GIS Mapping:

Creating Solutions for Rock Creek Lake

Rock Creek Lake is at risk. The centerpiece of Rock Creek State Park in Jasper County, Rock Creek Lake offers visitors a range of recreational opportunities, including the second-busiest campground in Iowa and great fishing.

However, many different factors are threatening the lake. Action is being taken to improve the lake for today's visitors and to preserve the lake for future generations. GIS mapping is helping to make those improvements possible.

DNR

What's GIS?

Geographic Information Systems (GIS) use graphics and data to create maps that identify problems and evaluate possible solutions. GIS mapping links spatial data – the actual physical location of something – with attribute data, or information about that location. For example, the physical location of a lake is spatial data, while the lake's name and size is attribute data.

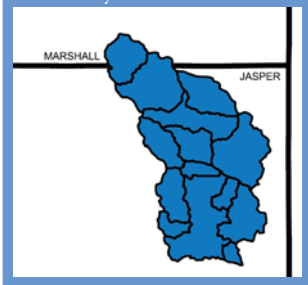
GIS works to combine spatial data with different layers of attribute data. In the Rock Creek project, for example, spatial data was combined with information on soil loss, best management practices and land use, among other things.

What's a watershed?

A watershed is an area of land that drains water into the lowest point – a body of water, such as a stream, lake or marsh. Watersheds can be as small as a city block, draining into a creek, or very large.

The Rock Creek Lake watershed covers 26,698 acres in northeast Jasper and southeast Marshall Counties. The lake itself is only 491 acres.

During a rainfall, water either travels over the surface or seeps into the ground. Water traveling over the surface or through groundwater may pick up contaminants like sediment, chemicals and waste and deposit them in a body of water.



This map shows where the Rock Creek watershed lies in Jasper and Marshall Counties.

Improving water quality

Rock Creek Lake, located in Rock Creek State Park in Jasper County, offers visitors a range of recreational opportunities, including the lakeside campground, which is consistently the second-busiest campground in Iowa. The lake is known for its catfish, bass, bluegill and crappie fishing. However, many factors are threatening the lake. Projects are being planned and implemented to improve water quality for today's lake users and future generations. GIS mapping is at the center of these projects.

Beach-goers enjoy a day at the lake at Rock Creek State Park.

Sediment and nutrients, especially phosphorus, are the largest threats to Rock Creek Lake, placing the lake on Iowa's impaired waters list. High levels of nutrients can result in high levels of algae, which not only cloud the water, but also lead to more serious problems like low oxygen levels, more rough fish like carp, and a greater chance of toxic algae. Sediment fills in the lake, reducing the depth of the water, and also carries nutrients into the lake.

The Rock Creek Watershed Project was created to improve the lake's water quality, with the main goals of reducing sediment entering the lake by 80 percent and reducing the amount of phosphorus reaching the lake by 70 percent.

To begin working towards these goals, research was needed to determine the areas in the watershed that contribute the most soil and phosphorus to the lake. To do this, a Geographic Information Systems (GIS)- based assessment of the watershed was conducted by a team consisting of the Iowa Department of Natural Resources (DNR), Jasper County Soil and Water Conservation District, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service of the USDA, and the Division of Soil Conservation of the Iowa Department of Agriculture and Land Stewardship.

The first step in the GIS-based assessment of the watershed included staff reviewing aerial photography maps to determine land use in the watershed – pastures, corn fields, residential areas, etc. Next, staff went out into the watershed to collect baseline data over four weeks during a

begins with GIS mapping

driving windshield survey of the 26,698-acre watershed.

Additional staff members went out in the field to confirm land cover data and determine soil loss by collecting revised universal soil loss equation (RUSLE) data on a field-by-field basis.

Staff in the field also determined the amount of protective vegetative groundcover in pastures and grazed timbers; the location and severity of streambank, shoreline and gully erosion; and the location of livestock facilities and existing best management practices (BMPs). Best management practices address nonpoint pollution problems and work to resolve them.

A family fishes along the lake.

