Lake Restoration
2008 Report and 2009 Plan

Submitted To

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

Submitted By

Iowa Department of Natural Resour*ces*
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Executive Summary

The Department of Natural Resources (IDNR) Lake Restoration Program (LRP) focuses on restoring impaired lakes to improve the quality of life for Iowans. Communities are rallying around their water resources as they seek population growth and economic success. Communities of the Iowa Great Lakes Region, Storm Lake, Crystal Lake, Creston and Clear Lake are obvious examples, but other communities including Lake View and Brighton are identifying the importance of lakes for their futures as well. The distribution and nature of Vision Iowa grants, Community Attraction and Tourism grants, and now, Great Places, all further emphasize the importance of water to community, quality of life and economic growth.

Iowans value water quality and desire safe healthy lakes that provide a full complement of aesthetic, ecological and recreational benefits. In Fiscal Year (FY) 2006, the legislature created the Lake Restoration Program in HF 2782, and appropriated $8.6 million for the first year. Annual funding from FY2007 through FY2009 has enabled the IDNR to continue work on improving Iowa's lakes. The source of current level funding for the LRP is appropriated from the bond proceeds of the restricted capital funds account tobacco settlement trust fund for the fiscal year beginning July 1, 2008, and ending June 30, 2009. To date, these bonds have not been sold, therefore appropriated FY09 funds have not been made available to the IDNR's Lake Restoration Program. Meeting our FY09 program contracts and obligations will require the current $2.01 million dollar balance of LRP funds and the FY09 $8.6 million appropriation. Examples of obligated costs scheduled for FY09 implementation include Green Valley Lake and Lake Darling. These lakes have both been lowered; fish populations renovated and limited in-lake construction initiated. Project completion for these two lakes will require most of the remaining obligated FY09 funds and a significant portion of the proposed FY10 budget to complete.

Included in Section (26) of The Endowment for Iowa's Health Account is a process and criteria for completing successful lake restoration projects. It also directs the IDNR 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.

Lake Restoration Prioritization Process and Program

- Modeled after the Federal Clean Lakes Program established in the 1970's.
- Ranked 131 public lakes for lake restoration potential.
- Ranking based on a 5-year Iowa State University (ISU)/IDNR assessment of water quality, technical feasibility of restoration, potential economic benefits, use by Iowans, and local support.
- IDNR initially provided the 2006 legislature with list of 35 lake candidates.
- Projects require a lake and watershed (land draining to the lake) restoration assessment and plan.
- Lake and watershed protection requires local resources in combination with state and federal funds.
- Local groups can petition to have their lake added to the priority list.
- IDNR provides an annual progress report to the legislature that includes a work plan and budget.

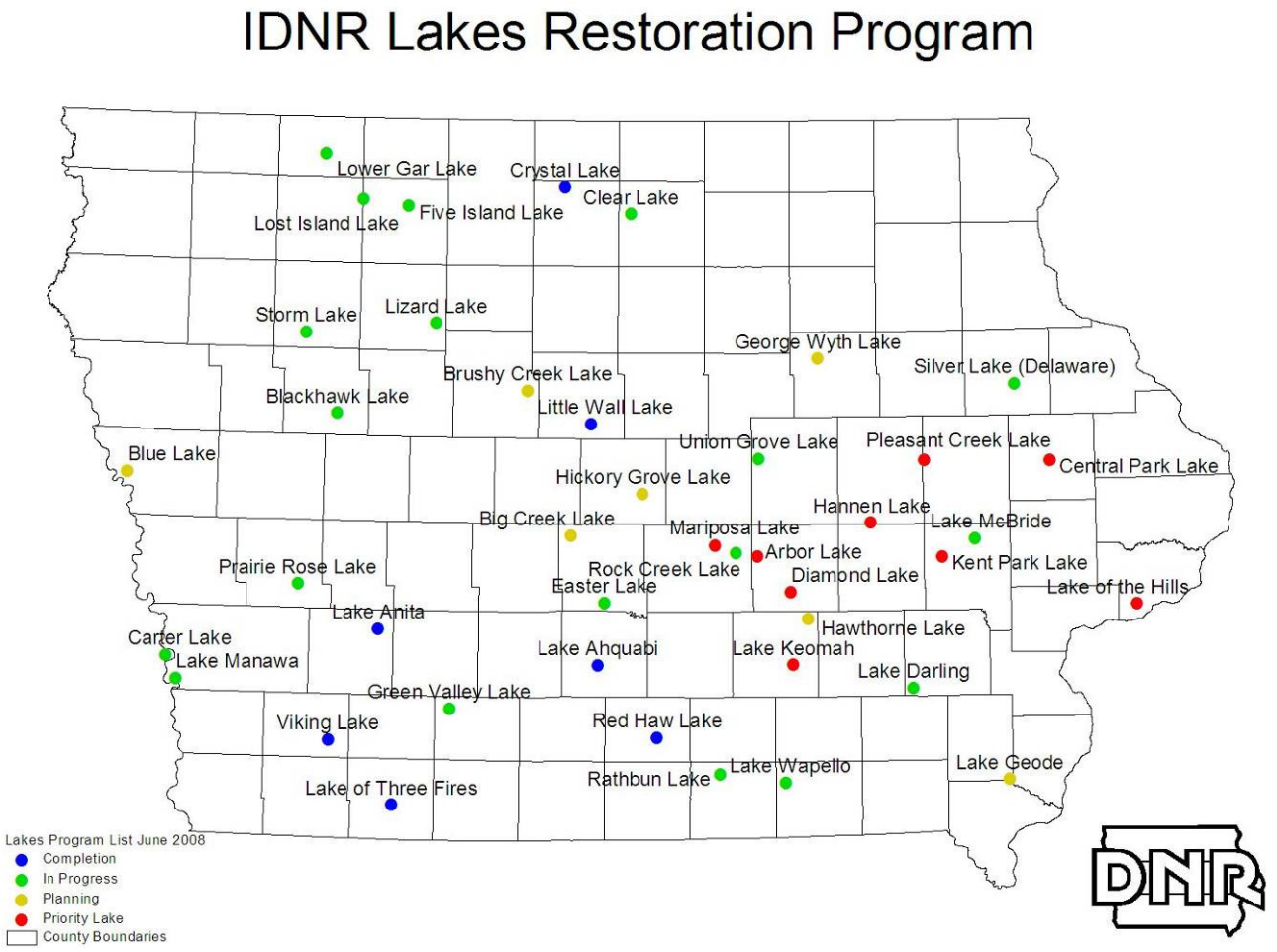
Water Quality Goals [Stipulated in 2006 State Legislation (HF2782)]

- Phosphorous and sediment coming from the watershed must be controlled before lake restoration begins.
- Shallow lakes management will be considered among options for restoration.
- 4 ½ foot secchi disc transparency (water clarity) 50% of the time, April – September.
- Water quality impairments must be eliminated.
- A diverse and sustainable aquatic community will be maintained.
- Water quality and public use benefits must be sustained at least 50 years.

Lake Restoration Program Status

The intent of the program is to develop and administer lake restoration projects that achieve the following goals: 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.

The Lake Restoration Program initially ranked 131 public lakes to prioritize lake restoration efforts. A group of thirty-five lakes, classified highest in priority for restoration, was established and served as a starting point for identifying potential lake restoration projects. Major water quality improvement initiatives are completed or near completion at seven of the initial thirty-five lake systems. Current program activities are in progress at nineteen lakes throughout the state and either in the planning or initial community outreach stage at an additional sixteen lakes.



Project planning involves working with representatives of the local community to develop a joint restoration plan. In order to achieve lake restoration goals it is critical that the IDNR 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. 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. It is also necessary that a proper assessment of the lake and watershed be completed to provide restoration alternatives to meet given water quality goals.

Timelines for many of these projects usually fall within a two-year period. However, dredging or spillway construction may take even longer (Table 1). Dredging contractors face substantial costs to mobilize and set up lake dredging operations and this critical work needs multiple year commitments to secure contactors. As such, the most practical and efficient way to complete a dredging plan is as one continuous project. The Lake Restoration Program has matured to the point where a number of multi-step projects are nearing the implementation phase. At current funding levels we will have more projects ready to start in a given year than we have available dollars.

Clear Lake, Crystal Lake, and Storm Lake are all examples of dredging projects that required a multiple-year funding commitment from the State in order to achieve lake restoration goals. A significant portion of the FY08 budget was spent on the three, above mentioned, multi-phase projects (Table 2). Final components to the Crystal Lake restoration included completion of the dredging project, spillway modification and renovation of the fishery. The DNR, and local partner City of Storm Lake continued working toward their long-term sediment removal goals and dredging efforts at Clear Lake reached two-thirds the way toward the goal of removing 2.3 million cubic yards of sediment from the Little Lake portion of Clear Lake.

The majority of lake restoration projects involve a construction or installation phase of watershed or in-lake improvements. A typical construction project might include the following stages: 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 or land acquisition before construction can begin, followed by required approvals and permits such as archeological/cultural (SHPO), environmental (T&E species), floodplain/404 permit, and sovereign lands permit.

Tables 3 and 4 summarize current and planned expenditures for FY09 and FY10. A descriptive project summary by lake follows. The program continues to develop new projects and make contact with local communities about the lakes in their area prioritized for restoration. Current efforts are focused on continued work and completion of projects where restoration efforts have already been initiated.

Table 1. Overview of select multi-year lake restoration projects

Project Name	County	Projected Timeline	Current Status of Project
Blackhawk Lake	Sac	2010 - 2014	Diagnostic / Feasibility (DF) study and TMDL reports are in process and will be completed fall 2009
Carter Lake	Pottawattamie	2008 - 2010	DF study completed; engineering and design of diagnostic study implementation plan has been initiated; partnership includes the States of Iowa and Nebraska and the cities of Omaha and Carter Lake ; Phase I - watershed improvement projects and fish renovation scheduled for 2009
Clear Lake	Cerro Gordo	2000 - 2010	Dredging commenced in late spring of 2008, with likely completion by late-summer / fall of 2009; sixty-five percent of the targeted 2.3 million cubic yards has already been removed; continued work in the watershed; Ventura Marsh restoration – partnership with Army COE, construction phase in fall/winter 2009
Easter Lake	Polk	2011 - 2013	DF Study will be completed fall 2009; current project activities will include public involvement and communication with potential partners
Five Island Lake	Palo Alto	1990 - 2011	Continued support of local dredging project; summer 2008 tour with the DNR Director Leopold, State Senator Kibbe, local stakeholders and the DNR Lakes Program to review progress and discuss the need for continued watershed work to compliment local dredging efforts
Green Valley Lake	Union	2008 - 2009	Containment site land acquisition; spillway re-construction; final design completed; lake was lowered;; fisheries renovated and restocking has been initiated; Construction – shoreline stabilization, silt removal and silt dike construction; construction scheduled for winter 2008 / spring 2010
Lake Darling	Washington	2008 - 2011	Spillway repair/replace investigation completed; design for dam reconstruction near completion; lake drained fall 2008; In-lake restoration (shoreline deepening, silt dike construction, fish renovation) and dredging will begin in June 2009 through March 2011; final watershed work on state property completed by fall 2009
Lake Manawa	Pottawattamie	2009 - 2014	DF study will be completed by February 2009; the DNR will continue to explore the option of utilizing dredge materials for future Iowa DOT highway projects
Prairie Rose Lake	Shelby	2011 - 2012	DF Study has been completed; a watershed assessment was conducted followed by a grant to accomplish targeted soil conservation work in the watershed; the Shelby County Soil and Water Conservation District was awarded a $510,611 Water Quality / Watershed Protection Project Grant
Rock Creek Lake	Jasper	2008 - 2013	Purchased containment site adjacent to lake; a watershed restoration plan is being developed
Storm Lake	Buena Vista	2000 - 2013	Continued support of local dredging project; matching locally sponsored WIRB Grant to improve Little Storm Lake water quality

Table 2. Actual Budget: Fiscal Year 2008

FY07 Carryover ($5,340,923) and FY08 Appropriation **$13,940,923**

Project Name	Project Description	FY2008 DNR Expenses	Fed	Other
Brushy Creek Lake	Shoreline Protection	$72,067		
Carter Lake	Diagnostic / Feasibility Study	$20,000		
Clear Lake	Effects of carp and zebra mussels on Clear Lake	$52,165		
Clear Lake	Dredging project	$1,139,419		$1,000,000
Crystal Lake	Spillway repair, containment site, dredging	$1,602,246		
Green Valley Lake	Containment site land acquisition	$340,551		
Lake Darling	Watershed improvement project	$35,845	$26,884	
Lake Darling	Spillway repair/replace investigation	$45,490		
Lake Manawa	Diagnostic / Feasibility Study	$55,845		
Lake of Three Fires	Wetland and watershed projects	$93,177	$69,883	
Lost Grove Lake	Sediment ponds	$3,807	$2,855	
Silver Lake	Spillway repair	$294,489		
Storm Lake	Dredging project	$1,000,000		
Union Grove Lake	Spillway repair	$178,572		
Administration	Transfer to Operations and Engineering Services	$586,734		
Dam Safety	Portage signage	$49,784		
Minor Projects	Minor Projects	$65,041		
Restoration Action Plans	Diagnostic / Feasibility Studies	$957,861		$22,685
Shallow Lakes	Pumping system, water quality improvement project	$175,878		
Use Attainability Analysis	Use Attainability Analysis (UAA)	$320,995		
Total FY2008		**$7,089,966**	**$99,622**	**$1,022,685**

