

CHAPTER 11: ELEMENT I. - MONITORING

The Deer Creek Watershed Management Plan reflects management measures that when implemented are intended to improve the water quality within the watershed. Monitoring programs will be designed to track the progress in meeting load reduction goals and attaining water quality standards. It is important to specify monitoring objectives that, if achieved, will provide the data necessary to satisfy relevant management objectives. The selection of monitoring plans, which include sites, parameters, and sampling frequencies, will be driven by agreed-upon objectives and will include feasibility factors such as site accessibility, sample preservation concerns, staffing, logistics, and costs. Measurable progress is critical to ensuring continued support of watershed projects, and progress is best demonstrated with the use of monitoring data that accurately reflect water quality conditions relevant to the identified problems. Because of natural variability, one of the challenges in water quality monitoring is to be able to demonstrate a link between the implementation of management measures and water quality improvements. Monitoring results will be used to collect baseline data and track long term changes in Deer Creek.

11.1 HISTORICAL WATER QUALITY MONITORING RESULTS IN DEER CREEK AND ITS TRIBUTARIES

Historical monitoring results documented high nutrient, *E. coli* and chloride concentrations in the Deer Creek watershed. Approximately 20% - 60% of the sources of *E. coli* in the watershed are from wildlife and other animals. MSD has progressed in reducing sanitary sewer overflows into area creeks and stormwater permits are addressing other human sources of *E. coli*. However, it is not feasible to remove wildlife and animal excrement as a source. Therefore, the management measures described in Chapter 5 that reduce these non-point sources of nutrients and *E. coli* are key to reducing these pollutant loads in the watershed. According to a 2010 USGS study of Metropolitan St. Louis streams, *E. coli* densities and loads typically were many times greater during storm events than at base flow, primarily because loading increased as a result of runoff that contain bacteria contributions from the numerous combined and sanitary sewer overflows within the study area, as well as contributions from nonpoint source runoff. [Occurrence and Sources of Escherichia in Metropolitan St. Louis Streams, October 2004 <https://pubs.usgs.gov/sir/2010/5150/pdf/sir2010-5150.pdf>]

11.2 ONGOING MONITORING OF WATER QUALITY IN DEER CREEK AND ITS TRIBUTARIES

Cooperative Stream Investigation (CSI) Project Monitoring Plans will be developed in cooperation with the Missouri Department of Natural Resources (MoDNR) and Missouri Botanical Garden (MBG) on an annual basis in subwatershed priority focus areas to monitor *E. coli* and other identified pollutants in Deer Creek and its tributaries. Project objectives, sampling locations, sampling parameters, sampling schedules, and Level 3 CSI trained Stream Team volunteers will be evaluated and selected by MoDNR and MBG staff annually based on 319 project implementation plans. Sampling methods for the selected parameters, sampling responsibilities, stream flow measurements, sample analysis, data reporting, and QA/QC will remain the same for subsequent CSI Project Monitoring Plans. The overall objective of each monitoring plan will be to collect water quality samples in relation to 319 project implementation within priority areas in the Deer Creek Watershed that are defined in Map 5-1 in Chapter 5, Section 5.4, Identifying Critical Areas.

Additional water quality monitoring data will be obtained from MSD, USGS, and other partners. Both internal and external sets of data as well as modeling will be used to assess present pollutant or baseline levels and future water quality trends to determine if water quality is improving and water quality standards or target levels are being achieved in the Deer Creek Watershed over time.

