

Chapter 3: Learning More

Monitoring to Secure New Data

Introduction

3.1 Determining Additional Monitoring Data Needs

3.2 Obtaining Additional Data Through Monitoring

Active Options

Write It Down

This chapter will help you:

- Identify monitoring data gaps
- Develop a monitoring program to fill the gaps

As in every chapter, this one also provides:

- Active Options
- Write It Down

Find related information about this stage of watershed planning in Chapters 6, 7, 8 and 9 of EPA's Handbook

Introduction

There are two major goals of watershed planning: protect good water quality and improve poor water quality. To achieve these goals, efforts must be targeted to protect any areas without problems and to restore areas with problems. To prioritize target areas with problems, it is necessary to identify where pollutants impact waterways. The work conducted for Chapter 2 gave you a better understanding of your watershed, the stream and people systems in it. However, in many cases additional data and more in-depth analysis are needed to identify sources and target implementation projects to places where they will have the most benefit.

For 319-funded watershed plans in Kentucky, a source is considered to be an area, or catchment, of a sub-watershed that is contributing a pollutant. You need a comprehensive understanding of the watershed to identify these pollutant contribution areas, or sources. This understanding can be achieved through the analysis of the watershed data.

Section 3.1 provides instruction to determine additional monitoring data needs and Section 3.2 provides instruction for obtaining additional data through monitoring. If you are developing a watershed plan using 319 funding, then you must fulfill *at least* the monitoring and analysis requirements identified in this Chapter. Section 3.2.1 explains this in detail.

Some watershed planning projects will not have sufficient resources to conduct in-stream monitoring and will have to rely on the data compiled from Chapter 2. Don't let this deter your efforts, because a great deal can be done with existing data. Use the information in this chapter to better understand how to look at your existing data and to identify monitoring that you may want to complete if future resources allow.

