Prepared by: EOR/IVRCD/ISA

For the Middle Cedar Watershed Management Authority

Village of Reinbeck-Black Hawk Creek HUC-12 Watershed Plan

02.07.2019

EOR

TABLE OF CONTENTS

LIST OF TABLES

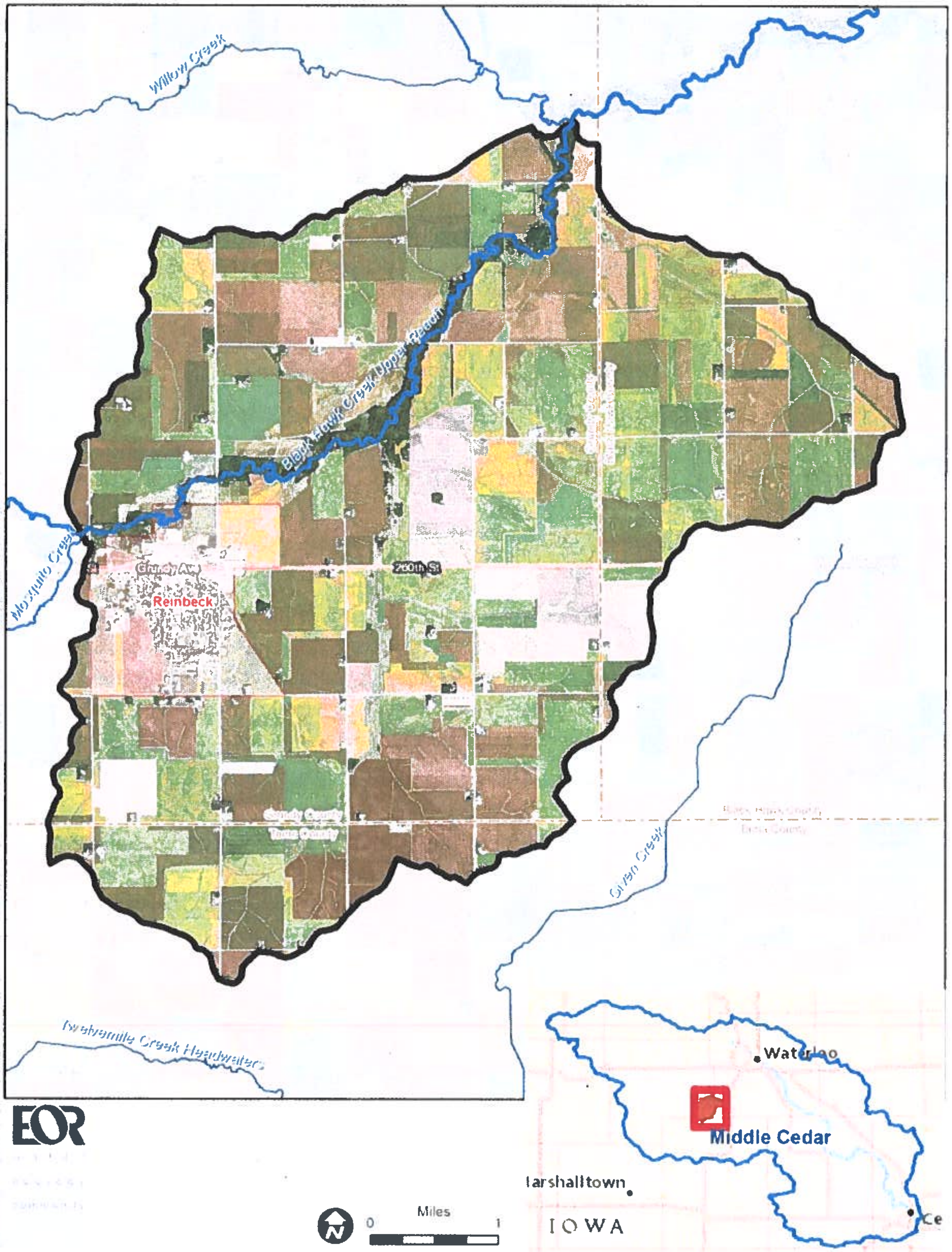


Figure 1. Village of Reinbeck – Black Hawk Creek Subwatershed

on rural-municipal cooperation centered primarily on the Reinbeck wastewater utility, the allocation of responsibilities between point and non-point sources under the Iowa Nutrient Reduction strategy, and innovative projects in Iowa that are linking downstream/municipal partners with upstream farmers and landowners. These two additional priorities were incorporated in the ranking exercise as a reflection of priorities identified by the participants.

In the second exercise, participants ranked conservation practices based off what they believed would have a high adoption rate in their watershed. During the exercise, the planning team explained each item on the list of presented conversation practices, which included, grassed waterways, saturated buffers, and nitrification inhibitors, and also described the specific benefits and challenges of each practice to the participants. For example, grassed waterways effectively reduce phosphorous runoff and provide beneficial wildlife habitat, but do not increase soil health, reduce flooding, or improve aquatic life. Out of this exercise, the group suggested filter/buffer strips as a practice to consider and also helped to identify potential locations that might be suitable for buffer/filter strips along Black Hawk Creek.

Overall, this group of individuals participated in a lively discussion and would be an effective group as an advisory team for the Black Hawk Creek Watershed.

Second Input Meeting, June 29, 2018
Goal Setting
Outreach to residents for the second input meeting included email to all of the original invitees that ISA had contacted for the first input meeting, and for those whose contact information was available, they received a personal follow-up call the week leading up to the meeting. In addition, the attendees from the first meeting were invited by personal follow-up phone calls and/or emails. The purpose of this meeting was:

1. Report and ground-truth the initial ranking results for priorities and practices.
2. Introduce modeling data to assist the group in visualizing the impacts of their prioritized practices.
3. Create achievable practice implementation goals that meet the INRS.

Iowa Nutrient Reduction Strategy

The planning team kicked off the meeting by reviewing each priority and practice ranking that had been identified in the first input meeting. The planners then asked the participants if they felt these compiled rankings accurately reflected the general experience of individuals living in the watershed. Several of the attendees agreed that the priorities of the watershed were aligned with what they had experienced, many people had not heard about the INRS and expressed their appreciation that it is voluntary and not mandatory. Upon reviewing the results of the prioritized practices, the top three highest priorities selected were grassed waterways, nutrient management, and nitrification inhibitors. Participants noted that these practices aligned with what they experienced in the watershed and indicated that it would be difficult to implement different practices without more information, training, and cost-share available.

During group discussion, it was brought to attention of the planning team that a previous watershed-related project had left a bad impression on many area residents. According to the participants, in 2014 the Iowa Department of Natural Resources received an Iowa Water Trail sign grant to promote waterway recreation and failed to include community input on the front end of the project. Many

3. WATERSHED CHARACTERIZATION

3.1. General Background

The Village of Reinbeck- Black Hawk Creek Subwatershed spans Grundy, Tama, and Black Hawk counties (see Figure 1). According to the 2010 United States Census, the subwatershed has an estimated population of 1,956, the majority of which (1,664) reside within the City of Reinbeck. The population density of the subwatershed is 115 people per 1000 acres. The Village of Reinbeck- Black Hawk Creek population represents less than 1.0% of the total population of the Middle Cedar Watershed.