Carry forward to FY2009 **$6,850,957**

Table 3. Budget: Fiscal Year 2009

FY08 Carryover ($6,850,957) and FY09 Appropriation **$15,450,957**

Project Name	Project Description	LRP FY09 Spent as of 11-30-08	LRP FY09 Obligated	LRP FY09 Total Expenses	Federal	Other
Carter Lake	Engineering design of diagnostic study implementation plan,; State of Nebraska contributing $300,000		$200,000	$200,000		$300,000
Clear Lake	Dredging, stormwater, water quality improvements	$2,905,495	$2,917,973	$5,823,468		$1,000,000
Crystal Lake	Final components of project, fall 2008 fish renovation, watershed improvement project	$22,986	$42,014	$65,000		
Five Island Lake	Continued support of local dredging project		$200,000	$200,000		$70,000
Green Valley Lake	Spillway re-construction; final design near completion; lake is drained; construction schedule for winter 2008 / spring 2009; Shoreline stabilization; bids accepted, pending NRC approval; Containment site acquisition and construction; Silt removal	$17,731	$2,640,000	$2,657,731		$170,000
Lake Darling	Spillway / Dam replacement; final design near completion; lake scheduled for fall draining; Spring / Summer 2009 construction; Shoreline deepening; Watershed work on state property	$140,397	$2,519,603	$2,660,000		$150,000
Lake Manawa	Diagnostic / Feasibility Study; dredge planning	$69,801	$190,200	$260,001		
Lake Wapello	Water Quality Improvements		$224,998	$224,998		
Lake Rathbun	Shoreline Riprap; water quality improvement; ready for bid		$275,000	$275,000	$1,100,000	
Lost Island	Fish barrier construction; RFP issued		$40,000	$40,000		
Prairie Rose Lake	Containment Site land acquisition and watershed work		$300,000	$300,000		$165,000
Rock Creek Lake	Purchase of containment site	$500,000		$500,000		
Storm Lake	Continued support of local dredging project	$952,082	$47,918	$1,000,000		$150,000
Storm Lake	Matching locally sponsored WIRB Grant to restore LSL water quality		$200,000	$200,000		$200,000
Dam Safety	Signage		$200,000	$200,000		
Minor Projects	Minor Projects	$147,055	$52,945	$200,000		
Restoration Plans	Diagnostic / Feasibility Studies	$85,456	$459,304	$544,760		
Shallow Lakes	Water Quality Improvements	$5,254	$94,746	$100,000	$60,000	
		$4,846,256	**$10,604,701**	**$15,450,957**	**$1,160,000**	**$2,205,000**

Table 4. Proposed Budget: Fiscal Year 2010

Project Name	Project Description	FY10 Proposed Budget	Federal	Other	Total Budget
Carter Lake	Watershed improvement projects; fish renovation	$400,000		$400,000	$800,000
Clear Lake/Ventura Marsh	Marsh restoration, stormwater, water quality improvements	$500,000	$2,500,000	$200,000	$3,200,000
Five Island Lake	Continued support of local dredging / watershed project	$200,000		$50,000	$250,000
Green Valley Lake	Watershed improvement, dredging, silt dike construction	$1,600,000			$1,600,000
Lake Darling	Dredging, land acquisition, silt dike construction, dam replacement, fish renovation	$3,000,000			$3,000,000
Lake Manawa	Watershed improvement projects, fish renovation	$300,000			$300,000
Lake Rathbun	Shoreline Riprap; water quality improvement projects	$275,000	$825,000		$1,100,000
Lizard Lake	Watershed improvement ; spillway repair; fish renovation	$250,000			$250,000
Lost Island Lake	Fish barrier construction	$75,000			$75,000
Prairie Rose Lake	Watershed improvement projects	$25,000			$25,000
Rock Creek Lake	Watershed improvement	$150,000		$300,000	$450,000
Storm Lake	Continued support of local dredging project	$1,000,000		$200,000	$1,200,000
Dam Safety	Signage	$200,000			$200,000
Minor Projects	Minor Projects	$200,000		$100,000	$300,000
Restoration Action Plans	Diagnostic-Feasibility Water Quality Studies	$325,000		$50,000	$375,000
Shallow Lakes	Water Quality Improvements	$100,000		$100,000	$200,000
		$8,600,000	**$3,325,000**	**$1,400,000**	**$13,325,000**

Lake Restoration Program (LRP) Highlights

Clear Lake (Cerro Gordo County)

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/watershed diagnostic/feasibility study. They presented a number of lake restoration options including dredging.

- A 208 acre dredge spoil site was purchased with approximately $660,000 of 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.).
- Bids were let in January 2008 for the hydraulic dredging of the Little Lake portion of Clear Lake; the low bidder, L.W. Mattensen of Burlington, Iowa, was awarded the $6,453,000 contract (75% LRP and 25% local-match funding).

- Dredging commenced in late spring of 2008, with likely completion by late-summer / fall of 2009. Sixty-five percent of the targeted 2.3 million cubic yards has already been removed.

- In addition to dredging, plans are being developed for 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 present degraded state, the marsh serves as a major source of nutrients contributing to water quality problems in the lake and is a major reproduction area for common carp.
- The recently presented Federal omnibus appropriations bill has $2.6 million earmarked to the Army Corp of Engineers (COE) for a Ventura Marsh restoration project. Ventura Marsh land credits and approximately $500,000 in LRP dollars will fund the IDNR's portion of the marsh restoration project.
- The goal is to work with the COE in FY2009 and FY2010 to restore Ventura Marsh and gain water level management capabilities. This will allow for fish removal and revegetation of the marsh.

- Local groups and the DNR continue to pursue projects that have the potential to decrease sediment delivery to Clear Lake
- The total cost of the above mentioned activities is $11.7 million. Of this amount, local and federal match represent 40% of the funds necessary to complete these restoration efforts.

Anticipated Benefits

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. In addition, future planned restoration of Ventura Marsh will improve the water quality of Clear Lake and help keep the Carp population under control. The Mayor of Clear Lake, Nelson Crabb, had the following comments regarding the partnership between the IDNR and the local community. - "The City of Clear Lake has enjoyed their partnership with the Iowa DNR in lake restoration efforts. The lake provides nearly $43 million annually to the local economy and we recognize the importance of maintaining and improving this valuable resource. The city has invested $2 million in the dredging project and over $1 million in urban conservation practices over the past several years. We feel the water quality has already started to improve and will continue to progress as additional conservation and restoration measures are implemented. Investing in our greatest asset (the lake) has been very rewarding for all Clear Lakers."

Crystal Lake (Hancock County)

Crystal Lake is a small 269-acre natural lake in Northwest Iowa with a watershed to lake area ratio of 8.8/1. IDNR completed construction of the dredge spoil site in July 2006 at a cost of $838,000. This project involved the IDNR acquiring approximately 100 acres of land to mitigate the use of the wildlife area as a containment site. IDNR awarded a contract to dredge and work commenced in October 2006.

- The contractor completed dredging operations in the fall of 2007.
- They removed 1.1 million cu./yds. of sediment at a cost of $3.1 million.

- The DNR modified the spillway structure to prevent carp from re-entering the system.
- In the fall of 2008, the DNR renovated of the fish community of Crystal Lake; they anticipate additional improvements to water quality due to the removal of common carp from the system.
- An aggressive DNR fish stocking program will be initiated during the spring 2009

Anticipated Benefits

This small community and the surrounding rural area is an excellent example of a locally driven project that will benefit from lake improvement. Following restoration, improved fishing opportunities alone could add nearly $400,000 annually to the local economy. In addition improved water quality will benefit other water-based recreation. The combination of the watershed and lake improvement work will remove Crystal Lake from the Impaired Waters List and add to the estimated $2.5 million spent annually by lake visitors.

Storm Lake (Buena Vista County)

Storm Lake is a shallow natural lake (4th largest natural lake in Iowa) with a surface acreage of 3,150 acres and a watershed to lake ratio of 4.5/1. Prior to the current dredging effort, IDNR last dredged Storm Lake in 1962. Lake depth maps developed in 1992 indicate that the 1962 dredging sites lost 77% and 46% of their volume. Studies indicate that sediment filled these areas from the watershed not from in-lake dynamics.

- Storm Lake constructed a dredge spoil site in 2001 and began dredging activities in 2001/2002. IDNR lake dredging removed 1.32 million cu./yds. of sediment at a total project cost of $3.3 million.
- Funding limitations restricted this initial dredging activity to 180-acres of the lake.
- The Lake Preservation Association (LPA) expressed a strong interest to continue dredging to achieve better water quality The LPA locally raised and received federal grants totaling over $1 million to continue dredging at Storm Lake.
- They purchased a dredge, and through an agreement with the IDNR, each group has provided $900,000 from 2003 through 2005 to continue dredging operations.
- State lake restoration funds have contributed $1 million to the City of Storm Lake in both FY07 and FY08 for dredging. An additional $1 million was requested and spent during FY09.
- Dredging by the City of Storm Lake is still ongoing. This year they removed 250,000 cubic yards of material.
- To reach project goals will require another 8 years of dredging at a projected cost of $9.8 million ($4.9 million state - $ 4.9 million local).
- The locally led project goal is to dredge 600,000 to 900,000 cu./yds. of sediment annually.
- The City of Storm Lake leased the IDNR containment site for an additional 2-years and has since constructed a new containment site east of Storm Lake.
- The City continues to improve stormwater delivery to the lake.
- Current data suggests that past restoration efforts have resulted in improvements to the water quality of Storm Lake. Recent water clarity has been observed at 19 inches opposed to the average clarity of 12 inches in 2005. There has also been a reduction in the average concentration of total phosphorus in the water column.

Little Storm Lake Ecosystem Restoration

The Lake Preservation Association (LPA) for Storm Lake applied and received a Watershed Improvement Review Board (WIRB) grant for $200,000 to reduce the sediment and phosphorous transport from Little Storm Lake in to Storm Lake. The Lake Restoration Program will match the grant with an additional $200,000.

- Little Storm Lake is a 190-acre state-owned marsh that is an extension of Storm Lake (marsh and lake elevation is the same).
- Approximately 70% of the water from the watershed flows through Little Storm Lake. Little Storm Lake originally had the ability to remove much of the sediment and nutrients from incoming waters. However, due to degradation, proper wetland function has been compromised. Under normal hydrologic conditions Little Storm Lake as the potential to function as a sediment trap for Storm Lake, but this capacity is overwhelmed during high flows. Little Storm Lake is at or near its sediment trapping capacity, which results in higher sediment transport into Storm Lake. Resuspension of sediments due to wind and other in-lake dynamics, such as rough fish, further exacerbate the total turbidity from suspended sediment and results in movement of sediment from Little Storm Lake into Storm Lake.
- This project includes a fish barrier and water retention structure between Little Storm Lake and Storm Lake and the construction of a pumping station and associated equipment. The project involves periodic dewatering of Little Storm Lake during years of favorable climatological conditions to consolidate the sediments and revegetate the area. Construction of the fish barrier would aid restoration efforts by preventing rough fish from destroying the vegetation and would decrease recruitment of rough fish by limiting their spawning area. In the future, if the diminished trapping capacity of Little Storm Lake still results in sediment moving into Storm Lake, a dredging project would be initiated to deepen the Little Lake.

<u>Anticipated Benefits</u>

- This aggressive dredging goal, coupled with watershed improvements and restoration of Little Storm Lake and wetland will mean significant improvements in water quality.
- In addition, lake restoration efforts so far have encouraged a $35 million economic development named “Project AWAYSIS” that has the potential to create 690 new jobs and over $28 million in new spending in Storm Lake and Buena Vista County.
- Completion of the Casino Bay Marina with $3 million dollars of State of Iowa funds which allow better access and a full service boat dealership on the lake.

Mayor of Storm Lake, Jon Kruse, believes that lake restoration has been a catalyst for economic development in the region – “Lake restoration work for Storm Lake and its watershed has been the inspiration for the community to come together and chart its destiny into the future. This community has traditionally had most of its economic base centered on agriculture. Because of lake restoration work,

our people determined that we could diversify our economic base by increasing recreational opportunities at Storm Lake."

Lake Restoration Program (LRP) – Projects In Progress

Blackhawk Lake (Sac County)

- A Citizens Advisory Committee has been formed and met several times.
- This committee locally raised $40,000 to help fund the Diagnostic / Feasibility Study; the goal of the study is to provide restoration alternatives to the DNR and local community; the report will be completed in January of 2010.
- Iowa State University (ISU) was contracted to do the D/F study;
- A Total Maximum Daily Load report is also in development to address the 303d listed of Blackhawk Lake. Algae and turbidity impairment continue; the bacteria impairment is new for the 2008 cycle. This report is scheduled for completion in the fall of 2009.
- The DNR held an initial public meeting to discuss common goals and concerns as well as a tentative time table of the project
- Lannie Miller, DNR Fisheries Biologist, has given several tours to DNR employees and ISU personnel of the Black Hawk Lake watershed.
- A public meeting is scheduled in January of 2009 to discuss the options for the lake and watershed.