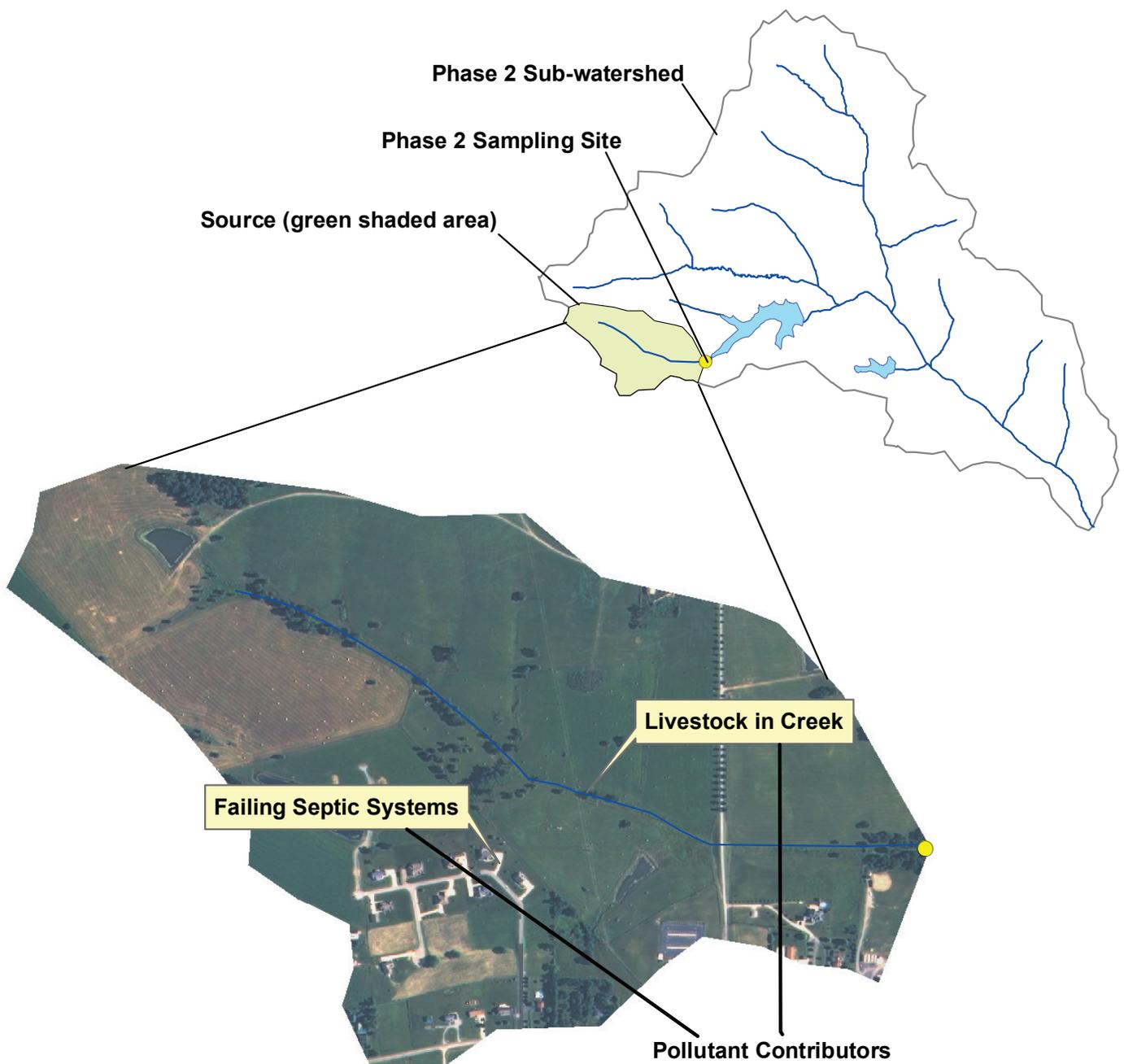


Figure 3.1 - Source and Pollutant Contributors

Source – There are many different definitions for source. It can be defined as a particular type of land use (e.g. mining), a discharge point (e.g. an outfall from a wastewater treatment plant that is not meeting permit requirements), or in some cases a specific landowner (e.g. Gudmilk Dairy). The KY 319(h) program defines source for the 319-funded watershed plans as the area that contributes a pollutant. Refer to Figure 3.1. In that figure, the source is the small catchment upstream from the Phase 2 monitoring sampling point. This source contains multiple pollutant contributors that are resulting in high levels of *E.coli*.

3.1 Determining Additional Monitoring Data Needs

At this stage of the watershed planning process, it's important to determine if you need to collect additional monitoring data to identify sources and target implementation efforts. This can be one of the most difficult challenges in watershed planning. It's often necessary to collect additional monitoring data. Sections 6.2 and 6.3 of the US EPA Handbook provide excellent guidance for identifying monitoring data gaps and should be utilized to identify these gaps.

Hiring Help. Your planning team may choose to hire someone to conduct the monitoring and analysis for your plan. Make sure that the person or organization you hire is familiar with the monitoring and analysis requirements in Chapters 3 and 4. It will also benefit you to include the fulfillment of these requirements in their contracts.

Section 3.2 outlines the minimum monitoring requirements for KY 319-funded plans. If you are developing a KY 319-funded watershed plan, then these minimum requirements must be met. You should review the monitoring requirements in Section 3.2 and determine if the existing monitoring data meet these requirements.

Another important factor to consider is the quality of the existing monitoring data. All KY 319-funded watershed plans require that monitoring data used have been collected in a manner that meets the requirements of a **Quality Assurance Project Plan (QAPP)**. Additional information regarding QAPPs for 319 projects is available in the Kentucky Nonpoint Source Application Instructions .

Many times available resources such as time, money and expertise will limit the monitoring efforts. If you are unable to collect additional data, do not let this prohibit your planning team from moving forward. Use the guidance in this chapter and Chapter 4 to better understand how to analyze your existing data and to identify monitoring that you may want to complete if future resources allow.

Quality Assurance Project Plan

A QAPP is a project-specific document that specifies the data quality and quantity requirements of the study, as well as all procedures that will be used to collect, analyze, and report those data. EPA-funded data collection programs must have an EPA-approved QAPP before sample collection begins. However, even programs that do not receive EPA funding should consider developing a QAPP, especially if data might be used in your plan to direct other projects to improve water quality or by state, federal or local resource managers. A QAPP helps monitoring staff follow correct and repeatable procedures and helps data users ensure that the collected data meet their needs and that the necessary quality assurance (QA) and quality control (QC) steps are built into the project from the beginning.

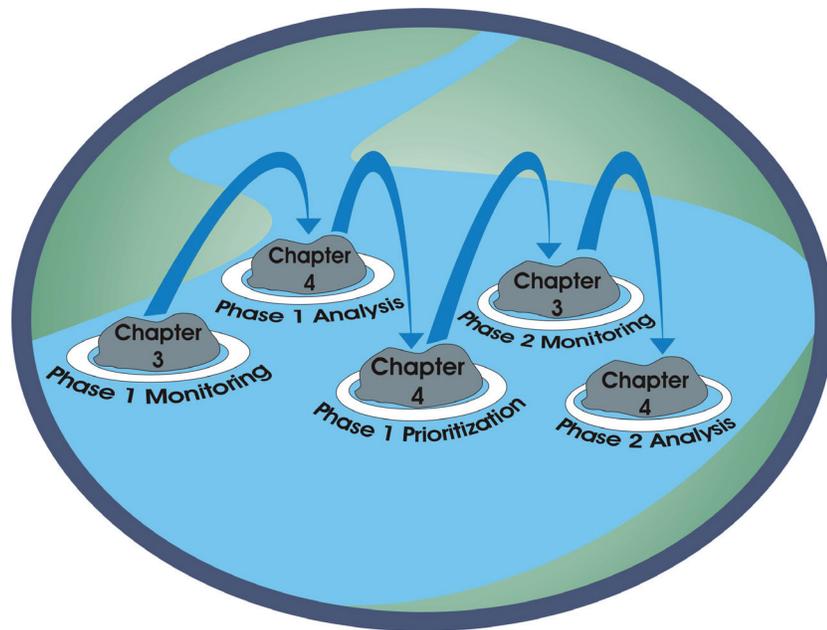
3.2 Obtaining Additional Data Through Monitoring

Once you have determined the need for additional monitoring, the next step is to determine where to monitor (scale), what to monitor (parameters), how to monitor (methods) and when to monitor (frequency).

