7043-017 North Fork Maquoketa River Headwaters Watershed Project

Project sponsor: Coffee Creek Watershed Improvement Association, Inc.

Final Project Report: July 2008 - June 2011

Interest in developing a watershed improvement project in the North Fork Maquoketa River Headwaters (NFMRH) first developed early in 2007 when 13 producers in the Coffee Creek subwatershed partnered with Winrock International and Iowa State University Extension. This initial NRCS Conservation Innovation Grant (CIG) project was a multi-state (Iowa and Vermont) study of the effectiveness of a performance-based approach to improve water quality. As a result of that project, the Coffee Creek Watershed Improvement Association (CCWIA) organized and proposed this broader effort to initiate the first phase of sediment, nitrogen and phosphorus reductions identified in the NFMRH Total Maximum Daily Load (TMDL) implementation strategy developed by the Iowa DNR.

A highlight of this farmer-led watershed improvement project has been an improvement in the Family Biotic Index (FBI), a measure of the quality and quantity of benthic macroinvertebrates, from 5.83 (fairly poor) in 2006 to 4.49 (good) in 2010. Higher scores are indicative of organisms that are more tolerant of pollution while lower scores result from organisms that are less tolerant. The importance of measuring benthic macroinvertebrates is noted in Iowa DNR Water Fact Sheet 2010-7 - What in the world are Benthic Macroinvertebrates?

> *Benthic macroinvertebrate serve as useful biological indicators in water. As water quality and habitat conditions change, the benthic macroinvertebrate community also changes. Unlike fish and other vertebrates, benthic macroinvertebrates are less mobile and are unable or unlikely to escape the effects of sediment and other pollutants that diminish water quality. Benthic macroinvertebrates represent a diverse group of aquatic animals. The large number of individual taxa have a wide range of responses to stressors such as toxic pollutants, sedimentation, and habitat disturbance. Therefore, the number and kinds of taxa collected and identified are relatively good indicators of stream health. Having an abundance of different types of taxa, or high biodiversity, is important.*

Family Biotic Index Results 2006-2010					
Year	**Site 1**	**Site 2**	**Site 3**	**3-Site Average**	**Evaluation**
2006	5.84	5.88	5.77	5.83	fairly poor
2007	5.36	4.92	5.04	5.11	poor
2008	5.90	5.43	4.14	5.16	poor
2009	4.17	4.86	4.69	4.57	good
2010	4.45	4.76	4.25	4.49	good

Table 1. NFMRH 3-Site Family Biotic Index (Klann, R. 2010. North Fork Water Quality Monitoring Report)

This report will summarize the involvement of 56% of watershed producers (37 of 66) in project activities; how they used Watershed Improvement Review Board (WIRB) and other funding, improved field, farm and watershed performance related to water quality and developed

partnerships that led to a much broader Mississippi River Basin Initiative (MRBI) project that will provide significant cost-share for producers to continue watershed improvement efforts.

Financial Accountability

The North Fork Watershed council took their responsibility of managing WIRB funds seriously by reviewing budget status and expenditures at each watershed council meeting and annually evaluating the effectiveness of the watershed incentive program offered by the council. Funds were held at the New Vienna Savings Bank and checks required signatures by the CCWIA treasurer and chairman. Financial documents, along with all project records, are held at the Extension Watershed Projects office in Fayette.

As shown in Table 2, funds were fully expended, except for $1. Extra funds in four line items were transferred to producer incentives when producers actively enrolled in and completed grassed waterway improvements during fall 2010 and spring 2011, resulting in total expenditures for producer incentives to be 101.6 percent of the proposed budget. Field demonstration funds provided for the installation of a denitrifying bioreactor that will be equipped for automatic flow monitoring and water sampling as part of a MRBI project located in the watersheds above Dyersville (North Fork Headwaters, Hewitt Creek and Bear Creek).

Watershed Improvement Funds			
Grant Agreement Line Item	**Total Funds Approved ($)**	**Total Funds Expended ($)**	**Available Funds ($)**
Field Demonstration	3,000	3,020	(20)
Contractual-administrative	226,068	226,068	
Travel Expenses	3,570	2,034	1,536
Supplies	4,800	4,635	165
Project Administration	600	450	150
Water Quality Monitoring	4,500	3,750	750
Incentives-Producers	163,600	166,180	(2,580)
Total	406,138	406,137	1
Difference			1

Table 2. Watershed Improvement Funds budgeted and expended.

