

IOWA DEPARTMENT OF NATURAL RESOURCES

LEADING IOWANS IN CARING FOR OUR NATURAL RESOURCES

BRUCE TRAUTMAN, ACTING DIRECTOR

Lake Restoration Program 2018 Report and 2019 Plan



**Before: Central Park Lake dewatered
and filled with sediment**



**During: Mechanical dredging and
shoreline armoring**



After: Central Park Lake Fall 2018

Submitted To

Joint Appropriations Subcommittee on Transportation, Infrastructure, and Capitals and
Legislative Services Agency

Submitted By

Iowa Department of Natural Resources
Bruce Trautman, Acting Director
December 31, 2018



IOWA DEPARTMENT OF NATURAL RESOURCES

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Executive Summary

The 2018 Iowa Lake Restoration Report and 2019 Plan outlines the need and demand for lake restoration in Iowa; identifies a prioritized group of lakes and the associated costs for restoration; and provides the status of past appropriated legislatively directed funding.

Iowans value water quality and desire safe healthy lakes that provide a full complement of aesthetic, ecological and recreational benefits. A recently completed water-based recreational use survey by Iowa State University found that six of 10 Iowans visit our lakes multiple times each year and spend \$1.2 billion annually in their pursuit of outdoor lake recreation. The most popular activities are fishing, picnicking, wildlife viewing, boating, hiking/biking, swimming and beach use. In addition, visitations at lakes that have completed watershed and lake improvements efforts continue to exceed the state average and their own pre-renovation visitation levels and people are willing to drive farther for lakes with better water quality and more amenities.

Legislative Action

Goals of Iowa's Lake Restoration Program are improved water quality; a diverse, balanced aquatic community and sustained public use benefits.

Many of our Iowa Lakes, similar to our nation's lakes, are impaired and suffer from excessive algae growth and sedimentation due to nutrient loading and soil loss. The Iowa Department of Natural Resources (DNR) Lake Restoration Program (LRP) focus is on restoring Iowa's significant publicly-owned lakes and publicly-owned shallow lakes/wetlands. This report provides our plan to restore our Iowa public lakes, which will lead to increased lake use and improved lake water quality. Public lakes are a major component of recreational facilities of the State of Iowa, and in addition to better water quality, LRP projects many times involve major repair/re-placement and protection of lake related infrastructure.

In the 81st General Assembly, with HF 2782, the legislature responded to our need for improving Iowa's lakes by creating the Lake Restoration Plan and Report, known as the Lake Restoration Program. Included in HF2782, Section (26) of The Endowment for Iowa's Health Account is a process and criteria for completing successful lake restoration projects. It directs the DNR to report annually its plans and recommendations for lake restoration funding, as well as progress and results from projects funded by this legislation. This report has been prepared in accordance with these requirements. In addition, it describes some of the important work done by local, state and federal partners. ***These partnerships, along with sound scientific information, are the foundation of current and future successful lake restoration projects.***

Funding for the Lake Restoration Program (LRP) is currently appropriated on an annual basis. We anticipate that at the current annual level of \$9.6 million per year the DNR can stay on schedule with implementing restoration efforts at the significant publicly-owned lakes and publicly-owned shallow lakes/wetlands currently prioritized in the ten-year plan.

Lake Restoration Program

The DNR modeled the Lake Restoration Program after the Federal Clean Lakes Program established in the 1970's. For the purpose of Iowa's Lake Restoration Program, Iowa code defines "significant, publicly-owned lakes" as those lakes that meet all of the following criteria:

- is owned by the federal government, the state of Iowa, a county, or a municipal government, and is maintained principally for public use;
- is a multi-use system capable of supporting diverse wildlife, fish, or recreational opportunities;
- has a surface water area of at least ten acres;
- does not have a watershed-to-lake surface area ratio of greater than two hundred to one;
- is not an on-stream impoundment that emulates riverine habitat rather than a lake environment;
- and, is not used solely as a water supply reservoir.

For the purpose of Iowa's Lake Restoration Program, Iowa code defines "publicly-owned shallow lakes/wetlands" as those water bodies that meet the following criteria:

- is owned by the federal government, the state of Iowa, a county, or a municipal government, and is maintained principally for public use;
- is a multi-use system capable of supporting diverse wildlife, fish, or recreational opportunities;
- has a surface water area of at least ten acres;
- does not have a watershed-to-lake surface area ratio of greater than two hundred to one;
- is an open freshwater system where maximum depth is typically less than six to eight feet at its deepest spot and is under four and one-half feet mean depth;
- and, is typically fringed by a border of emergent vegetation in water depth less than six feet and when clear is dominated by both emergent and submergent vegetation and provides important wildlife and fish habitat.

The goal is to invest money on projects with multiple benefits such as improved water quality and increased public use, while taking into account feasibility of restoration. Science based prioritization has been our most effective tool in targeting projects of value to the state. ***Potential projects are viewed in terms of their potential for meeting program goals. This assessment incorporates information on the public benefit of an individual lake, feasibility of restoration (can we be successful?), and the current status of the water quality. In addition, project development and implementation relies on the ability of the department being able to work cooperatively with stakeholders and representatives of each community to develop a joint lake restoration action plan.***

Lake Restoration Program - Project Goals

The department recommends funding for lake restoration projects that are designed to achieve the following goals:

- Ensure a cost effective, positive return on investment for the citizens of Iowa.

- Ensure local community commitment to lake and watershed protection.
- Ensure significant improvement in water clarity, safety, and quality of Iowa lakes.
- Provide for a sustainable, healthy, functioning lake system.
- Result in the removal of the lake from the impaired waters list.

Lake Restoration Program - Process and Criteria

The process and criteria to recommend funding for lake restoration projects are:

- The department, with input from stakeholders, maintains a list of not more than thirty-five significant publicly owned lakes and not more than five publicly-owned shallow lake/wetlands prioritized for funding based on the feasibility of each lake (water body) for restoration and the use or potential use of the lake, if restored. The department recommends these lake projects as a priority for funding so long as progress toward completion of the projects remained consistent with the goals of the program.
- The department meets with stakeholders and representatives of communities where prioritized lakes are located to provide an initial lake restoration assessment and to explain the process and criteria for receiving lake restoration funding.
- Communities with lakes not included on the current list may petition the Director of the department for a preliminary assessment of the lake for inclusion in the program (i.e. does the lake meet the program definition of significant, publicly-owned lake or publicly-owned shallow lake/wetland and does it rank well relative to other lakes in terms of potential for meeting program goals) and an explanation of the funding process and criteria.
- Projects need to follow the directives to the department regarding Project Goals, Process and Criteria, and Restoration Plan Guidelines from 2006 State Legislation (81st GA, HF2782) and 2016 State Legislation (86th GA, SF2324).

Lake Restoration Program – Water Quality Improvement Plan Guidelines

The department works with stakeholders and communities to develop a joint lake restoration action plan.

- At a minimum, each joint action plan documents the causes, sources, and magnitude of lake impairment, evaluates the feasibility of the lake and watershed restoration options, establishes water quality and fishery and wildlife goals and a schedule for attainment, describes long-term management actions, assesses the economic benefits of the project, identifies the sources and amounts of any leveraged funds, and describes the community's commitment to the project, including local funding.
- The stakeholders' and community's commitment to the project may include moneys to fund a lake diagnostic study and watershed assessment, including development of a Water Quality Improvement Plan.

Each joint lake restoration plan complies with the following guidelines:

- Biologic controls will be utilized to the maximum extent, wherever possible.
- If proposed, dredging of the lake will be conducted to a mean depth of at least eight feet (to gain water quality benefits) unless a combination of biologic and structural controls is sufficient to assure water quality targets will be achieved at a shallower average water depth.
- The costs of lake restoration will include the maintenance costs of improvements to the lake.
- Delivery of phosphorous and sediment from the watershed will be controlled and control structures will be in place before lake restoration begins.
- The department will evaluate the joint action plans and prioritize the plans based on the criteria required by the program.

In-lake, along with watershed management, will meet or exceed the following water quality targets:

- Clarity - A four and one half foot secchi depth will be achieved fifty percent of the time from April 1 through September 30.
- Safety - Beaches will meet water quality standards for recreational use.
- Biota - A diverse, balanced, and sustainable aquatic community will be maintained.
- Sustainability - The water quality benefits of the restoration efforts will be sustained for at least fifty years.

[Note: Appendix A (2006 State Legislation (81st GA, HF2782) and 2016 State Legislation (86th GA, SF2324) provides a summary of directives to the department regarding Project Goals, Process and Criteria, and Restoration Plan Guidelines for the Lake Restoration Program.]

Lake Restoration Program – Status

The intent of the program is to develop and administer lake restoration projects that ensure a cost-effective investment for the State of Iowa; foster a community commitment to lake and watershed protection; and provide significant improvement to the quality of Iowa lakes.

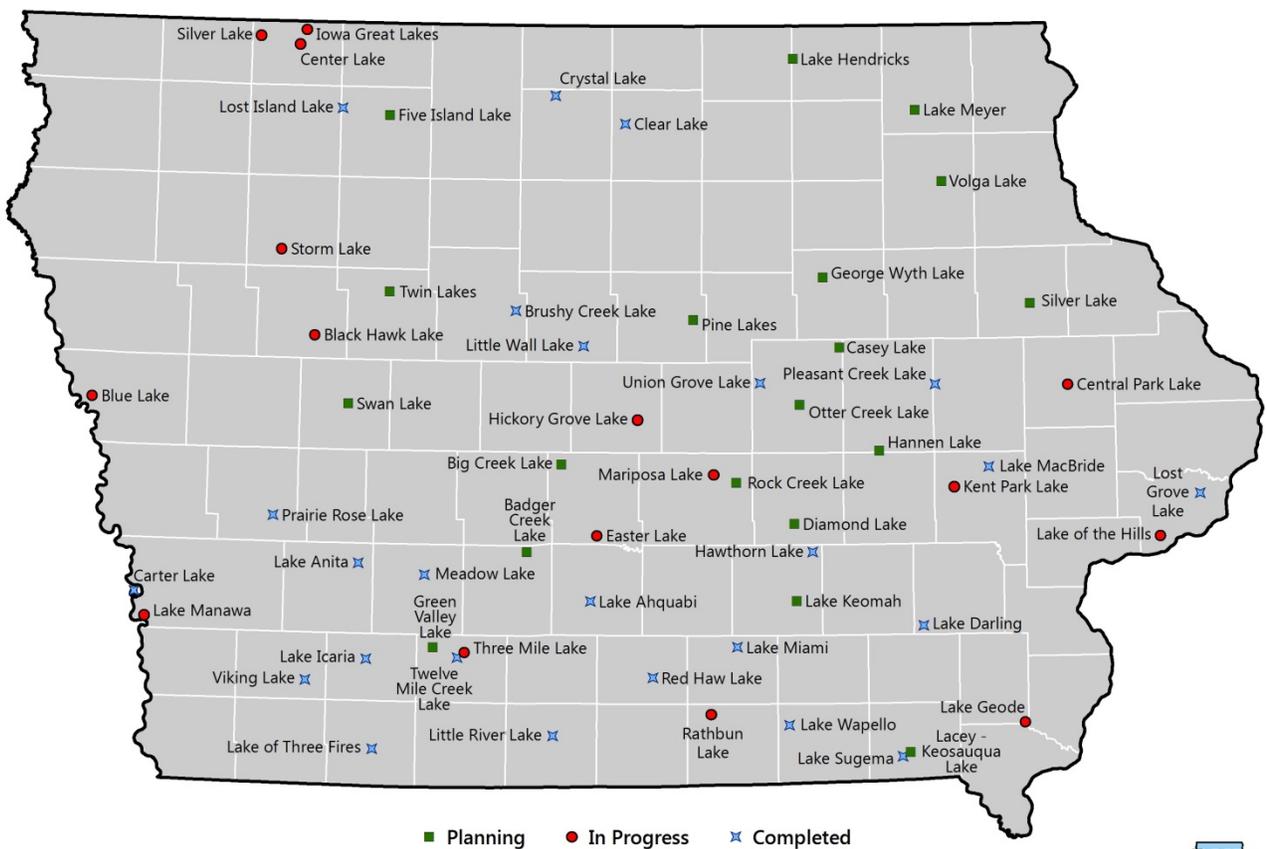
Major water quality improvement initiatives are completed or near completion at twenty-five lakes. Current program activities are in progress at an additional sixteen lakes throughout the state and in the initial community outreach, evaluation or planning stage at nineteen lakes (Figure 1).

Timelines for many of these projects usually fall within a three to five year period. However, major construction projects may take even longer. Contractors face substantial costs to mobilize and set up

lake improvement operations and this critical work needs multiple year commitments to secure contactors and develop cost-share agreements with local stakeholders and community groups. As such, the most practical and efficient way to complete these undertakings are as continuous projects. The Lake Restoration Program has matured to the point where a number of multi-step projects are concurrently at the implementation phase.

Iowa has completed restoration work at 25 lakes, with 16 projects underway, and 19 projects in the initial planning stages.

Figure 1. DNR Lake Restoration Program Status, State Fiscal Year 2019



Lake Restoration Program – Funding

The source of FY2019 funding for the Lake Restoration Program was an appropriation from the Rebuild Iowa Infrastructure Fund under SF2414. Under this appropriation, the DNR - LRP received \$9.6 million dollars in FY2019 to meet contracted and obligated program activities (Table 2 and Table 3). Table 1 summarizes program funding spent from the beginning of FY18 (7/1/17) through October 31, 2018 of FY19.

DNR Lake Restoration Program (LRP) Funding as of FY19 (10/31/2018)

Carry Forward from FY17 to FY18	\$13,304,285
FY18 Lake Restoration Program Funding Appropriation	\$9,600,000
Lake Restoration Program Spent FY18 thru FY19 (10/31/2018)	(\$13,987,792)
FY19 Lake Restoration Program Funding Appropriation	<u>\$9,600,000</u>
Lake Restoration Program Available Balance as of FY19 (10/31/18)	\$18,516,492
Under Contract - Actual Amount Due	(\$11,322,453)
LRP Obligated Funds, planned for 2019 contracting	Est. <u>(\$7,194,039)</u>
LRP Un-obligated Funds for FY20	\$ -0-

Funding from FY2007 through FY2019 of \$110 million (approximately \$8.5 million per year), seen in Figure 2, has enabled the DNR to improve many Iowa's lakes and proceed with implementing projects at a number of our other priority systems (see project summaries in this report). The Lake Restoration Program has now matured to the point where a number of multi-step projects are concurrently at the implementation phase; therefore, we now have more projects ready to start in a given year than we have available dollars to complete restoration at all the active projects.

Maintaining flexibility in when the Lake Restoration Program can allocate funding and consistent annual funding is critical for implementing multi-year projects and developing new projects. The LRP currently has \$11.3 million under contract, almost exclusively to Iowa firms, to assist with implementing things like watershed Best Management Practices, dam/lake outlet repair, shoreline protection, removal of sediment and shallow lake/wetland enhancement. Current and future appropriations will be critical to complete or initiate/implement restorations efforts in over twenty counties during FY19/FY20.

The majority of lake restoration projects involve construction phases of watershed and/or in-lake implementation. A typical construction project includes the following phases: project scoping, engineering design, work bid letting, contract development, construction, and inspection. All processes must adhere to the standards and requirements of doing business as a public agency. Certain projects may require easements before construction can begin and/or require approvals and permits such as an archeological investigation for historic properties, an environmental review for threatened or endangered species, COE 404 permit, and DNR floodplains / sovereign lands permit.

Examples from some of the 2018 projects:

Watershed Best Management Practices – protecting Iowa lakes

- Streambank stabilization
- 25 revetment rock check dams
- 19 sediment/nutrient control structures

- Fish barriers to protect against invasive species
- Three in-lake silt dikes

Four dam/lake outlet infrastructure projects

- Drain down pipe replacement, gate-valve and outlet structure repair

Seven miles of shoreline protection

Removal of 856,000 cubic yards of sedimentation (enough to stack a football field 400 feet high)

Partner activities that compliment on-going lake restoration efforts

- Three new boat ramps and a kayak access
- Two new boat ramp parking areas
- Additional handicap accessible fishing areas and jetties
- Fish habitat
- Beach improvements

Shallow Lakes

- Restoration of 829 shallow lake acres

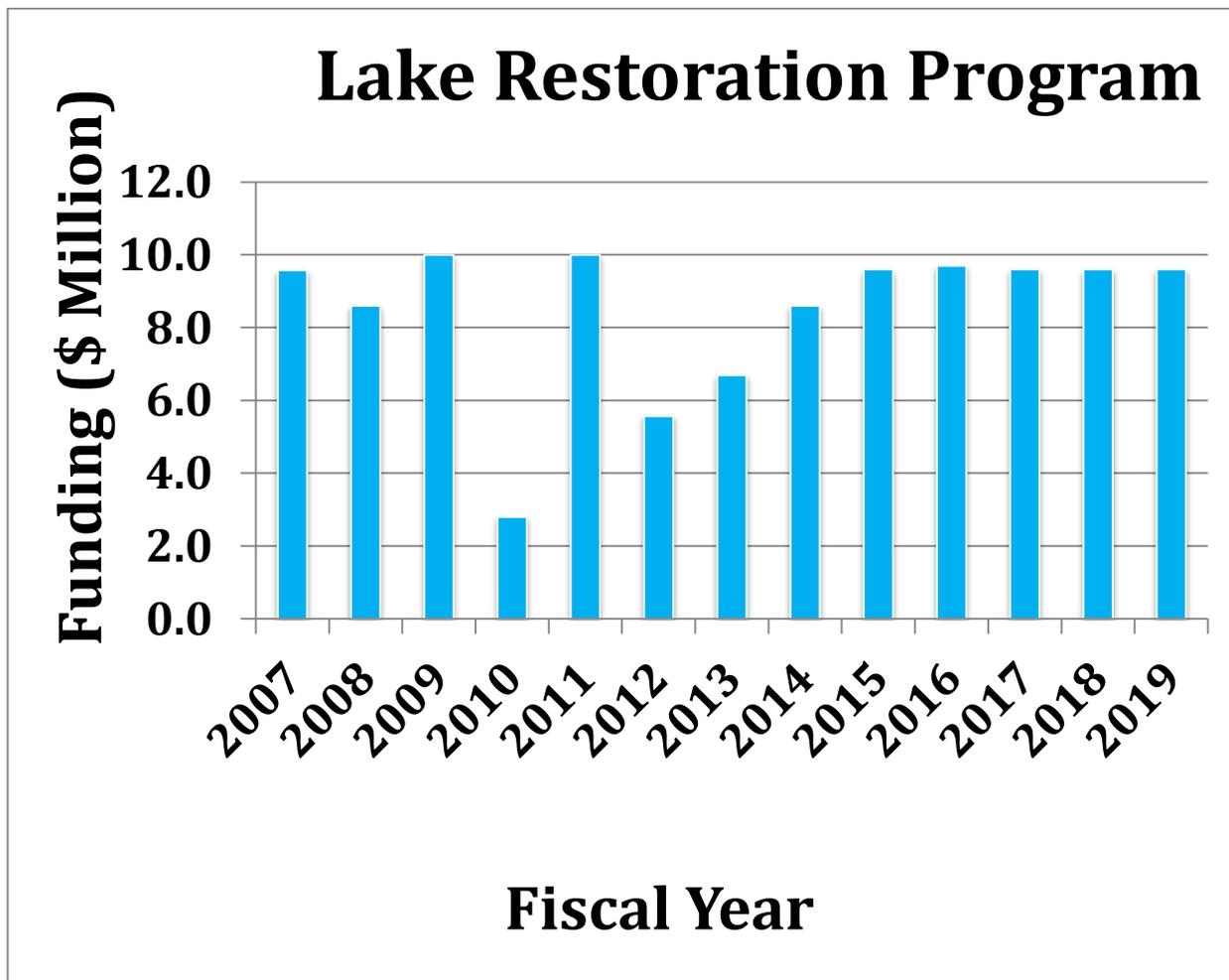
Wetland/Marsh Restoration

- Improvement of 238 wetland acres

Project planning involves working with representatives of the local community to develop a joint restoration plan. For planning purposes, it is necessary that a proper assessment of the lake and watershed is available to provide restoration alternatives to meet given water quality goals. In order to achieve lake restoration goals it is critical that the DNR form effective watershed partnerships. This includes partnerships at the local and administrative levels of government. Local, state and federal programs offer a multitude of programs for financial assistance to landowners for soil conservation and other water quality protection practices.

Building community support and development of partnerships is a long-term commitment from the Lake Restoration Program and is the foundation to the program's success.

Figure 2. DNR Lake Restoration Program Funding History



The Lake Restoration Program cooperates in a variety of cost-share partnerships with local, state and federal entities to accomplish the water quality improvement initiatives described in this report.

On average, there is a 35% cost-share match to Lake Restoration Program funds, which is critical to accomplishing the work detailed in this report and past summaries of LRP activities.

Local groups include associations; such as the IGL - Iowa Great Lakes, LIPA - Lost Island Preservation Association, RRWA - Rathbun Rural Water Association, LPA - Lake Preservation Association (Storm Lake), CLPS - Carter Lake Preservation Society and the LPHC - Lake and Park Holding Corporation (Union Grove) to name a few. The DNR 319 Water Quality Improvement Section, DNR Wildlife, DNR Parks along with the Iowa Department of Agriculture and Land Stewardship – Division of Soil Conservation have worked together to implement watershed BMPs. Non-profit groups; such as DU - Ducks Unlimited, PH - Pheasants Forever and the TNC - The Nature Conservancy have also provided funding for projects. A significant number of Iowa lakes are owned and/or managed by local entities such as County Conservation Boards or Cities. Local agencies have been very active in developing restoration plans and providing resources to these efforts.

Table 1. DNR Lake Restoration Program - \$13,987,792 spent from the beginning of FY18 (7/1/17) through October 31, 2018 of FY19

Carry Forward from FY17 to FY18			\$13,304,285			
FY18 Lake Restoration Program Funding Appropriation			\$9,600,000			
Total Available Funding at Start of FY18			\$22,904,285			
Project Name	Project Description	County	LRP Spent	Fed	Other	Total Spent
Administration	Program management, engineering		\$881,563			\$881,563
Badger Creek Lake	Sediment ponds, watershed BMPs	Madison	\$5,895	\$34,524		\$40,419
Big Creek Lake	Sediment ponds, watershed BMPs	Polk	\$54	\$21,183		\$21,237
Black Hawk Lake	Lake assessment, watershed improvement	Sac	\$16,342			\$16,342
Blue Lake	Shoreline, auxiliary water supply	Monona	\$470,867			\$470,867
Center Lake	Fish barriers, shoreline, wetland	Dickinson	\$100,978		\$139,742	\$240,720
Central Park Lake	Dredging, shoreline, boat ramp, in-lake	Jones	\$1,346,583		\$442,909	\$1,789,492
Easter Lake	In-lake, shoreline, BMPs, Yeader Cr.	Polk	\$4,387,414			\$4,387,414
Feasibility Studies	Restoration action plans, monitoring		\$201,202			\$201,202
Five Island Lake	Diagnostic feasibility study	Palo Alto	\$94,064			\$94,064
Hickory Grove L.	Watershed improvement, shoreline	Story	\$211,731		\$36,011	\$247,742
IA Great Lakes	Watershed improvement, shoreline	Dickinson	\$87,908			\$87,908
Kent Park Lake	Sediment ponds, dredging, shoreline, outlet	Johnson	\$320,617			\$320,617
Lake Geode	Sediment ponds, dredging, shoreline, outlet	Henry	\$837,696	\$121,729		\$959,425
Lake Manawa	Engineering design and oversight	Pottawattamie	\$99,386			\$99,386
Lake Miami	Watershed improvement	Monroe	\$174,660		\$2,058	\$176,718
Lake of the Hills	Engineering design and oversight	Scott	\$202,215			\$202,215
Lake Rathbun	Watershed improvement	Appanoose	\$202,760			\$202,760
Mariposa Lake	Shoreline, dredging, wetland	Jasper	\$1,303,971			\$1,303,971
Minor Projects	Lake restoration		\$14,966		\$1,791	\$16,757
North/South Twin	Diagnostic feasibility study	Calhoun	\$21,288			\$21,288
Silver Lake	Diagnostic feasibility study	Dickinson	\$78,344			\$78,344
Storm Lake	Dredging, island repair and stabilization	Buena Vista	\$906,071		\$50,000	\$956,071
Union Grove Lake	In-lake restoration, dredging	Tama	\$29,109			\$29,109
	Shallow Lakes					
Elm Lake	Fish renovation	Wright	\$176,240			\$176,240
Lizard Lake	Outlet repair and modification	Pocahontas	\$17,207			\$17,207
Shallow Lakes	Restoration action plans, monitoring		\$8,410			\$8,410
Shallow Lakes	Morse, West Swan	Worth	\$21,458			\$21,458
Shallow Lakes	Jensen Slough	Emmet	\$86,568			\$86,568
Silver Lake	Diagnostic study, watershed protection	Palo Alto	\$300,000			\$300,000
	Wetland / Marsh Restoration					
Black Hawk Lake	Inlet wetland restoration	Sac	\$1,025,469			\$1,025,469
IA Great Lakes	Lower Gar - Spring Run	Dickinson	\$313,259			\$313,259
IA Great Lakes	West Okoboji - Apple Jack Marsh	Dickinson	\$43,497			\$43,497
			\$13,987,792	\$177,436	\$672,511	\$14,837,739
Carry Forward from FY18 to FY19			\$8,916,492			
FY19 Lake Restoration Program Funding Appropriation			\$9,600,000			
Current Balance as of October 31, 2018			\$18,516,492			

Table 2. DNR Lake Restoration Program - \$11,322,453 Under Contract

Project Name	Project Description	County	LRP Contracted	Fed	Other	Under Contract	Contractor
Administration	Program management, engineering		\$440,782			\$440,782	
Black Hawk Lake	Lake usage survey	Sac	\$15,700			\$15,700	Sac SWCD
Blue Lake	Well repair, auxiliary water main	Monona	\$24,431			\$24,431	Niewohner Corp.
Carter Lake	Shoreline stabilization	Pottawattamie	\$40,000			\$40,000	City of Carter Lake
Central Park Lake	Boat ramp, habitat, dredging, spillway, shoreline	Jones	\$411,491		\$1,091,897	\$1,503,388	Triple B Constn., Peterson Contractors Inc
Clear Lake	Shoreline stabilization	Cerro Gordo	\$20,000			\$20,000	IDALS
Easter Lake	Shoreline, dredging, Yeader Creek, sediment basins	Polk	\$1,226,229	\$71,239	\$2,351,935	\$3,649,403	City of DSM; RW Excavating
Feasibility Studies	Restoration action plans, monitoring		\$901,441		\$260,519	\$1,161,960	ISU - Wilkinson, Weber
Green Valley Lake	Lake usage survey	Union	\$9,190			\$9,190	Union SWCD
Hickory Grove Lake	Spillway, shoreline, dredging, watershed	Story	\$2,651,262		\$860,782	\$3,512,044	Braun Intertec; Con-Struct; RW Excavating
IA Great Lakes	Watershed improvement, East Okoboji shoreline	Dickinson	\$172,753		\$170,000	\$342,753	Dickinson WQC; Greenrain Services; U of I
Kent Park Lake	Watershed BMPs, in-lake restoration	Johnson	\$860,450		\$860,450	\$1,720,900	Johnson CCB
Lake Geode	In lake restoration, sediment ponds, gate-valve	Henry	\$2,393,008	\$11,239	\$149,801	\$2,554,048	Road Builders, Kloubec, E&C Innovations
Lake Manawa	Engineering design, oversight	Pottawattamie	\$84,844		\$12,074	\$96,918	FYRA Eng.
Lake Meyer	Engineering design, watershed ponds	Winneshiek	\$92,111		\$31,289	\$123,400	Winneshiek CCB
Lake of the Hills	Engineering design, ponds, wetlands	Scott	\$669,565		\$205,907	\$875,472	Scott CCB
Lake Rathbun	Watershed improvement	Appanoose	\$250,000			\$250,000	IDALS
Mariposa Lake	Spillway, dredging, access, wetland	Jasper	\$143,666		\$199,007	\$342,673	Jasper CCB, Leffler Dirtworks, LLC
Silver Lake	Diagnostic feasibility study	Dickinson	\$19,895		\$6,147	\$26,042	City of Lake Park
Storm Lake	Island repair and stabilization	Buena Vista	\$241,231			\$241,231	Shekar Engineering PLC
Twin Lakes	Watershed improvement	Calhoun	\$4,239			\$4,239	IDALS
Shallow Lakes							
Shallow Lakes	Engineering design, oversight		\$25,378			\$25,378	Ducks Unlimited, Inc.
Wetland / Marsh Restoration							
Black Hawk Lake	Inlet wetland restoration	Sac	\$510,363			\$510,363	Bedrock Gravel, Inc.
Center Lake	Water control structures	Dickinson	\$77,106			\$77,106	Valley Contracting, Inc.
IA Great Lakes	West Okoboji, Apple Jack Marsh	Dickinson	\$37,318			\$37,318	Diamond Concrete & Const.
Current Balance as of October 31, 2018			\$18,516,492				
Under Contract - Actual Amount Due			\$11,322,453	\$82,478	\$6,199,808	\$17,604,739	
LRP Obligated Funds, planned for 2019 contracting			\$7,194,039				

The Lake Restoration Program updates their 5-year capitol plan and 10-year priorities on an annual basis to reflect the timeline and potential budget needs for lake restoration efforts at the lakes (water bodies) under restoration. This includes a five-year capital plan for on-going projects (Table 3) and a long-term commitment to projects in the assessment/planning stage.

- Lakes highlighted in orange are expected to complete on-going restoration efforts from FY19 through FY20.
- Lakes highlighted in green are active projects undergoing implementation of watershed or in-lake restoration efforts and will be completed by FY21/FY22.
- Program activities that maintain a budget line item are highlighted in blue. These include items such as continued statewide lake economic and water quality assessments used to guide our investments in lake improvement, program oversight and engineering services and assessment/planning and initial watershed efforts at prioritized lakes.

Table 3. Lake Restoration Program Five Year Capital Plan

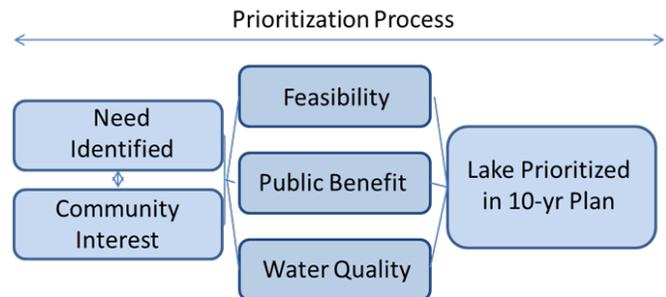
Project Name	County	LRP Obligated	LRP FY19	LRP FY20	LRP FY21	LRP FY22	LRP FY23	Description
Central Park Lake	Jones	\$55,000	\$55,000					Finish work for project and road repair
Easter Lake	Polk	\$625,000	\$625,000					Yeader Creek Phase 2
George Wyth	Black Hawk	\$300,000		\$300,000				Engineering and Design, Shoreline and breakwaters
Hickory Grove Lake	Story	\$65,000	\$65,000					Dredging, shoreline, habitat
Kent Park Lake	Johnson	\$40,000	\$40,000					Watershed BMPs, In lake restoration
Lake Geode	Henry	\$614,800	\$614,800					Shoreline, Permeable pavement, Spillway repair
Lake of the Hills	Scott	\$2,026,875	\$1,026,875	\$1,000,000				Dredging, shoreline, habitat
Pleasant Creek	Linn	\$100,000	\$100,000					Sediment/water control structures
Viking Lake	Montgomery	\$100,000	\$100,000					Sediment/water control structures
Volga Lake	Fayette	\$100,000	\$100,000					Sediment/water control structures
Blue Lake	Monona	\$3,310,000	\$1,500,000	\$1,160,000	\$400,000	\$250,000		Containment site, Dredging, Fish renovation
Black Hawk Lake	Sac	\$7,362,500	\$1,087,500	\$775,000	\$2,350,000	\$1,525,000	\$1,625,000	Watershed, Fish barrier, Containment site purchase/construction, Dredging
IA Great Lakes	Dickinson	\$2,240,000		\$560,000	\$560,000	\$560,000	\$560,000	Water quality improvement projects
Lake Manawa	Pottawattamie	\$6,350,000	\$1,280,000	\$1,720,000	\$1,100,000	\$1,100,000	\$1,150,000	Mosquito and Indian Creeks, dredging
Lake Rathbun	Appanoose	\$1,500,000	\$250,000	\$500,000	\$250,000	\$250,000	\$250,000	COE 1135 Environmental Restoration
Silver Lake	Dickinson	\$3,900,000		\$800,000	\$900,000	\$1,100,000	\$1,100,000	Eng. design, watershed, shoreline
Storm Lake	Buena Vista	\$1,500,000			\$400,000	\$550,000	\$550,000	Pumping station repair, Alum treatment (if needed)
Three Mile Lake	Union	\$2,450,000	\$50,000	\$300,000	\$600,000	\$750,000	\$750,000	Wetland, Watershed, Access/habitat, Shoreline
Program Mgmt., Eng.		\$2,640,000		\$660,000	\$660,000	\$660,000	\$660,000	Program management, engineering
Project Development		\$8,207,864	\$114,864	\$1,343,000	\$1,900,000	\$2,375,000	\$2,475,000	Badger Creek, Big Creek, Casey, Diamond, Five Island, George Wyth, Green Valley, Hannen, Hendricks, Keomah, Lacey Keosauqua, Meyer, Otter Creek, Pine Upper/Lower, Twin North/South, Silver (Delaware), Volga
Shallow Lakes								
West Swan / High	Emmet	\$275,000	\$175,000	\$100,000				Outlet structure, fish barrier
Morse Lake	Wright	\$289,000		\$175,000	\$114,000			Watershed, Lake restoration, outlet structure
Shallow Lake Projects		\$1,266,000		\$40,000	\$266,000	\$480,000	\$480,000	Elk Lake (Clay), West Twin Lake (Hancock) - Eng. design, watershed, lake restoration
Wetland Restoration								
IA Great Lakes	Dickinson	\$277,000	\$10,000	\$167,000	\$100,000			West Okoboji, Garlock Slough wetland; East Okoboji watershed
	Total	\$45,594,039	\$7,194,039	\$9,600,000	\$9,600,000	\$9,600,000	\$9,600,000	

Lake Restoration Program (LRP) Ten-Year Plan – Projects in the Assessment/Planning Phase

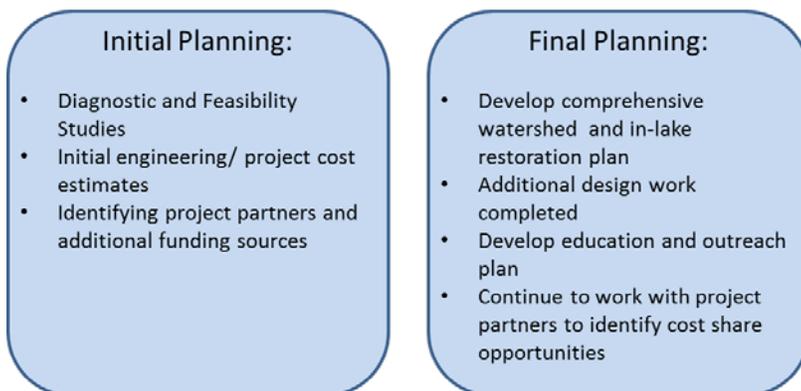
How a Lake Becomes a Candidate for Restoration – Prioritization Begins with a Need

Lakes are identified in one of two ways to become potential candidate lakes within the Lake Restoration Program.