The 16,956 acre area is classified as a HUC-12 Subwatershed in the United States Geological Survey hierarchical system. It is a subdivision of the Headwaters Black Hawk Creek HUC-10 Watershed and the Middle Cedar HUC-8 Subbasin. A local initiative, the Black Hawk Water and Soil Coalition, was recently formed for the purpose of restoring, improving, preserving and advocating for water quality and soil health. The coalition was formed to address issues in the three Black Hawk Creek HUC-10 Watersheds, Black Hawk Creek Watershed, Headwaters Black Hawk Creek Watershed, and North Fork Black Hawk Creek Watershed. Further information can be found on the Coalition facebook page at https://www.facebook.com/bhcwaterandsoil/

3.2. Land Cover

The predominant land cover of the Village of Reinbeck – Black Hawk Creek Subwatershed is row crop agriculture. According to the High Resolution Landcover of Iowa 2009 (HRLC) data set the subwatershed is 81% row crop agriculture. The High Resolution Landcover data was derived from three dates of aerial imagery, and from elevation information derived from LiDAR elevation data. It has a spatial resolution of one meter, and a class resolution of 15 classes which we have combined into the five general categories shown in. Additional information, including a link to download the actual data, on the HRLC can be found at https://geodata.iowa.gov/dataset/high-resolution-land-cover-iowa-2009

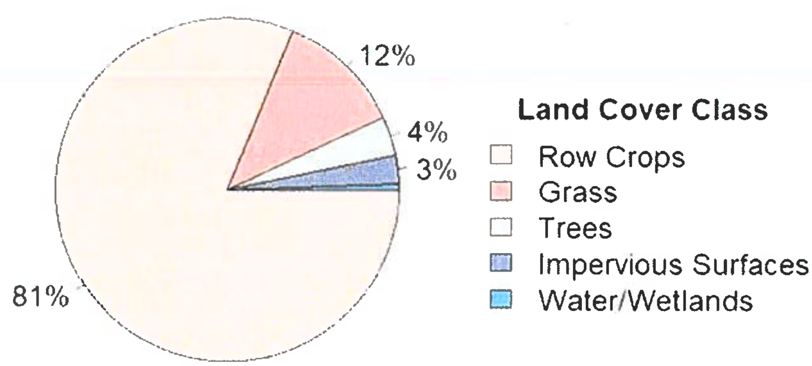


Figure 2. Land Cover of the Village of Reinbeck – Black Hawk Creek Subwatershed

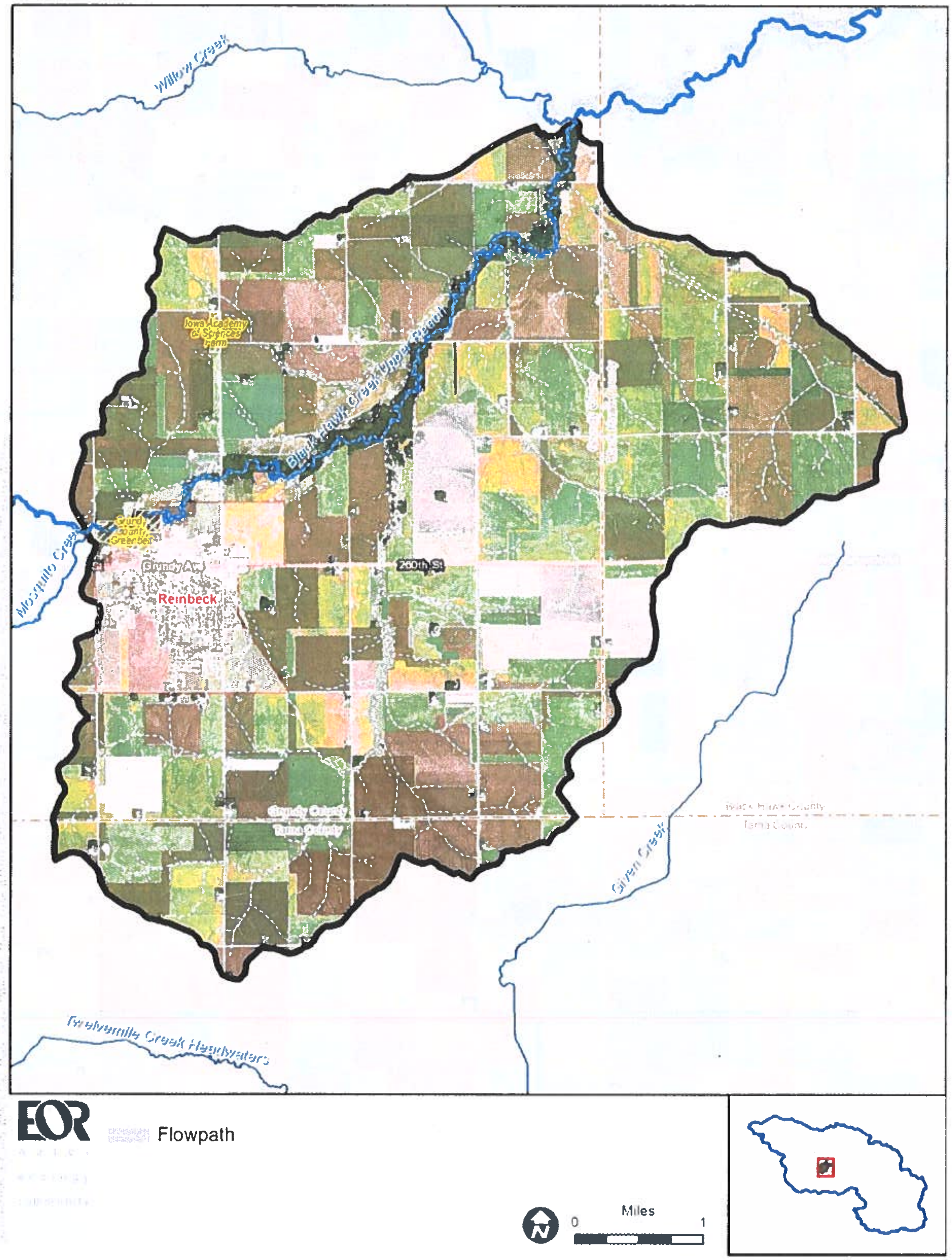


Figure 3. Water Resources of the Village of Reinbeck – Black Hawk Creek Subwatershed