A significant component of the watershed project implementation plan was to offer an annual performance incentive program to watershed farmers. A copy of the incentive program and a year-by-year comparison of the program are provided as attachments. The original performance program was based on the neighboring Hewitt Creek incentive program and on initial findings in the NRCS-CIG funded Coffee Creek project.

The watershed council reviewed the program annually and made changes to promote participation and adoption of particular practices that would improve field and farm environmental performance. Incentives were also in place for watershed performance (water quality improvement shown through 3 years of water monitoring results) and watershed-wide participation. Twenty-eight multi-year cooperators received the watershed performance incentive based on the 2010 FBI results. In 2008 a participation incentive was paid to 13

producers involved in the Coffee Creek NRCS-CIG project; however, other watershed participation incentives were not paid, due to budget constraints, when the annual benchmarks were achieved. Table 3 provides a summary of the primary performance incentives and other incentives paid by the watershed council using WIRB and NRCS-CIG funds.

Performance Program Incentives (WIRB & CIG)					
	2008 ($)	**2009 ($)**	**2010 ($)**	**2011 ($)**	**Total ($)**
Phosphorus Index	21,637	28,412	2,780	7,750	60,579
Soil Conditioning Index	11,960	8,765	5,810	8,763	35,298
Nitrogen Performance	7,660	11,440	4,430	400	23,930
Grassed Waterways	9,470	12,165	14,100	33,486	69,221
Other Incentives	3,800	3,610	4,250	4,520	16,180
Participation Incentives	6,500				6,500
Watershed Improvement				14,000	14,000
Total Incentives	61,027	64,392	31,370	68,919	225,708

Table 3. Performance program producer incentives, 2008-2011.

Cash and in-kind support to implement the NFMRH watershed improvement project came from three primary sources: WIRB, 64%, NRCS-CIG, 9%, and cooperators/council, 22%. While the investment by cooperators is much higher than budgeted, it is still underestimated in Table 4, as it was difficult to get producers to fully document the in-kind and cash contributions they made when making changes to management or investing incrementally in practices that improved watershed performance.

Total Project Funding						
Funding Source	**Cash**		**In-Kind Contributions**		**Total**	
	Approved Application Budget ($)	**Actual ($)**	**Approved Application Budget ($)**	**Actual ($)**	**Approved Application Budget ($)**	**Actual ($)**
WIRB	406,138	406,137			406,138	406,137
ISU			60,277	11,153	60,277	11,153
UIU			4,500	8,170	4,500	8,170
Winrock NRCS-CIG	15,000	56,808			15,000	56,808
Council			11,325	9,826	11,325	9,826
Cooperators		97,237	32,700	31,130	32,700	128,367
Other match		16,000				16,000
Total	421,138		108,802		529,940	636,461

Table 4. Total project funding.

Watershed Improvement Fund contribution: Approved application budget: 77%
Actual: 64%

Cash contributions to the project via the Winrock NRCS-CIG project were significantly more than budgeted because of a no-cost extension associated with that project, extending the commitment of watershed cooperators involved with the Coffee Creek project. Once the NRCS-CIG project concluded Coffee Creek cooperators enrolled in the performance incentive program offered through the NFMRH project. Iowa State Extension in-kind contributions were reduced due to the retirement of project staff that were funded through other sources but provided initial facilitation and coordination of this project.

Environmental Accountability

Three performance indices were used as primary measures of performance to determine incentive payments to producers: the Iowa Phosphorus Index (IPI), the Soil Conditioning Index (SCI) and the cornstalk nitrate test (CNT). The IPI is a risk rating for phosphorus loss on a scale of 0 to 15 with lower being preferred. The SCI is a product of the RUSLE2 soil loss calculation and predicts the trend of future organic matter accumulation. The SCI is on a scale of -1 to 1.1 with higher being favored. The CNT is a tool that measures the amount of residual nitrogen in the corn plant at maturity. CNT values greater than 2000 parts per million (ppm) indicate excess nitrogen levels that are not production limiting and values between 700 – 2000 ppm are considered optimal.