1. A need is identified by the local resource managers and through our science-based approach.
2. Communities may petition the director of the department to be included in the LRP.



Planning Process



The department meets with representatives of communities where prioritized lakes are located to provide an initial lake restoration assessment and to explain the process and criteria for being prioritized for lake restoration funding. As mentioned, DNR may initiate this process or in some cases the local community reaches out to the DNR about their concerns and potential involvement by the Lakes Program. The DNR ranking process, along with community's interest

and commitment to lake restoration, provides the basis for the maintained list of not more than thirty-five significant publicly owned lakes and not more than five publicly owned shallow lake/wetlands prioritized for program funding (ten-year plan).

Planning for Success

This phase of the process focuses on determining what types of work (both in the watershed and in the lake) will be most effective for improving water quality. The LRP partners with stakeholders and the community to complete (or use already completed) watershed improvement plans to target watershed best management practices (BMPs). If needed, additional assessment work is completed through a Diagnostic and Feasibility Study. The result of all of initial planning is tentative watershed BMPs design and placement, as well as conceptual cost estimates for restoration activities. Final planning includes more comprehensive engineering design and contracting for construction of watershed work. An important component of this part of the plan is continuous outreach with land owners and the community to engage those around the lake with the project.

As mentioned previously, funding for the Lake Restoration Program (LRP) is currently appropriated on an annual basis. We anticipate that at the current annual level of \$9.6 million per year the DNR can stay on schedule with implementing restoration efforts at the significant publicly-owned lakes and publicly-owned shallow lakes/wetlands currently prioritized below in the ten-year plan.

Lake Restoration Program - Shallow Lakes and Wetland Initiatives

Iowa has experienced a significant decline in the amount and quality of wetland complexes and shallow lakes. Contributing factors have been major changes to the hydrology of these systems, high/stable water levels, introduction of carp and sediment/nutrient loading. Iowa has made great strides over the past years in protecting valuable lake resources through wetland enhancement and improving shallow lake habitat.

Shallow lake management has always been a challenge in our highly modified environment. Shallow lakes are scattered throughout northwest Iowa and, in most of these lakes, water quality at these lakes is severely degraded. Significant watershed changes and the introduction of common carp in the late 1800's have forever made management of these water bodies a challenge. In fact, most of these lakes are turbid, algae-dominated systems with little to no vegetation, and poor sport fisheries comprised mostly of common carp and black bullheads. Successful restorations of deeper lakes have historically focused on reducing nutrient inputs by repairing the watershed and/or removing phosphorus-laden sediments from the lake. Successful shallow lake management strategies require intensive in-lake management strategies that can immediately flip the basin from the turbid-water state to the clean-water state, and long-term watershed protection efforts that help maintain clean water over time.

More intensive monitoring of shallow lakes for a variety of water quality parameters began in 2006 to better understand these unique ecosystems and evaluate how individual systems responded to restoration efforts. A number of surprising results were found when analyzing both the differences between unrestored and restored shallow lakes and the differences in individual lakes both pre and post-restoration. Overall, restoration efforts have resulted in lakes with better water clarity, changes to the nutrient dynamics in the lake, and changes to the plant and invertebrate communities. These changes are indicative of a clear-water plant-dominated stable state (Balmer, 2016).

The Lost Island Lake project alone resulted in the enhancement over 1,000 acres of wetland habitat within the Barringer Slough/Blue-wing Marsh complex. This 2,200 acre lake is one of Iowa's top recreation and tourism destinations and wetland protection was critical to the project's success. Lake restoration will provide long-term ecological, recreational and economic benefits for Iowans. Ducks Unlimited engineering staff surveyed and designed a series of water control structures and fish barriers that will allow managers to effectively manage for productive habitat. Unique fish barrier solutions, from electric to physical and specific to five different sites were needed for this project.

Many of the designs for shallow lake management incorporate water control structures and pumps that allowed for the temporary draining of the basins and fish barriers that preclude the passage of rough fish (e.g. carp) back into the lake. However, each site is different and requires solutions specific to a given area. Restoration or enhancement activities rely on engineering survey, design and feasibility analysis. Engineering needs for these projects include specifications of project features (e.g. water-control structures, pumping/tiling systems, fish barriers, etc.), associated cost estimates and design documents that can be included in a construction bid package.

DNR Lake Restoration Program's – Wetland Enhancement at Iowa's Significant Publicly Owned Lakes

The DNR Lake Restoration Program (LRP) is a statewide effort focused on Iowa's significant publicly owned lakes (SPOLs). Lake restoration projects are designed to ensure a cost effective, positive return

on investment for the citizens of Iowa; ensure local community commitment to lake and watershed protection; ensure significant improvement in water clarity, safety, and quality of Iowa lakes; provide for a sustainable, healthy, functioning lake system; and result in the removal of the lake from the impaired waters list. Projects prioritized for funding should also account for the feasibility of each lake for restoration and the use or potential use of the lake.

Lake Specific Plans

Decisions for spending at Lake Restoration Program lakes are driven by individual lake restoration plans. For certain lake plans, marsh/wetland enhancement is identified as a critical component to achieve water quality improvement. For example, in the last five years the LRP has worked on a number of wetland restoration projects in priority watersheds draining to a SPOL (e.g. Little Storm Lake, Lost Island Lake wetlands and Marble/Hottes). These projects meet the program criteria since the objective is to improve and/or protect a lake already prioritized according to the program guidelines.

IOWA DEPARTMENT OF NATURAL RESOURCES

LEADING IOWANS IN CARING FOR OUR NATURAL RESOURCES

BRUCE TRAUTMAN, ACTING DIRECTOR

Lake Restoration Program 2018 Report and 2019 Plan

Supplemental Information

Submitted To

Joint Appropriations Subcommittee on Transportation, Infrastructure, and Capitals
and
Legislative Services Agency

Submitted By

Iowa Department of Natural Resources
Bruce Trautman, Acting Director



December 31, 2018

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Lake Restoration Program – Project Development **(Assessment/Planning Phase and/or Watershed Improvements Phase)**

Lakes in Initial Planning Phase:

These lakes have been identified as good candidates for the program and are currently undergoing initial planning. For each of these projects, the LRP has met with community members, stakeholder groups, or the local fisheries biologist to learn about the water quality challenges and potential restoration needs. In some cases, the LRP has started to engage with some small projects in the watershed to help move the project forward.

Lakes in Final Planning Phase:

After some high level conceptual planning has been completed, an individual project moves towards more comprehensive planning – where a restoration plan for both the lake and watershed is developed and more concrete design and engineering work is completed allowing project partners to develop a budget for the overall project. Many lakes in this planning phase also are initiating or actively completing a watershed project to reduce sediment and nutrient inputs to the downstream lake through partnerships with other programs (Section 319 funding, Iowa Department of Agriculture and Land Stewardship, County Conservation Boards, etc.).

A summary of projects in these categories are provided below:

Badger Creek Lake (Madison County)

Badger Creek Lake is a 269-acre lake with an active watershed project to reduce nutrients and sediment inputs to the lake. Water quality at the lake has declined in recent years due to high phosphorus inputs from the watershed and increased sedimentation in the arms on the lake, resulting in a loss of volume to the lake and frequent intense algae blooms. Following the completion of a comprehensive watershed management plan, a watershed project, sponsored by DNR's Watershed Improvement Section began in 2013. Preliminary planning for in-lake restoration activities at Badger Creek Lake is also underway. Project partners met in the fall of 2017 to review watershed work completed to date and discuss the next round of watershed practices to be installed on public ground prior to beginning work in the lake. Specifics of the in-lake work have not been finalized; however, similar projects in Iowa have included shoreline restoration, targeted dredging, and fish habitat improvements.

Big Creek Lake (Polk County)

DNR began working with project partners at Big Creek Lake several years ago to develop strategies in the watershed to reduce nutrient and sediment inputs to the lake. Big Creek Lake has an active watershed project aimed at removing the bacteria impairment from the lake and reducing sediment inputs to the lake. In 2017, LRP partnered with other project partners to build several sediment detention basins on public land in the watershed to reduce inputs to the lake. The LRP is looking for additional ways to make improvements in the watershed that will improve water quality in the lake.

Casey Lake (Black Hawk County)

Casey Lake is a 545 acre lake located in Hickory Hills Park in Tama County and currently managed by the Tama County Conservation Board. With a 13.6:1 watershed to lake area ratio, the lake is an excellent candidate for restoration. The watershed also has a high percentage of forested land, which is very unique for Iowa. Water quality is pretty average, but the lake suffers periodically from high turbidity. A TMDL was completed for the lake in 2013, and the lake is currently not listed as impaired. This lake is in the initial planning and evaluation phase. Project partners plan to meet in early 2019 to discuss needs for the lake and watershed.

Diamond Lake (Poweshiek County)

DNR began working with the Poweshiek CCB in 2014 at Diamond Lake by updating and renovating the spillway at the lake. Prior to the modification, the lake experienced seepage issues and was in need of repair. In 2015, the spillway was re-constructed and the new design included a 10-foot drop that will act as an effective fish barrier to prevent the re-encroachment of rough fish (carp). Additional work will likely include a fishery renovation to remove rough fish already living in the lake. A comprehensive watershed and in-lake plan is needed to move forward with this project. Project partners met in the fall of 2017 to begin developing a comprehensive in-lake restoration plan.

Five Island Lake (Palo Alto County)

There has been an active project at Five Island Lake since the inception of the Lake Restoration Program. Up until 2016, the DNR had partnered with the City of Emmetsburg to dredge areas of the lake to reduce wind and wave resuspension of nutrients and turbidity. Beginning in 2016, the LRP worked with the City to develop a watershed planning effort and study that would help project partners determine what the next steps for the project should be. The City of Emmetsburg hired FYRA Engineering to complete a Diagnostic and Feasibility Study on the lake, which was completed in 2018. Project partners will use the information from this study to design restoration activities in the watershed and lake that will lead to additional water quality improvements. Local project partners are working together to apply for a joint 319 planning grant for watershed work at three lakes in Palo Alto County, including Five Island Lake. The group meets periodically to discuss potential in-lake needs and timelines for accomplishing water quality goals. Additionally, Five Island Lake is being included in a study examining rough fish populations in several shallow natural lakes in Iowa, with the hope of utilizing an incentivized commercial harvesting program in the future to remove excess rough fish from the lake. The study will be completed in 2021.

George Wyth Lake (Black Hawk County)

George Wyth is a sand borrow-lake with relatively low overall fertility when compared to other Iowa Lakes. George Wyth's historic fishery was moderate to poor, due to relatively low productivity and a lack of aquatic vegetation. Water quality parameters in George Wyth Lake compare favorably to other Iowa lakes, due to a low watershed to lake ratio and relatively small portions of watershed in agricultural production.

- The IDNR Watershed Improvement Section completed a Water Quality Improvement Plan for George Wyth Lake in 2008 to address impairment due to high bacteria levels on the beach, with the primary cause for impairment identified as resident geese.
- One of the primary goals of this project would be to promote the growth of native aquatic vegetation. Prior to 2009, very few aquatic plants were observed, which had a negative impact on the fishery and water quality.
- Starting in 2009, local biologists began actively planting aquatic vegetation to promote growth.
- A planning group met in 2018 to discuss needs for the project and begin formulating a restoration plan.

Green Valley Lake (Union County)

Green Valley Lake was home to an extensive restoration project in 2012; however, following in-lake restoration activities, carp have been re-introduced into the system and there has been an increase in phosphorus concentrations in the lake, which have led to increased algae blooms in the lake. The LRP is committed to improving water quality in the lake and is now exploring options for reducing in-lake phosphorus concentrations. The technical advisory team met in 2018 to discuss ongoing water quality needs and decided to partner with Iowa State University to collect additional information on the lake in 2019 to address concerns.

Hannen Lake (Benton County)

Hannen Lake is a 38-acre constructed lake located in Benton County with a mean depth of 8.7 feet and a watershed to lake area ratio of 15.7 to 1. The lake is currently managed as a part of Hannen Park by the Benton County Conservation Board. Water clarity has declined since the monitoring program began in 2000, with the average water clarity dropping from over 6 feet (2000) to about 4 feet in recent years. The lake is an excellent candidate for the program and ranks well using measures of water quality potential, public benefit, and feasibility. Park staff met with the DNR in the fall of 2018 to begin discussing needs for the park.

Lacey Keosauqua Park Lake (Van Buren County)

Lake Restoration, Fisheries, and IDALS staff met in the summer of 2014 to discuss watershed improvement in the Lacey Keosauqua watershed. Previous efforts have identified watershed issues, primarily gullies and their associated head cuts, as the primary threats to Lacey Keosauqua water quality. A watershed assessment was completed in 2015 and potential watershed treatments are being considered for implementation.

Lake Hendricks (Howard County)

DNR and IDALS have worked periodically with the Howard County Conservation Board over the last 15 years to improve water quality at the park through the installation of a variety of best management practices. Lake Hendricks is a 49 acre lake with a lake to watershed ratio of 28:1. The lake sits in a largely agricultural watershed, and has suffered from poor water quality for a number of years. To address water quality concerns, the CCB installed several sediment ponds in the park, completed some grade stabilization and timber stand improvement work, and installed two nitrogen bioreactors to reduce nutrient and sediment inputs to the lake. However, the lake continues to have water quality challenges and currently listed as impaired due to high levels of algae and high pH, usually caused by excessive algae. The LRP has been working with the local fisheries biologist and CCB staff to formulate a plan to complete additional watershed and in-lake work to improve the lake. This lake is in the initial planning/evaluation state. Project partners are slated to meet in early 2019 to discuss what additional information is needed to create a restoration plan for the lake.

Lake Keomah (Mahaska County)

DNR held a public meeting in fall of 2009 to gauge local support for restoration activities at Lake Keomah. Project partners recently created a "Friends" group for the State Park, laying the groundwork for local support and participation in future restoration activities. DNR Watershed Improvement Section completed a Water Quality Improvement Plan in 2012 to address non-support of designated recreational use due to impairment issues of algae and pH. DNR Lake Restoration Program has identified Lake Keomah as one of our 35 priority lakes for restoration. Currently, Lake Restoration and other Fisheries Bureau staff are communicating with the Mahaska Soil and Water Conservation District to in an effort to perform a watershed assessment of sheet, rill, and gully erosion on private and state-owned property comprising the Lake Keomah watershed.

Lake Keomah is a high priority lake for restoration, according to the Iowa Lakes Study. Lake Restoration, IDALS, and Rathbun Fish Management met on-site in 2014 to discuss steps for lake restoration at this 79 acre impoundment. An initial list of objectives was completed. IDALS will approach the Mahaska Soil and Water Conservation District, to determine interest in completing an updated watershed assessment. A new watershed coordinator began in January, 2016, and was be responsible for completing an assessment. Lake Restoration funded the study. The last assessment was completed in 1991. Keomah's TMDL's for sedimentation and nutrient impairments have been completed, but underlying causes have not been addressed since construction of one large basin on the western arm in 1996.

Potential restoration activities discussed included: dredge removal of 100,000 cubic yards of sediment, improvement of upper boat ramp, improvement of trail on Keomah Village side on the DNR setback, with improved marking of DNR access to the Keomah Village road, in conjunction with parking improvements for jetty access on the eastern side of the lake, construction of fishing jetties on the western side of the east arm, improved access from trails for the western arm of the lake, fish habitat improvements, timber clearing on and near the dam, construction of basins and other BMP's as indicated by the watershed assessment. Potential funding sources include POL and Lake Restoration. Additional potential treatments include removal of grass carp with low-dosage rotenone treatment and increased pool elevation of the large eastern basin on State property. The overall project is anticipated to cost approximately \$1.5 million.

Lake Meyer (Winneshiek County)

Lake Meyer is a 38-acre lake currently managed by the Winneshiek CCB with a watershed to lake ratio of 38:1. The watershed has a diverse mix of land uses, including forest, grassland, and cropland. While Lake Meyer is a small lake, it is one of the few lakes in Northeast Iowa for anglers and others to enjoy, and the lake has a history of relatively good water quality. Efforts to maintain this resource have been ongoing, however; additional work is needed to fully restore the lake. The Winneshiek CCB has already partnered with the DNR and Winneshiek SWCD to install watershed practices to protect the lake, including 66 acres of filter strips, 5 manure storage systems, over 35,000 feet of terraces, 3 bio-swales, and 4 wetlands. Additionally, over 11,000 tons of sediment has also been removed from the lake. The Winneshiek CCB petitioned the Director of the DNR in 2016 to be included in the LRP with the priority of eliminating seepage from the current dam structure and continuing to improve water quality through augmented watershed and in-lake efforts. Lakes restoration staff met with local project partners in 2017 to discuss the project and begin formulating a plan for the lake. In 2018 the CCB and DNR partnered to repair and expand an existing watershed pond in the part to protect Lake Meyer. Engineering design was completed over the summer of 2018 and the project is slated to be constructed in 2019 for a total cost of \$103,000 (75% DNR, 25% CCB).

Otter Creek Lake (Tama County)

Otter Creek Lake is a 74-acre lake with a 13.1:1 watershed to lake area ratio managed by the Tama CCB. The park is a popular spot for recreation and features an excellent nature center. The lake has experienced declining water quality over the last 20 years, with increased sedimentation in parts of the lake that have altered the overall lake volume. Rough fish also contribute to the water quality problem, re-suspending sediment from the bottom of the lake. The LRP met with a local group in 2015 to discuss a potential project and possible restoration solutions for the lake. The local SWCD recently completed a watershed assessment and plan, which is a critical first step towards completing projects in the watershed prior to investing in efforts within the lake. A technical advisory team was formed in the fall of 2017 and met to discuss options for the project, beginning with watershed efforts. The goal for the project is to develop several opportunities in the lake and watershed to be implemented in the coming years.

Pine Lakes – Upper and Lower (Hardin County)

Upper and Lower Pine Lakes are man-made lakes located in Hardin County and serve as a popular camping and recreation destination for the area. The lakes are currently impaired to poor water quality related to low water clarity from algal and non-algal turbidity and bacteria.

- Hardin County approached IDNR in 2014 to discuss the potential for construction of a large pond upstream up Upper Pine Lake. A bridge near the proposed construction site needed to be replaced the opportunity arose to raise the road and put in a large pond to prevent nutrients and sediment from entering Pine Lakes instead of re-building the bridge.
- IDNR Engineering developed preliminary design plans and cost estimates and presented them to the County Conservation Board, the County Engineer, several other stakeholders, and the land owners in 2016. DNR is waiting on a consensus from the land owners before moving forward with a potential project.

- LRP met with Parks staff in the summer of 2018 to discuss sedimentation concerns in both lakes, as well as discuss ongoing geese and vegetation issues at the lake. The LRP will continue to work with local project partners to develop a long term plan for managing the lake.

Rock Creek Lake (Jasper County)

Rock Creek Lake is a 491-acre lake constructed in 1952. The lake has a watershed to lake area ratio of 54/1. Iowa State University, in a 2000 Diagnostic/Feasibility Study, indicated that over the last 50 years the lake has lost almost 40% of its lake water volume and 102 lake surface acres. Local efforts have accomplished some work in the watershed; however, local and state partners need a renewed effort to move this project forward. Continued watershed improvement projects have been a difficult “sell” to area landowners.

- A technical working group met in 2008 to discuss the necessary reductions in sediment from the watershed to make the in-lake work feasible.
- During fiscal year 2009, landowners completed some small practices such as waterways and small basins in the Rock Creek Watershed as part of the funded Watershed Project. Implementation of these practices resulted in a sediment reduction of 1,439 tons/year and 750 acres protected from June 2008 to September 30, 2009.
- Work on the Rock Creek Watershed Project at this time is limited to five grade stabilization structures in the state park. The project coordinator had selected sites for the placement of three ponds and two large dry basins to address critical areas of gully erosion. The construction of these structures is completed and the IDNR has stocked three of the ponds.
- DNR invested in a new sediment catch basin at Rock Creek State Park in 2014 to help reduce sedimentation in the upper arm of the lake.
- IDNR met with the local friends group in the summer of 2015 to discuss options for addressing the in-lake sedimentation and reducing sediment and nutrient inputs to the lake from the watershed. The need for a watershed management plan and considerable watershed work was discussed in order for in-lake to be considered for additional restoration work.

Silver Lake (Delaware County)

Silver Lake is a small, natural lake enlarged by the construction of a dam. It has a 34-acre surface area lake and a lake ratio of 6.4 to 1. The University of Northern Iowa completed a diagnostic feasibility study in 2001 and the IDNR completed a Water Quality Improvement Plan analysis in 2001. Lake depth maps and sediment borings indicated excessive lake sedimentation depths ranging from 0.5 to 4 feet. A lake watershed assessment conducted in 2001, documented areas of high phosphorus input in the watershed. The assessment also identified excessive manure application levels as a problem. NRCS continues to work with landowners in the watershed to reduce nutrient and sediment lake inputs.

- In 2001, an engineering firm evaluated dam integrity and leakage issues. The construction firm hired to repair the dam and eliminate dam safety issues completed the work fall of 2007 at a cost of \$314,950. Lake water overflowed the Silver Lake spillway in April of 2008 following dam repair and wet weather conditions. According to local reports, that marked the first spillway overflow since 1993. Silver Lake has remained near full pool throughout 2008-2011, which indicates that dam repairs completed during 2007 were very effective.
- IDNR completed a Water Quality Improvement Plan for Silver Lake in the fall of 2008 and this study highlighted watershed areas responsible for primary phosphorus delivery. The goal is to form local action committees to address watershed inputs. Following watershed improvements that reduce sediment delivery and phosphorus inputs, the community and biologists are hoping to remove phosphorus-rich sediments from Silver Lake to help reduce problems associated with internal phosphorus loading.

- During 2010, members of the Delhi Community formed a small community-led workgroup. This workgroup held two meetings during the 3rd quarter of 2010 to discuss options for watershed improvement and in-lake water quality improvement. Activity of this group lost momentum during 2011.
- A new boat ramp and parking area were completed at Silver Lake during April 2015 and a new dock was placed during June 2015 to improve access amenities.
- DNR Fisheries staff met with Delaware County USDA-NRCS staff and Delaware County SWCD staff during February 2015 to discuss watershed improvement on agricultural lands within the Silver Lake watershed. Delaware County SWCD staff made personal contacts with primary agricultural landowners during March 2015 and formulated nutrient reduction strategies that include implementation of grassed waterways, perennial vegetation plantings, no-till farming, and P-based nutrient management. Implementation of new practices began during the 2016 crop year and they are expected to result in significant reduction of phosphorus delivered to Silver Lake in coming years. Additional watershed improvement planning is a priority for future restoration.
- LRP staff met with an interested group of local citizens in the fall of 2018 to discuss needs for the lake and begin formulating a watershed improvement plan.

Silver Lake (Palo Alto County)

Silver Lake is a natural shallow lake in Northwest Iowa with a mean depth of 4.3 feet. In August 2013, the lake association met with Fisheries, Wildlife, and Lake Restoration staff to determine if restoring this lake was possible and what it would take to improve water quality at Silver Lake. Together, the local group and DNR invested in a Diagnostic and Feasibility study to better understand how nutrients and sediment were being transported to the lake from the watershed and what could be done to improve water quality in the lake. The study was completed in 2016. The next step for the project is to complete a comprehensive restoration plan for the lake and watershed focused on improving water quality at the lake. Additionally, the local group and other project partners have invested in the future of Silver Lake through the following projects:

- The Silver Lake Protective Association was successful in 2012 at acquiring local grant money to pursue survey, design, and engineering of a fish barrier on the existing outlet structure and determining the feasibility of using the existing drawdown structure. The initial design is complete but implementation is on-hold to examine how the barrier will fit into the overall improvement plan.
- The Iowa Natural Heritage Foundation also acquired a tract of land along the shoreline in 2016 with the long-term goal of enhancing the land to help protect the lake through wetland improvements and native plantings along the shoreline of the lake. DNR acquired this piece of land from INHF in 2017 for the appraised value of \$920,400 (\$300,000 LRP; \$600,000 MFT; \$20,400 REAP Open Spaces).
- Silver Lake is slated to be included in the Palo Alto 319 planning grant application, which would help create a watershed plan for the lake in the 2-3 years. Implementing watershed practices is critical for the success for this project, as much of the pollution to the lake comes from the watershed.

Swan Lake (Carroll County)

Swan Lake has a long history of water quality challenges. DNR fisheries staff has been working closely with the Carroll CCB in efforts to re-establish emergent vegetation around the perimeter of Swan Lake through manipulating water levels at this lake. In addition, partners attempted an experimental removal of grass carp with a commercial angler using trammel nets. Through these efforts 40 grass carp were removed from Swan Lake. Three hundred grass carp were originally stocked in Swan Lake since the renovation in 2004 and none have been stocked since. In addition to the CCB's in-lake efforts, project partners have worked to restore a 4-acre wetland in the watershed through a WIRB grant. The lake currently has a watershed management plan, however; a comprehensive in-lake plan is needed to move forward with this project and improve water quality. The DNR and Iowa State University partnered with the county in 2017 to monitor the lake to better

understand oxygen dynamics and nutrient cycling in this lake. DNR installed a buoy for several summer months to learn how and when oxygen is being depleted within the lake. Iowa State and DNR to use this information to develop a more long-term strategy for managing algae blooms in the lake and preventing summer fish kills from low oxygen concentrations.

Twin Lakes North and South (Calhoun County)

Local DNR fisheries and wildlife biologists met with the Twin Lakes Restoration Association (TLRA) to discuss water quality issues in the lake system. Local DNR staff fielded a number of calls throughout 2011 in regards to water quality issues and potential projects at both lakes. The TLRA invited local biologists to attend a meeting and provide information regarding water quality projects.

- Biologists explained that the best way to start a water quality project is to conduct a comprehensive Diagnostic Feasibility Study on both lake systems. The TLRA has sent a letter to the Director of the DNR requesting that the Twin Lakes System be included in the Lakes Restoration Program budget to fund a DF Study.
- The potential for a successful restoration project on the Twin Lakes System is high. North Twin Lake has an average depth of 8.7 feet, which is relatively deep compared to other natural lakes in the region. Additionally, both North and South Twin Lakes have a relatively small watershed to lake ratios and although the land surrounding the two lakes is primarily in row crop production, the slope of the land is low.
- Project partners worked together to hire Iowa State University to complete a Diagnostic and Feasibility study for the Twin Lakes. The study, completed in 2016, called for a 65% reduction of phosphorus from the watershed to improve overall water clarity in the lake. A variety of in-lake and watershed restoration alternatives were presented to the community in the summer of 2016 for consideration as part of a complete restoration plan for the lakes.
- The LRP partnered IDALS and DNR's Watershed Improvement Section to hire a part-time project coordinator to develop a comprehensive watershed action plan and begin working with landowners in the watershed to implement conservation practices on to reduce nutrient and sediment inputs to the lake. The plan was completed in December 2017 and will serve as a road map implementing projects in the watershed. The part-time coordinator continues to work at Twin Lakes, regularly collected additional water samples to better understand where pollution is coming from, meeting with urban conservation staff to promote storm water practices, and investigating potential projects on public ground in the watershed.
- North Twin Lake will also be commercially fished in 2019, with an incentivized harvest structure in place, paying the angler bonus for removing high abundances of undesirable fish species (common carp and bigmouth buffalo).

Volga Lake (Fayette County)

Volga Lake is an 119 acre lake in Northeast Iowa with a watershed to lake area ratio of 51:1. The lake's watershed is a mixture of grassland, forest, and row-crop agriculture. Volga Lake is currently listed as impaired due to high levels of algal and non-algal turbidity, and a TMDL was completed for the lake 2014. DNR Fisheries Staff contacted the LRP about working at the lake in 2018, and project partners are in the process of forming a technical advisory team to determine the lake's needs and formulate a watershed and lake restoration plan. This lake is in the early planning/evaluation phase.

Lake Restoration Program - Shallow Lakes and Wetland Initiatives

Iowa has experienced a significant decline in the amount and quality of wetland complexes and shallow lakes. Contributing factors have been major changes to the hydrology of these systems, high/stable water levels, introduction of carp, and sediment/nutrient loading. Iowa has made great strides over the past 10 years in protecting valuable lake resources through wetland enhancement and improving shallow lake habitat.

Shallow lake management has always been a challenge in our highly modified environment. Shallow lakes are scattered throughout northwest Iowa and, in most of these lakes, water quality at these lakes is severely degraded. Significant watershed changes and the introduction of common carp in the late 1800's have forever made management of these water bodies a challenge. Most of these lakes are turbid, algae-dominated systems with little to no vegetation, and poor sport fisheries comprised mostly of common carp and black bullheads. Successful restorations of deeper lakes have historically focused on reducing nutrient inputs by repairing the watershed and/or removing phosphorus-laden sediments from the lake. Successful shallow lake management strategies require intensive in-lake management strategies that can immediately flip the basin from the turbid-water state to the clean-water state, and long-term watershed protection efforts that help maintain clean water over time.

More intensive monitoring of shallow lakes for a variety of water quality parameters began in 2006 to better understand these unique ecosystems and evaluate how individual systems responded to restoration efforts. A number of surprising results were found when analyzing both the differences between unrestored and restored shallow lakes and the differences in individual lakes both pre and post-restoration. Overall, restoration efforts have resulted in lakes with better water clarity, changes to the nutrient dynamics in the lake, and changes to the plant and invertebrate communities. These changes are indicative of a clear-water plant-dominated stable state (Balmer 2016).

The Lost Island Lake project alone resulted in the enhancement over 1,000 acres of wetland habitat within the Barringer Slough/Blue-wing Marsh complex. This 2,200 acre lake is one of Iowa's top recreation and tourism destinations and wetland protection was critical to the project's success. Lake restoration will provide long-term ecological, recreational and economic benefits for Iowans. Ducks Unlimited engineering staff surveyed and designed a series of water control structures and fish barriers that will allow managers to effectively manage for productive habitat. Unique fish barrier solutions, from electric to physical and specific to five different sites were needed for this project.

Inlet dredging at the wetland/slough complex that drains into Black Hawk Lake will reduce 68% of phosphorus and sediment pollution to the lake and serve as critical habitat for a variety of birds, amphibians, and fish. This project has not only improved the quality of the wetland, but helped to protect one of Iowa's most visited lakes.

Many of the designs for shallow lake management incorporate water control structures and pumps that allow for the temporary draining of basins and fish barriers that preclude the passage of rough fish (e.g. carp) back into the lake. However, each site is different and requires solutions specific to a given area. Restoration or enhancement activities rely on engineering survey, design and feasibility analysis. Engineering needs for these projects include specifications of project features (e.g. water-control structures, pumping/tiling systems, fish barriers, etc.), associated cost estimates and design documents that can be included in a construction bid package.

DNR Lake Restoration Program's – Wetland enhancement at Iowa's Significant Publicly Owned Lakes

The DNR Lake Restoration Program (LRP) is a statewide effort focused on Iowa's significant publicly owned lakes (SPOLs). Lake restoration projects are designed to ensure a cost effective, positive return on investment for the citizens of Iowa; ensure local community commitment to lake and watershed protection; ensure significant improvement in water clarity, safety, and quality of Iowa lakes; provide for a sustainable, healthy, functioning lake system; and result in the removal of the lake from the impaired waters list. Projects prioritized for funding should also account for the feasibility of each lake for restoration and the use or potential use of the lake.

Lake Specific Plans: Decisions for spending at Lake Restoration Program lakes are driven by individual lake restoration plans. For certain lake plans, marsh/wetland enhancement is identified as a critical component to achieve water quality

improvement. For example, over the past several years the LRP has worked on a number of wetland restoration projects in priority watersheds draining to a SPOL (e.g. Little Storm Lake, Lost Island Lake wetlands, Marble/Hottes (Iowa Great Lakes), and the Black Hawk Lake Inlet). These projects meet the program criteria since the objective is to improve and/or protect a lake already prioritized according to the program guidelines.

Iowa's shallow lake and wetland conservation efforts involve strong partnerships

One primary example of these partnerships is Ducks Unlimited (DU). DU has been a leader in Iowa's effort to improve shallow lake and wetlands. Working cooperatively through DU's Living Lakes Initiative in Iowa and Minnesota, great strides have been made in our management capabilities and the habitat quality of these systems. Success is also being measured in public education and outreach. Communities and user groups are coming together to make these projects truly successful demonstration models for improving not only water quality, but fostering partnerships for the long-term active management required to maintain the health of these lakes.

The Living Lakes Initiative was established by Ducks Unlimited to focus conservation work on large marshes and shallow lakes throughout the Prairie Pothole Region of Iowa and Minnesota. Their long-term commitment has resulted in the protection and improvement of Iowa and Minnesota's shallow lakes and enhancement of extensive wetland habitat. Contributions include innovative engineering solutions for carp control and water level management capabilities, in-kind support from their staff and partnering with resource agencies to obtain federal grants.

Ducks Unlimited efforts have resulted in substantial funding resources being brought to Iowa and Minnesota for shallow lake/wetland work. DU has facilitated a number of North American Wetlands Conservation Act grants from the U.S. Fish and Wildlife Service to protect wetland habitat and shallow lakes in Iowa. In addition, DU has partnered with the U.S. Department of Agriculture Natural Resources Conservation Service to deliver Wetlands Reserve Program habitat restoration projects on private lands. These projects improve watershed functions and complement our lake restoration efforts.

Implementation of marsh/wetland restoration efforts at Lake Restoration Program (LRP) prioritized lakes has been over a \$7 million investment over the past several years.

