Memorandum

To: Lower Mississippi River Watershed Management Organization Board of Managers
From: Greg Williams and Janna Kieffer
Subject: Summary of Stream Monitoring Options for LMRWMO Creeks
Date: September 5, 2018
Project: 23190078.18
c: Joe Barten, LMRWMO Administrator

This memorandum is provided in response to the Board of Manager’s request for additional information about stream monitoring voiced at the Lower Mississippi River Watershed Management Organization’s (LMRWMO) April 11, 2018 meeting. Monitoring the flow and water quality of streams is performed for a variety of reasons and provides a range of benefits. The intended objectives of stream monitoring impact the scope of the monitoring, which may range from periodic visual inspection of streambank conditions to real-time flow monitoring and automated water quality sampling. This memorandum summarizes the scope and benefit of potential stream monitoring activities that may be considered by the LMRWMO.

Background
Streams within the LMRWMO include Interstate Valley Creek, Ivy Falls Creek, Marie Creek, and Simon’s Ravine (Kaposia Creek). None of these streams are included in the Minnesota Public Waters Inventory (PWI). Interstate Valley Creek, Ivy Falls Creek, and Simon’s Ravine (Kaposia Creek) are included as “unnamed streams” in the Minnesota Department of Natural Resources’ (MNDNR) river and stream inventory and are classified in that inventory as intermittent (i.e., not flowing year-round). Interstate Valley Creek is listed by the Minnesota Pollution Control Agency (MPCA) as impaired for recreational use due to E. coli. This impairment is specifically addressed in the Upper Mississippi River Bacterial TMDL Implementation Plan (MPCA, 2016).

The MPCA’s Environmental Data Access (EDA) website identifies the following past monitoring locations along Interstate Valley Creek, Ivy Falls Creek and Simon’s Ravine (Kaposia Creek):

<table>
<thead>
<tr>
<th>Waterbody</th>
<th>Monitoring Type</th>
<th>Station ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivy Falls Creek</td>
<td>Chemistry</td>
<td>S007-242</td>
<td>Downstream of MN-13; sampled 16 times in 2012</td>
</tr>
<tr>
<td></td>
<td>Biological</td>
<td>99UM077</td>
<td>Sampled once in 1999</td>
</tr>
<tr>
<td>Interstate Valley Creek</td>
<td>Chemistry</td>
<td>S006-139</td>
<td>Off Lilydale Road; sampled 41 times from 2010-2013</td>
</tr>
<tr>
<td></td>
<td>Biological</td>
<td>99UM078</td>
<td>Sampled once in 1999</td>
</tr>
<tr>
<td></td>
<td>Biological</td>
<td>99UM079</td>
<td>Sampled once in 1999</td>
</tr>
<tr>
<td>Waterbody</td>
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<tr>
<td>Citizen Monitoring¹</td>
<td>S014-991</td>
<td>Unnamed Creek in Valley Park; sampled 19 times in 2017</td>
<td></td>
</tr>
<tr>
<td>Simon’s Ravine (Kaposia Creek)</td>
<td>Chemistry (transparency only)</td>
<td>S004-724</td>
<td>East of US 52; sampled 20 times from 2007-2008</td>
</tr>
<tr>
<td>Biological</td>
<td>99UM083</td>
<td>Sampled once in 1999</td>
<td></td>
</tr>
</tbody>
</table>

(1) includes transparency, temperature, and subjective assessment of physical appearance and recreational suitability.

In addition to the monitoring events referenced in the above table, the MPCA collected flow and *E. coli* data on Interstate Valley Creek between 2007 and 2011 as part of the development of the *Upper Mississippi River Bacteria TMDL Study & Protection Plan* (MPCA, 2014).

**Benefits of Stream Monitoring**

Data collected from stream monitoring can have many benefits, including, but not limited to:

- Establishing baseline conditions and tracking changes or trends in water quality, flow, or ecology;
- Identifying priority areas for protection or restoration activities;
- Assessing impacts of watershed projects or programs to reduce runoff and/or pollutant loading;
- Assessing water quality relative to applicable local and state standards (including de-listing of impaired waterbodies); and
- Characterizing the cumulative impact of land use in upstream drainage areas.

