

Water Quality Monitoring on Agriculture Fields in Northeast WI

Local researchers are measuring surface and tile water edge-of-field (EoF) runoff from agricultural fields across the Green Bay basin. These projects include gathering data from a variety of baseline field conditions, conservation practices, and monitoring systems. Water quality measurements include nutrient concentrations (i.e. phosphorus, nitrogen), soil erosion, and total water flow (volume of water leaving the field). In addition to water quality measurements, several of these sites are monitoring changes in soil health over time.

| Type of EoF Monitoring | Project Timeline, Field Management, and Conservation Practice | Location | Project Partners |
|---------------------------------|--|------------------------------|---|
| Surface Water (9 acres) | 2012 – 2015: Corn Silage 2015 – 2021: Dairy Rotation, Grassed Waterway & additional practices | Greenleaf (Upper East) | <ul style="list-style-type: none"> • U.S. Geological Survey • Fox Demo Farms • Natural Resource Conservation Service |
| Surface Water (28 acres) | 2013 – 2016: Soybean/Corn Silage 2017 – 2021: Corn Silage, Grassed Waterway & additional practices | Greenleaf (Upper East) | |
| Surface & Tile Water (11 acres) | 2014 – 2015: Corn Silage 2016 – 2020: Corn Silage, Cover Crops & No-Till | Greenleaf (Upper East) | |
| Surface Water (5 acres each) | Control Catchment 2015 – 2021: Corn Silage | De Pere (Apple Creek) | <ul style="list-style-type: none"> • UW-Green Bay • Fox-Wolf Watershed Alliance • Outagamie County Land Conservation |
| | Treatment Catchment 2015 – 2016: Corn Silage 2017 – 2021: Corn Silage, Cover Crops & No-Till | | |
| Surface Water (8 acres each) | Control Catchment 2016 – 2020: Row Crops | Forest Junction (Plum Creek) | |
| | Treatment Catchment 2016 – 2017: Row Crops 2018 – 2020: Row Crops w/ Vegetated Flow Paths | | |
| Surface Water (1 acre each) | Control Catchment 2016 – 2019: Corn Silage | Oneida (Silver Creek) | |
| | Treatment Catchment 2016 – 2017: Corn Silage 2018 – 2019: Managed Grazing | | |



Additional Water Quality Monitoring Projects

Discovery Farms is monitoring 24 **Agricultural Tile Drainage Systems** in Brown, Southern Door/Kewaunee, Manitowoc and Shawano counties to better understand the timing and mechanisms for soil and nutrient loss through tile systems. In addition, this project will perform soil health and soil carbon assessments at monitored tile sites to determine correlations between these assessments and nutrient loss to the tile systems. This information will be used to evaluate soil metrics that can effectively be used to predict nutrient loss to tile systems under differing farming and management systems.

- **4 Intensive Sites:** constant water flow monitoring and water sampling
- **9 Intermediate Sites:** constant water flow monitoring and bi-weekly water sampling
- **11 Basic Sites:** bi-weekly water flow monitoring and water sampling



Agriculture Treatment Wetlands – Plum Creek

Project Partners: The Nature Conservancy, Fox-Wolf Watershed Alliance, Outagamie County Land Conservation, UW-Green Bay, USGS

This project is measuring the effectiveness of constructed wetlands to capture nutrients and sediment at the edge of agricultural fields.

- Wetland tile and surface inflow & outflow monitoring –automated flow and loads
 - Wetland 1 (~10 acre catchment): 2016 – 2020
 - Preliminary results from year 1: 24,000 lbs of sediment and 18 lbs of phosphorus were trapped.
 - Wetland 2: 2017 – 2020

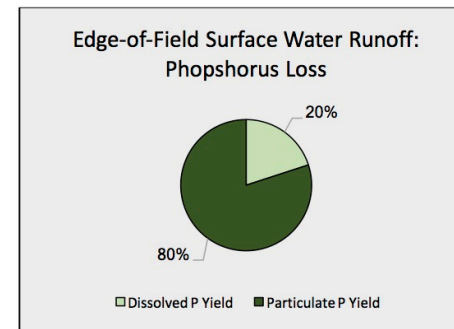
Preliminary Results

What have we learned?

