

7. Monitoring Plan

The primary goal of monitoring is to provide information to support future resource management decisions. These decisions may be based on comparison of monitored conditions to standards, changes detected from completed restoration and protection measures, or changes in watershed land uses or long-term climate changes. The ability to detect such changes in water quality and the reliability of comparisons depend upon the nature and design of the monitoring program.

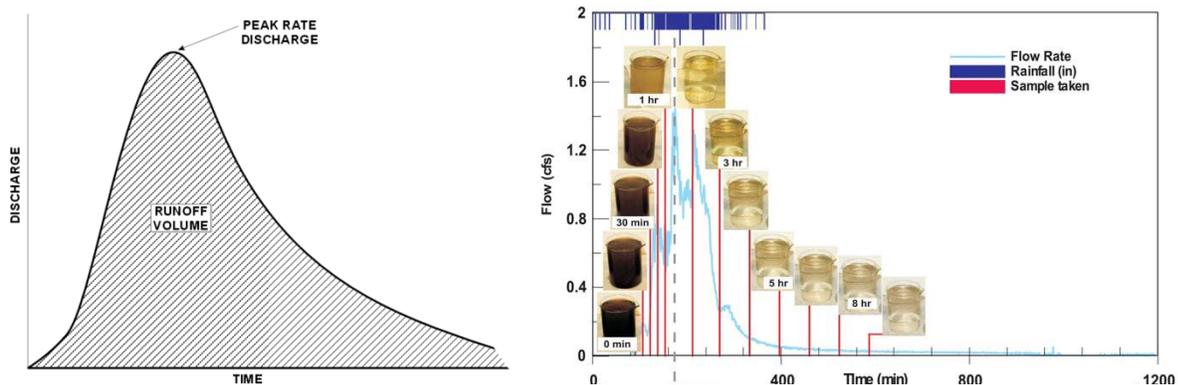
An intense monitoring effort over several years is recommended to adequately assess pollutant loading and to detect trends. Trend monitoring should be conducted at the USGS flow gauging station at Ames, IA (Station 05470500) as the long-term primary site. Upstream secondary stations can be added over time in a leap-frog method of identifying hot spots or areas of relatively good water quality.

7.1. Flows

The first and most important step is to characterize the creek's flows over time – how much water flows each day, month and year. Since pollutant loads (such as pounds of sediment or phosphorus per year) are calculated by multiplying stream flows by sampled pollutant concentrations this requires measuring continuous stream flows. This is done by use of computerized flow gauging stations that record the depth of the stream every 15 minutes or so. The depth of the stream is converted into stream flows based upon mathematical relationships derived from numerous measurements of flows and depths across the stream channel each year. The USGS (the nation's stream monitoring experts) maintains a continuous flow gauging site at the Ames, IA (Station 05470500) that can be utilized. Additional flow stations described in the Stream Water Quality section can also be used when assessing other reaches of the stream or tributaries.

7.2. Pollutant Concentrations

The next step is sampling of pollutant concentrations. This could be accomplished by Iowa State students, City of Ames staff or trained volunteers. Typically, the majority of annual loads occur during high flows (storm events and times with the highest monthly flows which for Squaw Creek are March-July). To adequately characterize water quality it is recommended to collect at least 25 samples per year. The samples should be collected during all seasons with a primary focus on high flow events and time periods. Automatic flow-paced sampling should be used to monitor water quality. This will allow for sampling of each storm event's rising and declining limbs of the storm hydrograph (peak and recession of flows). The below figures depict the general concept of storm event sampling. Rising water levels at the beginning of a storm typically have higher pollutant concentrations that decline with receding water levels. If funding is not available (or until funding becomes available) grab sampling could be done at the USGS station with recording of instantaneous river gauge height, date and time noted for each sample. Multiple grab samples would need to be taken over the course of a storm event. Monitored pollutants should include; total phosphorus, soluble reactive phosphorus, total suspended solids, nitrate-nitrogen.

Figure 7-1 Visualization of water quality over course of storm event

Graphics courtesy of Pat Baskfield, MPCA.

All samples should be analyzed by one certified laboratory familiar with these parameters and supporting standard EPA laboratory quality assurance methods including low level detection/reporting limit (e.g. less than 10 ppb) capabilities for total phosphorus and soluble reactive phosphorus. The laboratory should report analytical results via electronic spreadsheet format within ~14 days of sample receipt. The initial samples should be closely examined within this time period for reasonableness and laboratory detection limits.

7.3. Bacteria (*E.coli*) Monitoring

Bacteria monitoring should also be done at the USGS Primary Site at Ames. For comparison to standards, sampling should occur at least 5 times per month per site, from April through October, to obtain geometric mean concentrations for comparison to Iowa *E.coli* standards. A certified analytical laboratory should be used for all samples. Standardized sampling protocols have been established for monitoring *E. coli* in streams.

7.4. Biological Monitoring

It is recommended that biological monitoring be conducted in the Squaw Creek Watershed as a way to evaluate water quality trend. The biological monitoring protocol should ensure long-term stream health trends can be interpreted as well as a data set that can be used to target stressors.

7.5. Compiling the Data and Calculating Loads

The end result of the intensive monitoring is the calculation of water flows and nutrient/sediment losses from the land expressed as loads or pounds of phosphorus or sediment per acre per year. Wet years can have larger losses that may need to be adjusted for rainfall for inter-year comparisons (pounds P /acre/inch of precipitation). Very large storms can be expected to produce large amounts of runoff and associated pollutants and hence, the emphasis should be on evaluating average values for more typical years.

The more intensive trend monitoring data requires more rigorous compiling of continuous daily flows along with the sampling data for calculation of loads such as with the USACE's FLUX32 software. Sample

file formats can be provided to facilitate data reduction. Chronic and acute standard exceedances (E.coli and dissolved oxygen) and loads can be assessed along the flow network stations identifying areas of concern or improvement over time. This could include adjustment for climatic conditions. Urban and agricultural BMP can also be assessed directly by monitoring of representative stormwater discharges with automated equipment.

7.6. Future Phased Monitoring Approach:

Upstream tributaries can be added to the monitoring effort in the future to support modeled predictions of watershed hot spots, determine compliance to water quality standards; and to conduct detailed stream loading. Monitoring data could also be used to evaluate the performance of upper watershed areas from restoration efforts.

In the future it is recommended that priority consideration be given to monitoring Squaw Creek above the confluence of Montgomery/Prairie Creeks and Squaw Creek above the confluence of Onion Creek.

Secondary stations should be added further upstream on the mainstem of Squaw Creek. Secondary sites should have water level staff gauges installed and be periodically flow-gauged for correlation with downstream Squaw Creek flows. This would provide a cost savings but still require intensive grab and automatic flow-paced sampling. This is a kind of leap-frogging of stations is used to identify high and low loading watershed areas.

