

Date | May 7, 2012

To | Mike Vavricka

Contact info |

cc |

Contact info |

From | Nancy-Jeanne LeFevre

Contact info |

Cecilio Olivier

Regarding | Observed Water Quality Data per Task 4.2 of the Mustinka River (09020102) & Bois de Sioux River (09020101) HSPF Model Work Plan

This memo illustrates the available water quality data and the recommended approach for their use in calibration. Files associated with this deliverable have been included in the emailed submittal. Please provide feedback at your convenience, but no later than Monday, May 28th, if possible.

Observed Water Quality Data Assessment

Data Assessment Methods and Organization

Observed water quality data were retrieved from BASINS (USGS and EPA's STORET) and from the EQuIS data download provided by MPCA. Data have been assessed for number of samples and period of record. The assessment is summarized in the enclosed Excel spreadsheet (Recommendation for EQuIS_STORET_USGS 5-4-2012.xlsx), and stations are mapped in Figure 1 (also enclosed as wq_stations.jpg).

The spreadsheet data summary has been organized as follows:

- Three worksheets summarize data separately for EQuIS, USGS, and STORET.
- Constituents in **bold** are expected to be useful for water quality calibration and validation and are those constituents associated with sediment, nutrients, and dissolved oxygen. Specifically:
 - Carbon, organic
 - Chlorophyll *a*
 - Dissolved oxygen (and DO saturation)
 - Nitrogen:
 - Ammonia-nitrogen (N)
 - Ammonia as NH₃
 - Inorganic nitrogen (nitrate + nitrite)
 - Kjeldahl nitrogen
 - Nitrite
 - Phosphorus
 - Total phosphorus
 - Orthophosphate
 - Solids
 - Particle size, Sieve No. 230, 250 mesh (0.063 mm)
 - Total suspended solids
 - Total volatile solids
 - Dissolved solids
 - Total solids
 - Temperature

- Constituents deemed inappropriate for use in calibration or validation have been *hidden* (e.g. lake physical appearance, nickel, etc.). In addition, some very low frequency station locations for the period (1995-2009) have been removed from this summary:
 - USGS: 41 out of 44 locations were removed from analysis because no single constituent was sampled more than twice (and many only once).
 - STORET: 5 out of 12 locations were removed from analysis because no single constituent was sampled more than twice (and many only once).
- Constituents that we perceive MPCA may wish to review for inclusion in calibration and validation are *not* in bold (and are *not* hidden).
- Shading is used to identify those sites and individual constituents having high sample frequency. The determination of high frequency differs by data source (high frequency sites are also identified in Figure 1):
 - EQuIS
 - No shading: < 15 samples per individual constituent
 - Light pink: 15 – 49 samples per individual constituent
 - Dark pink: 50 or more samples per individual constituent
 - STORET
 - No shading: < 10 samples per individual constituent
 - Light blue: 10 – 14 samples per individual constituent
 - Dark blue: 15 or more samples per individual constituent
 - USGS
 - No shading: < 10 samples per individual constituent
 - Light blue: 10 – 29 samples per individual constituent
 - Dark blue: 30 or more samples per individual constituent

Summary of Findings

Overall findings regarding water quality data availability are as follows:

- EQuIS has the overwhelming majority of data; USGS & STORET (from BASINS) have much less data, but some.
- The overwhelming majority of data is from the period 2001-2009.

Deliverables: EQuIS_STORET_USGS 5-4-2012.xlsx, wq_stations.jpg

Proposed Approach for Water Quality Calibration and Validation

We will be using a calibration period of 2001-2006 and a validation period of 1995-2000. Table 1 identifies the proposed stations from which data would be used for water quality calibration and validation. Of particular note is the paucity of data for the validation period (1995-2000). Fortunately, meteorological data in BASINS was just released (April 18, 2012) for the period from 2007-2009. While it does not seem prudent to process it at this stage of the hydrologic calibration, we propose incorporating it in the next phase of the project, thereby having a validation period (2007-2009) for which there is sufficient water quality data¹. Could this period (2007-2009) be used exclusively for water quality validation? This memo will refer to validation during the period from 2007-2009 as the *optional validation*.

Summary of findings with respect to calibration, validation, and optional validation:

- For streams, there is very little data for validation within the 1995-2000 period – one location has a small watershed but just one year of data (384068 in 1996), two locations are on the Bois de Sioux River. On the other hand, there is sufficient data for calibration and optional validation in the 2001-2009 period. The proposed sites (identified in Table 1) include, among others, sites that coincide with three of the four USGS flow calibration sites plus a BdSWD flow calibration site.
- For lakes, there is no available data that is sufficient for calibration and validation (1995-2006 period). There is sufficient data only for optional validation (2007-2009 period) (refer to Table 1).

Calibration and validation are expected to be undertaken using discrete sample concentration data initially. It is apparent that FLUX modeling opportunities are limited to continuous flow stations that have water quality data. Three locations have USGS flow stations with a long period of record and water quality data. One of these three locations has flow that is primarily growing season data (a.k.a. non-continuous) (USGS Station 54017001), which precludes appropriate use of FLUX modeling. The two remaining sites are either on the mainstem Bois de Sioux River or near the mouth of the Mustinka River, rather than higher in the watershed. We propose selecting strategic water quality constituents for FLUX modeling (for calibrating to loading values) only after initial parameterization and sensitivity analysis of the water quality component of the model and taking into consideration the location of the candidate FLUX modeling stations.

Deliverables: Site selection and proposed approach to water quality calibration and validation as presented here

¹ Since the recently released BASINS meteorological and flow data is more recent (2007-2009), it could be used in Phase 2 for an additional, though abridged, hydrology validation period. We hope to discuss this option with you soon.