11.3 CURRENT COOPERATIVE STREAM INVESTIGATION (CSI) PROJECT MONITORING PLAN

11.31 PROJECT OBJECTIVES

This Deer Creek CSI project plan focuses on the collection of current water quality data from Deer Creek in St. Louis County, Missouri. Of specific interest are priority areas of Deer Creek and associated tributaries, which have been designated by the ongoing Deer Creek watershed 319 project. The following objectives were established for this plan:

1. Collect monthly samples for total phosphorus (TP) and total nitrogen (TN) from March 2021 through March 2022.
2. Collect monthly *E. coli* samples during the recreational season (April 1, 2021 – October 31, 2021).
3. Collect monthly chloride samples during November 2021 through March 2022.
4. Measure stream discharge in association with each sampling event.
5. Send TN, TP, and chloride samples to MoDNR's Environmental Services Program (ESP) for analyses using EPA approved/accepted standard methods.
6. Analyze temperature, conductivity, and water transparency as field parameters in conjunction with monthly samples. Analyses will use Missouri Stream Team, Volunteer Water Quality Monitoring (VWQM) Program procedures.
7. Use resulting nutrient and *E. coli* bacteria data to establish concentrations and loading prior to implementation of BMPs.
8. Use resulting chloride data to assess water quality.

11.32 SAMPLING SCHEDULE

Standard method nutrient samples and discharge measurements will be collected monthly from March 2021 – March 2022. Standard method *E. coli* samples will be collected from April 2021 – October 2022. Standard method chloride samples will be collected from November 2021 – March 2022. VWQM field analyses will occur in conjunction with each standard method sample collection. One set of duplicate samples will be randomly collected from one sampling station during each sampling event.

11.33 SAMPLING LOCATIONS

Sampling will take place at five locations in the headwaters of Deer Creek. This area has been designated as Deer Creek Priority Area 02 (DC-02). See Map 5-1 in Chapter 5, Section 5.4, Identifying Critical Areas.

There are three sampling stations on Deer Creek (WBID 4078) and two sampling stations on unnamed tributaries to Deer Creek (WBID 3960). See Map 11-1 of the Deer Creek 2021-22 CSI sampling locations below.



11.34 SAMPLING METHOD

Standard method samples for TP, TN, and chloride parameters, will be collected according to standard operating procedures (SOP) MDNR-ESP-001: Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations; and MDNRESP-005: General Sampling Consideration Including the Collection of Grab, Composite, and Modified Composites from Streams and Wastewater Flows. Each sample will be accompanied by an appropriate Chain-of-Custody, as detailed in MDNR-ESP-002: Field Sheets and Chain-of-Custody Record. Sample collection and Chain-of-Custody training will be provided to the volunteers by the ESP, VWQM Coordinator. Discharge will be measured following the SOP MDNR-ESP-113: Flow Measurement in Open Channels, and will be reported on the Chain-of-Custody. Training will be provided to the volunteers by the ESP, VWQM Coordinator. On the day of collection, nutrient and chloride samples will be delivered to a drop-off location for shipment to the Department's ESP for analyses. A memorandum of understanding has been developed between the Missouri Department of Health and Human Services to facilitate sample shipment to Jefferson City from sites throughout the state. Also on the day of collection, *E. coli* samples will be relinquished to a MoDNR Environmental Specialist with the ESP, Water Quality Monitoring Section (WQMS) at the Route 66 State Park office where there is a complete set of IDEXX equipment. The samples will be analyzed prior to the 8-hour holding time limit.

11.35 SAMPLING RESPONSIBILITIES

Use appropriate methods to collect and preserve monthly TP, TN, *E. coli* and chloride water samples for standard method analyses. Prepare equipment and perform field analyses of temperature, conductivity, and water transparency using VWQM methods. Record the data in the comment field of the Chain-of-Custody. Fill out appropriate sample information on the MoDNR's Chain-of-Custody. On the same day as collection, and prior to the designated pickup time, drop the nutrient and chloride samples at the courier locations for shipment to the Department's ESP. On the same day of collection, deliver the *E. coli* samples to a MoDNR Environmental Specialist with the ESP, Water Quality Monitoring Section (WQMS) at the Route 66 State Park office.

The Missouri Department of Natural Resources (MoDNR) will provide sample containers, chain-of-custodies for samples, training for TP, TN, and chloride sample collection and preservation, H₂SO₄ preservative for TP and TN sample preservation, training for performing stream discharge measurements following the SOP MDNR-ESP-113, Flow Measurements in Open Channels, training for proper chain-of-custody use, sample labels, shipping containers for shipping samples, and will pick up shipped samples at the Health Department Laboratory in Jefferson City.

