

Annual Report Of the State Geologist



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Iowa Department of Natural Resources

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*Cover design by Mindy Kralicek, Iowa DNR. Photos clockwise beginning from top left:
Project AWARE, ice fishing, wading on the Skunk River, corn crop, Clear Lake during drought.*

TABLE OF CONTENTS

Iowa Geological and Water Survey	1
The State of the State’s Earth, Water, and Landscape.	1
Fiscal Overview	2
Cycle of Effective Resource Management	4
Geology and Groundwater Section	4
Geographic Information Systems Section	5
Watershed Improvement Section	6
Watershed Monitoring and Assessment Section	7
Hydrology Work Group – Science Leadership through IGWS	7
IGWS Accomplishments for 2012	8
Geologic Mapping	8
Mapping the Earth’s Resources	8
Iowa’s High Resolution Land Cover	10
New Geodetic Dautm	10
Geologic Hazards	11
Mapping Historic Coal Mines	11
Geophysical Survey of Deer Creek Lake, Plymouth County.	12
Drought Assistance	12
Floodplain Mapping	13
Sinkhole Hazard Mapping	14
Mines, Minerals, Energy	14
U.S. Geological Survey Airborne Study of Northeast Iowa	14
Frac Sand Mining	15
Oil and Gas	15
Active Mining	16
Geothermal Energy	16
Water Resources	17
Drought of 2012 – Information and Coordination	17
Geophysical Surveys of the Floyd River Alluvial Aquifer	19
Water for Iowans – 2030 and Beyond.	20
Water Supply Development for Today	21
Source Water Protection for Iowans Drinking Water	21
Lake Monitoring	22
Stream Monitoring	24
Wetland Monitoring	25
Shallow Lake Monitoring	25
Groundwater Monitoring	26
Assessing Groundwater Quality around Iowa’s Great Lakes	26



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 2012. More information on IGWS is available at <http://www.igsb.uiowa.edu/>.

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

While flooding along the Missouri River was the signature Earth event impacting Iowa in 2011, in 2012 the state dealt with the flip side of the coin – drought. Before the Missouri River's high-water had fully receded, dry conditions began to settle into the northwest part of the state. As the year progressed, the entire state continued to experience varying degrees of drought, but as the year ended, the greatest impacts continued to be in the northwest part of the state.

IGWS responded to the drought by supplying information, expertise, and guidance to public and private water interests, both for particular water supplies and for critical planning in case the drought proves to be long-lived. While the immediate, and observable, effect of drought is its impact on crops and pastures, the drying up of water supply sources is a slower, less noticeable occurrence. However, those impacts are becoming apparent, and just as they are slow to develop, they are also slow to respond to rains when they come. IGWS also developed and led efforts to routinely provide an update on the state's water supply conditions.

In addition, IGWS provided technical and organizational leadership to the newly established Hydrology Working Group, which is charged with bringing the state's technical knowledge – from state, federal, private sector, and university organizations – to bear on water-related issues.

Beyond the drought, water programs were also called upon to evaluate sources for city expansion and industrial development. This included detailed assessments of numerous potential locations for a major fertilizer plant that ultimately will be built in Lee County.

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. ***This foundational mission is what allows us to respond to the state's short-term needs.*** To that end, we completed geologic mapping scaled to the needs of local users, produced refined delineations of zones supplying groundwater to public supply wells, created additional models of groundwater aquifers, 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.

Minerals mined in Iowa had a raw value of \$680M based on the latest statistics, and interest in Iowa's mineral resources continued to grow in 2012. Sandstones that are used for "frac sand" are exposed in far northeast Iowa, and as hydraulic fracturing for natural gas and oil continues to increase, so does the demand for sand. IGWS supplied information on the sandstone formations to both the mining industry and to county officials who have to manage local impacts of a potential surge in mining. Long-term studies by IGWS and others on the deep Precambrian rocks in northeast Iowa also attracted the interest of the U.S. Geological Survey's Strategic and Critical Minerals program, who began an airborne assessment of the area for metallic mineral potential as the year ended.

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. A network of groundwater wells were also sampled for the first time since 2006. Our nonpoint pollution program awarded almost \$3M 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 that 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.

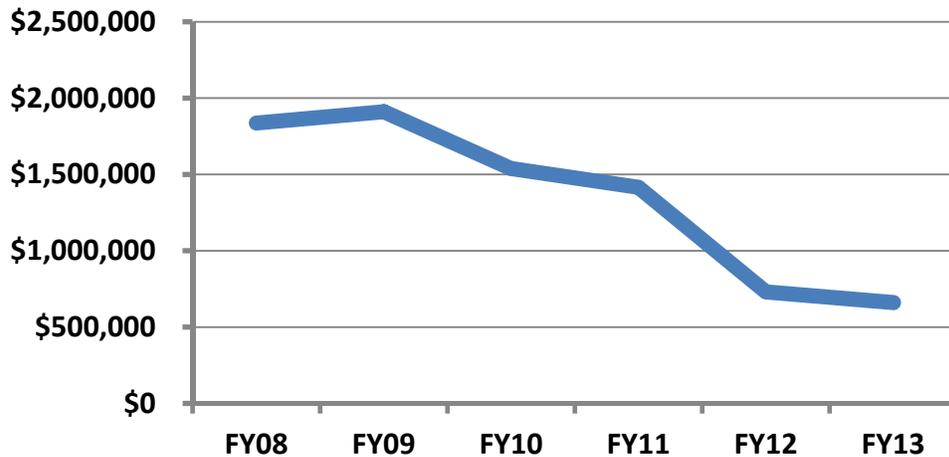
2012 was also marked by continued budget and staffing challenges, particularly to the basic data collection work we do. ***Support for this work is critical, as the information acquired today will be needed to answer the questions that will arise in the future.*** We enter 2013 determined to meet the challenges while working towards a more financially sustainable future.

Fiscal Overview

In the last six years, IGWS has seen an unprecedented loss of nearly 64% of our general funds. The most significant drop in funding occurred when the Survey's FY2012 state general fund

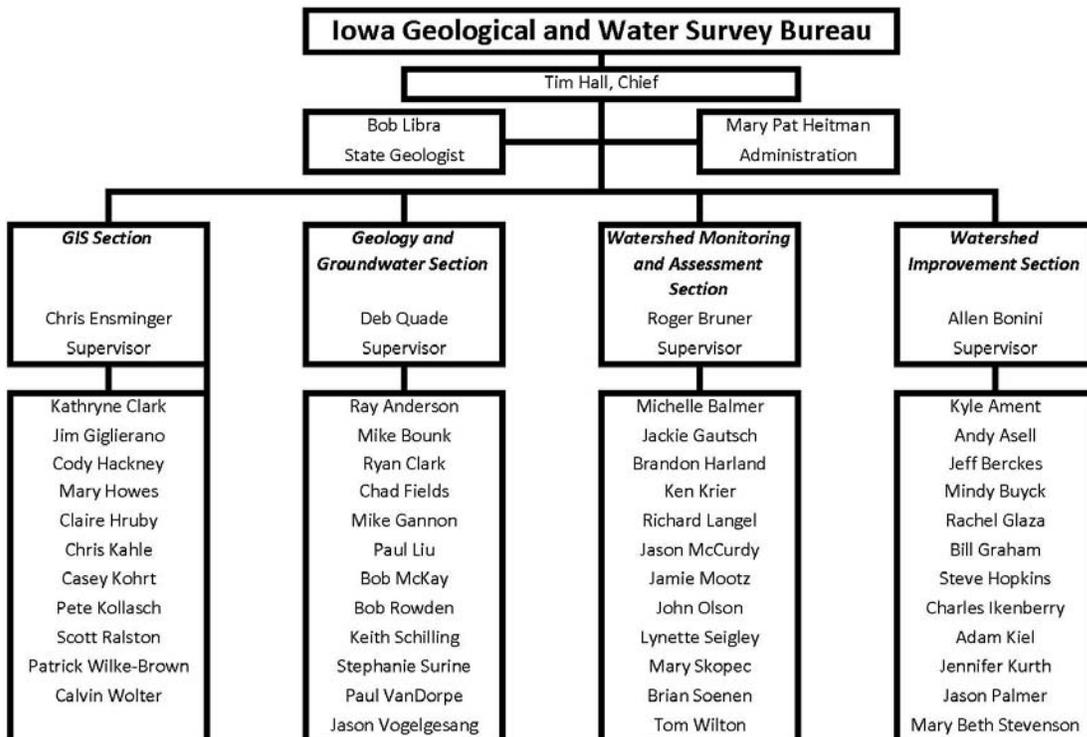
appropriation was reduced by 50% (a loss of \$685,566 from the FY2011 budget of \$1,415,656). As of FY2013, less than 10% of the Survey's staff is supported by general fund dollars. These cuts continue to have an adverse impact on the Survey's mission to "plan and implement programs that result in the 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



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

Table of organization for the Iowa Geological and Water Survey.

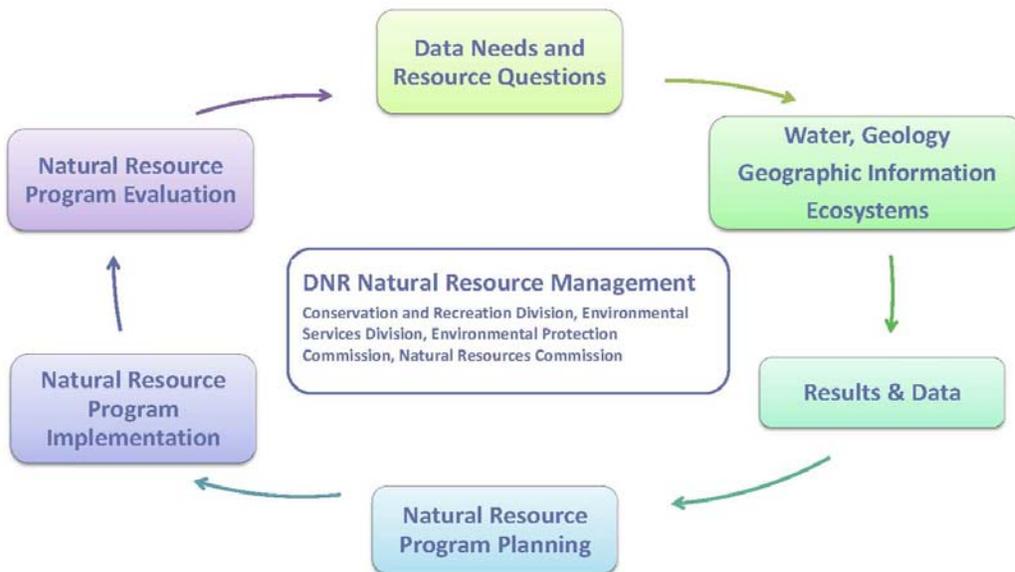


Cycle of Effective Resource Management

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:

- Citizen and 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 Service
- Utility Companies
- Board of Regents
- Non-Governmental Organizations
- Municipalities
- Local and County Governmental Agencies
- Rural Water Association
- Iowa Department of Agriculture and Land Stewardship



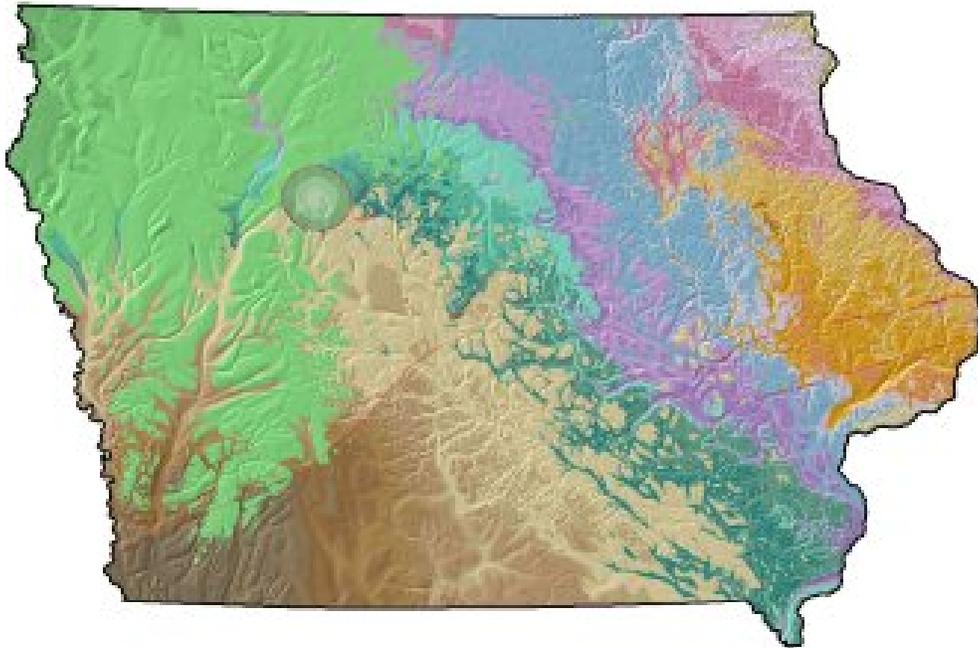
Cycle of effective resource management. IGWS staff provide critical information which is used to fill data needs and aid in the collection of data that can be used in the planning, implementation, and evaluation of natural resource programs in Iowa.

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 Iowa portrays the current interpretation of the distribution of various bedrock stratigraphic units present at the bedrock surface.

Geographic Information Systems Section

What we do: The GIS Section provides geospatial support to DNR, other agencies, and the public. During 2012, 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 2012, 390 new data layers were added to the NRGIS library while 252 existing layers were updated. In addition to new data, several web services were made available and online applications for historic photos and coal mines 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.



Elktoe mussel.