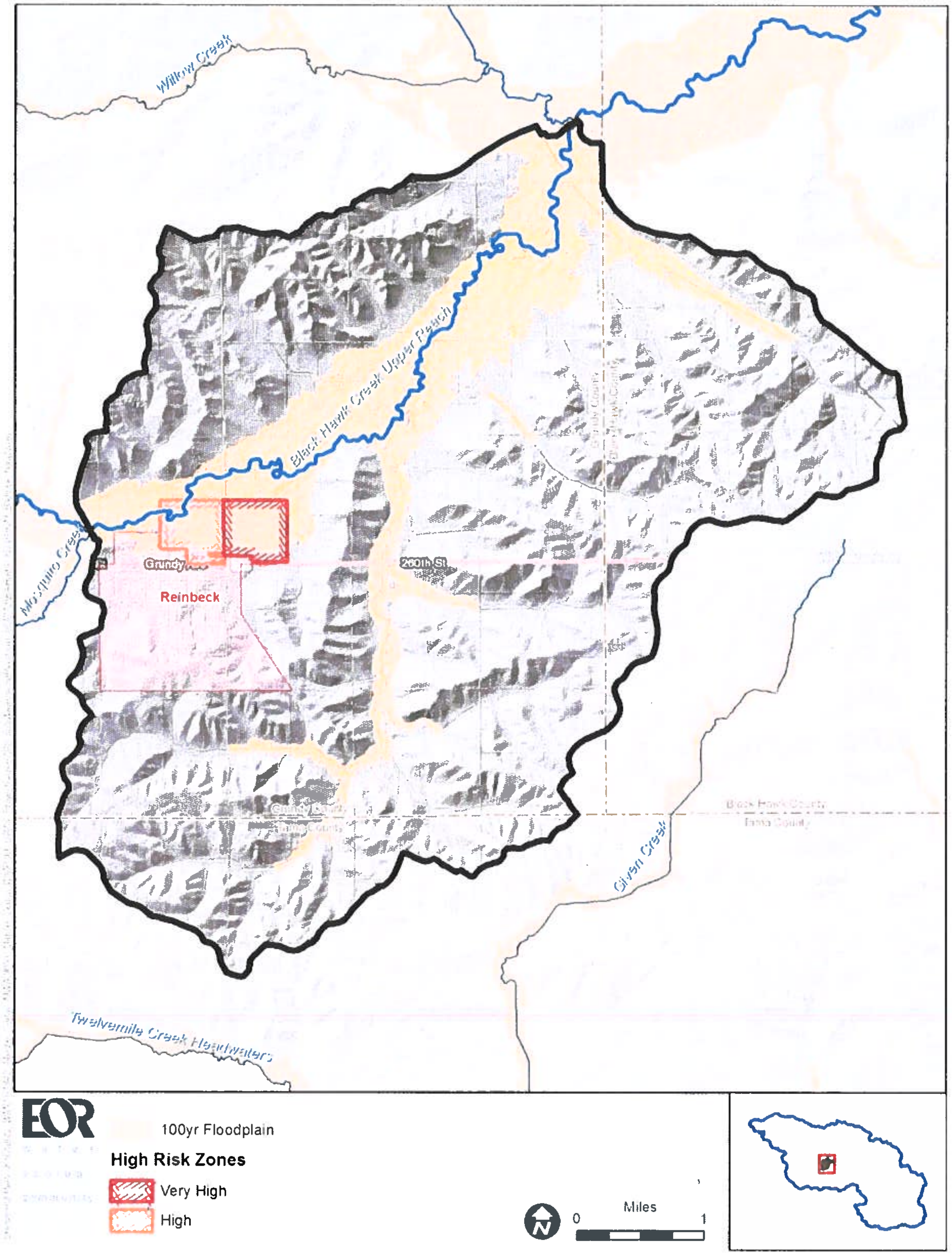


Figure 4. Flooding within the Village of Reinbeck – Black Hawk Creek Subwatershed

Southern region of Minnesota is 0.15 mg/l. This number can be used as a reference point for reviewing water quality measurements in the subwatershed. Total phosphorus is made up of several forms of phosphorus; dissolved reactive phosphorus, particulate inorganic phosphorus, dissolved organic phosphorus, and particulate organic phosphorus. Not all of these forms of phosphorus are routinely measured. As shown in Table 1 the Iowa Soybean Association currently monitors dissolved reactive phosphorus and dissolved organic phosphorus. A relationship can be established between either of these forms and total phosphorus so a reference point could be developed for the forms that are being measured.

High levels of nutrients can also cause water to be unfit for drinking. Some communities in the Middle Cedar Watershed are finding excess nitrate in their drinking water from polluted runoff which requires additional and costly treatment. Such water is unhealthy to drink, particularly for babies. A segment of the Cedar River within Cedar Rapids has been designated by the State as a drinking water supply.

The State of Iowa drinking water standard for Nitrate is 10.0 mg/L. Water quality measurements in the reach of Cedar River in Cedar Rapid demonstrated that Nitrate levels were in excess of the State drinking water standard which resulted in the segment being including on Iowa's impaired waters list and necessitated development of a TMDL(refer to the Cedar River Nitrate TMDL section).

3.7.1. Subwatershed Monitoring Data

The Iowa Soybean Association (ISA) conducts snapshot monitoring at several tributaries to the Middle Cedar River, including a site on Black Hawk Creek within the Village of Reinbeck – Black Hawk Creek subwatershed. The monitoring site is located at the stream crossing at 230th Street near the outlet of the subwatershed which is defined as the confluence with North Fork Black Hawk Creek. Data from ISA snapshot monitoring for 2017 is shown in Table 1. Monitoring results show elevated levels of Nitrate, and Phosphorus for both sampling dates. *E. coil* levels were below the single measurement standard. ISA continued snapshot monitoring in 2018. A final report will be completed and will be available from the City of Cedar Rapids.

Table 1. ISA Snapshot Monitoring Results, 2017

Site	CR28	CR28
Sample Date	4/25/2017	6/6/2017
Chloride (mg/L)	21.9	21.4
Conductivity (mS/cm)	425	439
Dissolved Oxygen (mg/L)	9.5	9.1
***E.coli* (MPN/100mL)**	**301**	**528**
Fluoride (mg/L)	<0.3	<0.3
Nitrate as N (mg/L)	**12.3**	**12.7**
Nitrite as N (mg/L)	0.47	0.38
pH	8.1	8.14
Dissolved Reactive Phosphorus as P (mg/L)	**0.04**	**0.06**
Dissolved Organic Phosphorus as P (mg/L)	**0.7**	**0.41**
Sulfate (mg/L)	15.6	16.2
Temperature (Degrees C)	11.3	17.8

recreational seasons of 2009 and 2010 at each of the six Section 319 monitoring stations in this assessment segment were as follows:

1. BHC-4, 2009 and 2010 geometric means (orgs/100 ml) were 1,349 and 822;
2. BHC-12, 2009 and 2010 geometric means (orgs/100 ml) were 1,278 and 703;
3. BHC-10, 2009 and 2010 geometric means (orgs/100 ml) were 1,257 and 1,042;
4. BHC-5, 2009 and 2010 geometric means (orgs/100 ml) were 1,025 and 873;
5. BHC-7, 2009 and 2010 geometric means (orgs/100 ml) were 1,025 and 1,121;
6. BHC-1, 2009 and 2010 geometric means (orgs/100 ml) were 578 and 755.

From 83 to 100% of the samples at each site exceeded the Class A1 single-sample maximum criterion of 235 orgs/100 ml. According to U.S. EPA guidelines for Section 305(b) reporting and IDNR's assessment/listing methodology, if a recreation season geometric mean exceeds the respective water quality criterion, the contact recreation uses should be assessed as "impaired" (see pgs 3-33 to 3-35 of U.S. EPA 1997b). Thus, because at least one recreation season geometric mean exceeded criteria for Class A1 uses, these uses remain assessed as "impaired".

The Class B(WW2) aquatic life uses remain assessed (evaluated) as "fully supported" based on results of IDNR/UHL water quality monitoring conducted at three stations in 2005 as part of TMDL development. Results of this monitoring show no violations of Class B(WW2) water quality criteria for dissolved oxygen, pH or ammonia in the combined 21 monthly samples collected from these three stations from April-September 2005.