11.36 STREAM FLOW MEASUREMENTS

When possible, monthly stream flow measurements will be taken during each sampling event. This will supplement USGS stream gauge discharge data for Deer Creek. The USGS gauge code for Deer Creek is 07010086 and its location is at the South Big Bend Blvd. Bridge, which is approximately 19.0-20.0 miles downstream from the study reach in WBID 4077. Although stream discharge is not necessary in locating sources of bacteria, it may prove useful in providing additional information for implementation activities or in calculating loading of nutrients, chloride, and *E. coli* concentrations.

11.37 SAMPLE ANALYSIS

Analyses of samples will follow two general approaches. One approach will use EPA approved/accepted standard methods; the other will use VWQM methods.

1. Standard Method Nutrient Analyses
 - 1.1. The standard analytical methods used by ESP for TP and TN analyses are:
 - 1.1.1. Total Phosphorus (USGS I-2650-03 – Modified by ESP)
 - 1.1.2. Total Nitrogen (USGS I-2650-03 – Modified by ESP)
2. Standard Method *E. coli* Analyses
 - 2.1. The standard method used by ESP for *E. coli* analysis is:
 - 2.1.1. The Missouri Department of Natural Resource's Standard Operating Procedure MDNR-ESP-109, Analysis of *E. coli* and Total Coliforms Using IDEXX Colilert and Quanti-Tray Test Method, based on EPA methods.
3. Standard Method Chloride Analyses
 - 3.1. The standard analytical method used by ESP chloride analysis is:

3.1.1. SM 4500 Cl- G; Mercuric Thiocyanate Flow Injection Analysis.

4. VWQM Method Analyses

4.1. At the time of sample collection for standard method analyses, water will be analyzed streamside using VWQM Program SOPs. Parameters to be collected include temperature, conductivity, and water transparency.

4.1.1. Temperature and conductivity will be analyzed using Hach Pocket Pro model meters.

4.1.2. Water transparency will be analyzed using a VWQM water transparency tube.

4.2. Applicable VWQM Program SOPs can be found at <http://www.mostreamteam.org/trainingmaterials-and-resources.html>.

11.38 DATA REPORTING

Data generated from CSI projects are collected for specific purposes. In order to meet the objectives of this project, data must be available for assessment purposes. The Deer Creek CSI Project data will be entered and housed in the ESP Laboratory Information Management System (LIMS). Results from discharge measurements will be reported as a field parameter on the appropriate MoDNR Chain-of-Custody. Since analyses for temperature, conductivity, and water transparency will utilize VWQM Program procedures, the results will be entered into the comment field of the Chain-of-Custody. Analytical results for TP, TN, E. coli, and chloride will be reported via the ESP LIMS. Analytical results for temperature, conductivity, and water transparency will be reported via the ESP LIMS. However, these results will be located as text in the comments field. Analysis will be charged to Labor Distribution Profile (LDPR) code, Volunteer Monitoring (FEVLM) and will automatically be provided to the Project Manager in the Water Protection Program (WPP). After receipt by the WPP, data will be entered into the Water Quality Assessment (WQA) database. A final report will be written by the ESP, VWQM Coordinator.

11.39 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Accurate and precise data is needed in any monitoring project. As part of quality assurance, one field audit will be conducted by the VWQM Coordinator. Additionally, standard QA/QC procedures incorporated into specific SOPs will be followed during the project and duplicate samples will be collected for nutrients, chloride, and *E. coli* during each sampling event. Training will be reviewed with volunteers, and the project plan will be updated as necessary.

To view the March 2021 – March 2022 Deer Creek Cooperative Stream Investigation Project Plan in full, see Appendix 11-A.

To view the results of the March 2021 – March 2022 Deer Creek Cooperative Stream Investigation Project, see Appendix 3-D Deer Creek Water Quality Monitoring Report 2021-22.

To view the April 2022 – April 2023 Windrush Creek Cooperative Stream Investigation Project Plan in full, see Appendix 11-B.