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 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.

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 decision makers for the management, protection, and development of our water resources. Water quality and watershed data are readily available through the DNR website.

Hydrology Work Group – Science Leadership through IGWS

The prolonged flooding on the Missouri River in 2011 and associated damages led to conversations about Iowa's hydrology expertise among state leaders. These discussions underscored the importance of our rivers and the significant impacts that flow from droughts and floods. The State Interagency Missouri River Authority formed a working group, under the coordination and leadership of the IGWS' Bureau Chief to analyze the State of Iowa's hydrology expertise, better understand stakeholder needs, and devise recommendations to fully leverage existing expertise.

As a result of numerous discussions, technical staff concluded that the State of Iowa has a great deal of hydrology expertise located in many state agencies, or within federal agencies staff located in Iowa or in other non-governmental organizations in Iowa. However, who these experts are and where they are located is often not clearly understood, and coordination and communication between those personnel needs improvement. In order to effectively utilize this expertise it was recommended that the Governor's Office establish an interagency hydrology coordination working group to improve coordination between relevant State and Federal Agencies as well as other interested parties. The group was to include the State Geologist, the State Climatologist, the Iowa Flood Center, the Iowa Department of Transportation, the U.S. Geological Survey, and Iowa State University.

The IGWS Bureau Chief was asked by the Governor to serve as the Hydrology Coordinator, and the Hydrology Work Group first met in the fall of 2012. In its initial meetings, the Hydrology Work Group developed a mission statement:

- The Hydrology Work Group's mission is to assist agencies of the State of Iowa in protecting the health of our citizens, and to protect and enhance the economic value of our resources by providing expertise to decision-makers in the state of Iowa so that they can better understand existing hydrologic data and information, and to provide recommendations on ways to improve and enhance Iowa's hydrologic data and information.
- The Hydrology Work Group recognizes the need to address the State's water challenges ranging from flood to drought by making sure that policy makers have access to correct, consistent, and current data and information.

In 2013 the Hydrology Work Group will be working 1) to provide expertise in the review and interpretation of reports and documents related to hydrologic issues, 2) in understanding current data collection networks, and identify future needs for enhanced and improved data collection, 3) to analyze hydrologic data and information and provide interpretation, predictions,

and modeling to make the information useable, and 5) to provide one single information center that makes data, interpretations and model predictions available to all Iowans.

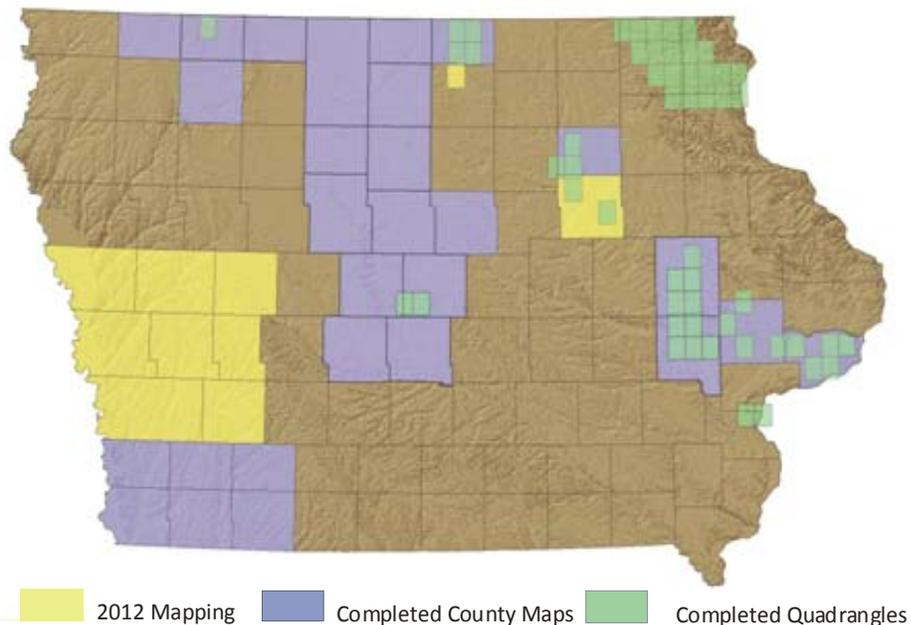
The Hydrology Work Group is prepared to call on specialists within state government, and from our federal partners, to address specific issues that might become critical at any given time (flood conditions, drought conditions, water quality emergencies, etc). These issues should include the investigation of water related issues which are beyond the borders of Iowa, but which may have an impact on our water supply or quality.

IGWS Accomplishments for 2012

Geologic Mapping

--Mapping the Earth's Resources

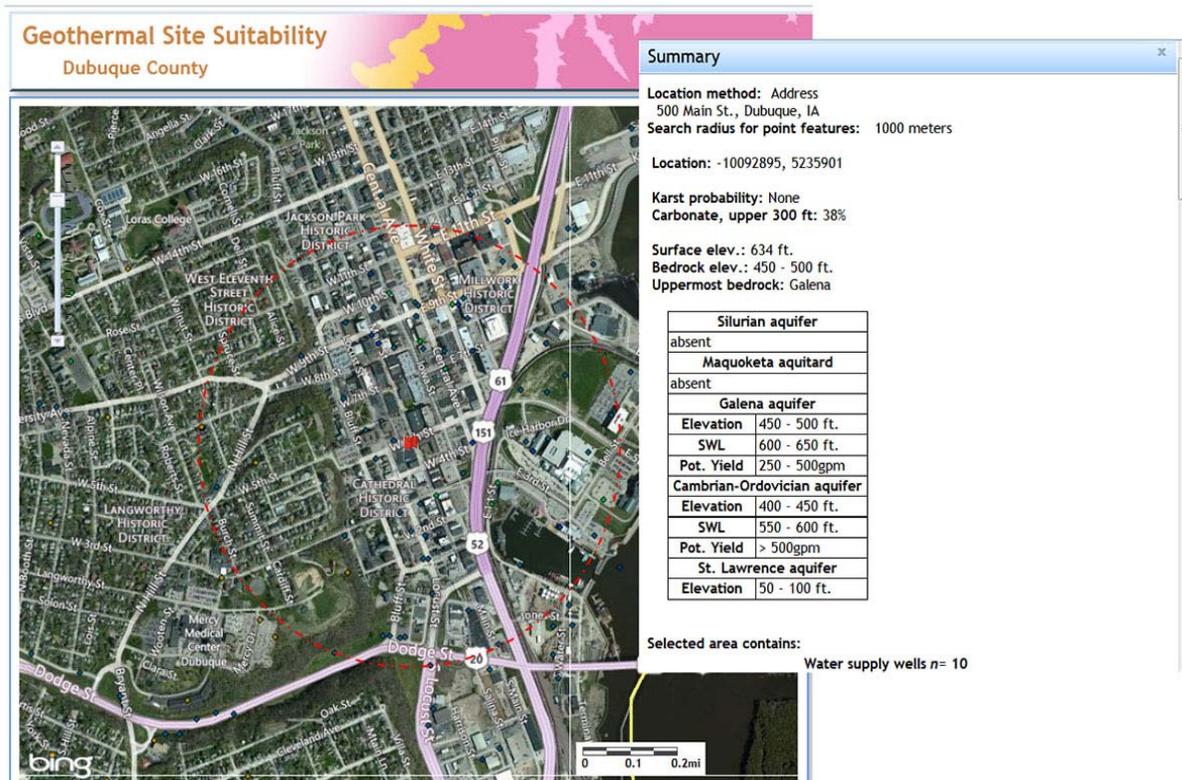
Geologic mapping of surficial deposits, the bedrock surface, and bedrock aquifers is a critical first step in providing resource evaluations to Iowans. During 2010, the first regional-scale remapping of the state's bedrock surface since 1969 was completed, incorporating 40 years of new information and 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.



STATEMAP Geologic Mapping, 1993-2012.

In 2012, more detailed mapping of key parts of the state continued, with quadrangle and county-scale maps completed in Black Hawk, Dickinson, and Worth counties, and mapping presently occurring in Black Hawk, and Worth counties. Current detailed mapping projects are focused on the Avenue of the Saints corridor in north-central Iowa and east-central Iowa. In 2012, compilation mapping was completed in Fremont, Mills, Montgomery, Page, and Taylor counties. Current compilation mapping is focused in Audubon, Carroll, Cass, Crawford, Harrison, Monona, and Pottawattamie counties. Geologic mapping is guided by an advisory committee of public and private interests, and is funded by 50-50 matching federal grants. Since 1993, IGWS has received over \$2 million in federal funds, an amount exceeding two-thirds of the 45 states participating in the program. In 2012, Iowa's State Geologist began a three-year term on the national mapping program's review board, which evaluates each state's proposed mapping for the coming year.

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 and current work is progressing to build an internet-accessible mapping application (below) that utilizes numerous geologic maps as well as hydrologic data and other pertinent information to assist community planners, drillers, and engineers to better place geothermal well fields.



Dubuque County geothermal site suitability application showing a summary of the aquifers and other features in downtown Dubuque that may influence development of ground-source heat pumps.

--Iowa's High Resolution Land Cover

Work has been underway for several years by remote sensing specialists in the GIS Section to produce 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 maps for roughly half of Iowa counties are currently available to the public through the DNR NRGIS Library (<http://www.igsb.uiowa.edu/nrgislib/>). The final product is a one-meter resolution GIS grid for each county, based on multiple high resolution photography sources, reflecting the condition of the land in summer of 2009. Products should be available for all Iowa counties by the end of 2013.

--New Geodetic Datum

The National Oceanic and Atmospheric Association's (NOAA) National Geodetic Survey, (NGS), is preparing to conduct a validation survey on an east-west line in Iowa from Cedar Rapids to Denison. The purpose of the survey is to validate airborne gravity measurements to be used to determine an accurate geoid model for use primarily with global navigation satellite system technology.

IGWS geologists have been working with NGS to provide information about boreholes in the vicinity of the project line and compiling existing down-hole gravity and other geophysical information. IGWS staff will also be producing a 3-D density model of materials above sea level

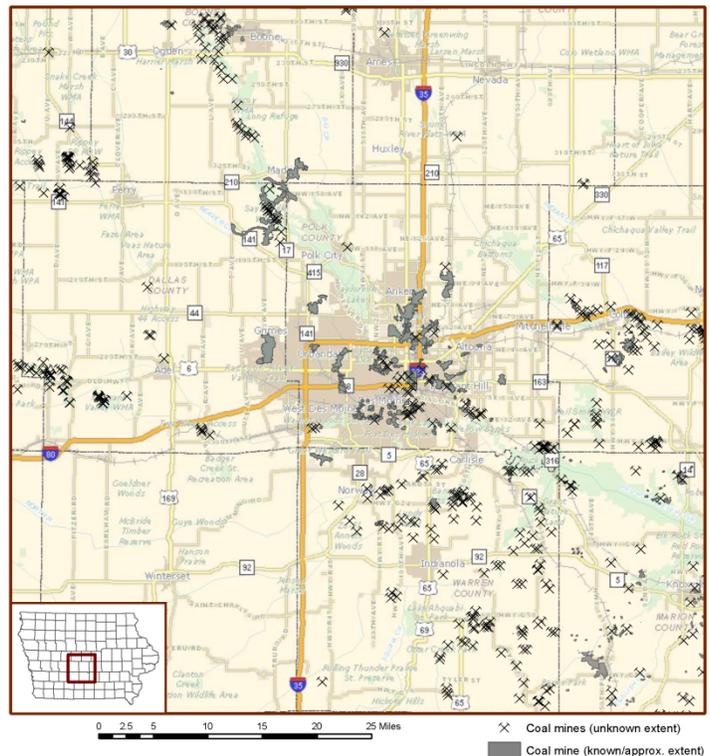
in Iowa for the NGS to use in their data reduction. NGS will be installing permanent absolute gravity stations in Cedar Rapids and Denison, then collecting a detailed series of relative gravity measurements at stations along Highway 30 between the cities in 2012. The data collected will be compiled and reduced to a sea level datum using the IGWS density model for updating the existing geoid model. This survey, one of two being conducted by NGS, will be used to produce a more accurate North American Datum (NAD13) for future geodetic projects.

Geologic Hazards

--Mapping Historic Coal Mines

Iowa had an active coal mining industry until 1994. However, mapping abandoned underground coal mines and improving availability of information about the mines continues to be an important aspect of assessing and managing geologic hazards. Out of an estimated 6,000 coal mines that operated in Iowa from about 1840 until 1994, approximately 3,000 can be located with at least one half mile accuracy. Of the mines that can be located, 770 have extant mine maps.

Under a contract with the U.S. Office of Surface Mining Reclamation and Enforcement for the 2011-2012 fiscal year, IGWS georeferenced over 200 scanned images of original mine maps from the central Iowa area, shown to the right. The project area location is shown on the small inset map in the lower left corner. The mapped mine areas are shown as gray polygons and a number of small mines, documented only as point locations, are shown as crossed-pick symbols.



The Central Iowa area was chosen because of the density of mining in the area and its proximity to the Des Moines urban area, as it is subject to the largest potential impact from mine subsidence on the population, buildings, or utilities.

