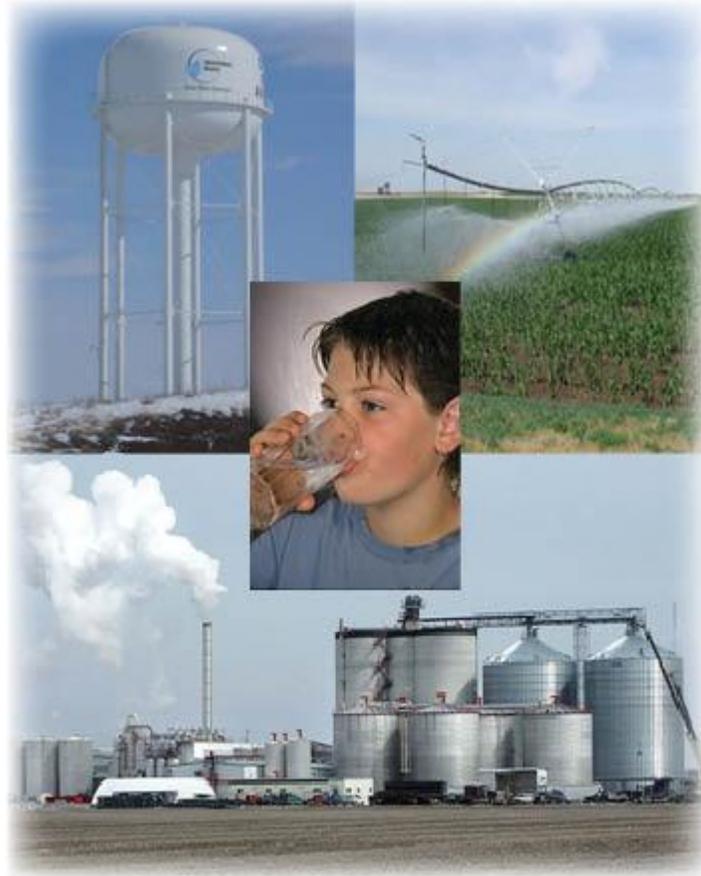


Annual Report Of the State Geologist



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Iowa Department of Natural Resources
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Iowa Geological and Water Survey

What we do: Since 1892, the Iowa Geological and Water Survey (IGWS) has provided earth, water, and mapping science to all Iowans. We collect and interpret information on subsurface geologic conditions, groundwater and surface water quantity and quality, and the natural and built features of our landscape. This information is critical for:

- Predicting the future availability of economic water supplies and mineral resources.
- Assuring proper function of waste disposal facilities.
- Delineation of geologic hazards that may jeopardize property and public safety.
- Assessing trends and providing protection of water quality and soil resources.
- Applied technical assistance for economic development and environmental stewardship.

Our goal: Providing the tools for good decision making to assure the long-term vitality of Iowa's communities, businesses, and quality of life.

Information and technical assistance are provided through web-based databases, comprehensive Geographic Information System (GIS) tools, predictive groundwater models, and watershed assessments and improvement grants. The key service we provide is direct assistance from our technical staff, working with Iowans to overcome real-world challenges.

This report describes the basic functions of IGWS program areas and highlights major activities and accomplishments during calendar year 2011. More information on IGWS is available at <http://www.igsb.uiowa.edu/>.

The State of the State's Earth, Water, and Landscape

Catastrophic flooding along the Missouri River was the signature event of 2011. Driven by snowmelt in the Rockies and heavy rains on the Plains, Missouri River reservoirs were opened and produced a different kind of flood, one with an extended period of extreme high flows. Some described it as a several month "flood plateau" rather than a flood peak. The long flood stressed levees and produced significant groundwater flooding – flooding "from below" even in areas that weren't inundated. IGWS supplied state and local emergency managers mapping products, conducted surveys to assess levee integrity, and provided groundwater expertise to help resolve groundwater-driven lake flooding.

Ironically, before the flood waters had fully receded, dry conditions began to settle into the northwest part of the state. By year's end a large part of the area was in "severe drought," and preliminary discussions with water interests and state agencies were planned. We continue to monitor drought status, particularly as it relates to stream flows and groundwater drinking water sources that supply much of the area.

While responding to the state's immediate needs is a key function of IGWS, we continued our long-term foundational mission of collecting and providing basic earth, water, and mapping information. We completed geologic mapping scaled to the needs of local users, produced refined delineations of zones supplying groundwater to public supply wells, and continued mapping the state's land cover in detail. Work to provide a suite of aerial images of the entire state by decade moved forward, as did mapping of hazards ranging from floodplains to sinkhole collapse potential.

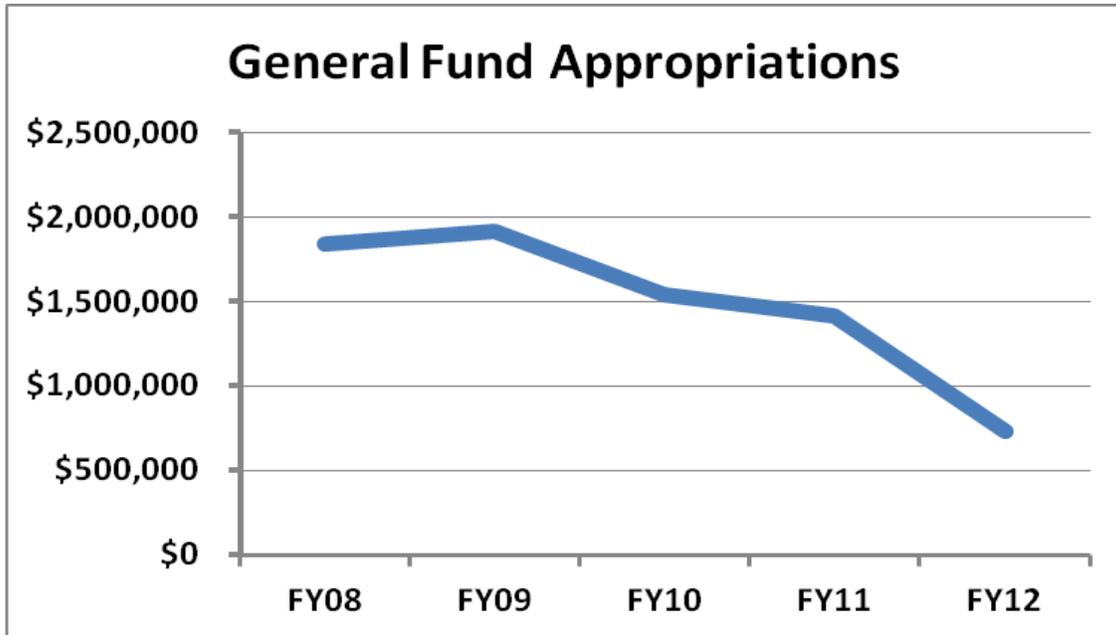
IGWS worked with current and potential future developers of mineral and energy resources. Resources mined in Iowa had a raw value of \$680 million dollars, based on the latest statistics. We continued developing powerful predictive tools for assuring sustained production of groundwater in the coming decades and in case of drought. Ongoing monitoring and assessment of 131 lakes, 82 streams, and 35 state beaches was conducted to track the quality and health of our natural water system and aquatic life. Our nonpoint pollution program awarded \$1.66M in federal funds to watershed improvement projects designed to support the local residents' efforts to improve their water quality.

The information we collect is interpreted and turned into web-available products our private and public sector customers rely on. This value-added component to basic data is another key function of IGWS. Traditional reports, and public presentations on Iowa's earth, water and landscape continue as an important public education and outreach function; these are tabulated at the end of the report.

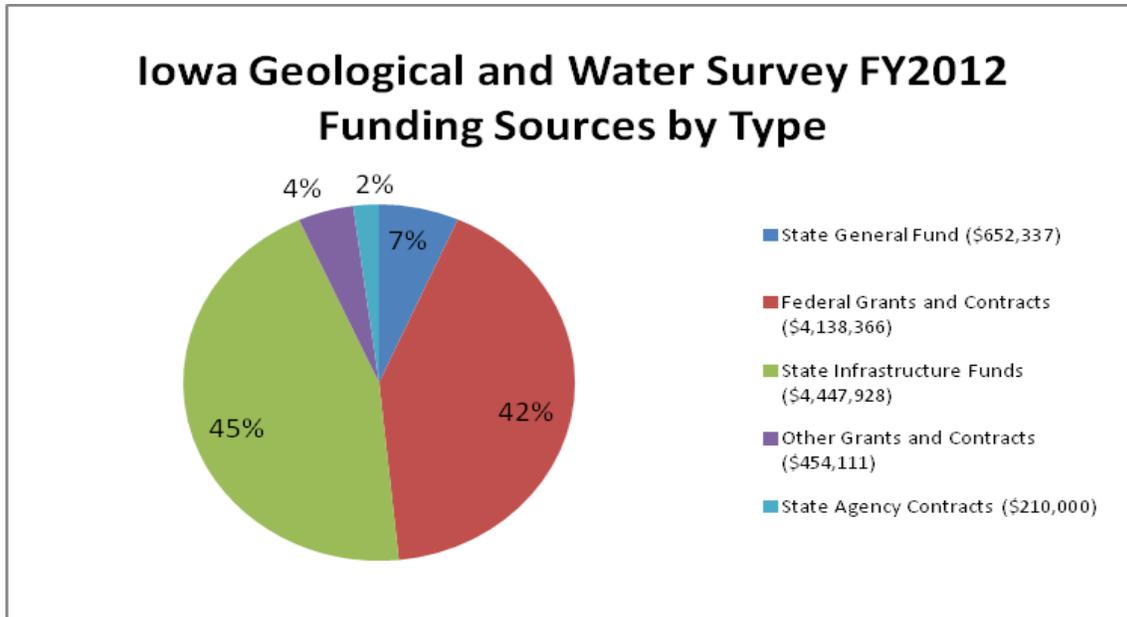
2011 was also marked by significant budget cuts and the resulting challenges, particularly to the basic data collection work we do. Support for this work is critical, as the information acquired today will be needed to answer the questions that will arise in the future. We enter 2012 determined to meet the challenges while working towards a more financially sustainable future.

Fiscal Overview

In the last five years, IGWS has seen an unprecedented loss of nearly 66% of our general funds. The most significant drop in funding occurred when the Survey's FY2012 state general fund appropriation was reduced by 50% (a loss of \$685,566 from the FY2011 budget of \$1,415,656). As of FY2012, less than 10% of the Survey's staff is supported by general fund dollars. These cuts had an adverse impact on the Survey's mission to "plan and implement programs that result in the acquisition of comprehensive information on the mineral and water resources of the State, with emphasis on water supply developments and monitoring the effects of environmental impacts on water quality."



General fund appropriations to the IGWS for Fiscal Years 2008 through 2012.



Funding sources that support the IGWS for Fiscal Year 2012.

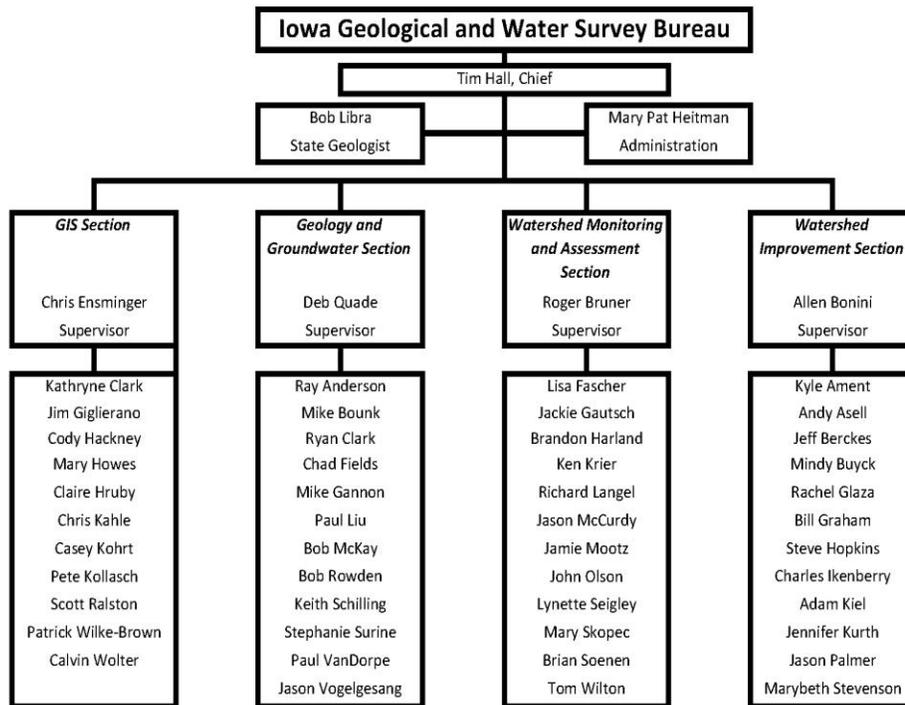


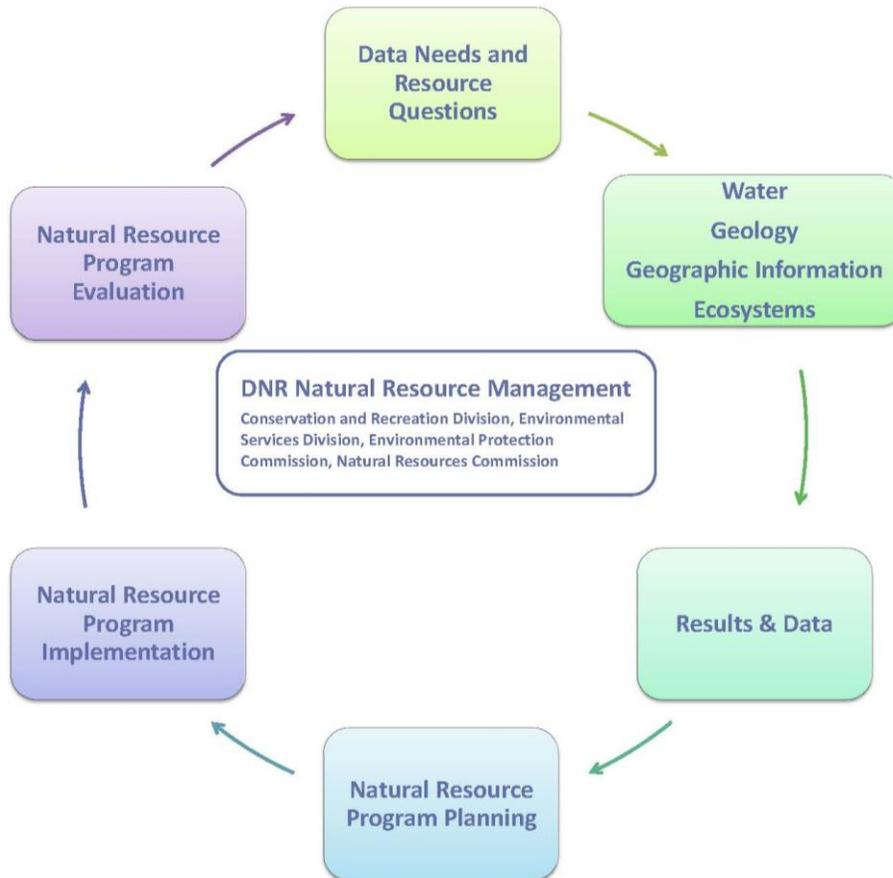
Table of organization for the Iowa Geological and Water Survey.