The goals of a stream monitoring program will dictate the parameters and scope of that program, including types of data collected, frequency of sampling, and spatial location of sampling sites. For example, the Metropolitan Council’s Watershed Outlet Monitoring Program (WOMP) includes continuous monitoring of flow, select water quality parameters, and periodic water quality grab samples at the downstream end of larger stream watersheds. This data is especially useful for characterizing the overall condition of the watershed, but may not provide spatial resolution to identify particular pollutant “hot spots.”

**Types of Data Collected**

**Hydrologic Data**

Streamflow (or discharge) is a function of the quantity of water in the stream and the rate (i.e., velocity) that the water is flowing. High stream flows can alter the physical stream and increase risk of flooding. Streamflow also affects water quality. High flows can cause higher turbidity because of increased erosion and resuspension of sediments, while low flows can result in increased temperature, decreased oxygen, and other conditions unfavorable for aquatic organisms.
Streamflow is typically measured indirectly by measuring stream stage (i.e., elevation) at a defined cross section and converting the stage to flow using a “rating curve” developed from a series of site visits where stage and flow are manually measured. Data loggers may collect continuous stage/flow data, or periodic “point measurements” can be made. Continuous flow data is more useful than point data in attempting to characterize stream impacts, but requires that equipment be installed and periodically maintained at monitoring locations.

**Water Chemistry Data**

Water chemistry data includes measurement of pollutants or other constituents in the stream. Pollutants of concern to watershed management organizations often include phosphorus, sediment, chloride, and bacteria such as *E. coli* or fecal coliform. The MPCA has established water quality standards for many of these constituents (see Minnesota Rules 7050), including stream eutrophication water quality standards adopted in 2015. Water chemistry data also includes parameters such as temperature, pH, dissolved oxygen, turbidity, and specific conductance. Some water quality parameters, such as temperature and specific conductance, can be measured continuously in-situ using instruments attached to streamflow monitoring equipment. Other parameters, such as phosphorus and chloride, must be collected as “grab samples” and analyzed in a laboratory.

Water chemistry can vary significantly with hydrologic conditions and time of year (e.g., chloride concentrations are typically highest in spring; bacteria concentrations may be high following large storm events). Because of this variability, water chemistry grab samples are often collected at specified intervals as well as during specific hydrologic conditions, such as during low flow or following storm events. Parameter concentrations are often presented as a function of flow percentile (e.g., 1% equates to flows exceeded only 1% of
Monitoring programs modeled after the Metropolitan Council's WOMP typically collect between 16 and 20 grab samples per year. The figure below provides an example of E.coli concentrations in Interstate Valley Creek as a function of flow (MPCA, 2014)

**Biological Data**
A primary function of many streams such as those in the LMRWMO is ecological – a place for fish and aquatic life to live. Biological data collected through surveys is often used to characterize the ecological health of streams. Ecological health is, in turn, an indicator of overall water quality.

**Macroinvertebrate Surveys**
Evaluating benthic macroinvertebrates (bottom-dwelling aquatic organisms, mainly insects) in a stream provides a long-term assessment of its water quality. The benthic invertebrates are exposed to all of the temporal variations in stream water quality and ‘integrate’ the quality of passing water. Therefore the presence or absence of pollutant-tolerant organisms demonstrates the water quality impacts of urban runoff better than grab samples of water flowing in the creek. The inventory of benthic organisms also indicates whether there is a suitable food supply for fish.

Macroinvertebrate surveys are performed by disturbing the creek bottom and allowing dislodged invertebrates to drift into a net downstream. The presence and number of particular organisms are recorded. Macroinvertebrate data may be used to calculate a "score" using the Macroinvertebrate Index of Biological Integrity (MIBI) or other indices. Because macroinvertebrate communities are dependent upon local stream geomorphology, sites are often monitored once per year over several years to assess temporal trends.