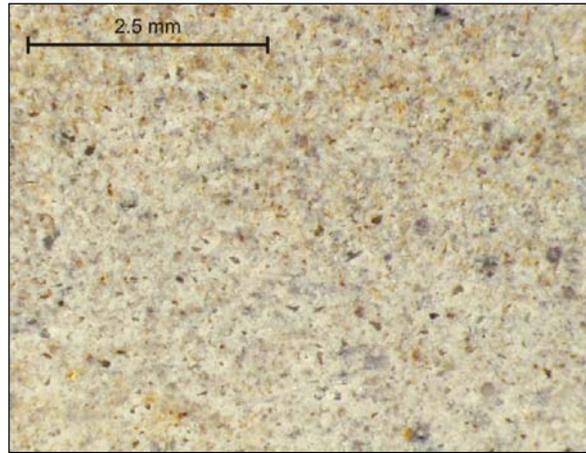
The georeferenced maps were collected into a GIS database and published as a web mapping service at IDNR. An internet-based application with simple query and view functions was created from the web mapping service at <http://programs.iowadnr.gov/maps/CoalMines>. This application is designed to allow users to locate undermined areas, gain some additional information about the mines, and view the georeferenced mine maps. Future plans include enhancements to the web-based application and addition of mine maps from other areas of the state to the supporting GIS data.

--Geophysical Survey of Deer Creek Lake, Plymouth County

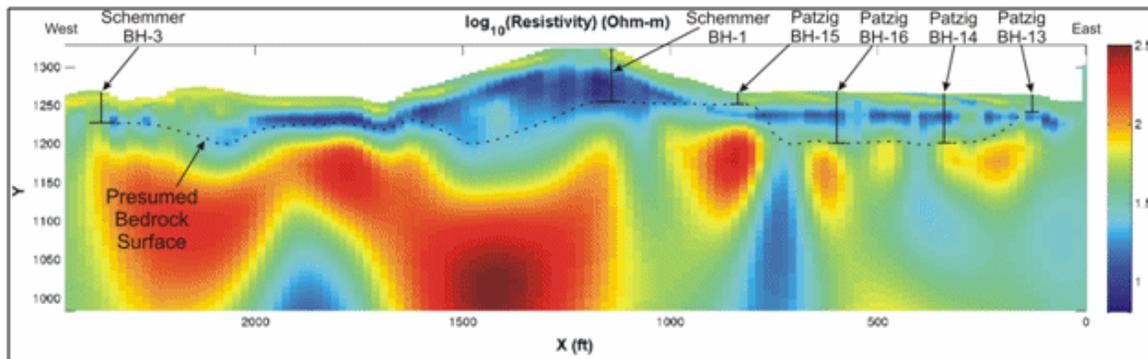
Deer Creek Lake in Plymouth County, Iowa, has been failing to reach its designed full pool for nearly twenty years, a result of water leaking past the dam. An attempt to seal the leak and make the lake viable for intended recreation was implemented years ago with the installation of a grout curtain. The grout curtain proved unsuccessful, and IGWS proposed a geological and geophysical investigation of the site. The assessment was completed in September 2012, and indicated water is likely leaking through fractures and/or voids in the underlying carbonate bedrock. Electrical Resistivity (ER) and Spontaneous Potential (SP) geophysical surveys were completed; indicating bedrock is near the surface at several locations near the lake. Additionally, the geological investigation identified sinkholes and fractures within the underlying Greenhorn Limestone, supporting the conclusion of subsurface leaking.



Iowa Geological and Water Survey geologist exposes and examines the seep south of the dam.



Close up view showing abundant pore spaces within the microcrystalline texture of the Greenhorn Limestone sample collected from the seep.



Resulting model from one of the ER geophysical surveys completed across the site. An inferred bedrock surface is shown by a dashed line. Models identified areas where vulnerable carbonate rock is near the land surface and lake water might be leaking.

--Drought Assistance

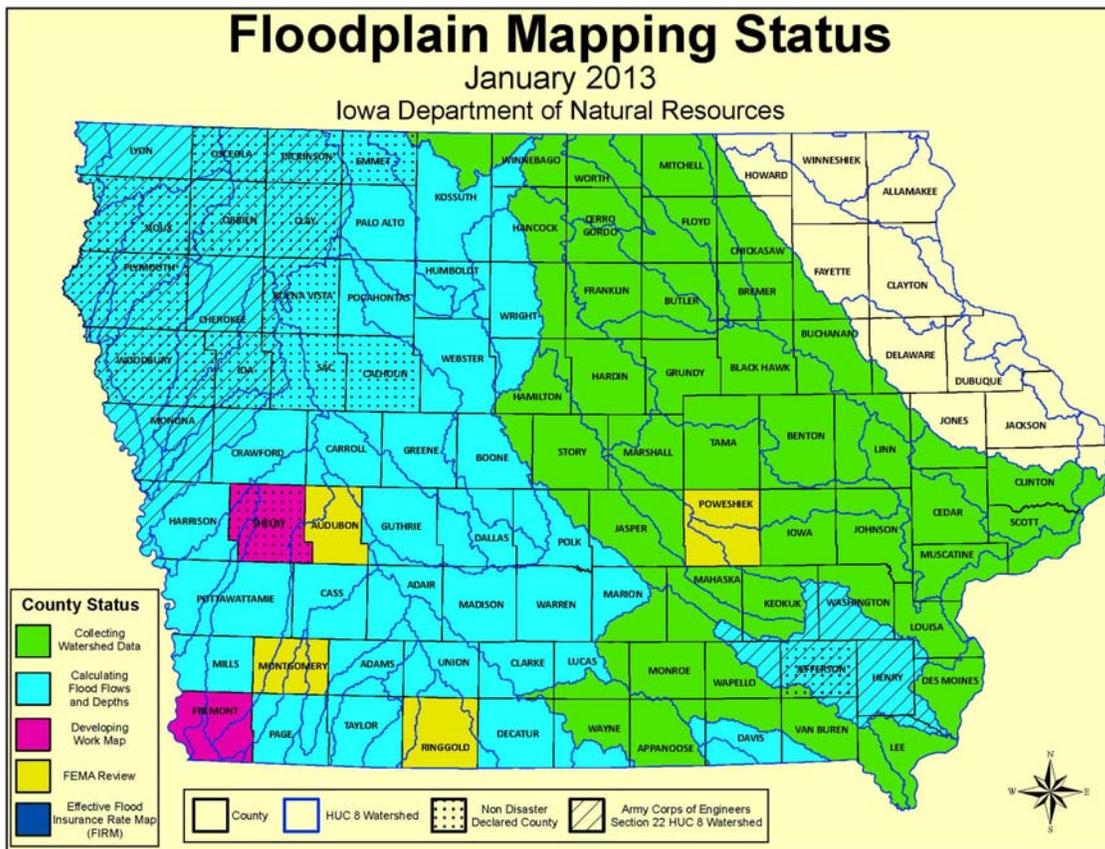
Severe to exceptional drought conditions persisted in Iowa throughout most of 2012. The drought had an impact on Iowa’s agricultural economy, but it also placed tremendous stress on water supplies throughout the state. To assist communities with the management of their water

resources, IGWS monitored shallow groundwater at 15 different locations. Wells at eleven locations monitored shallow sand and gravel aquifers, and four locations monitored shallow groundwater in limestone aquifers in north-central and northeast Iowa. Most of the wells had groundwater levels at or near historic lows for most of the summer and fall of 2012. Record water usage was recorded at Cedar Rapids, Des Moines Water Works, West Des Moines, Le Mars, and many other systems. Numerous public water systems implemented voluntary and mandatory water conservation measures. Municipal and rural water systems along the Rock, Floyd, Ocheyedan, and West Nishnabotna rivers in western Iowa were especially impacted by low groundwater levels and record usage.

Dry conditions have continued into 2013, and the DNR will continue to evaluate the state's water resources. Several discussion sessions are being planned in 2013 by the DNR to encourage public water systems to communicate and share drought strategies.

--Floodplain Mapping

The statewide Floodplain Mapping Program continues on in production mode. The DNR and its partner, the Iowa Flood Center (IFC at University of Iowa), have been conducting hydrologic, hydraulic, and flood mapping analyses at a HUC8 watershed level in southwest Iowa. The DNR has submitted three countywide draft Flood Insurance Rate Maps (FIRMs) in southwest Iowa (Ringgold, Audubon, and Montgomery) to the Federal Emergency Management Agency (FEMA). FEMA, as a partner with the DNR, will take these draft FIRMs through the process of map production and post preliminary processing – resulting in effective FIRMs for these counties. The IFC is near completion on additional countywide draft FIRMs for Shelby and Fremont counties, with more counties being added (Greene and Calhoun) with cost sharing opportunities for FEMA to take the draft FIRMs through effective FIRMs. FEMA grant funding is being used to complete Physical Map Revisions (PMRs) that address specific community needs for portions of counties with outdated or insufficient flood hazard mapping. A partnership with the U.S. Army Corps of Engineers is being used to secure funding for floodplain mapping in northwest Iowa counties and one county in southeast Iowa that were not declared disaster areas after the flood of 2008.



Floodplain mapping progress and status through 2012.

--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. A total of 28,690 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. Of the 28,690 sinkholes, 19,627 show up on LiDAR as active sinkholes.

Mines, Minerals, Energy

--U.S. Geological Survey Airborne Study of Northeast Iowa

Between 1953 and 1972 the Iowa Geological Survey contracted a series of aeromagnetic surveys that mapped the magnetic anomaly of the entire state. These surveys attracted several metallic mineral exploration companies to Iowa in the 1960s and they drilled thousands of feet of exploration cores that are now repositied at the Survey's Research Facility. Now, 50 years later, these magnetic surveys and subsequent cores are at the heart of a new metallic mineral exploration program. Beginning early in 2013, the U.S. Geological Survey (USGS) will initiate a

series of aerial surveys of portions of Winneshiek County, Iowa, and adjoining parts of Minnesota to collect information on a series of rocks that lie buried about 2,000 feet below the land surface. A part of Iowa's "basement complex," these rocks are a suite of iron- and magnesium-rich igneous rocks that were intruded into older rocks in that area about 1 billion years ago during the development of a major tectonic feature, the Midcontinent Rift System. It is suspected that these intrusive rocks could host significant deposits of strategic metallic minerals, such as nickel, copper, vanadium, and titanium, as well as gold and silver. Similar deposits with estimated values in excess of \$100 billion have recently been discovered in similar rocks of the same age in northeast Minnesota. These surveys will make careful measurements of variations in the Earth's gravity and magnetic fields in this area. With these measurements scientists will be able to create a more accurate model of the distribution and character of these intrusive rocks, perhaps leading to exploration drilling to accurately assess their mineral value.

Geologists from IGWS are working closely with the USGS and Minnesota Geological Survey geologists on this five-year research program that will ultimately be expanded to include larger areas of the Midcontinent Rift in central Iowa.

--Frac Sand Mining

The mining of quartz-rich silica sand for oil and gas field frac-sand application continues in northeast Iowa with expansion of the Pattison Sand Mine in Clayton County. The mine produces sand from the Ordovician St. Peter Sandstone from both surface and underground workings. Some of the sand is sold for use in Portland cement and geothermal grout applications. Shipments from the mine are primarily by truck and rail. A new frac sand mine site in the Cambrian Jordan Sandstone was proposed for northern Allamakee County, however the permit request to the Allamakee County Supervisors was withdrawn late in the year. Frac sand mining has expanded rapidly in western Wisconsin and producers appear to be considering new locations in northeast Iowa and southeast Minnesota, areas with similar quartz-rich sandstone formations.

--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



AgustaWestland AW119 Koala helicopter that will fly the magnetometer and electromagnetic surveys (see EM detector suspended below helicopter). Photo from <http://www.geotech.ca/Photo-Gallery>.

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.

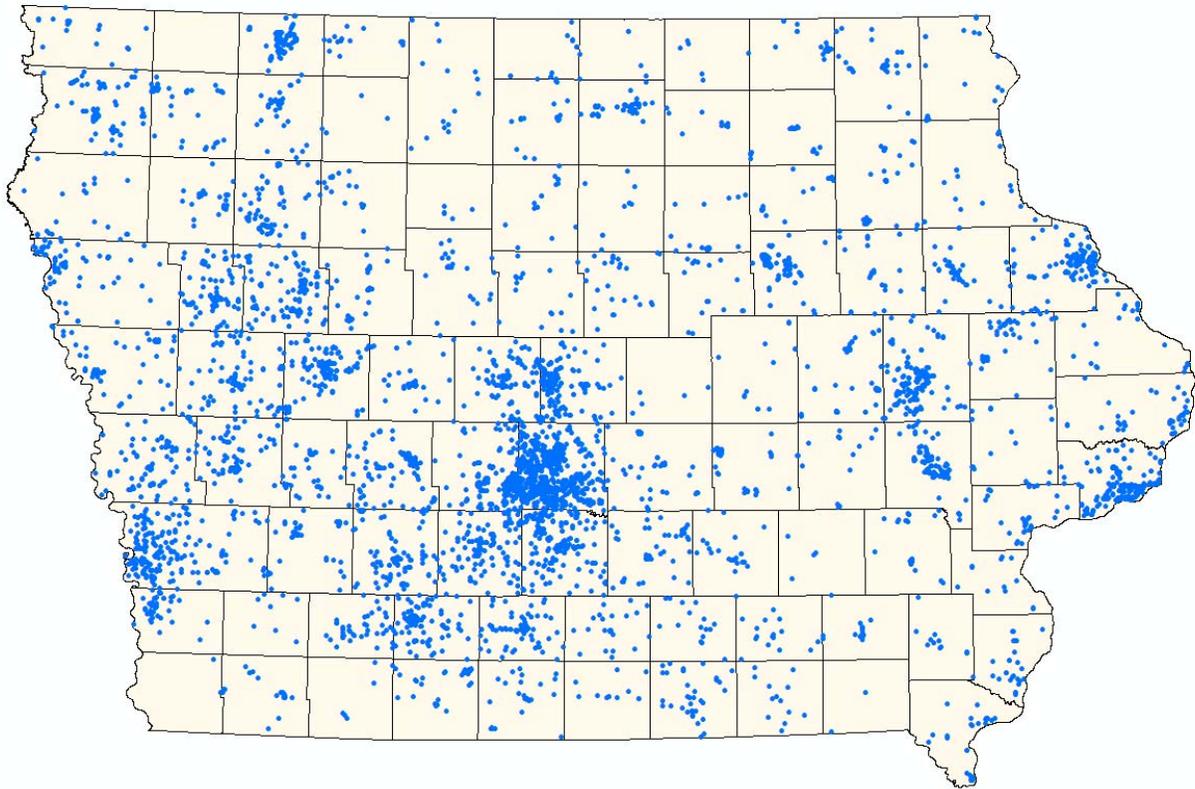
--Active Mining

In 2011, Iowa's nonfuel raw mineral production was valued at \$565M, based upon annual U.S. Geological Survey data. This ranked Iowa 37th in the United States in terms of production. A total of 45% of that value was crushed stone, 42% was combined cement, gypsum, lime, dimension stone, industrial sand, and peat, 13% was sand and gravel, and 0.2% was clay. Mineral production occurred in 84 of Iowa's 99 counties.

