



Social-Ecological Systems Approach to Water Quality Improvement in Two Iowa HUC-10 Watersheds

FY2016 NRCS Conservation Innovation Grant Final Report
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CIG is a competitive grant program that stimulates the development and adoption of innovative approaches and technologies for conservation on agricultural lands. Through CIG, NRCS partners with public and private entities to accelerate technology transfer and adopt promising technologies.

Prairie Rivers of Iowa (PRI) is a 501(c)(3) non-profit committed to promoting economic development through the restoration and conservation of Iowa's cultural and natural resources.

PROJECT SUMMARY

"Social-ecological systems approach" means collecting information, engaging stakeholders, and funding conservation within a watershed rather than on a municipal, county, or statewide basis. Building on the success of efforts in the Squaw Creek Watershed in central Iowa, Prairie Rivers of Iowa proposed to develop a plan and support a Watershed Management Authority for an adjacent HUC-10 watershed with overlapping jurisdictions, using the Agricultural Conservation Planning Framework (ACPF) to identify conservation opportunities. Over the course of the project and through public engagement, our understanding of the watershed approach has matured, and we have learned lessons that serve as a framework for developing more relevant watershed plans with measurable objectives. **The process resulted in the formation of the Headwaters of the South Skunk River Watershed Management Authority, which together with the Squaw Creek Watershed will guide conservation efforts in four HUC-10 watersheds.**

Our project delivered the tangible products outlined in the grant: a management plan for Keigley Branch Watershed, updates to Squaw Creek Watershed Management Plan, and technical deliverables to disseminate our analysis of both watersheds with the Agricultural Conservation Planning Framework (ACPF) and to support the development and use of ACPF as a planning tool.

BACKGROUND

The project was premised on three innovative approaches to come out of Iowa

1. **Watershed Management Authorities (WMA)**—a cooperative agreement between counties, municipalities, and soil and water conservation districts in a watershed to work together on water quality and flood risk. Iowa WMAs have no taxing or regulatory authority, but can pool resources to fund watershed-scale projects.
2. **The Agricultural Conservation Planning Framework (ACPF)**—A GIS-based toolkit developed by the USDA Agricultural Research Service (USDA-ARS) that uses high resolution elevation, soils, and landuse maps to identify suitable locations for agricultural conservation practices

3. **The Iowa Nutrient Reduction Strategy (INRS)**—Developed by the Iowa Department of Natural Resources, Iowa Department of Agriculture, and Iowa State University in response to the 2008 Gulf Hypoxia Action Plan, this framework included a science assessment of the nitrogen and phosphorus reductions that could be achieved with agricultural conservation practices

The **Squaw Creek Watershed Management Authority (SCWMA)** was formed in 2012. With the help of Minneapolis-based consultant **Emmons & Olivier Resources (EOR)**, the SCWMA board developed a 20-year Watershed Management Plan in 2014. In addition to assisting with the formation of the WMA and the writing of the plan, the Ames-based nonprofit organization **Prairie Rivers of Iowa (PRI)** was awarded a state Water Quality Initiative grant in 2015 to begin implementing the nutrient reduction and education goals of the plan. As of 2018, the project has funded 1 denitrifying bioreactor, 3,761 acres of cover crops and 4,867 acres of no-till/strip-till, organized 7 field days, and brought 31 partners to the table.

Excited by this progress, PRI proposed through this grant to create a watershed management plan for the adjacent 10-digit hydrologic unit (Keigley Branch-South Skunk River). With four of the same members (City of Ames, Story County Supervisors,

Story Soil and Water Conservation District, and Hamilton Soil and Water Conservation District), the new WMA would have a head-start in understanding the issues and building partnerships. We proposed that the Squaw Creek WMA be folded into a consolidated WMA including both Squaw Creek and Keigley Branch watersheds for greater efficiency. An early version of the ACPF had been beta-tested as part of the Squaw Creek Watershed Management Plan. We proposed to use version 2.0 of the ACPF to identify a larger range of conservation practices in both watersheds.