Supported by funding from the **Great Lakes Restoration Initiative (GLRI)**, the **U.S. Geological Survey** has partnered with four **Fox Demo Farms** to conduct edge-of-field monitoring. Preliminary data, measuring surface runoff prior to conservation practices, suggests that the soil of northeast Wisconsin presents a unique set of challenges.

Key Points:

- **High losses of sediment:** Approximately 4,000 pounds per acre lost annually (about six times the state average)
- **High losses of phosphorus:** Approximately 6 pounds per acre lost annually (nearly triple state average)
- **Particulate Phosphorus:** 80% of phosphorus leaving the field is attached to soil particles, 20% of phosphorus is dissolved



Take-Away: Conservation practices aimed at helping to retain soil and reduce erosion could drastically reduce amount of phosphorus leaving producer's fields.



Stream Monitoring in the Lower Fox River Watershed

| Project | Stream Monitoring Sites and Time Frame | | Monitoring Description | | | | | |
|--|---|---|---|--|---|--|---|---|
| NEW Water Adaptive Management Monitoring | Silver Creek (2014-2019) Ashwaubenon & Dutchman's Creeks (2018 - ?) | | Five sites are grab sampled weekly during the spring and fall and bi-weekly during the summer. Samples are analyzed for nutrients, total suspended solids (TSS), temperature, and dissolved oxygen. Event driven samples are also collected, as well as stream flow and gage height. | | | | | |
| Oneida Nation Stream Monitoring | Duck Creek Silver Creek Oneida Creek Dutchman Creek Trout Creek Fish Creek Lancaster Brook Thornberry Creek | Approximately 15 years of data monitoring for each creek. Monitoring began between 2006 and 2008 and continues today. | Water quality grab samples are collected from all creeks March through December. <ul style="list-style-type: none"> Quarterly nutrient monitoring for total phosphorus, nitrate, nitrite, ammonium, and TSS. Monthly monitoring for temperature, pH, dissolved oxygen, conductivity, and turbidity. | | | | | |
| WI Department of Natural Resources Lower Fox River Basin Monitoring | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" data-bbox="338 581 919 646">Streams Monitored</th> <th data-bbox="919 581 1157 863" rowspan="2">Monitoring began in 2015 with 14 sampling sites across 13 streams. Three new sites added in 2018.</th> </tr> </thead> <tbody> <tr> <td data-bbox="338 646 611 863">Apple Creek Ashwaubenon Creek Baird's Creek Bower Creek Duck Creek (3 sites) East River (3 sites)</td> <td data-bbox="611 646 919 863">Garner's Creek Kankapot Creek Lancaster Creek Mud Creek Neenah Slough Plum Creek</td> </tr> </tbody> </table> | | Streams Monitored | | Monitoring began in 2015 with 14 sampling sites across 13 streams. Three new sites added in 2018. | Apple Creek Ashwaubenon Creek Baird's Creek Bower Creek Duck Creek (3 sites) East River (3 sites) | Garner's Creek Kankapot Creek Lancaster Creek Mud Creek Neenah Slough Plum Creek | Volunteers collect grab samples once per month May to October. Samples are analyzed, following WDNR protocol, for total phosphorus, dissolved reactive phosphorus, and TSS. |
| Streams Monitored | | Monitoring began in 2015 with 14 sampling sites across 13 streams. Three new sites added in 2018. | | | | | | |
| Apple Creek Ashwaubenon Creek Baird's Creek Bower Creek Duck Creek (3 sites) East River (3 sites) | Garner's Creek Kankapot Creek Lancaster Creek Mud Creek Neenah Slough Plum Creek | | | | | | | |
| United States Geological Survey Stream Gaging (in cooperation w/ local partners) | Plum Creek at Cty D (2011-2019) West Plum Creek (2013-2019) East River at Cty ZZ (2015-2019?) Silver Creek at Florist Drive (2014-2019) Duck creek (continuous flow only) | | Automated continuous flow monitoring and event water sampling is combined with monthly or bi-weekly low-flow grab sampling. Samples are analyzed for nutrients (TP, DP, nitrogen, etc.) and TSS. Automated turbidity sampling at several sites. Daily, event, monthly and annual discharge and loads are computed. (waterdata.usgs.gov/wi/nwis) | | | | | |
| UW – Green Bay | Mahon Creek (automated 2011-present) Wequiock Creek (2016-2018) Baird Creek (2004-2018) | | Monthly or bi-weekly sampling and automated sampling (Mahon only) for phosphorus and TSS. | | | | | |
| Lower Fox River Watershed Monitoring Program | Five tributaries (2003-2018) | | High school teams monitor 3x per year (spring, summer, fall) for various water quality parameters including dissolved P. Program facilitated by UW-Green Bay. | | | | | |
| USGS Sediment source fingerprinting | Plum Creek and Apple Creek watersheds (2016-2021) | | Determine stream sources of fine sediment and particulate-bound phosphorus. In particular determine the contributions from stream bank and gully erosion. | | | | | |
| USGS In-stream nutrient cycling | Streams and rivers in the Fox River basin (2016-2019) | | Characterize rates of biogeochemical mechanisms (ambient and potential denitrification, sediment phosphorus release) and how land use, especially agricultural conservation practices adjacent to stream sites, impacts these processes. | | | | | |