3.7.3. TMDL Studies

The Village of Reinbeck – Black Hawk Creek subwatershed contributes drainage to three impaired streams for which Total Maximum Daily Load (TMDL) Studies have been developed. **A TMDL is a determination of the maximum load of pollutant a given water body can receive and continue to meet water quality standards for that particular pollutant.** TMDLs are conducted on water bodies where pollutant levels have been found to be in excess of water quality standards resulting in that water body failing to meet a designated use (also referred to as having an impairment). TMDLs determine a pollutant reduction target and allocate a portion of the needed reductions to each source of pollutant. Pollutant sources are characterized as either point sources or nonpoint sources. Point sources receive a wasteload allocation (WLA) and include all sources that are subject to regulation under the National Pollutant Discharge Elimination System (NPDES) program, e.g. wastewater treatment facilities, stormwater discharges in Municipal Separate Storm Sewer System (MS4) Communities and concentrated animal feeding operations (CAFOs). Nonpoint sources receive a load allocation (LA) and include all remaining sources of the pollutant as well as natural background sources.

Black Hawk Creek Bacteria TMDL

The Iowa DNR approved the *Total Maximum Daily Load For Pathogen Indicators Black Hawk Creek, Iowa* in 2006. The TMDL was developed to address a segment of Black Hawk Creek that had been identified as being impaired due to excessive indicator bacteria (fecal coliform). The 11.4 mile

The TMDL includes an informational implementation plan. An implementation plan is not a requirement for a TMDL but Region 7 developed a model (Hydrologic Simulation Program Fortran HSPF) to test potential scenarios. The model determined that the following scenario will result in the river reaches meeting the Iowa water quality standards. This scenario assumes that all wastewater treatment plants (WWTP) effluent and rivers entering Iowa will have bacteria concentrations less than or equal to the Iowa water quality standard.

1. Unpermitted feedlots will control/capture the first one-half inch of rain.
2. Cropland bacteria loading will be reduced by 40 percent through proper timing and application of animal waste.
3. Cattle in streams will be reduced by 40 percent.
4. Leaking septic systems will be eliminated.

Cedar River Nitrate TMDL

The Iowa DNR approved the *Total Maximum Daily Load For Nitrate Cedar River, Linn County, Iowa* in 2006. The TMDL was developed to address a reach of the Cedar River that had been identified as being impaired by excess nitrate. The impaired reach is defined as the Cedar River from its confluence with McCloud Run (S16, T83N, R07W) to the Cedar River confluence with Bear Creek (S21, T84N, R08W). Designated uses for the impaired segment are significant resource warm water (Class B(WW)), primary contact recreational use (Class A1) and drinking water supply (Class C). Excess nitrate loading has impaired the drinking water supply water quality criteria (567 IAC 61.3(3)) and hindered the designated use. The target of this TMDL is the drinking water nitrate concentration standard of less than 10.0 mg/L NO3-N.

The TMDL was written as a phased TMDL. Phasing TMDLs is an iterative approach to managing water quality that becomes necessary when the origin, nature and sources of water quality impairments are not well understood. In this first phase the waterbody load capacity, existing pollutant load in excess of this capacity, and the source load allocations were estimated based on the limited information available. A monitoring plan was then developed to determine if prescribed load reductions result in attainment of water quality standards and whether or not the target values are sufficient to meet designated uses. Monitoring activities may include routine sampling and analysis, biological assessment, fisheries studies, and watershed and/or waterbody modeling. A future phase of the TMDL will consist of implementing the monitoring plan, evaluating collected data, and readjusting target values if needed.

The targeted Nitrate reduction is 35%. This would equal a yearly reduction of 9,999 tons nitrate-N/year from the current loading of 28,561 tons nitrate-N/year. The TMDL states that the majority (91%) of the nitrate delivered downstream in the watershed is from nonpoint sources and sets a reduction target for nonpoint sources at 37%. The adjusted reduction (from the overall 35% target) accounts for wildlife, atmospheric deposition, and point sources.

Table 3. SWAT Model Results for the Village of Reinbeck - Black Hawk Creek Subwatershed

Total Nitrogen		Total Phosphorus		Tile NO_3		Sediment	
Load (lbs/ac/yr)	MC Rank (# of 68)	Load (lbs/ac/yr)	MC Rank (# of 68)	Load (lbs/ac/yr)	MC Rank (# of 68)	Load (tons/ac/yr)	MC Rank (# of 68)
25.7	35	2.5	14	16.2	29	1.6	16

3.9.2. Daily Erosion Project

The Daily Erosion Project (DEP) tool developed by the Department of Agronomy at Iowa State University that allows users to understand how fast soil is being lost off the land. The tool takes precipitation data provided by the Next Generation Weather Radar (NEXRAD) and estimates the amount of soil erosion taking place on the land based on soil type, vegetative cover and slope on a daily basis. The tool also estimates the amount of hillslope soil loss using the Water Erosion Prediction Project (WEPP) Model. Further documentation of the Daily Erosion Project can be found on the project website.

The DEP was run for the sixty-eight HUC-12 subwatersheds in the Middle Cedar Watershed for the ten year period 2008-2017. The output from the DEP analysis is used to show the average annual soil detachment and hillslope soil loss in terms of tons/acre. Note that this is a different measurement than the sediment loading estimate derived from the SWAT Model.

Table 4. Daily Erosion Project Results for the Village of Reinbeck - Black Hawk Creek Subwatershed

Average Annual Soil Detachment		Average Annual Hillslope Soil Loss	
Tons/Acre	MC Rank (# of 68)	Tons/Acre	MC Rank (# of 68)
6.0	7	5.7	7

3.9.3. Bacteria Source Assessment

Humans, pets, livestock, and wildlife all contribute bacteria to the environment. These bacteria, after appearing in animal waste, are dispersed throughout the environment by an array of natural and man-made mechanisms. Bacteria fate and transport is affected by disposal and treatment mechanisms, methods of manure reuse, imperviousness of land surfaces, and natural decay and die-off due to environmental factors such as ultraviolet (UV) exposure and detention time in the

According to the Iowa DNR Animal Feeding Operations (AFO) permit database, there are an estimated 3,798 animal units within the subwatershed. This number does not include any animals that are not included on AFO permits. There is one wastewater treatment facility in the subwatershed (see Figure 5). The City of Reinbeck operates a waste water treatment plan under Iowa NPDES Permit #3870001 which sets performance standards in terms of discharges limits for several pollutants including; *E. coli*, CBOD5, Total Suspended Solids, Nitrogen, Dissolved Oxygen and pH.

A detailed assessment of potential bacteria sources was conducted for the Black Hawk Creek Bacteria TMDL and determined that the nonpoint sources of *E. coli* bacteria in the Black Hawk Creek watershed include:

- Land application of hog and cattle manure
- Land application of poultry litter
- Grazing animals
- Cattle contributions directly deposited in stream
- Failing septic systems
- Urban runoff

The TMDL Study found that cropland and pastureland were the predominant land uses associated with *E. coli* contribution. Hog manure application was found to be the main source of *E. coli* for cropland and beef cattle grazing was determined to be the main source of *E. coli* on pastureland.

