

Nutrient Sensor Action Challenge

# Registration

Upload the completed form to [challenge.gov](https://challenge.gov) by clicking on the "Submit Solution" tab on the [Nutrient Sensor Action Challenge](#) page.



## General Information

### Project Lead:

First name: Beth Last name: Baranski

Organization: League of Women Voters of Illinois Education Fund

Title: Project Coordinator

Phone: 563/580-6192 Email: beth@bhms-arch.com

### Contact for matters of communication and media:

First name: Beth Last name: Baranski

Organization: League of Women Voters of Illinois Education Fund

Title: Project Coordinator

Phone: 563/580-6192 Email: beth@bhms-arch.com

**Do you agree to allow EPA to share project information with journalists for potential coverage of the project?**

☒ Yes

☐ No

**Are there others who should be notified via email about webinars and other updates? (provide as many as needed)**

First name: Dennis Last name: Busch

Organization: Water Resources Monitoring Group, LLC

Title: CEO

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Organization: Illinois State Water Survey

Title: Groundwater Section Head

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**Is there is any information about the project that should be treated as confidential?**

☒ Yes

☐ No

**If yes, please explain:**

The hardware, software, and monitoring methods being utilized for this sensor challenge are prototype in nature and intellectual property protection may be sought in conjunction with the technology. Therefore, specific attributes and techniques cannot be made public.

In addition, we would prefer to keep the name of the individual farmer participating in the project confidential.

## **Project Description and Potential for Impact [limit 250 words]**

**Describe the specific nutrient issue that the project will address.**

This monitoring project addresses nitrogen loss from farm fields by installing two low cost edge-of-field sensors providing real-time online information about nutrient loss to the farmer thereby directly informing farm management decision-making.

Illinois is among the states required to create nutrient reduction plans to address the hypoxic zone in the Gulf of Mexico. The *Illinois Nutrient Loss Reduction Strategy* cites agriculture as the primary source of nutrients lost from the state to the Mississippi River (including 82% of the Total N and 80% of the Nitrate-N). In addition, the Galena area (where the sensors will be located) is within the Northern Mississippi Valley having the highest Nitrate-N yield from non-tiled land in the state.

This project is located in the "Driftless Area" bypassed by ice-age glaciers. The region, covering areas of Wisconsin, Illinois, Iowa and Minnesota, is characterized by steep slopes and fragile soils prone to erosion. The League of Women Voters has a network of local chapters working on water resource management and the information gained through this project will be shared with others throughout this unique and challenging landscape. The Galena-area farmer group has plans to expand to a countywide entity and hopes to work with other farmers throughout the tri-state area, and the information will be shared through these avenues as well.

## How will the addition of data and information from nutrient sensors inform and improve specific decisions and actions pertaining to nutrient management?

Studies have shown that farmers prefer quick and simple evaluations that allow them to continually update their practices and plans rather than detailed and elaborate testing procedures. Moreover, a recent NRCS publication entitled "How Farmers and Ranchers Make Decisions on Conservation Practices" indicated that "Farmers will adopt practices that have a farm benefit that is easy to observe, such as reduced erosion from conservation tillage." Given this information, how do we support wide-spread farmer decision-making on issues that are transparent, such as nitrate and dissolved phosphorus loading to surface and groundwater? We believe low-cost, short-duration, higher uncertainty monitoring and data collection can provide management data to farmers and support conservation activities, such as nutrient management.

## What are the potential impacts and benefits of the project?

In addition to the direct benefits this data will provide the participating farmer, information gained from this project will be shared with other farmers in the area through the local Galena-area farmer-led group, the "Soil and Water Health Coalition," and will serve as another reference point for decision-making in the area. For example, farmers in this group are already beginning to focus on the multiple benefits that combining no-till and cover crops can provide. It is estimated that adopting these practices in this area could reduce Nitrogen loss by 28 lbs./ac/yr. If these practices were implemented on just half of the row cropped acres in the Lower Galena subwatershed that are currently being farmed conventionally, the reduction would be over 34,000 lbs. per year. The additional stormwater and soil health benefits resulting from the implementation of these projects are significant.

## Sensors

Provide the following information for each type of sensor that will be used in the project.