**Note this is not an exhaustive list of the past, current, and future monitoring efforts. Please contact the corresponding organization for more information about individual projects.*

Water Quality Monitoring in the Lower Fox River and Green Bay

| Project | Monitoring Sites and Time Frame | Monitoring Description |
|--|---|--|
| Fox River Monitoring: USGS and WDNR | Fox River at Appleton Fox River near mouth in Green Bay (both sites are part of the Long Term Trends program) | Automated continuous flow monitoring and monthly grab samples for nutrients and TSS. Continuous pH, dissolved oxygen, temperature, turbidity, and conductivity at the mouth. Concentrations are used to determine long term trends. Discharge is combined with all data sources of phosphorus and TSS at the sites to compute daily, monthly and annual loads. |
| Lower Fox River Dynamics: USGS | De Pere Dam to Fox River Mouth, 2016-2018 | The goal of this GLRI funded project is to determine water residence time for the lower Fox River including interactions of river flows with lake seiche oscillations. The goal of a second companion study is to determine nutrient retention, transformation, and release rates in the Fox River mouth. |
| River & Bay Sampling: NEW Water | 20 sites in the Lower Fox River, East River and Green Bay, 1986 - present | Currently, 20 sites are sampled on a weekly basis, May – October, for nutrients, solids, dissolved oxygen, temperature, pH, conductivity, turbidity, chlorophyll, phycocyanan, and chlorides. Two continuous monitoring stations are deployed in lower Green Bay each season to monitor surface and bottom water characteristics at a 15 minute interval from May – October. These data help to inform the scientific community and general public on changes in water quality in the Green Bay area. |
| Cyanobacterial Harmful Algal Blooms: WDNR, NEW Water, UW-Milwaukee Zilber School of Public Health, UWGB | Lower Green Bay 2016-present | This joint study is monitoring cyanobacteria, commonly known as blue green algae, and assessing the spatial abundance and long term presence of cyanobacterial toxins, including along the shoreline at Bay Beach. Weekly samples are collected from six sites in lower Green Bay from May – October each year. These samples are analyzed for chlorophyll, phycocyanan, cyanobacterial toxins, algal community composition, nutrients, and solids in addition to regularly collected water quality parameters by NEW Water. |