A rancher in the watershed and ISU agriculture students discuss opportunities for collaboration at a watershed planning workshop in October 2017

Methods/Process

The planning process has increased the willingness and capacity of the WMAs, Prairie Rivers of Iowa and our partners to initiate and sustain conservation projects in the watershed.

We held community meetings to organize the Keigley Branch WMA and receive input on the watershed management plan including:

- A February 2017 kickoff meeting that clarified that a controversial proposal for a flood control reservoir was no longer on the table
- Project updates at several City Council and Soil & Water Commissioner meetings
- Two planning meetings in 2017 to review the initial findings from Emmons & Olivier Resources' watershed assessment work
- Five public workshops around the watershed in 2017-2018, getting input from 56 adult residents and 24 high school and college students on goals to include in the plan and strategies to achieve them.



Gilbert High School students present invertebrate surveys and water quality sampling results at a watershed planning workshop

As a result of this engagement, 7 jurisdictions joined the Headwaters of the South Skunk River WMA in 2018: the Story County Supervisors, Story County Soil and Water Conservation District (SWCD), Hamilton County SWCD, City of Story City, City of Roland, City of Randall, and City of Ames.

Prairie Rivers of Iowa used the ACPF to identify conservation opportunities through the following activities:

- A two-day training session with USDA-ARS staff
- Ran ACPF analysis for Squaw Creek and Keigley Branch watersheds
- Development of a web-maps to make ACPF results available staff and partners
- Use of ACPF when meeting with producers in the Squaw Creek Watershed
- A field review with USDA-ARS staff to help them evaluate and refine ACPF results
- Presentation of ACPF maps at watershed planning meetings and public workshops

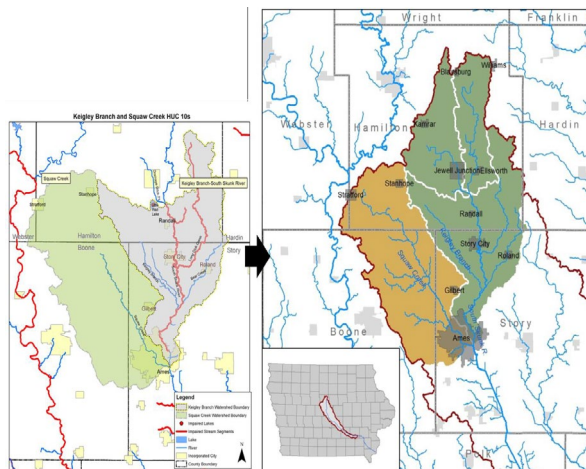
Developing an in-house capacity to use and interpret the ACPF has allowed PRI to better support r partners in the Squaw Creek WMA as they have initiated new projects to improve water quality:

- Story County’s countywide watershed assessment, for which we analyzed 21 watersheds with ACPF.
- A feasibility study by the City of Ames, which used our ACPF results to evaluate off-site alternatives to nutrient reduction at the Water and Pollution Control Facility

METHODS: CHANGES IN PROJECT SCOPE

Half or more of the hydrologic units in the Watershed Boundary Dataset are not complete watersheds¹. This includes the Keigley Branch-South Skunk River, a ten-digit hydrologic unit (HUC-10). Over the two years of the project, we came to recognize that the focus on the “Keigley Branch Watershed” was confusing for the public, excluded nearly 100,000 acres that influence water quality and quantity in the South Skunk River above Ames, and left out stakeholders in the Jewell and Ellsworth area that we want to include in the conversation.

These issues were discussed with key project partners at a meeting in July of 2018, and we agreed that expanding the scope of the WMA would be beneficial, especially if the Hamilton County Supervisors decided to participate. Story County offered to draft a revised 28E agreement for the Headwaters of the South Skunk River. This 28E Agreement was signed by 7 jurisdictions and filed with the State of Iowa in October of 2018.