The Iowa Department of Natural Resources was awarded the 2008 Cooperative Agency of the Year award. The DNR is taking the lead on the lake improvement project. They are working with 12 other groups, public and private, all working toward the same goal of water quality improvements in Black Hawk Lake.

Lakeview Community Update – November 2008

Award presented by Mayor, John Westergaard to
Mike McGhee, DNR Lakes Restoration Program and Lannie Miller, DNR Fisheries

Carter Lake (Pottawattamie County)

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 surface pool elevation 970.0 feet, with a watershed area of 2,675 acres (watershed area to lake area ratio of 7.6/1). 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 have centered on poor water quality, chronic low water levels and nuisance algae bloom. Impairments include nutrients/algae, indicator bacteria, and fish contaminants (PCBs).

Restoration of Carter Lake involves the cooperation of Iowa, Nebraska and the cities of Omaha and Carter Lake. A local Iowa group, the Carter Lake Preservation Society (CLPS), has been very active in moving this project forward. In addition, a Watershed Technical Advisory committee meets monthly to discuss concerns, assist planning, and complete restoration activities. The CLPS has been instrumental in securing funding for the lake. This includes grants from Watershed Protection Grant ($10,000), IDALS,

the Pottawattamie Co. Board of Supervisors ($163,000), IDNR ($27,000) for shoreline and water quality improvements, and IDNR, REAP & Project AWARE for a 2007 lake clean up project ($1,000). The CLPS applied, but was unsuccessful in securing a $49,470 WIRB grant for storm water improvements around the Iowa portion of the lake.

- IDNR is collaborating with Nebraska Department of Environmental Quality (DEQ), using Nebraska 319 funds ($30,000) and Iowa Lake Improvement Funds ($20,000), on a Diagnostic-Feasibility study.
- Develop water well on City of Omaha property and connect the new well to an existing infrastructure of pipes leading to Carter Lake. The well water will be used to maintain Carter Lake at the recommended full pool range level of 970.3 Feet MSL (+/- .5 ft).
- The preliminary cost estimate for the Recharge Well System is $378,480.00. The DNR agrees to pay the cost of the Recharge Well System. The City of Carter Lake and City of Omaha have met their match requirements for this Recharge Well System through in-kind contribution and the City of Carter Lake will coordinate the project.
- Olsson Associates, has collected information and provided information on potential restoration alternatives.
- The Metro Area Planning Agency (MAPA) issued a Request for Qualifications (RFQ) and selected Tetra Tech Inc. to perform all necessary services for preliminary design and engineering for the Water Quality Management Plan for Carter Lake. We anticipate that $200,000 will be needed to initiate these projects.

Easter Lake (Polk County)

Easter Lake is a 178-acre constructed lake with a watershed to lake ratio of 36/1. 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. Construction activities and storm water issues have contributed greatly to more than a 20% reduction in lake volume.

The Polk CCB owns and manages this area and they are very interested in developing a partnership to accomplish lake and watershed improvements. As an initial step, Iowa State University will conduct a diagnostic feasibility study with a targeted completion date of fall 2009.

- A Watershed Tactical Team met several times in 2007 and 2008 to discuss plans for Easter Lake and the watershed. Representatives from Iowa State University, NRCS, Iowa DNR, City of Des Moines and Polk County attended these meetings.
- The Iowa DNR conducted a fish population survey in the lake in 2007. Fish tissue was analyzed for contaminants in 2008. Yeader Creek was also sampled according to the Iowa DNR Stream Sampling Protocol.
- Iowa State University conducted a survey (2008) of residents in the watershed to determine their knowledge and attitudes of the lake and its watershed.
- Polk County and the Iowa DNR are working together to design a park and lake user survey to investigate how satisfied the users are and what they would like to see improved. This survey will take place in 2009 or 2010.
- A public meeting will take place in 2009 to inform the public of the results found during the surveys and studies.

Five Island Lake (Palo Alto County)

Five Island Lake is a 950-acre natural lake located on the north side of the town of Emmetsburg, Iowa in Palo Alto County. In 1989, following five 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.

- In 1989, a group of concerned citizens formed the Five Island Lake Board.
- The Lake Board has stabilized almost 10.5 miles of lake shoreline, dredged over 5 million cubic yards of silt, and worked in the watershed to reduce nutrients and sediment from entering the lake.
- Funding for this project has been a combination of state and local matching grants.
- Local monetary contributions to date exceed $1.2 million.
- State funding as of July 2007 is $980,000.
- In addition to the dredging portion of their project, the Lake Board is evaluating the need for additional work in the watershed and in-lake management strategies to achieve the desired water quality goals.
- The city of Emmetsburg requested $175,000 of lake restoration funds for both FY08 and $200,000 in FY09 to match with local funds for their on-going lake restoration projects.
- Summer 2008 tour with the DNR Director Leopold, State Senator Kibbe, local stakeholders and the DNR Lakes Program to review progress and discuss the need for continued watershed work to compliment local dredging efforts.

Green Valley Lake (Union County)

Green Valley Lake is a 390-acre lake constructed in 1950. It has a watershed to lake ratio of 11.3/1. A limited lake restoration project through the State and U.S. EPA's Clean Lakes Program was undertaken in the mid 1980s, however additional watershed and in-lake work is needed.

The local district soil group and NRCS have completed a watershed assessment and have developed a four-year plan to make needed watershed improvements. Cost share funding is now available for local landowners to accomplish soil and water quality improvement projects on their property. Iowa State University 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 workgroup that includes IDNR staff, the city of Creston, Southern Iowa Rural Water, Green Valley Chemical and CIPCO meet to coordinate activities.

- A four-year watershed improvement plan, with $70,000 available annually, is being utilized, to complete approved soil and water quality improvement projects.
- The local NRCS District Conservationist has indicted that they have an extensive list of willing watershed landowners that plan to participate in this initiative.
- The Natural Resource Commission has approved the acquisition of a parcel of land from LRP funding. The land is located 2.5 miles north of Creston, and adjacent to the northeast corner of Green Valley State Park. This 67.58-acre parcel was offered by the Betty E. Gater Estate for $338,000. The DNR has determined that over 30% of the phosphorus loading to the lake system comes from this portion of the watershed. In addition, this site can serve as a storage area for sediments that will be removed from the Green Valley Lake during the lake restoration process.
- The DNR has begun the process of facilitating the removal of silt from above the dike structures in the upper arms of the lake.
- The current design of the concrete spillway may allow common carp to enter the lake during high outflow periods. A renovation of the fishery and design of potential spillway modifications were conducted fall 2008. Spillway construction is scheduled for completion by May 2009.
- A contract was awarded to deepen and protect the existing shoreline.

Lake Darling (Washington County)

Lake Darling is a 267-acre man-make lake, constructed within a 1,400 acre state park, with a watershed to lake ratio of 46.5/1. Initially impounded in 1950, it has historically been a fair fishery plagued by severe in-lake siltation and poor water quality. Sedimentation has reduced the lakes original 305 surface acres to 267 acres. During the last five years, extensive watershed soil conservation work has reduced sediment delivery to the lake by 40%. Additional soil conservation work took place on state/private land in 2006 and 2007.

- Acting on the recommendations of the completed engineering report, the IDNR will repair the dam and address spillway leakage.
- IDNR has begun negotiations with several landowners for acquisition of a dredge spoil containment site.
- The Iowa Department of Natural Resources (DNR) relaxed the fishing regulations at Lake Darling on September 12, 2008. This allowed anglers to more freely harvest fish before the lake is completely drained to repair a spillway leak, extend the dam, and to perform a lake restoration project.
- With the lake drained, in-lake restoration and spillway construction is planned for late spring of 2009 with a tentative completion late summer of 2010.
- Work continues to decrease sediment and nutrient loading from the watershed; a bid letting is planned for twenty structures located on State land.
- The Iowa Department of Natural Resources conducted a public meeting on the Lake Darling Restoration Management Plan on Tuesday, October 14th.
- The Management Plan includes all in-lake improvements to be done while the lake is drained and sustaining those improvements over the next 50 years. The Plan and its affects will benefit not only Lake Darling State Park but also the local community and economy.

Lake Manawa (Pottawattamie County)

Lake Manawa is a 715-acre natural lake with a watershed to lake ratio of 3.5/1. Mosquito Creek supplies additional water to the lake. Past lake dredging work in the 1960s deepened significant portions of the lake. However, maximum lake depth does not exceed 13 feet with large expanses of 6 to 7 feet deep

water. The Iowa Department of Transportation approached the IDNR to explore the possibility of dredging the lake for sand to use for highway construction. However, there is concern about whether they can remove sand materials from Lake Manawa while still maintaining the hydraulic seal between the lake and the fluctuating Missouri River.

- The Iowa DOT and IDNR met during spring of 2007 and fall of 2008 to discuss opportunities to obtain highway building materials from Lake Manawa sediments.
- The IDNR hired Tetra Tech to conduct a diagnostic and feasibility study and review the option of dredging as a potential lake restoration activity. The report should be available for review in early 2009.
- The IDNR meets with groups such as the "Friends of Lake Manawa" to solicit support and to assist in moving the lake/watershed restoration project along.

Lake Macbride (Johnson County)

- 2007 - 900' of eroded shoreline was protected with riprap
- 2008 - 6 areas were chosen to construct gully erosion structures within the State Park boundaries. The archeological study is completed, an environmental review has been requested and construction is planned for 2009.
- The DNR and the County entered into an agreement for protection of approximately 1,200 feet of shoreline along the Cottage Reserve Road with riprap. Project completed fall 2008.

Lake Wapello (Davis County)

- Wapello is in the implementation phase of constructing of 20 structures on state property at a cost of $141,160; this project will be funded by 319 (75%) and Lake Restoration (25%) programs.
- Construction is in progress for in-lake fish habitat, shoreline deepening and armoring, new jetties, modifications to existing jetties, repair of several silt dikes, one new silt dam, and boat ramp improvements. Lake Restoration funds ($189,708) will be utilized for the portion of the project focused on shoreline protection and construction of silt dikes.
- The DSC has utilized additional EQUIP and watershed protection funds for work on private land.

Lower Gar Lake (Dickinson County)

- Local concerned citizens and business owners that live on or recreate on the Iowa Great Lakes system, specifically Lower Gar, Minnewashta and Upper Gar, formed The Three Lakes Improvement Association.
- IDNR Lakes Restoration staff met with this group several times in 2005 and 2006 to discuss lake water quality and water depth issues.
- Iowa State University has prepared and initiated a diagnostic/feasibility proposal to examine lake issues.
- This study, funded locally for 25% of the cost, will examine historic soft sediment deposition, potential removal of a portion of these sediments and the resulting impact on lake water quality. The study is scheduled for completion fall 2009. A spring meeting is planned to plan for a public role-out of the project.

Prairie Rose Lake (Shelby County)

Prairie Rose Lake is a 173-acre constructed lake with a watershed to lake ratio of 23.5/1. Problems at the lake center on low fish populations, historic lake siltation and poor water quality. Lake improvements in recent years include; jetties and fish structure (1998), sediment basin and shoreline riprap (2001) and sediment basins (2004). Local efforts have accomplished significant work in the watershed and identified additional work for completion.

- IDNR Fisheries and Parks staffs have been meeting with NRCS, IDALS, and others about remaining watershed work and initial lake restoration plans.
- A diagnostic/feasibility study was completed during 2008.
- A watershed assessment was conducted followed by a grant to accomplish targeted soil conservation work in the watershed.
- The Shelby County Soil and Water Conservation District was awarded a $510,611 Water Quality / Watershed Protection Project Grant
- IDNR is actively looking for a dredge spoil containment site, an important component to the in-lake restoration work, and have begun negotiations with several landowners for acquisition of a dredge spoil containment site.
- The Prairie Rose Watershed Council was formed at a public meeting in May of 2008 and meets regularly assisting in the restoration process.

Rathbun Lake (Appanoose County)

- Rathbun Land and Water 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).
- In-lake work is planned to protect vital habitats and improve water quality in several bays on the lake by protecting the channel-side points. By stabilizing these areas' shoreline loss will be reduced and water quality will be improved. Lake Restoration funds will be matched with U.S. Army Corps of Engineers 1135 Habitat Rehabilitation funds to provide approximately $1.2 million in total funding toward this project. The DNR has already spent $150,000 during the project planning phase of this project and plan to contribute $275,000 in both 2009 and 2010.