3.2.1 Monitoring and Data Analysis for 319-Funded Watershed Plans

A phased approach for monitoring and data analysis must be used for KY 319-funded watershed plan projects. Within a 319 project, the area in which you monitor is dependent on your planning team's progress and the project's geographic scope. The geographic scope is greatly affected by the need for source determination. Source identification should be at a small enough scale to allow for targeting of BMPs with an expectation of water quality improvement. This ultimately determines the monitoring scale requirements for watershed plans.

Section 3.2 describes the phased approach for monitoring, and Chapter 4 describes



Monitoring and Analysis Flow Chart

the phased approach for analysis. For this part of the watershed planning process, you will utilize these chapters together. When you complete the Phase 1 monitoring, you will need to complete the Phase 1 Analysis in Chapter 4, Section 4.2.1. Upon completion of the Phase 1 Analysis, you will need to complete the Phase 1 Prioritization in Chapter 4, Section 4.2.2, then the Phase 2 Monitoring in Chapter 3, Section 3.2.3. Then you will finalize the monitoring and analysis process by completing the Phase 2 Analysis in Chapter 4, Section 4.2.3.

As discussed in Section 3.1, your planning team may have existing data that fulfill all or part of the monitoring requirements for your plan. If so, it may be appropriate for your planning team to begin at a more advanced point in Phase 1 or possibly with Phase 2. Phase 1 of the monitoring and data analysis begins at a broad scale across your **watershed** and helps to make general assessments to direct the more detailed examination in Phase 2. In Phase 2, your monitoring and analysis will allow you to select **sub-watersheds** in which to implement the most effective management practices for water

For the 319 phased monitoring and assessment approach the term **watershed** refers to the Phase 1 watershed that measures approximately 50 mi². This may be a HUC 11, HUC 12 or a group of HUC 14s. The term **sub-watershed** refers to the smaller (approximately 10 mi² or less) Phase 2 watersheds selected from your Phase 1 watershed. These sub-watersheds may be parts of HUC 12s, HUC 14s, or multiple smaller delineated watersheds. The term **catchment** refers to the even smaller watersheds within the sub-watersheds that drain to the Phase 2 monitoring locations. Refer to Figure 3.2. When a catchment is contributing a pollutant, it becomes a source.

quality improvements. These sub-watersheds will be divided into **catchments**. These catchments are the smaller watersheds that drain to the Phase 2 monitoring locations.

Sections 3.2.2 and 3.2.3 describe the two phases of monitoring for KY 319-funded watershed plans. These are the minimum monitoring requirements for KY 319 watershed plans. It's important to keep in mind that watersheds are different and this monitoring plan may not fit your particular watershed. In the Watershed Basics section, you learned about groundwater and karst basins. If you are planning in an area with karst geology, it will be important to monitor for the entire watershed, including both the surface and groundwater network. This will require sampling at locations such as springs and karst windows throughout the watershed. In some watersheds, it may be necessary to perform more in-depth sediment and/or geomorphic studies. Certain planning teams may choose to conduct biological