Clear Lake (Ventura Marsh)

\$4,775,580 (\$783,818 LRP / \$3,991,762 Federal ACOE)

Iowa Great Lakes (West Okoboji View and Big Spirit – Marble/Hottes Wetlands)

\$2,307,153 (\$854,607 LRP / \$1,452,546 Other)

Lost Island Lake (Wetlands/Carp Management)

\$1,452,655 (\$1,226,866 LRP / \$180,000 WIRB Grant by Palo Alto / \$25K Casino Grant)

Storm Lake (Little Storm - Wetland Restoration)

\$1,089,071 (\$917,031 LRP / \$163,040 WIRB Grant by Lake Preservation Association)

Twelve Mile Lake (Wetland)

\$447,291 (\$297,291 LRP / \$75,000 NAWCA / \$75,000 State Duck Stamp)

Black Hawk Lake Inlet

Containment Site Construction \$729,531 LRP; Inlet Dredging \$2,099,000 LRP

Silver Lake (Palo Alto)

Diagnostic and Feasibility Study \$211,000; Watershed/shoreline protection land acquisition \$920,400 (\$300,000 LRP; \$600,000 Marine Fuel Tax; \$20,000 REAP Open Spaces)

Iowa Great Lakes (Little Swan Lake – Fish barrier and water control structure)

\$317,937 (Ducks Unlimited, NAWCA, Dickinson County Water Quality Commission, and LRP)

Black Hawk Lake (Sac County)

Blackhawk Lake is the southern most natural lake in Iowa, located in Sac County, Iowa, near the town of Lake View. This 922-acre lake has a watershed of 14,097 acres and has faced numerous water quality problems that have been documented as early as the 1930s. Restoration at Black Hawk Lake began in 2012 to improve water clarity in the lake, provide a better sport fishery for anglers, and to improve water quality in the lake by reducing nutrient and sediment inputs to the lake.

One of the key restoration activities called out in the Diagnostic and Feasibility Study for the lake was deepening the inlet of the lake. By restoring this wetland, phosphorus delivered to the lake could be reduced by as much as 68%. Additionally, the wetland serves as important habitat for a variety of migratory waterfowl and aquatic animals. Project partners began working on plans to restore the inlet around 2012. A spoil site for the project was developed utilizing a previous spoil site on state land and re-constructing the area to hold the dredge spoils from the inlet. Construction on the inlet spoil site was completed in 2016 for a total cost of \$729,531 (LRP).



Rough fish were also eliminated from the lake and watershed in 2012. Carp and buffalo preferred to spawn in the inlet, stirring up bottom sediments and up-rooting vegetation. Because the water was very turbid and very few plants were established prior to the fishery renovation, the inlet was very poor habitat for many migratory waterfowl.

With the removal of rough fish, vegetation has flourished in the inlet, attracting a variety of new inhabitants, including a species of greatest conservation need, the Wilson’s phalaropes (pictured top right). The federally protected Bald Eagle also now has a lake overlooking the inlet. Finally, state endangered Blanding’s Turtles have been documented in the small wetlands adjacent to the inlet.

Hydraulic dredging was also needed to re-establish depth to the inlet and turn it back into a functioning wetland. According to the Diagnostic and Feasibility Study, the inlet had lost much of its trapping efficiency due to sedimentation. The loss in volume in the wetland was allowing nutrients and sediments to pass through to the lake without slowing water down enough to filter water entering Black Hawk Lake. Dredging the mean depth from 1.8 feet to 3.0 feet will allow the wetland to function again and prevent sediment and nutrients from reaching the main lake. Dredging began in the summer of 2017 to remove 330,000 cubic yards of sediment from the inlet for a total cost of \$2,099,000 (LRP). Dredging resumed in 2018, restoring critical habitat and re-routing water through the wetland to restore functionality.

Clear Lake (Cerro Gordo County)

Section 206 U.S. Army Corps of Engineers - Aquatic Ecosystem Restoration Project for Ventura Marsh

- Construction is completed on a Section 206 U.S. Army Corps of Engineers Aquatic Ecosystem Restoration Project for Ventura Marsh, which flows into the west end of Clear Lake. In its past degraded state, the marsh served as a major source of nutrients contributing to water quality problems in the lake and was a major reproduction area for common carp. The Army Corp of Engineers (COE) budgeted \$3.2 million for the Ventura Marsh restoration project. Ventura Marsh state land and in-kind credits of \$1,331,200 and approximately \$884,062 in LRP dollars funded the DNR’s portion of the marsh restoration project. The goal was to work with the COE to restore Ventura Marsh and gain water level management capabilities. This allows for fish removal and revegetation of the marsh.
- The old stop log structure was removed and replaced with a new structure in 2011. The stop log structure will be used to control water levels from the marsh crest elevation down to Clear Lake’s water level. For water level manipulations below Clear Lake’s level, the pumping station will need to be used. A flow path was dredged in 2011 to allow the deeper portions of the marsh basin to drain towards the pumping station. This will allow nearly a complete drawdown.



*Carp are still present in Ventura Marsh, but water quality remains excellent. Dense beds of cattail exist on 80% of the basin.
Photo by Zenner, October 2014*

- In 2013 /2014, DNR constructed of a catch basin and a water flow path in the southwest corner of the marsh. This feature will treat water entering the marsh from two large tile sources and allow for longer retention of water entering the marsh before it gets to Clear Lake. The implemented project established two sediment basins to treat major tile inlets in the southwest corner of Ventura Marsh.
- Rotenone was applied to the dredged trench to kill the carp reproduction that occurred in the marsh. The treatment was effective in the area of the Ventura Grade, but live carp are likely still present in other portions of the basin and watershed for the marsh. Stoplogs were removed and water was allowed to flow west into Ventura Marsh. The water level stabilized with the current lake level, which gave adequate levels in the marsh to allow for waterfowl hunting opportunities.

Iowa Great Lakes (Dickinson County)

The DNR recognize that the Iowa Great Lakes (IGL) are a significant public resource and continue to support efforts to maintain and improve lake water quality in the region. The IGL are major recreational lakes for Iowa residents and visitors from adjacent states.

East and West Hottes Lake/Marble Lake/Grovers Lake Complex (Dickinson County)

Located within the Kettleston Hogsback wildlife complex in northern Dickinson County, these 4 basins are of extreme importance to fish and wildlife as well as water quality in the Iowa Great Lakes. Mable Lake (160 acres) and West Hottes (225 acres) drain to Big Spirit Lake. In fact, nearly 20% of the water entering Big Spirit Lake comes through these lakes. Historically, these basins contained a diversity of high quality aquatic plants that supported a wide array of sport fish, waterfowl, water birds, furbearers, reptiles, amphibians, and other wildlife. Excessive numbers of carp and chronic high water levels have resulted in the loss of many of these plants and the animals that depend on them.

A number of partners planned and implemented this \$500,000 restoration project for Marble and Hottes Lakes (\$350,000 from LRP). The Big Spirit Lake Association, DNR, DU, Dickinson County, and others provided funding and technical guidance to develop a comprehensive feasibility study to identify ways to return ecological health to this critical habitat. Final DU design incorporated water control structures and pumps that allowed for the temporary draining of the basins and the installation of fish barriers that allow for the passage of game fish but preclude the passage of carp.



Pumping station on Marble Lake

In May 2014, the Spirit Lake Protective Association hosted a well-attended/positive public meeting prior to the beginning of construction. In 2015, Ducks Unlimited installed new pump facilities and a fish screen that will transform the shallow water areas of these 3 lakes from murky, open water to stands of emergent vegetation such as cattail and bulrush. All phases of construction were completed in 2015 and the new infrastructure allowed West Hottes and Marble Lakes to be drawn down. Water levels have been managed to maximize water quality and aquatic plant benefits. Both lakes were maintained below pool level during the winter of 2015/2016 to eliminate common carp. In addition, wetlands within the watershed are being renovated during 2016 to improve water quality flowing into the lake. High diversity stockings will occur on Marble Lake in 2016 and current plans show both lakes brought back to normal pool level in late 2016. This project enhanced more than 450 acres of shallow lake/emergent marsh and provided better hunting and fishing opportunities on these popular lakes.



Before (left - 2014) and after (right - 2015) project photos of West Hottes Lake.

Spring Run Complex (Dickinson County)

The Clemens Tract within the Spring Run Marsh Complex is a recent addition to the wildlife management area. This management area drains to Lower Gar Lake. Restoring and establishing wetlands throughout the prairie pothole region is important for establishing habitat for aquatic organisms and improving water quality statewide. This project involved the construction of two wetlands totaling 17 acres that will filter water draining to the Iowa Great Lakes and establish good habitat for a variety of aquatic and migratory animals. Engineering design was completed by Ducks Unlimited, and project construction began in 2017 for a total cost of \$394,702 (\$228,927 LRP / \$ 98,756 DU / \$51,311 NAWCA / \$15,000 WQC). Construction for this project is expected to be completed by 2019.

Apple Jack Marsh (Dickinson County)

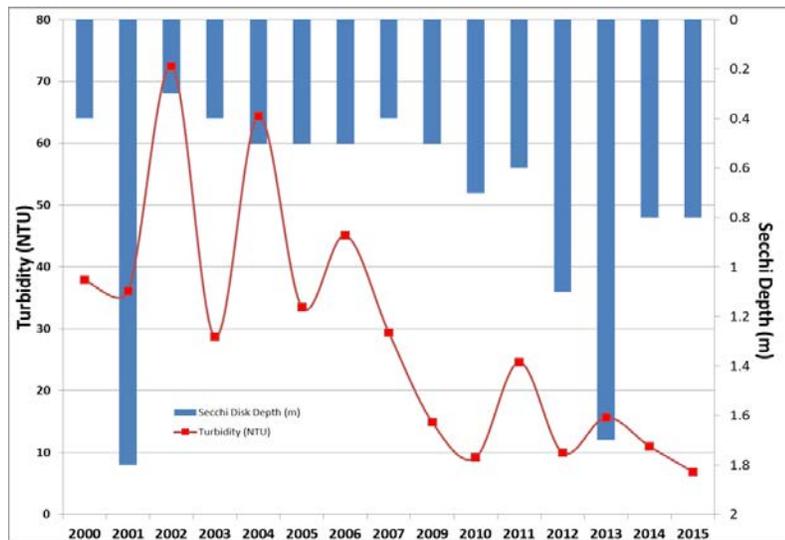
The Apple Jack Marsh is part of the much larger Welsh Lake wetland complex, which helps protect West Okoboji Lake from sediment and nutrient pollution. The marsh filters about 26,000 acres in the Iowa Great Lakes watershed and is critical for habitat and water quality at West Okoboji Lake. Naturally occurring wetlands, like this marsh, eventually fill in over time, and thus, restoration was needed of this critical wetland. A restoration project was designed in 2016 to excavate excess sediment from the basin and reroute incoming water from the watershed to better filter through the wetland before moving downstream to the great lakes. As a part of this project, approximately 4 acres along the edges of the marsh were deepened and a new channel was dug for incoming water. Additionally, a fish barrier was placed at the outlet of the marsh to minimize invasive fish passage and promote vegetation growth. The project cost \$80,815 and will be completed in 2019.

Lost Island Lake (Palo Alto County)

This was an aggressive and comprehensive plan to improve water quality in the > 2,200-acre complex, which includes the 1,162-acre lake. The plan included reducing existing carp numbers, preventing remaining rough fish from entering most spawning areas, conducting beneficial drawdowns on associated wetland areas (780-acre Barringer Slough, 150-acre Blue-wing Marsh) and eliminating rough fish from surrounding wetlands. Resulting germination of aquatic plants and consolidation of bottom sediments restored proper wetland function and improved the water quality at Lost Island Lake.

- The project included an innovative plan to allow for the removal of up to 75% of the existing carp biomass, aggressive stocking of predatory fish and new construction or rehabilitation of four water control structures and five fish barriers throughout the complex.
- Ducks Unlimited designed the effective water control and fish barrier structures. The survey and design work began during summer/fall 2009. Local support regarding the project has been high. Nearly 70 local stakeholders attended a December 2009 public meeting and voiced strong approval for the design work.
- The NRC approved Lake Restoration Funding toward the \$834,263 bid from Landwehr Construction, St. Cloud, MN for the project. The Watershed Improvement Review Board awarded the Palo Alto County Conservation Board \$180,000 to cover part of the cost (two water level control/fish barrier systems); construction began in the fall of

2010 and was completed summer of 2012. The \$1.3 million project has been a partnership between the Iowa Department of Natural Resources, Palo Alto County, Ducks Unlimited, and the Lost Island Protective Association.



Water quality trends in Lost Island Lake. Water transparency (secchi) has increased and turbidity has decreased.

- Various basins within the complex were initially dewatered to eliminate rough fish and create favorable conditions for re-vegetation. All basins are now at full pool providing excellent habitat for wildlife species and much-improved recreational opportunities for lowans.
- Over 1.27 million pounds of common carp and buffalo have been removed from Lost Island Lake since 2008 reducing the common carp density from nearly 400 lbs./acre to 55 lbs./acre. The lake has shown substantial increases in water quality and habitat.

The final infrastructure component of the Lost Island Lake restoration project (at Barrier Marsh) was completed fall 2013. An electric fish barrier was added to the water control structure that will prevent breeding common carp from reaching Blue-wing Marsh wetlands in the Lost Island Lake’s watershed while allowing debris to pass during high water events.

The Barringer Slough and Blue Wing Marsh complexes have been brought back to pool elevation and water quality and habitat have greatly improved. Water quality, aquatic plant, and fisheries surveys and monitoring continued through 2015. A long time area resident reported, “Our family was here all last week, in the lake every day and the water was amazing! Haven't seen such clean water since I came with my grandpa in the 50's! So happy to see the plant growth, too. Catching fish off the dock also. Looking forward to even better fishing in the fall!”



Constructed electric fish barrier in the Lost Island Lake watershed.

Storm Lake (Buena Vista County)

Storm Lake is a shallow natural lake (3rd largest natural lake in Iowa) with a surface acreage of 3,104 acres. Little Storm Lake is a unique project in that it involved the City of Storm Lake, the Storm Lake Preservation Association, the Iowa DNR, and Ducks Unlimited working together to improve water quality in Storm Lake. The little lake encompasses 190 acres. Approximately 70 percent of the watershed flows through Little Storm Lake and into Storm Lake. The project includes a water control structure between Little Storm Lake and Storm Lake and the construction of a pumping station and associated equipment. A serpentine inlet was also created to slow water and capture sediment before entering

Little Storm Lake. Management involves periodic lowering of Little Storm Lake to consolidate bottom sediments, improve aquatic vegetation growth, and eliminate undesirable fish species ultimately improving water quality for waterfowl, other wildlife, and people.



A \$1 million project transformed Little Storm Lake into a working marsh that once again removes sediment and absorbs nutrients from Powell Creek before the water enters the lake.

Buntrock-Salie Photography, taken June 2012

Twelve Mile Lake (Union County)

Twelve Mile Lake is a 595 acre lake with a 17 ft. mean depth and 42 ft. max depth. This multi-use resource (Wildlife Management Area) has a 14,080 acre watershed and 24:1 acre watershed to lake ratio. During its peak in the late 90's Twelve Mile held nearly 30 fishing tournaments per year. By 2004, that number dropped to two. There were problems with common carp, decrease in water quality and drinking water required additional treatment.

Work began in 2005 to address improve water quality. Work included shoreline protection, terraces, buffers and sediment structures placed in the watershed. DNR renovated the fishery and re-stocked the lake. Twelve Mile still has above average water quality compared to other IA lakes. Rooted vegetation has re-established in some areas with a recent trend is stable water quality. Twelve Mile continues to be in the top 1/3 in visitation. Over 50% of the anglers recently fishing 12-Mile are from > 50 miles away (twice what we normally see). Tournaments once again are scheduled throughout the open water season.



New 40-acre wetland structure above 12-Mile Creek Lake.

- A 40-acre wetland was constructed on the north end of 12-Mile Creek Lake in 2014 to retain nutrients and sediment. The project was delayed several times in 2014 due to record summer rainfall in southern Iowa.
- Lake Restoration Program and DNR Wildlife funds were used to help survey the 12-mile Creek Lake watershed and implement three grade control structures in the watershed. The wetland was constructed at a cost of \$447,291 (\$297,291 Lake Restoration / \$75,000 NAWCA / \$75,000 State Duck Stamp).

The wetland will further protect this valuable resource and add additional recreational opportunities for our constituents. Located at the upper end of permanent pool, the wetland is expected to remove and store

sediment/nutrients in runoff and compliments continued work in the watershed, which is important to the goal to improve/maintain water quality for the main lake.

DNR Conservation and Recreation Division (CRD) – Iowa’s Shallow Lakes Management Initiative

The DNR Conservation and Recreation Division manage wetlands in the North-Central part of the state for improved water quality, fishery restoration, and restoration of migratory waterfowl habitat. DNR shallow lakes management is regional in nature and focused on a select group of counties in northwest Iowa. In recent history, most of these lakes have been turbid, algae-dominated systems with little to no vegetation and poor sport fisheries comprised mostly of common carp and black bullheads. Successful restorations of deeper lakes have historically focused on reducing nutrient inputs by repairing the watershed and/or removing phosphorus-laden sediments from the lake. Successful shallow lake management strategies require intensive in-lake management that can immediately flip the basin from the turbid-water state to the clean-water state along with long-term watershed protection efforts that help maintain clean water over time. The goal of these projects is to develop tools (i.e. water level management/carp control) that managers can use to shift and maintain shallow lakes in a clear water state.

The DNR Lake Restoration Program and Wildlife/Fisheries Bureaus in cooperation with partners like Ducks Unlimited have identified a list of shallow lakes prioritized for renovation. These lakes are typically under 4.5 foot mean depth and about 6 to 8 feet deep at their deepest spots.

Since 2006, there have been 37 completed or on-going projects targeted on improving 14,000 wetland acres.

Each initiative involves a large amount of staff time that goes into planning (feasibility studies, surveying, hydraulic modeling, partnering with affected landowners, securing funding, public outreach, designing, and permitting); managing (system specific goals and strategies, water level management and fish barrier maintenance, rotenone applications, monitoring responses; on-going public education and information; and, internal and external research.

Public meetings are used to educate and promote the water quality/system health aspects of these projects. In addition to the benefit of improved water quality brings these projects result in diversified vegetation and insect communities, excellent fish and wildlife habitat for game and non-game species, improved recreational, educational, aesthetic opportunities, improved quality of life and local economic opportunities.

The Lake Restoration Program has been involved with most of these efforts as a cost-share partner (approximately 50% of project costs). This cost-share partnership has also enabled our DNR Wildlife Bureau to be more effective in obtaining North American Wetlands Conservation Act (NAWCA) grants. NAWCA was enacted in 1989 and provides federal cost-share funding to support the North American Waterfowl Management Plan. The goal is to conserve North America's waterfowl, fish and wildlife resources while producing a variety of environmental and economic benefits. Recent projects include:

Lizard Lake:	\$299,939 (\$174,939 LRP / \$124,000 NAWCA)
Pickeral Lake:	\$224,301 (\$60,000 LRP / \$164,300 NAWCA)
Rice Lake:	\$335,000 (\$200,000 LRP / \$135,000 NAWCA)
Silver Lake (Worth):	\$370,709 (\$174,591 LRP / \$196,118 NAWCA)
Virgin Lake:	\$234,596 (\$130,715 LRP / \$103,882 NAWCA)
Spring Run Wetland:	\$394,702 (\$228,927 LRP / \$ 98,756 DU / \$51,311 NAWCA / \$15,000 WQC)
Jensen Slough:	\$125,400 (\$75,240 LRP / \$32,604 DU / \$17,556 NAWCA)
Little Swan Lake:	\$317,937 (\$190,762 LRP / \$79,484 DU / \$41,331 NAWCA / \$15,000 WQC)

Jensen Slough (Emmet County)

Jensen Slough is part of the Ingham and High Lakes Wetland Complex. This wetland has degraded due to the presence of rough fish and stabilized water levels. Using engineering plans completed by Ducks Unlimited, this project involves drawing down the lake, installing a water control structure and fish barrier on the outlet of the lake, and eliminating rough fish from this wetland. Once completed, the fish barrier will minimize movement of rough fish between wetlands in the marsh complex, effectively cutting the fish off from their spawning areas. Additionally, the water control structure will allow managers to manipulate water levels to encourage healthy vegetation growth throughout the marsh complex. The project will restore the 57 acre slough; construction is anticipated during 2017-2019 for a total cost of \$125,400 (\$75,240 LRP / \$32,604 DU / \$17,556 NAWCA).

Little Swan Lake (Dickinson County)

Using DU completed designs; this project included the construction of a new water control structure and invasive fish passage barrier. The fish barrier will help limit movement of rough fish throughout the wetland complex. Additionally, the water control structure will allow managers to manipulate water levels in this shallow lake. Water level variation is integral to good water quality in shallow lakes, as low water levels allow plants to germinate and stabilize lake sediments. This project will improve water quality in Little Swan and improve water quality throughout the entire lake complex. The project will enhance 545 acres of wetland and marsh habitat, and will improve migratory bird habitat. Construction was completed in 2017, and cost \$317,937 (funding was a partnership between the LRP, DU, NAWCA, and a grant from the Dickinson County Water Quality Commission).

Lizard Lake (Pocahontas County)

Prior to restoration Lizard Lake was highly degraded, with some of the worse water quality in the state. Rough fish (buffalo, bullhead and carp) dominated the lake population, which limited aquatic vegetation and the lake experienced frequent and severe algae blooms. The below are pre (2010) and post (2015) photos taken at the Lizard Lake outlet.



During 2008 and 2009, DNR staff had met several times with local partners and stakeholders to discuss management options for Lizard Lake. With strong support from most local constituents, the DNR constructed a new water control structure and fish barrier in 2011. Design of a velocity tube fish barrier was provided by Ducks Unlimited. DNR drained the lake to eliminate high populations of common carp and other problem fish, allow for the consolidation of loose bottom sediments, and promote the growth of aquatic plants. These plants will help keep water in the lake clean by holding down bottom sediments, reducing wave energy, using up nutrients otherwise available for growing algae, and providing habitat for the small invertebrates that eat algae. Aquatic plants will also provide excellent habitat for sport fish and a multitude of game and nongame wildlife species that depend on clean-water lakes for survival.

- Lizard Lake was drawn down during the winter/spring of 2011 as planned. The draw-down went very well and weather conditions allowed vegetation to establish in the exposed lakebed.
- Construction activities on and around Lizard Lake were completed as planned. A new outlet and water control structure was installed to replace the antiquated one. The final elevation of the new structure was discussed with the public prior to construction and a private firm was contracted to survey the outlet structure to assure local citizens that the new outlet structure was installed at the agreed upon elevation.

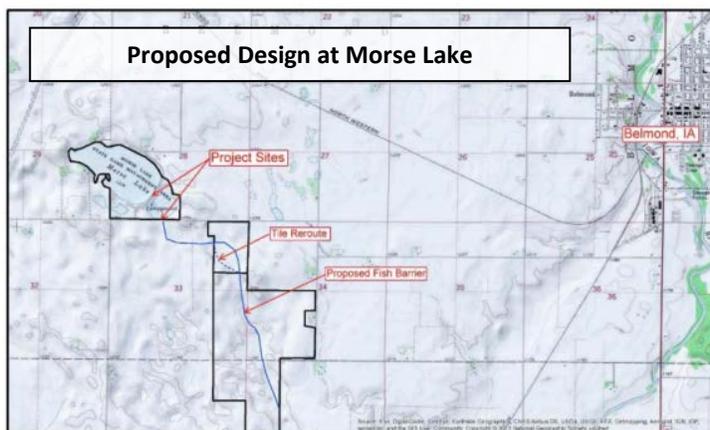
- A velocity tube fish barrier was installed just downstream of the outlet structure at Lizard Lake. This fish barrier is the first of its kind for Iowa. DU's resourceful design allows debris to flow through the structure, but does not allow fish to pass through it because it is installed at a steep enough grade.
- DU is providing funding through the Living Lakes Initiative and a NAWCA grant that will allow the County Conservation Board to purchase 119 acres immediately adjacent to the lake. This acquisition will increase public recreation opportunities as well as help decrease the nutrient and sediment load entering the lake.

DNR stocked yellow perch into the lake in 2012, 2013, 2014, and 2015; and although drought conditions early on may have limited the success of the initial stockings, the DNR has documented survival of yellow perch in the spring of 2015. In addition, the DNR has stocked northern pike in the lake every year since 2013.

In 2017, DNR altered the outlet structure at Lizard Lake to add capacity for managing water levels in the lake. The new structure was completed in the fall of 2017, and allows for water to be held at a higher level (at the ordinary high water line for the lake). This additional capacity may help mitigate vegetation concerns at the lake. Following the completion of the restoration project in 2012 and 2013, cattails established throughout the basin, and removing them from the main area of the lake has been very challenging. Allowing for deeper water will help limit the extent where cattails can establish and survive in the lake. Total cost for this project was \$16,950 (100% LRP).

Morse Lake (Wright County)

Morse Lake, a 103 acre wetland located in Worth County, is plagued by nuisance algae blooms, little to no submerged vegetation, and poor water quality. As a result, this important shallow lake has been underutilized by migratory waterfowl and other species of conservation need. Ducks Unlimited (DU), in partnership with DNR's Living Lakes Initiative are working to improve water quality and migratory waterfowl habitat in this shallow lake. DNR hired DU to design and construct a new outlet structure and invasive fish passage barrier at Morse Lake, planned for construction in 2018 and 2019. The project cost a total of \$214,310 (50% LRP, 50% federal NAWCA grant). Together, project partners held a public meeting in June of 2018 to answer the public's questions and address concerns about the project.



Pickerel Lake (Buena Vista County)

Pickerel Lake, located in extreme NE Buena Vista County, is a 170-acre basin that suffered from the same problems as most other shallow lake basins in the upper Midwest: poor water quality due to an intensively modified watershed, an overabundance of rough fish, and a lack of beneficial aquatic plants. Even with poor water quality, walleyes have surprisingly been able to reproduce in Pickerel Lake. Project partners initiated intensive in-lake management to enhance water quality, fish and wildlife habitat in Pickerel Lake. In addition, they will continue to work long-term throughout the watershed to ensure that soil, fertilizers, and pesticides stay on the uplands. In-lake actions included installing a new water control structure and fish barrier on the lake's outlet and enhancing existing draw down channels in the lake and downstream of the new water control structure. Once this infrastructure was in place, the DNR temporarily drained the lake to allow for the elimination of problem fish, the consolidation of bottom sediments, and the establishment of beneficial aquatic plants.

Pickerel Lake was drained in the late winter/early spring of 2011 and now has gone through its second year of a draw down since the project's inception. No boards were put in the stop log structure to hold water in 2012 and good stands of perennial emergent vegetation were established. Some attempts were made to hold water in Pickerel Lake in 2013, but water levels are quite low. Even with low water levels, 42,000 yellow perch were stocked into Pickerel Lake in July

2013 in the hope to get a start on the fishery going into 2014. DNR fisheries staff has been monitoring water levels at Pickerel Lake in 2014 and have assisted with stocking adult perch and fertilized perch eggs.

Rice Lake (Winnebago County)

Local interest has developed for shallow lakes management on Rice Lake. The fishery has declined and the water quality is currently poor. DNR held public meetings to discuss shallow lakes management with the community. The public meetings held in 2013 had overwhelming support for shallow lakes management.

Taking advantage of a severe drought, the lake was drawn down 4 feet in late 2013 to facilitate renovation of the fishery and promote aquatic vegetation growth. The DNR applied rotenone through the ice during the winter of 2013/2014. Vegetation growth responded well and water levels were brought up slowly starting in the spring of 2014. In addition, fish stockings were initiated in June 2014. Fish stocking included yellow perch ribbons and adults, walleye fry and fingerlings, largemouth bass fingerlings, bluegill fingerlings. The lake remained about 20 inches low going into winter 2014. In 2015 the lake level returned to crest. Fish stockings continued in 2015 with the fishery developing nicely. Water quality remained good in 2015. The aquatic plant community remains relatively stable.



Throughout 2014 and 2015, Ducks Unlimited worked with DNR and local stakeholders to design a new water control structure that would allow DNR managers to preserve this newly restored habitat. Construction of the new structure was completed in early 2016. DNR now has the capabilities to conduct periodic drawdowns to enhance vegetation, as well as barriers to prevent carp from reaching the lake.

Silver Lake (Worth)

DNR conducted shallow lakes restoration work at Silver Lake starting in 2011 in response to poor water quality. The plan was to replace the current water control structure, dig a channel in the lakebed to aid in draining the basin, and renovate the fishery. The benefits will be improved water quality, establishment of an aquatic plant community, and a restored fishery.

Silver Lake water control structure was replaced in 2011/2012 and a drawdown was conducted in 2012 for vegetation establishment. Three feet of stop logs were placed in new structure in August 2012 to begin re-filling the lake. The plant community response has been good. There is a good stand of bulrush establishing with several other species of aquatic plants coming as well.

Fish stockings of yellow perch and bluegill occurred in 2013. However, that fall the DNR started getting reports from the public that carp were in the lake. A DNR electrofishing survey confirmed that carp were present in the system. The Conservation Officer also collected some carp with a mud motor after the electrofishing survey. The only gamefish collected was one perch. A public meeting will be held and explain the situation. The opinion of the DNR is that a 7-inch rain event in late May either topped the barrier or allowed a few fish to jump the barrier and that required a modification of the barrier to address vulnerable spots for fish migration.



The management strategy was to lower the lake after freeze up and try to winterkill the carp. Rotenone was added under the ice to get a complete kill. The lake was then be boarded up to near crest to capture as much as the spring 2014 as possible. Spring 2014 fish stocking included yellow

perch ribbons and adults, largemouth bass fingerlings, and bluegill fingerlings.

In 2015, additional material was added to the water control structure berm. The dirt and rock work was needed to stop water from leaking across the berm during high water events and prevent any possibility of carp entering the lake. The aquatic plant coverage and density declined in 2015, especially the emergent cattail and bulrush growth.

Silver Lake (Palo Alto County)

Silver Lake is a natural shallow lake in Northwest Iowa with a mean depth of 4.3 feet. In August 2013, the lake association met with Fisheries, Wildlife, and Lake Restoration staff to determine if restoring this lake was possible and what it would take to improve water quality at Silver Lake. Together, the local group and DNR invested in a Diagnostic and Feasibility study to better understand how nutrients and sediment were being transported to the lake from the watershed and what could be done to improve water quality in the lake. The study was completed in 2016. The next step for the project is to complete a comprehensive restoration plan for the lake and watershed focused on improving water quality at the lake. Additionally, the local group and other project partners have invested in the future of Silver Lake through the following projects:

- The Silver Lake Protective Association was successful in 2012 at acquiring local grant money to pursue survey, design, and engineering of a fish barrier on the existing outlet structure and determining the feasibility of using the existing drawdown structure. The initial design is complete but implementation is on-hold to examine how the barrier will fit into the overall improvement plan.
- The Iowa Natural Heritage Foundation also acquired a tract of land along the shoreline in 2016 with the long-term goal of enhancing the land to help protect the lake through wetland improvements and native plantings along the shoreline of the lake. DNR acquired this piece of land from INHF in 2017 for the appraised value of \$920,400 (\$300,000 LRP; \$600,000 MFT; \$20,400 REAP Open Spaces).

Virgin Lake (Palo Alto County)

Virgin Lake is a unique 220-acre basin in western Palo Alto County that features a highly diverse shoreline, back bays, peninsulas, and islands. Like other shallow lakes in Iowa and the upper Midwest, it had become unhealthy due to intensive agriculture in its watershed and an overabundance of rough fish. Together, these and other factors had resulted in turbid water in the lake and the subsequent loss of the beneficial aquatic plants needed to sustain clean water and provide habitat for sport fish and aquatic wildlife. Project partners, including DNR and DU improved the lake by ridding the lake of problematic fish species, restoring aquatic plants, and stocking quality game fish. The lake was drained fall 2011 and was drawn down completely during early 2012. Aquatic plants germinated over the entire basin. Water levels recovered very slowly because of drought conditions in 2013.



Approximately 20,000 yellow perch fingerlings from Genoa National Fish Hatchery were stocked in August 2014. Walleye were stocked in Virgin in 2015. Drought conditions in 2012 and 2013 were unexpected and provided an opportunity for both aquatic and terrestrial vegetation to become very thick in the lakebed. This situation should improve with water back in the lake. The lake opened up slightly in 2015.

Table 1. Current shallow lake and wetland projects under contract

Project Name	Project Description	County	LRP Contracted	Fed	Other	Under Contract	Contractor
Shallow Lakes							
Shallow Lakes	Engineering, design, oversight		\$25,378			\$24,378	Ducks Unlimited, Inc.
Wetland/Marsh Restoration							
Black Hawk Lake	Intlet wetland restoration	Sac	\$510,363			\$510,363	Bedrock Gravel, Inc.
Center Lake	Water control structures	Dickinson	\$77,106			\$77,106	Valley Contracting, Inc.
IA Great Lakes	West Okoboji, Apple Jack Marsh	Dickinson	\$37,318			\$37,318	Diamond Concrete & Const.

Table 2. Shallow lake and wetland restoration planning budget

Project Name	County	LRP Obligated	FY19	FY20	FY21	FY22	FY23	Description
Shallow Lakes								
West Swan/High	Emmet	\$275,000	\$175,000	\$100,000				Outlet structure, fish barrier
Morse Lake	Wright	\$289,000		\$175,000	\$114,000			Watershed, lake restoration, outlet structure
Shallow Lakes Projects		\$1,266,000		\$40,000	\$266,000	\$480,000	\$480,000	Elk Lake, West Twin Lake - design and construction
Wetland Restoration								
IA Great Lakes	Dickinson	\$277,000	\$10,000	\$167,000	\$100,000			West Okoboji, Garlock Slough, East Okoboji Wetland

Future Shallow Lake Improvement Projects (within five-year planning effort)

- East Okoboji Lake – Wetland Restoration Project (Dickinson)
- Elm Lake (Wright)
- Elk Lake (Clay)
- Morse Lake (Wright)
- South Twin Lake (Calhoun)
- West Okoboji Lake - Garlock Slough (Dickinson)
- West Twin Lake (Hancock)
- West Swan/High/Ingham Lakes (Emmet)

Future Shallow Lake Improvement Projects (within ten-year planning effort)

- Little Clear Lake (Pocahontas)
- Pleasant/Lilly Lakes (Dickinson)
- Prairie (Dickinson)
- Trumbull/Round/Mud Lakes (Clay)
- Twelve Mile Lake (Emmet)

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BRUCE TRAUTMAN, ACTING DIRECTOR

Badger Creek Lake, Madison County

Background

Badger Creek Lake has great potential to become one of Iowa's premier recreational areas due to its proximity to the Des Moines Metropolitan Area and its size and configuration. However, current water quality at the lake is poor, with heavy siltation and frequent nuisance algae blooms plague this 269 acre lake. These water quality problems have led to several impairments for the primary contact and aquatic life uses at the lake.



The Lake Restoration Program has identified Badger Creek Lake as a priority for future funding and restoration efforts.

Implementation of the comprehensive Watershed Management Plan is currently the most critical step towards sustaining Badger Creek Lake's recreational viability. The management plan establishes water quality goals and builds on the current efforts of project partners and the Total Maximum Daily Load (TMDL) already established for the lake.