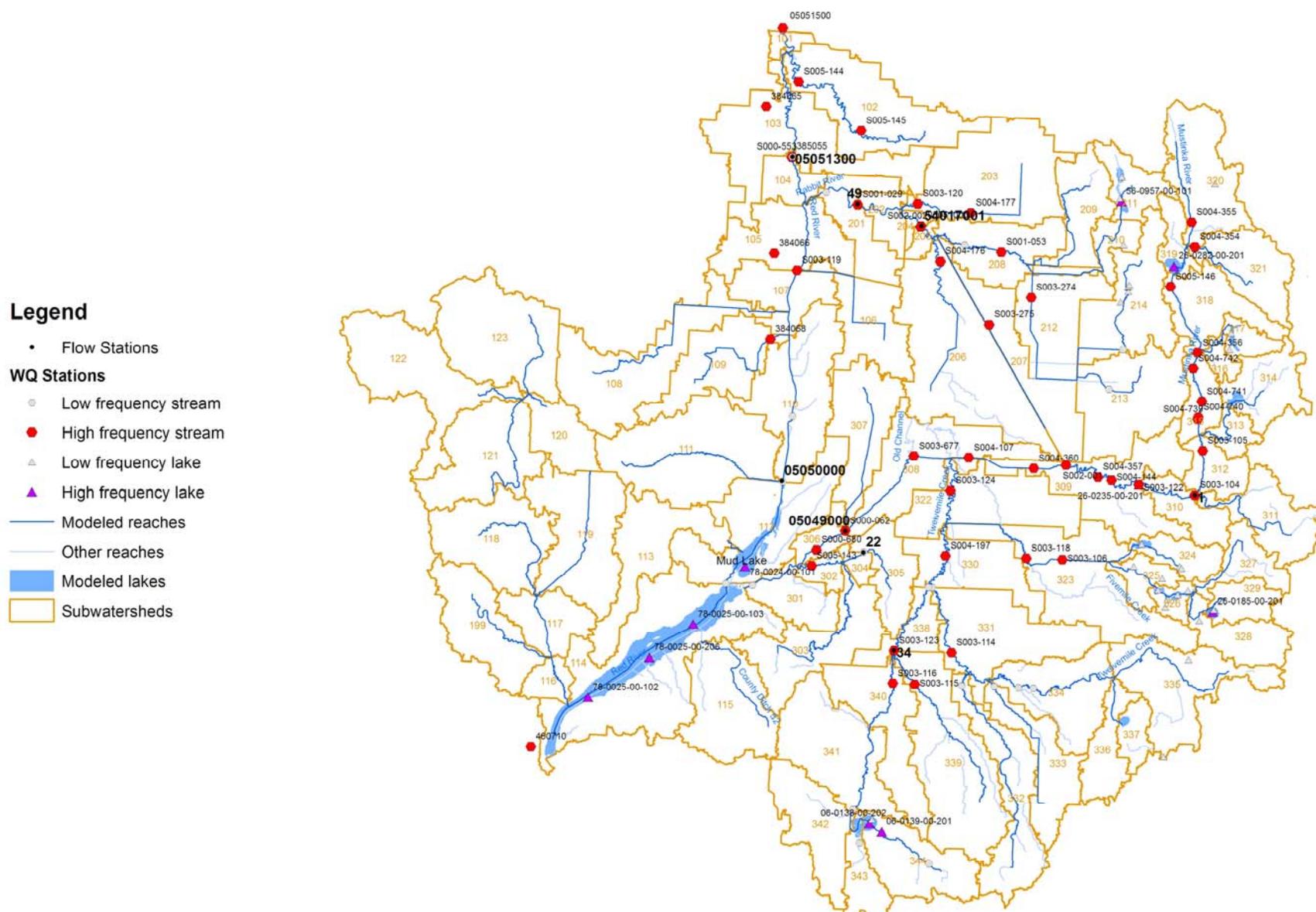


Figure 1. Observed water quality stations (high and low frequency, lake and stream) and flow calibration/validation stations.

Table 1. Water quality calibration, validation, and optional validation stations.

Type	Location (coinciding hydrologic calibration station)	Station ID	Data Source	Period of Record	Calibration (2001-2006)	Validation (1995-2000)	Optional Validation (2007-2009)
Stream	Mustinka River at Wheaton (USGS Gage 5049000)	S000-062	EQulS	2001-2009	x		x
	Bois de Sioux River SW of Doran (USGS Gage 5051300)	S000-553	EQulS	2002-2009	x	x	x
		385055	STORET	2000-2008			
		5051300 ¹	USGS	1995-2009			
	Rabbit River near Campbell (USGS Gage 54017001)	S002-002	EQulS	2001-2009	x		x
	Mustinka River NE of Herman (USGS Gage 54017001)	S003-104	EQulS	2002-2006, 2009	x		x
	Bois de Sioux River at Wahpeton	5051500 ^{1,2}	USGS	1995-2009	x	x	x
380001 ²		STORET	1995-1996				
Tributary to Bois de Sioux River	384068 ³	STORET	1996		x		
Lake	East Toqua Lake	06-0138-00- 202	EQulS	2008-2009			x
	Mud Lake	78-0024-00- -xxx	EQulS	2008-2009			x
	Traverse Lake	78-0025-00- xxx	EQulS	2008			x

¹ The only available water quality data likely useful is temperature and dissolved solids.

² This station is located 0.2 miles below the overall watershed outlet, but because it has data (though limited) for the validation period, it is recommended for use.

³ It is unclear whether or not we will need to delineate to this monitoring station; it is 1.2 miles from the watershed outlet. We can discuss this during the water quality phase of the project.