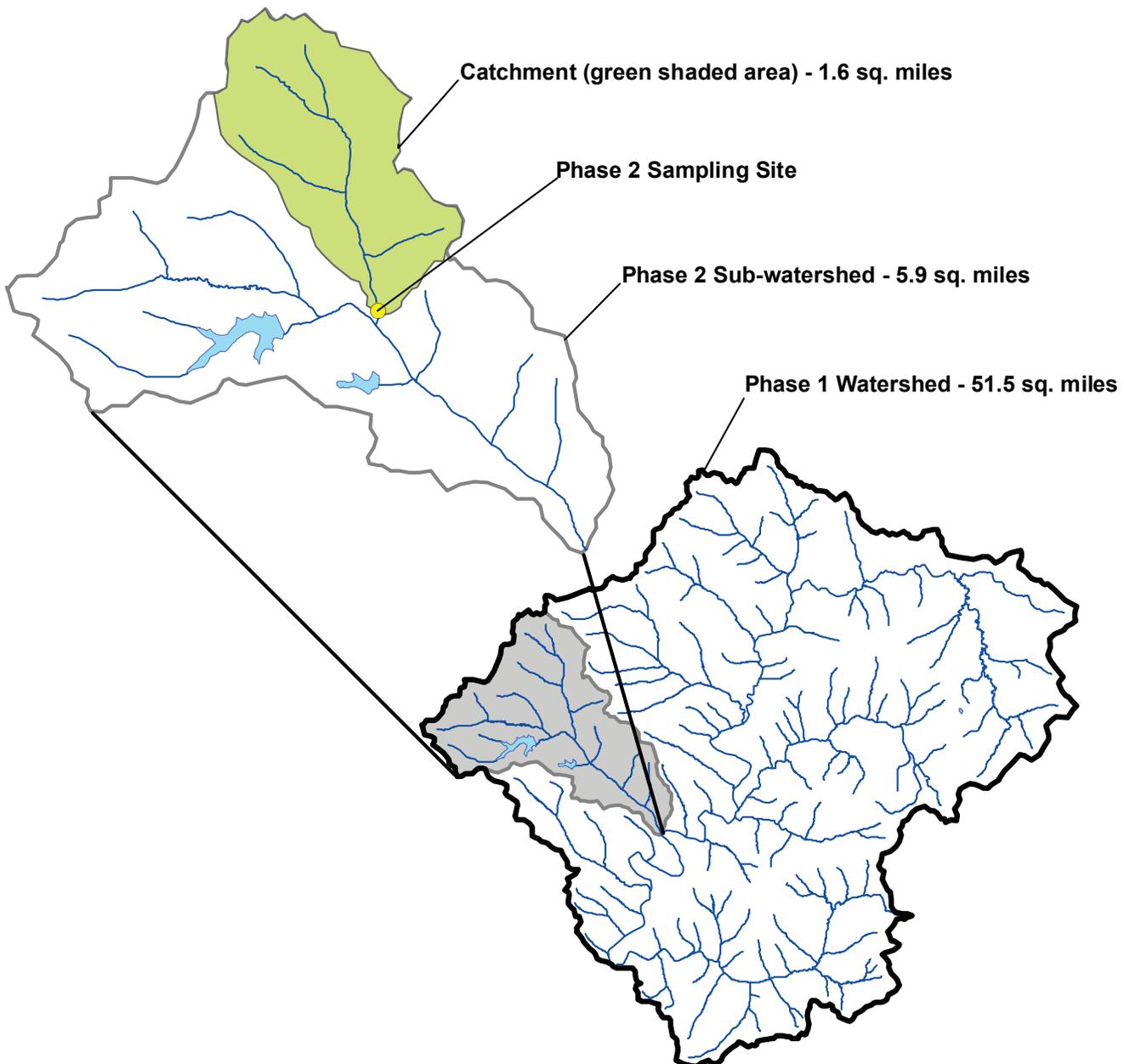


Figure 3.2 - Watershed, Sub-watershed and Catchment

assessments. In some cases it may be necessary to conduct Microbial Source Tracking (MST) studies to determine if elevated concentrations of bacteria are from human or animal contributors. You should contact your Nonpoint Source Program Technical Advisor and discuss these monitoring alternatives. It's vitally important that the monitoring strategy you choose will provide the information needed for your specific watershed.

Group	Parameter	Monthly	5X/30days May or June	1X/year May or June	Every Time	Standard Operating Procedure (SOP)
Bacteria	E.coli (Escherichia coli)	X	X			DOWSOP03017
	NO₃/ NO₂ (Nitrate/Nitrite)	X				DOWSOP03015
	NH₃-N (Ammonia - Nitrogen)	X				DOWSOP03015
	TKN (Total Kjeldahl Nitrogen)	X				DOWSOP03015
	TP (Total Phosphorous)	X				DOWSOP03015
	OP (Orthophosphate)	X				DOWSOP03015
	BOD5* (Biochemical Oxygen Demand)	X				DOWSOP03015
Sediment	TSS (Total Suspended Solids)	X				DOWSOP03015
Flow	Stream Discharge				X	DOWSOP03019
Field Data	Turbidity (actual or estimated)				X	DOWSOP03014/ DOWSOP0315
	pH				X	DOWSOP03014
	DO (Dissolved Oxygen)				X	DOWSOP03014
	Conductivity				X	DOWSOP03014
	% Saturation (Percentage of DO)				X	DOWSOP03014
	Temperature				X	DOWSOP03014
Habitat (required Phase 2 only)	Habitat Assessment (Barbour method)			X		EPA 841-B-99-002
Biology (required Phase 2 only)	Biological Assessment (Watershed Watch method)			X		WWSOP04000

* BOD5: The amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter.

Table 3.1. Watershed Plan Monitoring Table

3.2.2 Phase 1 Monitoring

The purpose of monitoring for watershed planning at the Phase 1 stage is to determine the current water quality conditions of your watershed. The water quality conditions will be determined by monitoring for a variety of parameters. The details below cover the prescribed scale, parameters, methods and frequency for the Phase 1 monitoring effort. Refer to Table 3.1 for details.