Watershed Improvements

In the watershed, project partners are implementing a Section 319 (of the Clean Water Act) Watershed Management Plan to address sediment and phosphorus loading to the lake. Accomplishments to date on private land include three grade stabilization structures, 4.7 acres of filter strips, 35,992 feet of terraces, 8.9 acres of grassed waterways, 439 acres of cover crops, 207 acres of conservation cover (CRP), and 40 acres of pasture/hay land management. Accomplishments on public land in the watershed include three grade stabilization structures, two sediment basins, 257 acres of brush management including removal of Tartarian honeysuckle, and 17 acres of prairie STRIPS.

STRIPS is an integrated prairie and agriculture system that utilizes small strips of prairie (10% of the total field area) at the base of a row-crop agricultural field to reduce nutrient and sediment exports from the field and improve soil health. Prairie strips also provide a number of other ecological benefits.



Additionally, sediment detention structures were built on public land in 2017 to reduce sediment input to the lake and reduce phosphorus loading. These structures eliminate active gully erosion in the watershed and treat surrounding surface water runoff. Three wet ponds and two dry ponds were constructed for a total cost of \$116,392 with a 50/50 cost share between DNR's Watershed Improvement Section (Section 319 funds) and the Lake Restoration Program. Additionally, one of the ponds constructed has the capacity to be used as a fish rearing pond.

Finally, invasive species and woody encroachment removal continues on the Badger Creek Wildlife Management area. Removal of non-native and undesirable plant life near the lake will allow new plants to

be established that will help stabilize the soils in the management area. Curly leaf pondweed, an undesirable aquatic plant was also treated in 2018, resulting in a 70% reduction of the plan in Badger Creek Lake. This reduction provides improved fishing access and may help reduce the severity of summer algal blooms.

Planning for In-Lake Restoration

Preliminary planning for in-lake restoration activities at Badger Creek Lake is also underway. Sedimentation in the arms of the lake has reduced the mean depth of the lake and caused some issues with sediment re-suspension due to wind and wave action. High nutrient concentrations currently fuel intense algae blooms during the summer months. Thus, it is important to address nutrients entering the lake before tacking in-lake restoration work. Specifics of the in-lake work have not been finalized; however, similar projects in Iowa have included shoreline restoration, targeted dredging, fish habitat improvements, and a fishery renovation. Project partners met in the fall of 2017 to discuss next steps for both watershed best management practices and in-lake restoration activities.

IDNR Fisheries staff also installed several cedar tree brush piles over the winter to improve fish habitat and fishing success in 2015. Brush removal began on state land near the lake where two grade stabilization structures are planned. Finally, a comprehensive fishery survey was completed in 2018, yielding good numbers of quality bluegill and crappies.

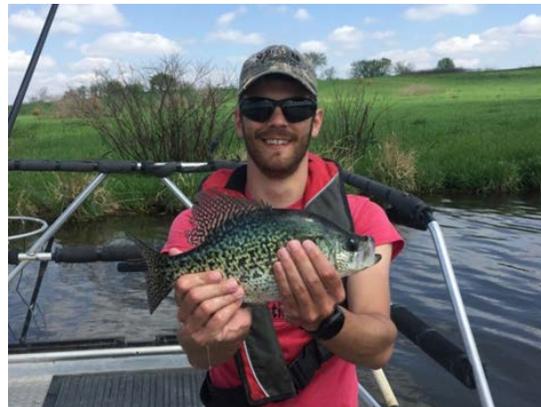
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Cedar trees and brush were installed on ice in the winter of 2015 to provide additional fish habitat within the lake.



Badger Creek Lake has a stable fishery, with good numbers of catchable bluegill and crappie, and a moderate abundance of largemouth bass.

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BRUCE TRAUTMAN, ACTING DIRECTOR

Big Creek Lake, Polk County

Background

Big Creek State Park/Lake is a major recreational destination for the citizens of Iowa. Over 350,000 visitors travel to Big Creek each year and they annually generate over \$19 million in spending. Improving the lake's water quality through watershed improvements is critical to maintaining and even increasing recreational use of the lake.

Big Creek Lake is currently on the impaired waters list for high levels of bacteria. In addition, nutrient and sediment loading to the lake that result in frequent blue-green algae blooms is of concern. A comprehensive review of the watershed indicates that the watershed annually delivers approximately 6,379 tons of sediment and 8,280 pounds of phosphorus to the lake. We must significantly reduce these numbers to preserve the lake's water quality and extend the lifespan of the lake. Additionally, we must also reduce waste products from humans and animals within the watershed that adversely affect water quality. During the past year, Blue-green algae blooms put Big Creek Lake in the news multiple times. Water quality sample data also revealed high *E. coli* levels at the beach.

Projects Completed to Date

- A 2007 development grant provided analyses of the Big Creek watershed. In addition, a 2008 gully analysis and 2009 land use analysis established a better understanding of critical areas in the watershed. Watershed assessment identified several gullies with severe erosion on State property.
- The Iowa IDNR Watershed Improvement Section completed a Water Quality Improvement Plan in September 2010 and in March 2010 contracted with the Iowa Department of Agriculture and Land Stewardship to provide Polk SWCD and Boone SWCD with funding to complete a Watershed Management Plan. The EPA approved the Big Creek Watershed Project for \$292,834 over the five-year duration of the project.
- Extensive water quality sampling was completed in the tributaries and main lake during 2011. Intensive beach monitoring began in 2013 and has continued over the past several years to better understand where beach bacteria are coming from and how to best manage the beach to minimize risk from pathogens.
- Watershed coordinators working on the Big Creek watershed formed a Big Creek Citizens Advisory Committee.
- Education efforts in 2015 included numerous programs, such as a female landowner meeting, public presentations, and the 5th annual Big Creek Appreciation Day. Project coordinators taught over 200 4th graders about soil and water conservation during an outdoor classroom event.
- Sediment basin construction on the two most severely eroded gullies was completed in 2015 and alternative BMP's will be explored for the other gullies that contribute significant sediment to the lake.
- 2016 was a big year for outreach and education. Numerous land owner meetings, press releases, and public presentations were held to garner support for the ongoing watershed project. In addition, a fishing event for youth with special needs was held at the lake (see picture below).





- Best Management Practices (BMPs) have been installed throughout the watershed, including 24.3 acres of grassed waterways, 8 sediment control basins, 13 acres of streamside buffers, 1720 feet of terraces, 1200 acres of cover crops, and 2 grade stabilization structures.
- The U.S. Army Corps of Engineers has been working on replacing the outlet structure over the past two years. Work continues on the project in 2018.
- Goose management continues at the beach to help reduce bacteria levels in the lake.
- In 2017, multiple watershed practices were installed to reduce

nutrient and sediment loading to the lake including 2500 feet of grassed waterways, 18 acres of stream buffers, 5 saturated buffers, and sediment basins.

- The DNR Lake Restoration Program and DNR's watershed Improvement section (319 funds) partnered to construct a large grade stabilization structure on park land. Construction was completed in 2017 at a cost of \$25,275..
- In June 2018, the 8th annual Big Creek Lake Appreciation Day was held with an estimated 300+ attendees.

Planning for Future Work

The long-term goal for Big Creek Lake is to continue to improve water quality through the installation of BMPs in the watershed and improvements in the park. The Lake Restoration Program will continue to partner with other groups to make improvements to the lake and watershed.

As urban development nears the southeast side of the Big Creek Lake watershed, DNR, the Polk SWCD, and the USACE began working with the City of Polk City to develop proactive storm water management practices and implement low impact development strategies as development moves into the watershed to protect Big Creek Lake.

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BRUCE TRAUTMAN, ACTING DIRECTOR

Black Hawk Lake, Sac County

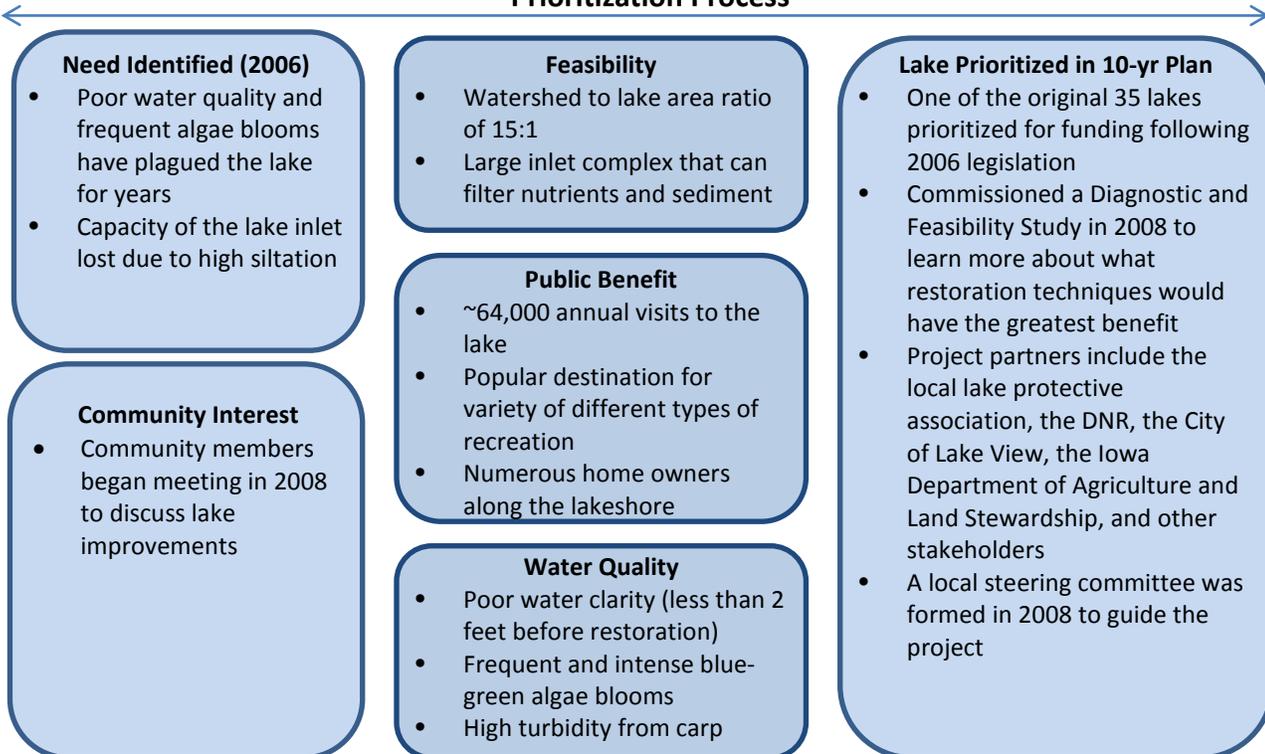


Photo by J. Grant

Lake Restoration at Black Hawk Lake

The DNR Lake Restoration Program (LRP) is a statewide effort focused on Iowa's significant publicly owned lakes (SPOLs). The program's goals are to ensure a cost effective, positive return on investment for the citizens of Iowa; ensure local community commitment to lake and watershed protection; ensure significant improvement in water clarity, safety, and quality of Iowa lakes; provide for a sustainable, healthy, functioning lake system; and result in the removal of the lake from the impaired waters list. Blackhawk Lake is the southern most natural lake in Iowa, located in Sac County, Iowa, near the town of Lake View. This 922-acre lake has a watershed of 14,097 acres and has faced numerous water quality problems that have been documented as early as the 1930s. Restoration at Black Hawk Lake began in 2012 to improve water clarity in the lake, provide a better sport fishery for anglers, and to improve water quality in the lake by reducing nutrient and sediment inputs to the lake.

Prioritization Process



← Planning Process →

Initial Planning:

- A TMDL was completed for the lake in 2008
- Diagnostic and Feasibility Study (DF Study) completed in 2010 and presented to the public and stakeholder groups
- Watershed assessment was completed and an approved plan was funded starting in 2012 to work with local landowners (grant funded by IDALS/319)
- Information from the DF study was used to determine which in-lake and watershed practices would be most beneficial for the lake. The local steering committee led the process for choosing restoration alternatives.
- The DF study recommended a suite of restoration alternatives to help project partners reach their water clarity goals including:
 - Extensive installation of BMPs in the watershed
 - A fishery renovation
 - Dredging the lake inlet to restore function to this important wetland

Final Planning:

- Best Management Practices (BMPs) were planned and continue to be implemented throughout the watershed.
- A public meeting was held in August of 2012 to discuss the plans to renovate the fishery at Black Hawk Lake. While this restoration step was completed before many watershed practices had been installed, historically low water levels allowed DNR to eradicate rough fish from the lake at a considerably lower cost than initially estimated
- Shoreline armoring and the installation of fish barriers were also completed in 2012 since water levels were so low.
- In 2015, an old state-owned spoil site was modified for the inlet dredging project. According to the DF report, increasing the average depth of the inlet from 1.5 ft. to 3 ft. would result in a 65% reduction in the annual phosphorus load delivered to the lake
- Project partners are actively working on locating a spoil site for any future in-lake dredging



Panoramic view of the excavation work at the inlet dredging spoil site completed in 2016. Dredging in the inlet began in 2017 and continued in 2018.

← Implementation Process →

Watershed Implementation (2012-present):

- Project to reduce nutrients from the watershed began in 2012. A project coordinator was hired to facilitate the installation of BMPs in the watershed.
- The City of Lake View also worked to create a wet detention pond on the EVAPCO grounds using funds from the BHLPA and a WQI grant. Additional water quality improvement projects, including many urban conservation practices, have also been installed over the last two years.
- A CREP wetland was installed in the watershed which has reduced nitrogen, sediment, and phosphorus inputs to the lake.
- Numerous streambank stabilization projects have been completed.
- To date, 25% of the 30 year goal for phosphorus reductions has been achieved through the watershed project

In-Lake Implementation (2012-present):

- Capitalizing on the drought and historic low water levels, the fishery was chemically renovated in the fall of 2012 and an estimated 354,000 lbs. of fish were removed through harvest and renovation.
- Following the renovation, water clarity in the lake improved dramatically causing some issues with vegetation
- The sport fishery was re-stocked following the renovation and is currently excellent.
- DNR purchased a vegetation harvester and has worked with the Lake Protective Association to manage vegetation levels for the fishery and recreation
- Hydraulic dredging in the inlet started in 2017. The goal of this project is to re-establish depth and sediment trapping efficiently of the marsh above the lake. Total cost of dredging and containment site construction was \$2,828,533.

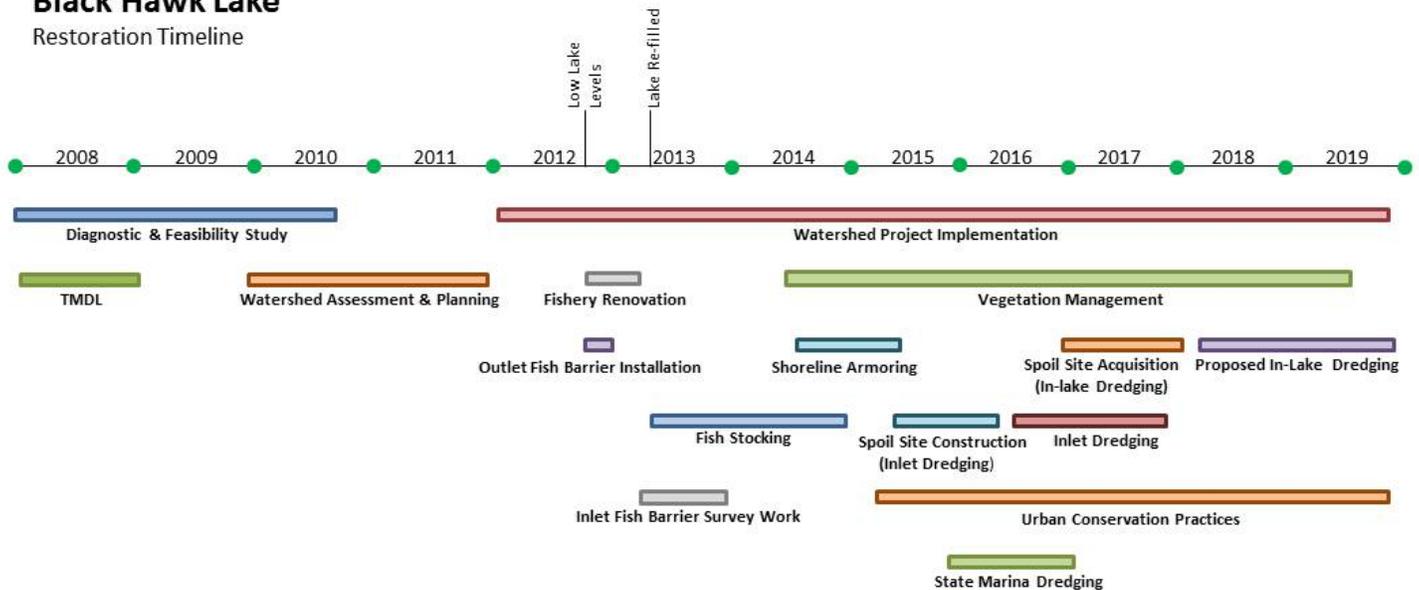
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Black Hawk Lake

Restoration Timeline



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BRUCE TRAUTMAN, ACTING DIRECTOR

Blue Lake, Monona County

Background

Blue Lake is a Missouri River oxbow lake located in Monona County three miles west of Onawa and three miles east of the Missouri River. The lake was an active channel of the Missouri River in 1804 when the Lewis and Clark expedition went through the area. The lake is now part of Lewis and Clark State Park. Current water quality impairments include aesthetically objectionable conditions caused by excessive algae and low water clarity due to algal and non-algal turbidity. These problems combine to limit the recreational use of the lake.

The Lake was chemically renovated and rough fish removed in 2006. 2007 showed considerably better water quality in the lake as rough fish were no longer disturbing bottom sediments and removing rooted aquatic vegetation. However, high water in 2007 and 2008 allowed rough fish to re-enter the lake and caused poor water quality conditions to return.

The Department of Natural Resources (DNR) completed a Water Quality Improvement Plan for Blue Lake in 2008. DNR held public meetings in 2008/2009 to present the lake assessment and restoration process and develop a local technical advisory team of conservation agencies and local stakeholders to help guide the project. Objectives of the project are to reduce nutrient and sediment inputs from the watershed, reduce re-suspension/recycling of in-lake nutrient and sediments, eliminate rough fish introductions and evaluate lake and water table interactions.

A public meeting was held in March of 2011 to discuss potential restoration efforts with the community. Lake Restoration contracted with MSA Professional Services to conduct a diagnostic-feasibility study on the lake. Extensive data collection was conducted by local DNR staff throughout 2010. The final report from MSA on the diagnostic-feasibility study was completed in November of 2011. The report proposed that construction of a storm water settling basin, reconstructing water control structures to minimize common carp introductions, dredging and removal of common carp will achieve desired water quality goals for the lake.



Completed construction on Nebowa Bay in Fall 2016

The report proposed that construction of a storm water settling basin, reconstructing water control structures to minimize common carp introductions, dredging and removal of common carp will achieve desired water quality goals for the lake.

A Technical Advisory Team meeting continued to work in 2013 to discuss the report and develop a restoration and implementation plan.

Recent Restoration Activities

The last three years have been busy construction years for the lake. The MSA diagnostic-feasibility study called for four major restoration activities to achieve water quality goals.

1. Construct fish barriers around the lake to exclude rough fish from the lake
2. Reduce nutrients entering the lake from the watershed by installing ponds in the watershed.
3. Selectively dredge areas of the lake to minimize sediment and nutrient re-suspension in the water column and reduce impacts of aquatic vegetation.
4. Chemically renovate the fishery to remove the rough fish population from the lake.



The lake aeration system was upgraded in 2013 with a new motor and blower to prevent fish winterkills. In 2015, a variety of fish barriers were installed around the lake to minimize the ability for rough fish, mainly carp, to enter the lake. Blue Lake is the first Iowa lake to utilize rotating screen fish barriers (as pictured) that allow managers to more easily clean the barriers and minimize water backups from debris.

Construction was also started on renovating and improving Nebowa Bay in 2015. The creation of ponds within the watershed was specifically called for in the diagnostic and feasibility plan, and the rehabilitation of the bay, including the mechanical removal of sediments, will allow the bay to act as a natural filter for the watershed. Construction of the bay was delayed considerably in 2015 due to very high water and heavy rains

throughout the construction period. High water continued in the spring of 2016, however, construction was able to be completed in the fall of 2016. Installation of the 3 fish barriers in the lake and the excavation of Nebowa Bay/Church Camp Slough cost a total of \$349,505.00. The enhancement of the bay will also help limit the interaction of the McCandless-Cleghorn ditch and the lake during high water events.

Project stakeholders decided the next step in the restoration process was to update the well/pump system that helps keep water levels stable in Blue Lake. Aging infrastructure and a broken pipe limited the DNR's ability to manage water levels at the lake. As a result, during years of drought, water levels dropped significantly. Prior to pursuing a dredging plan for the lake, it is important to be able to maintain an adequate pool level for the lake. Thus, design was completed to update the pump system by replacing the outdated pipe to the lake and increasing the pumping capacity of the system to better maintain water levels during low water years. A new pipe was placed in 2018 cost of \$327,948. Additionally, the pump was tested to verify added capacity of the system with the new pipe in place.

Additionally, project partners worked to stabilize critically eroding shoreline and re-vamp the beach in 2017. During the summer of 2017, the KOA campground armored part of the shoreline on their property along the Eastern shore of the lake. DNR also armored 1,795 feet of public shoreline along the western shore and replaced the seawall at the beach. The DNR project was completed in 2018 and cost \$168k.



Future Restoration Work

A public meeting was held in the summer of 2016 to discuss next steps for the project including dredging of the main lake and a potential fishery renovation. Additionally, the group discussed the potential for additional watershed work. DNR re-mapped the lake bottom in the fall of 2016 in preparation for future dredging operations. Currently, the DNR is working to finalize a dredge plan for the lake and acquire a spoil site for dredge materials based on the dredge plan.

To better understand the rough fish population in the lake, a comprehensive rough fish study was initiated in 2017 by marking and re-capturing fish within the lake to better understand the population density of undesirable fish. Because Blue Lake is a shallow oxbow, excessive vegetation is a concern if the entire rough fish population is eliminated from the lake. This population study will help stakeholders determine the best path forward for fish management within the lake, either by aggressive commercial removal of unwanted fish or by eradication. Preliminary results show high abundances of carp, but low numbers of buffalo. The study is expected to continue for the next two years.

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BRUCE TRAUTMAN, ACTING DIRECTOR

Carter Lake, Pottawattamie County



Background

Carter Lake is a natural lake that is uniquely located in both Iowa and Nebraska. Carter Lake is an old oxbow of the Missouri River that was isolated from the river main channel in 1877. The lake is approximately 300 surface acres at conservation pool elevation 970.0 feet, with a watershed area of 2,675 acres (watershed area to lake area ratio of 8/1). The lake is approximately 75% in Nebraska and 25% in Iowa. Park areas in Nebraska and the City of Carter Lake in Iowa dominate land use adjacent to the lake. Problems at the lake had centered on poor water quality, chronic low water levels and nuisance algae bloom. Past impairments included nutrients/algae, indicator bacteria, and fish contaminants (PCBs).

Restoration Work

Carter Lake is a highly productive lake with a history of poor water clarity, high nutrient concentrations, frequent algal blooms, and periodically high bacteria. Given the nature of the problems at Carter Lake, corrective measures focused on the reduction of phosphorus, which is the driving force behind algal production. The goals for this project pertained to protecting aquatic life and public uses of the lake such as recreation, fish consumption, and aesthetics.

- Restoration of Carter Lake involved the cooperation of Iowa, Nebraska, and the cities of Omaha and Carter Lake. A local Iowa group, the Carter Lake Preservation Society (CLPS), was very active in moving this project forward. In 2006, the cities of Carter Lake, Iowa and Omaha, Nebraska, requested assistance from environmental agencies in addressing water quality problems at Carter Lake. The Carter Lake Environmental Assessment and Rehabilitation (CLEAR) Council, with assistance from numerous local and state agencies, developed a conceptual plan to address water quality concerns. The community led steering committee finalized the Carter Lake Water Quality Management Plan in the spring of 2008.
- Fall 2008, the Metro Area Planning Agency (MAPA), with support of project partners, selected Tetra Tech, Inc. for the purpose of preliminary design and engineering of critical components of the Water Quality Management Plan for Carter Lake. Their work focused on the restoration alternatives of water-budget/seepage management, dredging, storm water, and in-lake alum treatment. By winter of 2009 project partners had enough information on probable cost, effectiveness and permitting issues to determine how to best move forward with implementation.
- Metropolitan Area Planning Agency (MAPA) hired a project coordinator to work with both the local Watershed Council and agencies. One of their primary responsibilities was to finalize plans on a first group of watershed improvement projects and have these projects ready to bid for final design/construction by fall of 2010.

Project funding partners

Iowa Department of Natural Resources – Lake Restoration Program	\$2,494,624
Iowa Department of Natural Resources – Section 319	\$381,744
Iowa Water Quality Improvement Review Board	\$175,000
Nebraska Department of Environmental Quality - Section 319	\$1,120,000
Nebraska Game and Parks Commission	\$2,105,837
Nebraska Environmental Trust	\$400,000
City of Omaha	\$500,000
City of Carter Lake (in-kind)	\$250,000

- Project partners made significant progress at Carter Lake in 2010 with a spring alum treatment followed up by a complete fish renovation in the fall. Nebraska and Iowa, following the community accepted restoration plan guidelines established a no-wake zone on 100 acres of the lake in 2010 to lessen the impacts of recreational boating.
- Clear water conditions have persisted post restoration allowing aquatic plants to fill a significant portion of the water column. Lifelong residents of Carter Lake commented that they had never seen the bottom the Carter Lake before. Due to the clarity and resulting response in plant growth a plan for aquatic plants was drafted in consultation with the local communities to establish guidelines for future plant management efforts.
- As part of the vegetation management plan the Technical Advisory Team authorized the chemical (herbicide) treatment of vegetation around public access points, canals, private docks, and ski club area. State agencies treated the public access areas in 2014. Local homeowners contracted a private aquatic pesticide applicator to treat vegetation around privately owned docks, canals, and ski club area. The TAT discussed various options, but ultimately decided to chemically treat a limited number of acres of open water areas to open up boating lanes. A permit to apply aquatic herbicide and a contractor were secured by the City of Carter Lake to chemically treat 100 acres of open water area with the herbicide “Reward” in 2014 and 2015.
- The lakes re-charge system was completed and activated in 2012. This system provides well water to Carter Lake, which helps maintain water levels during dry summer conditions and allows for better recreational use of the lake.
- To address aquatic plant management needs at Carter Lake, Iowa and Nebraska purchased an aquatic vegetation harvester (picture at bottom right); operation and maintenance is provided by the cities of Carter Lake and Omaha.



In 2018, the DNR partnered with the City of Carter Lake to repair some eroding shoreline along Wavecrest Park, 8th and Avenue R Park, and the Carter Lake Public Access Area. DNR supplied the rip rap for the project (valued at \$40,000) and the City installed the rock to protect the shoreline.

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BRUCE TRAUTMAN, ACTING DIRECTOR

Central Park Lake, Jones County



Lake Restoration at Central Park Lake

Central Park Lake is a 24 acre lake in Jones County, Iowa, located in a 365 acre watershed (watershed to lake area ratio of 15:1). The DNR identified the lake as one in need of restoration due to high siltation and poor water quality. Together, the Jones County Conservation Board (JCCB) and Department of Natural Resources (DNR) have worked together to improve the watershed by installing and managing several ponds in the watershed, upgrading septic systems within the park, and working to improve the lake through extensive restoration activities. The lake is currently listed as impaired due to a high pH, usually associated with excessive algae blooms. Central Park Lake is a heavily used local resource. According to the 2014 CARD survey, the park sees about 34,000 visitors annually and is popular destination for fishing, camping, and wildlife watching, and picnicking.

The JCCB conducted a watershed assessment and drafted an extensive plan to improve water quality at the lake in 2012. Together, the community, JCCB, and DNR worked to begin implementing the plan. Restoration efforts began in conjunction with other park efforts, including the construction of cabins, new playground area, an updated beach, and construction of an ADA fishing pier. A local steering committee was formed to help inform restoration activities and define goals for the project. Active partners include the JCCB, DNR, the Twin River Pheasants Forever Chapter, Watershed Improvement Review Board, and the DNR Fish Habitat Program.

Watershed Restoration Activities

Watershed improvements were completed around the park between 2012 and 2016. One of the biggest changes in the watershed that helped protect the lake was the acquisition of the Pearson Tract (77 acres of land located directly above the lake that was converted to CRP) and creation of a large sediment pond that will both prevent nutrients and sediment from entering Central Park Lake and act as an additional opportunity for recreation at the park. The pond was completed in 2015 and has been a great addition to the park. The Lake Restoration Program allocated \$56,122 for the creation of the pond. A total of two ponds and multiple wetlands have been constructed in the park improve water quality.



In addition to the Pearson tract pond, DNR and the JCCB partnered to install a new septic system in the park. Prior to the updated installation, sewage from the park could enter the lake

during periods of very high water, contributing to water quality problems in the lake. The updated septic system moves all treatment out of the watershed and will help protect water quality and human health for years to come.

The total cost for all watershed improvements was \$319,324, with the Lake Restoration program providing a total of \$56,122 (18%) and the remainder of funds being provided by local grants or county funds.

DNR Fisheries staff worked throughout the spring of 2016 to stock the new 6.75 acre pond adjacent to the lake. In the fall of 2016, a public meeting was held to discuss the in-lake improvements and other activities at the park. Following the public meeting, the lake was drawn down to allow for initial surveys to be completed in advance of in-lake construction. Construction of the new boat ramp, dredging, shoreline stabilization, and additional amenities will take place in 2017 and 2018.



2017/2018 Activities

In-lake restoration activities began in 2017 with the lake drawn down to remove rough fish from the system and prepare the lake bottom for mechanical dredging. In-lake work was completed in 2017 and 2018 and included mechanical removal of approximately 130,000 cubic yards of sediment from the lake and hard armoring approximately 7300 feet of shoreline to prevent erosion from wind and waves. Additionally, fish habitat was installed throughout the lake bottom to provide quality fishing and spawning areas throughout the lake following restoration. Finally, the spillway for the lake was updated and modified through this project. The updated infrastructure will ensure that generations to come can enjoy this local resource. Total cost for this phase of the project is \$1,306,565, with the LRP's cost share at \$1,088,250 (83%). Construction for this phase of the project is currently underway and is expected to be completed by the spring of 2019.

The final phase of the project, also completed in 2018, worked to improve recreational opportunities at Central Park Lake. JCCB and DNR partnered to rebuild the boat ramp and parking lot on the north side of the lake, construct a new fishing access pier and parking lot that will be handicapped accessible, and rebuild the beach and replace road culverts near the beach that currently drain on the beach. The re-designed beach will be more attractive and user-friendly for park-goers and deter geese from the beach area and reducing runoff from the road and campground to the beach. As a result, the newer beach should experience fewer problems with high bacteria levels. The total cost for this phase of the project is \$982,702 with the Lake Restoration Program's cost share at \$109,120 (11%). A grand re-opening of the park is slated for the spring of 2019.



Above: The newly installed accessible fishing pier and walkways.

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BRUCE TRAUTMAN, ACTING DIRECTOR

Clear Lake, Cerro Gordo County

Background

Clear Lake is a 3,625-acre natural lake in Northwest Iowa. It has a watershed to lake area ratio of 2.3/1. In 2001, ISU completed a lake and watershed diagnostic/feasibility study. They presented a number of lake restoration options; specifically dredging of Little Clear Lake and restoration of Ventura Marsh.



- The DNR and local sponsors purchased a 208-acre dredge spoil site with approximately \$660,000 of Lake Restoration Program (LRP) funds and an additional \$660,000 local match. Contractors completed the \$886,000 containment site in spring of 2008. The estimated cost of dredging was \$8 million dollars (2.3 million cubic yards at \$3.50/cu. yd.). DNR had a January 2008 bid letting for the hydraulic dredging of the Little Lake portion of Clear Lake and awarded the low bidder, L.W. Mattensen of Burlington, Iowa, the \$6,453,000 contract (75% LRP and 25% local-match funding).
- Dredging commenced in late spring of 2008 and completed by late summer of 2009. Contractors removed a total of 2.4 million cubic yards.
- In 2013/2014, the DNR lowered the dikes on the dredge containment site. Trees were also removed and pushed into piles. The Wildlife staff burned the trees during the following winter. Long-term plan for the containment site is management as a wildlife area in native prairie.
- 1,500 feet of publically owned shoreline was protected with native stone rip rap in 2011. This work took place on the ice along the shorelines of McIntosh Woods State Park. One hundred twenty five feet of this project was along the State Dock area on North Shore Drive. An additional 750 feet of native riprap was completed for the State Dock area in 2013.
- The recently dredged west end of Clear Lake has continued to show improved water quality when compared to pre-dredged conditions. The recent monitoring data indicates that water clarity is returning to what was seen in the mid 1970's. The west-end sampling site has shown better water quality than the other two sites on Clear Lake now that dredging has been completed. Prior to dredging, the west end site showed poorer water quality than the other two sites. Overall, the water quality of Clear Lake has shown substantial improvement over the past ten years that watershed and lake improvements have been implemented.
- Construction was completed on a Section 206 U.S. Army Corps of Engineers Aquatic Ecosystem Restoration Project for Ventura Marsh, which flows into the west end of Clear Lake. In its past degraded state, the marsh served as a major source of nutrients contributing to water quality problems in the lake and was a major reproduction area for common carp. The Army Corp of Engineers (COE) budgeted \$3.2 million for the Ventura Marsh restoration project. Ventura Marsh state land and in-kind credits of \$1,331,200 and approximately \$884,062 in LRP dollars funded the DNR's portion of the marsh restoration project. The goal was to work with the COE to restore Ventura Marsh by gaining water level management capabilities, allowing for better control of rough fish and revegetating of the marsh.

- The old stop log structure was removed and replaced with a new structure in 2011. The stop log structure will be used to control water levels from the marsh crest elevation down to Clear Lake’s water level. For water level manipulations below Clear Lake’s level, the pumping station will need to be used. A flow path was dredged in 2011 to allow the deeper portions of the marsh basin to drain towards the pumping station. This will allow nearly a complete drawdown.
- In 2013 /2014, DNR constructed of a catch basin and a water flow path in the southwest corner of the marsh. This feature will treat water entering the marsh from two large tile sources and allow for longer retention of water entering the marsh before it gets to Clear Lake. The implemented project established two sediment basins to treat major tile inlets in the southwest corner of Ventura Marsh.
- Rotenone was applied to the dredged trench to kill the carp in the marsh. The treatment was effective in the area of the Ventura Grade, but live carp are likely still present in other portions of the basin and watershed for the marsh. Stop logs were removed and Clear Lake and water was allowed to flow west into Ventura Marsh. The water level stabilized with the current lake level, which gave adequate levels in the marsh to allow for waterfowl hunting opportunities.