IPI and SCI performance were calculated for 342 fields on 33 watershed farms. Cooperators used individual IPI and SCI results to prioritize fields for management changes or practice implementation. A project goal was to reduce average IPI by 15%. Table 5 shows average IPI and SCI results by year, with average IPI reduced by 20%, from 2.70 to 2.18, primarily through the installation and improvement of over 150,000 feet of grassed waterways and vegetative buffers. Cooperators also improved average SCI scores by 10% through reduced tillage, changes in crop rotation and contour planting.

Annual Watershed Average Performance Results						
Year	**# fields**	**Acres**	**PI**	**SCI**	**Soil Test P,ppm**	**Stream Distance,ft**
2011	342	9,253	2.18	0.49	55	1,663
2010	326	8,426	2.47	0.50	59	1,670
2009	325	8,428	2.49	0.50	59	1,695
2008	194	4,964	2.70	0.44	57	1,916

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

Management practices that improved IPI and SCI performance led to reduced sediment and phosphorus delivery to the North Fork Maquoketa River. The Sediment Delivery Calculator was used to determine accumulated sediment reductions on fields/farms that received incentives for IPI, SCI or grassed waterways/ buffers. Accumulated sediment reductions of 10,498 tons per year and phosphorus reductions of 13,647 pounds per year were achieved by project cooperators, exceeding the sediment reduction goal of 7,500 tons per year. Table 6 details reductions by management practice and provides a total of acres impacted.

Sediment and Phosphorus Delivery Reductions				
Practice	**Sediment Delivery Reduction(T/a)**	**Phosphorus Delivery Reduction(#/a)**	**Length(ft)**	**Acres Protected**
Tillage/No-Till	1,078	1,401	--	869
Contour/Terrace	314	408	--	391
Rotation/Tillage	376	489	--	1,145
Waterways/Buffers	8,730	11,349	151,563	4,974
Total	10,498	13,647	--	7,379

Table 6. Accumulated annual sediment and phosphorus delivery reductions.

Twenty-nine farms participated in the CNT program, with the most samples collected during 2009. The number of samples analyzed in 2010 dropped significantly, primarily because of a rapidly maturing crop that pushed harvest earlier than usual and the time window to collect samples closed quickly. It is difficult to compare CNT results across crop years due to variations in rainfall and temperature that lead to differences in nitrogen availability and use; however, producers were provided an annual summary of watershed-wide CNT results to compare how their nitrogen management compared to others in the watershed. A copy of CNT summary reports is provided in the attachments. During the project 12 farms were paid performance incentives for achieving results less than 1,700 ppm NO_3-N. Table 7 highlights annual results compared by crop rotation.

Cornstalk Nitrate Test Annual Comparison					
Year	**Number of samples**	**Average CNT (ppm)**	**Corn following Corn CNT**	**Corn following Soybean CNT**	**Corn following Alfalfa CNT**
2007	46	3,190	3,434 (27)	2,210 (9)	3,414 (10)
2008*	83	2,659	2,700 (48)	2,449 (15)	2,824 (16)
2009	85	1,663	1,999 (46)	1,305 (26)	1,193 (13)
2010	47	2,636	2,828 (32)	1,541 (13)	6,680 (2)

**Table 7. Watershed average annual cornstalk nitrate test results. ***Crop rotation was not provided for 4 samples in 2008.

To gauge the impact of management changes within the watershed the council contracted with Upper Iowa University to conduct a water monitoring program at three sites along the impaired stretch of the North Maquoketa River. Parameters measured monthly (April-September) and after significant (>0.6") rainfall events included water temperature, pH, conductivity, dissolved oxygen, turbidity, suspended solids, total phosphorus (P), total nitrogen (N) and fecal coliform. There were typically 12 sampling events each year. Benthic macroinvertebrates were collected twice per year, in May and September. Upper Iowa University supplied monitoring results following each sampling event and prepared an annual report for the watershed council.

There were great differences in total P between rain events and non-rain events, as shown in Table 8, but differences in total N were much less. Total P concentration increased by an average of 4.6 times following rain events while total N concentration increased 1.4 times. The highest total N concentration occurred between the beginning of May and the middle of June of every year; however, the highest P concentration varied by the following months and was dependent on high rainfall events: April (2008, 2011), June (2009, 2010), July (2007) and September (2006). Suspended solids and fecal coliform varied widely and were dependent on rain events. Elevated levels of suspended solids occurred in conjunction with high total P while high fecal coliform were not necessarily tied to increased levels of total P or suspended solids.