Rock Creek Lake (Jasper County)

Rock Creek Lake is a 491-acre lake constructed in 1952. The lake has a watershed to lake ratio of 54/1. Over the last 50 years, it has lost almost 40% of its lake water volume and 102 lake surface acres. ISU completed a D/F study in 2000. Local efforts have accomplished significant 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 meeting earlier this fall by the technical work group resulted in outlining a different approach to meet the necessary reductions in sediment and nutrient delivery to Rock Creek Lake. It will revolve around dividing the total watershed into larger subwatershed segments, and then designing larger watershed

structures that will require a higher government percentage contribution to put these water quality improvement practices in place. Several landowners have expressed interest in this concept. This challenging watershed will require this and other innovative concepts to significantly reduce sediments and nutrients from reaching Rock Creek Lake and to eventually allow us to move forward with the D/F studies lake restoration measures.

- Work designing the structures and securing necessary permits and easements should move forward during FY2009 – FY2010. The NRCS is working on a proposal for Senator Dennis Black that will request funding from RIFF funds to provide an extra cost-share incentive for landowners who are interested in a pond/control structure on their property.
- The Natural Resource Commission has approved the purchase a parcel of land located in northeastern Jasper County for the appraised price of $475,409. The 138.5-acre property is located 7 miles northeast of Kellogg.
- The tract is adjacent north and east of Rock Creek Wildlife Management Area (WMA), and just north of Rock Creek State Park. This tract will increase the Rock Creek WMA to 835 acres. In addition, the acquisition will provide wildlife habitat, improve water quality, and enhance public recreation to this area and serve as a possible future dredge spoil containment site.

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 6.4/1. UNI completed a diagnostic feasibility study in 2001 and the IDNR completed a TMDL 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 this marks the first spillway overflow since 1993. Following dam repair and wet weather conditions, Silver Lake reached full pool in April of 2008 and that full pool level was maintained until approximately August of 2008. The current lake level in Silver Lake is approximately 6 inches below crest following a period of dry weather.
- Silver Lake suffered a moderate winterkill during the severe winter of 2007-2008 that effectively eliminated largemouth bass and channel catfish from the system and reduced the bluegill population. Largemouth bass were restocked in June 2008 and bluegill have recovered favorably following a 2008 growing season that included abundant vegetation in Silver Lake and secchi depth transparencies that commonly exceeded 30 inches. Vegetation was largely absent from Silver Lake during the 2006 and 2007 growing seasons and secchi transparency commonly fell below 24 inches.
- A TMDL was completed for Silver Lake in the fall of 2008 and brought focus to watershed areas responsible for primary phosphorus delivery. A community lake meeting is currently being planned with a goal of forming action committees to address watershed inputs beginning in 2009. Following watershed improvements that reduce sediment delivery and phosphorus inputs, the community and biologists are hopeful that phosphorus-rich sediments can be removed from Silver Lake to help reduce problems associated with internal phosphorus loading.

Union Grove Lake (Tama County)

Union Grove Lake, last dredged in 1990, is a shallow constructed lake, with a surface area of 105 acre and watershed to lake area ratio of 63/1. Statewide mapping efforts will develop current bathymetry for the lake and determine current lake volume.

- Spillway water seepage has been an on-going problem at Union Grove Lake. Past attempts to repair the problem have met with limited success.
- IDNR hired a geo-tech firm in 2005 to evaluate the problem and contracted a firm in 2006 to repair the structure.
- They 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.
- The IDNR is working with local sponsors to develop a plan to improve the lake and water quality conditions. Melody Bro was selected as the Watershed Coordinator; a TMDL is in the process of being completed, and a watershed assessment is planned for 2009.

Lake Restoration Program (LRP) – Projects Near Completion

Lake of Three Fires (Taylor County)

Lake of Three Fires Lake is a 96-acre constructed lake with a watershed to lake ratio of 38/1. ISU completed a diagnostic/feasibility study in 2000 and identified a number of restoration alternatives. Watershed work and lake dredging was completed in 2005. The final recommended component of the restoration project is a wetland on the IDNR Simmons Wildlife Area immediately above the lake. This wetland will provide water quality protection and diversify the wildlife area. The wetland project is a cooperative venture in which NRCS will design the project, and IDNR will acquire the additional land necessary for the project, manage project construction and inspection. IDNR utilized lake restoration funding to acquire 80 acres of land at a cost of $185,000 and following the land purchase constructed a wetland at a cost of $95,000. The wetland project utilized 75% Federal 319 funds and 25% State Lake Restoration funds.

- Lake of Three Fires maintained excellent water quality despite excessive rainfall events, 30% above normal in 2007.
- The fishery and water quality improvements following lake restoration have far exceeded expectations. Fish growth and abundance is high, water clarity exceeds any previous level and park use continues to exceed previous levels.
- Activities at Lake of Three Fires since the 2006 refilling and restocking have centered on completing the fish stocking plan, monitoring water quality parameters, completion of a sediment retention structure, and introducing various desirable plant species. Channel catfish were the final species needed to complete the stocking plan. The current existing fish population is growing fast offering many angling opportunities to the public.
- A sediment-nutrient retention area was completed on the main arm of the lake in the fall of 2007. The retention area has filled with water and appears to be functioning as designed. Water clarity of water leaving the retention area appears to be as good as or better than that flowing into the lake from unprotected areas.
- Desirable rooted plants have been shown to improve water clarity in other southern Iowa water systems. An effort was begun in 2007 to introduce various plant species to help consume nitrogen and phosphorus. An existing lotus population is expanding and crowding some of the newly

introduced species. Progress can be seen in small areas of the lake but extensive new growth in limited. A sampling and monitoring project is underway.
- Plans for the lake are to monitor the water quality, integrity of the silt retention structures, and the growth and or expansion of the plant community. All of these issues will affect the water quality, fish growth, and or public use of the area.

Red Haw Lake (Lucas County)

- In 2001, an additional wetland and three sediment retention ponds were constructed within this watershed to improve and protect water quality.
- Recently IDALS performed a watershed assessment and identified priority gully areas. The District and NRCS require additional assistance in funding for the design and construction of six to eight park structures for these project areas.

Viking Lake (Montgomery County)

Viking Lake is a 137-acre man-make lake, located within a 1,000-acre state park. Initially impounded in 1957 it has historically been an above-average fishery, however with the introduction of yellow bass approximately 10 years ago, the fishery has dramatically declined. Water quality at the lake has always been average, however following periods of heavy rainfall turbid water conditions could persist for up to two weeks, persistent algal have also been an issue at the lake• A watershed coordinator through the 319 program has implemented corrective measures within the watershed.

- IDNR staff identified twenty-two (22) areas near the lake, on or including portions of state property, as needing grade stabilization structures to control soil erosion and improve water quality. Construction of twenty sediment structures is complete.
- IDNR did drain the lake after Labor Day (2006) and renovated the fishery to eliminate the problem yellow bass population.
- In addition, after lowering the lake, they repaired the dam gate, protected the shoreline, constructed jetties, deepened shoreline, and improved angler access and fish habitat.
- Viking Lake returned to full pool during the spring of 2007 and has been restocked with largemouth bass, bluegill, channel catfish, and crappie. The development of the fish population has been rapid and some angling began in 2008.

Lake Restoration Program (LRP) – Projects In Planning / Outreach Stage

Big Creek Lake (Polk County)

Agency leaders to herald better water quality in Big Creek Lake
Posted: November 20, 2007

NOTE: This is a joint press release from the Iowa Department of Agriculture and Land Stewardship, the Iowa Department of Natural Resources and the U.S. Department of Agriculture – Natural Resources and Conservation Service.

POLK CITY – DNR Director Richard Leopold, Secretary of Agriculture Bill Northey and NRCS State Conservationist Rick Van Klaveren will help the Boone and Polk County Soil and Water Conservation Districts celebrate securing a development grant to improve water quality at Big Creek Lake on Nov. 26. The districts will receive a check for $18,212 from Secretary Northey in a ceremony that begins at 11 a.m. at the Jollyboat Shelter on the west side of the park.

"Improving and protecting water quality is critical and central to what we do," said Northey. "Soil and water conservation districts, like these in Polk and Boone Counties, have a long history of fostering cooperation between landowners, government, and private organizations."
The grant will help the districts evaluate the watershed and develop a plan to address the issues to improve the water quality of the lake. "Big Creek Lake is one of 35 priority lakes the DNR has identified for lake restoration. It has tremendous value as a resource for the state," Leopold said. "This grant will help the districts develop a quality watershed plan that can keep the lake a top destination for area anglers and boaters." He added that more than 335,000 people visit the park each year, bringing more than $18.6 million annually to the area economy.

- On November 26, 2007, a development grant was received to improve water quality at Big Creek by implementing several analyses of the watershed.
- A gully analysis was performed in 2008 and a land use analysis will be performed in the spring of 2009 to gain a better understanding of critical areas in the watershed.
- A Wildlife Specialist position was jointly funded by the Iowa DNR's Fisheries and Wildlife Bureaus. Dusten Paulus was hired for this position and he has been working with landowners in the Big Creek watershed to implement conservation programs, such as WRP and CRP on their properties to reduce sediment and nutrient input into Big Creek.
- A Watershed Tactical Team will be formed in 2009 and subsequently a public meeting will be held to inform landowners and lake users of the study results and to discuss plans.

George Wyth Lake (Black Hawk County)

George Wyth is a sand borrow-lake with relatively low overall fertility when compared to other Iowa Lakes due to predominately sand substrates and a "new" lake basin. George Wyth's fishery is 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, which can be attributed to a low watershed to lake ratio and relatively small portions of watershed in agricultural production.

- A TMDL was completed 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.
- George Wyth Lake was affected by flooding from the Cedar River in 2008 and the State Park was closed during the period from June 5 to July 25. Biologists are currently in the preliminary planning phase for vegetation reintroduction into Wyth Lake.

Hawthorn Lake (Mahaska County)

The Mahaska County SWCD applied for and received a watershed assessment grant from IDALS. This assessment was completed in the winter of 2007. Funding for this project must yet be secured. The District applied for 319 funds and DSC funds for implementation, both of which were turned down. Lake Restoration funds as well as some Public Owned Lakes funds are the only potential sources of funding identified at this point. Public Owned Lake funds can only be spent on private ground; therefore, Lake Restoration remains our only potential funding source at this point for work on DNR land.

Hickory Grove Lake (Story County)

- Watershed Tactical Team met in the summer of 2008 to discuss future direction of the lake
- Development grant was received in 2008 to determine critical areas in the watershed where significant quantities of sediment and nutrients are delivered to the lake.
- The Watershed Tactical Team plans to meet with Iowa State University professors (engineering) to discuss potential options for improving water quality of the lake.

Meetings with Local Leaders and Stakeholders

In accordance with Section 26 of House File 2782: "The Department shall meet with representatives of communities where lakes on the initial list are located to provide an initial lake restoration assessment and to explain the process and criteria for receiving lake restoration funding".

The IDNR has established local stakeholder groups and communicated with the public. We have had these discussions with a number of active or planned lake/watershed improvement projects. Including; Blackhawk Lake, Carter Lake, Clear Lake, Easter Lake, Green Valley, Lake Darling, Lake Geode, Lake Manawa, Lake Wapello, Lizard Lake, Lost Island Lake, Lower Gar Lake, Prairie Rose Lake, Rathbun Lake, Rock Creek Lake, Silver Lake (Delaware), Storm Lake, and Union Grove Lake.

Initial technical field staffs planning groups have held meetings for the following lakes: Big Creek Lake (Polk County), Blue Lake (Monona Co.), Brushy Creek Lake (Webster Co.), Lake Geode (Henry Co.) and Lake Keomah (Mahaska Co.). The lakes listed below do not have active lake improvement projects underway. IDNR staff, during the second half of FY08, plans to compile a list of local community leaders and stakeholders associated with these projects then schedule informational meetings with interested stakeholders representing these lakes.

<u>Potential Future Projects that need Meetings with Local Leaders and Stakeholders:</u>
Arbor Lake (Poweshiek Co.), Central Park Lake (Jones Co.), Diamond Lake (Poweshiek Co.), Hannen Lake (Benton Co.), Hickory Grove Lake (Story Co.), Kent Park Lake (Johnson Co.), Lake of the Hills (Scott Co.), Lake Keomah (Mahaska Co.), and Pleasant Creek Lake (Linn Co.).

Lake Restoration Program Components

Lake Restoration Prioritization Process

The Lake Restoration Program initially ranked 131 public lakes for lake restoration priorities in 2006. A group of thirty-five lakes, considered highest priority for restoration, was established and serves 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.

IDNR will periodically review the list of thirty-five lakes annually to determine which lakes should proceed with lake restoration. 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.

The other necessary ingredient to begin lake restoration is local commitment. In order to better document how lake restoration will benefit Iowa we will use cost benefit analysis, as well as identifying non-economic benefits to people and our natural resources. Computing and documenting the economic

benefits, recreation benefits, health benefits, and natural resource/environmental benefits of lake improvements will be a great asset to the lake restoration process. This information will also go a long way in communicating the need of lake restoration projects to local communities and the legislature.

Inquiries from Stakeholders of Lakes not on the Priority List

Also in accordance with HF2782, “Communities with lakes not included on the initial list may petition the Director of the Department for a preliminary lake restoration assessment and explanation of the funding process and criteria”.