The Keigley Branch-South Skunk River WMA (one HUC-10) was replaced with the Headwaters of the South Skunk River WMA (three HUC-10s). Coordination with Squaw Creek WMA will be achieved through joint meetings and an informal alliance. Together, these WMAs represent the upper 35% of the South Skunk River Watershed which is a priority HUC-8 watershed for the Iowa Nutrient Reduction Strategy.

¹ Omernik, James M., et al. "How misapplication of the hydrologic unit framework diminishes the meaning of watersheds." *Environmental management* 60.1 (2017): 1-11.

REVISED PROJECT DELIVERABLE: WMA ORGANIZATION

A RESULT OF THE PROJECT WILL BE A CONSOLIDATED WATERSHED MANAGEMENT AUTHORITY (WMA). DEMONSTRATING A SUCCESSFUL COOPERATION ACROSS TWO ADJACENT WATERSHEDS WITH OVERLAPPING MUNICIPALITIES AND PARTNERS WILL SHOW THE ABILITY FOR OTHER WMAS TO CONSOLIDATE WHEN APPROPRIATE AND EFFECTIVELY USE PUBLIC AND PRIVATE RESOURCES.

The Squaw Creek WMA discussed consolidation at their quarterly meeting in October 2016, but raised concerns that this would exacerbate quorum issues. Supervisor Rick Sanders proposed that Story County initiate a 28E agreement for a separate Keigley Branch WMA and the motion carried unopposed. The board determined that once a second WMA was formed and a watershed plan written, the benefits of coordination could be achieved with an informal umbrella group and joint meetings.

Even without formal consolidation, the benefits of building on existing partnerships were apparent.

The finger- pointing and suspicion that had to be overcome during the planning meetings for Squaw Creek Watershed in 2013- 2014 were mostly absent from this project. Representatives of the City of Ames, Story County, and Story County Soil and Water Conservation District spoke at planning meetings, making the case for participation in a WMA and for collaborative solutions to water quality challenges. Prairie Rivers of Iowa used the programs that came out of the Squaw Creek Watershed Management Plan to frame the meetings in terms of opportunities rather than problems. As a result, the tone of meetings was mostly positive and constructive, with many participants talking about shared responsibility and offering suggestions for partnerships.



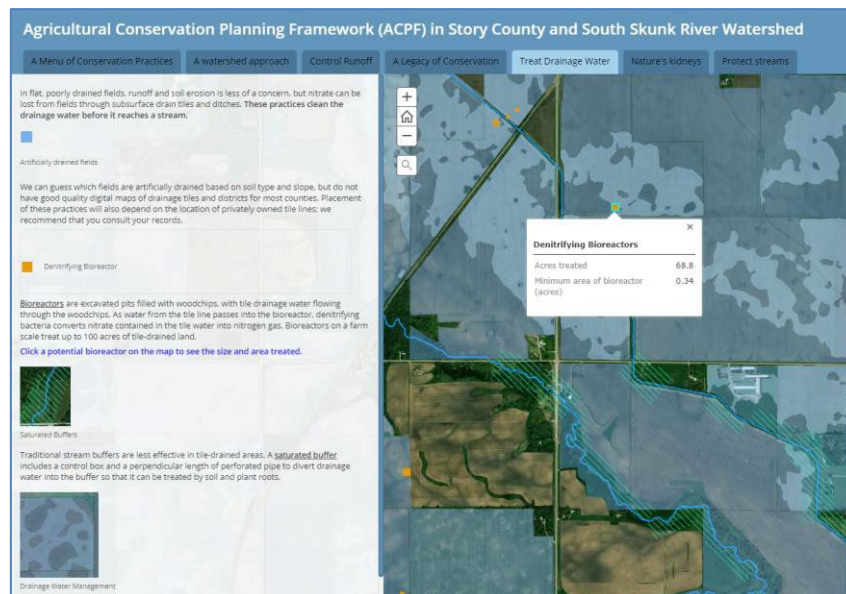
Story County Supervisor Rick Sanders addresses 29 people at a watershed planning workshop in February of 2018

Ultimately, the project did streamline watershed planning and partnerships through the formation of the Headwaters of the South Skunk River WMA, which covers both the Keigley Branch-South Skunk River HUC-10 and two upstream HUC-10s. **It will make more effective use of public and private resources by:**

- 1) Eliminating the need for separate plans and WMAs to address conservation in the two upstream HUC-10s
- 2) Facilitating education and outreach by clearly communicating the South Skunk River above Ames as the resource of concern and including its entire 210,556-acre watershed.
- 3) Revising the bylaws to make it easier for remaining jurisdictions to join.