Cycle of Effective Resource Management

The IGWS works collaboratively with a variety of internal and external stakeholders to provide critical information for natural resource and water management programs. These partners have come to rely on IGWS staff for their knowledge and expertise about Iowa's geological and hydrological resources.

IGWS external stakeholders who benefit from IGWS staff expertise and knowledge include:

- Citizens & Citizen Groups
- Local Watershed Groups
- County Conservation Groups
- County Soil and Water Conservation Districts
- Iowa Department of Public Health
- K-12 School Districts
- Natural Resources Conservation Services
- Iowa Department of Agriculture and Land Stewardship
- Aggregate Industry
- Water Well Industry
- Homeland Security
- Department of Transportation
- U.S. Geological Survey
- Consulting Engineers
- Utility Companies
- Board of Regents
- Non Governmental Organizations
- Municipalities
- Local and County Governmental Agencies
- Rural Water Association



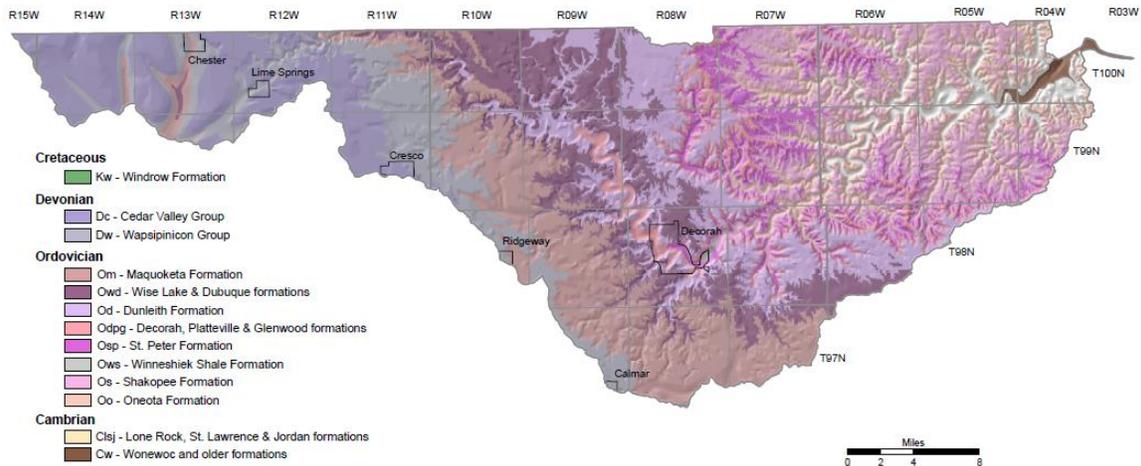
Cycle of effective resource management. IGWS staff provide critical information which is used to fill data needs and aid in the collection of data that can be used in the planning, implementation, and evaluation of natural resource programs in Iowa.

Geology and Groundwater Section

What we do: This program is responsible for the analysis of all parameters of geologic and hydrogeologic conditions, water resources budget relationships between supply and demand, economic mineral resources, geologic hazards, and defines the extent, recurrence interval, and impact of local and/or regional water development. Each year we answer several thousand phone requests and emails for earth and water science information from within IDNR, other government agencies, businesses, and the general public. Our core functions include:

- Comprehensive mapping, data collection, and investigative programs are developed and implemented to enhance the state's geologic and water resources databases.

- Site specific and areal information services are provided to well contractors, engineering firms, municipalities, and the private sector for water supply development and management, mineral extraction, construction projects, hazard avoidance, and other aspects of resource management.
- Data review and interpretation are provided to DNR's Environmental Services Division to assist in regulatory decisions relative to water withdrawal permits, well-interference problems, waste disposal sites, and other permitted facilities.



Bedrock geologic map of the Upper Iowa River watershed in northeast Iowa.

Geographic Information Systems Section

What we do: The GIS Section provides geospatial support to DNR, other agencies, and the public. During 2011, support projects for DNR included calculating stream statistics and nutrient loads for the National Pollutant Discharge Elimination Program (NPDES), SWAT watershed modeling for the TMDL section, assisting the Forestry Bureau with forest stand delineations and Gypsy Moth detections, LiDAR processing for various applications, and maintenance of the water well database for the environmental division's One-Stop application and the Source Water program. The GIS section also maintains the DNR's Natural Resources GIS Library (NRGIS), which for over 20 years has been a primary source of free, downloadable GIS data for all users in the state. In 2011, 258 new data layers were added to the NRGIS library while 75 existing layers were updated. In addition to new data, 53 web services were made available and online applications for forestry and source water were developed. The section also assists DNR GIS users with training, software maintenance, and day-to-day questions.

The GIS Section also partners with universities, and state and federal agencies on geospatial research and support projects that benefit DNR programs as well as other efforts to map and characterize Iowa's natural resources. A major area of effort

involves creating watershed models to calculate watershed parameters like runoff, erosion, and nutrient loss. In 2011, SWAT watershed models were created in cooperation with Iowa State University's (ISU) Center for Agricultural and Rural Development for the Raccoon and Walnut Creek watersheds. Also in conjunction with ISU and the Iowa Department of Agriculture and Land Stewardship, IGWS staff developed watershed parameters and phosphorus loss calculations for the Nutrient Reduction Strategy, which aims to reduce nutrient loads to the Mississippi River and Gulf of Mexico.

Watershed Improvement Section

What we do: The Watershed Improvement Section includes the Total Maximum Daily Load (TMDL) Program and the Nonpoint Source Program. These two programs together make up the core of DNR's Watershed Improvement Program. The overarching goal of this program is to work to solve water quality problems which are causing Iowa's rivers, streams, and lakes to be listed on the Iowa Impaired Waters List.

The TMDL Program produces Water Quality Improvement Plans (WQIP) in accordance with the federal Clean Water Act. These WQIPs are designed to calculate the maximum daily pollutant loading capacity that can be assimilated by a water body and allocates that pollutant load among the various point and nonpoint sources for the pollutant in question. WQIPs are then used, in part, by DNR's NPDES Permitting Section to allocate pollutant discharge limits for permitted point sources in accordance with DNR and the U.S. Environmental Protection Agency (EPA) regulations and the Clean Water Act. WQIPs are also used to guide planning by local watershed groups interested in reducing pollutant loads coming from nonpoint sources through the development of a comprehensive Watershed Management Plan.



Lake Macbride, Johnson County (Photo by Iowa DNR).

The Nonpoint Source Program manages the EPA Section 319 Nonpoint Source Program for the State of Iowa, in accordance with the requirements of the federal Clean Water Act. The Nonpoint Source Program implements the EPA Section 319 Program by helping local watershed groups develop comprehensive Watershed Management Plans (WMP) through a variety of technical assistance and financial assistance programs. Once these WMPs have been developed and approved by EPA, the Nonpoint Source Program then offers additional technical and financial assistance to local watershed groups to implement the strategies outlined in the approved WMP. The overarching goal of these WMPs is to implement watershed improvement strategies needed to remove water bodies from the Iowa Impaired Waters List.

Watershed Monitoring and Assessment Section

What we do: The Watershed Monitoring and Assessment Section is responsible for the design and implementation of water monitoring for Iowa's lakes, rivers, wetlands, and groundwater resources. The program develops and delivers consistent, unbiased information about the long-term condition of Iowa's surface and groundwater resources. Water quality is tracked to determine status of water bodies and changes in trends through time. The program informs decisions makers for the management, protection, and development of our water resources. Water quality and watershed data are readily web available.

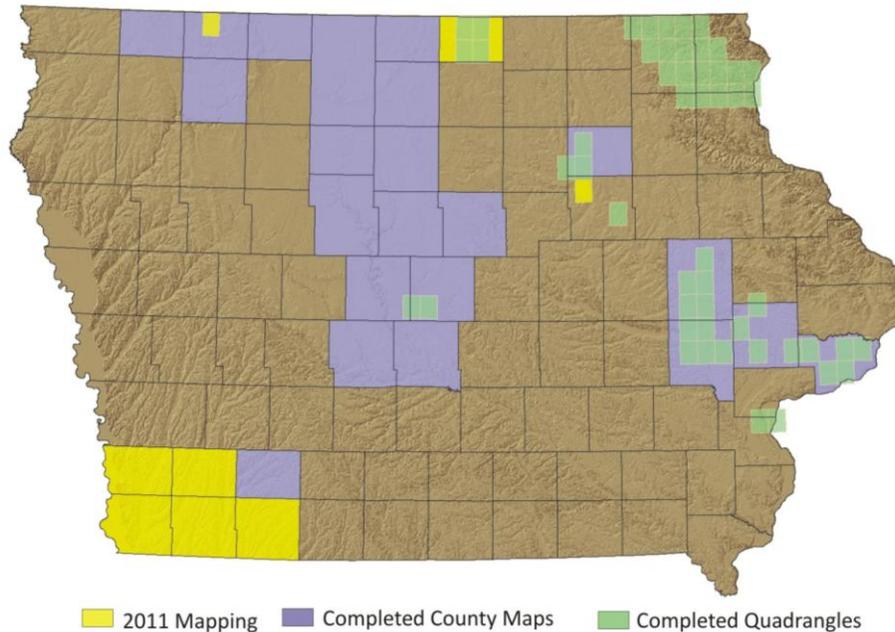
IGWS Accomplishments for 2011

Geologic Mapping

--Mapping the Earth's Resources

Geologic mapping of surficial deposits, the bedrock surface, and bedrock aquifers is a critical first step in providing resource evaluations to Iowans. During 2010, we completed the first regional-scale remapping of the state's bedrock surface since 1969, incorporating 40 years of new information and geologic interpretations. This effort also included mapping the elevation of the bedrock surface and the depth to bedrock. Products are available online as GIS data layers and as paper products. This mapping is a major asset for forecasting water supplies, mineral deposits, hazardous conditions, and groundwater vulnerability. An additional new tool acquired and put into use in 2011 is a multi-channel resistivity unit to perform geophysical surveys in conjunction with various mapping projects. Already, this new mapping tool has proven itself extremely useful in assessing the underlying geology of river valleys, identifying karst areas, as well as the thickness, extent, and integrity of various aggregate deposits. Such mapping tools are critical for Iowa to develop new strategies for assessing water supply sustainability, aggregate resource potential, and assessing aquifer vulnerability.

In 2011, we continued more detailed mapping of key parts of the state, with quadrangle maps completed in Black Hawk, Scott, and Worth counties, and presently are mapping



STATEMAP Geologic Mapping, 1993-2011.

in Black Hawk, Dickinson, and Worth counties. Current mapping projects are focused on Iowa's Great Lakes Region in northwest Iowa, a portion of the I-35 corridor in north-central Iowa, and the Avenue of the Saints corridor in east-central Iowa. Geologic mapping is guided by an advisory committee of public and private interests, and is funded by 50-50 matching federal grants. Since 1993, we have received over \$2 million in federal funds, an amount exceeding two-thirds of the 45 states participating in the program.

Geologic maps are combined with related information that is tailored to our constituents needs. A particularly useful "applied" map produced in 2010 delineates areas where karst features such as sinkholes and losing streams are common, possible, or unlikely to occur. This map has been used by local watershed projects, planning departments, and road departments. Similarly, we have begun mapping areas where different types of geothermal heating/cooling systems are more economically feasible to install and use. This effort is funded by a grant from the U.S. Department of Energy and is designed to head off the construction problems that have been encountered by some users of this promising, rapidly growing renewable energy source. We are partnering with active interests in the City of Dubuque as this work begins.