In 2015 the DNR completed work on the Ventura grade project. This work included placing a concrete pad on top of pump station outlet / carp capture structure (jetty) and adding a chain link fence panel to the bottom railing section of pump outlet to prevent carp from jumping onto the shoreline area. In addition, DNR installed metal grating over the area between the Ventura Marsh stop logs and the County Road S14 culvert to prevent rough fish transport from Ventura Marsh to Clear Lake.



The total cost of all above activities was approximately \$17.0 million. Of this amount, local and federal match represented 40% of the funds necessary to complete these restoration efforts. Restoration efforts and improvements in water quality have the potential to double the annual economic return that Clear Lake generates to the local economy. The Center for Agriculture and Rural Development at ISU has projected a significant benefit to cost ratio from lake and watershed restoration at Clear Lake. Restoration of Ventura Marsh will improve the water quality of Clear Lake and help keep the carp population under control. Local groups and DNR Section 319 continue to pursue watershed projects that have the potential to decrease sediment delivery to Clear Lake.

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Diamond Lake, Poweshiek County



Background

Diamond Lake Park is a 660 acre county park with a 98 acre lake that is managed by the Poweshiek County Conservation Board. The fishery is managed by the DNR. Diamond Lake Park is located near the city of Montezuma and features fishing, camping and day use activities. The Poweshiek CCB and the DNR have a history of working together to maintain water quality and provide a fishery at Diamond Lake.

The DNR entered into an agreement to reimburse the Poweshiek CCB for repair and modification of the existing spillway at the lake outlet. The spillway that had been in place was in need of repair, and upgrading the lake's infrastructure would help preserve this important resource for years to come. By working with the Poweshiek CCB, project partners were able to modify the spillway with a 10-foot drop, which will eliminate migration of rough fish (e.g. carp) from Moon Creek into the lake. Modification of the spillway with an effective fish barrier is an essential step in the long term restoration plan for Diamond Lake. Construction took place in 2015 (see pictures above) and was the first step in the in-lake portion of this restoration project.

This will benefit both the DNR and the CCB in terms of future fish management and negative effect of rough fish on water quality. The spillway modification was completed in 2015 with costs totaling \$160,000. DNR Lake Restoration contributed 80% of the funds for the project, with the county conservation board contributing 20% of the funds needed to complete the spillway modification.

Future Restoration Activities

Modifying the spillway to prevent the encroachment of rough fish was a critical step to any future restoration efforts. Additional work will likely include a fishery renovation to remove rough fish already living in the lake. Project partners formed a technical advisory team and met in the fall of 2017 to begin forming a long-term restoration and management plan for the lake.

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Easter Lake, Polk County



Background

The DNR Lake Restoration Program (LRP) is a statewide effort focused on Iowa's significant publicly owned lakes (SPOLs). The program's goals are to ensure a cost effective, positive return on investment for the citizens of Iowa; ensure local community commitment to lake and watershed protection; ensure significant improvement in water clarity, safety, and quality of Iowa lakes; provide for a sustainable, healthy, functioning lake system; and result in the removal of the lake from the impaired waters list.

Easter Lake is a 178-acre constructed lake with a watershed to lake area ratio of 36 to 1. Constructed in 1967, Easter Lake began as a lake in an agriculture/suburban watershed that over the years has shifted to a highly developed urban area. The lake currently is estimated to have over 95,000 visits annually. Construction activities and storm water issues have contributed greatly to more than a 20% reduction in lake volume. Non-algal turbidity continues to cause the majority of water quality problems, resulting in very low water clarity observed throughout the year at this lake. The Polk County Conservation Board owns and manages this area, and they continue to work in partnership with DNR and other stakeholders to accomplish lake and watershed improvements.

A technical advisory team was formed for the project and met for the first time in 2008 to discuss the future of Easter Lake and how partners may work together to improve water quality. DNR hired Iowa State University in 2009/2010 to complete a diagnostic and feasibility study on the lake and watershed. The study helped project partners identify problems in the watershed and develop a suite of restoration alternatives that would help improve water quality at Easter Lake. Following the completion of the study, EA Engineering, Inc. was hired to develop a comprehensive restoration plan for the lake and watershed with project partners. All of these efforts culminated with a memorandum of understanding signed by a number of stakeholder groups committed to improving water quality at Easter Lake.

Watershed Restoration Activities

Project partners began funding a watershed project at Easter Lake in 2012. The Iowa Department of Natural Resources Watershed Improvement Section (Federal Section 319 funds) and the Iowa Department of Agriculture and Land Stewardship jointly hired a watershed coordinator in 2012 to work with homeowners and businesses throughout the watershed to implement best management practices aimed at reducing storm water pollution to the lake. To date, over 103 rainscaping practices have been installed, including rain gardens, permeable paver driveways, bioswales, and rain barrels. Practices installed to date have helped manage and treat over 6 million gallons of water that travel to the lake annually. On average, storm water flows have been reduced by 27% in neighborhoods where many practices have been installed.



The DNR has also partnered with the City of Des Moines to address stream bank erosion in Yeader Creek, the primary tributary to Easter Lake. A number of priority stream segments were identified for restoration in the restoration plan for Easter Lake. To date, two priority segments have been restored to minimize

sediment pollution to the lake from stream bed and bank erosion. Before and after photos are pictured above.

In 2017, the City of Des Moines and DNR’s Lake Restoration Program and Watershed Improvement Section partnered to complete engineering designs for the remaining priority stream segments on Yeader Creek, as well design out a number of other watershed practices. Project partners will then work to restore these sites to reduce nutrient and sediment inputs to the lake and manage storm water.



In addition to watershed practices on Yeader Creek and surrounding neighborhoods, project partners have worked to install a number of wetlands and ponds around the lake to treat water draining to the lake. A large sediment basin was added to the west side of the the historic covered bridge adjacent to the lake. The new basin is expected to reduce 214 tons of sediment to Easter Lake annually. In 2017, project partners also added a wetland near the dam on the northeast side of the lake to intercept runoff from nearby housing developments. This wetland (pictured above) will help capture sediment for years to come.

Watershed Project Costs to Date:

	2014-2016 Funding Need	2014-2016 (319)	2014-2016 (LRP)	2014-2016 (DSM)	2014-2016 (PCCB)	2014-2016 (IDALS)	2014-2016 Other
Watershed Phase 1							
Coordinator/I&E/Monitoring	\$318,500	\$318,500					
YC-8 and YC-14	\$1,492,332	\$373,083	\$373,083	\$746,166	Support to project for office space and vehicle provided by NRCS		
WS-15 (Ewing Park)	\$165,668	\$41,417	\$41,417	\$82,834			
Woodland Restoration	\$195,300	\$45,000					\$150,300
Urban BMPs/Rainscaping	\$399,150	\$99,788		\$99,788	\$99,788		\$99,788
Urban BMPs/Rainscaping	\$135,133					\$101,350	\$33,783
Sediment Basin	\$252,000	\$100,000			\$152,000		
Grade Stabilization Structure	\$22,000	\$16,500		\$4,400			\$1,100
Watershed Phase 1 - Total	\$2,980,083	\$994,288	\$414,500	\$933,188	\$251,788	\$101,350	\$284,971

Several additional watershed practices were initiated in 2018, with proposed construction in 2019. The City of Des Moines, in partnership with the Section 319 program and the LRP initiated engineering design for additional storm water practices along SE 14th Street to reduce runoff to Yeader Creek. Project partners also completed engineering design for rehabilitating the Three Lakes Estates ponds and restoring five additional sites along Yeader Creek. Finally, a fishery renovation was completed in late 2018 in part of the watershed to remove unwanted fish species from the watershed as a part of the lake’s restoration.

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Lake Restoration Activities

A variety of restoration strategies have been employed in the lake to reclaim volume lost to sedimentation and improve the lake for years to come. Snyder and Associates was hired to develop a dredge plan for Easter Lake and help project partners design and build practices to protect the lake and improve recreational opportunities. First, the outlet structure of the lake was modified through the addition of invasive fish barriers that will prevent rough fish (like carp and buffalo) from entering the lake during periods of high water. Rough fish have a negative impact on water quality by removing vegetation from the lake bed and re-suspending nutrient-rich bottom sediments. In addition to the fish barriers, a fish rearing pond was built on the east side of the lake. This pond will allow managers to grow juvenile fish on site before releasing them into the lake for anglers.



The Polk County Conservation Board (PCCB) and DNR worked to develop a dredge plan and locate an appropriate spoil containment site for placement of dredging materials prior to developing a full dredging plan for the lake. PCCB acquired an old gravel pit to use as a spoil site a couple miles away from the lake across the Des Moines River. The total goal for dredging was to remove approximately 590,000 cubic yards of soft sediment. Dredge America was hired to hydraulically remove ~300,000 cubic yards of sediment from the lake and pump it to the containment site in 2016.

The lake was then drawdown in the spring of 2017 to prepare the basin for shoreline work, construction of the wetland on the north east side of the lake, and to upgrade the outlet structure for the lake. Additionally, PCCB is constructing a multi-use recreational trail around the lake, and needed the lake drawn down to complete parts of the trail on the dam face.

In May of 2017, additional dredging was completed in the bay near shelter 4 of Easter Lake Park to increase depth (see photo top right). A total of 4,000 cubic yards was removed from the bay. Fish habitat structures will be installed in 2018 and additional work will be completed to stabilize shorelines in the bay. Lastly, railing heights on the pier overlooking the bay will be adjusted to improve accessibility.

Phase One of In-Lake Restoration Cost Breakdown:

Lake Restoration Phase 1	2015 - 2017 Funding Need	2015 - 2017 (319)	2015 - 2017 (LRP)	2015 - 2017 (DSM)	2015 - 2017 (PCCB)	2015 - 2017 (IDALS)	2015 - 2017 Other
Containment site purchase	\$279,422		\$92,209		\$187,213		
Engineering (Snyder & Assoc.)	\$771,000		\$462,600		\$308,400		
Engineering Admin./Oversight - consultant	\$250,453		\$187,840		\$62,613		
1A- Fish Rearing Pond and Spillway Modification	\$475,428		\$356,571		\$118,857		
1B - Sedimentation Basins and Drainageway	\$514,735		\$386,051		\$128,684		
2- Dredging Hydraulic	\$3,253,068		\$2,439,801		\$813,267		
Lake Restoration Phase 1 - Total	\$5,544,106		\$3,925,072		\$1,619,034		

The second phase of in-lake was designed in the fall of 2017 with the goal of removing an additional 271,000 cubic yards of sediment. An extensive mechanical dredging project was completed in 2018 to remove excess sediment from bays in the lake and shape the shoreline to create additional park greenspace, fishing jetties, and habitat. An in-lake silt dike on the western (Yeader Creek) arm of the lake was constructed below the newly added trail bridge that will reduce nutrient and sediment inputs to the lake and improve overall water clarity. Extensive shoreline armoring was also completed to protect the shores

from shoreline erosion. Total costs for this phase were \$3,873,827 (\$968,456 PCCB; \$2,905,827 LRP). The PCCB also invested grant monies to install fish habitat throughout the lake and reconstruct the main boat ramp at the park.

Future Restoration Efforts

Future efforts in the watershed will continue, with the goal of further reducing nutrient and sediment loads to the lake. DNR will continue to partner with the City of Des Moines to restore sections of Yeader Creek. The estimated cost for restoring remaining Yeader Creek sites and rehabilitating ponds in several housing developments within the watershed is \$3.3 million. Additionally, the watershed project will continue to make progress in residential, commercial, and industrial developments within the watershed. Total project costs are estimated between \$15-18 million between all of the project partners.

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Five Island Lake, Palo Alto County

Background

Five Island Lake is a 973-acre natural lake located on the north side of the town of Emmetsburg, Iowa in Palo Alto County. In 1989, following years of diminished recreational opportunities and poor water quality conditions due to low lake levels, a group of concerned citizens formed the Five Island Lake Board. They established two major goals for the project: Increase the lake water depth; and, improve the lake water quality. Goals of the 1994 diagnostic feasibility study included goals for dredging and shoreline stabilization. From the early 90's, the Lake Board has stabilized almost 10.5 miles of lake shoreline, dredged over 7 million cubic yards of silt, and has worked in the watershed to reduce nutrients and sediment from entering the lake. Funding for this project since 2000 has required a combination of 1:1 state and local matching grants. Dredging concluded in 2015 and together DNR and the City of Emmetsburg began moving forward with a new plan to improve water quality in the lake.

Year	Cubic Yards
1991-1993	1,390,000
1994-1999	3,028,000
2002-2011	1,926,296
2013	205,221
2014	250,968
2015	208,912
Total	7,009,397

Planning for Success



The City of Emmetsburg hosted an informational meeting in winter 2016 to explore the need for additional restoration work at Five Island Lake. While dredging improved the overall depth of the lake, water clarity only improved marginally, thus there is a need to explore other alternatives at the lake. The City, in partnership with the DNR, issued a request for proposals in the summer of 2016 to complete a lake and watershed assessment and examine the current outlet structure at the lake. FYRA Engineering was hired to complete a two year study that culminated with a suite of restoration alternatives for project partners to consider, as well as a watershed assessment that will allow partners to better address watershed issues. Preliminary watershed modeling results show

that about half of the total phosphorus load to the lake is coming from the watershed, and about half of the annual load is recycled internally, thus focusing on both watershed and in-lake restoration strategies will be important moving forward. The long-term goal for the project is to find alternatives for the lake that will result in better water quality while minimizing the impact of excessive vegetative growth in the lake. As a part of the study, FYRA will regularly be meeting with the community to ensure that the needs and concerns of the community are being addressed throughout the next phase of this project.

In 2018, the DNR also initiated a study to better understand how rough fish may be impacting water quality at Five Island Lake. As a part of this project, carp and buffalo fish populations are tagged and monitored annually to determine the total number of fish in the lake and their relative biomasses. The long term goal for this project is to establish targets for removal that will help improve water quality. Rough fish, such as carp and buffalo can have a negative impact on water quality as they shift the plankton community in the lake and stir up bottom sediments.

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Green Valley Lake, Union County



Background

Green Valley Lake is a 390 acre lake constructed in 1950. It has a watershed to lake ratio of 11:1. The DNR implemented a limited lake restoration project through the State and U.S. EPA's Clean Lakes Program in the mid-1980s, however additional watershed and in-lake work was needed. Project partners initiated current restoration efforts at Green Valley Lake in 2006.

Union Soil and Water Conservation District (SWCD) and the Natural Resources Conservation Service (NRCS) completed a watershed assessment and developed a four-year plan to make needed watershed improvements. Cost share funding allowed local landowners to accomplish soil and water quality improvement projects on their property. Iowa State University also completed a Diagnostic Feasibility study in 2008 and presented a variety of restoration alternatives (i.e. spillway modification, fish restoration and dredging of coves) for consideration. A technical working group that included DNR staff, NRCS and SWCD staff, the City of Creston, Southern Iowa Rural Water Association, Green Valley Chemical and CIPCO was also formed to coordinate restoration project activities.

Restoration Activities and Park Improvements

DNR Parks has worked in parallel with lake improvements efforts to complete a facelift to the park. A number of improvements were made to the popular campground, including: adding full hook-up sites, removing a number of campsites to increase the size of each site, redesigning all the camping pads, and adding a new electrical system upgrading from 30 amps to 50 amps. Additionally, each site was upgraded with a new picnic table and fire grill and a new shower building was installed at the center of the campground. DNR Parks added new pit latrines at the campground, the cabins and the north picnic area and built a third camping cabin. Green Valley also has a new playground that was donated in part by the family of Greg Haley, who was the park manager when he passed away in January 2009, and built by volunteers. In addition, the park was connected to the City of Creston by a paved bike trail in 2009 that allows park visitors easy access to the amenities in town.

DNR's Lake Restoration Program worked with project partners to make a number of improvements to the lake and watershed. Restoration activities included:



- The local NRCS District Conservationist implemented a four-year, \$409,000, watershed improvement plan to help reduce sediment and nutrient inputs to the lake.
- Elimination of yellow bass and common carp, species both considered detrimental to sport fish populations, with common carp having the additional negative impact of contributing to poor water quality conditions. The DNR renovated the fishery in September 2008 and has since restocked the lake with bluegill, largemouth bass, channel catfish, crappie and walleye. Fishing following the restoration has been excellent.
- Prior to restoration, the concrete spillway was starting to develop some structural problems and its design allowed common carp to enter the lake during periods of high flow. Iowa Bridge & Culvert LC completed a redesigned spillway in May 2009 at a cost of \$510,435.
- DNR awarded a \$348,767 contract to CL Carroll Company Inc. for in-lake fish habitat and shoreline protection through rock armoring. Fish Habitat Stamp funds in cooperation with Federal Dingell-Johnson, Marine Fuel Tax and Lake Restoration Program funds paid for this aspect of the project.
- The Natural Resource Commission approved the acquisition of a parcel of land adjacent to the northeast corner of Green Valley State Park. The Betty E. Gater Estate offered this 67.58-acre parcel for \$338,000. This site first served as the containment site for sediments removed from the lake as a part of the

mechanical dredging element of the restoration project. Following dredging, the site was re-seeded with native plants.

- Taylor Construction & Excavation signed a contract in the fall of 2009 for removal of approximately 250,000 yards of sediment targeted from both existing sediment retention basins and in-lake areas. In addition, a new sediment dike was installed at a location below an area identified in the diagnostic study as a subwatershed area contributing significant sediment and nutrient loading and critical areas of shoreline were stabilized.
- Since the lake restoration activities were completed and the fishery renovated, aquatic vegetation has once again been observed in the shallow areas of the lake. Aquatic vegetation is an important component for fish habitat, helps stabilize lake sediments, and helps retain nutrients in the water column.

Current Restoration Activities

Project partners worked to expand the multi-use trail leading to the park from the City of Creston and throughout the park. As a part of this project, DNR Engineering, Parks, and the Lake Restoration Program completed the construction of two silt dike dam structures that will also help to improve water quality in the lake and will maximize sediment trapping efficiency. The completed structure is pictured below. The Lake Restoration Program (LRP) contributed to the construction of the west silt dike. Total costs for this project were \$180,756 (\$168,756 LRP; \$11,950 MFT).

DNR met with the technical advisory team in 2018 to explore additional needs at Green Valley Lake. Together, they are working with Iowa State University to collect some additional water quality monitoring data. Project partners will then use these data to determine if, and what, steps are needed to continue to improve the lake.

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Hawthorn Lake, Mahaska County

Background

Hawthorn Lake is a 181-acre constructed lake in southern Iowa with a watershed to lake area ratio of 17.6 to 1. The Mahaska County Soil and Water Conservation District (SWCD) applied for, received a watershed assessment grant from the Iowa Department of Agriculture and Land Stewardship, and completed the assessment during the winter of 2007. They then held a kick-off meeting in May of 2010, with 34 landowners, stakeholders, staff, commissioners, and news media in attendance. Partners discussed shoreline work, structures on public property, signage, private land opportunities, and reviewed goals. The Mahaska SWCD applied for and received a Watershed Improvement Review Board (WIRB) grant of \$165,949 toward lake restoration activities. A total of \$208,618 in Publicly Owned Lakes (POL) funds were available to the project. In addition, the DNR Lake Restoration Program utilized funds of \$407,729 for in-lake shoreline stabilization (see picture), deepening, and watershed improvement on state lands.

Restoration Activities

- To-date landowners have completed a grade stabilization structure with sediment loading reduction of 157 (tons/year). 3,238' of terraces on private property have been installed reducing sediment loading by 104 (t/y), and 2,109' of waterways reducing sediment loading by 32 (t/y) on private property.
- DNR awarded a \$384,854 contract to Cornerstone Excavating, Inc. of Washington Iowa for in-lake restoration work at Hawthorn Lake (\$147,824 Fish and Wildlife Habitat Funds, \$137,030 Lake Restoration Program, \$100,000 Mahaska County SWCD WIRB grant). The project, completed April 2011, consists of the placement of in-lake habitat, shoreline armoring and deepening, and jetty construction/repair.
- The fishery in the lake was renovated in 2010 and re-stocked in 2011. Following restoration, largemouth bass abundance and quality are excellent.



The DNR designed eight sediment control ponds for watershed improvement on public ground and stream protection on private ground. Phase I: Five of the eight structures on public property were let for bid on January 19, 2012 and are now complete. The last structures were completed in November of 2016. A 40 acre parcel was added to the northwest portion of the Wildlife Management Area. This allowed for construction of the largest sediment control pond above the lake, additional wetland/stream enhancement, and restoration of prairie within the watershed of Hawthorn Lake. Total cost for the watershed projects were \$343,569 (\$138,803 LRP; \$65,949 WIRB LRP; and \$6,921 Landowner).

Water quality benefits from restoration efforts have already been observed. Trends in water transparency suggest that water quality has improved in the years following the completed restoration efforts. Additional treatments completed in 2016 should further improve water clarity. Finally, project partners are working to eradicate woody vegetation from the management area that has a negative impact on water quality. Following removal, native grasses were planted to stabilize soils and improve both land and water quality at the management area.

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BRUCE TRAUTMAN, ACTING DIRECTOR

Hickory Grove Lake, Story County



Left: shoreline armoring on the island in Hickory Grove Lake. Center: stream bank stabilization project in the watershed. Right: Hickory Grove Lake in the summer.

Background

Hickory Grove Lake is a 100-acre constructed lake in Story County, Iowa, with a lake to watershed ratio of 40:1. In recent years, the lake has experienced a number of rain event-driven water quality problems that are negatively affecting this resource. Sedimentation in arms of the lake has impacted recreation and surface run-off has led to gully erosion, debris, and nitrogen spikes in samples collected from the watershed. Additionally, the beach at the lake has been listed as impaired due to high concentrations of indicator bacteria. While the fishery remains relatively healthy, carp have limited vegetation in the lake. Aquatic vegetation is important fish habitat and helps keep water clear by removing nutrients from the water column and minimizing sediment re-suspension due to wind and wave action in nearshore areas.

Starting in 2008, a watershed technical advisory team was formed to discuss water quality improvement efforts at the lake. The Natural Resources Conservation Service received a development grant in 2008 to determine critical areas within the watershed for restoration and complete a land use assessment. In 2011, Iowa State University also received a planning grant to develop a watershed management plan for Hickory Grove Lake. This plan outlined strategies for managing bacteria levels at the beach and included recommendations for goose control, lake draw-down, sediment removal and a fishery renovation.

Watershed Improvements

Story County Conservation Board (CCB) received a Watershed Improvement Review Board grant and partnered with the Department of Natural Resources (DNR) Lake Restoration Program to complete a livestock exclusion project and streambank stabilization project on the main tributary of the lake. The project was completed in 2016 and helped minimize new sediment and nutrients being delivered to the lake (see before and after photos on the next page).

In the summer of 2016, DNR and Story CCB worked to complete a preliminary assessment of the park grounds to determine where additional practices could be placed to mitigate gully erosion in the park and improve existing sediment ponds in the park. A project to implement Best Management Practices at identified locations was then initiated and 25 rock silt dikes were

constructed, shoreline areas were armored, and drainage tile repair work was done. The \$124,043 project (75% Lake Restoration, 25% SCCB) was completed in September 2018.

Additionally, the County has provided a cost-share program for watershed residents in need of updated septic systems. To date, all unpermitted systems in the watershed have been improved to reduce nutrients delivered to the lake.



The County received a WIRB grant in 2014 to use with Lake Restoration funding and relocate livestock from a tributary stream and reduce erosion on a watershed landowner's property. Pictures from this project are shown above (before and after).

In-Lake Restoration

While the bulk of in-lake restoration work is slated for 2018-2020, Story County has already invested in helping to protect some critical shoreline around the lake and island. In 2013/2014, the CCB worked to stabilize approximately 450 feet of shoreline with rip rap along the southwest shoreline and emergency spillway. A more comprehensive shoreline assessment was completed in 2014 to identify areas of critical need that will be incorporated into the in-lake restoration project.

Engineering design for the in-lake portion of the project began in 2017. A public meeting was held at the park in the summer of 2017 to solicit feedback from the local community about project goals for the lake. DNR engineering completed a design plan for the lake that will remove excess sediment from targeted areas of the lake, armor shorelines, install needed fish habitat, and rehabilitate the eastern portion of the lake.

The lake was partially drawn down in the summer of 2018 to facilitate in-lake restoration activities. Construction in the lake is slated to begin in early 2019, with completion of the project in 2020 and is expected to cost \$2,994,024.97 (75% LRP, 25% SCCB). The SCCB is also improving some recreational experiences for park uses as a part of this project, including a new section of park trail and a bridge that will connect to the island in the center of the lake.

Finally, when the lake is drawn-down, a fishery renovation is being planned to remove rough fish (carp) from the lake and improve the sport fishery. Removal of the rough fish, in combination with other watershed and in-lake improvements should help improve overall water clarity and promote growth of aquatic plants in nearshore shallow waters.

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Iowa Great Lakes/Center Lake, Dickinson County



Background

The Iowa Great Lakes (IGL) are a significant public resource in the state of Iowa. DNR recognizes this unique group of lakes and continues to support efforts to maintain and improve water quality in the region. In the last six years, the Lake Restoration Program (LRP) has partnered with a variety of other local and state agencies to improve the IGL. Together, partners have invested over \$5 million dollars since 2010 in practices and restoration techniques to enhance the lakes. In addition to improving the Great Lakes, the DNR has worked to restore and enhance myriad of wetlands in the IGL watershed, providing important habitat for a variety of animals and reducing nutrient and sediment loads to the lakes.

Current Restoration Projects

The LRP is currently working with a variety of partners to improve water quality in the IGL. At present, the DNR is working with the Department of Agriculture and Land Stewardship (IDALS) to implement conservation strategies, in cooperation with the local County Soil and Water Conservation District including:

Urban Practices

- Improved storm water intakes for filtering storm water before it reaches the lake and improve lake shoreline to prevent further erosion
- Constructed several bio-cells as a water control structure to filter or settle sediment from water draining to East Okoboji Lake, West Okoboji Lake and Center Lake
- Constructed two subdivision bio-swales which filter storm water runoff

Wetland Restoration

- Implemented a wetland and prairie restoration on the North Shore of West Okoboji that reduced the amount of sediment reaching the lake from 80 acres
- Enhanced a wetland to intercept 19 acres of agricultural runoff entering East Okoboji Lake

An ongoing partnership with the Dickinson County Water Quality Commission (WQC) has helped fund a variety of local projects including assisting the Spirit Lake Protective Association with a small land acquisition in a key sub watershed entering

Big Spirit Lake and providing funding for project management at the Great Lakes. Since the partnership began, the LRP has helped fund over 10 projects, contributing over \$200,000.



Other project activities include:

- Participation in the annual Iowa Prairie Lakes Conference, hosted at the IGL. The conference draws over 100 professionals and associations together to discuss issues natural lakes in the region face.
- Continued support of the Marble and Hottes Lakes restoration project in the Big Spirit Lake watershed. This important restoration filters nearly 20% of the land flowing into Big Spirit Lake. Construction was completed in 2015 but water level management to restore aquatic plants and water quality is ongoing.
- Completion of six underground tile inlets to reduce soil and nutrient loading to Big Spirit Lake in the Reeds Run sub watershed.
- Partnered to fund a 1.2 acre urban wetland detention basin in the East Okoboji Lake watershed.
- Funded FY18 and FY19 WQC projects, including the construction of an urban storm water wetland, shoreline protection on West Okoboji Lake, and water quality monitoring.

Center Lake Restoration

Restoration of Center Lake was a major focus in 2016 and 2017. Center Lake drains directly into West Okoboji Lake, and has experienced problems with high densities of carp, low vegetation, frequent algae blooms, and shoreline erosion. Restoration activities included:

- Common carp barriers were constructed between the lake and two wetlands to prevent carp from accessing spawning areas in an effort to curb carp reproduction.
- Over 1,100 feet of severely eroding shoreline was armored and re-graded to allow for natural vegetative cover to return and minimize sediment and nutrient delivery to the lake from wind and wave erosion (see before and after).
- Wetlands surrounding the lake were also enhanced as a part of this project to filter nutrients and sediment before water enters the lake and enhance wildlife habitat (see above photo).
- Work continues on a feasibility study by the Iowa Great Lakes Sanitary District to determine the cost and methods for replacing septic tanks on the south side of the lake with sanitary sewer service.
- Partners worked to improve an existing storm water retention pond in an urban area of the watershed.
- The LRP is in the process of improving the water control structure on Center Lake. Construction started in late 2018/early 2019 for a total cost of \$77,106.00

Through the restoration of Center Lake, DNR will enhance not only Center Lake, but will help to maintain excellent water quality in West Okoboji Lake.



Future Restoration Projects

The LRP continues to partner with the Dickinson County Water Quality Commission (WQC) to implement best management practices throughout the Great Lakes watershed. Since 2016, the lake restoration program helped fund a number of local watershed projects on public ground that will help protect water quality in the great lakes. DNR is also committed to continuing to improve and enhance shallow lakes and wetland systems in Dickinson County.

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Kent Park Lake, Johnson County



Background

Kent Park Lake is a 27 acre man-made lake in Johnson County that serves as a popular recreation destination for the surrounding communities. The lake has a 25 to one watershed to lake area ratio, and much of the land in the watershed is forested or grassland. The park is currently operated and maintained by the Johnson County Conservation Board (JCCB). Visitation at Kent Park Lake is in the top 25% of lakes statewide, and 2/3 of the watershed is in public ownership, including a number of remnant and restored prairies within the county park. Planning meetings began in early 2015 to develop a watershed plan for the lake and discuss future potential in-lake work to improve degrading water quality conditions. Prior to working with the Department of Natural Resources (DNR) Lake Restoration Program, the county worked to improve water quality in the watershed.

Current Restoration Work

In early 2016, Johnson CCB hired Stanley Engineering to design and oversee construction for in-park improvements that would help protect the lake. Stanley has since completed engineering design to renovate six existing sediment basins in the park and build six new structures that will capture nutrient and sediment run-off from entering the lake. Costs for engineering work were split 50/50 between the Johnson CCB and the DNR Lake Restoration Program. Construction began in 2016 and was completed in 2018 (see photo at bottom). Total costs for construction of this phase of the project were \$1,184,460 (50/50 cost share between JCCB and DNR). Engineering costs for both the watershed and in-lake work at the park were \$435,600 (50/50 cost share between JCCB and DNR).

The lake was drawn down in the summer of 2017 in preparation for in-lake work in 2018. A public meeting was held in the summer of 2017 to address the interested parties' concerns and comments on the project. Following the meeting, project partners worked to develop a comprehensive in-lake plan for restoration work.

Construction in the lake began in 2018 and called for targeted removal of ~100,000 cubic yards of soft sediment from the main basin of the lake to re-establish depth in the lake, mitigate vegetation concerns following restoration, and remove excess nutrients from the lake bottom. Arms of the



lake are also being dredged and silt dikes created to reduce sedimentation in the main lake. Areas of critically eroding shoreline are being hard armored, including the construction of a new limestone access shoreline near the boat ramp and accessible fishing pier. A new boat ramp and kayak access is being constructed to increase recreational opportunities at the lake. Additionally, numerous fish habitat structures are being created throughout the lake to enhance angling opportunities. The lake will be re-stocked with sport fish following the restoration project. Total costs for this phase are \$1,268,526.00. Construction began in the winter of 2018 (see photo below) and continues into 2019, with a plan to re-fill the lake in early spring of 2019 in time for the recreation season.



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Lake Anita, Cass County



Background

Lake Anita is a constructed 159-acre Lake located ½ mile south of Anita, IA. The lake has a small watershed with numerous silt ponds that help to project the lake. The watershed also contains a significant number of acres in grass, pasture, or CRP that help to reduce the amount of sediment and nutrients entering the lake.

Restoration Work Completed

Restoration at the lake began with a fishery renovation in 2003 to eliminate an over-abundant and stunted population of yellow bass from the lake and promote vegetation growth in the shallow areas of the lake. While the lake was drawn down, additional fish habitat was also installed around the lake bottom. DNR wanted to take additional steps to improve the lake, however; so a restoration project was initiated to help protect the good water quality observed at the lake for years to come. Because the watershed already had a good number of conservation practices, efforts were focused on reducing sedimentation in the lake and promoting vegetation growth. Between 2013 and 2015, a sediment retention basin on the east arm of the lake was designed and expanded. The box culvert at the road was raised four feet and 8,000 CY of sediment was removed in an effort to increase the trapping efficiency of the pond. The total cost of the project was \$41,000, funded by the DNR Lake Restoration Program.

Following the fishery renovation in 2003, four types of native aquatic plants were introduced to the lake to help promote healthy levels of vegetation, which is important for water quality and fish habitat. Vegetation was able to establish throughout the lake, and the lake has continued to meet Lake Restoration's goals for water quality. In 2013, Lake Anita had an estimated 64 acres vegetated (39% of the lake surface area) which falls within the goal of 10-40% coverage. Because vegetation was problematic in several bays, limiting anglers and boaters' access to the lake, several areas of the lake were chemically treated to remove excess vegetation, reducing the total coverage to about 28% of the lake's surface area.

Fishing continues to be excellent following the renovation in the lake, with abundant populations of 8+ inch bluegills and a sustainable population of largemouth bass. Crappie and catfish fishing are also excellent.

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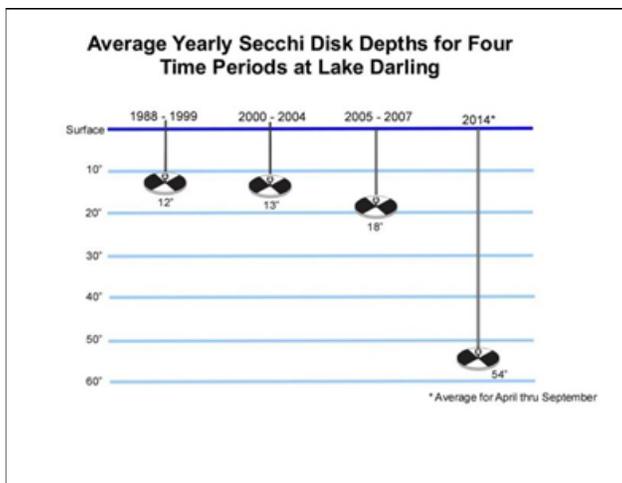
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Lake Darling, Washington County

Background

Initially impounded in 1950, Lake Darling had in recent history been a fair fishery plagued by severe in-lake siltation and poor water quality. Sedimentation had reduced the lake's original 305 surface acres to 267 acres. Extensive watershed soil conservation work on state and private land has reduced sediment delivery to the lake by 60% and laid the groundwork for a complete renovation of the lake and park. All in-lake improvements were done while the lake was drained with the goal of sustaining improvements for the next 50 years.