Manufacturer/Model	Triad / NO3-0001
Parameter being measured	Nitrate-Nitrogen
Sensor Price	\$4,000*
Maintenance Requirements	Sensor
Accuracy	+/- 10%
Precision	+/- 4%
Range	0.1 – 14,000 ppm NO3-N

**\*This sensor is prototype hardware currently unavailable commercially, and currently being field-tested.**

## Monitoring [limit 250 words]

**What is the general schedule for the project? Include: sensor deployment, maintenance and calibration, data analysis, and approximate date that data will be available to the Challenge Administrator.**

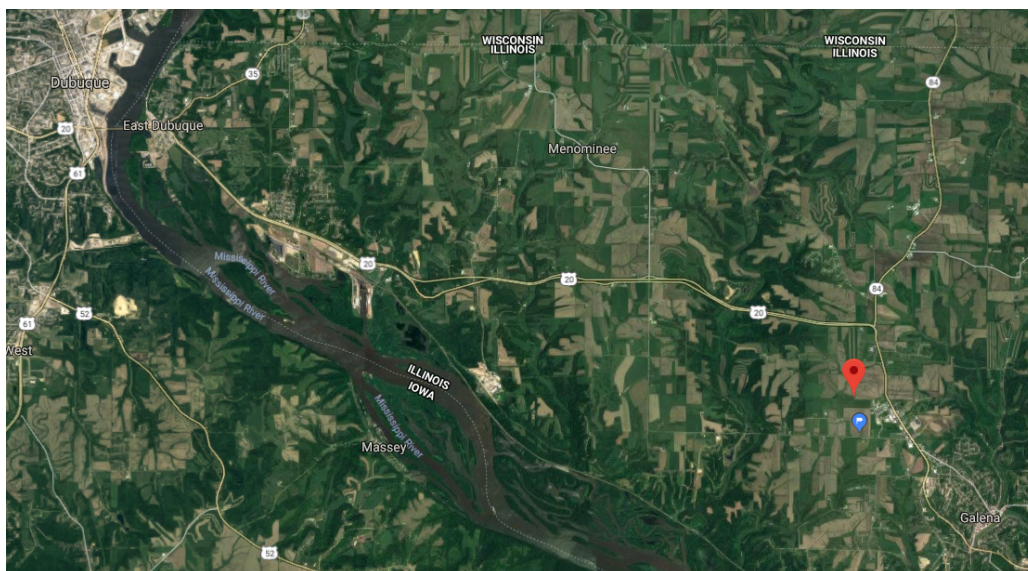
Installation of monitoring hardware in the field will be completed in June. After commencement of monitoring program, technicians will visit the site on a weekly basis to replace consumables, collect samples, and evaluate condition of monitoring systems. Site visits will also be conducted after runoff events to collect samples from surface-water monitoring gauges. Technicians will also have remote access to the site through remote cameras connected via cellular modems located on site.

Gauging stations will be monitored daily by remote technicians located at WRMG laboratory in Lancaster WI. Daily checks will evaluate status of sensors, controllers, cameras, pumps, and power systems. If the daily check indicates system errors, a technician will visit the site to make corrective measures.

The gauging stations will be operational through September of 2018. Data will be made available to challenge administrators by the November 1<sup>st</sup>, 2018 deadline.

**Describe location (provide map or link to a map) and monitoring frequency for each sensor.**

Two sensors will be provided at the edge of a field on a farm located in northwest Illinois, outside of the City of Galena. One sensor will be located in a drain tile, and the other one in a culvert. The monitoring frequency for each sensor will be 30 minutes when stage is above threshold of 0.05 feet.



**If applicable, describe any existing monitoring data being collected in the area and whether these data will be integrated:**

In addition to the nitrate sensor data collection, the site will be instrumented with pre-calibrated weirs and automated stage-measuring devices to calculate flow rate at a one-minute timestep for subsurface tile flow as well as edge-of-field surface-water runoff. Discharge data will be used to trigger a peristaltic pump which will collect flow-weight composite samples for laboratory analysis (nitrate, dissolved reactive phosphorus, suspended solids). Flow and nitrate sensor data will be integrated to determine nitrate nitrogen load data.

The League of Women Voters has worked with scientists from the Illinois State Geological and Water Surveys at the University of Illinois Champaign-Urbana's Prairie Research Institute to sample the Galena River and springs throughout the area.

The League of Women Voters will be working with the U.S. Geological Survey to complete a year of grab sampling (19 events in each of two locations) to analyze for a complete array of nutrients.

The nutrient data described above, as well as data from regular Illinois EPA monitoring, will be reviewed together and referenced in efforts to portray an accurate picture of nutrient loss from agricultural fields in the Galena area.

**Data Architecture [limit 250 words] [Web service endpoint and authentication information are due to Challenge Administrator by November 1, 2018.]**

**Describe the plan for sensor data collection and management. Please provide any information about plans to meet data and web interface standards. Also identify any software products you intend to use that support the use of the standards.**

On site monitoring is being implemented using Internet of Things approach. Our monitoring platforms use the latest controllers, sensing solutions, and telemetry technology to create a low-cost, low-power, scalable monitoring solution.

Data collected on site is stored locally on a micro SD card, and uploaded to on-line servers. Data is then visualized in real-time using Grafana open-platform time series analytics systems. Custom dashboards have been developed to visualize data feeds and create user alerts based on field conditions.

While the Grafana platform does not natively support the listed formats or web services, we will be developing custom applications utilizing WaterML and USGS Instantaneous Values Web Service to allow for required data access.