A vision for a more resilient Iowa

The Iowa Watershed Approach

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IIHR—Hydroscience & Engineering

IIHR is a unit of the University of Iowa’s College of Engineering. At IIHR, students, faculty members, and research engineers work together to understand and manage one of the world’s greatest resources—water.
Iowa Flood Center

- Provide accurate, science-based information to help Iowans better understand flood risks
- Develop hydrologic models for physically-based frequency estimates and real-time flood forecasting
- Establish community programs to improve flood monitoring
- Develop strategies to mitigate and prevent future flood damage
- Develop Iowa’s workforce in flood-related fields
Iowa Nutrient Center

- The 53 sensors (along with 17 additional USGS sensors) measure:
  - Nitrate, pH, Specific Conductance, Turbidity, Dissolved oxygen, Temperature
- Near real-time data, sampled every five minutes, are relayed to the center every 15 minutes and displayed online: [Iowa Water-quality Information System (IWQIS)]
- Forty percent of all real-time nitrate sensors in the nation are in Iowa
Iowa Geologic Survey

- The IGS focuses on research, service, and outreach
- Currently under contract with the Iowa DNR to fulfill specific activities
- We continue to work to change Iowa code to permanently establish the state geologist and the IGS at the UI, with direct state support
- IGS staff conduct research on general geology, geophysics and hydrogeology, STATEMAP, and groundwater modeling
Iowa Watershed Approach: $96,887,177

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IWA Goals

- Reduce flood risk
- Improve water quality
- Increase resilience
- Engage stakeholders through collaboration and outreach/education
- Improve quality of life and health, especially for vulnerable populations
- Develop a program that is replicable throughout the Midwest and the United States
IWA Project Description

- **Built off the framework of the IWP**
- Establish a WMA
- Develop a hydrologic assessment and watershed plan
- Deploy monitoring equipment
- Work with *project coordinators* and volunteer landowners to implement projects that reduce the magnitude of downstream flooding and improve water quality
- Assess project benefits based on monitoring and modeling data
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Hydrologic Assessment

- Iowa’s Flood Hydrology and Water Quality
- Conditions in each IWA Watershed
  - Hydrology
  - Geology and Soils
  - Topography
  - Land Use
  - Instrumentation/Data records
- BMPs: Existing and Potential
- Hydrologic Model
- Watershed Scenarios
Modeling

- Develop and run watershed-scale hydrologic models (GHOST) to estimate watershed responses to rainfall events
- Modeler breaks the watershed down into manageable and representative user defined areas
- Simulate hydrologic processes using a physically-based approach
- Compare simulated results to observed hydrologic time series (e.g. streamflow) to assess model performance
- Quantify the impact of existing and potential BMPs
- Documentation
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- Corn (40.7% - 45.6%)
- Soybeans (31.9% - 27.0%)
- Grassland/Pasture (10.2% - 12.4%)
- Developed/Open Space (6.0% - 5.8%)
- Deciduous Forest (2.7% - 2.5%)
- Developed/Low Intensity (3.1% - 1.7%)
- Woody Wetlands (1.9% - 1.3%)
- Open Water (0.6% - 0.9%)
- Other (2.8% - 2.9%)

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Iowa BMP Mapping Project

- Iowa State University
- Iowa Department of Natural Resources
- Iowa Department of Agriculture and Land Stewardship
- National Laboratory for Agriculture and the Environment
- Iowa Nutrient Research Center (ISU)
- Iowa Nutrient Research and Education Council

http://www.gis.iastate.edu/gisf/projects/conservation-practices
Iowa BMP Mapping Project

Hillshade showing narrow base terraces

Pond dam on hillshade

Images provided by: Calvin Wolter, GIS Analyst. Iowa Department of Natural Resources
Iowa BMP Mapping Project

Upper Clear Creek

HUC12: 070802090101

Best Management Practices
- WASCOB
- TERRACE
- POND_DAM
- STRIPCROPPING
- GRASSED_WATERWAY
- CONTOUR_BUFFER_STRIPE
Agricultural Conservation Planning Framework (ACPF)

http://northcentralwater.org/acpf/
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BMP Mapping + ACPF

<table>
<thead>
<tr>
<th>Grassed Waterways</th>
<th>Distance (miles)</th>
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<tbody>
<tr>
<td>Existing</td>
<td>131.7</td>
</tr>
<tr>
<td>ACPF</td>
<td>62.0</td>
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<tr>
<td>Potential</td>
<td>30.3</td>
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</table>
BMP Mapping + ACPF
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BMP Mapping + ACPF

Upper Clear Creek

<table>
<thead>
<tr>
<th>Location</th>
<th>Existing Ponds</th>
<th>ACPF Wetlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Clear Creek</td>
<td>10</td>
<td>45</td>
</tr>
</tbody>
</table>

Marengo

Williamsburg

Oxford
Data Collection & Monitoring
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Iowa Flood Information System

http://ifis.iowafloodcenter.org/ifis/en/app/
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Iowa Water Quality Information System

http://iwqis.iowawis.org/app/
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Upper Mississippi River Water Quality Information System
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Iowa stream nitrate and the Gulf of Mexico

Christopher S. Jones [1,2], Jacob K. Nielsen [1], Keith E. Schilling [1], Larry J. Weber [1]

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Abstract

The main objective of this work was to quantify and update the U.S. Midwest agricultural state of Iowa's contribution of nitrate-nitrogen to the Mississippi River stream network against the backdrop of the ongoing problem of Gulf of Mexico hypoxia. To achieve this objective, we used stream nitrate and discharge data collected from 1999 until 2016 at 23 Iowa stream sites near watershed outlets, along with publicly-available data for sites downstream of Iowa on the Missouri and Mississippi Rivers. Our analysis shows that Iowa contributes between 11 and 52% of the long-term nitrate load to the Mississippi-Atchafalaya Basin, 20 to 63% to the Upper Mississippi River Basin, and 20 to 89% to the Missouri River Basin, with averages of 29, 45 and 55% respectively. Since 1999, nitrate loads in the Iowa-inclusive basins have increased and these increases do not appear to be driven by changes in discharge and cropping intensity unique to Iowa. The 5-year running annual average of Iowa nitrate loading has been above the 2003 level for ten consecutive years, implying that Gulf hypoxic areal goals, also based on a 5-year running annual average, will be very difficult to achieve if nitrate retention cannot be improved in Iowa. An opportunity exists for land managers, policy makers and conservationists to manifest a positive effect on water quality by targeting and implementing nitrate reducing-practices in areas like Iowa while avoiding areas that are less likely to affect Gulf of Mexico hypoxia.
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5- and 10-Year Moving Average of Load Leaving Iowa

5- and 10-Year Moving Average of Load Leaving Iowa

Millions

1,400

1,200

1,000

800

600

400

200

0


Calculated Load (lbs)
5-Year Moving Average of Load Leaving Iowa

- Calculated Load (lbs)
- 5-year Running Average (lbs)
Nitrate Load Leaving Iowa
Enhance virtual reality

True virtual reality creates the illusion of actually being in a different space. It can be used for training, treatment, and communication.
Enhance virtual reality

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SHAPE THE FUTURE

NAE Grand Challenges Scholars Program

Vest Scholars Program

GRAND CHALLENGES IN THE NEWS

Manage the Nitrogen Cycle
Provide Access to Clean Water
Provide Energy from Fusion
Prevent Nuclear Terror
Develop Carbon Sequestration Methods
Engineer the Tools of Scientific Discovery
Far and away the best prize that life has to offer is the chance to work hard at work worth doing

– Theodore Roosevelt