6012-006 Lime Creek Market-Based Nonpoint Source Management Project

Project sponsor: Lime Creek Watershed Improvement Association, Inc.

Final Project Report: January 2007 - December 2009

Long-term monitoring of Lime Creek and six other tributaries of the Cedar River shows a promising trend in water quality improvement. Since 2006, average nitrate concentration is 19% lower in Lime Creek when compared to the four years prior to organization of the Lime Creek watershed council. Water monitoring by Coe College since 2000 consistently showed Lime Creek to be the highest contributor of nitrate with concentrations greater than 14 ppm NO_3-N in 2 of 6 years prior to council formation. However, during the most recent two years nitrate concentrations have fallen to less than 10 ppm NO_3-N. Dr. Martin St. Clair wrote in a 2008 report to Iowa DNR, "In a somewhat encouraging development the average concentration of nitrate in Lime dropped below 10 mg NO_3-N/L and it remains third [among the seven tributaries] after having the highest average for five of the previous six summers."

Lime Creek is a 27,039 acre sub-watershed of the Cedar River in western Buchanan County with its outflow in northwest Benton County approximately 25 miles from Cedar Rapids. The lower one-half of the 16 mile stream is on the final 2004 Iowa list of Section 303(d) Impaired Waters. The cause/stressor is identified as biological, potentially flow alteration, habitat modification, nutrients and/or siltation. A TMDL has not been completed for Lime Creek; however, a completed TMDL for the Cedar River includes a goal of 35% reduction of nitrate to 9.5 mg/L due to the classification as a drinking water supply resource for the people of Cedar Rapids. Recognizing Lime Creek as a contributor of nitrate to the Cedar River, the Lime Creek watershed council adopted a goal of reducing both nitrate and phosphorus by 35%.

To achieve the nutrient reduction goals and to promote broad participation and increased implementation of nonpoint source management strategies in Lime Creek the watershed council developed a performance-based incentive approach. The primary components of the incentive program were the cornstalk nitrate test (CNT), Iowa Phosphorus Index (IPI) and Soil Conditioning Index (SCI). The program also included a short list of best management practice incentives such as grassed waterways, spring nitrogen application and soil testing. A copy of the incentive program is attached. The council also investigated the use of denitrifying bioreactors as an alternative nitrate reduction strategy. This report will highlight the financial, environmental and programming outcomes of the nonpoint source management project.

<u>Financial Accountability</u>

Forty-five percent (27 of 60) of rural watershed residents participated in the Lime Creek project by enrolling in the incentive program. Twenty-three cooperators completed IPI and SCI calculations, while 21 cooperators did cornstalk sampling. Even with significant watershed participation, only 48% of the budgeted producer incentives were spent leading to only 70% of the total budget being expended. Table 1 shows the Watershed Improvement Fund budget and expense by category. A primary reason for the low level of producer incentive payments was the already high performance related to the IPI and SCI. Cooperators reported 48% of fields as having been no-till planted to at least one crop, typically soybean. This historically high rate of

no-till limited potential improvement in IPI and SCI performance and therefore lowered incentive payments for improvement. A cooperator/monitoring map is included with this report.

Watershed Improvement Funds			
Grant Agreement Line Item	**Total Funds Approved ($)**	**Total Funds Expended ($)**	**Available Funds ($)**
Field Demonstration	4,000	2,170	1,830
Contractual-administrative	116,141	116,141	0
Travel Expenses	2,070	1,898	172
Supplies	3,300	2,087	1,213
Project Administration	4,500	4,029	471
Incentives-Producers	160,000	76,385	83,615
Total	290,011	202,710	87,301
Difference			87,301

Table 1. Watershed Improvement Funds comparison of budget and expenditures.

Another reason for reduced producer incentive payments was lower CNT performance in years two and three and lower participation in year three. Incentive payments by performance measure are shown in Table 2. Local climate, collection time and/or a combination of factors produced higher CNT values in years 2 & 3 than in year 1. During those two years, only two cooperators qualified for enhanced nitrogen performance payments.