During the first half of FY08, local stakeholders of Lake Rathbun (Appanoose Co.), Lost Island Lake (Palo Alto Co.) and Summit Lake (Union Co.) contacted the IDNR to consider their respective lakes for a restoration project.

Rathbun Reservoir (Appanoose Co.) is a 11,000 acre lake in south-central Iowa that is one our most significant state recreational destinations and a provider of water to the states largest rural water system (Rathbun Rural Water). It is distinct from several of our other large reservoirs, Saylorville, Coralville and Red Rock in that its watershed to lake ratio is only 37:1 and has great potential to maintain and improve lake water quality with a combination of watershed and lake restoration alternatives.

Lost Island Lake (Palo Alto Co.) is a 1,000 ac. natural lake in northwest Iowa that is not meeting its water quality and recreational potential. The Iowa IDNR currently owns 23 percent of the watershed and proposes a watershed assessment of the entire system.

The DNR is working cooperatively with local groups at Summit Lake to assist in a technical capacity and to help fund efforts associated with the ability to drain Summit Lake, future elimination of rough fish from the system and modification of the spillway to prevent migration of these fish back into Summit Lake. The City of Creston recently applied and was successful in obtaining a WIRB Grant top fund $493,117 of a $678,590 project. The WIRB project will focus on watershed improvements, streambank and lake shoreline stabilization and stormwater improvements.

The IDNR has reviewed the available lake and watershed information and has indicated that these lakes should be included in the lake restoration program. We will schedule meetings with local stakeholders from both these lakes in early 2008 to discuss an overview of the funding process and the required next steps.

Estimated Restoration Costs for the Thirty-Five Priority Lakes/Watersheds

The cost estimates in this table represent a first attempt to approximate financial resources needed for restoring 35 priority lakes. In-lake restoration cost is an estimation of dredging costs ($5.50/cubic yd) associated with deepening lakes to an average depth of 10 ft. This cost includes either an estimated 30% cost above dredging for other in-lake restoration work. Lakes with no proposed dredging include an estimate of other in-lake work and costs that might be required to achieve water quality goals. Permanent watershed protection was estimated for all watersheds at costs of $150/ac (good), $250/acre (fair), and $350/ac (poor). Urban watershed acres were assessed at $1000/ac. Some lakes were adjusted for costs because of recently completed restoration work or special needs.

Lake name	County	Lake Area (acres)	Watershed Area (acres)	Est. Lake Restoration Cost	Est. Watershed Restoration Cost	Estimated Total Cost	Cost / Lake Acre
Arbor Lake	Poweshiek	13	1,046	$187,334	$674,254	$861,588	$66,276
Big Creek Lake	Polk	864	46,822	$3,900,000	$11,705,436	$15,605,436	$18,062
Black Hawk Lake	Sac	919	13,179	$33,670,911	$1,976,796	$35,647,707	$38,790
Blue Lake	Monona	264	5,027	$10,568,625	$754,011	$11,322,636	$42,889
Brushy Creek Lake	Webster	710	56,318	$275,000	$14,079,438	$14,354,438	$20,218
Carter Lake	Pottawattamie	314	2,398	$3,247,972	$1,366,983	$4,614,955	$14,697
Central Park Lake	Jones	25	370	$344,951	$92,606	$437,557	$17,502
Clear Lake	Cerro Gordo	3,669	9,538	$13,289,756	$2,218,904	$15,508,660	$4,227
Crystal Lake	Hancock	264	1,984	$10,332,036	$297,658	$10,629,694	$40,264
Diamond Lake	Poweshiek	96	2,673	$809,364	$668,190	$1,477,554	$15,391
Easter Lake	Polk	185	6,368	$6,000,000	$3,750,638	$9,750,638	$52,706
Five Island Lake	Palo Alto	964	7,726	$950,000	$1,267,289	$2,217,289	$2,300
George Wyth Lake	Black Hawk	44	440	$236,556	$65,947	$302,503	$6,875
Green Valley Lake	Union	420	4,756	$3,011,262	$1,188,891	$4,200,153	$10,000
Hannen Lake	Benton	37	566	$225,305	$141,581	$366,886	$9,916
Hickory Grove Lake	Story	82	3,955	$650,000	$988,653	$1,638,653	$19,984
Kent Park Lake	Johnson	26	669	$463,322	$100,281	$563,603	$21,677
Lake Ahquabi	Warren	116	1,729	$1,000,000	$259,315	$1,259,315	$10,856
Lake Anita	Cass	178	2,317	$50,000	$347,568	$397,568	$2,234
Lake Darling	Washington	268	12,451	$4,500,000	$3,112,751	$7,612,751	$28,406
Lake Geode	Henry	190	10,136	$975,000	$2,534,098	$3,509,098	$18,469
Lake Keomah	Mahaska	77	1,875	$300,000	$468,677	$768,677	$9,983
Lake Macbride	Johnson	870	16,163	$350,000	$4,462,871	$4,812,871	$5,532
Lake Manawa	Pottawatt.	733	2,425	$30,128,179	$1,199,843	$31,328,022	$42,739
Lake of the Hills	Scott	54	1,650	$16,441	$412,532	$428,973	$7,944
Little Wall Lake	Hamilton	246	187	$5,000,000	$28,083	$5,028,083	$20,439
Lower Gar Lake	Dickinson	264	10,506	$14,125,036	$2,747,713	$16,872,749	$63,912
Pleasant Creek Lake	Linn	418	2,060	$750,000	$308,934	$1,058,934	$2,533
Prairie Rose Lake	Shelby	190	4,450	$3,203,083	$1,557,394	$4,760,477	$25,055
Red Haw Lake	Lucas	73	947	$60,000	$236,728	$296,728	$4,065
Rock Creek Lake	Jasper	595	26,071	$8,500,000	$9,124,914	$17,624,914	$29,622
Silver Lake	Delaware	37	201	$983,304	$30,224	$1,013,528	$27,393
Storm Lake	Buena Vista	3,142	14,701	$28,000,000	$3,169,039	$31,169,039	$9,920
Union Grove Lake	Tama	115	6,834	$3,257,200	$2,392,041	$5,649,241	$49,124
Viking Lake	Montgomery	144	2,023	$65,000	$505,856	$570,856	$3,964
	Totals	**16,606**	**280,561**	**$189,425,637**	**$74,236,137**	**$263,661,774**	**$15,878**

Local, State and Federal Partnerships

In order to achieve lake restoration goals it is critical that the IDNR 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
- IDNR Field Offices (Environmental Services, Fisheries, Forestry, Parks, Wildlife)
- IDALS/ Division of Soil Conservation – Project Coordinators
- IOWATER Volunteers / Educators / Interested Citizens
- Lake Associations / Groups
- NRCS Soil and Water Conservation Districts (SWCD)
- Private Landowners
- USDA Resource Conservation and Development (RC&D)
- Watershed Organizations

State:

- Agribusiness and Community Organizations
- IDALS/ Division of Soil Conservation
- Iowa Department of Transportation
- Iowa Environmental Council
- Iowa Farm Bureau
- Iowa Natural Heritage Foundation

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 IDNR, in cooperation with Iowa Department of Agriculture Land Stewardship (IDALS), has worked to develop a holistic approach to locally led watershed projects. The Watershed Improvement Review Board has adopted it as the basic planning requirement for successful proposals.
The IDNR website includes the current 9-step planning protocol:
http://www.iowaIDNR.gov/water/watershed/files/protocolguide.pdf

The group plans to develop a brochure (small enough to fit in your shirt pocket) that outlines how the protocol works and identifies where the public fits into the process. 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 (Appendix I.).

Several brochures are available on-line that offer more information about lake restoration and watershed improvement.

- Lake Ahquabi
  http://www.iowaIDNR.com/water/nonpoint/files/ahquabi.pdf
- Brushy Creek Lake
  http://www.iowaIDNR.com/water/nonpoint/files/brushycreek.pdf
- Lake Darling
  http://www.iowaIDNR.com/water/nonpoint/files/darling.pdf
- Nine Eagles Lake and Slip Bluff Lake
  http://www.iowaIDNR.com/water/nonpoint/files/nineeagles.pdf

Program Challenges

Unforeseen Delays in Construction

One of the greatest challenges with construction projects is making sure complex projects move forward without unnecessary delays. The Lakes Water Quality Improvement projects are no exception. The majority of lake restoration projects involve constructing or installing watershed or in-lake improvements. A typical construction project might include the following stages: 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 or land acquisition before construction can begin, followed by required approvals and permits such as archeological/cultural (SHPO), environmental (T&E species), floodplain/404 permit, and sovereign lands permit. Obtaining these approvals or permits may result in delays to the process. In addition, adverse weather, equipment breakdowns, and other unforeseen occurrences can cause delays. IDNR is committed to streamlining project development and implementation. Resources have been committed to develop an improved project management tracking system for lake restoration projects and budgets. During FY08, we will work to expedite project development steps and use funds for their intended purpose without unnecessary delays.

Multiple-year Projects

Timelines for larger construction projects at a minimum fall within a two-year period. Large dredging projects may take even longer. Dredging contractors face substantial costs to mobilize and set up lake dredging operations and this critical work needs multiple year commitments to secure contactors. As such, the most practical and efficient way to complete a dredging plan is as one continuous project. Clear Lake, Crystal Lake, and Storm Lake are all examples of dredging projects that require a multiple-year funding commitment from the State in order to achieve lake restoration goals.

Local partners may also need a multiple year funding commitment from the lake restoration program in order to pursue funding sources to match State funds. State Infrastructure Appropriations for lake restoration accepts requests on a yearly basis; therefore, it is difficult to guarantee ongoing funding support. The process should incorporate a funding approach and structure that addresses the multi-year commitments needed to secure dredging contractors and local funding sources.

Shallow Lakes Management Initiative

Ducks Unlimited and the Iowa DNR's Wildlife and Fisheries Bureaus established a prioritized list of at least 50 shallow lakes to be renovated over the next ten years. The first lake to be renovated was Diamond Lake in Dickinson County. Renovation work began during summer 2006. Shallow lakes prioritized for restoration include; Dan Green Slough in Clay Co., Four-Mile Lake in Emmet Co., Pickerel Lake in Buena Vista Co., South Twin Lake in Calhoun Co., Virgin Lake in Palo Alto Co., and Lizard Lake in Pocahontas County.

The following excerpt, provided by Joe Larscheid, DNR Fisheries Research Supervisor, describes the basis and objectives for the DNR's Shallow Lakes Management Initiative.

"Shallow lake management has always been a challenge in Iowa and around the world. Shallow lakes are scattered throughout Northwest Iowa and, in most of these lakes water quality lakes is less than desired. 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 (Cyprinus carpio), and black bullheads (*Ameiurus melas*). 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."

Shallow lakes differ substantially from deeper lakes in many respects (Scheffer 1998). Shallow lakes usually exist in either of two alternative stable trophic states with or without any change in the nutrient budget of the lake (Scheffer et al., 1993, Moss et al., 1996). These lakes can exist as very turbid, algae-dominated systems with little to no vegetation, or as clear water, macrophyte dominated systems. In shallow lakes, the benthivorous and planktivorous fishes along with wind and wave action and in some cases heavy boating traffic can perpetuate the algae dominated system.

By controlling or removing the factors perpetuating the algae dominated turbid system, it is possible to "flip" the system into a clear water macrophyte dominated system (Scheffer, 1993). The positive impacts of emergent and submergent vegetation on water quality are due to several factors. Rooted vegetation prevents resuspension of sediments into the water column by solidifying bottom sediments and suppressing wind and wave action. Rooted plants provide habitat for periphyton and zooplankton and fish species commonly found in clear water lakes. Rooted vegetation also ties up nutrients making them unavailable for algae. Some plants also release allelopathic substances into the water suppressing algae growth. Many of these mechanisms are difficult to assess and vary among water bodies; however, their combined effect stabilizes the clear water trophic state (Scheffer et al., 1993). Both the clear water macrophyte state and the algae dominated state are stable, and it takes a major perturbation to move from one state to another (Scheffer et al., 1993). Three methods that show great promise to cause the shift from the turbid to the clear water state are benthivorous fish control, heavy piscivore stockings (to control both benthivorous and planktivorous fishes), and water level draw downs (Scheffer et al., 1993).

The goal of this project is to develop tools that managers can use to shift and maintain shallow lakes in a clear water state.

Shallow Lakes Management Project Components:

- Shallow lake renovation based on alternative stable trophic states: Management guidelines that cause shallow lakes to shift from the turbid, algae -dominated systems to the clear, macrophyte-dominated systems.
- Physical characteristics of shallow lakes before and after restoration: Characteristics include information about the watershed, bathymetry, sediment profile, and water chemistry of the lakes.

- Biological characteristics of shallow lakes before and after restoration: Characteristics include the plankton, macrophyte, fish community and waterfowl use of the assessed lakes and the related changes to benthivorous fishes from biomanipulation of these biological components.