--Details of Iowa's Land Cover

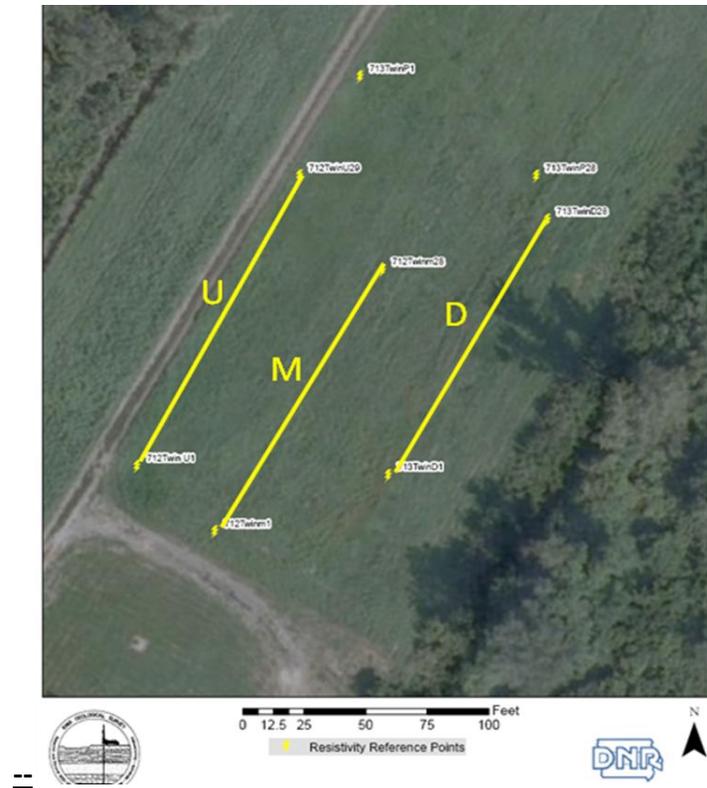
Remote sensing specialists in the GIS Section are producing a statewide, high-resolution, land cover layer, which provides an incredibly detailed look into the status of our land use. Final inspections and processing are currently taking place and several Iowa counties are currently available to the public through the DNR NRGIS Library (<http://www.igsb.uiowa.edu/nrgislib/>). The final products are a one-meter resolution GIS grid based on multiple high resolution photography sources. Products will be available for all Iowa counties in 2012.

Geologic Hazards

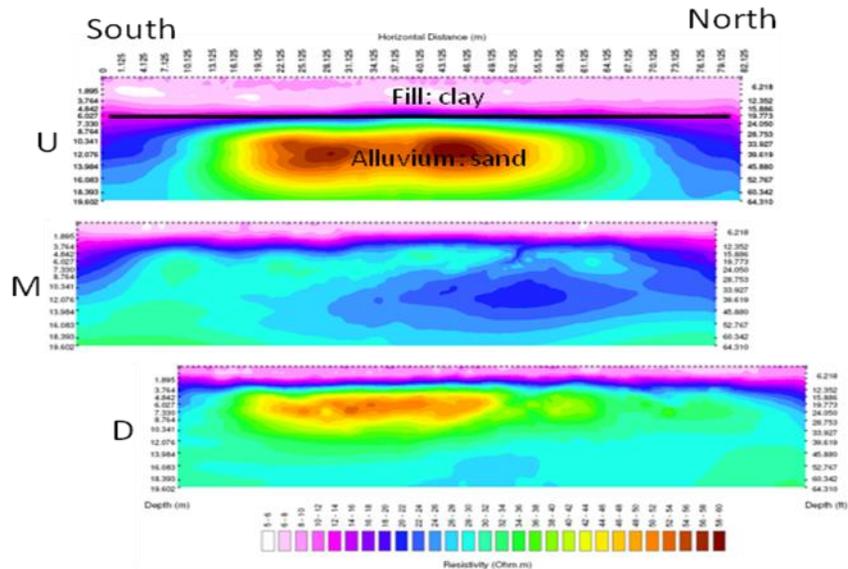
--Geologic Hazards Geophysical Report

Iowa's varied geologic settings and history result in a range of potential hazards to public safety and infrastructure. Floods, landslides, sinkholes, abandoned mine subsidence, and earthquakes are hazards that require public awareness and understanding. Information on basic geologic hazards is available through our website or by direct contact with staff through email or telephone. Geological mapping conducted through the STATEMAP program and various investigations provides baseline information on the location and nature of hazards in various regions of the state. This information is incorporated into planning documents and provides the basis for detailed investigations on hazard assessment. Annually, the Survey cooperates with various county and state agencies involved in Iowa hazard mitigation. In 2011, the Iowa Geological and Water Survey participated in the following hazard mitigation activities at the request of the Iowa Homeland Security and Emergency Management Division:

- Conducted geophysical investigations to assess levee vulnerability in the Council Bluffs area in western Iowa as a result of the sustained flooding along the Missouri River.
- Asked to develop geophysical investigative procedures to evaluate levee integrity in response to Missouri River flooding and the potential for levee failure in the Council Bluffs area.
- Participated in the review and revision of the Iowa State Hazard Mitigation Plan. Updating the State Hazard Mitigation Plan qualifies Iowa for all available federal assistance in the event of disasters. It provides a framework to save lives and reduce the vulnerability to natural and man-made hazards.



Geophysics lines collected on Twin Cities Levee, Council Bluffs, Iowa in July 2011. Lines collected to assess levee integrity from prolonged Missouri River flooding.



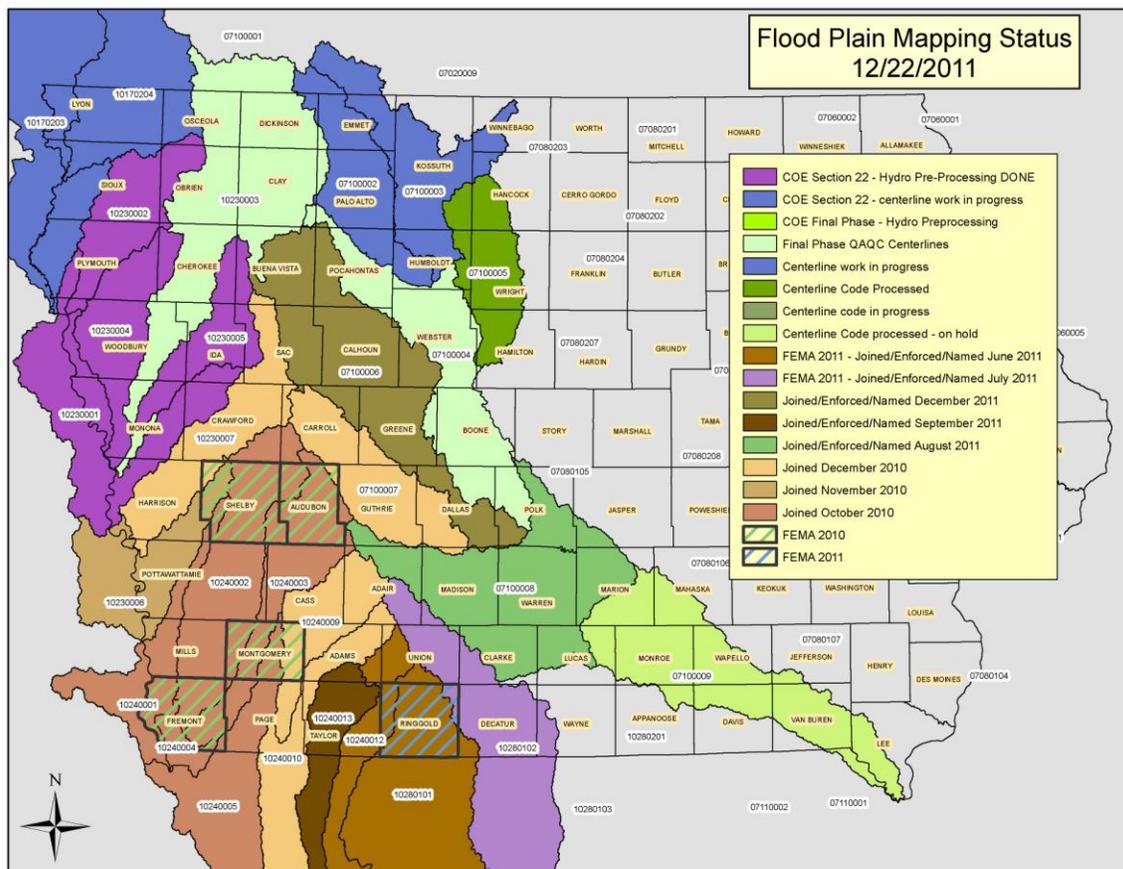
Electrical resistivity results from the Twin Cities levee show consistent fill in the levee and no sand present in the levee midslope. Geophysics indicates adequate levee integrity at this location.

--Flood Assistance

During the extended flooding along the Missouri River, IGWS provided a number of services for affected communities and residents. These included assessments of high water levels at Lake Manawa, evaluation of mitigation methods, and preparation of predictive maps for areas facing the potential for groundwater flooding. We also tested methods for non-destructive testing of levees and mapping of geologic conditions that might lead to levee instability. These methods hold promise as tools for proactive steps towards flood protection.

--Floodplain Mapping

The statewide floodplain mapping project is now in full production mode. The DNR is partnering with the Iowa Flood Center (IFC at the University of Iowa) to accomplish the mapping and is working closely with Federal Emergency Management Authority (FEMA) and the U.S. Army Corps of Engineers to ensure final products will meet federal expectations. Five Iowa counties are in the process of being submitted to FEMA for review and final map production. This effort has been made possible by State of Iowa and Community Development Block Grant funding.



Floodplain mapping progress and status through 2011.

--Sinkhole Hazard Mapping

Where limestone bedrock is found close to the land surface, the porous rock may allow for surface collapse to occur. This can result in property damage, drainage alteration, and the funneling of unfiltered and contaminated runoff into groundwater aquifers. IGWS staff utilized LiDAR and historic photography to map locations where current and past sinkholes have occurred, allowing for these features to be better planned for, avoided, and mitigated. Over 24,000 sinkholes have been mapped in the most sinkhole-prone parts of the state, primarily northeast Iowa, with mapping of additional large areas still in process.

--Earthscope Comes to Iowa

EarthScope is a \$300 million National Science Foundation sponsored program to use geological and geophysical techniques to explore the structure and evolution of the North American continent and to understand the processes controlling earthquakes and volcanoes. One major part of the program is the Transportable Array, a series of 400 seismometers that are being deployed in a rolling array across the United States over a



10-year period. These seismometers record seismic waves released by earthquakes that occur around the world and telemeter that information to a central data repository. By analyzing the records of earthquakes obtained from this dense grid of seismometers, scientists can learn about Earth structure and dynamics and the physical processes controlling earthquakes and volcanoes. The stations are spaced 70 km apart and record for two years before being removed and installed in a new location. In the summer of 2010, stations were installed in the western half of Iowa. In 2011, the eastern stations were installed. A total number of 32 Iowa stations are now reporting information. Geologist from the IGWS were instrumental in spearheading the initial organization of the Iowa Earthscope program, as they taught several training classes and selected faculty at the University of Northern Iowa to supervise seismic station site selection.

Mines, Minerals, Energy

--Hydraulic Fracking and Natural Gas

Natural gas produced from fracturing otherwise non-producing shale strata has become an incredible and fast developing addition to the nation's energy portfolio. Just five years ago, little gas was produced this way; currently "fracking" accounts for 25% of the nation's gas production, and may account for half in 20 years. While fracking isn't occurring in Iowa the process has raised considerable interest and questions for IGWS staff. Currently the fracking boom has resulted in increased production of sand from an existing mine in Clayton County. The geologic strata called the St. Peter Sandstone is mined there, and it is the "industry standard" sand for fracturing shale, because of its

uniform size and natural purity. There has also been some interest in the deep geologic structure known as the Midcontinent Rift as a shale gas play, the same expansive zone that Amoco drilled an 18,000-foot oil test in the 1980s. While this is viewed as a long shot as a resource, it has served as a reminder that our oil and gas regulations are in need of being updated, a situation that needs to be addressed.

--CAES - Compressed Air Energy Storage Project

CAES is a system for storing compressed air underground until the need arises to utilize it to supercharge gas turbine power generators. Two CAES facilities are currently in operation, and both are storing compressed air in abandoned salt mine cavities in Germany and Alabama. A proposed Iowa CAES facility was to be the first to store air in the pore spaces in a sandstone aquifer, in much the same way that natural gas is stored in Iowa. The Iowa Geological and Water Survey has been working since the plan's conception with a consortium of Iowa and Midwest energy companies on the Iowa Stored Energy Park west of Des Moines. The facility was to use wind energy to compress air and store it in a geologic formation about 3,000 feet below the surface. IGWS geologists worked closely with contractors to select an appropriate geologic structure for the facility, train and advise the contractor geologist, and provide technical expertise in the geologic and hydrologic aspects of the project. Unfortunately, after geophysical studies and the drilling of three test cores, it was determined that the geologic capacity of the structure was not sufficient for the required storage and the project was abandoned.

--Base Metal Potential in Northeast Iowa

In late 2011, a project was launched to investigate the potential for base and precious metal resources in the Precambrian basement of northeast Iowa. The project is under the direction of geologists from the U.S. Geological Survey and Iowa Geological and Water Survey. The USGS, along with a host of academic institutions and others, began work to devise an exploration strategy to explore a suite of mafic igneous plutons, ranging in depth from 2,000 to 4,000 feet below the land surface. These plutons are related to the Duluth Complex in Minnesota, where world class economic concentrations of chromium, vanadium, platinum, titanium, gold, and silver have been recently discovered. Initial stages of the exploration program will include acquisition of detailed geophysical information, such as airborne gravity, magnetic, and electromagnetic information, to inform exploration core drilling. IGWS geologists have played a critical role in the project, initially sparking interest in the potential resource with a presentation at a national geological professional meeting, then providing project scientists with geological and geophysical maps, rock analyses, copies of student theses, and other related studies, as well as providing general information derived from years of in-house investigations of the Iowa Precambrian.