After information was collected, it was placed on baseline maps by DNR GIS staff over a period of six weeks. The data was used to create detailed maps showing current land cover, soil loss, sediment delivery, the location of current BMPs and acres of land enrolled in the Conservation Reserve Program.

These maps helped identify priority areas in the watershed and priority BMPs, and where to consider permanent conservation easements and land purchases in the watershed to ensure long-term water quality benefits.

Rock Creek Lake: A History

Rock Creek Lake was constructed in 1952 as a 641-acre lake with a 24-foot maximum depth. Over the last 50 years, erosion and soil deposition have caused the lake to lose almost 40 percent of its volume and 102 acres of surface area.

Sediment and phosphorus are the two major threats to the lake's water quality, according to a 2000 Iowa State University (ISU) study.

While agricultural practices have improved over the past 50 years, sediment from the surrounding watershed, which is primarily agricultural, continues to be a problem for the lake.

Many farms in the Rock Creek Lake watershed currently practice no-till and minimum till methods, but the water quality of the lake was heavily affected in its early years by intensive row cropping and pasture use. Today, more than 25,000 tons of soil is still carried into the lake every year. The ISU study suggests that 89 percent of the phosphorus moving through the watershed is attached to this sediment.

Rock Creek Lake, December 1965

A large amount of land drains into the lake – the watershed contains 26,698 acres, which is 54 times larger than the 491-acre lake. To maintain good water quality, the recommended land to lake ratio in a watershed is 20 to 1. If there is more than 20 acres of watershed for every acre of the lake, sediment can become a large problem, much like it has at Rock Creek.

Identifying and understanding p

Identifying priority areas and practices

Once data was gathered and GIS maps were created, staff used the maps to identify existing best management practices (BMPs) and structures, like terraces and ponds. Maps were also used to find priority areas within the Rock Creek watershed where priority BMPs are needed most.

Priority areas were identified by the following criteria:

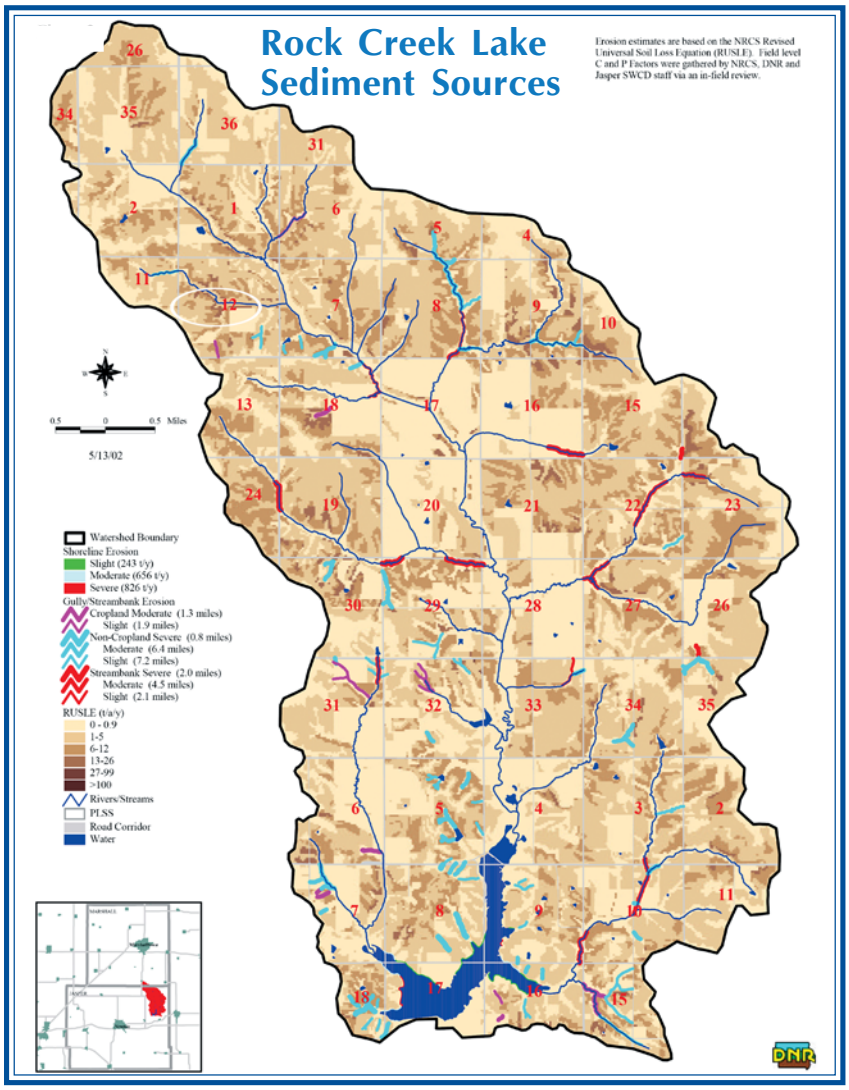
- Areas of high potential sediment delivery based on RUSLE (revised universal soil loss equation) calculations
- Areas in proximity to Rock Creek Lake
- Riparian (stream) corridors
- Areas without functioning sediment-trapping structures

