MISSISSIPPI RIVER BASIN INITIATIVE (MRBI)
Storm Water Monitoring Protocol for Edge of Field Monitoring (Tier I)
Developed July 2010

To date, there has been no national guidance on storm water monitoring at edge of field for MRBI. In order to develop payment scenarios and obtain usable information, a protocol is necessary. The following protocol is for storm water monitoring activities conducted for the MRBI under conservation practice standard Interim 799 Monitoring and Evaluation. The protocol was developed during the conservation practice payment schedule scenario determination.

The protocol is based on The Technology Acceptance Reciprocity Partnership (TARP) Protocol for Stormwater Best Management Practices Demonstrations, in field water quality research project, municipal combined sewer overflow (CSO) and storm water flow monitoring publications.

Flow Measurement:
The type of flow measurement device must be matched to the intended conditions of the installation and the peak flow values. The device must also be capable of operating in remote locations with minimal over site. The literature identified flow measurement devices and the type of application:

1. Portable Area – Velocity Flowmeter with data logging. This device uses a submerged ultrasonic sensor to continuously measure both velocity and level in a channel or pipe. The sensor has no moving parts and is resistant to fouling with debris. The minimum depth is 1 inch for measurement. Therefore, the device is appropriate for use in a pipe or channel such as found on a terrace UGO or water sediment control basin outlet pipe that has a quick increase and decrease in flow. It is not an appropriate device for field drainage tile outlets or outlets with low flow (sustained flow less than 1 inch in depth). The device will have data logging capability for 15 minute recording interval for a minimum of 30 days.

2. Portable Ultrasonic Level Measurement with data logging. This device uses a downward facing, non-contacting ultrasonic sensor for sensing flow over a weir or in a flume. The sensor is attached in a fixed location and measures the distance between the sensors location and the water level. The device is programmed to use the level data to calculate and record the flow for typical weirs and manufactured flumes. The device requires a weir or flume for it to function as a flow meter. The weir or flume will be chosen based on the anticipated peak flow of the site. The device will have data logging capability for 15 minute recording interval for a minimum of 30 days.

3. Portable Bubbler or Transducer Level Measurement with data logging. This device uses a pressure sensor for sensing water depth over a weir or in a flume. The sensor is attached in a fixed location and measures the water level's corresponding hydrostatic pressure. The device is programmed to use the level data to calculate and record the flow for typical weirs and manufactured flumes. The device requires a weir or flume for it to function as a flow meter. The weir or flume will be chosen based on the anticipated peak flow of the site. The device will have data logging capability for 15 minute recording interval for a minimum of 30 days.

Sample Collection:
Sample collection of storm water runoff events will be performed by a portable, automatic sampler utilizing a peristaltic pump. The device must be capable of operating in remote locations with minimal oversight. The sampler will have flow sensing capabilities and programmable sampling criteria (time, flow based, etc.). The sampler will have capacity for 24 each 1 liter bottles and sequential sample mode. It is anticipated that 30 runoff events will be sampled per year. The minimum sampling year will begin on March 1 and end on November 30.

The sampling protocol for each runoff event is designed to capture the "first flush" and still obtain a sample for 21 hours. The sampler will collect 4 sequential periods per runoff event (4 * 30 = 120 samples per year). The sequential time based samples will be a composite of subsamples in the following order:

Bottle 1 – 1 hour with 25 ml every 5 minutes. Approximately 300ml.
Bottle 2 – 4 hours with 25 ml every 15 minutes. Approximately 400ml.
Bottle 3 – 6 hours with 25 ml every 15 minutes. Approximately 600ml.
Bottle 4 – 10 hours with 25 ml every 15 minutes. Approximately 1000ml.

The sampler's 24 bottles will allow 6 runoff events with 4 timeframes to be sampled. Servicing the sampler includes labeling and shipping the samples for analysis. The label will include the length of composite (1hr, 4hr, 6hr, 10hr), date of runoff event, and the initials of person handling the sample. A logbook will be kept for each sampler to record the condition of the sample bottles and corresponding label. The logbook will also be used to describe activities with flow meter system and weather station. The entries in the logbook will indicate all equipment is functioning correctly or identify any malfunction, break down, or other issue that can impact the sample collection or analysis.

Sample analysis parameters:
The collected samples will be analyzed for the following components:

Total Suspended Solids
Total Dissolved Solids
Ammonia – N
Organic Nitrogen – N
Nitrite / Nitrate – N
Soluble Phosphorus (Orthophosphate)
Total Phosphorus

The samples will be analyzed by following standard laboratory procedures, such as Standard Methods for Examination of Water and Wastewater. When the ambient high temperature is 70 degrees Fahrenheit (F) or above the samples will be removed from the sampler within 48 hours after the runoff event and sent for analysis or cooled to 40 degrees F and stored until the next lab submittal date. Samples will be submitted to the laboratory for analysis, at a minimum, every 30 calendar days starting March 31 (sampling started March 1) and ending November 30.

Laboratory results will be summarized in a Microsoft compatible electronic report. The report will include the raw data from data loggers and laboratory analysis results. The final report will include flow based mass loss determination for the project for the baseline condition and after conservation practice installation in order to determine effectiveness of the installed practices.

Weather Data:
Weather data collection will be coordinated with edge of field sampling process. The minimum weather data will be rainfall volume and intensity as recorded by a tipping bucket rain gauge. The tipping bucket rain gauge will have data logging capabilities or be connected to a data logger. For example, the Isco auto-sampler has capability to connect a tipping bucket rain gauge to the sampler's logic controller.

Monitoring Plan:
Each EQIP contract participating in the MRBI with Interim Conservation Practice Standard (799) Monitoring and Evaluation will develop a monitoring plan (contract monitoring plan). The monitoring plan will comply with the standard and be utilized to identify the appropriate conservation practice payment schedules for interim practice 799 for contract purposes. The monitoring plan will be used to identify the activities that will be performed, on an annual basis, to comply with contract time lines and identify when an activity has been completed so payment can be requested.

References:

1. Technology Acceptance Reciprocity Partnership (TARP) Protocol for Stormwater Best Management Practices Demonstrations. This document outlines sampling criteria in order to obtain uniform, comparative results. The protocol for Missouri MRBI does not follow the TARP protocol to the letter due to funding consideration.

2. High Accuracy CSO and Stormwater Flow Monitoring, Terrance Burch and Joanna Phillips, Accusonic Technologies. The document describes the appropriate application of flow monitoring devices.

3. A Framework for Water shed and Edge of Field Monitoring, Including Environmental Indicators, MRBI Website. This document is too general without a specific protocol. The same issue was found when evaluating ARS projects.

4. USGS Discovery Farms, specifically Soaring Eagle Dairy, Wisconsin. The Soaring Eagle Dairy has done a good job document their activities. The information included in the documentation was not adopted because it did not separate the different sources of runoff and subsurface flow (drain tiles).

5. Standard Methods for the Examination of Water and Wastewater, 18th Edition. The sample handling information is based on this document. The protocol does not follow Standard Methods to the letter due to funding considerations.

6. Urban Stormwater BMP Performance Monitoring, EPA, April 2002. This document was used to develop general outline for Missouri MRBI protocol.

7. Basic Requirements for Collecting, Documenting, and Reporting Precipitation and Stormwater-Flow Measurements, USGS Report 99-255. The document was used to develop general outline for Missouri MRBI protocol.

8. Interim Conservation Practice Standard (799) Monitoring and Evaluation, Feb. 2010, NRCS. The document was used to develop general outline for Missouri MRBI protocol.

9. Teledyne Isco, Lincoln, NE. Manufacturer's literature used to establish specifications.