Scale

Phase 1 monitoring should be conducted in a watershed that measures approximately 50 mi². This may be a HUC 11, HUC 12, or a group of HUC 14s. This is considered an initial monitoring effort that will help with preliminary identification of sources at a broad scale and prioritize sub-watersheds for further study and targeted implementation. Monitoring should first occur at the mouth of all sub-watersheds with an estimated area of 10 square miles or less (e.g. the mouth of all HUC 14s within the watershed). Additional sampling locations may need to be added based on land use within the watershed. Monitoring above and below major point sources (e.g. wastewater treatment plant) and areas of local concern may also be determined necessary by your planning team. Use the results of the visual survey that was completed in Chapter 2 to help determine these areas of local concern. Kentucky Division of Water (KDOW) monitoring sites or any other long-term monitoring sites must be considered when determining sampling locations. KDOW or other agencies/groups may have already determined the best sampling locations in your watershed. Your data collection efforts could be a continuation of these existing data records. Additionally, you could choose sites in other locations to supplement existing data records and avoid duplication of prior efforts. Figure 3.3 provides an example.

Parameters

Required parameters include nutrients, Total Suspended Solids (TSS), *E.coli*, field data (including Turbidity, pH, DO, DO %, Conductivity, and Temperature), and stream discharge. Habitat and biological assessments may be performed as desired. Additional parameters may need to be collected based on 305(b) impairments and parameters of local concern. Refer to Table 3.1. for details.

Methods

KDOW Standard Operating Procedures (SOPs) must be utilized for water quality monitoring. SOPs to be referenced include: "Sample Control and Management," "In-situ Water Quality Measurements and Meter Calibration," "Sampling Surface Water Quality in Lotic Systems, and the "Bacteriological SOP." Refer to Table 3.1 for details.

These documents can be found at KDOW's website . If any parameters of local concern were selected for monitoring, and the above specified SOPs do not address those parameters, contact your Nonpoint Source Program Technical Advisor for the appropriate SOP. Alternative procedures can be used with prior approval. For Habitat Assessment, follow "Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers" (EPA 841-B-99-002) . For Biological Assessment follow "Kentucky Water Watch Biological Assessment Monitoring Protocol" (KDOW 2010) . The

To understand what these parameters tell you about the quality of water in your waterway, refer to the Watershed Basics Section.

protocols for Habitat and Biological Assessment are intended to provide a minimum baseline condition while minimizing time and resources.

Frequency

E. coli, nutrients, and TSS must be collected monthly for twelve months. In addition, *E. coli* must be collected five times within thirty days to ensure a sufficient number of samples are obtained during the Primary Contact Recreation (PCR) season. This sampling event should begin in May or June resulting in five grab samples collected within a 30 day period. For example if you collect the first of the five samples on May 12th, then the remaining four samples must be collected by June 10th.

Habitat and Biological Assessments must be performed once per year in either May or June during Phase 2. Keep in mind that you will need stream flow for these assessments. For monitoring locations that drain smaller catchments (<5mi²), it will be best to conduct these assessments in May.

