pollutants impairing cost-share programs, wastewater treatment facility upgrades, etc.?

4e) Are there any probable future threats to the water body, such as imminent increases in development within the watershed?

5. Begin to define the scope of the TMDL project

5a) What impairments will you be addressing?

5b) Are all these impairments included on the MPCA's 303(d) List? If not, which are newly discovered?

5c) Are there any areas of the watershed that are known to be in attainment and which could be excluded from further study?

5d) Have you been able to identify areas of the watershed that are contributing to the impairment? If so, describe them.

5e) Define the critical conditions for the impairment. If you cannot yet do this, describe how you will get this information?

5f) Does the impairment occur only during certain times or seasons of the year? If not, how will you find out?

5g) What land areas will be included in your study?

5h) Briefly discuss the financial and human resources available to complete the project. Consider technical assistance, funding, match, space, staff, equipment, etc.

5i) From the discussions you have had pertaining to this worksheet, were you able to confirm or eliminate any sources and effects as a result of the newly gathered information?

5j) Were you able to use circumstantial evidence (strength of evidence) to confirm or eliminate any causes or sources of the impairment?

5k) Are there significant data gaps that need further investigation?

6. Social/political considerations

6a) Are there any specific stakeholder organizations that need to be brought into the data gathering phase of the project?

6b) What are the ultimate audiences for the information you are gathering and analyzing?

Worksheet 7-2: Complete this worksheet when analyzing the data you have gathered.

When completing this worksheet, respond to the questions with several sentences or brief paragraphs, explaining why you answered them as you did. Be sure to cite the sources of information you used. Be willing to answer, "I do not know," or "I am not sure."

This worksheet is not intended to address every possible question that may arise. Feel free to add additional questions and answers if needed. The important thing is to document your work.

1a) Will the data provide you with what you need to complete the load allocation calculations needed for the TMDL study? If not, why?

1b) What is the outcome you want as a result of gathering additional data?

1c) What level of rigor and detail is needed when collecting new data?

2. Describe what you already know about the watershed and water quality

2a) Identify known water quality impairments:

2b) Based on *existing* information, describe the conditions causing impairment (Temperature? Sediment? Excess nutrients? Flow? Other?)

2c) Is the impairment problem localized and distinct or is it cumulative, representing many sources?

2d) Is this impairment a result of a discharge (point source, feedlot, etc.) or land use habitat loss, stream alteration, loss of riparian areas, etc.)?

2e) How many point sources may be contributing to the impairment? What information supports this? What is your level of confidence in this information?

2f) How many nonpoint sources may be contributing to the impairment? What information supports this? What is your level of confidence in this information?

2g) Are these problems unique to specific areas of the watershed or is it prevalent throughout? If it is localized, what is your hypothesis as to why? Do you have data to support your hypothesis?

2h) Are there any natural background sources affecting the conditions of the impaired reach (e.g. ground water recharge, wetland complexes, karst features, etc.)? Describe briefly.

2i) Have you been plotting flow and duration curves?

2j) Do you have continual data sets to capture diurnal fluctuations in condition?

2k) Using box plots, do you see differences in daily, weekly, monthly averages?

2l) Describe seasonal or critical flow conditions contributing to the impairment?

2m) Are there apparent relationships between flow conditions and the instances of impairment? For example, are impairments most prevalent during periods of high flow?

2n) How do pollutants get to the water of concern? What are the connections (or pathway of delivery) between the sources and the waterbody? (e.g. tile line inflow, direct overland flow, etc.)

2o) What are the dominant land uses in the tributary watersheds? For these intensive land uses (urban, row crop agriculture, etc.) what is the prevalence of BMPs in place to address possible pollution sources?

2p) What are the land uses are the predominant contributors to the impairment(s)? Is this contribution a pollutant or hydrologic?

2q) What is the contribution to the stream from groundwater inflow? Specifically: Does the stream go completely dry during the year?

- **What is the 7Q10 (low flow) for the river/stream?**

2r) Have you characterized the natural condition of the groundwater in this area? For example, some areas may be high in chlorides or sulfates.

2s) At this point in time, what is your working hypothesis about the causes of impairment?

2t) Does the data you have allow you to validate or eliminate any suspected causes and sources of the impairment?

2u) If not, what is the appropriate level of rigor to apply as you gather additional data for the TMDL?

Monitoring Plan Worksheet 7-3

Completing this worksheet will provide much of the information required in a monitoring plan.

Filling Data Gaps -- What do you still need to know? Why are you monitoring? How will you monitor?

1. Water Quality Data

1a) What are your data collection goals and objectives?

1b) What additional water quality data sets do you need to design solutions? Concisely describe the data sets.

1c) Is this problem fixable? If not, why (too expensive, magnitude is too great, too time or resource-intensive, etc.)

1d) Do you need to gather any data to eliminate certain perceptions about the impairment?

1e) What further understanding do you need and what kind of monitoring would you need to gain that understanding?

1f) What will you use to evaluate your BMPs to see if they are effective at improving water quality?

1g) Given the analytical tools you have selected, what data would you need to apply them appropriately? For example, if you are using best professional judgment, you will need a limited amount of data. For models, you will require significantly more data.

1h) What do you now need to do to get the data? For example, resources, technical skills, personnel, equipment, etc.

1i) If you need more data, how will you sample to get it? What will your sampling seasons be? Why these?

▪ What will your sampling frequency be? Why this number?

▪ At what locations will you sample? Why there?

▪ Have you planned to gather enough data so that the FLUX model can be run?

1j) Will you gather this data? Or will it be gathered by a consultant or MPCA staff?

1k) Roger Fischer (MPCA) will develop your QA/QC Plan. Have you discussed this with him?

1) All data must be submitted to MPCA's STORET Team. All time series data must be entered into HYDSTRA. Have you familiarized yourself with any requirements they have developed for submitting data for these databases?

2. Watershed Assessment Data

2a) Is a watershed assessment necessary for this project? If not, explain why.

2b) If an assessment is needed, do you feel you have adequate land use, hydrogeology, and geomorphology data? If not, what are the data gaps?

2c) What are your data collection goals and objectives?

2d) What additional watershed assessment data sets do you need to develop and calibrate your model or to use GIS software? Name the specific data sets.