--Oil and Gas

IGWS is the permitting bureau within the IDNR for oil and gas exploratory drill tests as well as tests for underground natural gas storage and metallic minerals. Permit applications and rules are available at

<http://www.igsb.uiowa.edu/EconomicResources/OilGasRegulation.htm>. Our bureau maintains records from 130 oil exploration tests and numerous tests for natural gas storage projects. Records include driller logs, geologist logs of sample sets, and borehole geophysical logs. Information about most of these drillhole records is available at <http://www.igsb.uiowa.edu/webapps/geosam/>. Iowa does not have commercial oil or gas production and only two wells have ever produced measurable amounts of oil. Commercial oil production occurs close to the southern border of Iowa in the adjacent states of Nebraska, Missouri, and Illinois. The most recent oil test drilled in the state was the Ozona Natural Gas Company, Daniel and Linda Brown #1 (IGWS W-64885), Garfield Township, Montgomery County. The 3,594 foot deep test was not successful and was plugged and abandoned in May, 2010.

--Active Mining

In 2008, Iowa's nonfuel raw mineral production was valued at \$680 million, based upon annual U.S. Geological Survey data. This was a \$13 million, or 1.9%, decrease in Iowa's total nonfuel mineral production value from that of 2007, which followed a \$12 million, or 1.7%, decrease in 2007 from that of 2006. Though Iowa's total production value decreased, Iowa rose to 31st in rank from 32nd in 2007 among the 50 states in total nonfuel mineral production value and accounted for less than 1% of the U.S. total. With a population of nearly 3 million, the per capita production value of the State's nonfuel mineral industry was \$227, making Iowa 16th in the Nation on a per capita basis.

Since 2005, Iowa has continued to be second among the 18 crude gypsum-producing states. Iowa continued to rank among the top 20 producing states for crushed stone, portland cement, construction sand and gravel, and lime. No metals were mined in Iowa; the state's metal production, including molybdenum and raw steel, came from the processing of materials acquired from other domestic and foreign sources. During 2011, requests for minerals information and reports increased as a result of the boom in exploration activity, particularly with critical minerals and rare earth elements.

Silica sand for the oil and gas hydrofracking industry is now mined at the Pattison Sand Mine at Clayton, Iowa. The mine operates both underground workings and an open pit quarry to mine St. Peter Sandstone. The sand is processed onsite into several products and shipped mostly via rail to customers. Pattison Sand Company LLC operates the mine and process plant.

--Geothermal Energy

The Survey successfully completed the first year of a major three-year Department of Energy-funded subcontract administered by the Arizona Geological Survey to identify, compile, and digitally format relevant geotechnical information within the state. The long-term goal is to produce maps that serve as a resource and guide for geothermal system installation throughout Iowa. These data will be cataloged in the new National Geothermal Data System and will be nationally accessible via an on-line browser interface.

Water Resources

--Water for Iowans - 2030 and Beyond



IGWS staff produced predictive models of our major groundwater aquifer systems to address long-term questions about “water quantity.” These models combine all available information on the geology, hydrology, and use of groundwater. Following rigorous testing, they can be used to predict how current or proposed groundwater withdrawals will affect other users and the sustainability of our groundwater supplies; how climate change or severe drought will impact our water; and what future water development scenarios will mean for the resource and users. As the full impacts of groundwater use decisions are not felt until well into the future, the models are a critical tool for sustainable water management for our communities, economy, and quality of life.

In 2008, our work focused on the Dakota Sandstone, which underlies much of northwest Iowa, and in 2009 on the deep Jordan Aquifer, which underlies much of the state. In 2010, predictive models were completed for the West Nishnabotna River aquifer in southwest Iowa and the Des Moines River alluvial aquifer between Emmetsburg and Graettinger (Palo Alto Co.). In 2011, predictive models were completed for the Silurian aquifer in east-central Iowa. The calibrated groundwater flow model was used to address the wellfield expansion for the City of Marion and the City of Coralville.

In addition to developing the new models, models and staff expertise provided a localized assessment for a moderate drought in Linn County during the fall of 2011. The impact of this moderate drought forced the City of Marion to lower the pump in one of their city wells. The groundwater flow model was used to evaluate the potential well interference of numerous municipal and industrial water users, and how each user may have contributed to the overall decline in water levels.

As 2012 begins, we are monitoring and evaluating the effects of developing drought conditions in northwest Iowa on water resources. In addition we are planning for public information sessions with water interests in Linn and Johnson counties, where increasing withdrawals from the Silurian and Jordan aquifers will require informed local decisions.

--Water Supply Development for Today

For over 70 years, the Iowa Geological and Water Survey has partnered with wells drillers and consultants to gain an understanding of Iowa’s geology and groundwater. Drillers collect samples of the rock they are drilling through, store them in bags, and describe the well on forms supplied by IGWS. In turn, IGWS archives the well cuttings and records, studies and interprets them, and supplies the information and expertise

out the next time a business, rural resident, or town needs water. For example, staff assisted Shawver Well Company on these larger projects in the last several years:

- Arthur Ethanol, Arthur, Iowa
- Grand Junction Ethanol, Grand Junction, Iowa
- Dyersville Ethanol, Dyersville, Iowa
- Pine Lake Ethanol, near Eldora, Iowa
- Golden Grain Ethanol, Mason City, Iowa
- Fairbank Ethanol, Fairbank, Iowa
- City of Laurens, Iowa
- City of Manson, Iowa
- City of Bellevue, Iowa
- Pattison Sand Company, Clayton, Iowa
- Red Star Yeast, Cedar Rapids, Iowa
- Decorah High School, Geothermal well project, Decorah, Iowa
- Waverly Middle School, Geothermal well project, Waverly, Iowa
- Pilot Truck Stop, I-80 (Atalissa Exit)
- River City Stone (Ruby Quarry), Dubuque, Iowa
- Davenport Schools test wells, Davenport, Iowa

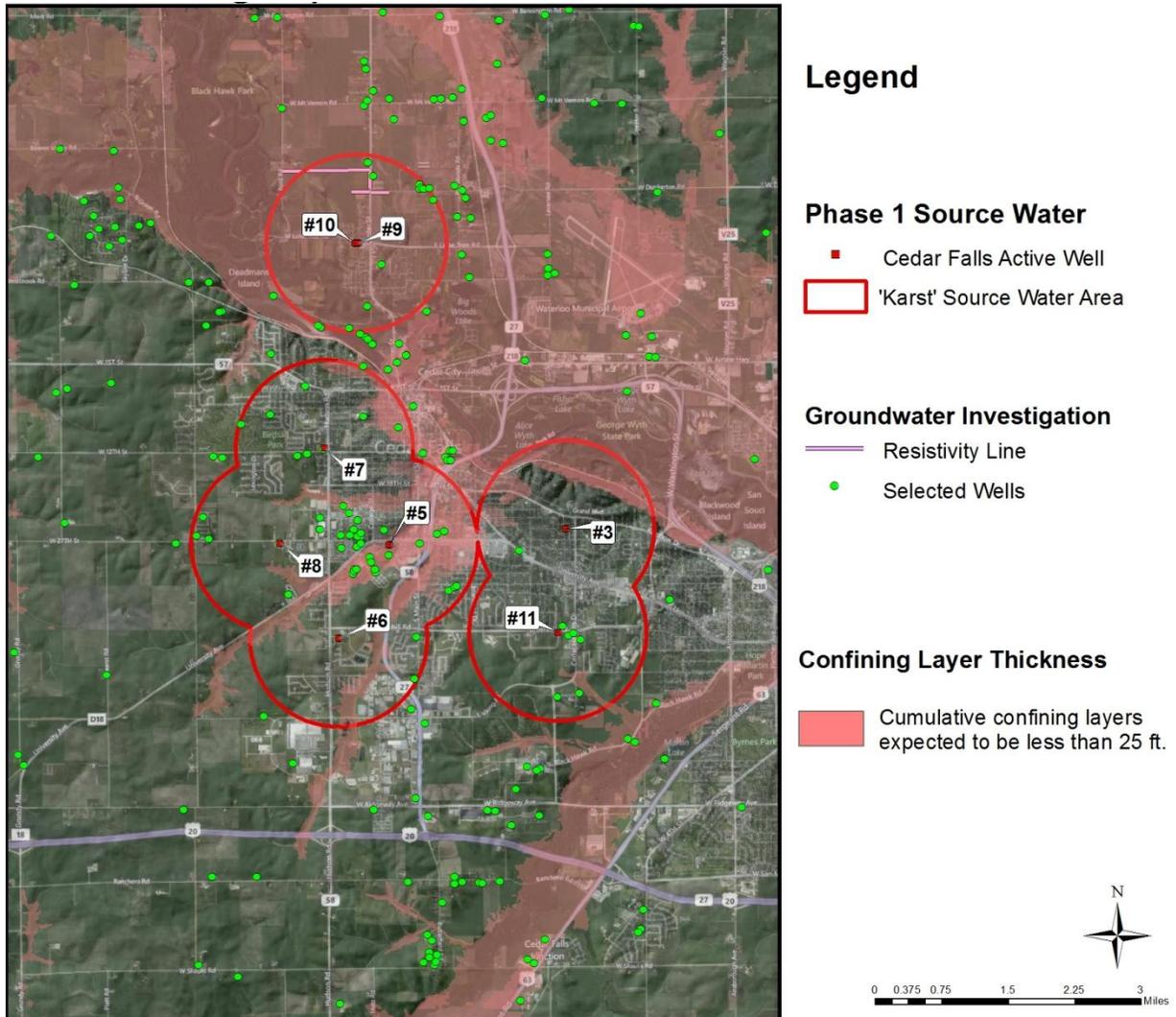
--Source Water Protection for Iowans Drinking Water

Iowa's Source Water (a.k.a. drinking water) Protection program provides public water supplies with information and technical assistance needed to protect their wells or surface water intakes from natural and human contamination. The Iowa Geological and Water Survey plays a key role in interpreting geologic information to help communities proactively address both water quality and quantity issues, and reactively address well construction or contamination problems. IGWS well and system records go back over a century and provide extensive information on historic changes in well construction, drilling methods, and aquifer use.

This past year public water supply mapping and inventory resources were merged together into a single easy to access online application (Source Water Tracker). This application graphically depicts the drinking water areas, wells, and potential contaminants located in the community, along with hosting other information such as Iowa DNR field visits and reports. Additionally, the source water assessment report given by the program to every Iowa community water supply has been updated to include more useful information such as a five-year nitrate history, web-linked wells, and linked potential contaminant sources.

Many Iowa communities received scientific help from the program during the past year. Cedar Falls had a groundwater investigation completed by a joint Source Water and University of Northern Iowa study to address water movement through the highly fractured bedrock (karst) surrounding the city. The investigation merged geophysics, water chemistry, and high resolution elevation data (LiDAR) to better map groundwater movement, direction, and vulnerability in the area. Many other communities including

Charles City, Coralville, and Mount Vernon had their groundwater modeled for the purpose of better protection.

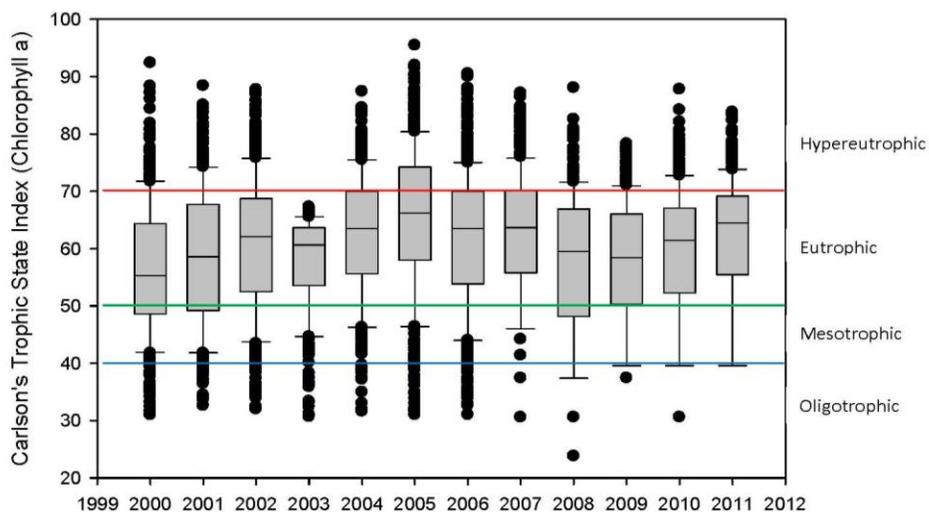


Geologic mapping and source water protection, Cedar Falls.

--Lake Monitoring

The ambient lake monitoring program sampled 131 lakes in 2011 for a variety of chemical, physical, and biological parameters. The lake monitoring program is a partnership between DNR's Watershed Monitoring and Assessment Program and Lake Restoration Program. The data were used in 2011 to track the status and trends in water quality in Iowa's lakes, to track the success of watershed improvement projects and lake restoration activities, and to better manage our lakes.

The figure below shows Carlson's Trophic State Index (TSI) for chlorophyll a for all lakes from 2000 through 2011. Carlson TSI values range from 0 to 100. The Carlson TSI values can be used to divide lakes into four main lake productivity categories (amount of biological activity or relative nutrient richness): oligotrophic (least productive), mesotrophic (moderately productive), eutrophic (very productive), and hypereutrophic (extremely productive). Mesotrophic lakes, for example, generally have a good balance between water quality and algae/fish production. Eutrophic lakes have less desirable water quality and can have an overabundance of algae. Hypereutrophic lakes have poor water quality and experience frequent algae blooms. For 2011, based on the average chlorophyll a TSI value, 11 lakes were mesotrophic, 105 lakes were eutrophic, and 16 lakes were hypereutrophic.