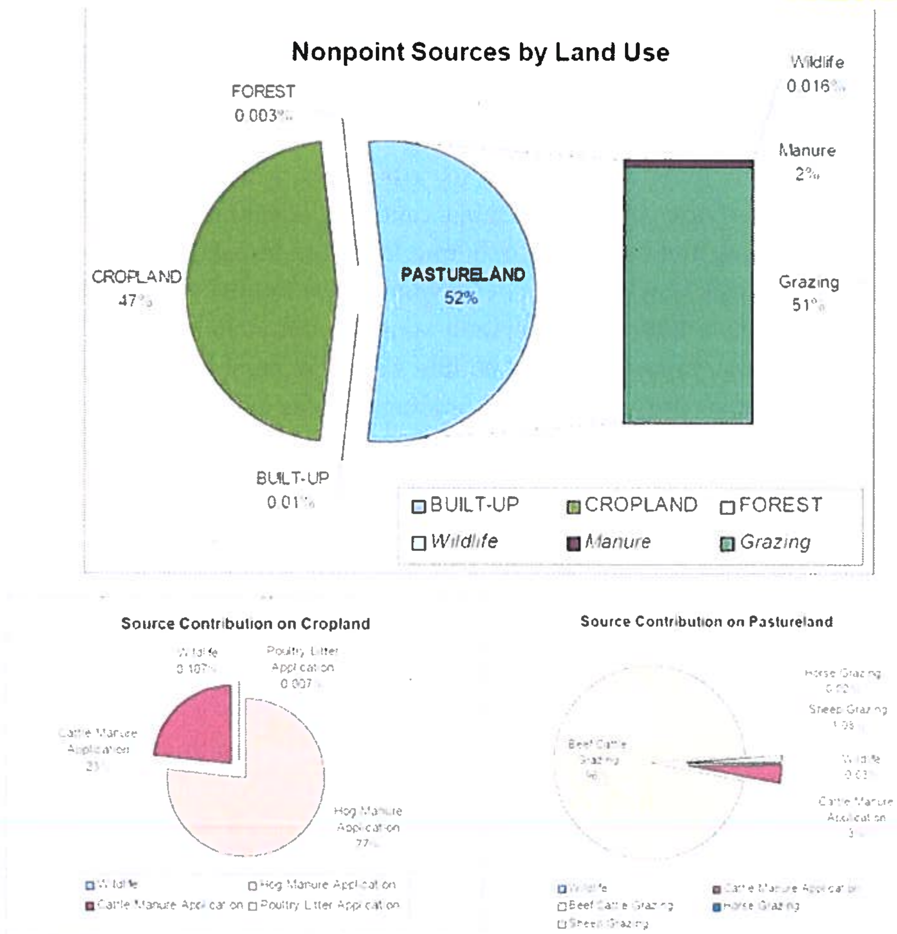


Figure 6. Nonpoint Sources of *E. coli* by Landuse, Cropland *E. coli* Source Contribution, Pastureland *E. coli* Source Contribution; Black Hawk Creek Subwatershed. Source: Total Maximum Daily Load for Pathogen Indicators Black Hawk Creek, Iowa. Iowa DNR 2006.

baseline conditions on resource health but it should continue to collect the information needed to establish trends and evaluate projects and programs to better inform future management decisions.

- *Partnerships:* Watershed Management Authorities (WMAs) are, by definition, partnerships between local Cities, Counties, and Soil & Water Conservation Districts. The Middle Cedar WMA was formed to jointly address the challenges facing the watershed. While the WMA intends to assume a leadership role it does not bear the sole responsibility nor does it possess all the resources - financial, regulatory authority, or knowledge - needed to meet the challenge of managing the watershed.

4.2. Village of Reinbeck - Black Hawk Creek Subwatershed Issues

As noted in the Stakeholders Engagement Process, participants in both input meetings helped to identify important issues to them and their community. In particular, in both meetings, participants emphasized the importance of increased communication with the community at-large in regards to the watershed planning underway and future watershed-related projects. It is important that community members are asked for their input early on, as demonstrated with the first input meeting with stakeholders. Other important issues brought up and identified by participants are:

- *Improved infrastructure for cover crops:* specifically, participants identified need for growers of crop seed, shared storage, grant money for high-clearance interseeders or other planting equipment.
- *Wetland restoration:* participants expressed the desire to utilize the 1-acre wetland that already exists within the watershed to implement a program that allows farmers to seed wetlands.
- *Consider filter strips/buffer strips:* participants believed there are less barriers to implementing this practice and therefore feel that they are more likely to be adapted. Additionally, saturated buffers were scored as the most likely edge-of-field practice.
- *Potential for areas for oxbow restorations:* participants identified some locations along Black Hawk Creek that could be suitable for oxbow restorations.
- *Strategic approach to targeted conservation:* there was discussion among participants interested in strategically targeting areas with specific conservation practices that would benefit the overall community by affecting multiple farms, fields, or landowners with one practice. For example, although oxbows were rated as relatively unlikely to be adopted, there was some discussion regarding the community benefits of targeted oxbows that can reduce nutrient loss from multiple fields, farmers, or landowners.
- *Rural-municipal cooperation:* participants feel strongly about cooperation on a variety of issues, including the importance of the Reinbeck waste water utility and the allocation of responsibilities between point and nonpoint pollution sources under the Iowa Reduction Strategy.
- *Link downstream/upstream communities:* participants would like to see innovative projects that are linking downstream and municipal partners with upstream farmers and landowners.

5. GOALS AND OBJECTIVES

5.1. Middle Cedar Watershed Management Plan

Goals and objectives have been established for the Middle Cedar Watershed (HUC-8) based on the general issues that were identified during the planning process. These goals and objectives are used to guide the implementation plan for the Middle Cedar Watershed Management Plan and will be used to set the framework for the Village of Reinbeck- Black Hawk Creek Subwatershed Management Plan.

In order to address the issues identified in the Middle Cedar Watershed, the following primary goals have been established:

1. *Flooding/Water Quantity Goals*: reduce flooding risk and damage, reduce flooding potential, protect life and property from flood damage, improve stormwater management, and increase watershed awareness.
2. *Water Quality Goals:* all waters in the watershed meet their designated uses, ensure high quality drinking water, and meet the Iowa Nutrient Reduction strategy goals.
3. *Recreation Goals*: enhance the watershed's existing water-based recreational areas, develop new recreational opportunities on lakes and streams, increase awareness of recreational opportunities within the watershed, and improve the health of the watershed ecosystems.
4. *Monitoring and Evaluation Goals:* evaluate temporal trends in water quality and quantity, determine the water quality and quantity conditions of water sources within the watershed, and evaluate the effectiveness of the WMA management efforts.
5. *Funding and Organizational goals:* identify and obtain funding sources that are reliable and sufficient to meet the goals of the watershed management plan, and effectively manage the WMA through implementation of this watershed management plan and appropriate governance structure.
6. *Regulation and Enforcement Goal:* ensure that existing regulations that are in place to protect water resources are actively and fully enforced.
7. *Education and Outreach Goals:* increase awareness of the watershed and its resources, inspired watershed stewardship and ownership, disseminate water-resource information and materials, ensure all stakeholders in the watershed are included in activities and programs, and identify and empower local watershed stewards to build watershed management ethic at the grassroots levels.
8. *Partnership Goal:* work cooperatively to achieve mutual watershed management objectives.

Each of the eight goals has a set of specific objectives to practice in order to meet the goal. For more on the goals and objectives, please refer to the Middle Cedar Watershed Management Plan.