PROJECT DELIVERABLES

UPDATE THE SQUAW CREEK WATERSHED MANAGEMENT PLAN.



We updated the Squaw Creek Watershed Management Plan by using ACPF version 2.0 to identify suitable sites for a larger list of conservation practices. The results (along with ACPF results from other watersheds) are available to the public on PRI's website (<http://arcg.is/eOTC0>) as an interactive web map. This is a major improvement over print maps in the original management plan, as landowners can zoom in to the farm-scale.

An interactive "Story Map" allows stakeholders in Squaw Creek Watershed and several other watersheds to zoom in to the farm-scale to see suitable locations for conservation practices(as identified with ACPF) and learn about each practice

PRODUCE A MANAGEMENT PLAN FOR THE KEIGLEY BRANCH WATERSHED

Major elements of a watershed management plan have been completed including:

- An 85-page assessment of water resources, watershed characteristics, pollutant sources, and nutrient reduction scenarios.
 - This element provided baseline data to support goal-setting and has helped us identify additional information needs.
- Draft goals and associated implementation strategies, based on comments from 56 adult and 24 student participants in five public workshops.
 - This element raised public interest and engagement, and ensures that the watershed plan reflects local concerns and opportunities.
- An interactive web-map (described above) showing suitable sites for conservation practices in the Keigley-South Skunk watershed, as identified with ACPF.

This element will facilitate conservation assistance to landowners
- A minimum detectable change analysis to determine the number of water quality samples and scale of improvement needed to monitor statistically significant nutrient reductions in the South Skunk River
 - This element will align goal-setting with monitoring so that water quality results are conclusive.

After much evaluation and discussion by the team, it has been decided to seek out new funding sources to take these elements to the next level. **The comprehensive watershed management plan for the Headwaters of the South Skunk Watershed will build on this work by addressing additional issues raised by stakeholders at public workshops and adding information from the two upstream HUC-10 watersheds.**

THIS PROJECT WILL INCLUDE A SET OF TECHNICAL DELIVERABLES TO ASSESS THE PERFORMANCE AND BROADER APPLICABILITY OF THE PROJECT BY REPORTING AND DISSEMINATING ACPF ANALYSIS FOR BOTH WATERSHEDS AND REPORTING ON HOW IT CAN BE USED AS A PLANNING TOOL FOR CONSERVATION PLANNERS IN THE MISSISSIPPI RIVER BASIN.

1. PRI staff supported University of Minnesota's research into the applications of ACPF, contributing video interviews and recommendations for a guidance document.
2. The City of Ames used the ACPF results from this project to evaluate watershed-based alternatives to nutrient reduction at the Ames Water Pollution Control Facility.
3. PRI staff used ACPF maps when meeting with producers in the Squaw Creek Watershed
4. PRI reviewed case studies from these field visits with USDA-ARS to evaluate bioreactor and saturated buffer placement.
5. Staff at the Story County NRCS office will be using countywide ACPF maps to support their work in 2019. PRI has a strong working relationship with Story SWCD and are committed to provide training or technical support beyond the term of this project.
6. PRI staff used ACPF results to select three HUC-12 watersheds in the South Skunk River Watershed with high potential for practices that could address both nutrient reduction and wildlife habitat goals. This analysis supported a grant proposal from the National Fish and

Wildlife Foundation, awarded in November 2018.

7. PRI produced a guidance document for how to incorporate existing conservation practices into ACPF analysis for quality control, prioritization, and assessment purposes.

