# WDNR Office of the Great Lakes AOC Capacity Grants 2016

***Project Title:*** Sediment Budget and Sediment Source Apportionment Study for Plum Creek

***Project Applicant:***

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***Project Location:***

Plum Creek sub-watershed

***Problem Statement:***

Plum Creek is part of the Total Maximum Daily Load (TMDL) and watershed management plan for total phosphorus (TP) and total suspended solids (TSS) in the Lower Fox River Basin. The small watershed of 35 mi2 has almost 20 miles of stream length on the Wisconsin state impaired waters list for TSS. Plum Creek is located about 10 miles upstream of the Green Bay/Fox River AOC. The AOC has proposed BUI targets for eutrophication and undesirable algae based on achieving the load reductions identified in the TMDL for 7 subbasins, including Plum Creek. Based on SWAT modeling results, Plum Creek produces an estimated 31,600 lbs/yr of TP and 5,500 metric tons/yr of TSS (Cadmus, 2012). The TMDL goal is to reduce the TP loading by 77 percent and the TSS load by 70 percent. Based on a SWAT model output, agricultural land in Plum Creek is estimated to contribute 94 and 95 percent of the annual loading of TP and TSS, respectively. Natural areas are estimated to contribute 1 percent of the TP and TSS. TP and TSS from bank erosion sources were not included in the modeling (Cadmus, 2012). However, recent stream inventories of Plum Creek by Outagamie County indicate that 24 of the 43 miles inventoried had actively eroding banks. Preliminary estimates are that these banks could be contributing 45 percent of the TSS annual loading measured at the USGS gage. If stream processes are producing almost half of the annual loading of TSS, the proposed TMDL goal to reduce TSS by 70 percent will not be achievable through upland soil conservation practices alone.

One of the first steps in the sediment TMDL process along with identifying targets is to identify the major sources of sediment. A stream corridor-based sediment budget and source apportionment study is needed to quantify the proportion of the TP and TSS loading originating from in-stream sources of bank and channel erosion compared to soil erosion. Gullying associated with headward extension of stream networks also needs to be quantified as a possible TP and TSS source. This proposal describes a combined sediment budget/fingerprinting approach that will help identify the proportion of annual loading of TP and TSS originating from stream corridor sources. The results from this study will be compared to expected field contributions based on RUSLE2 calculations and measured TP and TSS loadings from the USGS water quality monitoring stations. The source assessment results can be used in all subsequent steps of the TMDL process, including monitoring and targeted implementation of the plan.

***Proposed Work:***

This study will build off of previous stream corridor inventories of sediment sources conducted by Outagamie County and additional sampling activities by others that are being conducted in the watershed. Data on annual TP and TSS loading calculated at the USGS streamgage at the watershed outlet will be used for the watershed export and transport. The study will also be linked with the 2016 USGS GLRI study of characterizing stream zones of high potential nutrient cycling (William Richardson, 2015, USGS, oral commun.).

The study will take two years to complete, the first year for writing a QAPP, compilation of existing data, watershed reconnaissance of geomorphic setting, and collection of field data. The second year is needed for laboratory analyses, data workup, and publishing results.

As part of the sediment budget approach, the USGS will conduct an inventory of sediment sources and sinks using a river walk approach aerial photo analyses (Gellis et al., in prep; Fitzpatrick, 2014; Fitzpatrick et al., 1998). Mapping of sediment sources will include for bank erosion, valley side and terrace erosion, gully erosion and channel incision. For bank erosion rates, the WI NRCS published estimates of lateral recession rates will be employed. Sediment sinks will be measured in terms of volume and mapped including soft, fine-grained sediment deposited in the channel, depositional bars, and floodplain deposition. Sediment sources, transport, and sinks will be described in terms of a longitudinal continuum along the drainage system and mapped in a geographic information system (GIS).

Rapid geomorphic assessments of channel characteristics will be conducted at 30 sites in the Plum Creek watershed. Sediment samples will be collected from eroding banks and soft sediment deposition at the 30 sites and analyzed for TP, particle size, density, loss on ignition, and a suite of trace elements used in sediment fingerprinting. Samples will be analyzed at the Wisconsin State Laboratory of Hygiene.

The two USGS streamgages will be augmented with in situ suspended sediment samplers (Phillips, 2000). These samplers will be used to collect suspended sediment for fingerprinting and TP laboratory analyses. Samples will be collected monthly for approximately one year.

Sediment fingerprinting and source apportionment will be conducted for agricultural upland and hillslope processes and channel sources such as bank erosion in subwatersheds upstream of the two USGS monitoring stations using techniques previously developed by Gellis and others (2015) and used in the Pecatonica watershed (Lamba et al., 2015a,b ). Approximately 60 soil samples will be collected from cropland, grassland, and woods. The targets will include suspended sediment and soft sediment samples. Since the Plum watershed is naturally rich in fine-grained sediment, the study will help toward distinguishing anthropogenic vs. natural sediment loading and distinguish reaches along the stream network with gullying, bank, and channel erosion.

***Collaboration with partners:***

The counties in the Lower Fox River TMDL Agriculture Committee have been supportive of this project. The assessment results will inform implementation efforts of the TMDL.

***Timetable:***



***Deliverables***:

Products from this study will include GIS maps and spreadsheets of stream corridor sources and sinks of sediment and TP. A presentation will be given and made available to project partners and local watershed groups. A journal article will be published with the results, with submittal to a journal (to be selected with input from partners) at the end of year 2.

***Project Budget:***

The cost of the project excluding $30,100 for State Lab of Hygiene laboratory analyses is $119,506, with $89,630 from DNR and $29,876 from USGS matching funds from the Cooperative Program (pending availability). In order to lower costs associated with USGS salaries, the approach assumes 3 weeks of field assistance from two local agency personnel for stream inventories, rapid geomorphic assessment, and upland soil sampling.

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| **Total budget for two years:** |  |
| Salaries and leave | $105,429 |
| Travel | $7,692 |
| Supplies and equipment | $1,930 |
| Report | $4,455 |
| Total USGS costs | $119,506 |
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| SLOH Lab costs | $ 30,100 |
| **Total project costs** | $149,606 |

**Funding breakdown by State year:**



***References:***

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