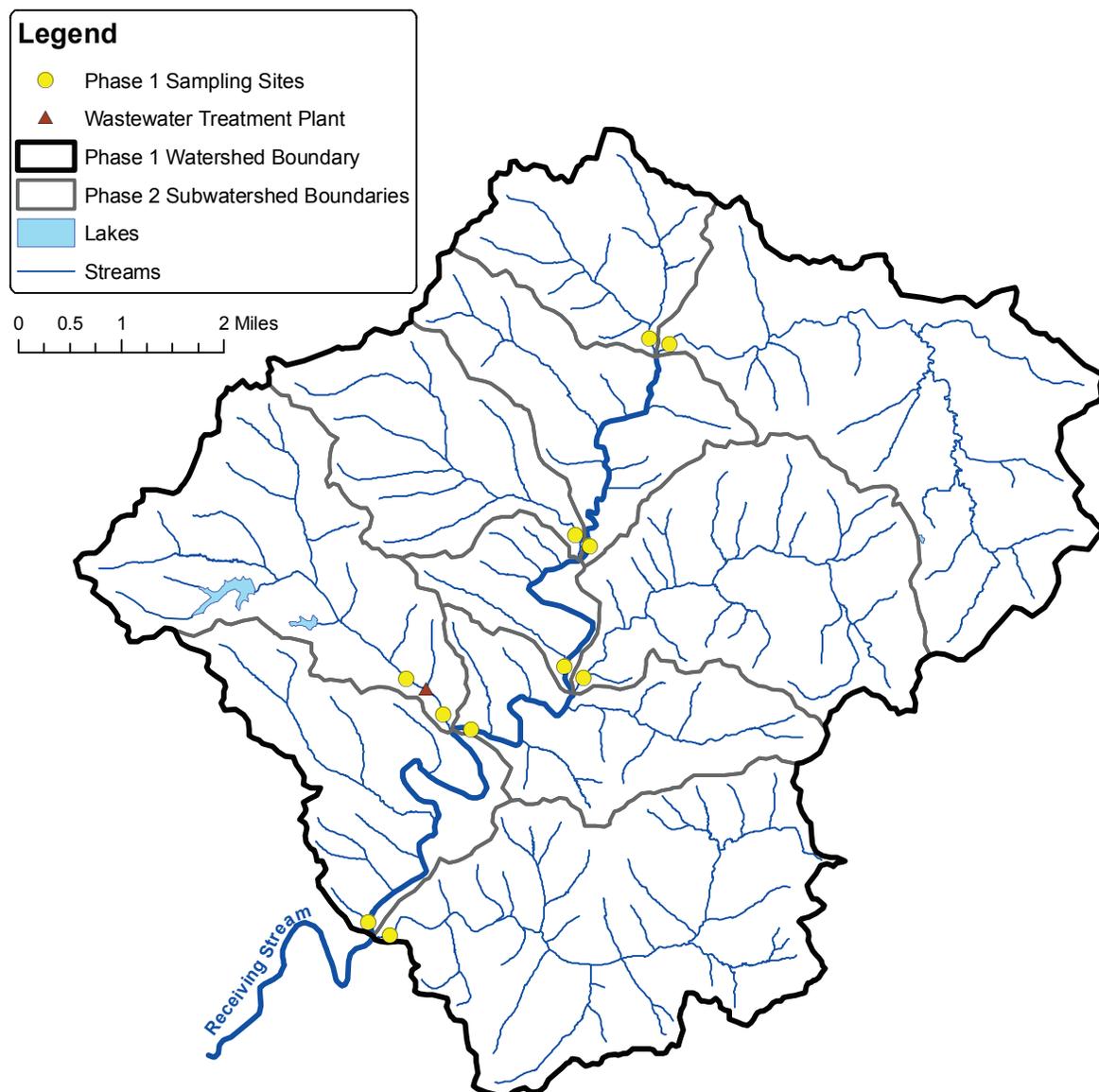


Figure 3.3 - Example Locations of Phase 1 Sampling Sites

Stream discharge and field data must be collected at each site for every sampling event. **Stream discharge** is the volume of water flowing past a fixed point in a fixed unit of time. This measurement is needed to analyze the **pollutant load** for each sampling site (see Section 4.2.1). For water flow in streams, the U.S. Geological Survey expresses the discharge value in cubic feet per second (cfs). Refer to Table 3.1 for details.

Samples should only be collected when there is visible flow between the pools of the stream. In dry months you may not be able to collect a sample at certain locations. If this becomes a regular occurrence at particular sites, then you should contact your Nonpoint Source Program Technical Advisor to discuss this issue. Remember, it is important to collect sufficient data to identify sources and target implementation efforts.

At a minimum, you must collect two wet weather samples (to identify nonpoint source pollution) and two dry weather samples (to identify point source pollution) for

each of the parameters identified in the "Parameters" section above. It is likely that the wet and dry weather samples will be captured through your regular monthly sampling. It is important to ensure that these events are captured within the sampling year, and this may necessitate collecting samples outside of a regular monthly schedule. A wet weather event is defined as a seven-day antecedent dry period (in which no more than 0.1 inch of precipitation occurs) followed by visible run-off conditions, such as sheet flow on impervious surfaces and visible surface flow in ephemeral channels. A dry weather event is defined as following a seven-day dry period, in which no more than 0.1 inch of precipitation occurs.

Safety First! Water Quality monitoring can pose a number of threats. It's always important to ensure that your monitoring locations are safely accessible. This is especially true when you collect wet weather samples. Never go out alone and always carry a cell phone or other communication device in case of an emergency. Also remember to dress appropriately. If you are sampling at a site with high bacteria levels, you do not want the water to come into contact with your mouth, eyes, cuts or any other vulnerable areas. Be sure to wear latex or vinyl gloves.

Ensuring that you collect both **wet weather and dry weather samples** will be helpful for analyzing the data to determine if the water quality issues are related to point or nonpoint sources of pollution. The Watershed Basics section explains the differences between point and nonpoint sources of pollution. Since a large percentage of nonpoint source pollution comes from runoff, wet weather samples that have high levels of pollutants may indicate a nonpoint source. If you see high levels of pollutants in the dry weather samples it may indicate a point source.

3.2.3 Phase 2 Monitoring

Phase 2 begins upon the selection of three or less prioritized sub-watersheds (e.g. HUC 14s) from the larger watershed you monitored and analyzed in Phase 1. The

purpose of monitoring at this scale is to target implementation in the sub-watersheds. The details below cover the prescribed scale, parameters, methods and frequency for the Phase 2 monitoring effort.

