

Managing Cropland for Nutrient Capture

THE LEOPOLD CENTER FOR SUSTAINABLE AGRICULTURE

About the Nashua research site

Long-running research projects at Iowa State University's Northeast Iowa Research and Demonstration Farm near Nashua shed light on how farm management practices influence water quality.

In 1988 a state-of-the-art water quality monitoring system was installed at Nashua with some of the first funds awarded by the Leopold Center. Field drainage tiles and groundwater wells are monitored at 36 one-acre plots. Each plot has a separate subsurface drainage system, allowing researchers to isolate flow-proportional samples for analyses of chemical, nutrient and pesticide leaching. In addition, the plots have more than two decades of tillage and cropping records.

The Nashua site has been used for three major water quality studies since its creation, resulting in more than 10 M.S. and Ph.D. theses and 30 refereed papers. The Leopold Center continues to support water quality work at Nashua through its competitive grants program.

Why does this work matter?

Iowa producers are increasingly challenged to provide food, fiber and biofuel, while still protecting soil health and water quality.

In the late 19th and early 20th centuries, an extensive underground drainage system was installed in much of the Midwest to move excess water from crop fields to nearby waterways.

These underground tile lines carry nutrients such as nitrogen and phosphorus into streams and rivers of the Mississippi River watershed, where they contribute to poor water quality and the growing hypoxic zone in the Gulf of Mexico, a large area of low oxygen that can't sustain marine life.

Understanding how farm management practices can reduce nutrient loads is a vital step in protecting human and environmental health as well as livelihoods in the Mississippi River region.



An experimental crop field at Nashua. Credit: Laura Miller

About the Iowa Nutrient Reduction Strategy

The 2012 Iowa Nutrient Reduction Strategy, written in response to the 2008 Gulf Hypoxia Action Plan, evaluates options for reducing nitrogen runoff in the Mississippi River watershed. Nearly all the practices evaluated have some history of research support from the Leopold Center, such as denitrifying bioreactors, riparian buffer strips, cover crops and extended crop rotations. Data from Nashua projects played a prominent role in the Strategy's science assessment. Learn more at: www.leopold.iastate.edu/nutrients

Water quality research

These Nashua projects have received funds from the Leopold Center. For more information, search by project ID at www.leopold.iastate.edu.

Antibiotic-resistant pathogens, 2012 - present

This project investigates the fate and transport of pathogens on land that receives swine manure applications, and addresses emerging issues related to antibiotic resistance. *Investigators: Michelle Soupir, Matt Helmers, Michael Thompson, Antonio Mallarino, and Ramesh Kanwar. Project ID: E2012-05.*

Impacts of cropping systems and farm management practices on water quality, 2006 - present

This project evaluates how cropping systems and farm management practices can influence the amount of nitrogen in drainage water. Data has shown nitrate-N concentrations to be about 40 percent greater from continuous corn plots compared to corn-soybean plots. Stover removal and the use of no-till had little impact on water quality. However, planting a cover crop significantly reduced nitrogen loss (by about 25 percent), as did applying swine manure only before the corn rotation rather than before both corn and soybean. *Investigators: Matthew Helmers, Ramesh Kanwar and Antonio Mallarino. Project IDs: XP2011-04, ESP2008-NASHUA.*

Denitrifying bioreactors, 2009 - 2012

Woodchip bioreactors show significant potential for removing nitrate from tile drainage while taking little or no land out of production. In 2009 investigators installed a bioreactor at the Nashua site, one of four field-scale bioreactors located around the state at the time. The bioreactors removed between 12 and 57 percent of the annual nitrate load, with an average load reduction of 32 percent. Retention time was strongly correlated with nitrate removal. Funding came from the Leopold Center, Coldwater Palmer Watershed Improvement Association and Iowa Soybean Association. *Investigators: Matthew Helmers, Laura Christianson and Carl Pederson. Project ID: E2009-11.*

Impacts of manure management on water quality, 1990 - 2003

Field experiments from 1990 to 2003 investigated the impact of liquid swine manure application on surface and groundwater quality. Six different nutrient (N and P) management systems were evaluated. Nitrate-N concentrations in tile water were highest when swine manure was applied each year (to both corn and soybeans). Investigators determined that the leaching of nitrate-N from manure application can be managed with the right application method and timing. *Investigators: Ramesh Kanwar, James Baker, Carl Pederson, Antonio Mallarino, John Sawyer and Ken Pecinovsky. Project IDs: 1990-41, 1993-14, 1997-60, SP1999-NASHUA.*



Top: A field-scale bioreactor is installed at Nashua in 2009. Credit: Laura Christianson

Bottom: Ross Tuttle, an M.S. student in ISU Civil Engineering, collects a water sample from tile drainage at a Nashua experimental plot. Credit: Michelle Soupir

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