The following priority BMPs were identified:

- Sediment reducing structures and management practices
- Stream corridor protection
- Conservation cover establishment and enhancement
- Animal waste management systems
- Nutrient management education

Permanent conservation easements and land purchases are also being used in the watershed to ensure long-term water quality benefits. The following easement priorities were identified:

- Sediment trapping structures
- Riparian corridor stabilization
- Critical area stabilization (for areas outside the riparian corridor and areas not associated with significant structural BMPs)



The pictures below display types of areas and practices within the Rock Creek Lake watershed that are major sources of sediment to Rock Creek Lake.

roblem areas with GIS

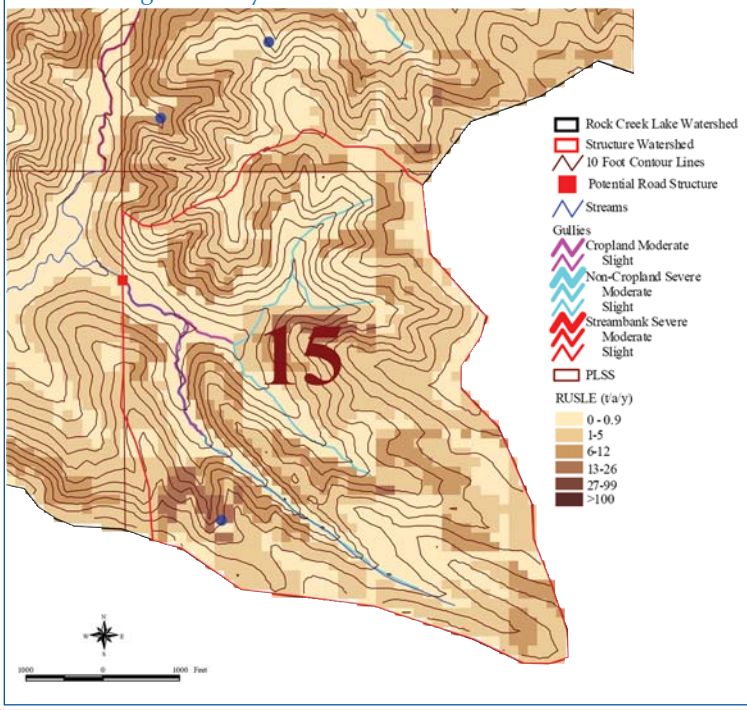
Communication

GIS maps of the watershed have helped to improve communication with landowners, as they provide a detailed illustration of the potential for problems in specific fields and across the watershed. The maps take complicated data and illustrate ideas, like sediment delivery rates, in an easy-to-read format. For example, newcomers to the Rock Creek Watershed Project have gained a better understanding of project activities through GIS information.

Funding accountability

GIS maps and data are also used to summarize the accomplishments of the watershed project, including locating newly implemented BMPs and significant land use changes. GIS is also used to calculate the associated change in soil loss to report sediment and phosphorus delivery reductions on a per project or watershed scale. Using the GIS data in this way can target the use of public funds to actual watershed improvements, which increases project accountability to funding sources, project partners, stakeholders, governing bodies and lake users.