Completed Restoration Activities

The park reopened in late July 2014 after being closed for renovation since 2010. In September 2014, more than 200 people gathered under a new shelter to officially rededicate Lake Darling State Park, 64 years to the day that the gates were formally set. The \$13 million investment to improve and protect the lake and completely remake the campground and park roads is now complete, returning the park to its status as a destination for outdoor getaways. Speaker after speaker thanked the Lake Darling Friends Group, the Washington County Riverboat Foundation, the local chapter of the Izaak Walton League, the Iowa Department of Natural Resources, local landowners, the Washington County Board of Supervisors, the Brighton Chamber of Commerce, the Iowa Legislature and area residents for the role they played in the renovation.

Lake Darling Restoration Project Activities

- Replacing the dam
- New sediment catch basins in the watershed
- Two silt dams in the lake
- Lake level raised two feet to increase surface acres back to 305 acres
- Installed shoreline riprap, fishing jetties and piers
- New ADA fishing trail
- New roads, trails, and trail bridge
- New campground, with 50 amp service
- New boat ramps and fishing bridge
- New shelter at boat rental area and park lodge
- New sand on the beach
- New waterlines throughout the park



- Two new shower buildings and a new dump station

Funding Sources: Lake Restoration Program, Parks & Institutional Roads, Fish and Wildlife Trust Fund, Sheldon Shoreline Access Foundation, Washington Co. River Boat Foundation, Izaak Walton League, Friends of Lake Darling, REAP Land Management, and REAP Open Spaces.

The \$13 million investment to improve and protect the lake and completely remake the campground and park roads is now complete, returning the park to its status as a destination for outdoor getaways.

Landowners need to be recognized for their role in protecting the lake. Stan Simmons, the watershed coordinator who played a significant role in working with landowners to install more than 160 ponds, terraces, water control basins, soil-holding grasses and other conservation measures, accepted a water quality initiative leadership award on behalf of the project from Iowa Secretary of Agriculture Bill Northey.

The new park will provide important health and economic benefits through visitation and outdoor recreation. An economic study by Iowa State University’s Center for Agriculture and Rural Development estimated the renovated park and lake would provide \$8.7 million annual economic benefit to the area and complements Iowa’s improved quality of life initiatives.

“Businesses are looking to locate to areas that provide a healthy place to live, work and play,” added Iowa Department of Natural Resources Director, Chuck Gipp.



- A Documentary titled, “Darling is Back” was created highlighting the partnerships and work completed in the watershed and at the park. Many members of the restoration project were interviewed during the filmmaking. The film premiered at Lake Darling State Park on December 12-13, 2015, and was released on PBS. The Lake Darling Restoration Project is sure to be a model for future projects in Iowa, and likely, the nation.
- Construction on the \$1.1 million lodge was completed in 2015 (99% local and 1% State Parks & Infrastructure funds). In addition, a total of 6 cabins were constructed in 2015 and 2016 (See photo).

- New Pit Vault Toilet at Campground Boat Ramp, \$36,000, 45% MFT/10% Infrastructure 2015/45% Federal Boat Safety (Coast Guard) was installed in 2018.
- Interpretive Trail from cabin road to beach area, \$85,000, (100% REAP funding) installed in 2018.

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BRUCE TRAUTMAN, ACTING DIRECTOR

Lake Geode, Henry County

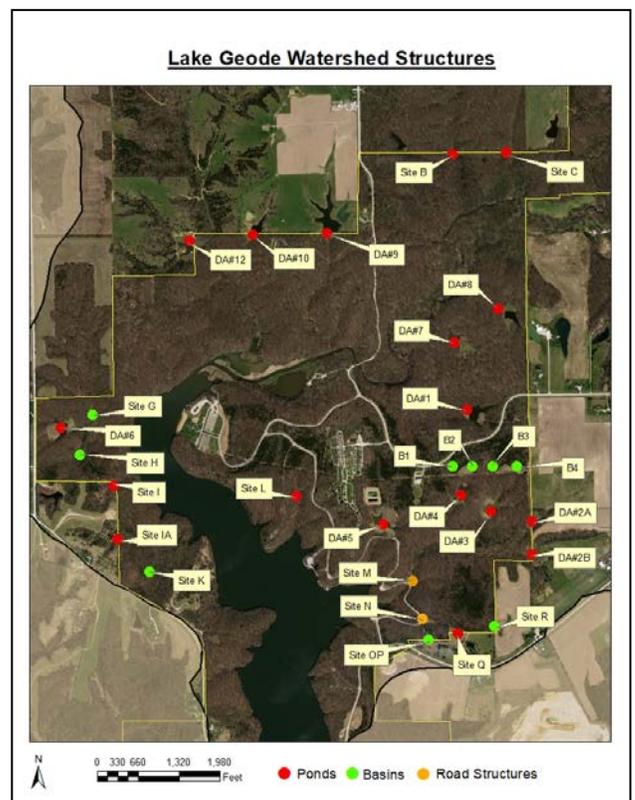
Background

Lake Geode, located in Henry and Des Moines Counties, is a 174-acre lake encompassed by a 1,640-acre state park. The entire Lake Geode watershed consists of approximately 10,327 acres. The watershed encompasses drainage from Cedar Creek and the lake outlets to the Skunk River. This scenic lake was constructed in 1950 and has historically been considered an excellent fishing lake. DNR estimates that Lake Geode State Park attracts approximately 180,000 annual visitors who camp, hike, fish, and boat within the park.

The goals of the Lake Geode Watershed Project are to reduce bacteria, sediment and phosphorus loading into Lake Geode. Project partners plan to achieve these goals through a combination of best management practices that will target identified source contributors from state and private land. The following agencies are working in partnership to achieve this goal, Iowa Department of Natural Resources (DNR), Iowa Department of Agriculture and Land Stewardship – Division of Soil Conservation (IDALS-DSC), Natural Resources Conservation Service (NRCS), Henry Soil and Water Conservation District and Des Moines Soil and Water Conservation District.

- Goal 1: Address bacteria impairment of Lake Geode in an effort to remove it from the 303(d) list.
- Goal 2: Reduce total phosphorus and sediment delivery from agricultural and non-agricultural sources by 6,351 lbs./year and 2,499 tons/year, respectively.

The Natural Resources Conservation Service, Iowa Department of Agriculture and Land Stewardship and the Iowa Department of Natural Resources have been working together to install Best Management Practices (BMP's) on state property. The Lake Geode Watershed Coordinator also continues to make progress on private land in the watershed. For example, terrace projects have been completed and septic systems are being investigated in terms of leakage/upgrading.



Current Restoration Work

Beginning in 2012, a series of watershed BMPs (above image) were constructed in Lake Geode State Park to reduce nutrient and sediment inputs to the lake. Between 2012 and 2018, a total of 29 structures were completed.

Ponds Built to Date: (18 no.); Basins Built to Date: 2 rebuilt, 7 new: (9 no.); Road Structures Rebuilt to Date: (2 no.)

These sediment/nutrient control structures were constructed at a cost of \$864,060 (~ 50% DNR Lake Restoration Program; 50% DNR Watershed Improvement Section). Following construction of some ponds, fish have been stocked by the DNR to allow for additional angling opportunities at the lake.

In addition to watershed improvements, a number of projects are underway in the park to improve recreational opportunities and provide better wildlife habitat within the park. Wood duck boxes were installed near the recently constructed ponds. Each of the wood duck boxes were donated by citizens from the community. New trail construction is being planned to allow for better access to the recently constructed ponds in the park. Finally, multiple practices to help deter geese from living near the beach and contributing to beach bacteria problems (see photo right). Practices that have been used to date include wood-lathe snow fencing, pyrotechnics, and Mylar tape.



A public meeting was held in the summer of 2017 to discuss future restoration plans for the park and lake at Geode State Park. Over 100 people attended the meeting to learn about the project and share their comments and concerns about the park and lake. Fishing regulations were relaxed in preparation for a fall draw down at the lake to begin construction.

Lake Restoration Work

Work began in the summer of 2017 to open the valve at the lake and begin the draw down process. A dive crew was hired to investigate the condition of the lake's draw down structure, as the sluice gate (which usually prevents water from flowing out of the lake) was inoperable prior to draw down. In addition, the investigation revealed that a metal plate was covering the inlet pipe of the lake on and needed to be removed for the lake to drain. Throughout the fall of 2017, DNR Engineering staff worked with several contractors to carefully and safely draw down Lake Geode. The lake was completely drained by November of 2017 (photo below).

Restoration work in the lake bed began in the spring of 2018 and will continue into 2019. Targeted dredging (200,000 cubic yards) will remove excess soft sediment and re-establish depth at the upstream end of the lake. An in-lake silt dike will be constructed at the primary inlet of the lake to prevent sediment from entering the main basin of the lake. Additionally, 2,127 linear feet of shoreline will be armored to minimize wind and wave erosion. The in-lake restoration portion of the project was bid in December of 2017 with a low bid price of \$2,996,026. Construction will

conclude in early spring of 2019, allowing the lake to refill and the park to re-open for the Memorial Day Holiday.

The fishery will also be renovated as a part of the restoration project, with new fish habitat installed throughout the lake following dredging. Sport fish will be re-stocked following the completion of dredging and shoreline armoring.

Finally, as the lake will be undergoing major changes, the campground is also getting an update. The Parks Bureau renovated the campground in the summer of 2018 to update bathrooms, shower houses, and electric sites to suit more modern RVs and campers. Construction will be completed in time for the 2019 camping season.

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Lake Icaria, Adams County

Lake Icaria's clarity used to be measured in inches; it is now measured in feet. Before, you could only see down six inches in the murky waters of this southwestern 647-acre Iowa lake. Now, following work in the watershed and in the lake, you can watch your toes wiggle when standing in waist-deep water. Landowners set out in 1996 to improve the lake as part of the Adams County Three Lakes Project.

In the past decade, landowners have changed how they farm to improve water quality. Following work in the watershed, the DNR moved ahead with restoration efforts in the lake in 2004. At Lake Icaria, in-lake work has helped protect 10,000 feet of shoreline from erosion. Anglers will notice four new fishing jetties, repaired jetties and a repaired main boat ramp, as well as a renovated fishery and restocked lake. The DNR also placed 12 underwater rock mounds to attract fish for anglers. Since Lake Icaria completely refilled in the spring of 2007, the water is remarkably clearer – generally, a person can see three feet down in the water, sometimes up to six feet. With an improved lake, anglers, campers and other park visitors are taking notice. Starting in 2008, fishing and park visitations have improved.

- The DNR Lake Restoration Program cooperated with the Adams Soil and Water Conservation District by providing funding resources to repair and improve the main tributary wetland that was originally constructed in 2004. In 2013, the DNR contracted with Murphy Heavy Contracting Corp. to repair the wetland at a cost of \$386,028 (Watershed Improvement Review Board grant to the SWCD paid \$170,525 and the Lake Restoration Program paid \$215,503). Construction was completed September 2013.
- In addition, Adams County Conservation Board applied for a fish habitat grant for four sediment control ponds above Lake Icaria. The DNR and Adams CCB coordinated planning for these structures during the winter of 2012/2013 and the ACCB constructed these ponds during the summer of 2013 at a cost of \$67,221 (Fish Habitat Grant \$34,871, SWCD \$22,500 and Lake Restoration \$9,850).

In 2014, the DNR repaired the existing riprap shoreline along the point that surrounds the primitive campground at Lake Icaria.

- Good numbers of 14-20 inch largemouth bass have been recently caught as a part of DNR's fishery management monitoring. Good numbers of young-of-the-year walleyes were also captured, indicating that the future of the fishery looks bright.
- DNR Fisheries staff modified the wetland and silt dam structures above the lake in 2016 to reduce common carp abundance in the lake. Total cost for this project was \$19,000. Fisheries staff is also evaluating two sediment retention ponds near the lake that could be used as fish rearing ponds. If plans are implemented, these ponds could supplement walleye populations in the lake by as much as 10-40%.



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Lake Manawa, Pottawattamie County



Background

Lake Manawa is a 715-acre oxbow lake with a watershed to lake area ratio of 4:1. Mosquito Creek supplies additional water to the lake. The DNR contracted with Tetra Tech, Inc., in 2009 to provide a diagnostic feasibility study for Lake Manawa as part of DNR Lake Restoration Program planning activities. These studies include specifics on a suite of water quality improvement efforts, one of which is planned dredging. The dredging project is a vital component of an overall water quality improvement project, as it would create additional depth and volume at Lake Manawa, both important to achieving long-term water quality goals. The studies also prioritized the lake areas to conduct dredging activities based upon potential effect of dredging on the overall lake seepage and quality of material. The unique quality of the sand material may provide an opportunity to recycle it for other uses such as road or other construction projects.

Past lake dredging work in the 1960s deepened significant portions of the lake. However, maximum lake depth still does not exceed 13 feet with large expanses of 6 to 7 feet deep water. If feasible, Lake Manawa's restoration would include an increase in mean depth from the current 6.1 feet to approximately 8.2 feet.

Current Restoration Activities

Due to the complexity, time commitment, technical expertise, groundwater monitoring, and sensitivity of leakage areas in the oxbow, the DNR contracted with FYRA Engineering to provide professional design and oversight on an initial phase of dredging at Lake Manawa toward meeting restoration goals. FYRA's responsibilities included:

- Conduct any necessary topographic survey and site analysis sufficient to furnish conceptual designs, cost estimates and initiate permitting for dredging 500,000 CY from Lake Manawa.
- Determine, in consultation with the DNR, the performance specifications for the Project (i.e. preferred method of dredging, location/depth of dredging and metrics for suitability of dredged material for use as building material).
- Provide final design and construction plans for dredging activities to meet project goals
- Be onsite for all critical construction activities as defined by both the designated DNR engineer and consultant's engineer.
- Implement a quality control program to monitor the material properties of the sand produced, any impacts of dredging on seepage and feasibility of continued dredging.
- Provide design/oversight services related to dredging Lake Manawa with storage of material on adjacent state land

As a result of the above planning, the DNR contracted with JF Brennan to remove 500,000 cubic yards of material in 2016 at a cost of \$4,200,586. This resulted in a stockpile of sand within the park. As mentioned, Manawa is a unique dredging operation relative to past projects at other Iowa lakes in that for most cases we are dredging silt, which needs to be disposed of, versus the stockpiled material that can re-purposed to other uses. The DNR made the investment in separating material to a higher grade to develop the potential for an end user of the product. The advantage to the state is the re-use of limited space on state land to accomplish the total goal of 2.5 million cubic yards of sediment removal.

Ames Construction Inc. applied for and received a sand and gravel permit through the DNR to remove the sand pile left at the spoil site from the first phase of dredging. Throughout 2018, Ames Construction removed over 609,000 tons of material for use at nearby Mid-American Energy for their construction needs.



Long-term: The DNR has identified potential a number of end users of material near Lake Manawa with varying needs in terms of quantity of material and material specifications and is exploring potential options on how material needs can complement overall dredging goals. For example, the DNR is working cooperatively with the City of Council Bluffs to explore if a future phase could both meet the City’s needs for materials for a planned levee project while also improving water quality in the lake. Supplemental work from FYRA Engineering will provide both parties information related to the feasibility and cost associated with dredging additional sand material from the lake (phase 2 plans and specifications for dredging up to 1.0 million cubic yards from two regions with Lake Manawa).

FYRA Engineering was also hired to complete additional monitoring on Mosquito and Indian Creek and develop additional restoration tools that could be used to improve water quality in Lake Manawa. A final report for this watershed assessment was completed in 2018 and shows the need for additional watershed work; specifically options for treating water that enters Manawa from the Mosquito Creek diversion.

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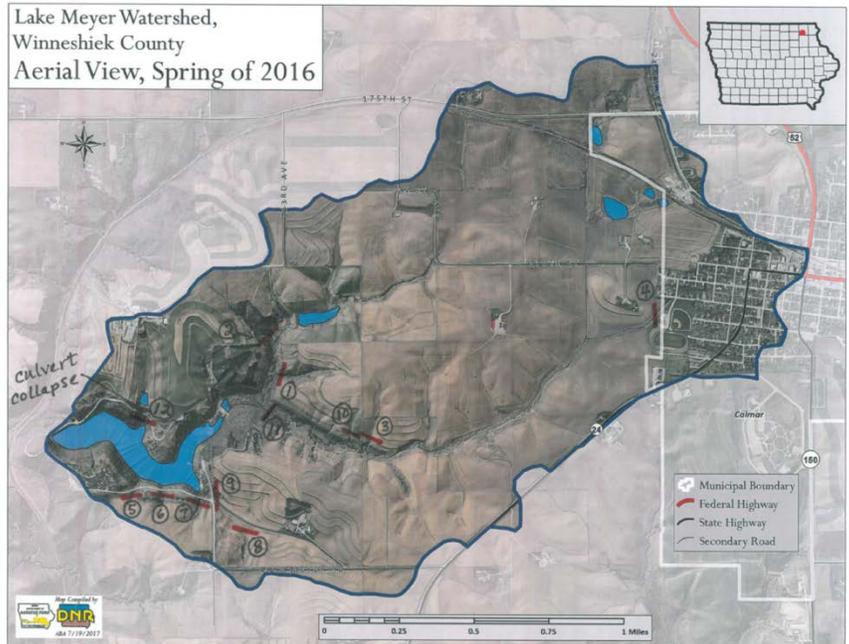
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BRUCE TRAUTMAN, ACTING DIRECTOR

Lake Meyer, Winneshiek County

Background

Lake Meyer, located in northeast Iowa, is a 33 acre lake with a watershed to lake area ratio of 48:1. The bulk of the watershed (77%) of the watershed is in working agricultural production. Lake Meyer, and the surrounding county park, provides a diversity of habitats for a variety of plants and wildlife, and the lake serves as a locally important recreation destination. The area is recreational hub that draws and estimated 18,000 visitors annually, resulting in an estimated \$1.8 M in total spending. Popular activities at the lake include fishing, relaxing, wildlife viewing, trail use, and paddling. The park is also home to the Winneshiek County Conservation Board's headquarters, modern camping facilities, and a nature center.



The WCCB has worked with local partners for a number of years to preserve water quality at Lake Meyer. To date, numerous watershed practices have been installed to improve water quality in the lake and prevent future sediment and nutrient pollution. Practices installed include 66 acres of filter strips, 5 manure storage systems, over 35,000 feet of terraces, 8 grade stabilization structures, 5 sediment and water control structures, over 4,000 feet of grassed waterways, 3 bio-swales, and 4 wetlands. Additionally, about 11,000 tons of sediment (equivalent to about 700 dump trucks) have been removed from the lake. The WCCB petitioned the DNR to be included in the Lake Restoration Program in 2016 to complete restoration work in the lake and watershed.

Current Restoration Work

In 2018, a culvert under the road to the nature center collapsed and impacted a pond located above the park. DNR and the WCCB worked together to re-design the pond to better protect the lake. Plans were completed in the fall of 2018 to build a pond in the park that will treat 46.4 acres of the watershed. As a part of the project, the existing basin will be excavated to regain sediment storage capacity and the height of the dam will be raised to allow for a longer design for the pond. The sediment basin will be constructed at the park boundaries and will revitalize the existing road infrastructure within the park as a part of the dam construction. The proposed basin was designed by WHKS engineering and project oversight is being administered by the WCCB. DNR will reimburse the WCCB for 75% of the total cost of the project, which is expected to be constructed before the fall of 2019. The total project is estimated to cost \$103,000.

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Lake Miami, Monroe County

Background

Lake Miami is a 122-acre impoundment located on the 776 Miami Wildlife Area, approximately 6 miles northwest of Albia, in Monroe County. The lake, constructed in 1967, is owned by the Iowa Department of Natural Resources. The area is cooperatively managed by the Iowa DNR and through a 28-E agreement by the Monroe County Conservation Board, which operates a campground, cabin rental, and a nature center facility on 89 additional acres of adjacent County Park. The lake and park provide facilities for boating, fishing, camping, picnicking, and hiking. Park use, as determined in the recent Center for Agricultural and Rural Development (CARD) study is estimated at approximately 43,000 visits per year. However, angling and camping usage of the area declined in the early 2000's, as did water quality and angling quality.

The Iowa Department of Natural Resources (DNR) has identified Lake Miami as impaired and has placed it on the Clean Water Act Section 303(d) list of impaired waters in the state. The identified pollutant is siltation from agricultural non-point sources (NPS) impairing aquatic life in the lake. In addition, Lake Miami is one of the significant publically owned lakes in Iowa as identified by the Iowa Department of Natural Resources Lake Restoration Program. From 1971 to 1991 mean Secchi disk readings exceeded 25 inches eight out of 10 times (80%); since that time mean Secchi readings have exceeded 25 inches only four out of 10 times (40%). These data indicate a substantial decline in water transparencies in this time. Possible reasons for the decline in water quality include turbidity from sediment, nutrient delivery from sheet/rill and gully erosion in the watershed, shoreline erosion due to wind and wave action and the re-suspension of these bottom sediments and their associated nutrients from wave action, and re-suspension of sediments by rooting action of Common Carp.

Current Restoration Work

The Monroe County Soil Conservation District applied for and was awarded \$17,000 (\$15,000 from Division of Soil Conservation with \$2,000 from DNR Lake Restoration Program funding) for an updated watershed assessment of the Lake Miami Watershed. This assessment was completed fall 2012. Monroe CCB also received \$150,000 in Watershed Improvement Review Board funding for the construction of sediment control structures on State property to reduce gully erosion. Construction started in the fall of 2016 and concluded in the fall of 2017. Total cost for this project was \$326,024 (\$284,874 Lake Restoration Program; \$41,150 WIRB).



An assessment of the fishery indicated that common carp were present in excess of 400 lbs./acre while gamefish biomass was minimal. Angling quality had declined dramatically in recent years, mirroring changes in water quality. The fish population at Miami was renovated in late October 2013. Common carp and all other fishes were removed from the lake. The lake was restocked in the spring of 2015. Largemouth bass up to 20 inches and bluegills up to 9 inches are already available for anglers. Fishing will continue to improve, and water clarity has improved in the last couple of years with the removal of rough fish from the lake.

The Lake Restoration Program funded the design and construction of a carp barrier in the Lake Miami spillway. This structure will ensure that carp will not reinvade the renovated fishery and thus, negatively affect water quality. The total cost of this structure was \$46,000 and was completed in May 2014.

A shoreline survey was conducted at Lake Miami in February of 2013. A total of 10,000 feet of priority shoreline was identified from this survey. Marine Fuel Tax funds (MFT) were available for a shoreline restoration project in winter 2014/2015.

The Lake Miami shoreline restoration project was awarded \$687,848.70 in funding through MFT and Lake Restoration funds. A total of 10,000 feet of shoreline were armored and the project was completed in March 2015. Rathbun Fisheries Management and the Monroe County Conservation Board jointly cut and placed several dozen cedar trees at 4 separate locations in the lake basin in the winter of 2014/2015 as fish habitat.

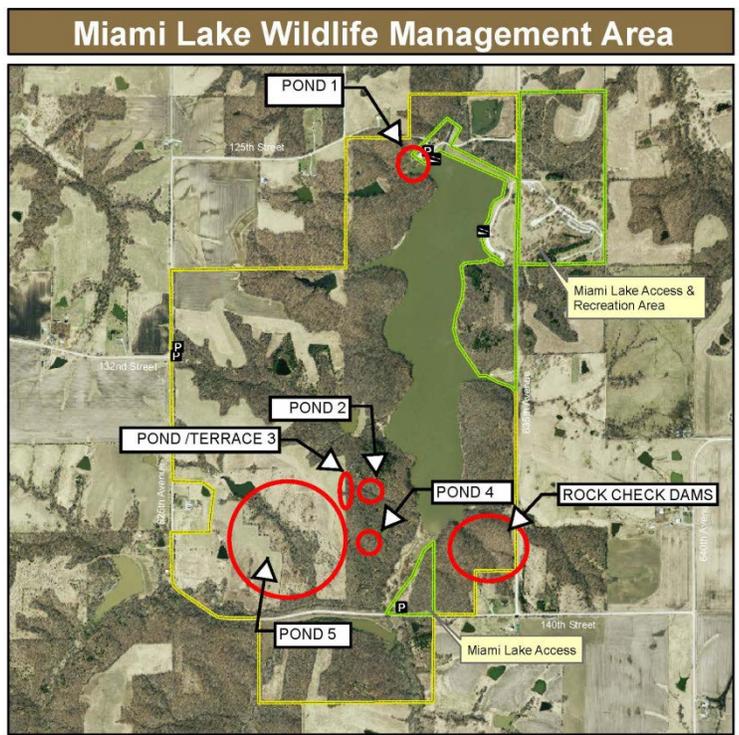


Additionally, five watershed improvement structures were completed in 2018 to help protect the lake from watershed sediment loading. These structures primarily protect the watershed draining state-owned land. A recent watershed assessment showed that whole state-owned land only represents 19% of the total watershed; it suggested that up to 73% of the total sediment load to the lake originated on state-owned land. Thus, these watershed structures are critical for reducing inputs to the lake. The total cost for this project was \$326,024.21 with LRP funding 56% of the project and the Monroe CCB funding 44%.

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BRUCE TRAUTMAN, ACTING DIRECTOR

Lake of the Hills (West Lake Park), Scott County



Background

The Lake of the Hills complex of lakes encompasses four publicly owned lakes (Lake of the Hills, Railroad Lake, Bluegrass Lake, and Lambach Lake) within West Lake Park, which is owned and operated by SCCB. The park serves as an important recreation destination for eastern Iowa, with approximately 500,000 visitors to the park each year. During the summer months, the campground is filled most days and most park shelters are rented to capacity. The park is in the process of making additional infrastructure improvements, including building cabins to attract additional users. Additionally, West Lake Park is the home of the Quad Cities Triathlon, drawing approximately 700 athletes to the park. Other day uses include fishing, paddling, environmental education, hiking, photography, bird watching, and relaxation.

Lake of the Hills, located within West Lake Park, is a 54.6 acre lake with a watershed of approximately 1500 acres (27.5:1 watershed to lake area ratio). Thirty-eight percent of the watershed is located within the park's boundaries, including 98 acres of water and 521 acres of land. Lake of the Hills is surrounded by four smaller lakes, three of which are contained within the park and under public ownership. Until recently, the smaller lakes have protected Lake of the Hills; however high sedimentation rates and declining water quality in recent years have had a negative impact on overall water quality and recreational opportunities at the park.

Over the years, water quality at Lake of the Hills and the surrounding lakes has degraded due to increased nutrient and sediments from the watershed. Excess nutrients, especially phosphorus, have led to frequent algae blooms and low water clarity. Sedimentation in the smaller lakes surrounding Lake of the Hills has contributed to the decline in overall water quality at the park. Lake of the Hills is considered impaired by DNR and the EPA. Research conducted by DNR and others determined that phosphorus inputs to the lake needed to be reduced by 78% for Lake of the Hills to meet state water quality standards. A combination of restoration practices are needed to achieve this goal. In 2016, both a TMDL and Watershed Management Plan were developed for Lake of the Hills. In 2017, The SCCB hired FYRA Engineering to evaluate potential restoration strategies identified in the watershed improvement plan. Restoration strategies within the park (watershed) and in the lake were prioritized for water quality benefits to the lake and costs, and a conceptual design and planning budget for the overall project was completed as a part of a technical memo from FYRA.

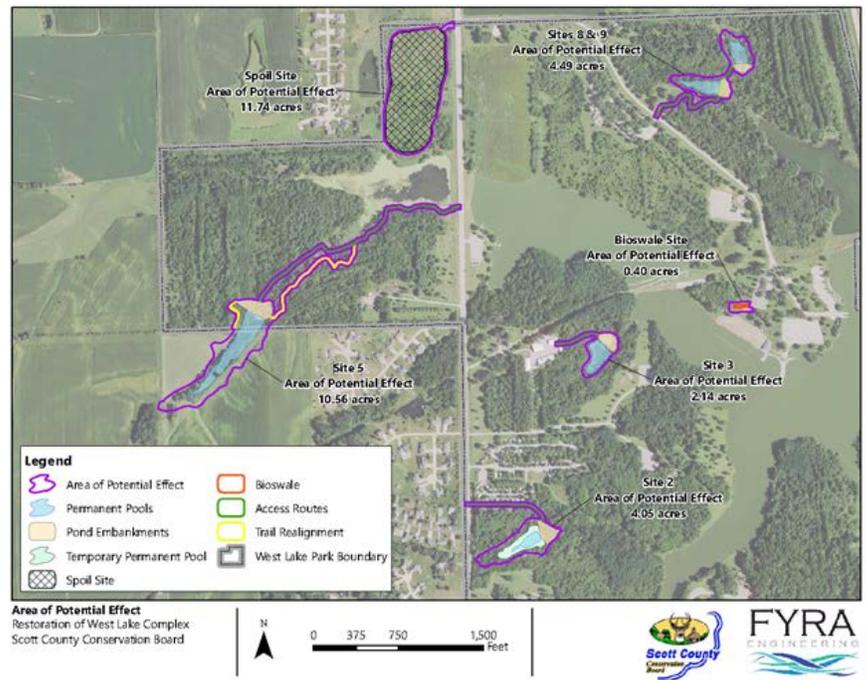
Current Restoration Work

Reducing sediment and nutrient inputs to the lake from the watershed is the first step in improving water quality for the lakes in West Lake Park. In 2018 DNR and the SCCB partnered with FYRA Engineering to design a variety of park best management

practices aimed at minimizing sediment delivery to the lake. Three new sediment ponds are being constructed within the park, as well as rehabilitating two existing ponds within park to restore capacity. Additionally, a bioswale will be constructed near the beach to intercept storm water off of the large parking lot located just above the beach. Finally, stream enhancement work will be completed in several parts of the park to further reduce erosion. Construction for this phase of the project is expected to be completed by the fall of 2019 and cost a total of \$616,257.00 (75% DNR, 25% SCCB).

Future Restoration Work

Future work will include in-lake restoration strategies that are currently being designed. The total estimated cost for construction for remaining elements of the project is currently \$2.8 Million and will include targeted mechanical dredging of ~150,000 CY of sediment from the lakes in West Lake Park, shoreline deepening and stabilization, installation of fish habitat, and upgrades/repairs to the drawdown structures at Railroad and Bluegrass Lakes. Construction for this phase of the project is expected to begin in 2020.



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Little River Watershed Lake, Decatur County

Background

Little River Lake was created in 1985 as a multipurpose PL-566 structure to reduce flood damage, provide drinking water for the City of Leon and Decatur City, provide an established fishery, and to provide recreational opportunities for Decatur County and neighboring areas. Little River Lake is a 788-acre lake with a 17:1 watershed to lake area ratio. For the first 15 years, the lake produced tremendous quantities of quality fish. However, common carp, an inadequately protected watershed, and unprotected shoreline problems had reduced water clarity, suppressed sport-fish abundance and growth, recreation opportunities, and increased water treatment costs. The lake had no shoreline protection in place at initial impoundment. Shoreline erosion, silt loading, and a common carp population had all adversely affected water clarity. Fish quality and angling activity had steadily declined since 2000 to a point where the lake no longer offered quality angling opportunities.

Restoration Activities

The Decatur County Soil and Water Conservation District (SWCD) and the Natural Resources Conservation Service (NRCS) completed a watershed assessment and developed a four-year plan to make needed watershed improvements. Cost share funding was made available for local landowners to accomplish soil and water quality improvement projects on their property.

- Decatur County, Southern Iowa Rural Water Association, Decatur County Conservation Board, Decatur County Soil and Water Conservation District, the City of Leon, and the Iowa Department of Natural Resources began planning water quality improvement efforts in 2008. Since that time, the group has worked to implement water quality improvement practices for the watershed.
- The Decatur County SWCD and NRCS personnel assessed the watershed's problems, quantified soil erosion, and identified best management practices, (BMPs). The Watershed Improvement Review Board (WIRB) awarded the Decatur SWCD a \$423,900 grant to cost-share improvement efforts with landowners. The group also received a letter of support from the DNR Lake Restoration Program to consider Little River Lake for future funding for in-lake improvement projects; such as shoreline stabilization, rough fish management and silt basin improvements.
- The restoration process during 2011 involved WIRB funded implementation of remaining targeted watershed practices and re-assessment of the watershed to guide planners on any remaining areas of the watershed to address before potential work in-lake.
- The local NRCS District Conservationist has implemented \$384,419 of WIRB funding, \$214,359 of EQIP funds, \$192,471 of Public Owned Lakes funding, \$100,865 of State cost share funding, \$14,793 REAP funding, and \$316,439 of landowner commitments totaling \$1.2 million to improve the watershed and complete approved soil and water quality improvement projects. Landowners in the watershed receive bonus points when competing for countywide funding from the Soil District and NRCS.
- Past fish population estimates had indicated a dense common carp population. Their feeding for bottom organisms suspends fine clay sediments causing poor water clarity. The DNR renovated the fishery in October 2011 and in 2012 restocked the lake with walleye, largemouth bass, bluegills, crappies, and channel catfish. Fish population surveys conducted during 2012 has found excellent growth and survival of all stocked species.
- The elevation of the dike and outflow chute of the wetland above Little River Lake was raised two feet to allow additional storage capacity. The additional area is expected to restore the wetland's sediment and nutrient trapping efficiency. Expansion of the wetland area above Little River Lake (completed spring 2012 at a cost of \$207,340 and paid for by the Lake Restoration Program) doubled the area, improved sediment trapping capabilities above the lake and allowed for water level management of the wetland.

- In 2011, the DNR awarded a \$1.1 million contract to TK Concrete of Pella for shoreline deepening, shoreline stabilization, and in-lake fish habitat. The Lake Restoration Program funds paid for \$880,000 million for shoreline improvements and Fish Habitat Stamp funds in cooperation with Federal Dingell-Johnson, Marine Fuel Tax funds paid for \$220,000 in fish habitat improvements. Construction was complete in spring 2013.



Shoreline stabilization of regions with significant erosion

Little River now has water clarity of over 10 feet at times. This level of clarity has not been seen since the lake's initial impoundment in the late 1980's. ***Post restoration water clarity measurements at Little River Lake routinely exceed 36 inches and have been over 80 inches.*** The largemouth bass population had a very strong 2012 year class. Growth for bass increased from that found in 2012 and all sizes have good body condition. Bluegills of all sizes are present ranging from 1 inch to 8.5 inches with a lot above 7.0 inches. Little River Lake is becoming a popular destination for walleye anglers. Good numbers of 12-20 inch walleye were captured during recent sampling. The bluegill population is increasing with fish up to 9 inches available to anglers. Spring electrofishing also indicated a high abundance of largemouth bass up to 18 inches in length. Pan fish populations remain excellent, with phenomenal fishing reported throughout the 2017 open water recreational season.

Project stakeholders met in July of 2017 to discuss the status of the lake following major restoration activities. While water quality at the lake remains excellent, stakeholders want to address fencing issues and add additional ponds to reduce nutrients entering the lake from the watershed. Following the meeting, a new fence line was placed adjacent to the lake to keep cattle out of the county conservation board property. A new restroom was also constructed near the main boat ramp in 2017.