--Geothermal Energy

The Survey completed the second year of a three-year project funded by the Department of Energy and administered by the Arizona Geological Survey. The Department of Energy project is focused primarily on developing a national data system for developing geothermal energy resources. During the second project year, IGWS prepared new and updated records describing wells, current geothermal facilities (heat pumps), and the State's geology. As part of this project IGWS is developing a collection of GIS data, a web-mapping service, and a web-based application that can be used to assess the suitability of a site for development of heat pumps based on the local geology and accounting for nearby potential impacts such as karst, existing wells, and contaminant sources as a means of supporting the rapidly growing ground-sourced heat pump industry. During the second year of the project, data were developed for Dubuque County as a pilot project for the entire state.

The map below shows the distribution in 2012 of permitted heat pump facilities in Iowa and includes closed- and open-loop facilities installed for private, commercial, and public users.



Distribution in 2012 of permitted heat pump facilities in Iowa. Included in the map are closed- and open-loop facilities installed for private, commercial, and public users.

Water Resources

--Drought of 2012 – Information and Coordination

In December 2011, several Geological and Water Survey Bureau staff discussed unusually dry conditions that existed in northwest Iowa. Low groundwater levels, low stream flow, and low lake levels were causing concern for drinking water supplies in some communities. From that discussion the idea of an interagency effort began, and with the coordination of the Chief of the Geological and Water Survey Bureau, staff from the DNR, IDALS, IGOV, Homeland Security, and the USGS met to share observations and data, and to discuss how the information could be used and distributed. The group came up with the idea of a regularly produced and distributed "[Water Summary Update](#)" (WSU) that includes information on precipitation, stream flow, groundwater levels, and statewide drought conditions. With the assistance of DNR Communications staff, and a large group of technical staff from across state government, an updated WSU was issued every other Thursday throughout most of 2012. Each WSU includes a mix of data and observations from across the state, and allowed state agencies to be out ahead of drought concerns and to prepare for other issues as they develop. The Bureau Chief states that "this has been a widely accepted way of communicating important information to a broad range of Iowans, and is the product of great collaboration between staff at many agencies." The scientific and technical leadership of IGWS staff has been critical to the ongoing usefulness and success of these efforts.



Drought conditions statewide in 2012 resulted in low groundwater, stream flow, and lake levels.

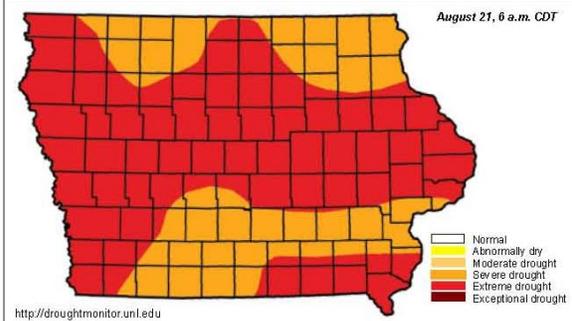
WATER SUMMARY UPDATE

No. 12

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August 23, 2012

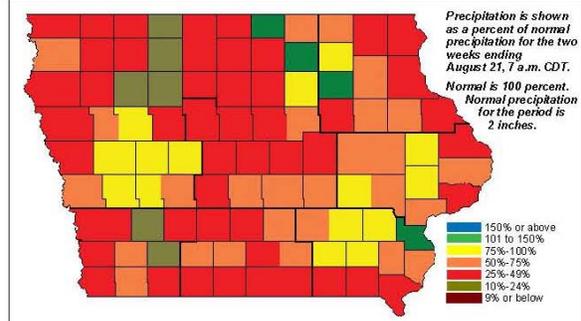
Drought Monitor

National Drought Mitigation Center and partners



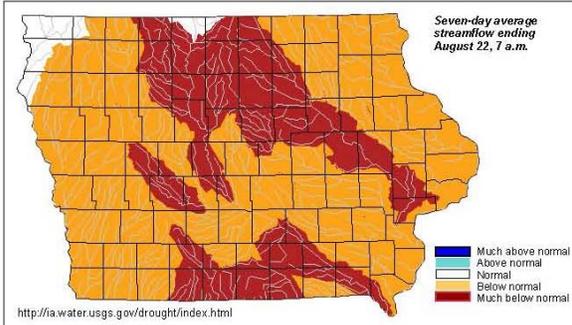
Precipitation

State Climatologist



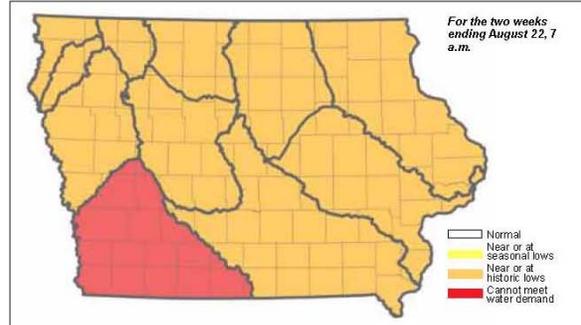
Streamflow

US Geological Survey



Shallow Groundwater

Iowa DNR



The Water Summary Update, produced weekly, includes information on precipitation, stream flow, groundwater levels, and statewide drought conditions.

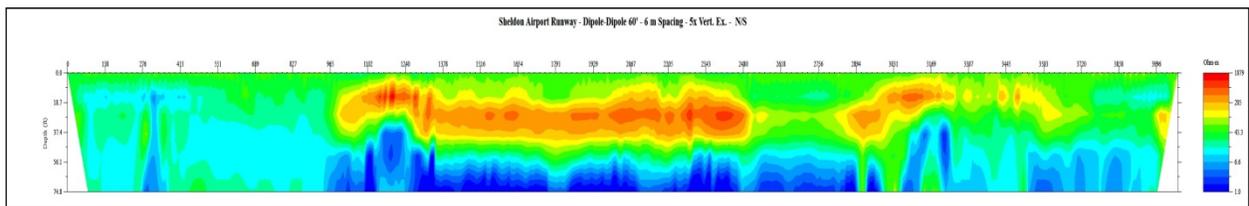
--Geophysical Surveys of the Floyd River Alluvial Aquifer

As drought conditions engulfed much of Iowa in 2012, concerns of shallow groundwater availability surfaced. The IGWS has placed an emphasis on studying shallow groundwater availability in northwest Iowa, a region hit especially hard by a lack of precipitation and aquifer recharge. An effort to incorporate geophysical surveys into groundwater availability mapping was implemented in 2012. Electrical Resistivity (ER) geophysics is helpful in identifying aquifer parameters that assist in groundwater modeling efforts. A preliminary ER survey was completed near the town of Sheldon, Iowa, as part of a Floyd River alluvial aquifer characterization and assessment. Results from the survey outlined areas of anticipated groundwater-bearing sands and gravels (image below). Plans are underway to incorporate ER surveys into additional future assessments.



Location of ER survey (yellow line) in relation to the Floyd River alluvium boundary (red lines).

ER equipment collecting data along the Sheldon, Iowa survey line.



ER model showing coarse grained sand and gravel (reds, yellows) alluvium. Model is shown northwest to southeast (left to right), and represents a 4,000' (1,220 m) length. Note: model vertically exaggerated.

--Water for Iowans - 2030 and Beyond

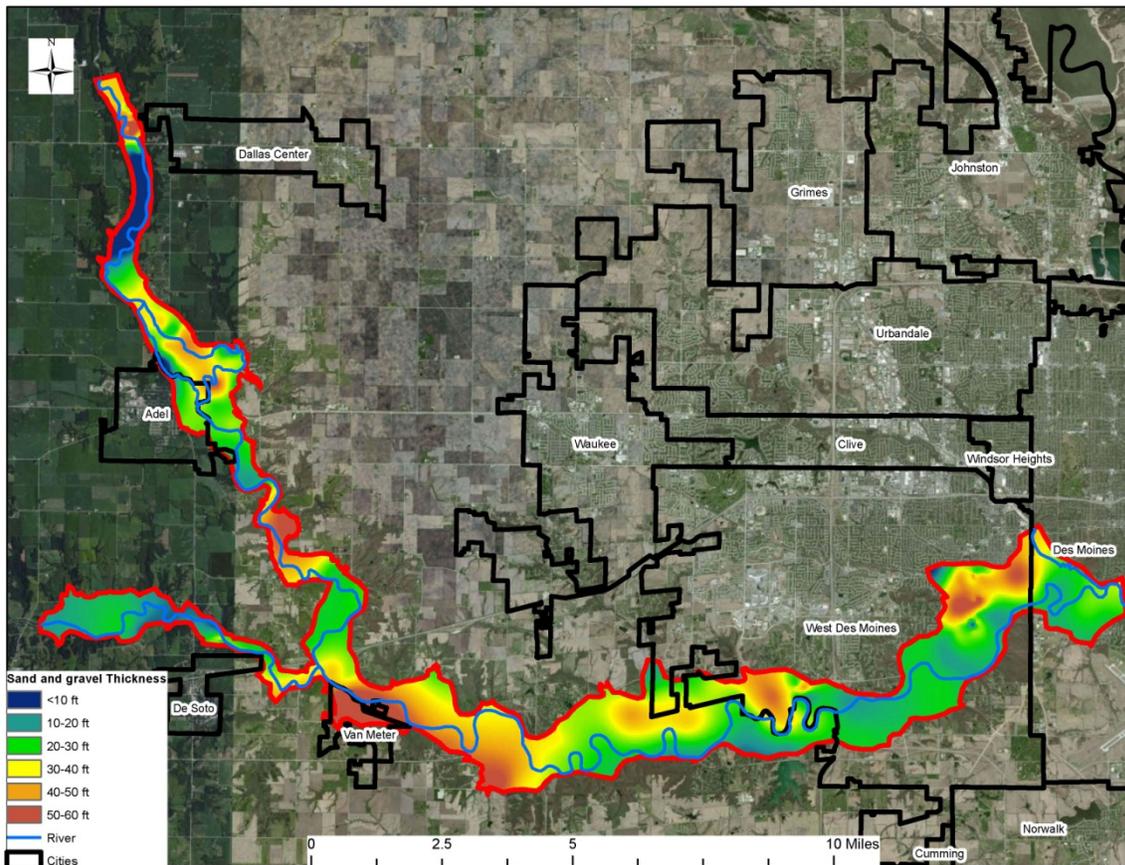
In 2012, the Iowa Geological and Water Survey completed a detailed geologic description and predictive groundwater model for the shallow sand and gravel aquifer associated with the lower reach of the Raccoon River near Des Moines. The groundwater model was used to estimate maximum sustainable pumping rates under severe drought conditions. Water level data during the summer of 2012 were used to help calibrate the model. Based on the mass balance calculations in the model, the percentage of water production supplied by the Raccoon River (induced recharge) was 52 percent, and 29 percent was supplied by induced recharge from the numerous sand and gravel quarries. The remaining 19 percent of the water production was supplied by precipitation recharge and groundwater inflow into the model area. The percentage of induced recharge varied from 0 percent at Van Meter, to 89% at the Des Moines Water Works radial wellfield.



Based on available pumping records, an average of 14.6 billion gallons of water are pumped from the Lower Raccoon River aquifer each year. Additional water production is available from the aquifer, but limitations exist during extremely dry years. Additional pumping capacity ranges from 10 percent in the West Des Moines wellfield, to over 1,000 percent at Adel. Potential well yields greater than 500 gallons per minute (gpm) are found near Adel, Van Meter, and West Des Moines.

A hydrogeologic study was also completed for the Floyd River alluvial aquifer. A groundwater flow model for the Floyd River aquifer near Sheldon was used to simulate a severe drought. Based on the mass balance calculations in the model, the percentage of water production supplied by the Floyd River (induced recharge) increased from 54 percent during normal precipitation to 68 percent during a moderate to severe drought. The increase in induced recharge allows the City of Sheldon to maintain water production during prolonged dry periods. Limitations in water production exist when streamflow along the Floyd River drops below 1.58 cubic feet per second.

The modeling and geologic information is a major step forward in developing and protecting water supplies, evaluating drought impacts, and addressing groundwater and stream water quality concerns. These studies are important to assure the long-term sustainability of our groundwater resources.



Thickness map of the Lower Raccoon River aquifer and its tributaries.

--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.

--Source Water Protection for Iowans Drinking Water

Iowa’s Source Water (a.k.a. drinking water) Protection program (www.iowasourcewater.org) helps public water systems 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 and contaminant information to help communities proactively protect both water quality and quantity issues, and reactively address well construction or contamination problems.