Update on Shallow Lake Projects using Lake Restoration Funds, December 2008

Introduction: Natural Lakes in Northwest Iowa are mainly characterized as shallow, wind swept systems that exhibit poor water quality. Significant watershed changes and the introduction of common carp in the late 1800's have forever made management of these water bodies a challenge. Through work accomplished on the projects listed below, great strides have been made in our understanding of these systems. These ground breaking projects in Iowa will undoubtedly lead to others as the health to these unique water bodies is restored. 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 current focus of the Lake Restoration Program is on shallow lakes that support both fishing and wildlife benefits. In addition, there is an emphasis on shallow systems above important natural lakes.

Center Lake, Dickinson County – Due to strong local support, the damaged and ineffective Center Lake outlet culverts were replaced at a lower elevation with a variable-crest concrete water control structure during fall 2008. Improvements to in-lake and downstream outlet channels were also completed. Collectively, these improvements will reduce flooding impacts on the 264-acre Center Lake and will allow for beneficial partial drawdowns on Center Lake and two associated Type III wetlands. Establishment of aquatic vegetation in the lake and wetlands will improve fish and wildlife habitat and will enhance water quality in Center Lake and its downstream neighbor, West Lake Okoboji.

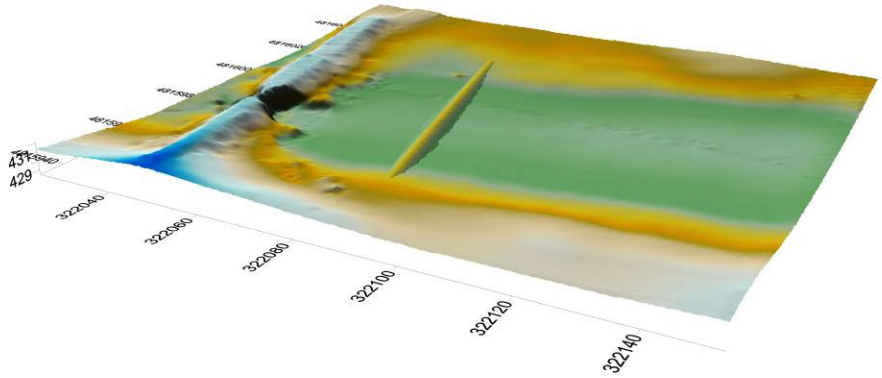
This work on the lake outlet is only a small part of a comprehensive plan being developed for this lake. Storm water modeling and prioritization of other watershed inputs are underway. The Center Lake Improvement and Protection Association has collaborated with local agencies to develop a lake restoration plan to reverse recent declines in water quality and received a $15,000 local grant to cost-share improvements to the outlet.

Dan Green Slough, Clay County – During fall 2008, the existing water control structure was rehabilitated and a pump system and a fish barrier were installed on this 311-acre shallow lake. This project was made possible through the donation of a key tract of land on the lake's outlet. Similar to other projects, efforts were made to reduce erosion during construction and pumping. Upon sufficient freezing of the lake bottom this winter, contractors will install the remainder of the pump intake pipe. At present, Dan Green Slough has been partially dewatered to induce a winterkill of rough fish. The basin will be kept mostly dry through summer 2010 to allow for the establishment of aquatic vegetation and the consolidation of bottom sediments.

Diamond Lake, Dickinson County - During winter 2006-07, the initial efforts to enhance this 166-acre basin were completed with the installation of a drawdown tile designed to allow the lake to be periodically dewatered to eliminate rough fish and to allow for the germination of aquatic plants and consolidation of bottom sediments. Excessive rain in late summer 2007 prevented a successful drawdown. A winter rotenone project in January 2008 eliminated the few remaining rough fish in the lake. A successful drawdown was realized in summer 2008 through the continuous use of the drawdown tile and the temporary use of an auxiliary diesel pump, which was purchased with Lake Restoration funds. The outlet of the lake was also lowered about 0.5' to a more natural elevation, which will prevent excessive shoreline erosion, tree toppling and should provide for water levels more conducive to aquatic plant growth. Despite a cool spring, regrowth of vegetation did well over the summer.

Diamond Lake dewatered area showing regrowth of vegetation 9-11-08. Note the lake is completely dry.

A “reef” fish barrier will be installed during winter 2008-09 to prevent the reinfestation of rough fish into Diamond Lake. The barrier is best described as a flow-through rock weir. At present, the lake is in excellent condition with robust and diversified stands of aquatic vegetation on the lake’s perimeter, hard-packed sediments in the lake’s interior, and few, if any rough fish present. Plans are to re-hydrate the lake and to begin re-establishing a quality fishery during summer/fall 2009. Initial stocking of fingerling perch is planned for next summer/fall. Northern pike fingerlings will be stocked the following year.



Surface created from LiDAR data. Rock barrier will be upstream from the existing bridge. The existing bridge is on the left. A computer generated structure is in the center of the image.

Four Mile Lake, Emmett County – During fall 2008, the exiting water control structure was rehabilitated and a catwalk and a fish barrier were installed. Once the basin bottom freezes adequately, contractors will improve the in-lake drawdown channel to facilitate the transfer of water from the basin to the water control structure. Thanks to an aggressive dewatering strategy and relatively dry weather in 2008, Four Mile Lake is presently free of problem fish and well vegetated. As a result, the 200-acre basin will be rehydrated in spring 2009 to provide excellent spring and fall migration habitat and public recreation/education opportunities.

Jemmerson Slough, Dickinson County - Located at the top end of an important West Lake Okoboji watershed, the 932-acre Jemmerson Slough complex is an important water quality, wildlife habitat, and public recreation/education area. In 2006, Phase I of the Jemmerson Slough Enhancement Project was completed with the installation of two water control structures and two outlet improvements. During fall 2008, the second and final phase was completed with the installation of a pump station, new gravity-flow water control structure, and fish barrier. Intensive efforts were made during construction to prevent water quality problems in West Lake Okoboji and other downstream basins. Upon sufficient freezing of the lake bottom this winter, contractors will install the remainder of the pump intake pipe. At present, Jemmerson Slough has been partially dewatered to eliminate rough fish through creating natural winterkill conditions. The basin will be kept dry through summer 2010 to allow for the germination of beneficial plants and the consolidation of bottom sediments. Once re-hydrated, over 200 wetland acres will send cleaner water to West Lake Okoboji and other downstream basins and will provide excellent production and migratory wildlife habitat.

Lizard Lake (Pocahontas County) - Lizard Lake is a 285-acre shallow natural lake. Rough fish (buffalo, bullhead and carp) dominate the lake population. The lake contains very little area of aquatic vegetation and exhibits poor water quality. A local lake group has promoted lake restoration and they continue to meet with IDNR staff to discuss their concerns. In June 2006, IDALS and the local Soil and Water Conservation District awarded a Development Grant to evaluate the watershed of Lizard Lake.

Iowa State University Limnology Laboratory conducted a Diagnostic Feasibility study for Lizard Lake. As part of potential restoration alternatives, ISU presented "shallow lakes management" as an option for improving the lake's water quality, fish population structure and wildlife potential. In addition, ISU compared shallow lakes management to other options including no action, partial dredging, and complete dredging. Management may also include renovation of the fisheries population, aquatic vegetation management and/or watershed treatment. Local sources have committed 25% for the diagnostic/feasibility study cost. Several meetings have been held with the public and stakeholders concerning the options for Lizard Lake and current activities include finalizing restoration options into a preferred management plan. The proposal for 2009 is to modify the spillway and conduct a full lake fish renovation.

Lost Island/Barringer Slough/Blue-wing Complex – An aggressive and comprehensive plan to improve water quality in the > 2,200-acre complex by reducing existing carp numbers, preventing remaining rough fish from entering most spawning areas, and conducting beneficial draw downs on associated wetland areas (780-acre Barringer Slough, 150-ace Blue-wing Marsh, others) to eliminate rough fish and allow for the germination of aquatic plants and the consolidation of bottom sediments. The project will require an innovative plan to allow for the removal of up to 75% of the exiting carp biomass, the aggressive stocking of predatory fish, and the new construction or rehabilitation of up to 3 control structures and 4 fish barriers throughout the complex. During summer 2008, DNR-Fisheries used mark – recapture techniques to estimate in-lake carp numbers and biomass. Recently, Ducks Unlimited, Inc. was awarded a contract to design effective water control and fish barrier structures. It is anticipated that survey and design work will begin during summer/fall 2009 and that infrastructure construction will begin in 2010. Carp removal and targeted drawdowns of various parts of the complex may begin in 2010 or 2011.

Related Activities and Studies

Aquatic Vegetation BMPs

We are more than halfway through the IDNR's three-year cooperative study with Iowa State University to develop both short- and long-term strategies needed to address the impact of aquatic plants on fish, fishing and other lake uses. The overarching goal of this multifaceted study is to find ways to strike a balance between clear water, plant growth and lake use. Although aquatic plants are an essential component of lake ecosystems, the combination of clear and nutrient-rich water can result in excessive growths of vegetation, especially in shallow water near shore. These same, near shore areas are also the portions of our lakes most used by the public. Information gained in this study will result in a detailed knowledge of the relationships between water quality, the aquatic food web, plants and fish. This information will greatly benefit assessment of aquatic plant communities and methods used to control nuisance growths. The result will be implementation of those practices most suited to management of plants in Iowa's valuable and heavily used lakes.

Previous studies have shown restoration that includes limited growths of aquatic plants can result in a healthier aquatic community and greater public use. Lake of Three Fires, a recent lake restoration project nearing completion, is a case in point. Lotus choked several areas of the lake prior to dredging causing limits to recreational use. Lotus colonies can expand rapidly, produce a canopy above the water, are difficult to control with herbicides, and reduce public use in large areas.

In fall 2006, IDNR started a project to replace lotus with waterlilies. Unlike lotus, growths of waterlilies are not nearly as prohibitive to anglers and other lake users, and are easy to control with herbicide. These earlier attempts at lily introduction were not successful. Efforts started this year include control of the lotus with herbicide and concurrent introductions of lilies and a variety of submersed aquatic plants in small wire enclosures. Our studies and those done by Missouri show that aquatic plant establishment is more successful when the new plants are protected from geese, muskrats and other herbivores.

A lake just entering the restoration process, Prairie Rose, has had its aquatic plant community sampled with techniques developed in this study, which will allow a complete assessment of the impacts of plants before and after restoration efforts.

Determining Historic Water Quality Conditions in Iowa Natural Lakes

Principal Investigator: John Downing
Student Investigator: Adam Heathcote (Ph. D.)

Introduction
This project aims to provide the Iowa Department of Natural Resources with baseline values of total phosphorus nutrient concentrations in Iowa's 34 natural lakes of recreational importance. This will yield a clear understanding of the amount of disturbance that has taken place since human settlement and assist in the setting of realistic standards for lake restoration, remediation and nutrient impaired reference conditions. This will be an improvement on current reference conditions, which are determined indirectly and do not consider historical information. In addition to providing information on these lakes, this work will set the stage for hind-casting water quality conditions for other lentic ecosystems in the state.

Goals and Objectives:

- Determine total phosphorous levels and sedimentation rates that existed prior to European settlement in Iowa (ca. 1850) along with their level of precision.
- Use determined total phosphorus levels and sedimentation rates to: (A) aid in the setting of benchmarks for lake restoration; (B) provide quantitative historical information on pre-European status of natural lakes included in the Project; and (C) provide the DNR with clear reference conditions for the minimally disturbed condition of lacustrine ecosystems within the state.
- Determine eutrophication rates in Iowa's natural lakes via fluxes in sedimentation and nutrient levels, prior to and since European settlement, to evaluate the impact of land-use changes within the lakes' watersheds.
- Develop the necessary technology (a diatom transfer function) from current environmental conditions and species assemblages unique to Iowa and inclusive of conditions and assemblages hypothesized to have historically existed in the state.