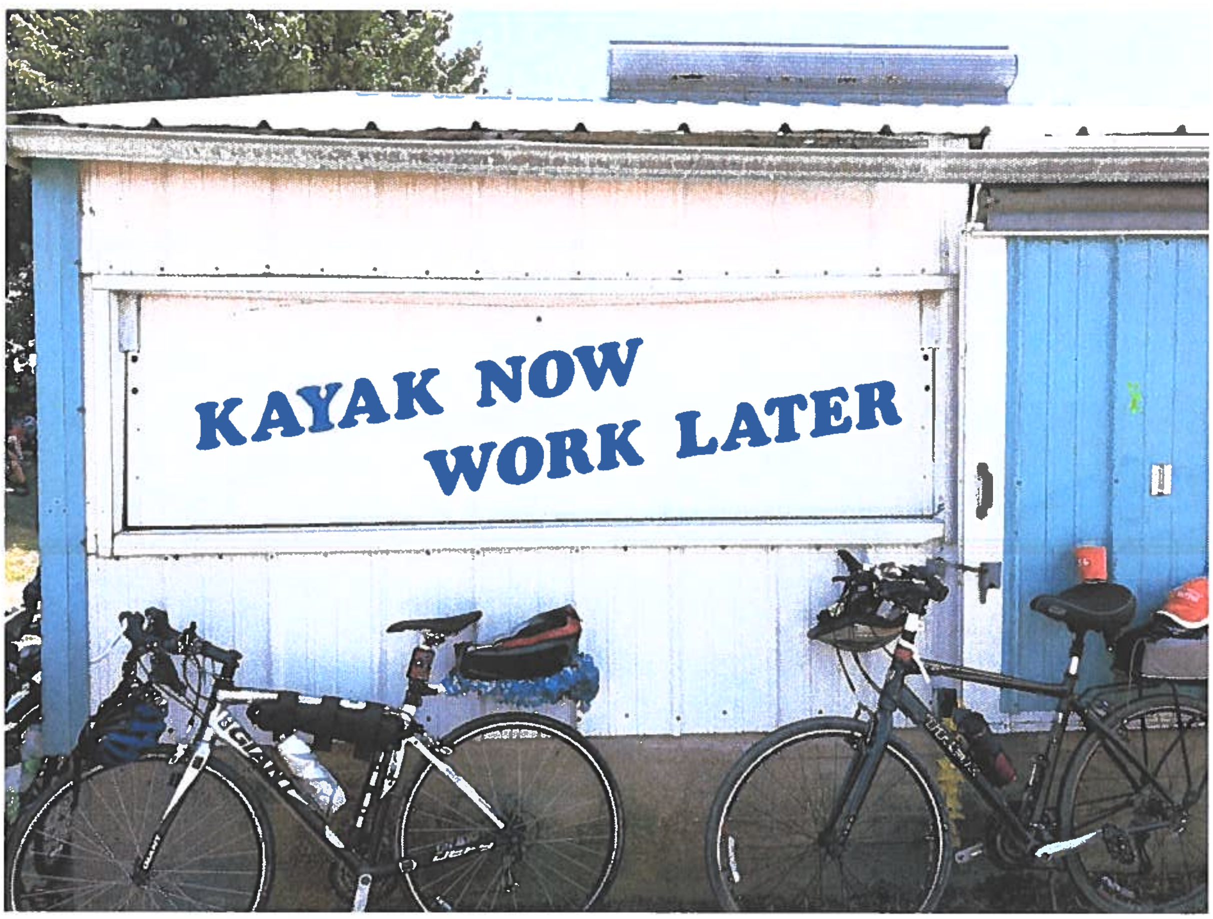
5.2. Village of Reinbeck – Black Hawk Creek Subwatershed Specific Goals

The following specific goals and objectives have been identified for the Village of Reinbeck - Black Hawk Creek Subwatershed. These goals and objectives were developed through the following:

- Input received by local subwatershed resident in stakeholder engagement meetings objectives were needed for this Cedar River segment to achieve the *E. coli* water quality standard:

- Unpermitted feedlots will control/capture the first one-half inch of rain.
- Cropland bacteria loading will be reduced by 40 percent through proper timing and application of animal waste.
- Cattle in streams will be reduced by 40 percent.
- Leaking septic systems will be eliminated.

- Cedar River from McCloud Run to Bear Creek. This segment of the Cedar River is impaired due to levels of Nitrate above the State Standard for drinking water. A TMDL was developed for this segment of the Cedar River that established a 37% loading reduction target for nonpoint sources of Nitrate.



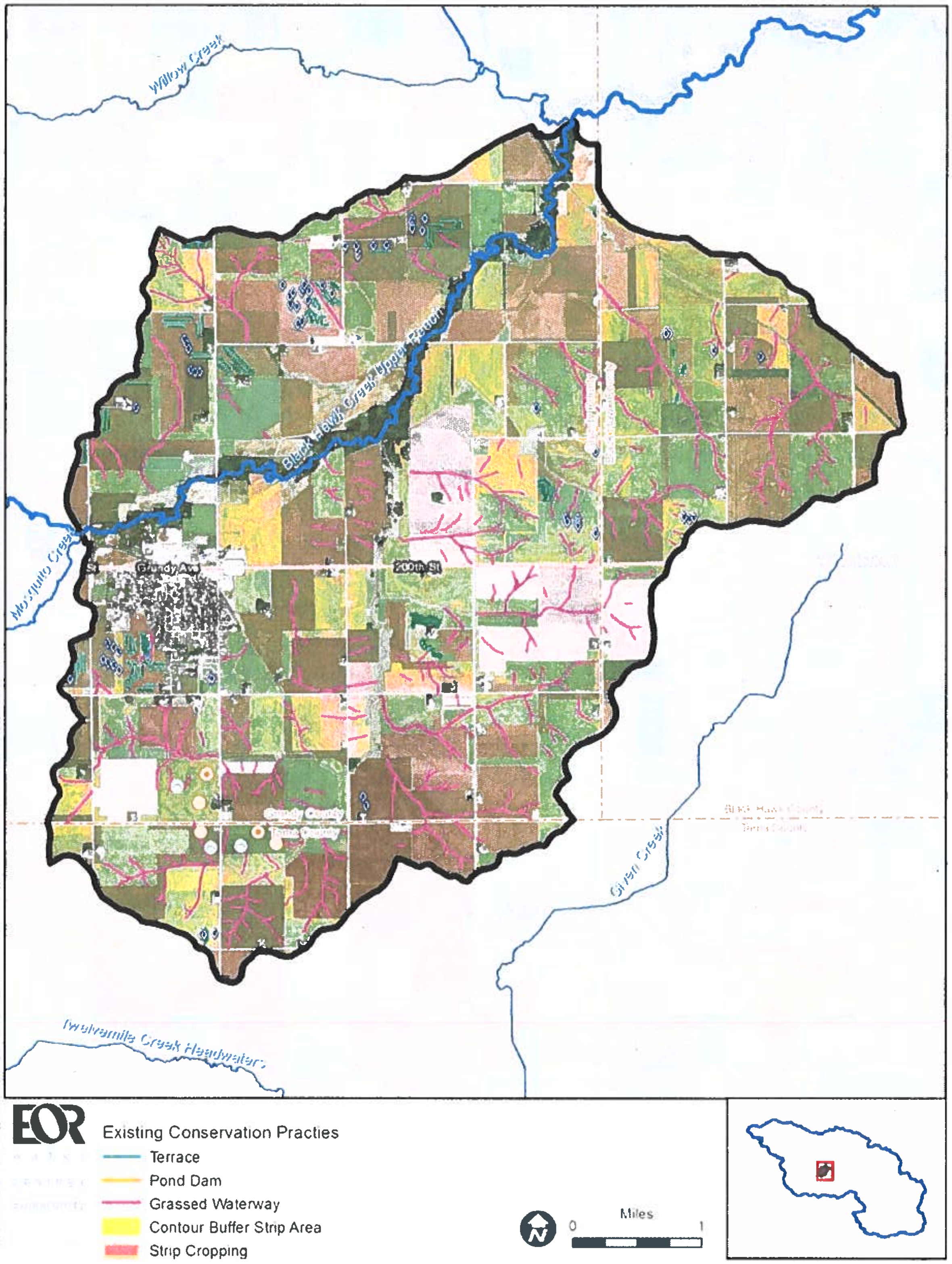


Figure 7. Existing Conservation Practices in the Village of Reinbeck – Black Hawk Creek Subwatershed

6.2.1. Soil Health Practices

Starting at the base of the conservation pyramid, the following practices reduce nutrient and sediment runoff from fields while also building soil health.