CHALLENGES

Project objectives are (1) develop a systems approach to water quality improvements that engages people to achieve ecosystem service benefits, (2) broaden the use of conservation practices that uses new technologies to quantify and improve water quality impacts, (3) increase the capacity for conservation planners to serve farmers and landowners, and (4) provide a model for public-private partnerships to address water quality.

While the project deliverables have been met and are valuable to local partners, project objectives were not specific and measurable. After the departure of the original grant-writer, it was not clear to the rest of the team how completion of project milestones would achieve these goals in the short-term or what innovations were expected from our use of the ACPF.

Public-private partnerships were an important part of the project, with the Iowa Agricultural Water Alliance, Story County SWCD, Story County Conservation, USDA-ARS, Technical Service Providers Network, and Key Cooperative meeting or exceeding their commitments.

However, staff turnover and losses among partner organizations presented a major challenge for communication and continuity. Tragically, two supporters of the project, Story County Supervisor Paul Toot and Story County SWCD Commissioner Steve Fales, died in 2016 and 2017. Elections in 2016 and 2017 resulted in new representatives from Boone County, Ames, and Stratford on the Squaw Creek WMA, which meant that PRI had to spend as much time educating and building relationships with existing partners as reaching out to the new partners. A major private partner was bought out by a competitor and pulled out of the project. Our partners at Iowa State University were unable to perform social assessments due to two staff changes and funding limitations. As Watershed Management Authorities in Iowa age and expand their partnerships, navigating and persevering through these kinds of transitions will become more and more important.

LESSONS LEARNED: LINKING STATEWIDE NUTRIENT REDUCTION TO LOCAL WATERSHEDS

WHY PLAN FOR NUTRIENT REDUCTION ON A WATERSHED BASIS?

This watershed planning project was motivated in large part by public interest in the statewide nutrient reduction strategy, and much of our analysis focused on identifying locations for practices that can control nitrogen and phosphorus. However, if the goal was only to increase cover crop acreage to address hypoxia in the Gulf of Mexico, it would be much simpler to promote conservation practices on a

county or statewide basis. If the goal was only to engage farmers and other stakeholders, it would be simpler to work within familiar social groups, media markets, or political boundaries.

At our public workshops, we offered three possible reasons why it makes sense to tackle nutrient reduction on a watershed basis:

1. **In order to measure nutrient reductions in the river.**
2. **In order to focus conservation funding on sensitive areas.**
3. **In order to promote practices that protect both downstream and local waters.**

A watershed plan should include enough information to support one of these reasons and justify the challenge of working across jurisdictions. However, the 85-page watershed assessment produced by Emmons & Olivier Resources left some unanswered questions. We are already beginning to fill in the gaps in the Keigley Branch-South Skunk River Watershed Assessment to create a more relevant plan for the larger Headwaters of the South Skunk River Watershed. **The following technical considerations are relevant for any watershed plan that emphasizes nutrient reduction in rivers and streams.**

1. IN ORDER TO MEASURE NUTRIENT REDUCTIONS IN THE RIVER, WE NEED THE RIGHT MONITORING DESIGN

Nitrogen and phosphorus concentrations vary with streamflow, so improvements in water quality can easily be swamped out by year-to-year variations in weather. **Detecting a statistically significant nutrient reduction in a stream requires a large number of samples both before and after implementation, a large reduction in nutrient loading, or a paired watershed monitoring design that can control for weather-related variability.** For example, if phosphorus concentrations are relatively low (mean of 0.23 mg/L) and highly variable (standard deviation of 0.44 mg/L) as we have observed in the South Skunk River, 6 years of biweekly phosphorus sampling would be conclusive only if there was a 53% reduction in loading.