Rock Creek Lake Watershed
Potential Sheet, Rill and Gully Erosion
SE Road Right-of-way Structure



Additional benefits of GIS assessment

- Helps define priorities of a newly developed project
- Efficiently answers the "what ifs" that may be encountered in a project
- Involves more landowners and non-traditional stakeholders in project activities
- Provides a better understanding of lake and watershed problems
- Provides a visual location of sediment and nutrient source areas
- Helps Soil and Water Conservation District commissioners to allocate financial resources to critical areas more efficiently

Rock Creek Quick Facts

Watershed size:
26,698 acres

Lake size 2004:
491 acres

Lake size 1952:
602 acres

Watershed land use:

60%	row crop
14%	CRP land
10%	pasture
4%	timber
2%	grassland
2%	hayland
8%	farmsteads, roads, water, etc.

- GIS maps estimate that 80% of erosion in the watershed comes from only 20% of the land area (if no conservation practices are used)

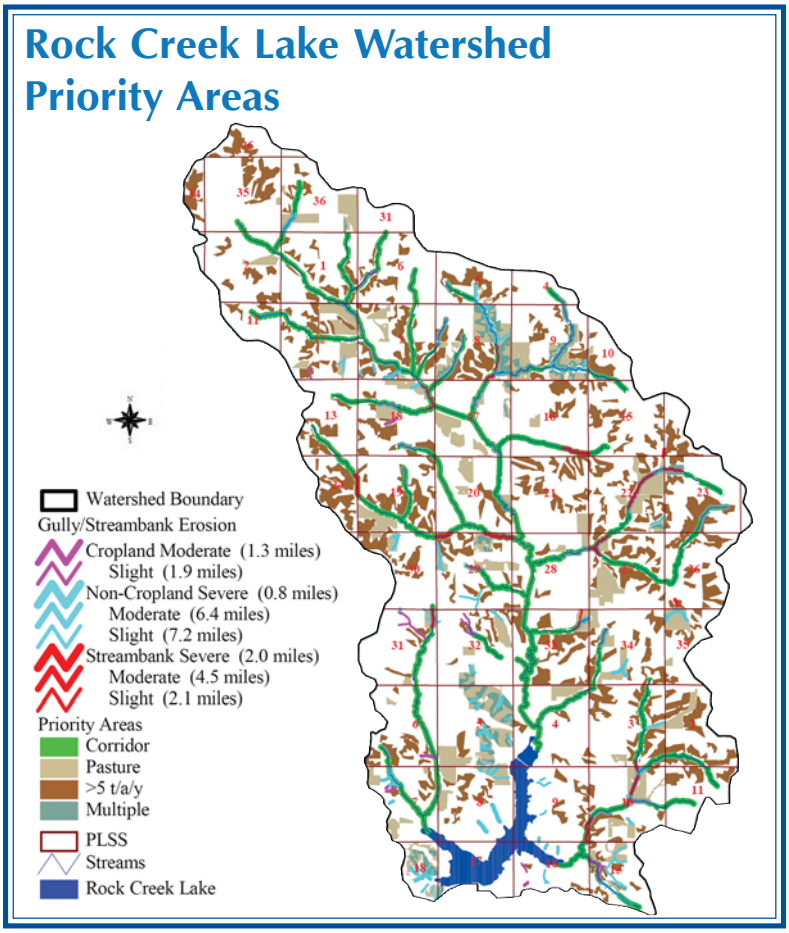
Glossary

RUSLE:
A calculation that estimates soil loss from erosion caused by rainfall on cropland.

BMP:
Best management practices (BMPs) address nonpoint pollution problems and work to resolve them.

Pinpointing priority areas

While GIS is an effective resource for looking at an entire watershed, it can also be used to zoom in on areas within the watershed, like individual sites or smaller sub-watersheds. Maps of these smaller areas can be used to research potential sites for priority best management practices (BMPs).



The above map shows priority areas, or areas with the highest rate of erosion, in the Rock Creek Lake watershed.