Cover Crops: Cover crops is a term to describe any crop grown primarily for the benefit of the soil rather than the crop yield. Cover crops are typically grasses or legumes (planted in the fall between harvest and planting of spring crops) but may be comprised of other green plants. Cover crops prevent erosion, improve the physical and biological properties of soil, supply nutrients, suppress weeds, improve the availability of soil water, and break pest cycles among various other benefits. More information on cover crop use in Iowa can be found at:
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_005818.pdf

Extended Crop Rotations: An extended crop rotation is a farming practice that includes a rotation of corn, soybean, and two to three years of alfalfa or legume-grass mixtures managed for hay harvest. Extended rotations reduce the application and loss of both nitrate-N and P. Due to growing nitrogen fixing legumes three years in a row, very little, if any nitrogen needs to be applied in the subsequent corn year. Additional information can be found at: https://www.cleanwateriowa.org/extended-crop-rotation/

Nitrification Inhibitors: When ammonia or ammonium N is added to the soil, it is subject to a process called nitrification. Soil bacteria converts the ammonia ($NH3$) or ammonium ($NH4$) to nitrate ($NO3$). This conversion is strongly temperature dependent and occurs quickly under warm soil temperature conditions. Using a nitrification inhibitor with early spring applications of ammonia or ammonium nitrogen will slow the conversion to nitrate until it can be readily used by crops. This will allow the crop to take up more of the N.

4Rs of Nutrient Management: The 4Rs of nutrient management refer to fertilizer application techniques focused on minimizing the risk of nutrient loss from the field. The principles of the 4R framework include:

Right Source – Ensure a balanced supply of essential nutrients, considering both naturally available sources and the characteristics of specific products, in plant available forms.

Right Rate – Assess and make decisions based on soil nutrient supply and plant demand.

Right Time – Assess and make decisions based on the dynamics of crop uptake, soil supply, nutrient loss risks, and field operation logistics.

Right Place – Address root-soil dynamics and nutrient movement, and manage spatial variability within the field to meet site-specific crop needs and limit potential losses from the field.

Recently a program called 4R Plus was developed by a coalition of organizations dedicated to conservation stewardship for Iowa's farmers. 4R Plus is a nutrient management and conservation program to make farmers aware of practices that bolster production, build soil health and improve water quality in Iowa. The program is guided by a coalition of more than 25 organizations, including agribusinesses, conservation organizations, commodity and trade associations, government agencies and academic institutions. To learn more, visit www.4RPlus.org.

Drainage Water Management: Controlled drainage describes the practice of installing water level control structures within the drain tile system. This practice reduces nitrogen loads by raising the water tables during part of the year, thereby reducing overall tile drainage volume and nitrate load. The water table is controlled through the use of gate structures that are adjusted at different times during the year. When field access is needed for planting, harvest or other operations, the gate can be opened fully to allow unrestricted drainage. When the gate is used to raise local water table levels after spring planting season, this may allow more plant water uptake during dry periods, which can increase crop yields. Controlled drainage may be used on fields with flat topography, typically one percent or less slope.

Grassed Waterways: These are constructed channels that are seeded to grass and drain water from areas of concentrated flow. The vegetation slows down the water and the channel conveys the water to a stable outlet at a non-erosive velocity. Grassed waterways should be used where gully erosion is a problem. These areas are commonly located between hills and other low-lying areas on hills where water concentrates as it runs off the field (NRCS, 2012). The size and shape of a grassed waterway is based on the amount of runoff that the waterway must carry, the slope, and the underlying soil type. It is important to note that grassed waterways also trap sediment entering them via field surface runoff and in this manner performs similarly to riparian buffer strips.

No-till: No-till is a way of growing crops or pasture from year to year without disturbing the soil through tillage. No-till increases the amount of water that infiltrates into the soil, the soil's retention of organic matter and its cycling of nutrients. It can also reduce or eliminate soil erosion, increase the amount and variety of life in and on the soil. The most powerful benefit of no-tillage is improvement in soil biological fertility, making soils more resilient. No till opportunities were not sited by the ACPF Tool.

The current extent of in-field management practices in the subwatershed was estimated by reviewing the Iowa DNR BMP Mapping Project (see Figure 7), and through professional judgement as described for the soil health management practices.

Table 6. In-field Conservation Practice Existing Adoption Rate Assumptions for the Village of Reinbeck – Black Hawk Creek Subwatershed

Conservation Practice	Existing Adoption Rate	Adoption Rate Estimate Source
Contour buffer strips	0%	Comparison of ACPF output to BMP Mapping Project findings
Terraces	100%	Comparison of ACPF output to BMP Mapping Project findings
Drainage Water Management	0%	Professional Judgement
Grassed Waterways	43%	Comparison of ACPF output to BMP Mapping Project findings
No-Till	20%	Professional Judgement

6.2.3. Edge of Field Conservation Practices

The following conservation practices are categorized as edge of field practices due to their typical location just off the edge of a farm field. Note that conversion to perennial cover is included in this

6.2.4. Riparian Area Management

The final tier of the conservation pyramid is management practices within the areas adjacent to existing waterways. These practices are commonly referred to as riparian area conservation practices. An evaluation of the existing riparian area throughout the subwatershed was conducted. The land cover types within 50 feet on either side of each stream (the riparian area) within the subwatershed were inventoried to determine the current condition. Areas where natural land cover types (forests, wetlands, etc.) were found within the riparian area were determined to have an existing buffer. The existing adoption rates shown in Table 8 are the percentage of natural cover types within each type of riparian area management as sited in the ACPF tools.

<u>Riparian Buffers:</u> The ACPF tools identify a variety of riparian buffers based on the primary function they serve. The riparian buffer types are as follows:

- Critical Zone- sensitive areas: identified as areas with a high level of surface runoff delivery
- Deep-rooted Vegetation – for areas with saturated soils
- Multi-species – for water uptake, nutrient and sediment trapping
- Stiff stemmed grasses – for areas with overland runoff where sediment can be trapped
- Stream stabilization – for areas where bank stability is the emphasis

<u>Saturated Buffers</u>: Saturated buffers are a vegetated area, typically a riparian area along a stream or ditch where draintile water is dispersed in a manner that maximizes its contact with the soils and vegetation of the area. Draintile lines that typically discharge directly to the ditch or stream are intercepted and routed into a new draintile pipe that runs parallel to the ditch or stream. This allows drain water to exfiltrate and saturate the buffer area. The contact with soil and vegetation results in denitrification.

Table 8. Riparian Area Management Practice Existing Adoption Rate Assumptions for the Village of Reinbeck – Black Hawk Creek Subwatershed

Conservation Practice	Existing Adoption Rate	Adoption Rate Estimate Source
Critical zone riparian buffer	87%	Evaluation using High Resolution Land Cover Mapping Data and Stream Riparian Areas
Deep-rooted vegetation riparian buffer	82%	
Multi-species riparian buffer	80%	
Stiff stem grass riparian buffer	85%	
Stream stabilization riparian buffer	74%	
Saturated buffers	0%	Professional Judgement

The conservation practices described in the previous section were compiled for the Village of Reinbeck – Black Hawk Creek Subwatershed and processed using a custom set of scripts written in the R programming language. Essentially, these scripts aggregated the individual BMP features and created a summary for the Village of Reinbeck – Black Hawk Creek HUC-12 containing the total potential extent for each BMP type along with the total footprint and drainage area served (see Table 9).