Scale

A number of factors can influence the quantity and location of sampling sites within the sub-watersheds. Budget may restrict the number of sites that you are able to sample. Hydrology, topography, and land use will direct the location of sampling sites. A generalized target is four or five sites within the sub-watershed. These sites must be evenly distributed throughout the watershed to help accurately determine sources. You should consider the following factors when selecting the location of monitoring sites:

- Stream flow at Phase 1 sampling site – During Phase 1 you monitored at the mouth of all sub-watersheds. If lack of flow was an issue with the Phase 1 site, it is likely it will be more of an issue for sampling sites located on smaller tributaries within the sub-watershed. It is important that you are able to collect enough samples to determine source and target implementation efforts. If you think obtaining the amount of samples required (detailed in the Frequency section below) will be problematic in your Phase 2 sub-watershed, contact your Nonpoint Source Program Technical Advisor to discuss alternatives.
- Hydrology and Topography – It is important that the monitoring locations subdivide the watershed to better determine the location of the source. In some watersheds this may be accomplished by monitoring the mouth of all major tributaries. In watersheds with steep topography and many small tributaries, you may not have the resources to monitor all of the tributaries. In this case you may have to monitor along the mainstem and target tributaries that are suspected sources.
- Point sources/Areas of local concern – Monitoring locations should also target point sources or areas of local concern. This includes sampling upstream and downstream of major point sources.
- Nonpoint sources – Monitoring locations should be placed in areas that capture the effects of different landuses within the watershed. For example, if your watershed is a mix of urban and agricultural lands, then your monitoring sites should be placed to show the contributions from these different areas.
- Original monitoring location from Phase 1 – Make sure to include the monitoring locations from Phase 1 that are located within your selected sub-watershed. This will provide you with two consecutive years of data for these sites

Figure 3.4 provides an example.

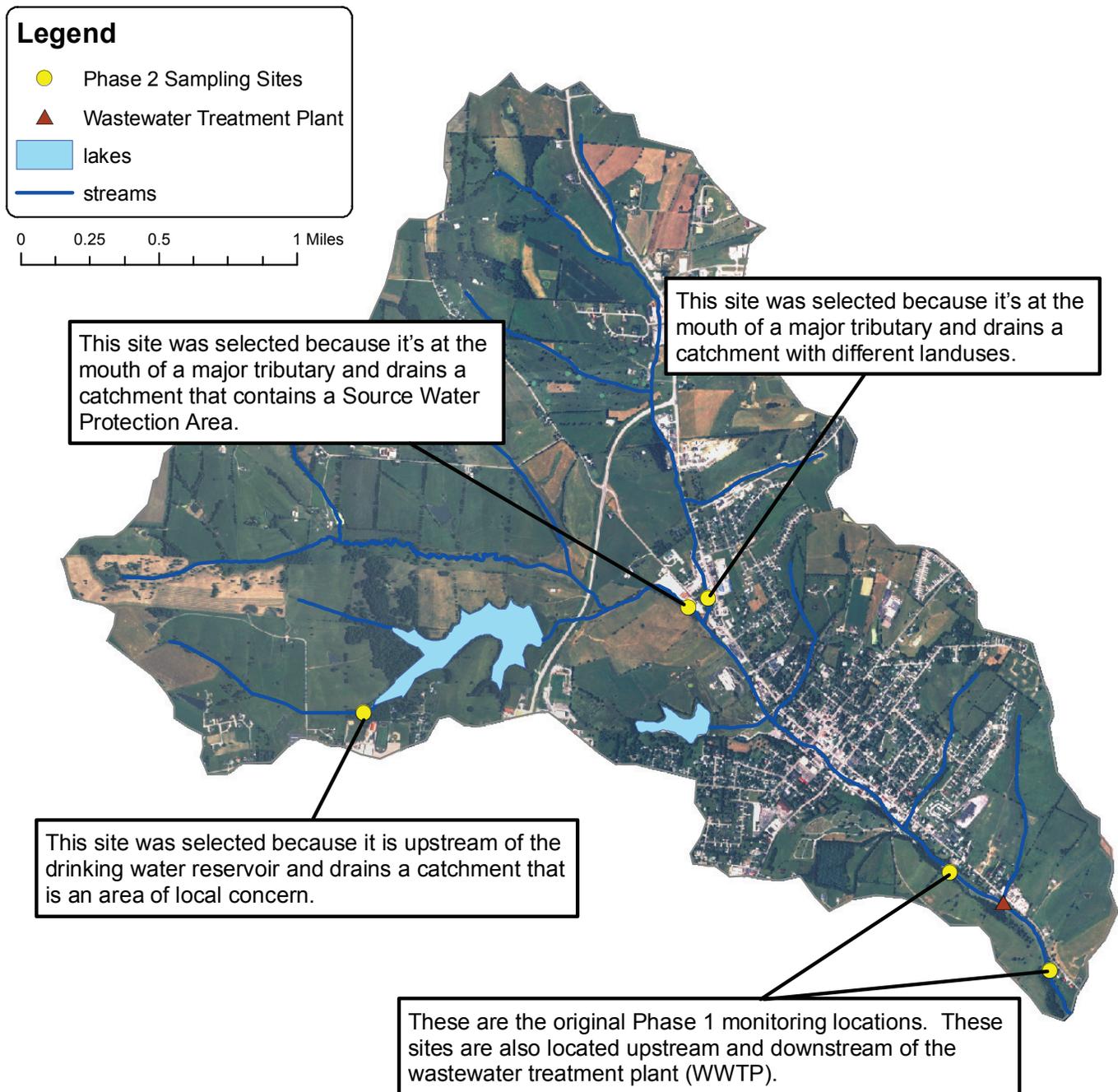


Figure 3.4 - Example Locations of Phase 2 Sampling Sites

Parameters

The Phase 1 monitoring results will help to determine the parameters that need to be monitored in Phase 2. Remember, the purpose of this monitoring effort is to better determine sources for targeted implementation. The location is important to determine where to implement BMPs, but you also need to know what types of BMPs should be used. The parameters monitored will help you make that decision. Therefore, all parameters that indicate problems or exceedances from Phase 1 must be monitored in Phase 2. Habitat and biological assessments must be performed in Phase 2 as well. Refer to Table 3.1 for details. In addition, Phase 1 may indicate the