Performance Program Incentives (WIRB & ICGA)				
	2007 ($)	**2008 ($)**	**2009 ($)**	**Total ($)**
Phosphorus Index	5,813	4,890	3,738	14,441
Soil Conditioning Index	17,480	13,924	11,070	42,474
Nitrogen Performance	9,610	3,040	3,810	16,460
Other Incentives	4,650	2,100	3,950	10,700
Watershed Performance	0	2,400	5,200	7,600
Total Incentives	37,553	26,354	27,768	91,675

Table 2. Performance program incentive expenditures.

A third potential reason for unused producer incentives was that proposed incentive payments were too low to attract additional participation. Watershed producers are accustomed to higher per acre payments available through federal farm programs and the relatively low per farm payments provided by the watershed council may not have been adequate. The Lime Creek watershed is a long, narrow watershed that doesn't represent a single town or school district. Without a common focus of cultural activity outside of the watershed it is may be more difficult to build a watershed community and might require higher incentive payments to make change. A detailed annual comparison of producer incentives is provided.

Table 3 shows a comparison of the full project budget and expenditures by funding source. The actual Watershed Improvement Fund contribution was less than budgeted at 55% and total project funding was 29% less than planned.

Total Project Funding						
Funding Source	Cash		In-Kind Contributions		Total	
	Approved Application Budget ($)	Actual ($)	Approved Application Budget ($)	Actual ($)	Approved Application Budget ($)	Actual ($)
WIRB	290,011	202,710	0	0	290,011	202,710
ICGA	60,000	18,270	0	0	60,000	18,270
ISU	0		63,213	28,241	63,213	28,241
CRMC	0		46,500	32,800	46,500	32,800
Cooperators	0	38,533	30,300	33,516	30,300	72,049
Council	0		11,325	7,950	11,325	7,950
County Ext.	0		1,125	375	1,125	375
NRCS	0	4,280	0	0	0	4,280
Total	350,011	263,793	152,463	102,882	502,474	366,675

Table 3. Total project funding comparison of budget and expenditures.

Watershed Improvement Fund contribution: Approved application budget: 58%
Actual: 55%

Contributions from partnering sources were less than planned except documented in-kind and cash contributions from cooperators. Their contributions were more than twice the budgeted amount. About one-third of the Iowa Corn Grower (ICGA) funding was used during the project. These funds were targeted to producer incentives which were less than planned. The watershed council will use surplus ICGA funding to continue the incentive program at least one more year. In-kind contributions from Iowa State University were less than expected due to federal funding supporting staff being exhausted. The Cedar River Monitoring Coalition provided their expected contribution, just at a lower documented cost. Total cash and in-kind contributions were 77% of budgeted levels.

Environmental Accountability

As mentioned previously, monitoring of Lime Creek was a highlight of the project. Table 4 shows the nitrate concentration of the seven watersheds monitored by Coe College, broken into two periods – before and after the Lime Creek council organized. Also included is the change in nitrate concentration. An example mid-season monitoring summary is attached.

Average Nitrate Concentration of Seven Cedar River Subwatersheds (ppm NO_3-N)								
Period	Blue	Otter	Morgan	Bear	N Bear	Mud	Lime	Average
2002-05	6.82	6.78	8.52	8.43	12.33	11.30	12.39	9.51
2006-09	7.01	8.22	7.78	8.35	10.72	11.13	10.03	9.03
% change	2.7	21.2	-8.7	-1.0	-13.1	-1.5	-19.0	-5.0

Table 4. Nitrate concentration of seven Cedar River subwatersheds.

In addition to water monitoring, the council also used average IPI, SCI and CNT scores as watershed-wide measures of environmental performance during the project. Tables 5 and 6 provide average annual performance measure summaries. The council used these values when evaluating their incentive program and developing priorities for the next program year. Phosphorus delivery was determined to be a low risk with average IPI in the very low risk category. Due to a high level of no-till planting the SCI values were higher than expected. The IPI is on a scale of 0 to 15 with lower being preferred, and the SCI is on a scale of -1 to 1.1 with higher being better. A detailed field listing/summary is included. Cooperators used these summaries to compare their performance to other watershed fields.

Annual Watershed Average Performance Results						
Year	**# fields**	**Acres**	**PI**	**SCI**	**Soil Test P,ppm**	**Stream Distance,ft**
2009	248	11,897	0.88	0.56	30	2,830
2008	252	12,067	0.86	0.56	29	2,862
2007	223	10,636	0.88	0.57	30	2,928
2006	99	4,445	0.95	0.57	32	2,950

Table 5. Average Iowa Phosphorus Index and Soil Conditioning Index performance.