Annual Phosphorus and Nitrogen Water Monitoring Results – Site 3				
Year	**Total Phosphorus (ppm)**		**Total Nitrogen (ppm)**	
	Rain Event	**Non-rain Event**	**Rain Event**	**Non-rain event**
2006	**2.56** (0.61-4.89)	**0.67** (0.37-0.86)	**11.1** (8.1-12.8)	**8.2** (3.8-15.5)
2007	**2.30** (1.63-4.85)	**0.60** (0.40-0.75)	**13.6** (7.2-17.0)	**11.2** (8.1-13.7)
2008	**1.70** (0.41-4.54)	**0.55** (0.28-1.05)	**11.7** (8.8-16.0)	**9.4** (7.7-10.6)
2009	**3.99** (0.73-9.22)	**0.61** (0.19-0.96)	**12.9** (6.7-22.9)	**7.0** (6.5-7.4)
2010	**1.95** (0.84-2.86)	**0.37** (0.09-0.55)	**12.5** (9.4-19.4)	**8.4** (6.4-10.2)
2011*	**1.58** (0.53-4.29)	**0.30** (0.14-0.44)	**13.0** (8.8-21.8)	**8.8** (7.7-10.0)

Table 8. NFMRH Site 3 average annual total phosphorus and total nitrogen concentration compared by rain event. *2011 results are for a partial sampling season.

Program accountability

An integral part of the success of the NFMRH watershed improvement project was the development of a watershed council that was able to provide an incentive program through a process that engaged a majority of local producers, gave them ownership of the watershed issues and primed them to act. The watershed council met 5 to 6 times per year at the New Vienna VFW, a central meeting location, to evaluate water monitoring data; develop and improve an incentive program designed to promote improved environmental performance at the field, farm and watershed level; and encourage neighbors to become involved in the community watershed project. While the council originally formed as the Coffee Creek Watershed Improvement Association there was a seamless transition to focus on the whole NFMRH watershed.

The council contracted with Iowa State University Extension to facilitate council activities, coordinate water monitoring and cornstalk sampling, calculate and document cooperator performance, promote partnerships and provide administrative support. Extension staff prepared field and farm specific data for cooperators and developed watershed-wide summaries that cooperators and the council used as decision making tools. The council was able to learn from the experiences of previously funded WIRB projects in northeast Iowa by accessing model incentive programs and comparing how other councils addressed water quality issues.

A demonstration denitrifying bioreactor was installed on a cooperator's farm to investigate the efficiency of this new practice. The demonstration is a partnership between the farmer, the watershed council, Dubuque SWCD and ISU Extension. MRBI funding will equip the bioreactor with automated flow monitoring equipment. Fifty water samples will be collected annually before tile drainage water enters the bioreactor and after it has been treated to determine nitrate removal before water enters the stream. The idea for the demonstration came after the watershed council heard aout positive results at other bioreactor sites.

A successful partnership developed with the Hewitt Creek Watershed Improvement Association and the Dubuque and Delaware SWCDs to successfully submit a NRCS-MRBI proposal for a 5 year, $5.4 million watershed project. This project will be available to producers in three HUC 12 watersheds (North Fork Headwaters, Hewitt Creek and Bear Creek) above Dyersville. A proposal was submitted to NRCS in May 2010 and approved in July 2010. Nearly $100,000 was cost-shared with producers in FY2010 to primarily build terraces. Four of the cooperators were located in the NFMRH watershed. In FY2011 $1.3 million has been obligated to projects within the MRBI project area, with $639,000 directed toward projects in the NFMRH watershed, including the multi-year automated water monitoring effort at the demonstration bioreactor.

Council members have used opportunities to share their experiences and results locally, regionally and nationally. Local and regional news media covered project activities such as water monitoring and bioreactor installation, while national media focused on the performance program as an alternative approach to conservation implementation. Two council members also told of their watershed project experiences at a 2011 national Pay for Performance workshop in Washington DC.

A website was developed to provide electronic access of project archives for watershed residents and for others, anywhere, that are interested in the performance-based incentive approach. The project website can be found at http://northforkmaquoketa.wordpress.com/ .

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