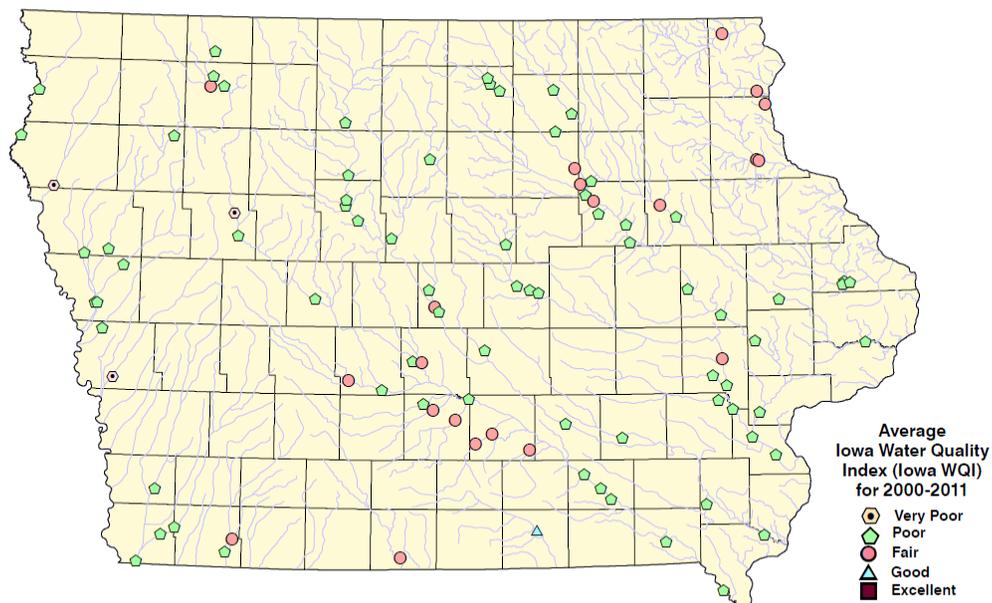
Carlson's Trophic State Index for chlorophyll a for all lakes monitored from 2000 through 2011 as part of the DNR's ambient lake monitoring program.

--Stream Monitoring

The ambient stream monitoring program sampled 82 stream locations for chemical and physical parameters during 2011. The stream monitoring program is conducted in partnership with the State Hygienic Laboratory to provide information on the status and trends of streams in Iowa and to report the condition of streams to citizens, decision makers, and resource managers. Stream monitoring data are currently being used to develop stream nutrient standards, to provide guidance as part of the point source nutrient reduction strategy, and to report on Iowa's Water Quality Index (IWQI). IWQI rates water quality using the following nine parameters: biological oxygen demand, dissolved oxygen, *E. coli* bacteria, nitrate+nitrite as nitrogen, total detected pesticides, pH, total phosphorus, total dissolved solids, and total suspended solids. IWQI values are calculated monthly and are divided into categories of excellent, very good, fair, poor, and very poor. The IWQI results are posted on a Google map, which allows the user to see the current status of the stream as well as historical trends (<http://www.igsb.uiowa.edu/wqm/data/wqi/wqi.htm>).

The Iowa Water Quality Index data were used by Iowa State University to examine factors influencing river and stream usage patterns in Iowa. Site quality and site characteristics, including the Iowa Water Quality Index, were evaluated to determine their impact on river and stream usage. Do Iowans value their rivers and streams based on water quality or do a variety of factors influence their usage?

Biological monitoring, including fish and benthic macroinvertebrate taxa identification, continued in 2011. The biological monitoring program focused on the development of an index of biotic integrity for small headwater streams in the north-central or Des Moines Lobe region of Iowa. Additionally, the wadeable stream reference network continued to be monitored at the rate of 20 sites per year. These reference sites are minimally impacted by human activity and provide information on the expected



Iowa Water Quality Index for 2000 through 2011. For 2000-2011, 1% of the monthly stream IWQI values were in the excellent category, 11% were good, 34% were fair, 35% were poor, and 19% were very poor.

biological condition of streams in different ecoregions of the state. Monitoring of these sites may also provide information on the impact of climate change or changes in the hydrologic system through time. Information from Iowa's biological monitoring network is being used to help understand the impact of nutrients on biological communities and a report on the data analysis will be available in mid-2012.



Biological monitoring of streams provides an indication of the overall health of a stream based on the fish and aquatic insect populations (photo courtesy of the State Hygienic Laboratory at the University of Iowa).

--Wetland Monitoring

Iowa's wetland monitoring program participated in the National Wetland Condition Assessment (NWCA) in 2011. The NWCA is the first survey ever designed to assess the ecological integrity of wetland resources at the national scale. The probability based

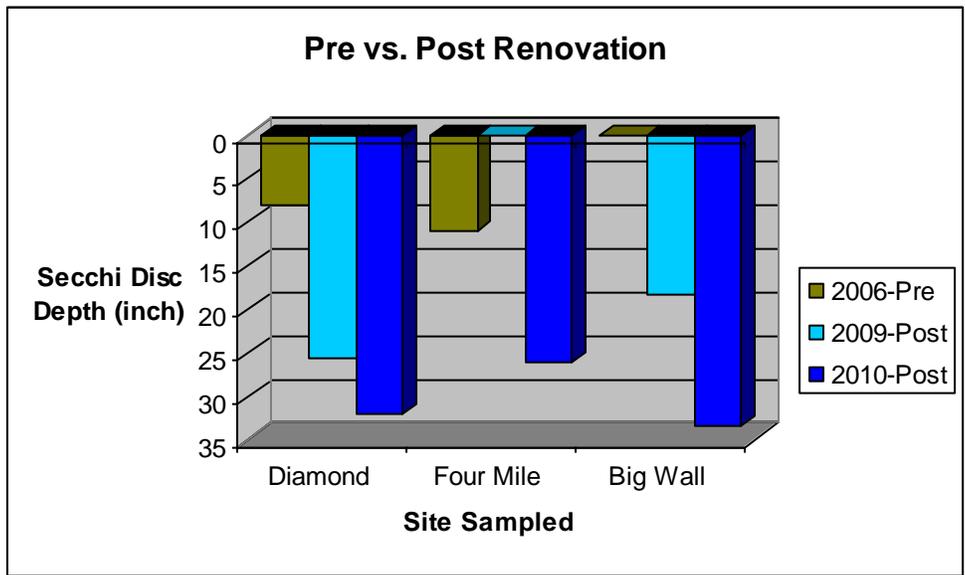


Healthy wetlands remove nutrients from water, provide wildlife habitat, and provide recreational opportunities for Iowans.

survey develops a consistent baseline of information to determine changes in wetland health through time and across jurisdictional boundaries. Data were collected on algae, plant composition, water chemistry, and soil chemistry from 14 sites across Iowa. The wetland program is developing an index of wetland health for prairie pothole systems. Data on water chemistry, biology, and disturbance factors are used to separate high quality wetlands from degraded wetlands. The index will be used to report on the condition of prairie pothole or depressional wetlands. Also in 2011, a study on the value of farmed wetlands in Iowa was initiated. This project is providing baseline information on amphibian and reptile use, waterfowl and shorebird use, water quality, and hydrology in farmed wetlands.

--Shallow Lake Monitoring

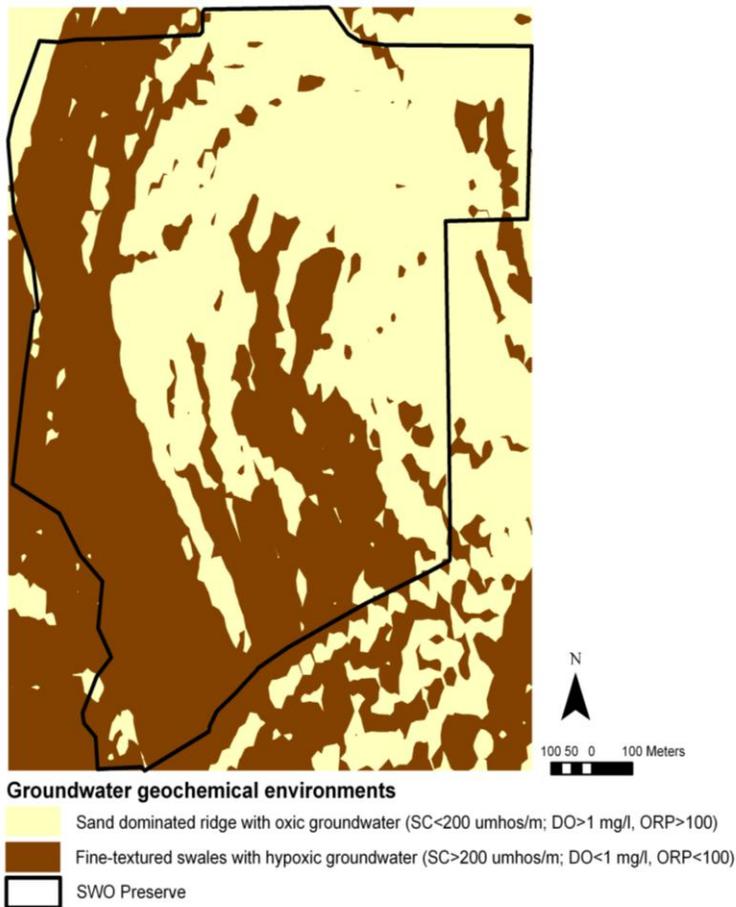
Over the past century, the biological integrity of Iowa’s shallow lakes (defined by a mean depth of <10 feet) has declined significantly due to altered hydrology, inputs of sediment and nutrients, and the introduction of invasive rough fish. In 2006, the Iowa Department of Natural Resources (IDNR) Wildlife and Fisheries bureaus, and Ducks Unlimited, Inc. (DU) launched an initiative aimed at restoring these highly degraded shallow lakes and large wetland complexes located within Iowa’s Prairie Pothole Region. Continuing in 2011, the IDNR Watershed Monitoring and Assessment Section conducted pre- and post-renovation water quality monitoring and biological assessments. These data are used to evaluate baseline ecological conditions, determine specific restoration needs, and assess possible renovation techniques and the effectiveness of restoration projects.



Shallow lake monitoring has shown improvements in water clarity from pre- to post-lake renovation for Diamond Lake (Dickinson Co.), Four Mile Lake (Emmet Co.), and Big Wall Lake (Wright Co.).

--Quantifying Ecosystem Services in Floodplains

Intensive urban development and agricultural utilization have reduced the potential for water and nutrient processing to occur on floodplains. In collaboration with Grinnell College and The Nature Conservancy (TNC), we are investigating how floodplains process excess water and nutrients at monitoring sites located on the floodplain of the Cedar River in Muscatine County, Iowa. Hydrologic investigations, including continuous water table monitoring, surface and groundwater sampling, geophysical surveys and GIS analyses are revealing that ecosystem dynamics within floodplains are very complex, driven by spatial and temporal dynamics of surface water inundation, sediment deposition, and groundwater geochemistry. Our work is showing that floodplains in their native state provide important ecosystem services in agricultural watersheds by processing water and nutrients delivered during both flood and non-flood periods.



Variable groundwater geochemistry documented at TNC's Swamp White Oak Preserve located on the Cedar River floodplain in Muscatine County (from Schilling, K.E. and P. Jacobson. 2011 Spatial relations of topography, lithology and water quality in a large river floodplain. River Research and Applications, DOI:10.1002/rra.1531)

Public Health

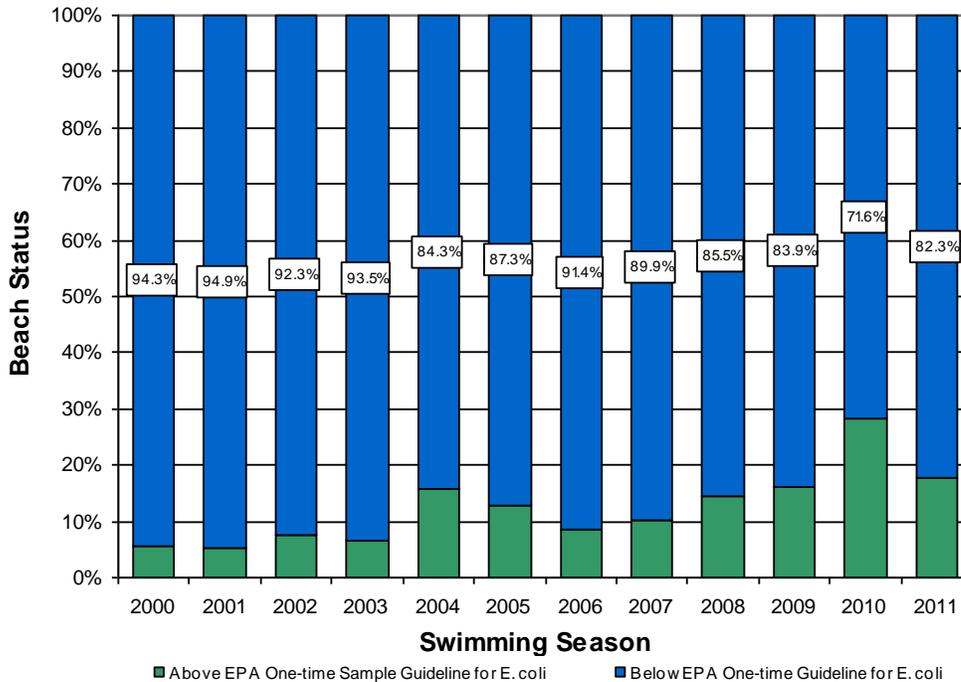
--Arsenic

Arsenic is a naturally occurring element that may occur in our groundwater at concentrations that exceed health recommendations. IGWS partnered with University of Iowa researchers and the Department of Public Health to conduct a survey of water quality from private wells. This survey showed that 8.5% of the private wells tested exceed the drinking water standard for arsenic. An analysis of existing records from public water supply wells gave a similar result, with 10% exceeding recommendations. This also provides an assessment of which groundwater aquifers are most likely to produce high levels of arsenic. In addition, we are assisting Cerro Gordo Public Health with an assessment of arsenic in private wells, as this area is a known hot-spot in Iowa for quite elevated arsenic levels.