The watershed council contracted with a local individual to complete cornstalk sampling during the 2006-08 crop seasons. In 2009, the Jesup FFA was hired to do the sampling. The FFA used the project as an educational experience and fund raiser. Participation in the stalk sampling effort was lower during 2009 somewhat due to farmer opinion that 2008 results were not an accurate representation of the nitrate left in the corn plant. Most cooperators expected results to be low due to high rainfall in 2008 but results were considerably higher than 2007. CNT results from other parts of Iowa were very low in 2008 which created more questions than answers. Another item that created more questions was water monitoring results showing the lower nitrate levels in 2008 and 2009. Annual CNT summary reports are attached.

Annual Average Cornstalk Nitrate Test Results				
Year	**Stalk NO3-N (ppm)**	**Stalk NO3-N Range (ppm)**	**Estimated Yield (bu/a)**	**Number of samples**
2009	2,876	358 – 5,010	206	24
2008	2,570	902 – 6,405	143	53
2007	1,162	20 – 5,070	190	32
2006	2,156	20 – 8,160	182	24

Table 6. Average Cornstalk Nitrate Test performance.

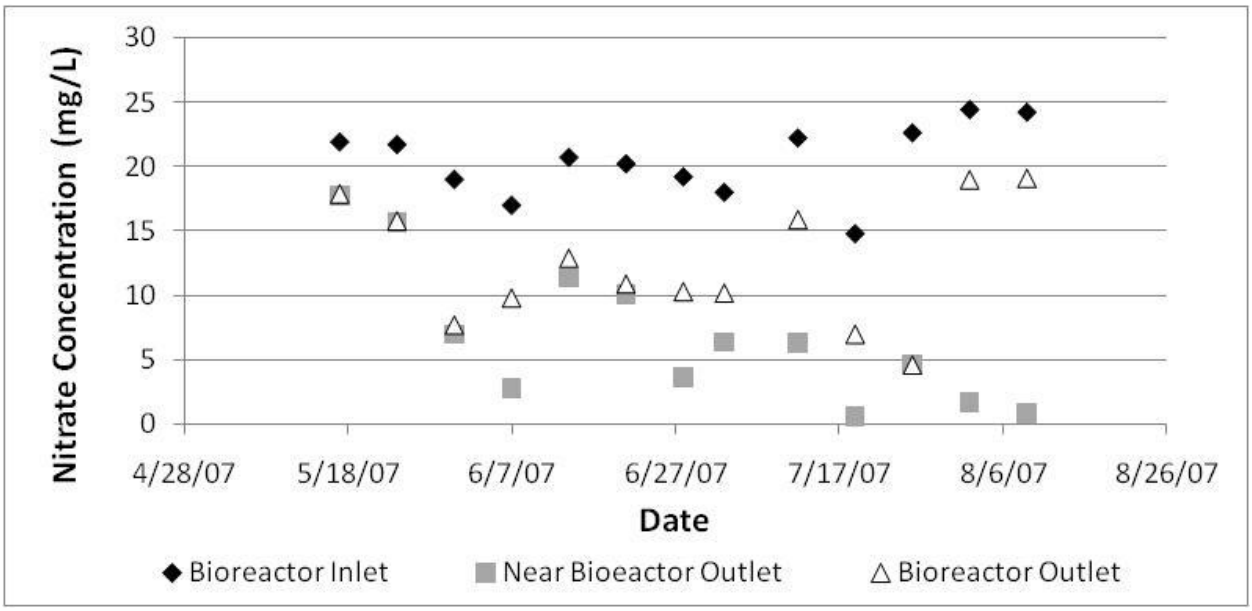
Cooperators adopted new practices at a slower rate than was expected but did make changes that reduced sediment delivery by 959 tons per year and phosphorus delivery by 1,462 pounds per year. The most popular management change was reducing tillage and/or adjusting rotations to increase crop residue. These changes did not produce as large of sediment and phosphorus reductions as waterway installation and repair. In many cases, cooperators were already doing some level of reduced tillage so the additional gains were not as great as if they had been doing

more conventional tillage. By evaluating performance cooperators found they improved SCI scores 200% when notill planting soybeans on environmentally sensitive fields, an improvement increases sustainability and helps protect soil and water quality in the Lime Creek watershed.