need for the collection of additional parameters. You should consider the following factors:

- Any parameters of local concern- You may have knowledge of possible problems within the watershed. Parameters should be included that will better determine the source of these issues. For example, in Phase 1, the results may not indicate a problem for the selected watershed, but you know there have been recent complaints about straight pipes in one of the tributaries. Therefore, it may be necessary to collect parameters of local concern in addition to the other parameters.
- Additional parameters based on Phase 1 results – The parameters you collected in Phase 1 may have been limited due to resources. The analysis may have shown a problem that was not explained by the other parameters collected. If this is the case, then it may be necessary to collect additional parameters. For example, the field data may have shown high levels of conductivity. If you suspect that metals are an issue in the watershed, then you may want to collect metals.

Methods

The methods discussed in Phase 1 should be used in Phase 2 as well. Refer to Table 3.1 for details. However, based on data collected in Phase 1, you may realize the need for a more in-depth assessment. For example, at this point you may deem it necessary to perform a more detailed sediment or biological assessment that would use different methods than recommended in Phase 1. If this is the case, you should contact your Nonpoint Source Program Technical Advisor for further guidance.

Frequency

The frequency discussed in Phase 1 and outlined in the Watershed Plan Monitoring Table should be used for Phase 2. Based on data collected in Phase 1, however, you may realize the need for more frequent sampling. If this is the case, you should contact your Nonpoint Source Program Technical Advisor and discuss these options.

3.2.4 Other Monitoring Options for Non-319-Funded Watershed Plans

Monitoring can be a very resource-intensive process. Watershed planning projects that have limited funding will have a hard time conducting the level of monitoring discussed in the previous sections. However, there are other options for collecting additional water quality data. Although you may not require the level of quality assurance described above, you do want to take steps to insure that the data are accurate. One potential source of assistance is the Kentucky Watershed Watch program, which is an excellent volunteer monitoring network and can serve as a resource for this endeavor.



Active Options

The following provides a number of activities your planning team can perform to assist with the monitoring effort and to develop a better understanding of the monitoring program.

- Get your planning team to help with selecting the monitoring sites. Local knowledge is invaluable when you are determining your sampling sites.
- Drive out to your proposed sampling sites to make sure that they are easily accessible and safe. If any of the sites are on private land, schedule time to speak to the landowner about your planning effort and get their permission to sample on

their property. Visit the sites after a rain event to determine how you will safely collect your wet weather samples.

- Involve interested members of your planning team in the monitoring effort. Even if you have hired a contractor to collect the samples, members of your planning team can assist them with the monitoring. Getting people in the stream is a great way to increase their understanding. Your planning team can be a great help, especially for the biological data collection effort in Phase 2.
- Sign up to be a Watershed Watch volunteer for your basin. By doing this you will learn more about proper sampling techniques and your data will be added the large network of volunteer data collected throughout the state.
- Present your sampling results to your planning team throughout the sampling year. You may want to have an outdoor cookout after you've completed your "5 in 30" *E.coli* sampling to present the results to the local public.



Write It Down

Upon completion of this stage of the watershed planning process you will have selected your monitoring sites, designed your monitoring program and completed a phase of monitoring. You now need to document the following

items in your plan.

Learning More

Introduction

Provide a brief overview of the existing monitoring data that you have and the additional monitoring data needs. If you are developing a KY 319-funded watershed plan, be sure to explain the phase of monitoring that you completed at this stage of the planning process.

Provide an overview of your monitoring strategy.

- Include a map with all of the sampling locations clearly labeled.
- Discuss how you selected your monitoring locations.
- Provide a brief overview of the parameters collected, methods used and the sampling frequency. If you are developing a KY 319-funded watershed plan, reference your KDOW approved QAPP for details.

Describe any problems you encountered during the monitoring effort. For example, you should provide an explanation if it was an unseasonably dry year and you were unable to collect a number of samples. This information will be important for Chapter 4.

Include all of the qualified monitoring data results as an appendix. If you are developing a KY 319-funded watershed plan, these results should be thoroughly reviewed and properly flagged to ensure they meet the standards set forth in the KDOW approved QAPP.

Record Keeping

Remember you will have a great deal of information upon the completion of this chapter. You will not be including all of this in your watershed plan, but you need to maintain this information and keep it on file.