**Fish Surveys**
Similar to aquatic macroinvertebrate, fish communities are an indicator of overall water quality. Fish surveys in streams are often performed using electro-shocking methodology over a defined reach of the stream. Electro-shocking is generally non-lethal to fish and methods are designed to minimize mortality, but not all specimens survive sampling and processing. Fish survey data may be used to calculate a Fish Index of Biological Integrity (FIBI).

Sampling is typically performed when streams are at or near base-flow because flood or drought events can have a profound effect on fish community structure and sampling efficiency. Fish surveys in streams such as Ivy Falls Creek and Interstate Valley Creek may have limited value based on their intermittent flow conditions.
Physical Data

Physical stream conditions are typically assessed by walking reaches of the stream and recording the presence or absence of specific conditions. Conditions evaluated in physical stream surveys may include, but are not limited to:

- Streambank erosion or failure;
- Pollutant sources (e.g., pipe outlets);
- Streambank vegetation;
- Bottom scouring;
- Bottom substrate;
- Pool/riffle ratios and lengths; and
- Aesthetics.

These and other features may be measured qualitatively, semi-quantitatively (e.g., on a scale from 1 to 5), or quantitatively (e.g., length of eroded streambank, in feet). Physical characteristics may be evaluated individually or combined into an overall stream quality score. Physical stream surveys may be performed once to establish baseline conditions and identify potential project locations, or on an annual or semi-annual basis to assess the progression of specific issues identified by the survey.

Data regarding the physical condition of the stream may be less costly to obtain than other types of data due to simpler analytical methods and absence of laboratory analysis. The qualitative nature of physical stream data, however, may limit its application in assessing overall stream health, and physical stream data is most valuable when evaluated alongside concurrent flow, water quality, or biological data.

Discussion

Interstate Valley Creek, Ivy Falls Creek, Marie Creek and Simon’s Ravine (Kaposia Creek) drain significant portions of the LMRWMO and include tributary area from the Cities of Inver Grove Heights, Lilydale, Mendota Heights, South St. Paul, Sunfish Lake, and West St. Paul. Limited amounts of chemical, biological, and flow data have been collected for Interstate Valley Creek, Ivy Falls Creek, and Simon’s Ravine (Kaposia Creek). The LMRWMO Watershed Management Plan (2011, amended 2015) identifies lack of stream data as a problem area and includes actions related to stream monitoring.
From LMRWMO Plan (page 4-2):

**Problem 4.1.C:** There is not enough data to understand the quality of water reaching the Mississippi River through stormwater outfalls and streams.

**Approach for Addressing Problem 4.1.C:** The WMO will work with member cities to develop a monitoring program to monitor select outfalls to the Mississippi River. Monitoring will be determined annually and by the WMO budget. This monitoring effort will help identify point source locations for pollutant loadings to the river and will help establish high priority areas for water quality improvements and BMP implementation. This will also help identify the most cost-effective locations to construct water quality capital improvements.

The LMRWMO Plan includes the following as a WMO strategy 5.3.2-E (page 5-8):

The WMO will monitor select storm sewers and streams that outlet to the Mississippi River. Prioritization of storm sewers and streams will be determined annually and by the WMO budget. Monitoring parameters should be consistent with downstream impairments and may be modified at the discretion of the Board. Possible parameters include: Total Phosphorus, PCBs (Polychlorinated biphenyls), PFOS (Perfluorooctane sulfonate), Fecal Coliform, Turbidity, and Dissolved Oxygen.

Since 2013, monitoring of LMRWMO creeks has been limited to citizen monitoring of Interstate Valley Creek beginning in 2017. Characterizing the current physical, chemical, and/or biological condition of streams would be useful in identifying and prioritizing issues to be addressed in the 2021-2030 LMRWMO Watershed Management Plan. As a starting point, we recommend that the Managers consider conducting physical assessments of LMRWMO streams to better understand the stream systems within the watershed and the current physical condition of these resources. This would involve a physical stream survey (i.e., walking the stream) and summary report documenting findings and recommendations. Following this step, the Managers may have more informed discussions of stream monitoring objectives and approaches to achieve these objectives.