This past year the Source Water program did an extensive overhaul of both the inventory application (Source Water Tracker) and our ‘Phase 1’ assessments. Source Water tracker was modified to integrate with our online mapping application (Source Water Mapper), and be a more user-friendly searching tool. Now all a community needs to know is its name to access all

of the digital information we have gathered over the years, from old wells drilled a century ago to a site visit completed just months ago.

Additionally, every Iowa community using groundwater as a drinking source received an updated assessment with many new features, including a time-plot of nitrate-nitrogen (to help spot trends in water quality), hyperlinked wells and contaminants (to help research potential issues), and an updated map using the latest 2011 land cover information. These reports are all publically accessible through Source Water Tracker.

Finally, the Source Water Program completed an intensive three-day training program on understanding the Source Water fundamentals through the use of GIS. These training sessions were designed to help smaller communities in the State of Iowa collect, create, and integrate spatial data into their everyday duties. Over 60 attendees from more than 20 communities attended the training sessions, and learned about contaminants, wells, GIS, and the basics of the Source Water Program.



The Source Water Program conducted several trainings for smaller communities to help them collect, create, and utilize spatial data in their community.

--Lake Monitoring

The ambient lake monitoring program sampled 130 public lakes throughout the summer of 2012 for various chemical, physical, and biological parameters. This monitoring program is a partnership between the DNR's Watershed Monitoring and Assessment Program and the Fisheries' Lake Restoration Program. Data are collected and used statewide to characterize water quality in Iowa's lakes, to show trends in water quality across years, and to track the success of watershed improvement projects and lake restoration activities. These data also help better understand and manage our lake resources.

Lake monitoring during 2012 was unusual, with low lake levels and frequent algal blooms observed in many Iowa lakes. These conditions were partially attributed to decreased lake flushing and extreme drought throughout much of the state. Nutrient concentrations in the majority of Iowa lakes remained high in 2012 because of nutrient-rich soils throughout Iowa and because of nutrient runoff from point and nonpoint sources. While nutrients like nitrogen and phosphorus are essential for all life in lakes, high concentrations of these nutrients can result in frequent nuisance algae blooms, decreased water clarity, low dissolved oxygen concentrations due to algae decomposition, water taste and odor problems, and changes in the biological community.

Several measures are frequently used to characterize water quality in Iowa's lakes. Water transparency or clarity is measured using a black and white patterned disc, called a Secchi disc, lowered into the water (see photographs below). This simple measurement helps to understand how far light can penetrate in the water. In Iowa, the median water clarity for lakes sampled as a part of the lake monitoring program was 0.6 meters. Ideally, Iowa lakes should have a Secchi depth or water clarity greater than 0.7 meters. In 2012, 72 lakes had average clarity readings greater than this target.



Photos of Secchi discs at a depth of 0.2 meters at several Iowa lakes in 2012 (photos courtesy of the Iowa State University Limnology Laboratory).

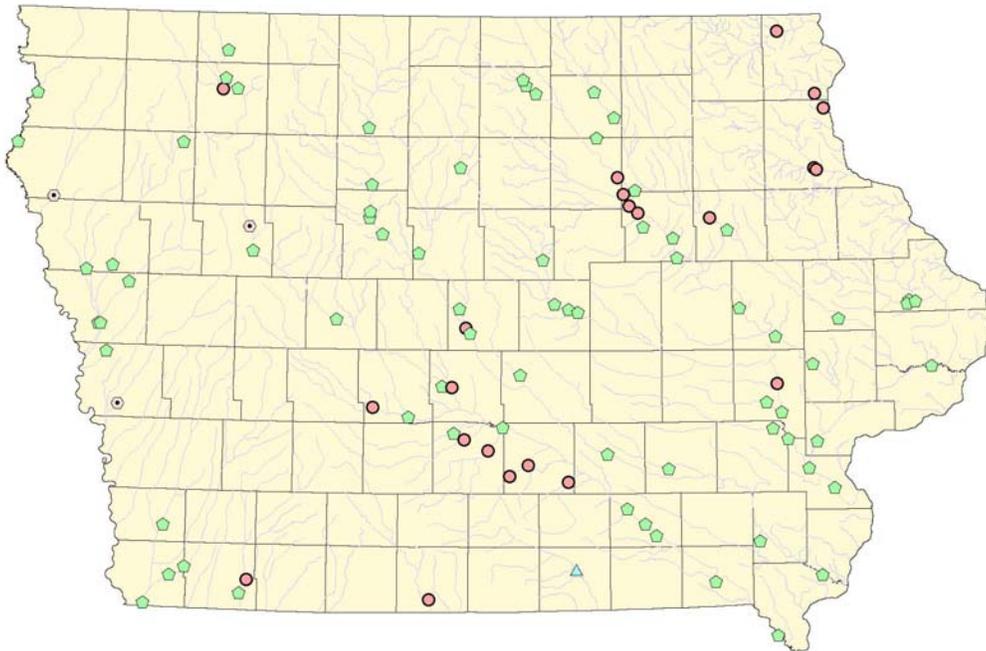
Algae and plants require essential nutrients to grow, thus, nutrient availability will greatly influence the amount of algae that can grow in a lake. Phosphorus is nearly always the limiting nutrient (the nutrient in shortest supply) in Iowa lakes. Lakes with phosphorus concentrations above 50 parts per billion (ppb) are likely to have decreased water clarity, low oxygen, and frequent algal blooms dominated by blue-green algae. The average phosphorus concentration in Iowa lakes for 2012 was 117 ppb. Ninety of the 130 lakes sampled had average phosphorus concentrations above 50 ppb, and thus would be considered eutrophic or “highly productive.” A total of 33 lakes had extremely high average total phosphorus concentrations (above 150 ppb of total phosphorus) and would be considered hypereutrophic or “extremely productive.” These hypereutrophic lakes experience continuous blue-green algae blooms in the summer, low oxygen concentrations near the bottom of the lake, and very low water clarity.

Frequent algae blooms were observed in lakes across the state in the summer of 2012 as a result of high nutrients, hot temperatures, and decreased lake flushing due to the extreme drought. Chlorophyll *a*, the green pigment produced during plant photosynthesis, is frequently used to estimate the amount of algae in lakes. Concentrations above 30 parts per billion (ppb) are associated with visible algae blooms. A total of 82 of the 130 lakes sampled had average

chlorophyll *a* concentrations above 30 ppb in 2012. High chlorophyll *a* concentrations (above 55 ppb) are associated with thick green surface algae scums and lake water odor concerns. A total of 41 of the 130 Iowa lakes sampled had average chlorophyll *a* concentrations above 55 ppb.

--Stream Monitoring

The ambient stream monitoring program sampled 82 stream locations for chemical and physical parameters during 2012. The stream monitoring program provides the information to assess the status and trends of water quality in Iowa streams and to report the condition of streams to decision makers, citizens, and resource managers. Stream monitoring data are being used to develop nutrient criteria for stream biological health, to provide information for the point source nutrient reduction strategy, and to report on Iowa's Water Quality Index (WQI). WQI 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. WQI 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 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/wqiallyears.htm>).



Iowa Water Quality Index for 2000 through 2012. For 2000-2012, 1% of the monthly stream IWQI values were in the excellent category, 12% were good, 34% were fair, 34% were poor, and 19% were very poor.

Biological monitoring, including fish and benthic macroinvertebrate taxa identification, continued in 2012. 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 the state. 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 biological condition of streams in different ecoregions of the state.

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-2013.

--Wetland Monitoring

In previous years, the focus of Iowa's wetland monitoring program was on Prairie Pothole wetlands located within the Des Moines Lobe, in north-central Iowa. In 2012, a three-year monitoring project began which will focus specifically on riverine wetland sites across the entire state. There are no existing data for this type of wetland in Iowa, as it has previously never been studied. Riverine wetland sites were selected randomly and a total number of twenty sites were sampled. Physical and chemical measurements were taken, and surveys were conducted on fish, vegetation, and benthic macroinvertebrate species. Data from the riverine wetland project will help define and describe the typical characteristics of this type of wetland, and assist in the effective management and protection of these types of ecosystems.



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

--Shallow Lake Monitoring

In 2012, sixteen shallow lakes were sampled for physical, chemical, and biological parameters as part of a cooperative project with the DNR Wildlife and Fisheries bureaus and Ducks Unlimited, Inc. (DU) to assess the quality of shallow lakes. These data were combined with similar data from 2010 and 2011 to determine the general health of these systems, as well as to discover if significant trends or changes in water quality have occurred over time.

The 16 sites that were sampled consisted of both previously restored, as well as non-restored shallow lakes and wetlands. This project has allowed the DNR to measure the success of restoration efforts, and to compare the conditions of healthy sites to those of degraded sites. The information gathered from these monitoring efforts will advance our understanding of the functionality of these systems, and will also help us to determine candidate sites for future restoration projects.

--Groundwater Monitoring

IGWS and the United States Geological Survey (USGS) collaborated on a groundwater monitoring network from 1982 to 2006 that collected raw, untreated, water from municipalities across the state. A network of 90 “core” wells was identified in 2002 and monitored yearly thereafter. All wells in the network were components of public water supplies (no irrigation or private wells were utilized) and are completed in one of the major aquifers of Iowa. Budgetary prioritization forced the suspension of the network in 2006.

In 2012 the IGWS coordinated the collection of samples from the “core” wells that were available. Samples were analyzed for a wide range of parameters, including general water chemistry, nutrients, ions, pesticides, metals, and volatile organic compounds. The data will be used to develop a proposed monitoring schedule that can be sustained into the future. A report on the current water quality in these wells and trends through time will be completed in 2013.



Historically, the IGWS and U.S. Geological Survey coordinated a groundwater level network to measure water levels in aquifers across Iowa. Up until 2007, water levels were measured at 160 wells on a quarterly basis. In 2007 due to funding issues, the network was discontinued. Since 2010, a reduced water level network was re-instated. Currently, water levels from 64 bedrock wells are being measured on a semi-annual basis.

--Assessing Groundwater Quality around Iowa’s Great Lakes

IGWS personnel are working with local partners to evaluate groundwater flow and quality in the West Lake Okoboji watershed. In November 2011, in cooperation with the Natural Resources Conservation Service, 21 shallow monitoring wells were installed around the watershed to assess groundwater conditions under representative land cover types, including cropped fields, wetlands, perennial grassland, forest, golf course, and urban settings in a variety of landscape positions. Water levels are being measured in all the wells on a monthly basis by local partners and water level recorders were placed in six representative wells to measure water table fluctuations on a continuous basis. Water quality samples are being collected on a quarterly basis for field water quality indicators and laboratory analysis of nitrogen and phosphorus concentrations. Despite very dry conditions in 2012, results indicate groundwater nitrate

concentrations vary considerably in the watershed ranging from an average of 8.6 milligrams per liter (mg/l) beneath cropped fields and 0.1 mg/l beneath perennial grass. Phosphorus concentrations exhibited less spatial variability than nitrate, ranging from 0.05 to 0.09 mg/l in most groundwater wells. Interestingly, highest average phosphorus concentrations (0.5 mg/l) have been detected in groundwater associated with an urban bioswale that receives runoff from nearby parking areas, whereas among the lowest P concentrations were those beneath a golf course. IGWS will continue to monitor water levels and quality in 2013.

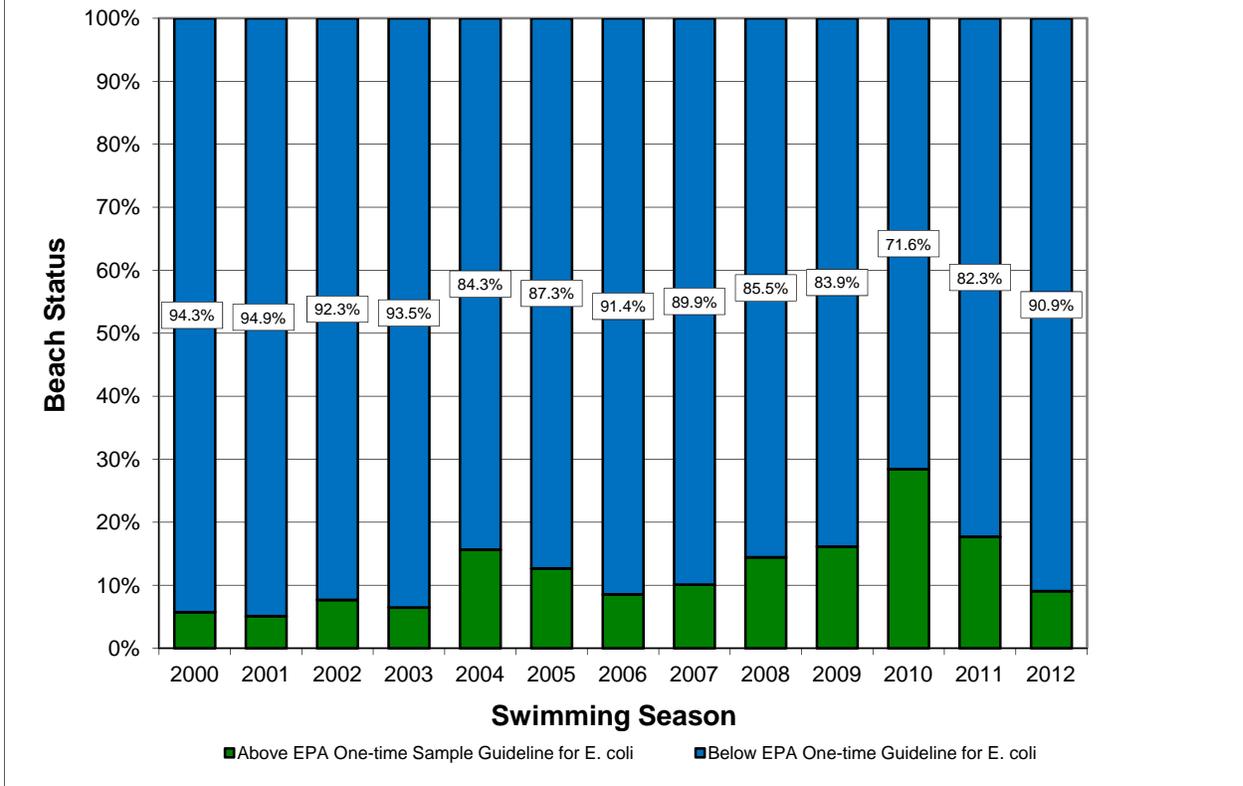
Public Health

--Beach Monitoring

The IGWS beach monitoring program collects and analyzes samples for indicator bacteria with the goal of safeguarding the health of those who choose to swim at beaches throughout the state. The beach monitoring program routinely monitored 36 state-owned beaches in 2012; 30 city- and county-managed swimming areas elected to submit water samples for bacteria analysis, 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 advisory status at each beach, were updated on the IGWS website and Beach Hotline while advisory signs were posted at beaches exceeding recreational standards for indicator bacteria. Beachgoers have come to rely on this information to make informed decisions about when and where to recreate at Iowa's beaches. During the program's thirteen-year existence, monitoring has shown that the overall bacterial water quality at Iowa's state-owned beaches has been generally good: bacteria concentrations were below the one-time standard for *E. coli* 87.6% of the time and were below the geometric mean standard for *E. coli* 89.2% of the time.