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BRUCE TRAUTMAN, ACTING DIRECTOR

Lost Grove Lake, Scott County



Background

The Iowa Department of Natural Resources has completed work to construct Lost Grove Lake, Scott County. The project is an investment in Iowa's infrastructure; promoting long-term economic growth; is a watershed/water quality project; and will provide flood protection and soil conservation benefits. The Lost Grove Lake recreation site was selected in 1987. Land acquisition from willing sellers began in 1988 and completed in 2003. The state purchased a total of 1,701 acres of land as the site for this 400 surface acre lake. This recreation project has strong local support from groups such as; the Quad City Conservation Alliance, Pheasants Forever, the Izaak Walton League, Scott County Soil and Watershed Conservation District and the Quad City Bass Club. In addition, the Scott County Soil and Watershed District completed a watershed assessment and implemented water quality projects that have included filter strips, grass waterways, sediment basins and EQIP nutrient and pest management enrollments.

Lake Construction

- The Lost Grove Lake and Recreation Area project provided 60 to 75 jobs during the construction phase. Iowa State University Center for Agriculture and Rural Development (CARD) research supports that a lake of this size that exhibits good water quality will annually provide over 350,000 visits, create approximately \$20 million in local spending and will result in supporting 175 jobs. This project will provide a high quality recreational lake while at the same time providing immediate economic stimulus to the region.
- Project activities included dam construction, shoreline stabilization, boating and shore access, fish habitat enhancement and site access roads. Prior land acquisition, watershed improvements, utility relocation, dam design and road modification funding expenditures have totaled \$4.495 million (Federal Sport Fish Restoration \$2.610M, DNR Fish and Wildlife Trust Fund \$1.00M, and State Marine Fuel Tax Fund \$885,000).
- Langman Construction, Inc. was awarded the Fish Habitat, Riprap, and Shoreline Access phase of the project. The bid was for \$1.17 million. Construction commenced the week of July 25 and was completed on October 7, 2011. J.B. Holland Construction was the lowest bidder (\$4,341,437) on the Lost Grove Lake dam construction project. The DNR Natural Resource Commission approved the bid on June 10, 2010. Dam construction began in July 2010 and was completed summer 2012. Scott County Secondary Roads designed two road culvert risers on Utica Ridge Road. These risers will temporarily impound water to allow settling of sediment and nutrients, and thus, preserve the water quality of Lost Grove Lake. Arensdorf Excavating & Trucking, Inc., Anamosa, IA received the bid for \$90,090. The project was completed in December 2012.
- The boat ramp, parking lot, and pit-vault toilet construction phase of the project was bid in February 2013 and work on the \$920,000 project began in late July 2013. These items were completed in fall 2014.

The lake reached full pool in June of 2015 and has drawn numerous anglers and recreationists over the course of the past few years. Recent fish surveys show the development of an excellent fishery, with muskellunge up to 24 inches, many bluegills between 6 and 7.5 inches, and numerous largemouth bass in the 10-13 inch class sizes.

The lake was formally dedicated on October 7, 2015. Numerous speakers commented on the impact of Lost Grove Lake to the people of Scott County and beyond. Nearly a 100 people came out for the dedication of the lake. Prior to the formal dedication, many standup paddle boarders, windsurfers, swimmers, and even kite surfers were enjoying the lake, since it officially opened to the public in 2014.

Improvements continue to be made around the lake including:

- 911 addresses posted at the entrances to all infrastructure areas.
- Pit-vault toilets were installed at the middle and west boat ramps in August of 2015 (Marine Fuel Tax \$90,155)
- A maintenance agreement was established with DJ Laughlin (D&D LawnCare) to mow grass near infrastructure areas, maintenance of trails, trash removal, and snow plowing (at middle boat ramp); this was the second year a maintenance agreement with a private contractor.
- Efforts were continued to post wayfinding signage on the perimeter on the property.
- Established an agreement with Scott County Secondary Roads to complete maintenance of interior shoreline/boat ramp access roads.

Water quality at this new lake looks excellent, with low nutrient and suspended solids levels promoting the healthy establishment of some aquatic vegetation and water clarity over 6 feet observed in throughout the summer of 2015.

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Mariposa Lake, Jasper County



Background

Mariposa Lake, an 18-acre constructed lake in Jasper County, is a part of Mariposa Recreation Area and is owned and managed by the Jasper County Conservation Board. The lake and park serve as an important recreational destination and natural resource for Jasper County. According to the 2014 lake usage survey conducted by Iowa State University, Mariposa Lake sees approximately 26,000 visitors annually and accounts for about \$2.5 million in annual spending. The lake has a 32:1 lake to watershed area ratio and the watershed is 22% in public ownership.

Large amounts of sediment entering the lake over the past 50+ years have decreased the surface area and depth, creating a significant water quality problem at Mariposa. In addition, phosphorus attached to the sediment has caused algal blooms, producing poor water quality and clarity, as well as impairing the aesthetic value and aquatic life of the lake. In 2006, the JCCB began their project development with the overall goal of improving the water quality and recreational potential at Mariposa Lake. This recreation area is a very important local resource to the residents of Jasper County, and was once a destination for excellent pan fishing.

Watershed work has been completed to reduce the amount of sediment and nutrients entering the lake and ensure that restoration practices implemented within the lake have a long lifespan. Work completed to date includes acquisition and construction of a wetland on the north end of the park (completed in 2011), timber stand improvements (2010) and shoreline protection (2008). Additionally, the JCCB has installed new restroom facilities. In 2012, Jasper County Conservation installed a 3.9 acre wetland to collect runoff from 368 acres in the watershed and to help trap nutrients and sediment to prevent them from entering the lake.

Description of Work Completed	DNR Contribution:	JCCB Contribution:
Engineering Design	\$248,473.00	\$11,078.00
Wetland on North End		\$134,514.00
New Restroom		\$20,000.00
Timber Stand Improvement		\$2,596.00
Fish Habitat		\$25,000.00
Shoreline Protection		\$14,800.00

Current Restoration Work

In 2015 Jasper County hired Shive-Hattery to develop conceptual plans and engineering for a new outlet structure, sediment removal, wetland enhancement and park and angler access improvements. Shive-Hattery worked with the county conservation board to develop a sediment spoil site on their property. The lake was drawn down in the summer of 2017 to allow for in-lake restoration work to commence in the fall (top left - aerial photo of lake being drawn down).

In-lake restoration activities are helping to re-establish depth throughout the lake basin, protect the lake from wind and wave erosion, and improve the fishery at the lake through the installation of fish habitat. The infrastructure at the lake is being

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Pleasant Creek Lake, Linn County

Background

Pleasant Creek is a 401-acre lake owned by the State of Iowa with a watershed to lake ratio is 5:1. The State owns 90% of the 2,035-acre watershed. The other 10% is mainly in timber.

A meeting was held in October 2013 with DNR Parks, DNR Lake Restoration Program and the Iowa Department of Agriculture and Land Stewardship to develop a management approach and time line for restoring Pleasant Creek Lake. The plan was for DNR Fisheries and Parks to work cooperatively with IDALS to develop a watershed plan to address potential issues. Using information from the initial survey, there are some opportunities to build some gully control structures on park property and review/update land management approaches on state ground to improve water quality. In-lake restoration included shoreline riprap, shoreline deepening and fishing access improvement.

Lake Improvements

Pleasant Creek dam had a crack around the valve housing and was leaking water. Divers were hired in August 2015 to place a plate over the intake pipe so the gate valves could try to be opened. The two 10 inch valves opened, but the larger 24 inch valve was not functional; so, a new gate valve was ordered and paid for by the DNR Lake Restoration Program. Gate valve replacement was completed on October 2nd (see photos below); divers removed the plate from the intake pipe and the valve was opened to begin the lake drawdown. The planned 15 foot lake drawdown was completed on October 23rd, 2015.

Restoration work within the lake began in 2016, when Peterson Contractors was hired to complete shoreline, habitat and access work at the lake for \$2.2 million.

This phase of the project consisted of placing riprap along the raw banks at Pleasant Creek. Select areas were deepened along the shoreline to enhance angling. Waste material generated by digging out along the shoreline remained in the lake bottom and was shaped to create variations in the lake bottom designed to attract fish. These variations will be both under water and above water, and will be armored with rock for structural protection. Additionally, two jetties were constructed to provide increased angler access to deeper water. They will also act as wave breaks sheltering a boat ramp and shoreline. The main boat ramp and the boat rental area ramp were also replaced. These are the most heavily used ramps and were in need of replacement. Immediately adjacent to the main boat ramp,





an ADA boat slip was installed to provide a stable platform for boaters to enter and exit their boats.

In-lake work was completed in March of 2017. Funding included: 79% Lake Restoration Program Funds, 12% Boat Access Grants, 6% Marine Fuel Tax Funds, and 3% REAP Land Management Funds.

In the fall of 2018, project partners met to discuss additional water quality improvements within the park, including water control

structures that would stop sediment and nutrients from entering the lake and address gully erosion within the park. Storm water practices at the main boat ramp parking lot were also discussed through the installation of a bioswale.

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Prairie Rose Lake, Shelby County

Background

Prairie Rose Lake is a 173-acre constructed lake with a watershed to lake area ratio of 24:1. Low fish populations, siltation, and poor water quality plagued the lake in recent years, thus watershed and lake improvements were planned to bring this popular recreation destination back to life. Previous lake improvements included; jetties and fish structures (1998), sediment basin and shoreline riprap (2001) and sediment basins (2004); however, water quality in the lake remained poor. Prairie Rose was one of the initial list of 35 lakes prioritized for restoration by the program. The park is an important public resource and averages an estimated 41,000 annual visits and is a popular fishing and camping destination in Western Iowa.



Planning For Success

The DNR commissioned a study in 2007 to learn more about the lake and watershed and better understand what was causing degrading water quality at Prairie Rose Lake. The Shelby County Soil and Water Conservation District also conducted a watershed assessment followed by a joint Iowa Department of Agriculture and Land Stewardship / DNR Watershed Improvement Section grant to accomplish targeted soil conservation work in the watershed and reduce the amount of sediment and nutrients reaching the lake. The Shelby SWCD was awarded a \$510,611 Water Quality /Watershed Protection Project Grant in 2008. Through the Prairie Rose Water Quality Project, over 225,000 feet (40 mi.) of terraces were constructed, and numerous grassed waterways and nutrient management plans were added to the watershed reducing sediment and nutrient delivery to the lake by 60%.



In 2010 the DNR, in partnership with Pheasants Forever, acquired a 77-acre parcel adjacent to the park to initially serve as a dredge spoil containment site needed for in-lake restoration work and after restored to prairie. Rock chute wetlands and road risers were constructed on public land on the four main drainages of the lake during fall 2011/spring 2012.

The 2008 Water Quality/Watershed Protection Project led the way by reducing sediment and nutrient delivery to Prairie Rose

Project Implementation

With work in the watershed wrapping up, project partners looked to in-lake restoration to continue to improve water quality in the lake.

- The lake was dewatered in July 2011 to allow construction work in the above lake silt basin. Stabilizing the eroding shoreline and removal of 60,000 cubic yards of sediment was completed during the winter of 2011-12. The spillway modification to prevent rough fish re-entering the lake from below is now in place.
- Additional fish habitat and shoreline access has been added to the lake basin utilizing \$150,000 of DNR Trust Fund dollars. In September 2012, Prairie Rose Lake began to re-fill following the treatment of the watershed to remove undesirable fish species (e.g. common carp). By June of 2013, the lake had refilled.
- Restocking Prairie Rose Lake began in April 2013 with largemouth bass, bluegill, and channel catfish. The development of the fish population in the lake is on track. In addition to the largemouth bass, bluegill, and channel catfish populations already established in the lake, adult black crappie (800) were stocked during the fall of 2014. Fishing activity at the lake increased dramatically by 2015.
- The NRC accepted a donation of a permanent easement for storage of water for a silt retention pond adjacent to Prairie Rose State Park above the campground arm of the lake. The DNR accepted the low bid of \$109,966 to build a grade stabilization pond at this location. Construction was completed in 2015.
- The in-lake dredging project started removing sediment in mid-July of 2015. The contractor used a barge mounted excavator dumping into a slurry box because of the amount of terrestrial and aquatic vegetation. Approximately 185,000 CY of sediment was removed from Prairie Rose Lake at a cost of \$1.4 million.



Water Quality Improvements

Water quality has improved since the project was completed, with increased water clarity being observed throughout the summer months. Aquatic vegetation has also started to establish in the shallow areas of the lake, providing excellent habitat for fish and removing additional nutrients from the water. Total phosphorus concentrations (the limiting nutrient in most freshwater systems) have decreased dramatically since the projects' completion. Additionally, measures of algal biomass have also decreased, suggesting that algae blooms in the lake are less frequent and intense than previously observed.



In addition to the lake restoration, Prairie Rose State Park has made a number of improvements to provide additional recreational opportunities at the park for years to come.

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IOWA DEPARTMENT OF NATURAL RESOURCES

LEADING IOWANS IN CARING FOR OUR NATURAL RESOURCES

BRUCE TRAUTMAN, ACTING DIRECTOR

Rathbun Lake, Appanoose County



Background

Rathbun Lake, a federal flood control reservoir located in Appanoose County, is currently listed as impaired for its Class A1 (primary contact uses) due to high levels of algal and non-algal turbidity in parts of the lake. The lake frequently experiences water transparency of less than 1 meter, and the arms of the lake frequently experience dense algae blooms in the summer. A watershed improvement project for Rathbun Lake began in the late 1990's. The Rathbun Land and Water Alliance (RLWA) has spearheaded efforts in the 6-county, 354,000 acre watershed and partnered with the Iowa Department of Natural Resources (IDNR), the United States Army Corps of Engineers (USACE) and others to monitor streams in the watershed and several points in the lake. Watershed best management practices have been completed through key partnerships each year to protect water quality in Rathbun Lake. Water quality in the lake has remained relatively constant since monitoring began in the late 1990s in spite of considerable land use change in the watershed due to increasing crop prices and changes to CRP contracts. The Rathbun Land and Water Alliance has been successful in assisting 400 farmers with BMP application for priority land in 24 targeted sub-watersheds; they helped apply BMP on 16,500 acres (goal: 60,000 acres); these practices will reduce sediment delivery to Rathbun Lake by 25,600 tons per year (goal: 84,000 tons). In addition' these BMPs will reduce phosphorus delivery to Rathbun Lake by 110,400 pounds per year (goal: 360,000 pounds).

Current Restoration Activities

The Iowa DNR Lake Restoration Program has been an active partner with the U.S. Army Corps of Engineers Kansas City District since the program came into existence. In 2013 a Section 1135 Habitat Restoration Project was completed with the Army Corps of Engineers at Rathbun Lake. This project included the stabilization and restoration of habitat at nine shoreline sites. Sites were chosen based on data developed from previous Iowa DNR studies that identified the critical locations for water quality improvement. A post-construction research study has indicated substantial water quality improvements, as well as improvements in plankton production in these treated locations. Cost share for this project was awarded on a 75% Federal: 25% State basis (which included in-kind costs). The total cost of the project cost exceeded \$6 million. A second 1135 project has been initiated to explore the ability to limit fish out-migration and continue work at an additional five shoreline sites chosen by the same criteria as the previous project. These projects will result in additional water quality and spawning habitat improvements, protect important cove habitat at Rathbun Lake, and protect the fishery. Lake Restoration also entered into a partnership with the Rathbun Land and Water Alliance to provide an additional \$250,000 to fund proposed activities in the Rathbun Lake watershed. These funds are being matched with \$70,000 contributed by cooperating landowners and \$64,160 to be provided by the Rathbun Land and Water Alliance. Construction was completed in 2017 and practices installed will help reduce nutrient and sediment pollution to the lake from priority sub-watersheds.

In 2018 the LRP initiated a second round of watershed practices with the Rathbun Land and Water Alliance to construct large sediment and debris basins within the watershed to reduce sediment and phosphorus loading to the lake, through an investment of \$250,000. Basins are currently being designed, with construction to occur in the fall of 2019 and into 2020.

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Silver Lake, Dickinson County



Background

Silver Lake (Dickinson County) is a 1,032 acre natural lake located in Northwest Iowa and serves as an important regional asset. This shallow lake has at 17:1 watershed to lake area ratio and a mean depth of 7ft. According to the 2014 CARD survey, the lake receives over 40,000 visitors annually and is a popular destination for boating, fishing, and wildlife watching. Silver Lake is bordered by the City of Lake Park and Trappers Bay State Park. Water quality at the lake has declined in recent years, and the lake is currently listed as impaired for turbidity. A TMDL (Total Maximum Daily Load) report was prepared and approved for Silver Lake in 2009. Shallow water conditions, coupled with rough fish, shoreline erosion, and pollutant loading have led to frequent algae blooms and high nutrient concentrations. The local community worked to develop and began implementing a watershed management plan in 2011. The lake is currently on the priority list of lakes for restoration within the Lake Restoration Program.

Planning for Restoration

DNR began planning for restoration with the City of Lake Park, working together to develop and jointly fund a diagnostic and feasibility study to improve water quality at Silver Lake. Together, project partners hired Wenck Engineering to take a comprehensive look at the lake and watershed and determine what the sources of pollution to the lake were causing water quality issues and to develop a suite of restoration alternatives for project partners to consider. The study was completed in late 2018 and cost project partners \$130,985.00 (75% DNR, 25% City). Results from the study will be used in 2019 to determine next steps for the project.

A study examining rough fish (carp and buffalo) populations was also commissioned through Iowa State University to better understand how rough fish are impacting water quality in the lake. Rough fish have a detrimental impact on water quality as they disturb lake sediments to feet and uproot vegetation. To date, the study has tagged several hundred fish in the lake and is monitoring populations and population densities of these undesirable fish. Commercial fisherman removed over 120,000 lbs. of rough fish from the lake in the fall of 2018. Reducing population numbers of these types of fish has improved water quality in other Iowa lakes. The long term goal of this project is to determine how we can be effective at managing fish populations to promote good water quality in our lakes.

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Storm Lake, Buena Vista County



Above: Shorty's Island (Small Island) before and during construction. LRP re-built islands within Storm Lake to reduce wind and wave erosion and prevent re-suspension of bottom sediments that cause turbidity issues in Storm Lake.

Background

Storm Lake is a shallow natural lake (4th largest natural lake in Iowa) with a surface acreage of 3,104 acres and a watershed to lake ratio of 5:1. The Diagnostic / Feasibility Study and the Impaired Water's Assessment both indicated that internal loading from re-suspension of bottom sediment is the primary source of nutrient availability and water turbidity, which supported dredging as an approach to improve water quality in the lake. Recently, the project has started to shift focus to use other restoration alternatives to improve water quality in the lake.

- DNR constructed a dredge spoil site at Storm Lake in 2001 and began dredging activities in 2001/2002. Lake dredging removed 1.32 million cu./yds. of sediment at a total project cost of approximately \$4.0 million during this first year of operation. Funding limitations restricted this initial dredging activity to 180-acres of the lake.
- Between 2003 and 2017, the DNR and the City dredged 5.71 M cubic yard of sediment from the lake. As of end of year 2017, mean depth was estimated at 8.8 feet.

Lake Restoration Activities

In 2015, the City hired Dredge America to operate locally owned equipment for the final phase of dredging. Only ~170,000 cubic yards of sediment were removed in 2016 due to numerous challenges throughout the season with equipment. Repairs to the containment site, including the installation of a cross-over system between the two spoil site cells were also completed. 2017 was the final year of dredging at Storm Lake. Once again, the City partnered with DNR to remove 328,325 cubic yards from Storm Lake, resulting in an overall mean depth of 8.8 feet for the lake. An additional booster pump was added to the dredging operation in 2017 to maximize efficiency with the aging equipment. The total cost for dredging in 2017 was \$1,157,524 (\$834,021 DNR Lake Restoration Program / \$323,503 local).

ISU Storm Lake Dredging Analysis Study

Iowa State University, under the direction of Dr. John Downing, completed a study aimed to determine which areas of Storm Lake and to what depths Storm Lake could be dredged in the immediate future to yield the most reduction in sediment resuspension. In addition, this project explored alternative management scenarios that may further improve water clarity in Storm Lake.

Key take-home points from ISU Storm Lake Dredging Analysis Study

- 1) Current dredge only strategy will not be able to obtain water clarity goals unless stakeholders are willing to commit to dredging an additional 13.1 million cubic yards of sediment.
- 2) Dredging a larger surface area by removing less sediment in each location produces greater water clarity gains than dredging to deeper depths in a limited footprint.
- 4) Allowing degradation of the “big island” will have negative impacts to water quality.
- 5) If able to be successful in protecting existing islands, establishing islands independent of dredging may be a useful strategy to improve water clarity in Storm Lake.

Break Waters and Alum Treatment Analysis

FYRA engineering also completed a study that determined the composition of suspended particles in the water and what potential treatments could be used following dredging to remove those suspended particles from the water column. They also researched different compounds that could be used to settle phosphorus and sediment that was re-suspended due to dredging and wind/wave action. FYRA concluded that treating the lake with alum would help settle suspended solids when dredging at the lake was finished and improve water clarity in the lake. Finally, they proposed the installation of a number of break waters near the shoreline around the lake that would minimize shoreline erosion and re-suspension due to wind and waves. The DNR and the City of Storm Lake are currently researching and discussing these potential restoration alternatives as future phases of the project. Alum is frequently used in lake systems to remove phosphorus from the water column and floc and settle fine sediment particles to improve overall water clarity. An alum treatment at Storm Lake would improve water clarity and promote vegetation growth in the shallow waters around the lake’s edge. Aquatic plants are vital for a healthy sport fishery, help minimize sediment re-suspension, and remove nutrients from the water that would otherwise be used for algae production.

Rebuilding the Islands in the Lake

DNR Engineering worked to re-design the small island lake (Shorty’s Island) along the eastern shore of Storm Lake. The re-built island will help prevent shoreline erosion and help reduce sediment re-suspension due to wind and wave action by acting as a breakwater. The project was bid out in the summer of 2017, with the majority of the construction being completed during the summer and fall months. Low water conditions and wind prevented some of the work from being completed on schedule, thus some minor finish work was completed in 2018. Shekar Engineering was hired to re-build and enhance the island for a total cost of \$545,702.

Re-building the large island in the lake was bid in 2018 and constructed over the summer months. The total cost for the project was \$389,025.00. Additionally, the Fisheries Bureau secured funding in 2018 to re-build the Chautauqua jetty. In conjunction with breakwater construction, an alum treatment is being considered at the lake.

Next Steps for the Project

Additionally, DNR initiated a study with Iowa State University in 2017 to better understand how rough fish (carp and buffalo) populations are affecting water clarity at Storm Lake. This five-year study is establishing a population biomass for rough fish and determining if commercial fishing to reduce these population sizes can be an effective way at improving water quality. Rough fish are not desirable to most anglers and stir up bottom sediments in lakes, releasing sediment and nutrients into the water column. In shallow lakes, they can be particularly detrimental, eliminating vegetation that stabilizes the sediments and increasing turbidity. Removal of these fish can help improve overall water clarity. Commercial fishing is one way to target these groups of fish in the lake. This method for improving water quality has been applied at Lost Island Lake successfully in the past.



DNR fisheries staff, lake restoration staff, city officials, and other project partners continue to meet regularly to discuss other alternatives for improving water quality and decreasing long-term sediment mobility in Storm Lake.

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Three Mile Lake, Union County

Background

Three Mile Lake is an 880-acre reservoir in Southern Iowa that serves as a popular recreation destination and drinking water source for the Southern Iowa Rural Water Association. Impounded in 1995, the lake has nearly 24 miles of shoreline that draws over 77,000 estimated annual visits for a variety of different types of recreation, including: fishing, boating, wildlife watching, and public hunting. There is a well-developed camp ground with cabins and a lodge near the lakeshore. With a 26:1 watershed to lake area ratio and steep slopes with highly erodible soils in the watershed, sedimentation in the lake and high turbidity levels are of concern. While the lake has excellent water quality relative to many other Iowa lakes, the Lake Restoration Program began meeting with project partners



in 2015 to discuss ways to preserve its water quality and make needed infrastructure improvements to the lake, as well as initiate a watershed improvement project to minimize sediment and nutrients being delivered to the lake.

Recognizing the potential for agricultural nonpoint source pollution risks to Three Mile Lake, local sponsors and natural resource agency staff initiated a watershed project in 1991 to assist watershed producers in implementing best management practices that would protect the lake once construction was complete. While conservation efforts did a lot to protect the then-new lake, recently, water quality in the lake has begun to decline with dramatic increases in the suspended solids concentration, thus additional watershed and in-lake restoration and protective measures are needed.

Current Restoration Activities

To address concerns both in the lake and the watershed, a project technical advisory team was formed. DNR hired the Soil and Water Conservation District to complete a watershed assessment to determine where additional best management practices would most benefit the lake. DNR also completed a fishery renovation in September of 2016 to attempt to eliminate the yellow bass population in the lake. Yellow bass can have a detrimental effect on the sport fishery in man-made lakes. Unfortunately, the bass were found again shortly following the renovation.

While the lake was partial drawn down to complete the fishery renovation, DNR worked to armor critical sections of shoreline that were eroding to prevent suspended sediment pollution and additional erosion. Tri-Smith Construction, LLC, was hired to shape and armor shoreline with rip rap for \$716,287.04 using Marine Fuel Tax Funds.

Future Restoration Activities

The DNR plans to perform in-lake improvements within the next 5 years, as the project partners continue to work together to implement additional best management practices in the watershed. Proposed restoration activities include some shoreline deepening and armoring, installation of fishing jetties and habitat, and installation of a break water near the main boat ramp to protect the shores from wind and wave action.

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Twelve Mile Creek Lake, Union County

Background

Twelve Mile Lake is a 595 acre lake with a 17 ft. mean depth and 42 ft. max depth. This multi-use resource (Wildlife Management Area) has a 14,080 acre watershed and 24:1 acre watershed to lake ratio. During its peak in the late 90's Twelve Mile held nearly 30 fishing tournaments per year. By 2004, that number dropped to two. There were problems with common carp, decrease in water quality and drinking water required additional treatment.



Restoration Activities

Work began in 2005 to improve water quality. Work included shoreline protection, terraces, buffers and sediment structures placed in the watershed. DNR renovated the fishery and re-stocked the lake. Since these restoration efforts, Twelve Mile still has above average water quality compared to other IA lakes. Rooted vegetation has re-established in some areas with a recent trend of stable water quality. Twelve Mile continues to be in the top 1/3 in visitation. Over 50% of the anglers recently fishing 12-Mile are from > 50 miles away (twice what we normally see). Tournaments once again are scheduled throughout the open water season.

- A 40-acre wetland was constructed on the north end of Twelve Mile Lake in 2014 to retain nutrients and sediment. The project was delayed several times in 2014 due to record summer rainfall in southern Iowa. The wetland was constructed at a cost of \$447,291 (\$297,291 Lake Restoration Program / \$75,000 North American Wetlands Conservation Act funds / \$75,000 State Duck Stamp).
- Lake Restoration Program and DNR Wildlife funds were used to help survey the Twelve Mile Lake watershed and implement three grade control structures in the watershed.
- 12-Mile Creek Lake has developed into a popular fishery since renovation. There are good numbers of 14-16 inch largemouth bass, and a few bass exceed 16 inches. Bluegills up to 10 inches are available to anglers at 12-Mile Creek Lake as well as moderate numbers of yellow perch and crappies in the 9-11 inch length range.

The wetland will further protect this valuable resource and add additional recreational opportunities for the community. Located at the upper end of permanent pool, the wetland is expected to remove and store sediment/nutrients in runoff and compliments continued work in the watershed, which is important to the goal to improve/maintain water quality for the main lake.

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North and South Twin Lake, Calhoun County

Background

North Twin Lake and South Twin Lake are two natural, glacial lakes located 4 miles north of Rockwell City. Together, the two lakes form a natural lake complex, in which the outflow of North Twin serves as the primary inflow into South Twin Lake. The two lakes have a relatively small watershed to lake area ratio of 4.6:1 for North Twin and 6:1 for South Twin. The majority of land in both watersheds is row crop agriculture. Both lakes also have high visitation rates, with an estimated visitation of over 44,000 visits annually.



Both lakes suffer from poor water quality associated with nutrient enriched systems. Problems associated with this nutrient enrichment commonly observed at the Twin lakes include low water transparency, high concentrations of suspended solids, high sedimentation rates, frequent blue-green (cyanobacteria) blooms, and frequent winter fish kills. Both lakes are currently listed as impaired due to high levels of algae and turbidity. Because of the small watershed area, high public use, and water quality issues, these lakes were identified as good candidates for the Lake Restoration Program.

Project partners worked together to hire Iowa State University to complete a Diagnostic and Feasibility study for the Twin Lakes. The study, completed in 2016, called for a 65% reduction of phosphorus from the watershed to improve overall water clarity in the lake. A variety of in-lake and watershed restoration alternatives were presented to the community in the summer of 2016 for consideration as part of a complete restoration plan for the lakes.

The LRP partnered IDALS and DNR's Watershed Improvement Section to hire a part-time project coordinator to develop a comprehensive watershed action plan and begin working with landowners in the watershed to implement conservation practices on to reduce nutrient and sediment inputs to the lake. The plan was completed in December 2017 and will serve as a road map implementing projects in the watershed.

Current Restoration Work

A study examining rough fish (carp and buffalo) populations was also initiated in partnership with Iowa State University to better understand how rough fish are impacting water quality in the lake. Rough fish have a detrimental impact on water quality as they disturb lake sediments to feet and uproot vegetation. To date, the study has tagged over a thousand fish in the lake and is monitoring populations and population densities of these undesirable fish. Reducing population numbers of these types of fish has improved water quality in other Iowa lakes. The long term goal of this project is to determine how we can be effective at managing fish populations to promote good water quality in our lakes. In 2018, the DNR solicited bids for a commercial fishing business to remove these fish and sell them to a commercial market, effectively reducing the population to improve water quality. DNR is incentivizing the harvest of these fish to ensure high abundances of carp are removed from the lake.

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Union Grove Lake, Tama County

Background

Union Grove is a 105-acre shallow constructed lake owned by the State of Iowa, with a watershed to lake area ratio of 63:1. It has 6,640 acres in the watershed with the vast majority is in private ownership. In the late 1980s, the state dredged the lake and installed an in-lake silt and nutrient dike on the north end of the lake. The DNR also purchased an additional 60-acre parcel on the southwest side of the park and constructed a 10-acre pond. Union Grove Lake dredging, from 1988 – 1990, involved removal of 275,000 cubic yards of sediment accumulated since the lake was built in 1936.

Spillway water seepage had been an on-going problem at Union Grove Lake and past attempts to repair the problem had limited success. DNR hired a geo-tech firm in 2005 to evaluate the problem and contracted a firm in 2006 to repair the structure. The DNR completed the project in July of 2007 and successfully addressed the water seepage issue. Total project cost for the spillway repair was \$178,572, with the Lake Restoration Program as the funding source. The construction firm also made several recommendations for additional future spillway modifications that will preserve the integrity of the system at an estimated cost of \$40,000.

Union Grove Lake is on the Iowa's impaired waters list because of four limitations: pH, bacteria, algae, and turbidity. The Union Grove Lake Watershed Project has been underway since April of 2008. The project aims to reduce the soil and phosphorus reaching the lake, as well as reduce the effects of livestock on streams in the watershed.

As progress continued in the watershed, a 116-acre parcel at the top of the lake went to auction. This strategically important piece of land that filters 40 percent of the watershed

was purchased by the Iowa Natural Heritage Foundation and held until the DNR's watershed improvement section, using EPA section 319 funds, and local supporters could purchase the \$695,000 parcel. This acquisition will be seeded with perennial prairie grasses and an existing wetland will be expanded providing permanent water quality protection for the lake.

Local partners, with the DNR have updated the plan to improve the lake and water quality conditions. The Tama SWCD Watershed Project Coordinator worked to revise and approve the Management Plan. In addition, the Tama County Sanitarian completed a report on a septic plan for the lake community.

In-Lake Restoration Work

In 2015, Union Grove Lake was drawn down to prepare for many in-lake renovations (see photo below). DNR engineering worked to survey and plan for extensive shoreline stabilization at the lake, modification of the spillway, installation of an effective fish barrier, and dredging to restore depth to the lake, especially in many near shore areas. Fisheries staff also worked to plan a complete renovation of the fishery and installation of fish habitat around the lake.





Throughout the winter of 2015/2016, shoreline stabilization was completed around the perimeter of the lake to prevent future shoreline erosion and establish additional fish habitat around the lake (See picture at left). Most of the actively eroding areas of the shoreline were armored, costing a total of \$339,769 (25% Lake Restoration Program; 75% Marine Fuel Tax). Work was completed, save for one area that was not easily accessible. This

remaining section was completed February 2016. In spring of 2016, the watershed was chemically renovated to eliminate rough fish (carp) from the lake and watershed. Following the fishery renovation, the valve was closed and the lake was allowed to re-fill.

Hydraulic dredging (see photo on previous page) was completed in 2016 following construction of the containment site on the Northwest side of the lake. Construction was completed on the containment site throughout the 2015 and 2016 construction seasons for a total of \$130,001 by the Kinman Company Inc. Dredging was the final phase of the active restoration project. Southwind Construction Corp. was hired to dredge 250,000 CY from the lake bottom, increasing the mean depth of the lake from 7.5 to 9.5 feet. This included removing sediment from above the existing in-lake silt dam which restored the effectiveness of the silt dam. Increased depth throughout the lake will help limit excessive aquatic vegetation growth, increase water clarity, and improve the health of the fishery. The total cost for hydraulic dredging was \$1,591,531 (100% LRP). The DNR Fisheries bureau began re-stocking the lake after it reached full pool, with the expectation that pan fish will reach 8-10 inches within the next two years.

Vegetation following the restoration was a concern in 2017. DNR Fisheries worked with local partners to chemically remove excess vegetation throughout the lake over the summer. An active vegetation management plan was developed to guide vegetation management at the lake for the coming years.

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Lake Restoration Program – Other Program Activities

Ambient Lake Monitoring

The IDNR invests in monitoring the status and trends of many of Iowa's publicly owned lakes. Data are collected three times each growing season (once in early summer/late spring, once in mid-summer, and once on late summer/early fall) to better understand water quality at Iowa's Lakes.

The program was created in 2000 based on lake surveys completed by Bachmann in the late 1970s and early 1990s. Currently the program includes 135 lakes throughout the state; they are monitored for chemical, physical, and biological parameter. Data are used to inform stakeholders, determine the impairment status of lakes in the state, establish water quality trends, and prioritize lakes for restoration. All data collected are made available to the public through Iowa AQUIA (online database) or through a records request made to the DNR.