For example, using a sediment delivery map, staff located areas with the worst potential erosion and then went into the field to discuss possible BMPs with landowners.

Once a potential site for a BMP is located, GIS contour maps of the site can be used to predict the sediment delivery rate, watershed area, planned pool area, land use, revised universal soil loss equation (RUSLE) and runoff curve number (RCN) calculations, cross section elevations and stage storage values.

This information can then be used to begin the design of a project, and maps can help show a landowner what a proposed project or structure may look like. Cost estimates for the project can also be created from this information.

GIS mapping is being used to help plan a number of projects in the Rock Creek Lake watershed, including a large lake, smaller lakes and road structures.

A giant effort to reduce sediment

One of the largest conservation projects in the Rock Creek Lake watershed is currently underway.

A large, 22.6 acre lake will be constructed on a new 255-acre tract of DNR-owned land, located about one mile northwest of Rock Creek Lake.

GIS maps on drainage area and sediment delivery rates were used to find a site for the lake. The current site was chosen for its large drainage area, and because the area would have a high sediment delivery rate if it returned to cropland after its CRP contract expires.

This large structure has a drainage area of 1,414 acres and will filter out sediment before it reaches Rock Creek Lake, potentially reducing sediment entering the lake by 774 tons per year.

A smaller lake structure, about two to three acres, is planned to be built on the same site. The structure has a drainage area of 76 acres and will reduce sediment to Rock Creek Lake by 154 tons per year.

Using GIS to predict results

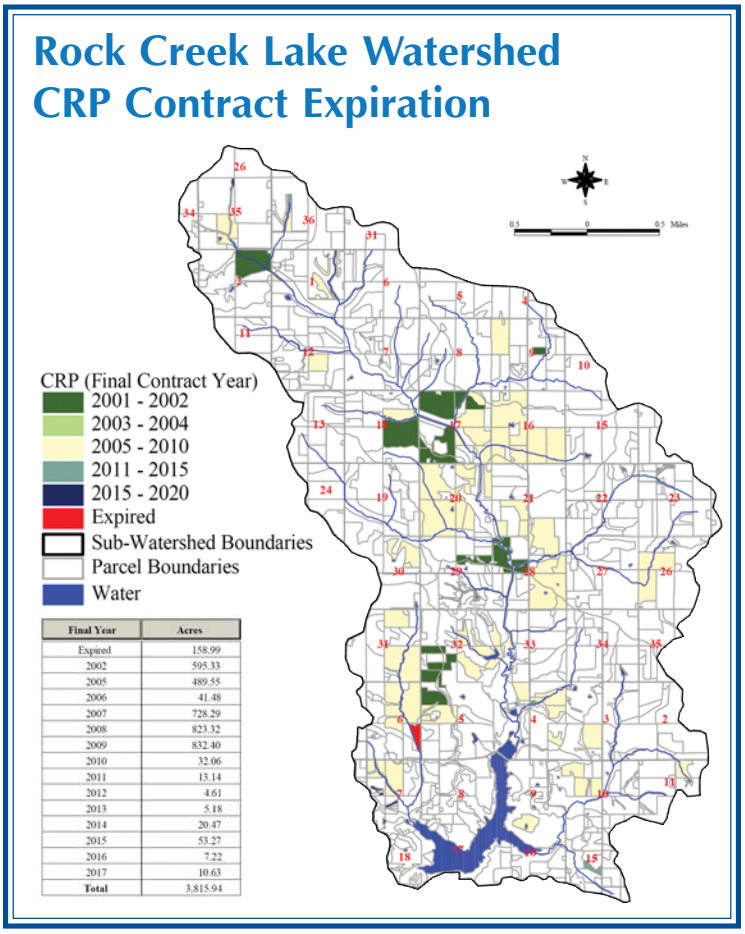
Not only can GIS maps single out current areas creating problems in the watershed, they can also be used to predict what areas could become problems in the future.

The GIS map to the right shows when certain areas will come out of the Conservation Reserve Program (CRP), a federal program that pays rent to farmers wanting to remove land with a high environmental risk from crop production. GIS mapping can calculate how much erosion would result if the land returns to farming production after the CRP contract expires. These numbers can be shared with landowners to show the importance of conservation practices and to promote new CRP contracts.