Monitoring for cyanotoxins, harmful substances produced by cyanobacteria (blue-green algae), has been conducted during the last few beach monitoring seasons. An advisory policy has been implemented to inform beachgoers of potential threats posed by cyanotoxins at state park beaches. The IGWS also works closely with the Iowa Department of Public Health to monitor the health effects of exposures to cyanobacterial blooms and their associated toxins.

Beach Status - One Time Standard (Memorial Day - Labor Day)



Percentage of weeks between Memorial Day and Labor Day from 2000 through 2012 when samples from Iowa's state-owned beaches exceeded the state one-time indicator bacteria standard of 235 E. coli per 100 mL of water versus weeks when samples were below the state one-time standard. In 2012, 91% of samples had E. coli concentrations below the state one-time standard.

Landuse Planning

--Watershed Management Authorities

The Watershed Improvement Section was afforded the opportunity in 2012 to issue a Phase 2 Request for Proposals to provide financial assistance to existing Watershed Management Authorities (WMA) to initiate the development of comprehensive watershed management plans. With support from the US 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 grants totaling over \$560,000 to the following three WMAs to begin their planning process: Indian Creek (Linn County); Turkey River (Clayton County); and Catfish Creek (Dubuque County). These WMAs will spend the next two years working with their respective authority members (including cities, counties and local soil and water conservation districts) to craft comprehensive watershed management plans to improve water quality and reduce flood risk potential within their watersheds.

--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, a network of five Basin Coordinators was created to serve the watershed improvement needs of the six major drainage basins and three major river regions within the state of Iowa. DNR Watershed Improvement staff members serve as the Iowa/Cedar River Basin Coordinator and the Upper Des Moines/Raccoon River Basin Coordinator. The 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 is also providing technical support to the Upper Cedar River, Indian Creek, Turkey River, and Catfish Creek watershed management authorities that were created in 2012. The DNR's Upper Des Moines/Raccoon River Basin Coordinator provides technical support to a variety of locally led watershed improvement projects throughout the Upper Des Moines and Raccoon River basin, including innovative public-private partnership initiatives to restore oxbow habitat and reduce nitrogen loading in the Boone River watershed. 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. Another, new USDA water quality initiative for 2012, the National Water Quality Initiative (NWQI) is also being supported in the Raccoon River basin with the assistance of DNR's Basin Coordinator. The NWQI is also being supported by the DNR NPS Program's Section 319 monitoring funds to track water quality improvements within the Black Hawk Lake Watershed in the Raccoon River basin.

--Environmental Geology and Animal Feeding Operations (AFO)

IGWS staff no longer perform geologic and environmental assessments for the AFO program regarding permits for earthen basins, well variances, or siting issues relative to sensitive areas such as floodplains and karst.

While IGWS staff no longer directly assist producers or consultants with regulatory issues related to environmental protection, IGWS staff do continue to maintain the interactive mapping services (the AFO Siting Atlas and Livestock Burial Zones), which help producers, consultants, and field office staff identify potential environmental issues related to siting new facilities or addressing livestock mortalities.

IGWS staff continues to track and evaluate water monitoring required by AFO construction permits. Current efforts are underway to summarize the groundwater monitoring data that has been collected by IGWS at long-term earthen manure storage basins and to compare these data to that which has been submitted by permitted facilities with earthen basins and by unpermitted confinements in karst areas.

IGWS staff provides maps and GIS coverages of AFO locations to assist federal, state, and local groups and individuals with watershed projects, enforcement activities, and research and education efforts.

Watershed Studies

--TMDLs – Targets for Water Quality Goals

The TMDL program experienced another 6.6 percent cut in its federal EPA funding in 2012 (on top of the 27 percent cut in 2011). This has resulted in a loss of over \$141,000 in funds used to develop Water Quality Improvement Plans (WQIP) over the last two years. These federal budget cuts continue to force the program to scale back on its planned water quality monitoring efforts and TMDL development plans. In spite of these major budget cuts, the TMDL program completed and/or initiated WQIPs, also known as total maximum daily loads (TMDL) for six water bodies in 2012. These included Hannen Lake in Benton County (algae, pH); Lake Keomah in Mahaska County (algae, pH); Casey Lake in Tama County (algae, pH); a basin wide project in the Yellow River in Winneshiek and Allamakee counties for bacteria; Beeds Lake in Franklin County (algae); and Volga Lake in Fayette County (algae, pH). In addition, EPA approved WQIPs for four water bodies in 2012. These included: Black Hawk Lake in Sac County (algae, turbidity); Silver Creek in Clayton County (sediment, ammonia); Briggs Woods Lake in Hamilton County (organic enrichment / low dissolved oxygen, algae); and Lake Keomah in Mahaska County (algae, pH). Biologists on staff completed stressor identification analyses and prepared reports on causes of the biological impairment on two water bodies in 2012 – Walnut Creek in Jones County and Dick Creek in Wayne County. Staff biologists also continued work on two recent initiatives; a statewide mussel survey scheduled to be completed in 2016, 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 another deep (16.5 percent) cut in its base level of funding from the U.S. Environmental Protection Agency. This translated into a loss of an additional \$257,000 in federal funding to support the program's base mission, on top of the \$576,300 cut in base funding in 2011. Combined, these cuts constituted a nearly 39 percent cut in base funding for the program since 2010 and 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. These cuts also forced an elimination of 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 forced to be held at previously reduced levels in order to comply with these federal budget cuts. At this writing it is unclear how congressional budget negotiations for federal fiscal year 2013 in response to the pending sequestration scheduled to take effect on January 1, 2013, may impact future Nonpoint Source Program funding.

In spite of these major cuts in funding, in 2012, the Nonpoint Source Program awarded nearly \$3M in EPA Section 319 nonpoint source grant funds to seven new and ongoing watershed improvement projects designed to improve water quality throughout the state. These watersheds included Iowa Great Lakes (Dickinson County), Badger Creek Lake (Madison and

Dallas counties), Silver Creek (Clayton County), Big Creek Lake (Boone and Polk counties), Tete des Morts Creek (Jackson and Dubuque counties), Yellow River (Winneshiek and Allamakee counties) and Lake Rathbun (Wayne, Lucas, and Appanoose counties). The Nonpoint Source Program has also allocated nearly \$209,000 in funding to conduct water monitoring over a three-year period in the seven watersheds mentioned above. In addition, the Nonpoint Source Program provided \$133,439 in funding to continue support for the Iowa Learning Farms project, a water quality/farmer education project based in the Leopold Center at Iowa State University.



Tete des Morts, located in Jackson and Dubuque counties, has been the focus of a watershed improvement project designed to improve water quality.

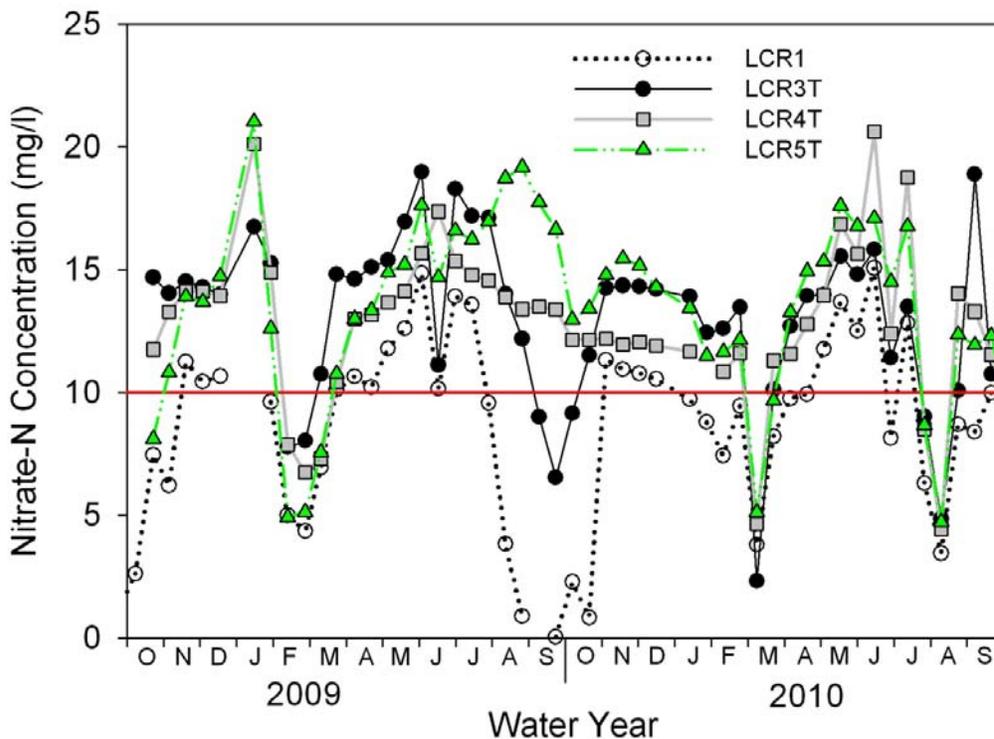
--Nonpoint Source Management Plan Updated for 2012

A major initiative for the Nonpoint Source Program in 2012 was the completion and subsequent approval by EPA of a much needed update to the Nonpoint Source Management Plan (Plan). The Nonpoint Source Program used the updating of the state's Plan as an opportunity to engage the core Nonpoint Source 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, engaged a group of 30 partners and stakeholders to craft a new direction for Iowa's Nonpoint Source Program. The final document was submitted to the U.S. Environmental Protection Agency in June 2012 and was officially approved by EPA under provisions of the Clean Water Act in August 2012. This updated Plan provides a blueprint for work by the Nonpoint Source Program, the state's water quality professionals at the DNR, and our partners at Natural Resources Conservation Service, Iowa Department of Agriculture and Land Stewardship-Division of Soil Conservation, Iowa State

University, Conservation Districts of Iowa, and engaged stakeholder groups throughout the state over the next five years. New U.S. Environmental Protection Agency guidelines will require Iowa to update this Plan at least once every five years in order to maintain eligibility to receive federal Section 319 grant funds from the U.S. Environmental Protection Agency.

--Evaluating Nitrate-Nitrogen Concentrations and Loads

Extensive subsurface tile drainage networks in the Corn Belt region of the United States are organized into drainage districts. In Iowa alone, there are approximately 3,000 of these engineered watersheds. Watersheds containing subsurface drainage tile systems represent a major source of nitrate-N to the Mississippi River and Gulf of Mexico and efforts to reduce nitrate loads require use of best management practices. Through a joint project with the Iowa Soybean Association and The Nature Conservancy, nitrate-N concentrations and loads discharged from three typical drainage districts in north-central Iowa are being evaluated in order to: 1) explore the relation of drainage district nitrate-N concentrations to the downstream drainage network, and 2) quantify the effectiveness of field and landscape-scale best management practices. Data gathered from the first two years of the project show that nitrate-N concentrations averaged approximately 13 milligrams per liter (mg/l) and exceeded 10 mg/l (the standard for safe drinking water in the U.S.) nearly 90% of the time. Based on data collected as part of this study, it is recommended that best management practices selected for implementation in the tile drained basins should be focused on those practices capable of achieving on average an 8% reduction in nitrate-N concentrations. Those practices could include reduced fertilizer applications, adoption of cover crops, and land use change.



Nitrate-nitrogen concentrations measured in tile drainage water and Lyons Creek. Site LCR1 is Lyons Creek while the other sites are the tile locations. The red line represents the drinking water standard.

Data Management

--Historic Aerial Photos

The Historic Aerial Photography project completed the decadal series - a major milestone. The aerial photo mosaics are currently made available in two ways. The first method is most useful for professional GIS users or others who work with the files directly. By going to the DNR's FTP site <http://www.igsb.uiowa.edu/nrgislibx/> and clicking on the Data available by Theme link on the left-hand side of the page the user will be taken to a page that allows them to select aerial photo imagery from many different dates. The second method is a DNR web site at which all the decades of historic photos can be viewed. Currently, this includes the 1930s, the 1950s, the 1960s, the 1970s, the 1980s, 2002, and 2008. The link to the site is <http://programs.iowadnr.gov/maps/aerials/>. Finally, the photos can be viewed and downloaded from the Iowa State University OrthoServer, <http://ortho.gis.iastate.edu/>.