Seasonal Distribution, Aggregation, and Habitat Selection of Common Carp in Clear Lake, Iowa

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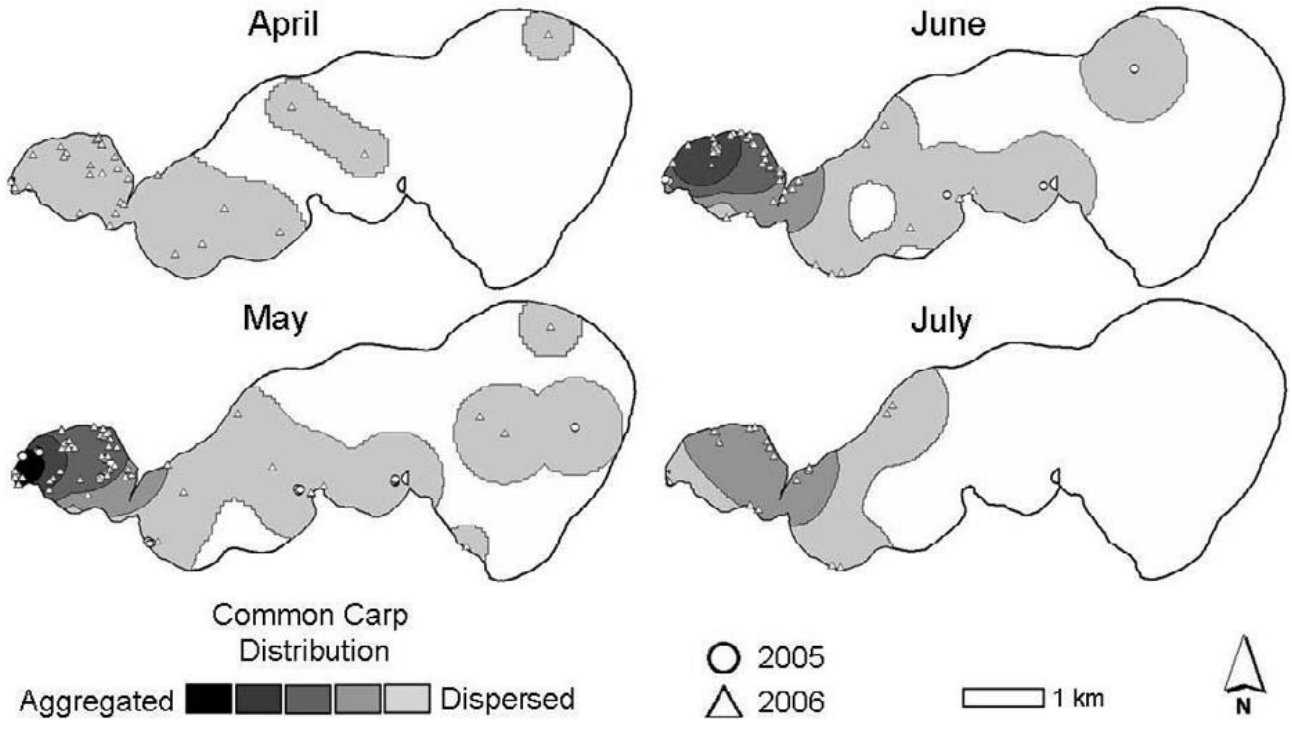
Abstract.—The common carp Cyprinus carpio is widely distributed and frequently considered a nuisance species outside its native range. Common carp are abundant in Clear Lake, Iowa, where their presence is both a symptom of degradation and an impediment to improving water quality and the sport fishery. We used radiotelemetry to quantify seasonal distribution, aggregation, and habitat selection of adult and subadult common carp in Clear Lake during 2005–2006 in an effort to guide future control strategies. Over a 22-month period, we recorded 1,951 locations of 54 adults and 60 subadults implanted with radio transmitters. Adults demonstrated a clear tendency to aggregate in an offshore area during the late fall and winter and in shallow, vegetated areas before and during spring spawning. Late-fall and winter aggregations were estimated to include a larger percentage of the tracked adults than spring aggregations. Subadults aggregated in shallow, vegetated areas during the spring and early summer. Our study, when considered in combination with previous research, suggests repeatable patterns of distribution, aggregation, and habitat selection that should facilitate common carp reduction programs in Clear Lake and similar systems.

COMMON CARP SEASONAL DISTRIBUTION



The Clear Lake Ecosystem Project

Michael E. Colvin1, Eric D. Katzenmeyer1, Timothy W. Stewart1, and Clay L. Pierce2
1 Department of Natural Resource Ecology and Management, Iowa State University
2 U.S. Geological Survey, Iowa Cooperative Fish and Wildlife Research Unit

Clear Lake is a valuable natural resource for Iowa (Downing et al., 2001b). Clear Lake is the third largest natural lake in the state, and has been a popular tourist attraction for over a century. Camping, picnicking, boating, fishing, swimming and other recreational activities are popular there, and the economic impact on the City of Clear Lake and surrounding area is enormous (Azevedo et al., 2001). Improving and stabilizing the water quality of Clear Lake is a top priority of the Clear Lake community and the Iowa Department of Natural Resources. Clear Lake is also a highly valuable fishery resource for Iowa (Wahl, 2001). The lake's long history as a popular and quality fishery reflects its history as a tourist destination. In recent years, Clear Lake has received attention primarily for its walleye and yellow bass fisheries, although historically it also supported excellent northern pike, largemouth bass, bluegill and crappie fisheries. Improving and diversifying the fishery of Clear Lake are also priorities of the Clear Lake community and the Iowa Department of Natural Resources. Water quality improvements will be needed for this goal to be achieved.

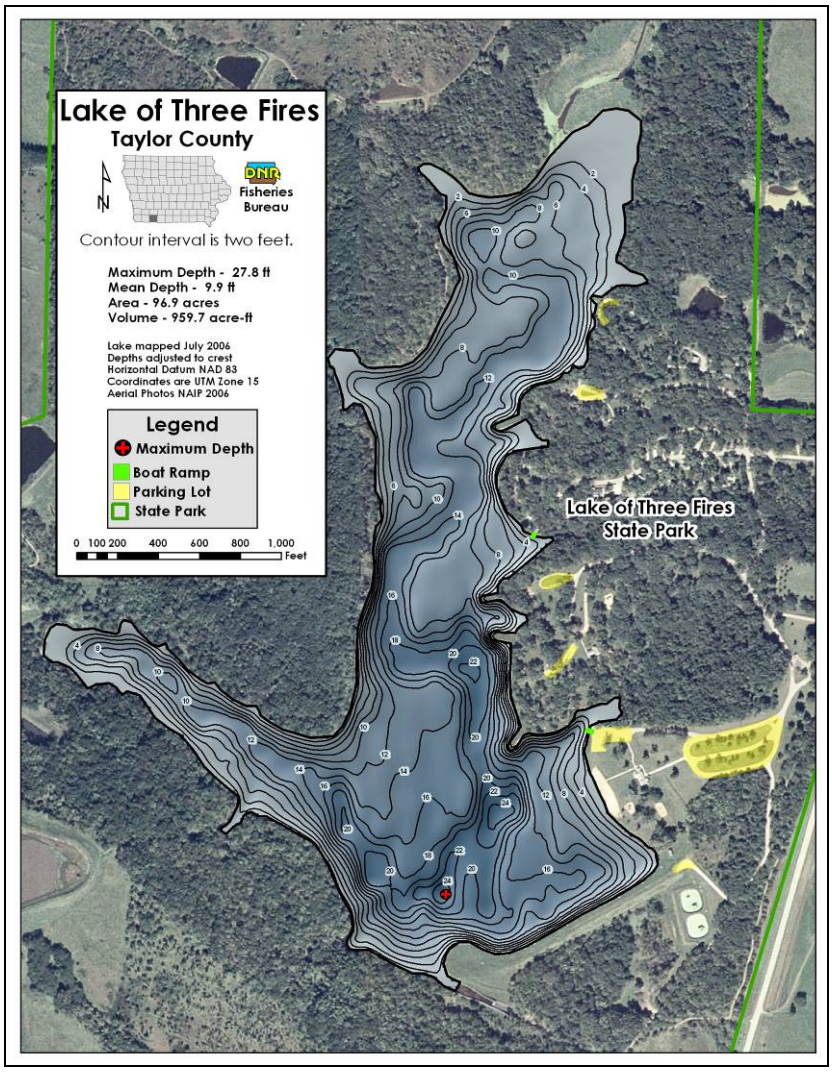
The interaction of invasive carp and zebra mussels and their effects on the biological community and water quality in Clear Lake is uncertain and potentially follows multiple direct and indirect pathways. The effects of management strategies to maximize water quality and biological productivity in multiple use lakes may take many years to be realized and are not guaranteed to be successful. The ability to evaluate alternative management strategies prior to implementation is a potentially useful tool for decision makers. Translating the pathways and interactions of the conceptual model of Clear Lake into a quantitative simulation model will enable the evaluation of alternative management strategies prior to implementation.

Fieldwork began in May of 2007 to quantify portions of the Clear Lake ecosystem to monitor changes during the invasion of zebra mussels and for use in a quantitative ecosystem simulation model. Data have been collected on the carp population, benthic invertebrates, benthic algae, fish community, benthic chlorophyll a, and juvenile zebra mussels. Additional ancillary data have been collected from existing data for Clear Lake and similar ecosystems. These data has resulted in 81.1 megabytes of data stored in a relational database. Preliminary results have shown that juvenile zebra mussels can be found in Clear Lake throughout the summer months; however this is temporally and spatially variable. Veligers were not detected in Ventura Marsh. The fish community is numerically dominated by carp, yellow bass, black bullhead and walleye. Benthic algae communities are dominated by diatoms in Clear Lake and green algae in Ventura Marsh. The carp population was estimated to be 35,738 individuals with an estimated biomass of 25.9 kg per hectare in 2007, which is considerably down from Iowa Department of Natural Resources estimates of biomass from the late 1990's.

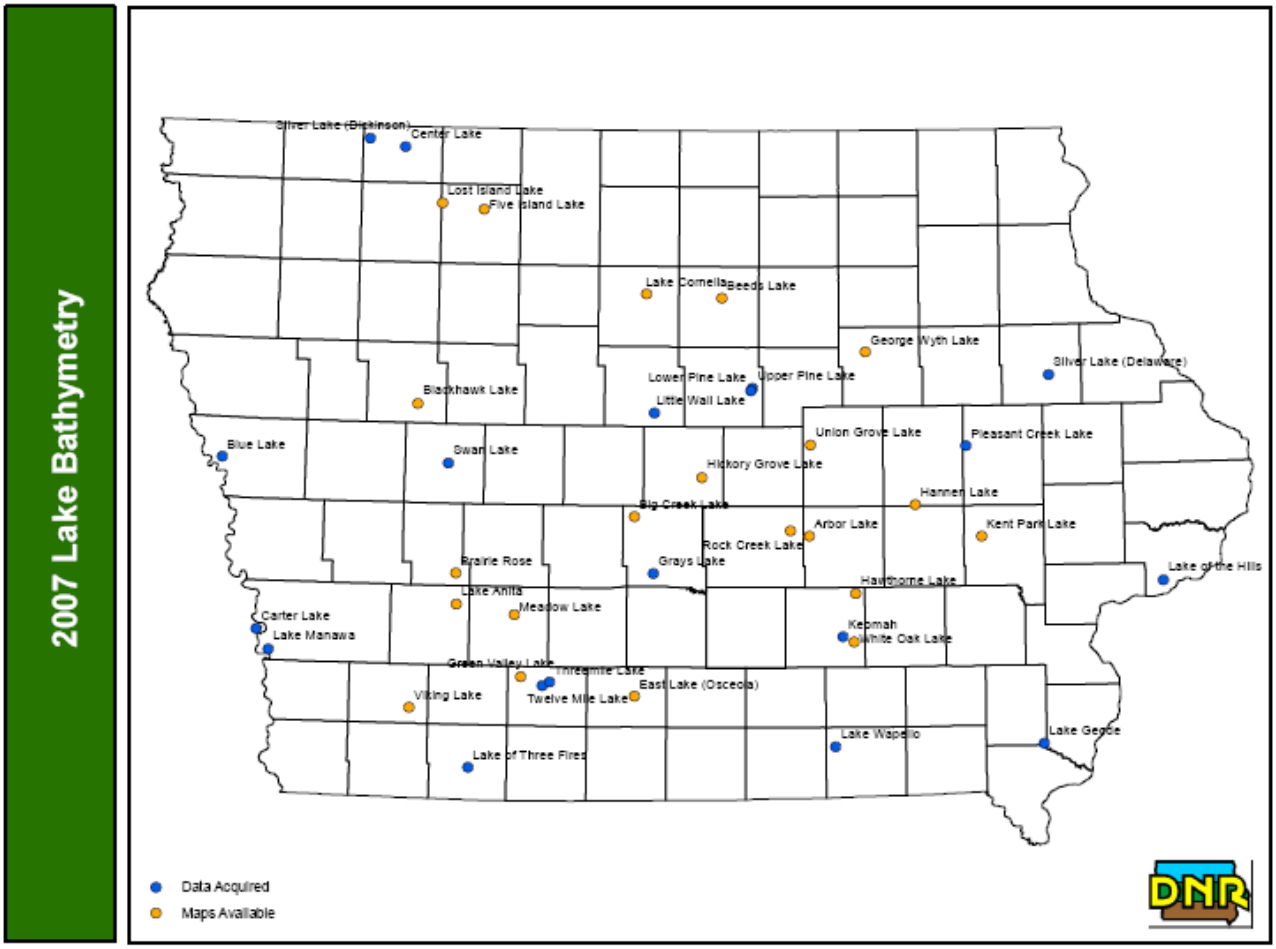
Statewide Bathymetric Lake Mapping

The last major effort to map Iowa's lakes began in the early 1970's. Managers relied upon these early contour (bathymetric) maps to guide restoration efforts, calculate water volumes and basin characteristics, and assist recreational users. Lakes go through many changes during their lifespan, and over the past 30 years silt deposition has profoundly changed many lakes in Iowa. Older maps, in many cases, have simply become obsolete. Additionally, many of Iowa's new lakes are not mapped.

Since the 1970's, there have been significant technological advances leading to improvements in map accuracy and utility. Our current mapping efforts are utilizing state-of-the-art electronics and map generating software. This effort, including maps and underlying data, provides a fundamental data layer needed by communities and resource professionals to make important lake management decisions.