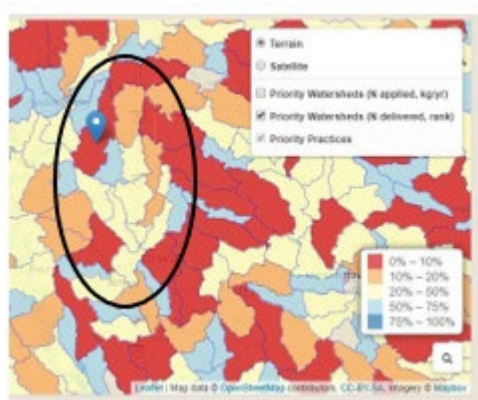
PRI used the Minimum Detectable Change approach outlined in EPA Tech Notes #7 to look at the interplay of these factors, using ten years of monthly data collected by the DNR at a gaging station in the watershed. The interim goal of the Hypoxia Task Force is a 20% reduction in nitrogen and phosphorus.

If we are successful in meeting this goal in the Headwaters of the South Skunk River watershed, we should be able to tell with only 4 years of monthly nitrate sampling post-implementation, thanks to the large volume of baseline data. However, phosphorus is so variable that no amount of sampling would be able to detect a 20% load reduction. Tracking phosphorus in the stream would require working with experts to develop a monitoring plan that can control for this variability, which we plan to do in 2019.

2. IN ORDER TO FOCUS CONSERVATION FUNDING ON SENSITIVE AREAS, WE NEED THE RIGHT NUTRIENT LOADING MODEL

How many pounds per acre of nitrogen are we losing from the watershed each year? A nutrient loading model can help answer this question.

However, if the goal is to identify “hot spots” or “critical source areas”—sub-watersheds where conservation practices could have a bigger impact—some models fall short. The Unit Area Load approach used in the Keigley Branch-South Skunk River Watershed Assessment estimates nitrogen and phosphorus loads based on landcover in each sub-watershed. While it is reasonable to assume, based on numbers reported in the literature, that a watershed with more cropland will have higher nitrate losses, it does not follow that a dollar of cost share will have a bigger impact if spent in a watershed with 90% rather than 85% cropland. The model uses the same loss rate for all agricultural acres.



The USGS SPARROW model includes soils, slope, fertilizer application, and water quality data, so is more likely to identify areas where management or environmental factors are driving nutrient losses, and thus where conservation practices might have greater benefit. The “Right Practice, Right Place” toolkit (<http://rprp.ags.io/>) uses an updated SPARROW model to rank HUC-12 watersheds in the Upper Mississippi River and Ohio River basins based on nitrogen loading. Three sub-watersheds within the Headwaters of the South Skunk River Watershed are in the top 20% and would be good candidates for small-scale implementation projects. Model results generally agree with water quality sampling organized by PRI in June of 2018, which found nitrate levels above 20 mg/L in Long Dick Creek and Drainage Ditch 71 and lower nitrate levels (between 10 and 15 mg/L) in Bear Creek and Keigley Branch.

3. IN ORDER TO PROMOTE PRACTICES THAT PROTECT BOTH DOWNSTREAM AND LOCAL WATERS, WE NEED A COMPLETE EVALUATION OF THEIR BENEFITS

The Keigley Branch-South Skunk River Watershed Assessment included a detailed analysis of stream erosion. Together with the ACPF, this can identify areas where stream restoration and riparian buffer strips can reduce nutrient losses while also preventing damage to infrastructure and improving wildlife habitat. However, other expected local benefits of nutrient reduction efforts were not sufficiently explored or did not apply.

Drinking water: Nitrate in the South Skunk River and its tributaries are not a concern for public drinking

water supplies.

Eutrophication: Reducing phosphorus in runoff can prevent algae blooms in Ada Hayden Lake and Little Wall Lake, but the watersheds of these lakes are a small portion of the project area. We have no information to suggest that eutrophication is a concern in the South Skunk River, or that nitrogen and phosphorus are the limiting factors for algae growth in rivers.

Runoff volume and flood risk: There are several nutrient reduction practices that can reduce the volume of runoff, but we need to quantify the potential flood reduction and erosion control benefits to encourage investment by beneficiaries.

Recreational safety: We need more information on which practices can address both nutrients and *E. coli*. This stretch of the South Skunk River Water Trail is on the impaired waters list for *E. coli*, so would benefit from such practices.