Currently, project staff are updating some of the earliest series (1930s and some 1950s) to the more robust methodologies implemented in the second year of the project. This will make the digital photos clearer in some cases and more accurate. Additionally, historic photography of the Mississippi River is being orthorectified.

--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 2012, and most have now been implemented. Examples include the Iowa Historic Photos and Iowa Coal Mines.

--Iowa Geospatial Infrastructure

The IGWS GIS Section continues to work 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. The Iowa Geocoding Project continued in 2012. This project collects county GIS information needed to create address points and building points for every structure in the state. 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

--IOWATER

IOWATER is Iowa's volunteer water quality monitoring program training 251 volunteers in 2012. Since 2001, IOWATER has trained thousands of Iowans interested in our State's water quality, the status of aquatic life in our streams, and our outdoor environment. We provide a web-available database for volunteers to enter and view the data they have collected. 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 2012, Project AWARE held its tenth annual event on the Iowa River in central Iowa. Project AWARE (**A Watershed Awareness River Expedition**) is the DNR's volunteer weeklong river cleanup. Low river levels, which dominated the state in 2012 due to the drought, brought both opportunities and challenges to the cleanup effort. On one hand, trash that had been buried in the depths of the Iowa River for years had no place to hide in the shallow, clear waters. Volunteers, however, then faced the challenge of navigating fully loaded canoes in the uncharacteristically low water.

In spite of low water levels, a total of 85 river miles were cleaned by 387 volunteers (ranging in age from 3 to 78) who contributed more than 9,000 volunteer hours to the effort. Nearly half of the volunteers were first-year volunteers. A record amount of trash (60 tons) was removed, 86% of which was recycled. Included were 1,371 tires and 42,700 pounds of scrap metal. One hundred and five sponsors supported the event through either monetary or in-kind donations.



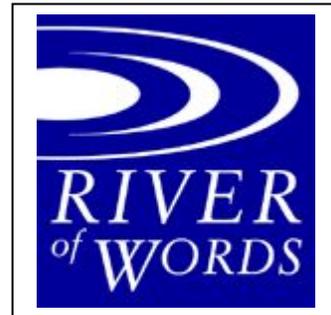
A total of 42,700 pounds of scrap metal and 1,371 tires were removed from the Iowa River.

Project AWARE received elevated coverage in 2012. During the ten years, David Williamson, the collaborating artist for Project AWARE, has helped volunteers transform trash into sculptures. For the past five years, these sculptures have also served a more functional purpose: security gates for the DNR Building on the Iowa State Fairgrounds in Des Moines. The artwork honors the dedication and commitment of volunteers to improving Iowa's water resources. In addition to having a five-day Iowa State Fair interpretive working exhibit in 2012, Project AWARE sculptures were the featured exhibit at the Patty and Jim Cownie Cultural Center at the Iowa State Fair. Additionally, Iowa Public Television broadcast a segment on Project AWARE as part of its Iowa Outdoors program in spring 2012

(http://www.iptv.org/iowaoutdoors/story.cfm/feature/9498/iao_20120506_203_aware), and the event will be featured in the DNR's *Iowa Outdoors* Magazine in spring 2013.

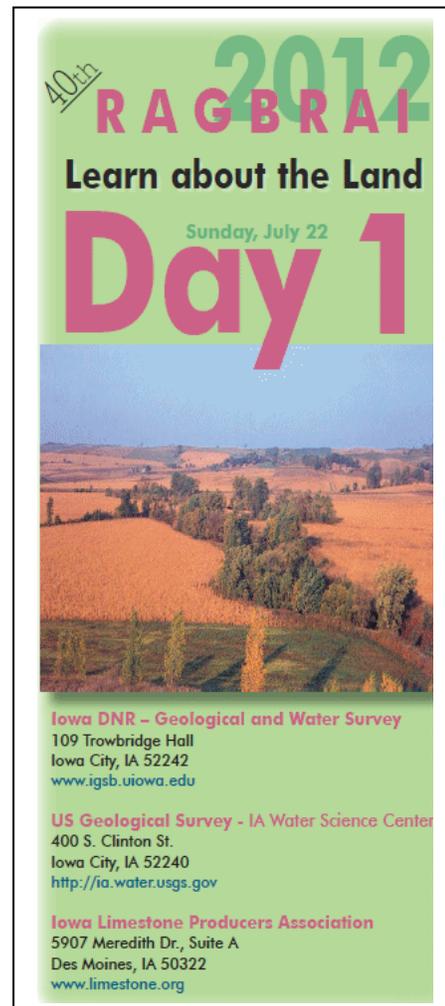
--River of Words®

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 Iowa DNR since 2004. In 2012, over 320 students from Iowa entered the contest, either through their schools, community art centers, community groups, or on their own. A total of 39 pieces were selected in the Iowa competition, and students of these pieces were recognized at an opening reception and award ceremony on August 5, 2012, at the Blank Park Zoo in Des Moines. The exhibit will travel around the state and include stops at the National Mississippi River Museum & Aquarium in Dubuque, Indian Creek Nature Center in Cedar Rapids, Reiman Gardens in Ames, and the State Capitol.



--Learn About the Land RAGBRAI Brochures

Once again in 2012, the IGWS, the U.S. Geological Survey, and the Iowa Limestone Producers Association partnered to develop *Learn About the Land* brochures that described interesting landscape, geologic, and other natural and historical features and resources along the RAGBRAI route. IGWS has been developing these daily brochures for RAGBRAI since 2005.



Publications

Aquifer Characterization and Drought Assessment, Floyd River Alluvial Aquifer, Mike Gannon, 2012, Iowa Geological and Water Survey Water Resources Investigation Report 6, 29 p.

Bedrock Geology of the Cedar Falls 7.5' Quadrangle, Black Hawk County, Iowa, Robert Rowden, Robert McKay, Huaibao Liu, Stephanie Tassier-Surine, Deborah Quade, and James Giglierano, 2012, Iowa Geological and Water Survey Open File Map 12-03, 1:24,000 scale map sheet.

Bedrock Geology of Worth County, Huaibao Liu, Robert McKay, Robert Rowden, Deborah Quade, Stephanie Tassier-Surine, and James Giglierano, 2012, Iowa Geological and Water Survey Open File Map 12-01, 1:100,000 scale map sheet.

Carbon export from the Raccoon River, Iowa: patterns, processes and opportunities, C.S. Jones, and K.E. Schilling, 2013, *Journal of Environmental Quality*, 42:155

Effects of thinning on transpiration by riparian buffer trees in response to advection and solar radiation, V.H. Hernandez-Santana, H. Asbjornsen, T. Sauer, T. Isenhardt, R. Schultz and K. Schilling, 2012, *Acta Hort. (ISHA)* 951:225-231.

Evaluation of analytical and numerical approaches for the estimation of groundwater travel time distributions, N.B. Basu, P. Jindal, K.E. Schilling and C.F. Wolter, 2012, *Journal of Hydrology*, 475:65-73.

Groundwater Availability Modeling Under Drought Conditions-Lower Raccoon River Aquifer-Dallas and Polk Counties, Iowa, Mike Gannon, 2012, Iowa Geological and Water Survey Water Resources Investigation Report 7, 59 p.

Impact of artificial subsurface drainage on groundwater travel times and baseflow discharge in an agricultural watershed, Iowa (USA), K.E. Schilling, P. Jindal, N. Basu and M.J. Helmers, 2012, *Hydrological Processes*, 26:3092-3100.

Lake Water Quality Summary 2000-2011, 2012, Iowa Department of Natural Resources Water Quality Fact Sheet 2012-3, 2 p.

Lake Water Quality Summary 2011, 2012, Iowa Department of Natural Resources Water Quality Fact Sheet 2012-4, 2 p.

Learn About the Land RAGBRAI 2012, 2012, Outreach Materials 2012-1.

Nitrate-nitrogen patterns in engineering catchments in the Upper Mississippi River basin, K.E. Schilling, C.S. Jones, A. Seamon, E. Bader and J. Filipiak, 2012, *Ecological Engineering*, 42:1-9.

Project AWARE 2012, 2012, Iowa Department of Natural Resources Water Quality Fact Sheet 2012-1, 4 p.

Surficial Geology of the Cedar Falls 7.5' Quadrangle, Black Hawk County, Iowa, Stephanie Tassier-Surine, Deborah Quade, Robert Rowden, Robert McKay, Huaibao Liu, and James Giglierano, 2012, Iowa

Geological and Water Survey Open File Map 12-04, 1:24,000 scale map sheet.

Surficial Geology of Fremont County, Iowa, Stephanie Tassier-Surine, James Giglierano, Deborah Quade, and E. Arthur Bettis III, 2012, Iowa Geological and Water Survey Open File Map 12-05, 1:100,000 scale map sheet.

Surficial Geology of Mills County, Iowa, Stephanie Tassier-Surine, James Giglierano, Deborah Quade, and E. Arthur Bettis III, 2012, Iowa Geological and Water Survey Open File Map 12-08, 1:100,000 scale map sheet.

Surficial Geology of Montgomery County, Iowa, Stephanie Tassier-Surine, James Giglierano, Deborah Quade, and E. Arthur Bettis III, 2012, Iowa Geological and Water Survey Open File Map 12-09, 1:100,000 scale map sheet.

Surficial Geology of Page County, Iowa, Stephanie Tassier-Surine, James Giglierano, Deborah Quade, and E. Arthur Bettis III, 2012, Iowa Geological and Water Survey Open File Map 12-06, 1:100,000 scale map sheet.

Surficial Geology of the Okoboji 7.5' Quadrangle, Dickinson County, Iowa, Deborah Quade, Stephanie Tassier-Surine, Robert McKay, and James Giglierano, 2012, Iowa Geological and Water Survey Open File Map 12-10, 1:24,000 scale map sheet.

Surficial Geology of Taylor County, Iowa, Stephanie Tassier-Surine, James Giglierano, Deborah Quade, and E. Arthur Bettis III, 2012, Iowa Geological and Water Survey Open File Map 12-07, 1:100,000 scale map sheet.

Surficial Geology of Worth County, Iowa, Deborah Quade, Stephanie Tassier-Surine, Huaibao Liu, Robert McKay, Robert Rowden, and James Giglierano, 2012, Iowa Geological and Water Survey Open File Map 12-02, 1:100,000 scale map sheet.

Water Quality Summary 2000-2011, 2012, Iowa Department of Natural Resources Water Quality Fact Sheet 2012-1, 2 p.

Water Quality Summary 2011, 2012, Iowa Department of Natural Resources Water Quality Fact Sheet 2012-2, 2 p.

Outreach

Title	Date(s)	People Attending	Location
Environmental Impact Analysis Class Presentation	1/31/2012, 2/2/2012	28	Iowa City, IA
IOWATER Bacteria Monitoring Workshop	2/14/2012	10	Dubuque, IA
Life in the Raccoon River	3/3/2012	75	Perry, IA
IOWATER Program for Sustainable Living at Maharishi University	3/9/2012	30	Fairfield, IA
Muddy Creek Cleanup Event Presentation - North Central Junior High School	4/2/2012	250	North Liberty, IA
IOWATER Introductory Workshop	4/13/2012	30	Packwood, IA
Earth Day Project AWARE event - Howe and Wright Elementary Schools	4/20/2012	75	Des Moines, IA
PlanetRecapture - Hoover Elementary	4/20/2012	40	Iowa City, IA
Muddy Creek Cleanup Event - North Central Junior High School	4/20/2012	250	North Liberty, IA
Iowa River Call	4/21-22/2012	75	River Junction, IA
Jones County 2012 Earth Day Fair	4/22/2012	300	Anamosa, IA
Mom's Night Out for STEM	4/23/2012	50	Coralville, IA
Iowa Childrens Water Festival	5/10/2102	2000+	Ankeny, IA
IOWATER Introductory Workshop	5/11/2012	43	Waverly, IA
IOWATER Introductory Workshop	6/4/2012	6	Oskaloosa, IA
IOWATER Introductory Workshop	6/9/2012	6	Osage, IA
Blank Park Zoo Adventure Series Day-Life During the Ice Age Exhibit	6/9/2012	3000	Des Moines, IA
IOWATER Introductory Workshop	6/30/2012	18	Ames, IA
Project AWARE 2012	7/7-14/2012	387	Iowa River
IOWATER Introductory Workshop	8/4/2012	11	Dallas Center, IA
Project AWARE working exhibit at the Iowa State Fair	8/10-12/2012 8/17-18/2012	5000+	Des Moines, IA
River of Words Opening Exhibit	8/5/2012	100	Des Moines, IA
IOWATER Introductory Workshop	8/28/2012	8	Osceola, IA
IOWATER Introductory Workshop	9/7/2012	14	Marion, IA
Iowa River Cleanup	10/6/2012	56	Iowa City, IA
Sunday at the Quarry	10/7/2012	900+	Raymond, IA
Water Quality of the Nishnabotna River	10/3/2012	30	Carson, IA
IOWATER Introductory Workshop	10/13/2012	18	Mason City, IA
Open Minds, Open Doors	10/16/2012	30	Cedar Rapids, IA
Creepy Campus Crawl	10/26/2012	1100	Iowa City, IA
Go Green: Planet Recapture	11/3/2012	100	Iowa City, IA