--Beach Monitoring

The IGWS beach monitoring program collects data on indicator bacteria concentrations at beaches throughout the state with the goal of safeguarding the health of swimmers. The beach monitoring program routinely monitored 35 state-owned beaches in 2011; 31 city-, county-, and locally managed swimming areas elected to submit water quality samples, as well. Weekly samples were collected from the week leading up to Memorial Day through Labor Day. The most recent sample results, along with the swimming status at each beach, was updated on the IGWS webpage and Beach Hotline while advisory signs were posted at beaches exceeding recreational standards for indicator bacteria. During the program's twelve-year existence, beachgoers have come to rely on this information to make informed decisions about when and where to recreate at Iowa's beaches. The monitoring has shown that the overall bacterial water quality at Iowa's state-owned beaches has been generally good.

The Iowa Geological and Water Survey is also working with the Iowa Department of Public Health to implement a cyanotoxin monitoring and health surveillance program for surface waters throughout the state of Iowa. This program will be used to determine the relative health risk from contact with water bodies containing commonly occurring genera of blue-green algae and their associated toxins.



Percentage of weeks from Memorial Day to Labor Day during 2000 through 2011 where samples from Iowa's state-owned beaches exceeded the state one-time standard (235 organisms per 100 ml) versus weeks where samples were below the state one-time standard. For 2011, 82% of the samples met or were below the one-time standard.

Landuse Planning

--Green Urban Stormwater Projects

The Watershed Improvement Section awarded \$1.425 million of I-JOBS Infrastructure funds to 17 Iowa communities, businesses, and schools to help them improve urban water quality and create jobs. The grants helped Iowa organizations design and build projects that benefit water quality and reduce runoff from urban stormwater. The I-JOBS funds were matched by almost \$7 million in local funds. Urban green stormwater practices, such as bioswales, rain gardens, and permeable pavement, help slow and filter rainwater as it runs off urban surfaces. As it runs across lawns and pavement, stormwater can pick up pollutants like soil, fertilizers, pet waste, and oil. Rainwater washes into storm sewers, which dump the water into a local stream or lake without any treatment. A total of 15 of the original 17 projects finished their work as proposed to produce an excellent suite of practices that can serve as a model for other communities to emulate. Two projects were unsuccessful in moving from planning to construction and the funds were redirected to the Lakes Restoration Program for stormwater related work.

--Watershed Management Authorities

The Watershed Improvement Section was afforded the opportunity in 2011 to issue a Request for Proposals for the development of Watershed Management Authorities (WMA). With support from the U.S. Department of Housing and Urban Development disaster relief funds in response to the 2008 flooding, the DNR, in partnership with the Iowa Economic Development Authority, awarded six grants throughout the state to the: Upper Cedar River, Indian Creek, Turkey River, Catfish Creek, Squaw Creek, and South/Middle Raccoon River. The WMA process encourages political subdivisions (cities, counties, and soil and water conservation districts) to collaborate within a defined watershed for water quantity and water quality planning and implementation through a 28E agreement. The program goals for this one time grant program are to establish functional WMAs, establish an understanding of time and costs for successful development of a WMA, and learn from any hurdles or failures along the way. A second phase of the program will be unveiled in 2012 with up to three grant awards for comprehensive watershed planning in the newly formed WMAs.

--Basin Approach to Improving Water Quality

In 2008, the Watershed Improvement Program initiated a discussion within its core partnership (DNR, Iowa Department of Agriculture and Land Stewardship – Division of Soil Conservation, Natural Resources Conservation Service, and the local Soil and Water Conservation Districts) to explore rethinking and reshaping the approach used to deploy staff resources to more effectively support efforts to improve watershed management and improve water quality throughout the State of Iowa. As a result of these discussions, in 2011 the Watershed Improvement Program continued to expand the network of Basin Coordinators from four to five staff members with the addition of a Basin Coordinator to serve the Iowa/Cedar River Basin. Long-range plans, subject to available funds, are to continue to expand this network to a total of nine Basin Coordinators covering the six major drainage basins and three major river regions within the state of Iowa. The recently added Iowa/Cedar River Basin Coordinator is actively supporting the U.S. Army Corps of Engineers Iowa River Basin Interagency Coordinating Team (IRBIACT), as well as the grassroots Cedar River Watershed Coalition. The IRBIACT, led by the Corps of Engineers, is working toward preparing a Watershed Plan for the entire Iowa/Cedar River Basin over the next several years. This staff position will also be providing technical support to the Upper Cedar River, Indian Creek, Turkey River, and Catfish Creek watershed management authority processes that will be initiated in 2012. The DNR's Upper Des Moines/Raccoon River Basin Coordinator will be providing technical support to the Squaw Creek and South/Middle Raccoon watershed management authority processes that will be initiated in 2012. In addition, this Basin Coordinator continues to support the implementation of the USDA Upper Mississippi River Basin Healthy Watershed Initiative funding to help landowners reduce nutrient loading which contributes to hypoxia in the Gulf of Mexico.

--Environmental Geology and Animal Feeding Operations (AFO)

IGWS staff provided geologic and environmental assessments and tools for the AFO program and for producers. These help assure compliance with regulations, allow producers to make informed choices about their operations, and provide the needed analysis for producers to take advantage of federal cost-share programs.

- IGWS staff assist producers and technical service providers with siting AFOs in locations that minimize environmental impacts through the interactive mapping web service, the AFO Siting Atlas.
- IGWS consulted directly on karst and alluvial issues related to 67 construction projects between January 1 and June 30, when support for this service was eliminated. A guidance document was developed to help producers meet requirements.
- IGWS staff assisted with 15 construction permit reviews and 6 well variance requests between January 1 and June 30, 2011. These reviews are dependent on bedrock depth, soils data, well data, sinkhole location data, and other information sources that IGWS continuously update and improve.
- IGWS staff track and evaluate water monitoring required by AFO construction permits.
- IGWS staff published a statewide map of AFOs which documents the current distribution of operations and their locations relative to sensitive areas including public lakes, karst areas, and source water capture zones for public water supplies.

GIS support for the AFO program has improved the ability of field staff to respond to spills, made it easier for producers to track their permits and maintain compliance, allowed watershed coordinators to identify candidates for voluntary improvements, and improved the accuracy of total maximum daily load (TMDL) assessments, which are the foundation of many watershed improvement programs.

Watershed Studies

--TMDLs – Targets for Water Quality Goals

The TMDL program experienced a 27 percent cut in its federal EPA funding in 2011. This resulted in a loss of over \$114,000 in funds used to develop Water Quality Improvement Plans (WQIP). This federal budget cut forced the program to scale back on its planned water quality monitoring efforts in support of TMDL development. In spite of this major budget cut, the TMDL program prepared WQIPs, also known as total maximum daily loads (TMDL) for five water bodies in 2011. These included Black Hawk Lake in Sac County (algae, turbidity); Dry Run Creek in Black Hawk County (biological due to runoff from continuous impervious surfaces); Briggs Woods Lake in Hamilton County (organic enrichment / low dissolved oxygen, algae); Hannen Lake in Benton County (algae, pH, ammonia, turbidity); and a basin wide project in the Yellow River for bacteria. The final versions of Hannen Lake and the Yellow River will be released in early 2012. Staff also

developed watershed/water quality models to support local watershed planning efforts in Rapid Creek in Johnson County, Duck Creek in Scott County, and Storm Lake in Buena Vista County. Biologists on staff started work on two new initiatives; a statewide mussel survey scheduled to be completed over six years, and a fish kill follow up sampling strategy to investigate potential recovery of biological impairments due to fish kills. Finally, the program conducted water quality monitoring in a number of water bodies in preparation for future WQIP development scheduled for the next two years.

--Nonpoint Source Pollution Projects

As with the TMDL program, the Nonpoint Source Program experienced a 27 percent cut in its base level of funding from the US EPA. This translated into a loss of \$458,000 in federal funding to support the program's mission. These cuts resulted in the elimination of the program's partial support for two field staff positions responsible for assisting landowners in implementing upland conservation practices that would benefit water quality and wildlife. It also forced a 60 percent reduction in funds to support wetland and trout stream restoration efforts. New funding to support watershed planning efforts was completely eliminated from the budget as a result of these cuts in federal funds. And finally, support for the Iowa Learning Farms was scaled back by over 30 percent in order to comply with these federal budget cuts.

In spite of these major cuts in funding, in 2011, the Nonpoint Source (NPS) Program awarded \$1,662,000 in EPA Section 319 nonpoint source grant funds to five new and ongoing watershed improvement projects designed to improve water quality throughout the state. These watersheds included Black Hawk Lake (Sac County), Clear Lake (Hancock and Cerro Gordo counties), Duck Creek (Scott County), Price Creek (Iowa County) and Lake Rathbun (Wayne, Lucas, and Appanoose counties). The NPS Program has also allocated \$156,000 in funding to conduct water monitoring over a three-year period in the five watersheds mentioned above. In addition, the NPS Program provided \$132,636 in funding to continue support for the Iowa Learning Farms project, a water quality/farmer educational project overseen by the Leopold Center at Iowa State University.

The NPS Program also awarded a Watershed Planning grant totaling \$41,969 to a local watershed group to develop a Watershed Management Plan for the Hickory Grove Lake watershed in Story County, and has tentatively awarded a Watershed Planning Grant totaling \$35,000 to a local watershed group to develop a Watershed Protection Plan for the Waterloo Creek watershed in Allamakee County. The Watershed Protection Plan would be the first plan of its kind in Iowa to protect a high quality water resource—Waterloo Creek—which is on Iowa's Outstanding Waters list. The NPS Program has also tentatively awarded a grant for \$7,480 to the Clarke County Soil and Water Conservation District that would provide funding for targeted water monitoring in the West Lake Osceola watershed, which serves as the drinking water supply for the City of Osceola.



Conservation practices for protecting water quality near Red Rock Lake in central Iowa. (Photo by USDA Natural Resources Conservation Service).

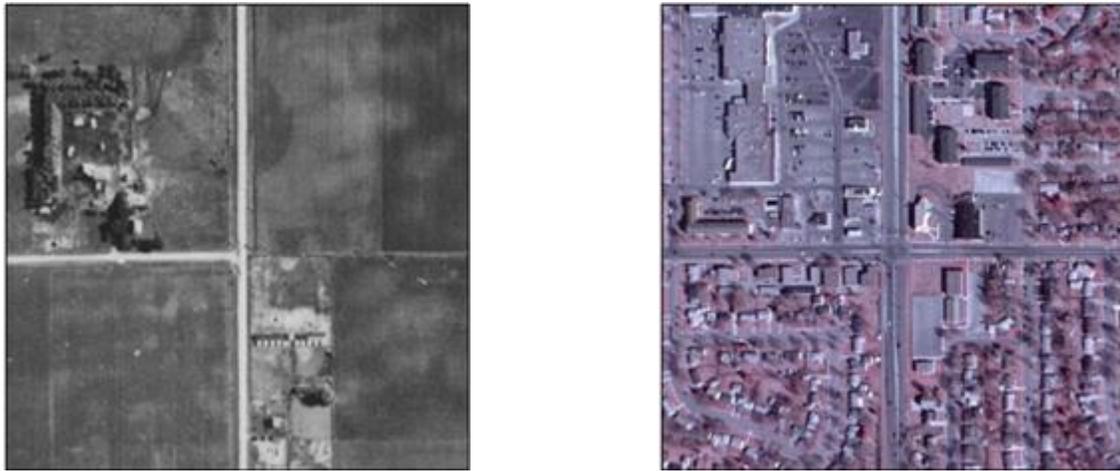
A major initiative for the NPS Program in 2011 was a much needed update to the Nonpoint Source Management Plan (NPSMP or Plan). The NPS Program used the updating of the state's Plan as an opportunity to engage the core NPS Program partners (Natural Resources Conservation Service, Iowa Department of Agriculture and Land Stewardship-Division of Soil Conservation, Iowa State University, Conservation Districts of Iowa) and over 50 stakeholder groups involved in the work of nonpoint source pollution reduction. Third party facilitation of a visioning process, led by the University of Northern Iowa's Institute for Decision Making, has spanned the better part of 2011 with an engaged group of partners and stakeholders crafting a direction for the next 5-10 years of work within the NPS Program. The final document is slated for an early 2012 finish and aims to provide a blueprint for work by the NPS Program, the state's water quality professionals at the DNR, and our partners at NRCS, IDALS-DSC, Iowa State University, Conservation Districts of Iowa, and engaged stakeholder groups throughout the state.

Data Management

--Historic Aerial Photography

Aerial photos from the past capture the history of Iowa's natural landscape and human activities. What was this land used for in the past? Is there contamination? Has the drainage changed? What used to be here? These are common questions from those who own or want to develop Iowa's lands. In 2011, the GIS program added the 1970s

and 1980s photos to the decadal collection which begins in the 1930s. These data are available free on most Iowa GIS websites.



Intersection of 24th and Grand, Ames, 1939 and 2002.

--Web-Based GIS Applications

The GIS program develops web-based mapping services for a variety of DNR's program areas. Several web services were built and tested during 2011, and most have now been implemented. Examples include the Iowa Water Web, Coal Mines, and the Outdoor Recreation Atlas. A number of applications were also developed for the facility-based One-Stop database.