The Iowa Statewide Lake Mapping Project designs maps around a standard set of methods developed over the past two years. Data acquisition began in 2006, with 31 lakes being mapped. IDNR acquired data for 12 lakes in 2007, and continued mapping efforts in 2008. Maps in final review are scheduled for release to the public this winter.



Combining shading models, aerial photography, the DTM, and contour lines creates one final product, the contour map. Public amenities, such as boat ramps, parking areas, and park and public land boundaries are added and labeled. Mappers add a legend before sending the map to lake managers for edits and comments. Finally, the lake map is ready for public use and distribution to field offices and websites. The combination of new data with aerial photography provides the public with an improved product.

In addition to a better visual product, the data will have additional uses in research and will benefit the Lake Restoration Program. The new lake data and maps will also become a very accurate and useful historical record for future lake management. In many cases, comparison of as-built contours to present day bathymetry can provide information of historical sedimentation rates and identify the regions most affected by sedimentation. In addition, they will allow for a current baseline to any proposed dredging activities.

Benchmarks of Biological Integrity for Lake Restoration Success

Submitted by: Jesse Fischer and Michael Quist
Period: July 1 – September 30, 2008

During this quarter, summer sampling was conducted on six lakes/impoundments (i.e. Don Williams, Prairie Rose, Pleasant Creek, West Okoboji, Minnewashta, and Silver) using six gear types; day and night electrofishing, seining, trawling, fyke netting, and mini fyke netting. A total of 18,309 fish were collected among all lakes and impoundments during summer sampling, compared to 10,806 individuals from spring sampling. All fish collected were measured to the nearest millimeter and fish greater than 100 mm were weighed and fin clipped for future population estimates. Hard structures were collected from several species for aging (i.e. common carp, black bullhead, black crappie, bluegill, green sunfish, channel catfish, largemouth bass, and walleye). A total of 1,924 structures were taken for aging. Currently, data from spring and summer sampling have been entered into a database and preliminary data summarization has begun. We have also begun processing and aging hard structures.

During the next quarter, Jesse will continue fall sampling (i.e. late September-October) for all six water bodies. Hard structures will once again be collected for the six targeted species. Once processed, sample and aging data will be entered into databases for continued data analysis.

LiDAR

LiDAR stands for "Light Detection and Ranging". It is a process of scanning the earth with lasers from an aircraft to obtain accurate elevations. LiDAR is similar to sonar (depth finder) in that it uses a time of travel method of measuring distance. LiDAR is capable of providing accurate elevation data. The statewide project will generate elevation data that is within 8 inches of actual elevations (currently available statewide data has an accuracy of ± 5 feet).

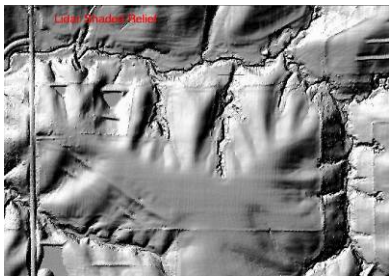
LiDAR acquisition started in the fall of 2006. Collections have taken place in the spring and fall of each year since. Equipment failures, spring flooding, and early snowfalls have hampered the rate of collection to date. Currently, approximately 50% of the state has been acquired and is in the QA/QC process at the USGS office in Rolla, MO. The DNR anticipates the majority of the state will be collected by the end of the fall 2009 season. Spring, color infrared photography collection has been funded and collection will begin in March or April of 2009. The LiDAR data will be used to develop elevation maps for all Iowa counties. These maps and the aerial photography will be freely available for public use over the Internet.

The DNR strongly believes LiDAR will provide tremendous environmental benefits to the state in terms of improved water quality modeling; conservation practice placement, design, and implementation; and flood plain delineations. Examples related to lake restoration include:

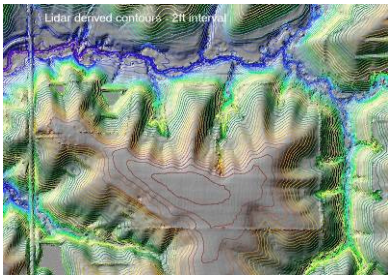
- Soil conservation structure (terraces, sediment ponds, etc.) planning and estimating
- Erosion potential measurements and modeling
- Watershed modeling
- Runoff modeling
- Conservation practice performance
- Watershed delineation

Currently, partnerships among IDOT, IDNR, NRCS, and IDALS have committed the funds needed to acquire the LiDAR data only ($4.3 million). The IDNR and IDOT were awarded a grant from the states Pooled Technology Fund for the aerial photography portion of the project.
The Lake Darling Watershed was part of a pilot project of LiDAR technology in Iowa. Below are several images that demonstrate the utility of LiDAR data.

Color infrared photography 2002



Shaded relief view with LiDAR *based elevation data*



Contours (2-foot intervals) derived from LiDAR

Related Monitoring and Assessment

Ambient Monitoring

The Iowa Lakes Survey project (2000-2005) conducted by the Iowa State University (ISU) Limnology Laboratory has provided invaluable water quality data and other information from among 132 Significant Publicly-Owned Lakes (SPOL) in Iowa. Sampling data and other summarized information about survey lakes are available on the internet at http://limnology.eeob.iastate.edu/lakereport/. Beginning in 2006, ISU Limnology Laboratory and the University Hygienic Laboratory (UHL) continued ambient lake monitoring of the 132 survey as part of their respective annual monitoring agreements with IDNR. Funding support for ambient lake monitoring comes from the IDNR Water Monitoring Program through annual appropriations of the State's Infrastructure Environment First Fund. In addition starting in 2006, IDNR expanded the list of lakes sampled to include 34 lakes that fall outside of the classification of SPOL, but are still a valuable resource for the state.

Ambient lake monitoring data provide the basis for evaluating status and trends in lake water quality and assessing compliance with water quality standards protecting designated beneficial uses. For example, development of a lake classification system used the 2000-2005 lake survey as the basis to prioritize lakes for restoration. Looking ahead, the data will be invaluable as an historical record of water quality to measure progress in water quality improvement.

Field crews monitor the lakes for basic water chemistry, nutrients, chlorophyll, phytoplankton and zooplankton at least three times during the spring and summer. Additionally, researchers construct a temperature profile for each lake to determine the thermocline and the oxygen content along the temperature profile. Past lake monitoring also includes testing for common herbicides, insecticides and metals in both the water and lake sediments. Sampling of lake water quality was coordinated with and augmented by the collection of fish data.

IDNR Fisheries / IOWATER Lakes Monitoring

This project provides flexibility to tailor sampling to individual lake needs and is able to supplement existing lake data by adding water quality information for sites or times of the year not sampled by the ambient program. Sample analyses are a combination of field tests used in the IOWATER volunteer monitoring program and laboratory analysis of chemical parameters done by the University Hygienic Laboratory.

IDNR staff selected and sampled for 12 water quality parameters at 23 sites in 13 lakes in 2008. They sampled a number of lakes that are restoration priorities or included in the shallow lake management project; including Clear Lake/Ventura Marsh (shallow); Lake Darling; and Lake Geode.

Beach Monitoring and Safe Lakes Initiative

The Iowa Department of Natural Resources (IDNR) has conducted bacterial monitoring at Iowa's state owned beaches since the IDNR's Ambient Water Monitoring Program's inception in 2000. Over the first seven years of monitoring, the IDNR has noticed different patterns emerge in the bacterial occurrences

at beaches. Bacterial monitoring at swimming beaches of 37 Iowa lakes during the summer recreational period in calendar years 2002 through 2007 found the majority of Iowa's state owned lakes have a low incidence of violations of either the one-time maximum or the geometric mean bacterial standards at their beach.

The lakes with vulnerable beaches currently eligible for special monitoring consideration include (members of the lake restoration priority list are underlined)

Backbone (Delaware), Beeds Lake (Franklin), Clear Lake (Cerro Gordo), West Okoboji - Emerson Bay (Dickinson), George Wyth (Black Hawk), Lake Darling (Washington), Lake of Three Fires (Taylor), Lower Pine Lake (Hardin), Nine Eagles (Decatur), and Rock Creek (Jasper).

The ***Safe Lakes Initiative*** coordinated by the IDNR Watershed Monitoring and Assessment Section through funding from EPA 319 and the State Revolving Fund is an organized attempt to address these problems. The activities of this project are divided into three major categories: 1) identification of bacterial sources, 2) development of pollutant reduction strategies for each bacterial source, and 3) implementation of the developed pollutant reduction strategies for each lake.

Bacterial Source Identification

For each lake, an intensive effort to identify the contributing bacterial sources has been ongoing since 2006. As part of this effort, a comprehensive watershed assessment was completed to identify and evaluate potential contributions from such sources as open feedlots, manure application fields, septic system or other wastewater discharges from rural residences or residential developments, livestock pastures (including livestock with direct access to streams), and wildlife. Based on the results of this assessment, the IDNR will conduct additional monitoring or other studies, as necessary, to define the magnitude of the bacterial contribution from identified watershed sources.

Development of Pollutant Reduction Strategies

For each identified potential bacterial source and each lake, a pollutant reduction strategy is being developed. In developing this strategy, we will consider both current approaches and new strategies that may be more effective in dealing with the problem.

Plan Implementation

In 2009, IDNR will attempt to implement the developed bacterial reduction plan for each lake. Specific activities may vary between lakes, and therefore the implementation efforts may differ. For some lakes, it may be possible for IDNR to carry out the bulk of the efforts internally. Some projects will require participation by outside parties, including; individual landowners, county supervisors or boards of health, the Division of Soil Conservation/IDALS, USDA's Natural Resources Conservation Service or Farm Services Agency, and lake preservation associations.

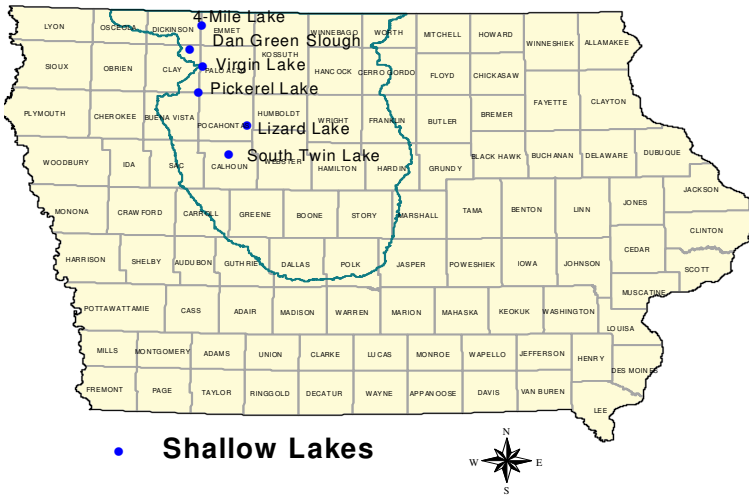
Shallow Lakes Monitoring

FY07-08 Lake Restoration Funds supported monitoring in seven shallow lakes in north central Iowa. The sampling will document the biological, physical habitat and water quality characteristics of these lakes before, during and after renovation work. To date, pre-renovation data exists for 2006 and 2007 sampling seasons. This data is available to assist resource managers as needed. However, this monitoring data is most useful in comparison with post-restoration data.

PROJECT OVERVIEW

In the spring of 2006, the Iowa IDNR's Wildlife and Fisheries Bureaus and Ducks Unlimited formed an agreement as part of a Shallow Lakes Initiative Project to renovate several ecologically degraded shallow lakes across northwest Iowa. The overall goal of this agreement is to use tools developed by managers to shift and maintain shallow lakes from an ecologically degraded system to a clear water state that supports desirable fish populations, abundant aquatic plants, invertebrates, and thus increased use by waterfowl. This agreement also represents a unique opportunity to improve an already existing resource for multiple benefits, which includes water quality, conservation of wildlife and fish and higher quality recreational uses for the public.

Locations of Six Shallow Lakes to be Monitored in 2006



The Iowa IDNR's Watershed Monitoring and Assessment Section performed wetland assessments on permanent and semi-permanent wetlands throughout north-central Iowa in the summer 2007 and 2008. Methods used to monitor the ecological condition of these wetlands were easily adapted for use on these shallow lake/permanent wetland environments. To assess the condition of these shallow lakes it will be important to collect information from all aspects of each of these systems. All partners of this agreement believe that the proposed methods for shallow lake monitoring should include basic physical/chemical analysis, analysis of nutrients and suspended solids and biological (fish, macrophyte and invertebrate communities) sampling.

Appendix I. Lake Restoration Prioritization Process and Program

Key Concepts and Facts

- Lakes are important to Iowans
  - Six of ten Iowans visit lakes each year; they will visit these lakes an average of eight times during the year
- Iowans prefer lakes with better water quality
- Lakes provide significant economic benefits
  - Statewide our lakes generate $1.6 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 35 lake candidates
  - Priorities based on a 5-year ISU/DNR 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
  - 7 Near completion
  - 19 In progress
  - 7 Planning 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

Budget

- 2007 funding $8.6 Million
- 2008 funding $8.6 Million
- 2009 funding $8.6 Million
- 2010 $8.6 Million requested

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