Presentations

Aquifer Sustainability- Case Studies, by Mike Gannon, American Water Well Association Dubuque, October 2012.
Bedrock Geology of the Cedar Falls 7.5' Quadrangle, Black Hawk County, Iowa, by Bob Rowden, STATEMAP Advisory Panel meeting, September 2012.
Bromalites from the Middle Ordovician Winneshiek Lagerstätte, northeast Iowa, USA, by Paul Liu and Bob McKay, The 34 th International Geological Congress-Brisbane, Australia, August 2012.
Considerations When Drilling a New Well, by Chad Fields, Iowa Association of Municipal Utilities Fall Conference, November 2012.
Deer Creek Lake - Geological and Geophysical Investigation, by Ryan Clark, Jason Vogelgesang, and Deborah Quade, University of Iowa Department of Geoscience, Engineering Panel Discussion, October 2012.
Defenders of Land and Water, by Lynette Seigley, North Central Junior High School, April 2012.
DeWitt Boy Scout Merit Badge Instruction, by Ray Anderson, Wendling Quarries Geology Merit Badge Training, June 2012.
Earth Science Update for Teachers, by Bob McKay and Stephanie Surine, University of Northern Iowa - Earth Science Program, April 2012.
Falkstone Dewatering-Impacts on Kuenne Quarry, by Mike Gannon, Worth County, April 2012.
Fluorescent Minerals, by Ray Anderson, University of Iowa Museum Creepy Campus Crawl, October 2012.
Geodes, More Than Just a Rock, by Ray Anderson, Black Hawk Gem & Mineral Club Monthly Meeting, January 2012.
Geodes, More Than Just a Rock, by Ray Anderson, Cedar Valley Rocks & Minerals Society Annual Rock Show, March 2012.
Geodes, More Than Just a Rock, by Ray Anderson, Geode Land Rocks and Minerals Club Annual Meeting, March 2012.
Geodes, More Than Just a Rock, by Ray Anderson, Keokuk Chamber of Commerce Bald Eagle Days, January 2012.
Geologic and Natural Resources Issues in the Driftless Area, by Bob Libra, Driftless Area Initiative - La Crosse, March 2012.
Geologic History of the Mississippi River, by Ray Anderson, Cedar Valley Rocks & Minerals Society Monthly Meeting, January 2012.
Geological Hazards Informal Discussion, by Ray Anderson, Dallas County Emergency Management, August 2012.
Geology of the Manson Impact Structure, by Ray Anderson, University of Iowa Impact seminar, September 2012.
Geology, Groundwater, and Karst in the Pine and Steele Watersheds, by Bob Libra, Pine-Steele Watershed Project Kickoff – Colesburg, July 2012.
Geology of a Haunted House in Keokuk, by Ryan Clark, Discovery Channel pilot (set to air in February 2013), November 2012.
Glacial History of the Iowa River, by Ray Anderson, AWARE 2012, Popejoy, July 2012.
Groundwater Monitoring of Liquid Manure Storage Structures in Iowa, by Claire Hruby and Bob Libra, Midwest Groundwater Conference, October 2012.
Groundwater Recovery Modeling-Conklin Quarry Closure, by Mike Gannon, City of Coralville, April 2012.
Groundwater Supplies in Iowa, by Bob Libra, WMT radio - Cedar Rapids, February 2012.
Groundwater Supplies in Iowa, by Bob Libra, Iowa Public Radio - River to River, March 2012.
Groundwater Supplies in Linn and Johnson Counties, by Mike Gannon, Bob Libra, and Mike Anderson, Public Information Meeting - Cedar Rapids, March 2012.
How has Agricultural Intensification Affected Nutrient Transport in the Corn Belt?, by Keith Schilling, Environmental Defense Fund, Washington, DC, June 2012.
Hydrology for Conservation Farmers, by Keith Schilling, Agren Master Conservation class, Sac City, June

2012.
Implications of Shale Gas - Fracking and Production, by Bob Libra, University of Iowa Sustainability, Physical Plant, and Utilities Department Directors and senior staff, October 2012.
Iowa Geological and Water Survey Aquifer Characterization and Modeling – Implications, by Bob Libra, Iowa Association of Water Agencies, February 2012.
Iowa Geological and Water Survey Aquifer Characterization and Modeling – Implications, by Bob Libra, Iowa Senate Natural Resources and Environment Committee, March 2012.
Iowa Geological and Water Survey Aquifer Characterization and Modeling – Implications, by Bob Libra, Dept. Economic Development Staff, May 2012.
Iowa Nutrient Load Estimations for Point and Non-point Sources, by Calvin Wolter, Building Science Assessments for State-Level Nutrient Reduction Strategies, November 2012.
Is Fracking a Good Idea?, by Ray Anderson, KCRG TV Cedar Rapids – Ethical Perspectives on the News, October 2012.
Iowa State Fair, by Paul Van Dorpe, IDNR Stream Table Exhibit, August 2012.
IOWATER and Water Quality Monitoring, by Lynette Seigley, Master Conservationist Program, July 2012.
Iowa's Driftless Region, by Ray Anderson, U.S. Fish & Wildlife Service Driftless Area Workshop, January 2012.
Iowa's Manson Impact Structure, by Ray Anderson, Iowa Limestone Producers Association Annual Meeting, February 2012.
Karst Hydrology and Water Quality in the Turkey Watershed, by Bob Libra, Turkey River Watershed Briefing and Discussion – Elkader
Karst Hydrogeology and Water Quality - Lessons from Big Spring, by Bob Libra, Iowa Groundwater Association Regional Dinner Meeting – Manchester, June 2012.
Landforms of Iowa and Water Quality, by Lynette Seigley, Master River Stewards, June 2012.
Land Use, Groundwater Quality, and Karst: Lessons from Big Spring, by Bob Libra, Midwest Groundwater Conference – Minneapolis, MN, October 2012.
Mapping Iowa's Historic Coal Mines, by Mary Howes, National Association of Abandoned Mine Lands Professionals, September 2012.
Mapping Iowa's Resources, by Ray Anderson, Basic Materials Corp., October 2012.
Match the Fossil Bones to the Ice Age Animals, by Ray Anderson and Deb Quade, Blank Park Zoo's Adventure Days "Life in the Ice Age", June 2012.
Match the Fossil Bones to the Ice Age Animals, by Ray Anderson and Ryan Clark, Blank Park Zoo's Adventure Days "Life in the Ice Age", August 2012.
Mining for Frack Sand in Iowa, by Bob Libra, Driftless Area Initiative - La Crosse, WI, March 2012.
New Geologic Map of Iowa, by Ray Anderson, Black Hawk Rocks & Minerals Club monthly meeting, November 2012
Oakdale and the Geology and Groundwater Studies, by Ray Anderson, University of Iowa Geoscience Department Grad student Geological Orientation, October 2012.
Pleistocene "Ice Age" Animals (fossil matching activity), by Ryan Clark, University of Iowa Museum Creepy Campus Crawl, October 2012.
Project AWARE, by Brian Soenen, Wednesday Night Live – Lutheran Church of the Resurrection, October 2012.
Project AWARE, by Brian Soenen, Franklin County Conservation Board, May 2012.
Project AWARE 10th Anniversary, by Lynette Seigley, Environmental Professionals of Iowa, November 2012.
Raccoon River: An Assessment of Changes in Water Quality, by Mary Skopec and Lynette Seigley, Life in the Raccoon River Watershed – Perry, March 2012.
RAGBRAI brochures, RAGBRAI 2012, July 2012.
River Form and Function, by Keith Schilling, Master River Stewards Program, Prairie City, June 2012.
Rocks & Minerals of the Grotto of the Redemption, by Ryan Clark, The Grotto of the Redemption (100th Anniversary), June 2012.

Rocks and Minerals of the West Bend Grotto, by Ray Anderson, West Bend Grotto Geology Day, September 2012.
Shale Gas Production - An Overview, by Bob Libra, Iowa Utilities Board, March 2012.
Sinkhole Mapping with LiDAR Derivatives and Historical Photography, by Calvin Wolter, Turkey River Watershed Briefing and Discussion – Elkader, June 2012.
Soils and Soils Mapping, by Ray Anderson, Grant Wood AEA "Kids STEM Academy," June 2012.
Source Water and GIS for Water Operators, by Chad Fields and Soren Rundquist, Three-day long training sessions at Fort Dodge, Cedar Falls, and Grinnell, March 2012.
Source Water Protection Capture Zones, by Chad Fields, 2012 Iowa Source Water Protection and Collaboration Workshop, December 2012.
Status of IGWS Groundwater Studies, by Bob Libra, Water Allocation Program Stakeholders - Des Moines, July 2012.
Status of Iowa's Water Supplies - Forecasting the Future, by Bob Libra, Water and the Industry - Cedar Rapids Metro Economic Alliance, October 2012.
Status Report - Drought of 2012, by Bob Libra, Agribusiness Association of Iowa Board Meeting - Iowa City, September 2012.
Status Report - Drought of 2012, by Bob Libra, Iowa Association of Water Agencies - Honey Creek, September 2012.
The Geologic History of Iowa, by Ray Anderson, Space Grant Consortium ICN Program, June 2012.
The Legendary New Madrid Earthquakes of 1811-1812, by Ray Anderson, University of Northern Iowa SGE Club, April 2012.
The Manson Impact Structure, by Ray Anderson, Cornell College Geology 2-hour seminar, September 2012.
The Manson Impact Structure, by Ray Anderson, WHO/Martin Marietta Ames Mine Journey to the Center of the Earth, September 2012.
The Impact of Increased Water Demand on the Silurian Aquifer, by Mike Gannon, Lunch and Learn, January 2012.
The Iowa Geological and Water Survey and Geology and Groundwater Studies, by Ray Anderson, University of Iowa Geography Class Lecture, January 2012.
The Iowa Geological and Water Survey and Geology and Groundwater Studies, by Ray Anderson, University of Iowa Geography Class Lecture, February 2012.
The Legendary New Madrid Earthquakes of 1811-1812, by Ray Anderson, Geode Land Rocks and Minerals Club Annual Meeting, March 2012.
The Midcontinent Rift System, by Ray Anderson, Cedar Valley Rocks & Minerals Society October Meeting, October 2012.
The Winneshiek impact structure, by Bob McKay Mid-America Paleontology Society - Iowa City, January 2012.
The Winneshiek Lagerstätte Project Updates, by Paul Liu, Mid-America Paleontology Society - Iowa City, January 2012
Three Posters on Iowa Geology, by Ray Anderson, Iowa Water Well Association Annual Meeting, January 2012.
Upper Iowa River Mapping for Water Quality Projects and the Decorah Impact, by Bob McKay and Bob Libra, DNR Lunch and Learn, May 2012
Using Geophysical Methods to Improve Our Understanding of Groundwater Susceptibility, Movement and Quality in Iowa, by Jason Vogelgesang and Chad Fields, Iowa Water Conference – ISU, March 2012.
Using Iowa P-Index to Calculate Phosphorus Losses in Iowa, by Calvin Wolter, Building Science Assessments for State –Level Nutrient Reduction Strategies, November 2012.
Wastewater Training, by Paul Van Dorpe and Soren Rundquist, IDNR Wastewater Training, February 2012.
Water Management, by Bob Libra, KCRG TV Cedar Rapids Ethical Perspectives on the News, December

2012.
Water Quality on Stony Creek, Clay County & Stream Table, by Bob McKay, Iowa State Fair – DNR Building, August 2012.
Watershed Awareness with Project AWARE, by Lynette Seigley, Have You Known Rivers (Drake University), November 2012.
Well Plugger Training, by Paul Van Dorpe and Ryan Clark, IDNR Well Plugger Training, August 2012.
What's Shakin', Iowa Earthquakes, by Ray Anderson, Iowa Contingency Planners, August 2012.

Grants and Contracts

<u>Grant Source</u>	<u>Amount</u>	<u>Length</u>	<u>Project Purpose</u>
Alliant Energy Foundation	\$2,000	2012	Support of Project AWARE 2012.
Cerro County Dept. of Public Health	\$7,500	2010-2013	Distribution of arsenic in Cerro Gordo wells.
Community Foundation of Marshall County	\$5,000	2012	Support of Project AWARE 2012.
Department of Energy	\$100,000	2011-2013	Develop maps/tools for geothermal well placement throughout Iowa.
Dickinson County - Water Quality Commission	\$11,635	2011-2012	Installation and monitoring of groundwater wells to assess water quality and water levels.
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).
Hardin County Community Endowment Foundation	\$5,000	2012	Support of Project AWARE 2012.
Iowa Department of Natural Resources - Lake Restoration	\$11,088	2011-2012	Performed geological and geophysical field investigations to assess subsurface geologic package at Deer Creek Lake, Plymouth County, Iowa. Identified pathways of lake leakage to aid in further discussions of remediation efforts.
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.
ISU Center for Agricultural and Rural Development	\$15,000	2011-2012	SWAT Model for Raccoon River Basin.
Leopold Center-ISU	\$30,000	2010-2012	Groundwater time of travel model (Bear Creek)
Martha-Ellen Tye Foundation	\$5,000	2012	Support of Project AWARE 2012.
National Science Foundation	\$257,950	2010-2013	Investigation of the Winneshiek Lagerstatte (rare fossils) at Decorah, IA, and their geologic setting.
Office of Surface Mining	\$29,700	2011-2012	Improve access to information about historic coal mining in the Des Moines, Iowa, area.
Rockwell Collins	\$2,500	2012	Support of Project AWARE 2012.
The Nature Conservancy-Lyons Creek	\$60,000	2010-2012	Lyon's Creek water quality data assessment.

The Nature Conservancy-Swamp White Oak	\$10,000	2011-2012	Impacts of riparian forests on water quality.
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.
U.S. Fish & Wildlife	\$11,490	2012	Walnut Creek Watershed assessment.
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.
USGS Geospatial Liaison's Office	\$50,000	2011-2012	The National Map - create structure and geographic names GIS data.
USGS National Spatial Data Infrastructure	\$45,000	2012-2013	Conflate NHD attributes to local resolution NHD.
USGS STATEMAP Program	\$172,573	2012-2013	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.