--Iowa Geospatial Infrastructure

The IGWS GIS Section is working with GIS data producers in the state, including county GIS departments and other state agencies, to develop a concept called the Iowa Geospatial Infrastructure (IGI). The IGI is a large-scale cooperative effort to produce and maintain common base GIS layers for the entire state (roads, rivers, land ownership, addresses, aerial photos, etc.), and make them available to all GIS users including government, private, academic, and non-profits. Using state information technology funds, two new projects were started in 2011 to get IGI going: a GIS service bureau to assist all agencies to create and use GIS data and make it more readily available, and GIS metadata training that assists data producers to create GIS metadata and publish it on the Iowa Geospatial Data Clearinghouse, where the public can more easily find it. The Iowa Geocoding Project continued in 2011 as well. This project collects county GIS information needed to create address points and building points for every structure in the state. As of the end of 2011, 50 counties were complete and 16 more in progress. Sustainable funding for IGI projects is needed to continue them into the future. Return on Investment studies of IGI show that through coordination, cooperation, and data sharing, substantial benefits (\$7 in benefits to \$1 in costs) to the state can be realized beyond the normal benefits of individual state and local GIS programs operating by themselves without coordination or cooperation.

Education Outreach

--State Geological Surveys Meet in Iowa

Each state has a state geological survey, serving the earth, economic, and natural resource needs of the state. Their national association is the Association of American State Geologists (AASG). Each June, an annual meeting is held and hosted by a different state. 2011 marked the first time Iowa has hosted this meeting in the 103-year history of AASG. The meeting, held in Dubuque, was attended by State Geologists or their designees from 35 states, senior managers from the U.S. Geological Survey and other federal agencies, and a variety of earth, water, and energy-related NGOs. The meeting featured workshops on geologic mapping, water, energy, and information technology, and included field trips looking at the geologic history and environmental setting of the Upper Mississippi River valley and northeast Iowa.

--IOWATER

IOWATER is Iowa's volunteer water quality monitoring program. Since 2001, IOWATER has trained Iowans interested in our water quality, the status of aquatic life, and our outdoor environment. We provide a web-available database for volunteers to enter and view results. IOWATER has been a highly successful effort, training thousands of Iowans of all ages and walks of life. The IOWATER program continues to connect citizens with watershed professionals in their area to help fill the data gaps for waters of local or regional importance. These volunteers provide a lasting sense of stewardship and commitment to improving water quality for all Iowans. The program has also begun to work more extensively with K-12 teachers to build IOWATER activities into the classroom by helping develop inquiry or problem-based learning modules. Students collecting water quality data through the IOWATER program are more likely to understand the complex dynamics of water quality than peers that are working exclusively with prescribed laboratory activities.

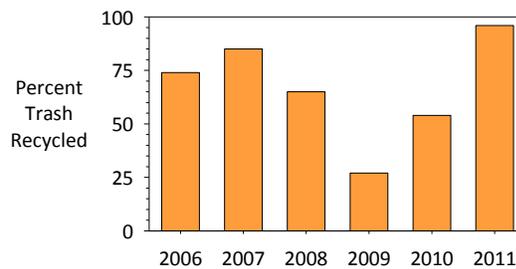
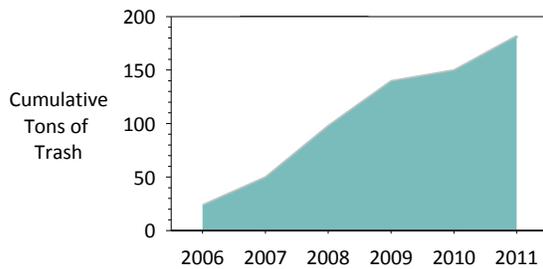
--Project AWARE

In 2011, Project AWARE held its ninth annual event on the Little Turkey, Turkey, and Volga rivers in northeast Iowa. Project AWARE (**A Watershed Awareness River Expedition**) is the DNR's volunteer weeklong river cleanup. A total of 90 river miles were cleaned by 429 volunteers (ranging in age from 2 to 76), and a total of 32 tons of trash were removed (96% was recycled) from the rivers. One hundred and four different sponsors supported the event through either monetary or in-kind donations.



AWARE volunteers construct a “canoemaran” to haul tires out of the Turkey River.

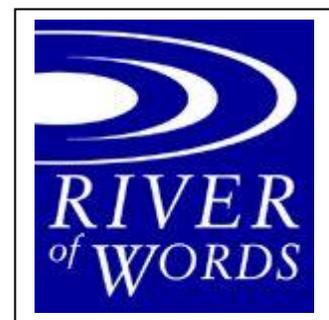
As part of a five-day Iowa State Fair interpretive working exhibit, volunteers and fair-goers also experienced Project AWARE by sculpting AWARE-collected trash into security gates for the DNR Building on the Iowa State Fairgrounds in Des Moines. The artwork not only promotes the good work of the AWARE volunteers, but is a living example of reduce, reuse, and recycle. This year marked the fourth year of this five-year project.



Tons of trash removed during Project AWARE and the amount of trash recycled each year. During its nine-year history, 2,150 volunteers with Project AWARE have removed 182 tons of trash from 700 river miles with 65% of the trash being recycled.

--River of Words®

River of Words® is an international poetry and art competition held annually for youth aged 5 to 19 in grades K-12. This free contest is designed to help youth explore the natural environment and cultural history of the place they live, and to express what they discover through poetry and art. Iowa entries not chosen as finalists or grand prize winners in the international contest are returned to Iowa where they are judged in a statewide competition which has been coordinated by the IOWATER Program since 2004. In 2011, over 420 students from Iowa entered the contest, either through their schools, community art centers, community groups, or on their own. A total of 34 pieces were selected in the 2011 Iowa competition, and students of these pieces were recognized at an opening reception and award ceremony. The art and poetry are now part of an exhibit that travels around the state.



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- Bedrock Geology of Fertile NE 7.5' Quadrangle, Worth County, Iowa, Huaibao Liu, Robert McKay, Robert Rowden, Deborah Quade, Stephanie Tassier-Surine and James Giglierano, 2011, Iowa Geological and Water Survey Open File Map 11-1.
- Bedrock Geology of Gilbertville 7.5' Quadrangle, Black Hawk County, Iowa, Robert Rowden, Robert McKay, Huaibao Liu, Stephanie Tassier-Surine, Deborah Quade and James Giglierano, 2011, Iowa Geological and Water Survey Open File Map 11-3.
- Bedrock Geology of Northwood 7.5' Quadrangle, Worth County, Iowa, Huaibao Liu, Robert McKay, Robert Rowden, Deborah Quade, Stephanie Tassier-Surine and James Giglierano, 2011, Iowa Geological and Water Survey Open File Map 11-2.
- Bedrock Geology of Scott County, Iowa, Robert M. McKay, Huaibao Liu, Stephanie Tassier-Surine, and James Giglierano, 2011, Iowa Geological and Water Survey Open File Map 11-4.
- Effects of slow water recovery rates on water column geochemistry in aquitard wells, Keith Schilling, 2011, Applied Geochemistry 26(7):1108-1114.
- From agricultural intensification to conservation: sediment transport in the Raccoon River, Iowa, 1916-2009, Christopher Jones, Keith Schilling, 2011, Journal of Environmental Quality, 40:1911-1923.
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- Groundwater Availability Modeling – Des Moines River Aquifer, Palo Alto and Emmet Counties, Iowa, J.M. Gannon, 2011, Iowa Geological and Water Survey Water Resources Investigation Report 4, 41p.
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- Spatial relations of topography, lithology and water quality in a large river floodplain, Keith Schilling, Peter Jacobson, 2011, River Research and Application, DOI:10.1002/rra.1531.
- Surficial Geology of Adams County, Iowa, Stephanie Tassier-Surine, James D. Giglierano,

- Deborah Quade, and E. Arthur Bettis III, 2011, Iowa Geological and Water Survey Open File Map 11-9.
- Surficial Geology of Scott County, Iowa, Stephanie Tassier-Surine, Deborah Quade, E. Arthur Bettis III, Robert M. McKay, Huaibao Liu, and James D. Giglierano, 2011, Iowa Geological and Water Survey Open File Map 11-8.
- Surficial Geology of the Fertile NE 7.5' Quadrangle, Worth County, Iowa, Deborah Quade, Stephanie Tassier-Surine, E. Arthur Bettis III, Huaibao Liu, Robert M. McKay, and James D. Giglierano, 2011, Iowa Geological and Water Survey Open File Map 11-5.
- Surficial Geology of the Gilbertville 7.5' Quadrangle, Black Hawk County, Iowa, Stephanie Tassier-Surine, Deborah Quade, Robert Rowden, Robert M. McKay, Huaibao Liu, and James D. Giglierano, 2011, Iowa Geological and Water Survey Open File Map 11-7.
- Surficial Geology of the Northwood 7.5' Quadrangle, Worth County, Iowa, Deborah Quade, Stephanie Tassier-Surine, Huaibao Liu, Robert M. McKay, and James D. Giglierano, 2011, Iowa Geological and Water Survey Open File Map 11-6.
- Variations in suspended sediment transport with land cover change in two agricultural watersheds, Keith Schilling, Tom Isenhardt, Jason Palmer, Calvin Wolter, 2011, Journal of the American Water Resources Association, DOI:10.1111/j.1752-1688.00533.
- Water and Waverly, Chad Fields, 2011, GSI Guidebook 88 - The Geological Wonders of Bremer County.
- Water Quality Summary 2000-2010, 2011, Iowa Department of Natural Resources Water Quality Fact Sheet 2011-2, 2p.
- Water Quality Summary 2010, 2011, Iowa Department of Natural Resources Water Quality Fact Sheet 2011-3, 2p.

Outreach

Title	Date(s)	People Attending	Location
IOWATER Bacteria Monitoring Workshop	3/12/2011	7	Okoboji, IA
Raccoon River Basin Water Quality Master Plan	3/17/2011	50	Perry, IA
IOWATER Bacteria Monitoring Workshop	3/22/2011	8	Elkader, IA
IOWATER Bacteria Monitoring Workshop	3/26/2011	9	Garner, IA
IOWATER Introductory Workshop	4/8/2011	13	Sac County
Using IGI GIS Products	4/12/2011	7	Dubuque, IA
IOWATER Introductory Workshop	4/13/2011	18	Fairfield, IA
Geophysics Demonstration for University of Iowa Geoarchaeology Class	4/21/2011	12	Iowa City, IA
Geological Society of Iowa Spring Trip	4/30/2011	65	Waverly, IA
Muddy Creek Watershed Day	5/4/2011	200	North Liberty, IA
Iowa Children's Water Fest	5/12/2011	2000	Ankeny, IA
IOWATER Introductory Workshop	5/14/2011	17	Okoboji, IA
IOWATER Introductory Workshop	5/23-24/2011	16	Dubuque, IA
IOWATER Bacteria Monitoring Workshop	6/2/2011	11	Fairfield, IA
IOWATER Introductory Workshop for IDALS employees	6/2/2011	15	Oskaloosa, IA
IOWATER Introductory Workshop	6/4/2011	13	Polk City, IA
IOWATER Introductory Workshop	6/7/2011	8	Waukee, IA
IOWATER Bacteria Monitoring Workshop for Davenport Teachers	6/9/2011	17	Davenport, IA
IOWATER Biological Monitoring Workshop for Davenport Teachers	6/10/2011	17	Davenport, IA
IOWATER Introductory Workshop	6/18/2011	8	Osage, IA
IOWATER Introductory Workshop for Geology for Iowa Teachers UNI course	6/22/2011	24	Cedar Falls, IA
IOWATER Introductory Workshop	6/25/2011	24	North Liberty, IA
Mississippi River Adventure Day	7/18/2011	185	Lansing, IA
IOWATER Biological Monitoring Workshop	7/23/2011	9	Dubuque, IA
IOWATER Introductory Workshop	8/13/2011	9	Elgin, IA
IOWATER Biological Monitoring Workshop	9/17/2011	12	Ames, IA
IOWATER Introductory Workshop	10/1/2011	12	Vinton, IA
Sunday at the Quarry	10/2/2011	750	Waterloo, IA
IOWATER Introductory Workshop	10/7/2011	28	Davenport, IA
USACE Aquatic Invertebrate Identification Training	10/12/2011	30	Davenport, IA
IOWATER Biological Monitoring Workshop	10/15/2011	12	Waterloo, IA
Mahaska County Field Day	10/19/2011	120	Pella, IA
Geological Society of Iowa Fall Trip	10/22/2011	50	Moscow, IA

Upper Mississippi River Fest	5/10-11/2011	600	McGregor, IA
BugGuide Gathering	7/30-31/2011	60	Ames, IA
Project AWARE 2011	7/9-16/2011	400	Northeast Iowa
Project AWARE Earth Day Event	4/22/2011	100	Des Moines, IA
River of Words Opening Exhibit	5/22/2011	150	Des Moines, IA
Green: What Does it Mean? Exploring Our Sustainable Community	5/24/2011	1000	Cedar Falls, IA
Octagon Gallery Tour for Project AWARE sculptures	6/23/2011	30	Ames, IA
Project AWARE working exhibit at the Iowa State Fair	8/12-14/2011 8/19-20/2011	5000+	Des Moines, IA
IOWATER Program for Sustainable Living at Maharishi University	9/7/2011	25	Fairfield, IA
Ames Natural Living Fair and Environmental Film Festival	9/17/2011	50	Ames, IA
iExploreSTEM	9/18/2011	900	Coralville, IA
Iowa Outdoor Expo	9/24-25/2011	500	Des Moines, IA
Iowa River Cleanup	10/9/2011	55	Iowa City, IA
Make a Difference Day	10/23/2011	100	Iowa City, IA
Paul VanDorpe	1/1-12/31/2011	247	statewide
Eco-Arts Festival	4/16/2011	75	Cedar Rapids, IA
Conservation Fair	4/17/2011	50	Anamosa, IA
Iowa River Call	5/16-17/2011	75	River Junction, IA
Open Minds, Open Doors	10/18/2011	30	Cedar Rapids, IA
Creepy Campus Crawl	10/28/2011	250	Iowa City, IA
West Branch High School IOWATER Program	11/3/2011	100	West Branch, IA