Sediment and Phosphorus Delivery Reductions				
Practice	**Sediment Delivery Reduction(T/a)**	**Phosphorus Delivery Reduction(#/a)**	**Length(ft)**	**Acres Protected**
Tillage/No-Till	173	224	--	883
Rotation Mgmt.	69	90	--	1292
Rotation/Tillage	100	130	--	722
Waterways	617	802	14,799	779
Total	959	1,246	14,799	3,676

Table 7. Sediment and Phosphorus Delivery Reductions.

The evaluation of a denitrifying bioreactor demonstration was a focal point for the watershed council. Early results were very promising with nitrate reductions exceeding 90% in the first year. Second and third year results were disappointing as local climate and drainage issues caused the bioreactor to become inundated with surface water and a high water table that brought in outside water throughout the whole bioreactor rather than just through the tile system.



Graph 1. 2007 Denitrifying bioreactor nitrate reduction results.

Promising results, Graph 1, shown by differences between nitrate concentration at the bioreactor inlet and near the bioreactor outlet have led to much more investigation of denitrifying bioreactors at several locations in Iowa. Results at the outlet show a mixing of treated and untreated tile water. An exciting outcome was the development of a new NRCS standard and EQIP eligibility for denitrifying bioreactors based in part on this bioreactor demonstration. A sample presentation given at the National Nonpoint Source Monitoring conference is provided.

Program Accountability

The watershed council consisted of any resident that wished to attend watershed meetings. The council met 5-6 times per year to set annual goals, review progress, analyze the incentive budget and approve producer incentives. Meetings were typically held during the summer and winter with 6-12 residents usually attending. Iowa State University Extension watershed specialists provided council facilitation; completed project administrative duties like reporting and budget management; worked with individuals to calculate field and farm-level performance measures; and developed watershed summaries and other resources for the council and project cooperators. An example fact sheet used to promote the watershed project is attached.

Review of stream and bioreactor monitoring data was a priority at every council meeting. A formal agenda always started with a monitoring review to center discussion on water quality improvement. Martin St. Clair, Coe College, provided mid-season and annual reports for the council that included a brief interpretation of the data. Early bioreactor success provided an additional focal point for the project with several opportunities to showcase the bioreactor at the Ken Pint farm. Later challenges also provided lessons on how to improve future bioreactor installations. The bioreactor demonstration and Coe College water monitoring led to the local media focusing on the watershed improvement project. Three news stories are included.

Documenting progress toward the 35% nitrogen and phosphorus reduction goal was very difficult. While water monitoring data showed improvement in nitrate concentration, cornstalk nitrate test results were not reduced during the project, and were higher than other comparable watershed groups. Seasonal variation, local climate and excess rainfall created additional challenges. Average Phosphorus Index levels were in the very low risk category and average soil test phosphorus levels were lower than in other watersheds; however, Lime Creek has had higher total phosphorus levels in water monitoring samples when compared to six other Cedar River subwatersheds monitored by Coe College.

Producer surveys were completed by Iowa State University sociologists in 2006 and 2009 and show changes in attitude about water quality. Ninety-two percent of respondents now say that some or most people believe there is a water quality problem, this compares to just 60% in 2006. Additionally, 100% of producers believe that nitrogen threatens water quality some or a lot. Increased awareness about water quality issues did lead to resident participation; however, the council continued to work to recruit more annually active cooperators. A core group of cooperators/council members participated each year with others enrolling for a specific practice or participating for one year. The shape of the watershed, distance from one end to other, and amount of rented land was a challenge to developing a more cohesive and active watershed community outside of the core group.

An evaluation of the incentives offered, participation and management changes made would support the need for future performance and practice incentives to be set at higher levels to gain additional operator interest in a long, narrow watershed like Lime Creek. Also, a watershed where there is significant rented land may need a more aggressive approach to garner higher participation. Better identification of land operators living outside the watershed and a more focused information campaign directed at non-resident operators may increase enrollment.