GIS maps can also predict soil loss, assuming no conservation practices are present, using soil survey data and color infrared (CIR) aerial photography. This helps identify areas in the watershed that are most at risk for erosion because they have more erodible soil types, steeper slopes or longer slopes.

By targeting these areas for conservation improvements, state, federal and local dollars can be used more efficiently.

For example, in the Rock Creek Lake watershed, GIS maps were used to identify that 80 percent of the erosion came from a small area (less than 20 percent) of the watershed.



Final Year	Acres
Expired	158.99
2002	595.33
2005	489.55
2006	41.48
2007	728.29
2008	823.32
2009	832.40
2010	32.06
2011	13.14
2012	4.61
2013	5.18
2014	20.47
2015	53.27
2016	7.22
2017	10.63
Total	3,815.94

Financial incentives for conservation practices

A number of cost-share, loan and other programs are available to landowners considering installing conservation practices and management techniques on their land.

Free technical assistance is available from your local NRCS, DSC or Soil and Water Conservation District staff, as well as DNR private lands biologists and forestry staff.

For more information on these programs, contact the following organizations:

U.S. Department of Agriculture
Farm Service Agency
www.fsa.usda.gov
Natural Resources Conservation Service (NRCS)
www.ia.nrcs.usda.gov

Iowa Department of Agriculture and Land Stewardship
Division of Soil Conservation (DSC)
www.agriculture.state.ia.us/soilconservation.html

Iowa DNR, Nonpoint Source Pollution
www.iowadnr.com/water/nonpoint/

An informational brochure with additional details on financial incentives and technical assistance is also available from the DNR by contacting Karen Grimes at (515) 281-5135 or at Karen.Grimes@dnr.state.ia.us.

GIS maps help landowners' conservation efforts

New technology is allowing Todd Lenz to carry on a family farming tradition.

Three generations of conservation: Nathan, Todd and Dwight Lenz near one of their ponds.

Lenz, whose family farms land in the north and northwest areas of the Rock Creek Lake watershed, is a believer in using conservation practices. With the help of GIS mapping, the Lenz family is implementing new conservation projects on their land.

"It goes way back, past my dad's generation," Lenz said of conservation. "You're not going to grow anything if there's not soil there."

When the family had an area they wanted to address with a new practice, field staff were brought in to create project maps and give cost estimates.

"If I can see it on paper, it helps me visualize things a lot better," Lenz said. "(Maps) help sell projects to farmers."

GIS maps detailing soil loss information have been used to help locate and plan a number of pond structures on the family's land.

The ponds, located in priority areas, have helped stabilize erosion, created a recreation area for the family, given a new home to wildlife and allowed native prairie plants to return to pastures.

The Lenz family uses a number of other conservation practices, including terraces, contour farming and waterways, and 90 to 95 percent of the land is farmed as no-till.

"There's not a lot of effort to return your investment," Lenz said. "You can be well-paid by being conservation-minded."

Prairie flowers look out over one of the Lenz's ponds.

For more information

Keri Batterson
Rock Creek Watershed Coordinator
(641) 792-4116
Keri.Batterson@ia.nacdnet.net

Ubbo Agena
Nonpoint Program Coordinator, DNR
(515) 281-6402
Ubbo.Agena@dnr.state.ia.us

A publication of the Iowa Department of Natural Resources 2004

For additional copies of this publication, please contact:

Iowa Department of Natural Resources
Wallace State Office Building
502 E. 9th St.
Des Moines, IA 50319-0034
(515) 281-5918
www.iowadnr.com

Produced by:
Jessie Rolph,
DNR Information Specialist
Photography:
Clay Smith, DNR
Contributors:
Keri Batterson, Rock Creek Watershed Coordinator
Chris Ensminger,
DNR GIS Specialist

The publication of this document has been funded by the Iowa Department of Natural Resources through a grant from the U.S. Environmental Protection Agency under the Federal Nonpoint Source Management Program (Section 319 of the Clean Water Act).