Presentations

- Lessons Learned from the Scott County Snapshot, by Lynette Seigley: Partners of Scott County Watersheds, January 2011.
- History of Well Drilling in Iowa (poster), by Ray Anderson: Iowa Water Well Association, January 2011.
- Iowa's Second Impact Crater? The Decorah Structure (poster), by Ray Anderson: Iowa Water Well Association, January 2011.
- Major Features on the New Bedrock Geologic Map of Iowa, by Ray Anderson: Iowa Water Well Association, January 2011.
- The Iowa Geological & Water Survey and the GSS (poster), by Ray Anderson: Kevin New USGS Chief, February 2011.
- Ecohydrogeology and Agricultural Sustainability, by Keith Schilling: Seminar: Department of Geoscience, University of Iowa, February 2011.
- Iowa's Ambient Water Monitoring Program and Volunteer Opportunities, by Lynette Seigley: Ashford University, February 2011.
- Iowa's Manson Impact Structure, by Ray Anderson: U of IA Dept of Physics & Astronomy, February 2011.
- Geological History of Linn County, by Ray Anderson: Linn County Conservation Board, March 2011.
- CO2 Sequestration in Iowa, by Ray Anderson: Iowa Department of Air Quality, March 2011.
- Spatial variations in groundwater quality, Swamp White Oak Preserve, Lower Cedar River, Iowa, by Keith Schilling: Iowa Groundwater Association 2011 Spring Conference, March 2011.
- Iowa's Glacial History, by Ray Anderson: Cedar Valley Rocks and Minerals Society, March 2011.
- Iowa's Glacial History, by Ray Anderson: Cedar Valley Rocks and Minerals Society, March 2011.
- Water, Watersheds, and Agriculture, by Mary Skopec: University of Iowa, March 2011.
- Iowa's Manson Impact Crater, by Ray Anderson: Cedar Rapids Astronomy Club, April 2011.
- Statemap and the New Iowa Bedrock Map, by Ray Anderson: UNI Earth and Atmospheric Science, April 2011.
- The Iowa Geospatial Infrastructure, by Jim Giglierano: Iowa Geographic Information Council 2011 Conference, April 2011.
- Poster Session: The New Bedrock Geology of Iowa Map, by Jim Giglierano: Iowa Geographic Information Council 2011 Conference, April 2011.
- GIS and Economic Development, by Jim Giglierano: Iowa Geographic Information Council

2011 Conference, April 2011.

Defenders of Land and Water, by Lynette Seigley: North Central JHS, April 2011

Water quality in Iowa: it's our choice, by Keith Schilling: Grinnell College symposium: Troubled Waters, the Challenges of Quality and Quantity, April 2011.

Iowa's Manson Impact Structure, by Ray Anderson: University of Iowa, April 2011.

Identifying Aquatic Species, by Jacklyn Gautsch: Iowa River Revival River Currents, April 2011.

Use of 3-D and other Modern Graphic Tools in Geologic Interpretation, by Ray Anderson: Iowa Academy of Science, April 2011.

Geologic setting of the Winneshiek Lagerstätte - Decorah, Iowa, by Robert McKay, Huaibao Liu, Brian Witzke: 2011 Iowa Academy of Science Annual meeting, April 2011.

Watershed-scale effects of tile drainage on hydrology: some observations, by Keith Schilling: Iowa-Cedar Interagency Groups' Technical Team, May 2011.

Project AWARE and Iowa City Stream Cleanup Projects, by Brian Soenen: Iowa City Public Library, May 2011.

Cleanup Culture - Environmental Stewardship for the Next Generation, by Brian Soenen: Green: What Does It Mean? Exploring Our Sustainable Community, May 2011.

Earthscope: The Magnetotelluric Transport Array Moves into Iowa, by Ray Anderson: CR-Inst of Electrical and Electronics Engineers, May 2011.

Project AWARE Accomplishments, by Lynette Seigley: Des Moines Chapter of the Izaak Walton League of America, May 2011.

Agriculture and Water Quality, by Mary Skopec: Leopold Center Advisory Board Meeting, June 2011.

Iowa Lidar Project Derivative Products, by Jim Giglierano: ICIT Mid-year, June 2011.

Iowa's Historic Meteorites, by Ray Anderson: Fairfield Rock & Mineral Club, June 2011.

The Iowa Geospatial Infrastructure, by Jim Giglierano: MAGIC Clearinghouse Meeting, August 2011.

Land Use Change and Water Quality: How Long Does it Take Before Improvements are Seen? by Keith Schilling: Seminar: IHR Hydroscience and Engineering, University of Iowa, August 2011.

Water Quality Protection in Iowa: Combining Science, Technology, and policy, by Mary Skopec: University of Iowa, September 2011.

Rocks and Minerals of the West Bend Grotto, by Ray Anderson: West Bend Grotto, September 2011.

A Walking Tour of the UNI Campus, by Mary Skopec: University of Northern Iowa, September 2011.

The Legendary New Madrid Earthquakes of 1811-1812, by Ray Anderson: University of Iowa

Museum, September 2011.

Sustainable Water Resources in Iowa, by Mary Skopec: University of Northern Iowa, September 2011.

Cleanup Culture: Environmental Stewardship for the Next Generation, by Brian Soenen: Upper Mississippi River Conference Youth Summit, September 2011.

Our Changing Earth (2 posters), by Ray Anderson: Basic Materials Co., October 2011.

The Devonian Geologic History of Iowa, by Ray Anderson: University of Iowa Museum, October 2011.

Preservation of the Middle Ordovician Winneshiek Shale in a Probable Impact Crater, by Robert McKay, Huaibao Liu, Brian Witzke: 2011 Geological Society of America Annual Meeting, October 2011.

Water Quality at Manson Impact Structure, by Ray Anderson: Geological Society of America, October 2011.

Primitive fish from the Middle Ordovician Winneshiek Lagerstätte of northeast Iowa, USA, by Huaibao Liu, Brian Witzke, Robert McKay: 2011 Geological Society of America Annual Meeting, October 2011.

Restoring Iowa's Water Quality, by Mary Skopec: University of Northern Iowa, October 2011.

The Middle Ordovician Winneshiek Shale of northeast Iowa – Correlation and paleogeographic implications, by Brian Witzke, Robert McKay, Huaibao Liu: 2011 Geological Society of America Annual Meeting, October 2011.

A giant prioniodinid conodont from the Middle Ordovician Winneshiek Lagerstätte of northeastern Iowa, USA, by Huaibao Liu, Brian Witzke, Robert McKay: 2011 Geological Society of America Annual Meeting, October 2011.

Water quality in Iowa: it's our choice, by Keith Schilling: Seminar: Department of Civil and Environmental Engineering, University of Iowa, October 2011.

Iowa's Manson Impact Structure, by Ray Anderson: Iowa Science Teachers Section, October 2011.

Iowa Geology poster display (3 posters), by Ray Anderson: Iowa Science Teachers Section, October 2011.

Iowa Lidar Project Update, by Jim Giglierano: ASCE/ICEA Surveying Conference, October 2011.

Geology of the Moscow Quarry, by Ray Anderson: Geological Society of Iowa, October 2011.

1987 Groundwater Protection Act Accomplishments - Groundwater Monitoring, by Mary Skopec, Lynette Seigley: Iowa Groundwater Association 2011 Fall Conference, October 2011.

New Methods for Finding Source Water Areas in Karst: The Cedar Falls Case Study, by Chad Fields: Iowa Groundwater Association 2011 Fall Conference, October 2011.

Careers in Geology, by Ray Anderson: Highland High School, October 2011.

Iowa's Manson Impact Structure, by Ray Anderson: Waterloo Technical Society, November 2011.

Water quality status and trends in the corn-belt region of the United States, by Keith Schilling: Seminar: Center for Hydrosociences Research, Nanjing University, Nanjing, China, November 2011.

The Decorah Structure - a probable meteorite impact crater basin beneath Decorah, Iowa, by Robert McKay: Public Information Presentation, Decorah, Iowa, November 2011.

Results from the Scott County Snapshots, by Lynette Seigley: Partners of Scott County Watersheds, November 2011.

The geology and geochemistry of ancient groundwater in the central peak of the Manson Impact Structure, Iowa, by Ray Anderson, Calvin Alexander, Keith Schilling, David Peate, Jeffrey Dorale: 2011 Geological Society of America Annual Meeting, November.

The Legendary New Madrid Earthquakes of 1811-1812, by Ray Anderson: Cedar Valley Rocks and Minerals Society, November.

Introduction to the Iowa Geological & Water Survey, by Ray Anderson: University of Iowa Geoscience, November 2011.

State and County GIS Cooperation, by Jim Giglierano: Iowa County Information Technology Fall meeting, November 2011.

How has land use/land cover change altered stream hydrology in the agricultural Midwest?, by Keith Schilling: Midwest Fisheries Conference, Des Moines, December 2011.

Impacts of Past Land Use Changes on Water Resources as an Analog for Assessing Effects of Proposed Bioenergy Crops, by BR Scanlon, KE Schilling, MH Young, PW Gerbens-leenes: American Geophysical Union, December 2011.

Geological History of Mississippi River, by Ray Anderson: Office of the State Archaeologist, December 2011.

The Potential for Agricultural Land Use Changes in the Raccoon River Basin to Reduce Flood Risk: A Policy Brief for the Iowa Flood Center, by Cathy Kling, Phil Gassman, Keith Schilling, Calvin Wolter, Manoj Jha, Todd Cambell: Seminar: IIHR Hydrosocience and Engineering, University of Iowa, December 2011.

Raccoon River Health: An Overview, by Mary Skopec: Des Moines Community College, December 2011.

Grants and Contracts

<u>Grant Source</u>	<u>Amount</u>	<u>Length</u>	<u>Project Purpose</u>
Department of Energy	\$100,000	2011-2013	Develop maps/tools for geothermal well placement throughout Iowa.
Iowa Pooled Technology	\$650,000	2009-2012	Iowa Geocoding Project: Phase 1 - Create address points and structure points for 50 counties
Iowa Pooled Technology	\$194,000	2012-2013	Iowa Geocoding Project: Phase 2 - Create address points and structure points for 20 additional counties
Iowa Pooled Technology	\$302,000	2011-2012	Iowa GIS Service Bureau: Phase 1 - create a GIS service bureau for Iowa state agencies
Federal Geographic Data Committee CAP Grant	\$75,000	2010-2011	Iowa One Map: A Public/Private Partnership ROI Study of the Iowa Geospatial Infrastructure (w/ Iowa Geographic Information Council)
Federal Geographic Data Committee CAP Grant	\$37,500	2011-2012	The Iowa Metadata Outreach Project - offer four GIS metadata workshops for GIS data producers in state and local agencies (w/ Iowa Geographic Information Council)
USGS Geospatial Liaison's Office	\$50,000	2011-2012	The National Map - create structure and geographic names GIS data
Office of Surface Mining	\$29,700	2011-2012	Improve access to information about historic coal mining in the Des Moines, Iowa, area
The Nature Conservancy	\$25,000	2010-2011	Investigating groundwater hydrology and nutrient dynamics associated with alternative floodplain land covers, Lower Cedar River
The Nature Conservancy	\$60,000	2008-2011	Paired watershed study, Lyon's Creek, Boone River watershed
U.S. Environmental Protection Agency Office of Wetlands	\$75,000	2010-2012	Groundwater monitoring component: Monitoring the wildlife value, hydrology and water quality of drained (farmed) wetlands of North Iowa
Leopold Center for Sustainable Agriculture	\$30,000	2009-2011	Quantifying the effect of perennial vegetation on soil and water quality
Center for Agricultural and Rural Development	\$30,000	2009-2011	Market feasibility assessment for water quality trading and a reverse auction in the Raccoon River, Boone River and Walnut Creek watersheds

Center for Agricultural and Rural Development	\$15,000	2011	The potential for agricultural land use change in the Raccoon River to reduce flood risk
National Science Foundation	\$257,950	2010-2013	Investigation of the Winneshiek Lagerstätte (rare fossils) at Decorah, IA, and their geologic setting
USGS STATEMAP Program	\$158,977	2011-2012	Bedrock and Surficial Geologic Mapping in developing areas of Iowa, key watersheds and in conjunction with NRCS soil survey updates. Maps are produced at quadrangle, county and state scale.
USGS Data Preservation Program	\$17,326	2011-2012	Funding to preserve geologic and hydrogeologic data by providing funding to create digital records of data previously only in paper copy.
Iowa Limestone Producers Association	\$6,000	2011	Develop online teaching module for the Geologic History of Iowa.
Alliant Energy Foundation	\$1,000	2011	Project AWARE
Clayton County Foundation for the Future	\$1,000	2011	Project AWARE
Fayette County Community Foundation	\$3,750	2011	Project AWARE
Rockwell Collins Green Communities	\$3,000	2011	Project AWARE
Humanities Iowa	\$200	2011	Project AWARE
Winneshiek County Solid Waste Agency/Recycling Department	\$1,500	2011	Project AWARE
Hy-Vee	\$1,000	2011	Project AWARE
Cargill	\$3,000	2011	Project AWARE
Sponsorship Contributions	\$18,073	2011	Project AWARE
W.G. Block Co. & Acme Materials Co.	\$10,290	2011	Geophysical resistivity survey to evaluate the extent and nature of sand and gravel resources and reserves.
Martin Marietta Materials, Inc.	\$5,887	2011	Geophysical resistivity survey to delineate zones of mineable bedrock.
Cerro Gordo County Department of Public Health	\$9,754	2011	Distribution of arsenic in Cerro Gordo wells.