The Lakes Restoration Program (LRP) has served as a partner in this monitoring program since its inception in 2000. Currently, the LRP funds a 40% cost share for monitoring program with the Water Quality Monitoring and Assessment Section in the Water Quality Bureau. Iowa State University is contracted with DNR to conduct monitoring for 2018-2020. Data collected as a part of this program are currently being used to inform restoration decisions and feed the water quality portion of the lake restoration prioritization process (see below). Water quality data collected through this program are also used in conjunction with the CARD survey data (shown above) to determine how Iowans value/perceive water quality and how water quality influences lake visitation and spending rates.

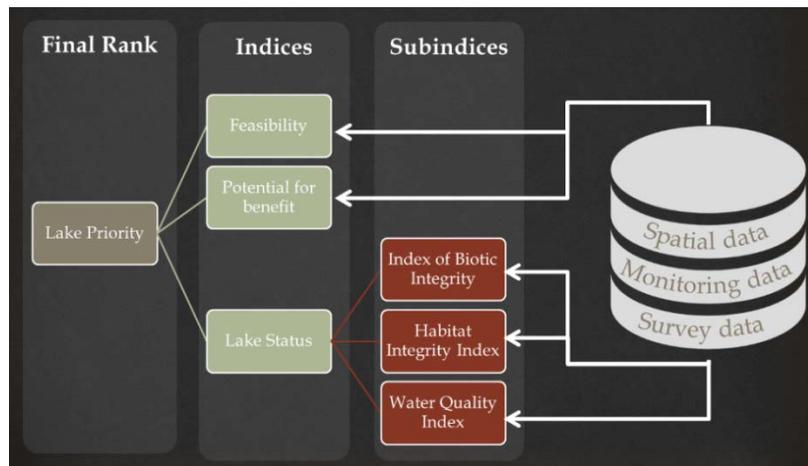
Lake Prioritization Process

The Lake Restoration Program initially ranked 127 public lakes for lake restoration priorities in 2006. A group of thirty-five lakes, considered highest priority for restoration, was established and served as a starting point for identifying potential lake restoration projects. Ranking indices used lake water quality data and watershed characteristics to create groups of good, fair, or poor lakes and watersheds. The department used these descriptions to categorize lakes into management action groups.

The initial list of thirty-five significant publicly-owned lakes was prioritized for funding based on the feasibility of each lake for restoration and the use or potential use of the lake, if restored. The list included lake projects under active development that the department recommended be given priority for funding so long as progress toward completion of the projects remained consistent with the goals of the program. Additional lakes have since been added to the priority list after communities have successfully petitioned the director of the department or were prioritized by the department based on the feasibility of the lake for restoration and the use or potential use of the lake, if restored.

DNR reviews projects annually to determine which lakes have the best potential for lake restoration. This process works in parallel with determining local interest and development of goals with the community that meet restoration objectives. Until watershed best management practices protect the lake, restoration work cannot move forward, therefore lakes with well-documented watershed protections are the best candidates for restoration. Local commitment and community support is another key component in determining which lakes receive funding for restoration.

The LRP uses cost benefit analysis to determine how lowans will benefit from potential restoration projects. We also work to identify non-economic benefits to people and our natural resources when considering new projects for restoration. Computing and documenting the economic benefits, recreation benefits, health benefits, and natural resource/environmental benefits of lake improvements are a great asset to the lake restoration process. Thus, in 2013, the program began to develop new metrics to rank our significant publically owned lakes in terms of their potential for meeting program goals that will allow us to make more informed decisions regarding where restorations dollars will be most beneficial to the public. The conceptual framework for this process is provided in the graphic below:



A water quality index for Iowa’s lakes was developed in 2015 to examine how Iowa lakes compare to one another using several key water quality parameters collected through the Ambient Lake Monitoring Program. This index allows the LRP to compare lakes in a consistent framework and prioritize those most in need of better water quality.

The feasibility index was also updated in 2015 using updated RUSLE (Revised Universal Soil Loss Equation) calculations based on recent watershed land use data and the watershed to lake surface area ratio. This index allows the LRP to better understand how likely a watershed and in-lake restoration project is to succeed if implemented.

Finally, the potential for benefit index was updated using recently collected CARD survey data that evaluated the visitation rates at each lake and the economic impact of each lake, so the LRP can prioritize lakes that will have a high impact on lowans and provide quality recreational experiences at lakes around the state.

Future work in LRP prioritization process includes the development and revision of additional indices. Additional work will incorporate new geographic data collected for each watershed, Creel survey data collected at our lakes, habitat and biological data collected at our lakes, and other metrics that will help us identify future candidate lakes for funding.

Social/Economic Impacts of Lakes in Iowa (CARD Survey)

The Iowa Lakes Valuation Project (CARD Survey) is an ongoing economic study funded by the Lake Restoration Program that identifies where and how frequently lowans use their lakes and the value of good water quality at those lakes. The survey was first conducted in 2002 through the Center for Agricultural and Rural Development (CARD) at Iowa State University, coupling survey data collected from lowans across the

state and water quality data collected through the Ambient Lake Monitoring Program. Since the program's inception, the survey has been carried out in 2002, 2003, 2004, 2005, 2009, and 2014, and is jointly funded by the Iowa DNR LRP and the U.S. Environmental Protection Agency. More information on the survey and data collected through the survey can be found at:

<http://www.card.iastate.edu/lakes/>.

The 2014 survey was sent to nearly 7000 Iowa households, with a 52% response rate. Respondents were asked about the number of trips and which lakes they made trips to in 2014. They were also asked about the activities they engaged in while visiting the 139 lakes included in the survey. Additionally, they were asked questions about their perception of water quality at the lakes they visited and pollution sources at Iowa's lakes. Finally, respondents were asked about social media that they currently use and which news and social media outlets they use for sharing and gathering information about Iowa lakes.

Results of the 2014 survey are consistent with previous years. About 60% of Iowans visit a lake at least one time per year, with the average of 8 single-day trips made by those who responded to the survey. Visitation rates at Iowa's lake remain relatively stable (and high). Iowans do a variety of activities when they visit our lakes, including relaxing/picnicking, fishing, wildlife viewing, and boating. Lakes that have the highest visitation rates are near urban areas, and usually have above average water quality. Complete results from the 2014 survey can be viewed at:

http://www.card.iastate.edu/ag_policy_review/f15-lakes/.

The Survey will be completed again in 2019. DNR staff met with CARD in 2018 to begin formulating the survey and determining what questions to ask and how to sample Iowans for the 2019 survey.

Rough Fish Biomass and Commercial Fishing Study

Common carp and bigmouth buffalo negatively impact water quality in many Iowa lakes. Common carp can extensively alter their environments due to high reproductive rates and through their feed habits, which consist of grubbing through bottom sediments and uprooting aquatic vegetation to find food. As a result, they are commonly associated with low water clarity and an overabundance of nutrients, especially in shallow lakes. The DNR has worked to eradicate common carp, as well as other species of rough fish, from our restoration lakes in an effort to improve water clarity and reduce internal nutrient loading associated with disturbing the bottom sediments of lakes. Complete removal of rough fish from a lake is a commonly used restoration practice, however; in some systems it is not feasible, and complete eradication of carp and other undesirable fishes can result in excessive aquatic plant growth following restoration.

A pilot study was conducted between 2008 and 2013 at Lost Island Lake, a large natural lake in Palo Alto County, where DNR incentivized commercial fishing for common carp in an effort to reduce the overall population size and biomass of carp in the lake and improve water quality. At the start of the project in 2008, Lost Island Lake had an estimated common carp population of ~450 lbs./acre. With biomass reduced to about ~70 lbs./acre, water clarity improved greatly (from ~1.5 ft. in 2008 to over 7 feet in 2013). Because the efforts were so successful at Lost Island Lake, the Lake Restoration Program intends to employ this strategy at a number of other priority restoration lakes as a part of a comprehensive restoration plan.

The purpose of this study is to collect biomass and population size estimates over a four year period for common carp and bigmouth buffalo for four priority restoration natural lakes in Iowa (Center Lake and Silver Lake – Dickinson County, Five Island Lake – Emmet County, Storm Lake – Buena Vista County), and provide incentives for the commercial harvest of common carp to reduce the overall population of these fishes in the targeted lakes. This portion of the study will be completed by Dr. Mike Weber at Iowa State University. Additionally, DNR Fisheries is gathering data on two additional lakes: Blue Lake – Monona County and the Twin Lakes – Calhoun County, both of which are priority systems for the Lake Restoration Program.

The DNR will use the information gathered and analyzed to assess how controlling the biomass of carp and bigmouth buffalo through commercial harvest can improve water quality in shallow natural lakes. This strategy of incentivizing a commercial fisher to aggressively harvest nuisance fish species has the potential to be used for future projects because it will balance improved water quality and excessive aquatic vegetation growth. Data will also be used to create target biomasses for carp and bigmouth buffalo populations in our shallow natural lakes, where water quality goals are achieved without excessive vegetation. Total costs for this five year study are \$397,139.

With at least a year of monitoring data completed, commercial fishing contracts (both incentivized and non-incentivized) are being issued for 2019. Using the biomass estimates collected to date, incentivized harvests will be completed at Center Lake (Dickinson County) and at North Twin Lake (Calhoun County).

Lake Restoration Program – Partnerships and Outreach

Local, State, and Federal Partnerships

In order to achieve lake restoration goals it is critical that the DNR form effective watershed partnerships. This includes partnerships at the local level, but also at administrative levels of government. Local, state and federal programs offer a multitude of programs for financial assistance to landowners for soil conservation and other water quality protection practices. The strategy pursued in the lake restoration program will be to seek out key individuals with expertise at the local level and the program administration level. This expertise will maximize access to financial incentives for landowner participation in watershed improvement and lake restoration projects. Listed below are several examples of potential partners in watershed improvement and lake restoration.

Local:

- Chamber of Commerce, City/Town Mayors and Councils
- Conservation and Recreation Clubs and Organizations
- County Board of Supervisors, County Conservation Board
- DNR Field Offices (Environmental Services, Fisheries, Forestry, Parks, Wildlife)
- IDALS/ Division of Soil Conservation and Water Quality– Project Coordinators
- IOWATER Volunteers / Educators / Interested Citizens
- Lake Associations / Groups / Watershed Organizations / Private Landowners
- Soil and Water Conservation Districts (SWCD)
- Resource Conservation and Development (RC&D)

State:

- IDALS/ Division of Soil Conservation and Water Quality

- Iowa Department of Transportation
- Iowa Environmental Council
- Iowa Farm Bureau
- Iowa Natural Heritage Foundation
- State Revolving Fund

Federal:

- U. S. Environmental Protection Agency / U.S. Fish and Wildlife Service
- Natural Resources Conservation Service
- U.S. Army Corps of Engineers / U.S. Geological Survey

Communication Tools and Strategies

The DNR, in cooperation with Iowa Department of Agriculture Land Stewardship (IDALS), has worked to develop a holistic approach to locally led watershed projects and information to help guide communities through the process of water quality improvement projects.

First Steps for Cleaner Water

<http://www.iowadnr.gov/Environment/WaterQuality/LakeRestoration.aspx>

Community Watershed Improvement Framework for Lakes

<http://www.iowadnr.gov/Environment/WaterQuality/LakeRestoration.aspx>

People will find these brochures useful as handouts at meetings. In addition to brochure type handouts, a number of communication and outreach tools for the public and lake stakeholders will be considered as deemed appropriate, including: display/kiosk, lake restoration tool kit and workshop, newsletters, opinion surveys, web site. For example, the Lakes Program developed a one-page handout that summarizes the Lake Restoration Process. This has proved to be a useful tool in communicate the important aspects of the program to the public.

Appendices

Appendix A. House File 2782 – Enrolled

PAG LIN

1 1 HOUSE FILE 2782

1 2

1 3 AN ACT

1 4 RELATING TO AND MAKING APPROPRIATIONS TO STATE DEPARTMENTS

1 5 AND AGENCIES FROM THE REBUILD IOWA INFRASTRUCTURE FUND,

1 6 ENVIRONMENT FIRST FUND, TOBACCO SETTLEMENT TRUST FUND,

1 7 VERTICAL INFRASTRUCTURE FUND, THE ENDOWMENT FOR IOWA'S

1 8 HEALTH RESTRICTED CAPITALS FUND, THE TECHNOLOGY REINVEST-

1 9 MENT FUND, THE ENDOWMENT FOR IOWA'S HEALTH ACCOUNT, THE

1 10 PUBLIC TRANSIT INFRASTRUCTURE GRANT FUND, THE IOWA GREAT

1 11 PLACES PROGRAM FUND, AND RELATED MATTERS AND PROVIDING

1 12 IMMEDIATE, RETROACTIVE, AND FUTURE EFFECTIVE DATES.

1 13

1 14 BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF IOWA:

31 13 Sec. 26. NEW SECTION. 456A.33B LAKE RESTORATION PLAN AND

31 14 REPORT.

31 15 1. It is the intent of the general assembly that the

31 16 department of natural resources shall develop annually a lake

31 17 restoration plan and report that shall be submitted to the

31 18 joint appropriations subcommittee on transportation,

31 19 infrastructure, and capitals and the legislative services

31 20 agency by no later than January 1 of each year. The plan and

31 21 report shall include the department's plans and

31 22 recommendations for lake restoration projects to receive

31 23 funding consistent with the process and criteria provided in

31 24 this section, and shall include the department's assessment of

31 25 the progress and results of projects funded with moneys

31 26 appropriated under this section.

31 27 The department shall recommend funding for lake restoration

31 28 projects that are designed to achieve the following goals:

31 29 a. Ensure a cost-effective, positive return on investment

31 30 for the citizens of Iowa.

31 31 b. Ensure local community commitment to lake and watershed

31 32 protection.

31 33 c. Ensure significant improvement in water clarity,

31 34 safety, and quality of Iowa lakes.

31 35 d. Provide for a sustainable, healthy, functioning lake

32 1 system.

32 2 e. Result in the removal of the lake from the impaired

32 3 waters list.

32 4 2. The process and criteria the department shall utilize

32 5 to recommend funding for lake restoration projects shall be as

32 6 follows:

32 7 a. The department shall develop an initial list of not

32 8 more than thirty-five significant public lakes to be
32 9 considered for funding based on the feasibility of each lake
32 10 for restoration and the use or potential use of the lake, if
32 11 restored. The list shall include lake projects under active
32 12 development that the department shall recommend be given
32 13 priority for funding so long as progress toward completion of
32 14 the projects remains consistent with the goals of this
32 15 section.

32 16 b. The department shall meet with representatives of
32 17 communities where lakes on the initial list are located to
32 18 provide an initial lake restoration assessment and to explain
32 19 the process and criteria for receiving lake restoration
32 20 funding. Communities with lakes not included on the initial
32 21 list may petition the director of the department for a
32 22 preliminary lake restoration assessment and explanation of the
32 23 funding process and criteria. The department shall work with
32 24 representatives of each community to develop a joint lake
32 25 restoration action plan. At a minimum, each joint action plan
32 26 shall document the causes, sources, and magnitude of lake
32 27 impairment, evaluate the feasibility of the lake and watershed
32 28 restoration options, establish water quality goals and a
32 29 schedule for attainment, assess the economic benefits of the
32 30 project, identify the sources and amounts of any leveraged
32 31 funds, and describe the community's commitment to the project,
32 32 including local funding. The community's commitment to the
32 33 project may include moneys to fund a lake diagnostic study and
32 34 watershed assessment, including development of a TMDL (total
32 35 maximum daily load).

33 1 c. Each joint lake restoration plan shall comply with the
33 2 following guidelines:

33 3 (1) Biologic controls will be utilized to the maximum
33 4 extent, wherever possible.

33 5 (2) If proposed, dredging of the lake will be conducted to
33 6 a mean depth of at least ten feet to gain water quality
33 7 benefits unless a combination of biologic and structural
33 8 controls is sufficient to assure water quality targets will be
33 9 achieved at a shallower average water depth.

33 10 (3) The costs of lake restoration will include the
33 11 maintenance costs of improvements to the lake.

33 12 (4) Delivery of phosphorous and sediment from the
33 13 watershed will be controlled and in place before lake
33 14 restoration begins. Loads of phosphorous and sediment, in
33 15 conjunction with in-lake management, will meet or exceed the
33 16 following water quality targets:

33 17 (a) Clarity. A four-and-one-half-foot secchi depth will
33 18 be achieved fifty percent of the time from April 1 through
33 19 September 30.

33 20 (b) Safety. Beaches will meet water quality standards for
33 21 recreational use.

33 22 (c) Biota. A diverse, balanced, and sustainable aquatic
33 23 community will be maintained.

33 24 (d) Sustainability. The water quality benefits of the
33 25 restoration efforts will be sustained for at least fifty
33 26 years.

33 27 d. The department shall evaluate the joint action plans
33 28 and prioritize the plans based on the criteria required in
33 29 this section. The department's annual lake restoration plan
33 30 and report shall include the prioritized list and the amounts
33 31 of state and other funding the department recommends for each
33 32 lake restoration project. The department may seek public
33 33 comment on its recommendations prior to submitting the plan
33 34 and report to the general assembly.

Senate File 2324 – Final Draft

SF 2324 (LSB 5018SV (8) 86)

RELATING TO AND MAKING APPROPRIATIONS TO STATE DEPARTMENTS AND AGENCIES FROM THE REBUILD IOWA INFRASTRUCTURE FUND, THE STATE BOND REPAYMENT FUND, THE TECHNOLOGY REINVESTMENT FUND, AND THE PRISON BONDING FUND, PROVIDING FOR RELATED MATTERS, AND INCLUDING EFFECTIVE DATE AND RETROACTIVE APPLICABILITY PROVISIONS.

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF IOWA:

DIVISION V
SHALLOW LAKES

Sec. 15. Section 456A.33B, Code 2016, is amended by adding the following new subsection:

NEW SUBSECTION. 01. For purposes of this section, unless the context otherwise requires:

a. "Lake" includes a significant public lake and a public shallow lake or wetland.

b. "Public shallow lake or wetland" means a water body that meets the following criteria:

(1) Is owned by the federal government, the state of Iowa, a county, or a municipal government, and is maintained principally for public use.

(2) Is a multi-use system capable of supporting diverse wildlife, fish, or recreational opportunities.

(3) Has a surface water area of at least ten acres.

(4) Does not have a watershed-to-lake surface area ratio of greater than two hundred to one.

(5) Is an open freshwater system where maximum depth is typically less than six to eight feet at its deepest spot and is under four and one-half feet mean depth.

(6) Is typically fringed by a border of emergent vegetation in water depth less than six feet and when clear is dominated by both emergent and submergent vegetation and provides important wildlife and fish habitat.

c. "Significant public lake" means a lake that meets all of the following criteria:

(1) Is owned by the federal government, the state of Iowa, a county, or a municipal government, and is maintained principally for public use.

(2) Is a multi-use system capable of supporting diverse wildlife, fish, or recreational opportunities.

(3) Has a surface water area of at least ten acres.

(4) Does not have a watershed-to-lake surface area ratio of greater than two hundred to one.

(5) Is not an on-stream impoundment that emulates riverine habitat rather than a lake environment.

(6) Is not used solely as a water supply reservoir.

Sec. 16. Section 456A.33B, subsection 1, paragraph b, Code 2016, is amended by adding the following new subparagraph:

NEW SUBPARAGRAPH. (6) When restored, will contribute to the

department's fish and wildlife conservation plans.

Sec. 17. Section 456A.33B, subsection 2, paragraphs a and b, Code 2016, are amended to read as follows:

a. The department, with input from stakeholders, shall ~~develop~~ maintain an initial annual list of not more than thirty-five significant public lakes and not more than five public shallow lakes or wetlands to be considered for funding based on the feasibility of restoring each lake and the use or potential use of the lake, if restored. The list shall include lake projects under active development that the department shall recommend be given priority for funding so long as progress toward completion of the projects remains consistent with the goals of this section.

b. The department shall meet with stakeholders and representatives of communities where lakes on the initial annual list are located to provide an initial annual lake restoration assessment and to explain the process and criteria for receiving lake restoration funding. Communities with lakes not included on the initial annual list may petition the director of the department for a preliminary lake restoration assessment and explanation of the funding process and criteria. The department shall work with stakeholders and representatives of each community to develop a joint lake restoration action plan. At a minimum, each joint action plan shall document the causes, sources, and magnitude of lake impairment, evaluate the feasibility of the lake and watershed restoration options, establish water quality and fishery and wildlife goals and a schedule for attainment, describe long-term management actions, assess the economic benefits of the project, identify the sources and amounts of any leveraged funds, and describe the community's commitment to the project, including local funding. The stakeholders' and community's commitment to the project may include moneys to fund a lake diagnostic study and watershed assessment, including development of a TMDL (total maximum daily load).

Sec. 18. Section 456A.33B, subsection 2, paragraph c, subparagraph (2), Code 2016, is amended to read as follows:

(2) If proposed, dredging of the lake will be conducted to a mean depth of at least ~~ten~~ eight feet to gain water quality benefits unless a combination of biologic and structural controls is sufficient to assure water quality targets will be achieved at a shallower average water depth.

Sec. 19. Section 456A.33B, subsection 2, paragraph d, Code 2016, is amended to read as follows:

d. The department shall evaluate the joint action plans and prioritize the plans based on the criteria required in this section. The department's annual lake restoration plan and report shall include the prioritized list and the amounts of state and other funding the department recommends for each lake restoration project. The department ~~may~~ shall seek public comment on its recommendations prior to submitting the plan and report to the general assembly.

Appendix B. Significant, Publicly-owned Lakes – Defined

Bachmann (1980). “Clean Lakes Classification Study of Iowa’s Lakes for Restoration”.

Authors: Roger W. Bachmann, Mark R. Johnson, Marianne V. Moore, Terry A. Noonan
Iowa Cooperative Fisheries Research Unit, Iowa State University, Department of Animal Ecology

Introduction

Approximately 175 lakes and reservoirs were considered by the Iowa Conservation Commission (ICC) staff for inclusion into the list of lakes to be surveyed and classified. Many of these 175 lakes are contained in “Iowa Fishing Guide”, a publication of the ICC. Time and money precluded survey and classification of all the lakes; therefore, the list was reduced to include only significant lakes in public ownership.

Significant Lakes – Defined and Explained

Significant publicly-owned lakes were defined as those lakes which are principally maintained for public use containing a minimum surface area of 10 acres and capable of supporting fish stocks of at least 200 pounds per acre. Species diversity in water bodies containing less than 10 acres is habitually low resulting in a fish density with minimal potential for maximum sustained yields via sport or food fish fisheries. Shallow lakes, which are most characteristic of wetlands and marsh-like habitat that are subject to chronic and extensive fish winterkills, were excluded from the survey. Establishment of productive fish populations is hopeless where massive mortality results from the lowering of life supporting oxygen concentrations under ice cover each winter. Federal-owned on-stream impoundment constructed for floodwater supplies were excluded because of Clean Water Act regulations. Multi-purpose lakes providing domestic water supply as only one of several major management objectives were included in the study. Impoundments containing a watershed to surface area ratio greater than 200:1 acres were omitted from the list since they are mainly on-stream impoundments formed by lowhead dams and emulate riverine habitat rather than lake environment.

Section 305 (b) report (2000)

Section 314 (a) (2) of the federal Clean Water Act of 1987 requires each state to include in its biennial Section 305 (b) report specific information on the water quality conditions and trends of the state’s “significant, publicly-owned lakes,” as well as a description of the state’s lake protection and restoration programs. In Iowa, “significant, publicly-owned lakes” are defined as those publicly-owned lakes that meet all of the following criteria:

- are maintained principally for public use;
- are capable of supporting fish stocks of at least 200 pounds per acre;
- have a surface water area of at least 10 acres;
- have a watershed to lake surface area ratio of less than 200:1;
- are not shallow marsh-like lakes, federal flood control impoundments, or used solely as water supply reservoirs.

As such, the 115 significant, publicly-owned lakes (SPOLs) represent a subset of the Iowa’s approximately 5,400 lakes, ponds, and reservoirs.

Lake Restoration Program (2015)

For the purpose of Iowa’s Lake Restoration Program, “significant, publicly-owned lakes” are defined as those publicly-owned lakes that meet all of the following criteria:

- are maintained principally for public use;
- are multi use systems capable of supporting a viable sport fishery and recreational opportunities;
- have a surface water area of at least 10 acres;
- have a watershed to lake surface area ratio of less than 200:1;
- are not federal flood control impoundments (exception is Rathbun Reservoir due to a watershed to lake surface area ratio that is less than 200:1); and
- are not lakes used solely as water supply reservoirs.

Lake Restoration Program (2016)

86th General Assembly - SF 2324, DIVISION V, amended Section 456A.33B, Code 2016

For the purpose of Iowa's Lake Restoration Program, Iowa code defines "significant, publicly-owned lakes" as those lakes that meet all of the following criteria:

- is owned by the federal government, the state of Iowa, a county, or a municipal government, and is maintained principally for public use;
- is a multi-use system capable of supporting diverse wildlife, fish, or recreational opportunities;
- has a surface water area of at least ten acres;
- does not have a watershed-to-lake surface area ratio of greater than two hundred to one;
- is not an on-stream impoundment that emulates riverine habitat rather than a lake environment;
- and, is not used solely as a water supply reservoir.

For the purpose of Iowa's Lake Restoration Program, Iowa code defines "publicly-owned shallow lakes/wetlands" as those water bodies that meet the following criteria:

- is owned by the federal government, the state of Iowa, a county, or a municipal government, and is maintained principally for public use;
- is a multi-use system capable of supporting diverse wildlife, fish, or recreational opportunities;
- has a surface water area of at least ten acres;
- does not have a watershed-to-lake surface area ratio of greater than two hundred to one;
- is an open freshwater system where maximum depth is typically less than six to eight feet at its deepest spot and is under four and one-half feet mean depth;
- and, is typically fringed by a border of emergent vegetation in water depth less than six feet and when clear is dominated by both emergent and submergent vegetation and provides important wildlife and fish habitat.

Appendix C. Lake Restoration Prioritization Process and Program

Key Concepts and Facts

- Six of ten Iowans visit lakes each year; they will visit these lakes eight times during the year
- Iowans prefer lakes with better water quality
- Statewide our lakes generate \$1.2 billion in annual spending by Iowans
- A lake is a reflection of both watershed and lake management
- Lake restoration starts in the watershed; it relies on strong local involvement and voluntary participation of landowners

Current Prioritization and Program

- Modeled after the Federal Clean Lakes Program established in the 1970s
- DNR provided the 2006 legislature with a priority list of up to 35 lake candidates and up to 5 shallow lake candidates
 - Priorities based on assessment of water quality
 - Technical feasibility of restoration
 - Potential economic benefits
 - Use by Iowans, and local interest/involvement
- Projects require a lake and watershed restoration assessment and plan
- Projects require local resources in combination with state and federal funds
- Local groups can petition to have their lake added to the priority list
- Project Status (Significant, Publicly-Owned Lakes)
 - 25 Completed or near completion
 - 16 Active projects in-progress
 - 19 Initial public outreach, evaluation or planning stage
- Project Status (Shallow Lakes and Wetlands)
 - 29 Completed or near completion
 - 6 Active projects in-progress
 - 10 Initial public outreach, planning or evaluation stage
- DNR provides an annual progress report to the legislature that includes a work plan and budget

Water Quality Goals

Stipulated in 2006 State Legislation (HF2782):

- Delivery of phosphorous and sediment from the watershed will be controlled before lake restoration begins
- Shallow lakes management will be considered among options for restoration
- Water quality targets
 - Clarity. 4 ½ foot secchi disc transparency 50% of the time from April – September
 - Biota. A diverse, balanced, and sustainable aquatic community must be maintained
 - Impairment. Water quality impairments must be eliminated
 - Sustainability. The water quality and public use benefits must be sustained for 50 years

Lake Restoration Program Budget

- Funding from FY2007 through FY2019 of \$110 million (approximately \$8.5 million per year) has enabled the DNR to improve many Iowa's lakes and proceed with implementing projects at a number of our other priority systems

Web Page: <http://www.iowadnr.gov/Environment/WaterQuality/LakeRestoration.aspx>

Appendix D. Significant, Publicly-owned Lakes List

The below table includes significant publicly-owned lakes (lake systems) prioritized for the program based on the feasibility of each lake for restoration and the use or potential use of the lake, if restored. The list included lake projects under active development by the department so long as progress toward completion of the projects remained consistent with the goals of the program. Lakes that have since been added to the original list of lakes prioritized for the program after communities have successfully petitioned the director of the department or were ranked high by the Department in terms of their potential for meeting program goals. The table also indicates status of the project and if a given lake is prioritized for funding under the current five-year plan.

Lake Name	County Name	Lakes Program Status FY19	Current 5-Year Plan
Brushy Creek Lake	WEBSTER	Completed	
Carter Lake	POTTAWATTAMIE	Completed	
Clear Lake	CERRO GORDO	Completed	
Crystal Lake	HANCOCK	Completed	
Hawthorn Lake	MAHASKA	Completed	
Lake Ahquabi	WARREN	Completed	
Lake Anita	CASS	Completed	
Lake Darling	WASHINGTON	Completed	
Lake Icaria	ADAMS	Completed	
Lake Macbride	JOHNSON	Completed	
Lake Miami	MONROE	Completed	
Lake of Three Fires	TAYLOR	Completed	
Lake Sugema	VAN BUREN	Completed	
Lake Wapello	DAVIS	Completed	
Little River Lake	DECATUR	Completed	
Little Wall Lake	HAMILTON	Completed	
Lost Grove Lake	SCOTT	Completed	
Lost Island Lake	PALO ALTO	Completed	
Meadow Lake	ADAIR	Completed	
Pleasant Creek Lake	LINN	Completed	Y
Prairie Rose Lake	SHELBY	Completed	
Red Haw Lake	LUCAS	Completed	
Twelve Mile Lake	UNION	Completed	
Union Grove Lake	TAMA	Completed	
Viking Lake	MONTGOMERY	Completed	Y
Black Hawk Lake	SAC	In Progress	Y
Blue Lake	MONONA	In Progress	Y
Center Lake	DICKINSON	In Progress	
Central Park Lake	JONES	In Progress	Y
Easter Lake	POLK	In Progress	Y
Hickory Grove Lake	STORY	In Progress	Y
IA Great Lakes	DICKINSON	In Progress	Y
Kent Park Lake	JOHNSON	In Progress	Y
Lake Geode	HENRY	In Progress	Y
Lake Manawa	POTTAWATTAMIE	In Progress	Y
Lake of the Hills	SCOTT	In Progress	Y
Mariposa Lake	JASPER	In Progress	

Rathbun Reservoir	APPANOOSE	In Progress	Y
Silver Lake	DICKINSON	In Progress	Y
Storm Lake	BUENA VISTA	In Progress	Y
Three Mile Lake	UNION	In Progress	Y
Badger Creek Lake	MADISON	Planning	Y
Big Creek Lake	POLK	Planning	Y
Casey Lake	BLACK HAWK	Planning	Y
Diamond Lake	POWESHIEK	Planning	Y
Five Island Lake	PALO ALTO	Planning	Y
George Wyth Lake	BLACK HAWK	Planning	Y
Green Valley Lake	UNION	Planning	Y
Hannen Lake	BENTON	Planning	Y
Lacey Keosauqua Lake	VAN BUREN	Planning	Y
Lake Hendricks	HOWARD	Planning	Y
Lake Keomah	MAHASKA	Planning	Y
Lake Meyer	WINNESHIEK	Planning	Y
Otter Creek Lake	TAMA	Planning	Y
Pine Lakes - Upper/Lower	HARDIN	Planning	Y
Rock Creek Lake	JASPER	Planning	
Silver Lake	DELAWARE	Planning	Y
Swan Lake	CARROLL	Planning	
Twin Lakes - North/South	CALHOUN	Planning	Y
Volga Lake	FAYETTE	Planning	Y

Planning/Evaluation: 19

In Progress: 16

Completed/Maintenance: 25

*Note – IA Great Lakes (Dickinson) includes Big Spirit Lake (incl. Little Spirit Lake), East Okoboji Lake, Lower Gar Lake, Minnewashta Lake, Upper Gar Lake and West Okoboji Lake

The following table includes other lakes recognized by the Iowa Department of Natural Resources Lake Restoration Program as Significant Publicly-Owned Lakes.

Lake Name	County
Arbor Lake	POWESHIEK
Arrowhead Lake	SAC
Arrowhead Pond	POTTAWATTAMIE
Avenue of the Saints Pond	BREMER
Badger Lake	WEBSTER
Beaver Lake	DALLAS
Beeds Lake	FRANKLIN
Belva Deer Lake	KEOKUK
Big Hollow Lake	DES MOINES
Bob White Lake	WAYNE
Briggs Woods Lake	HAMILTON
Browns Lake	WOODBURY
Casey Lake (Hickory Hills Lake)	TAMA
Cold Springs Lake	CASS
Crawford Creek Impoundment	IDA
DeSoto Bend	HARRISON
Dog Creek Lake	OBRIEN
Don Williams Lake	BOONE
East Lake (Osceola)	CLARKE
Eldred Sherwood Lake	HANCOCK
Fogle Lake S.W.A.	RINGGOLD
Green Belt Lake	BLACK HAWK
Green Castle Lake	MARSHALL
Greenfield Lake	ADAIR
Hooper Area Pond	WARREN
Indian Lake	VAN BUREN
Ingham Lake	EMMET
Iowa Lake	IOWA
Lake Cornelia	WRIGHT
Lake Hendricks	HOWARD
Lake Pahoja	LYON
Lake Smith	KOSSUTH
Little Sioux Park Lake	WOODBURY
Littlefield Lake	AUDUBON
Manteno Park Pond	SHELBY
Meyer Lake	BLACK HAWK
Mill Creek Lake	OBRIEN
Mitchell Lake	BLACK HAWK
Moorhead Park Pond	IDA
Mormon Trail Lake	ADAIR
Nelson Park Lake	CRAWFORD
Nine Eagles Lake	DECATUR
Nodaway Lake	ADAIR
Oldham Lake	MONONA

Orient Lake	ADAIR
Pierce Creek Pond	PAGE
Poll Miller Park Lake	LEE
Roberts Creek Lake	MARION
Rodgers Park Lake	BENTON
Rudd Lake	FLOYD
Silver Lake	PALO ALTO
Slip Bluff Lake	DECATUR
Snyder Bend Lake	WOODBURY
South Prairie Lake	BLACK HAWK
Spring Lake	GREENE
Springbrook Lake	GUTHRIE
Summit Lake	UNION
Thayer Lake	UNION
West Lake (Osceola)	CLARKE
White Oak Lake	MAHASKA
Williamson Pond	LUCAS
Willow Lake	HARRISON
Wilson Park Lake	TAYLOR
Windmill Lake	TAYLOR
Yellow Smoke Park Lake	CRAWFORD