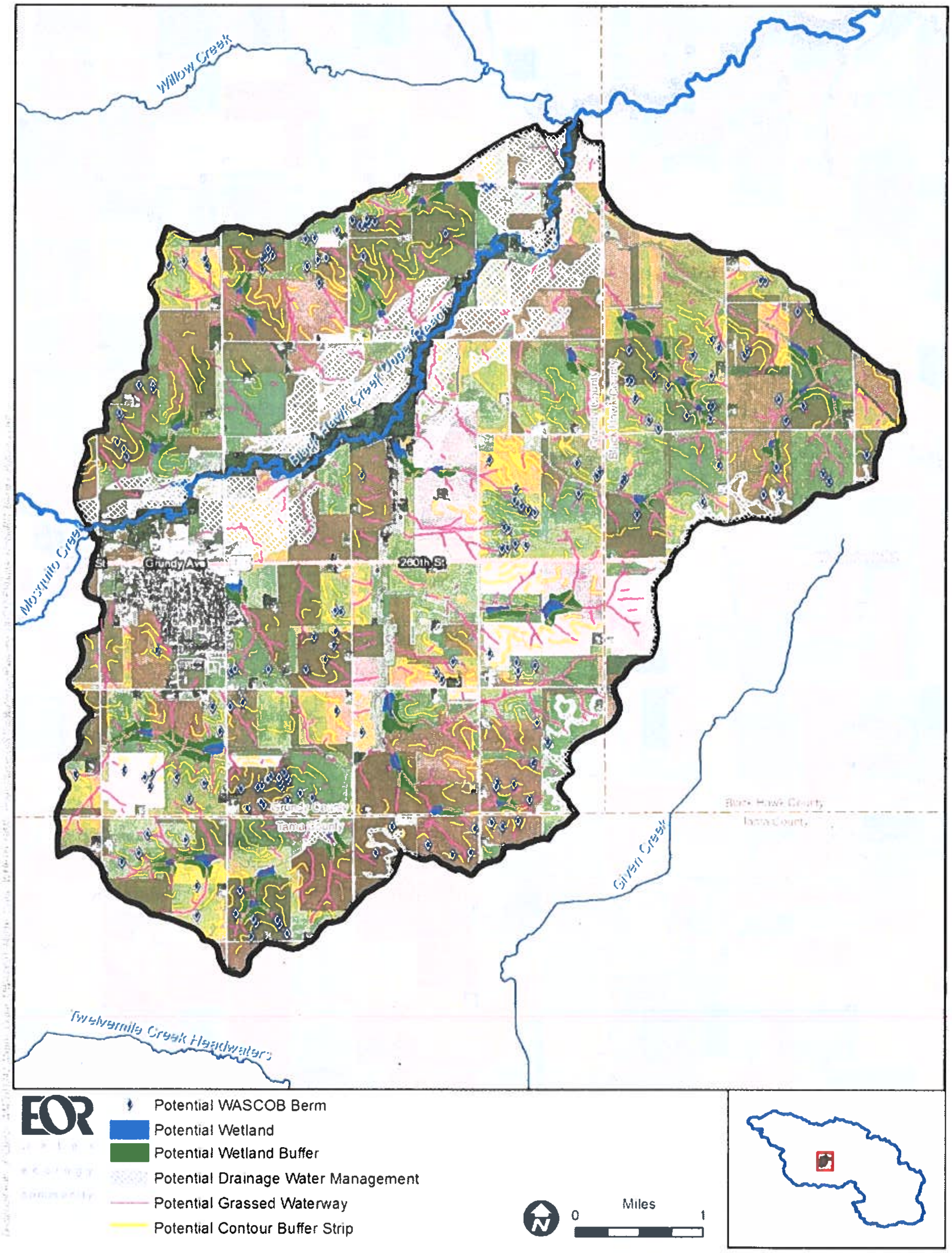


Figure 9. Potential Conservation Practices in the Village of Reinbeck – Black Hawk Creek Subwatershed

discharged water, or (b) reducing total water discharge along with the associated bacterial load. In some cases, multiple BMPs, including pre-treatment, may be necessary to achieve significant reductions in bacteria concentrations. Additionally, many BMPs are designed to reduce the loading of several pollutants at the same time.

Prior to evaluating BMP performance or selecting BMP strategies to target bacteria, it is important to understand basic fate and transport mechanisms as well as treatment processes anticipated to be effective for removing or inactivating bacteria. Inactivating bacteria refers to a natural process in which bacteria die-off or fail to reproduce due to existing environmental factors such as pH. Bacteria can thus be controlled without being removed. However, bacteria population can also increase without further bacteria loading if environmental conditions are conducive to population growth within the conveyance or receiving waters.

Properly designed BMPs that reduce the total volume of agricultural or urban runoff (e.g., infiltration BMPs) to receiving waters can effectively reduce the bacteria load by an amount equivalent to that contained in the reduced volume. They may also reduce the frequency of bacterial discharges to receiving waters if volume reductions are sufficient to retain runoff from most events.

BMPs that filter and/or reduce the rate or frequency of runoff (e.g., filtration or other BMPs that do not reduce volumes but do provide treatment) may reduce bacteria concentrations in this runoff and thereby reduce loading to receiving waters. Filtration and similar BMPs should, however, be carefully planned and investigated before implementation as they are sometimes ineffective and may even result in increased bacteria concentrations in discharges.

Overall, data on BMP effectiveness is limited and, with the exception of properly designed infiltration BMPs, broadly applicable conclusions cannot be drawn. Additional studies are needed for all BMP types to increase the confidence of performance estimates with regard to bacteria.

The strategies described above provide a general outline and description for the first steps of reducing bacterial loads through source controls. However, there are inherent differences in how to reduce bacteria loadings from urban as opposed to rural subwatersheds. The Middle Cedar Watershed Management Plan provides more detailed explanations of source controls and BMPs that are applicable more specifically to urban and rural areas. The measures and BMPs described in the Middle Cedar Watershed Management Plan are not the only available methods for reducing bacteria, but are the actions most recommended and applicable to the Middle Cedar Watershed.

6.4. Recommended Conservation Practice Adoption Rates

A specific scenario for conservation practice implementation/adoption rates was developed for each of the sixty-eight subwatersheds of the Middle Cedar Watershed. The objective for the scenario was to meet the nutrient reduction targets established in the Iowa Nutrient Reduction Strategy for non-point sources of 41% reduction in nitrogen and 29% reduction for phosphorus for each subwatershed. The recommended scenario for the Village of Reinbeck - Black Hawk Creek Subwatershed is shown in Table 10. The table indicates the recommended adoption rate of each practice with the corresponding acreage or quantity, and the percentage of the subwatershed 'treated' by that practice. The table also includes the estimated subwatershed nutrient load reduction provided as a result of the recommended adoption rate of each specific practice. The conservation

6.5. Flood Benefits

To demonstrate the flood damage reduction benefits achieved through implementing the recommended suite of conservation practices throughout the Middle Cedar Watershed, a series of flood damage reduction reporting locations were established. The objective in developing this network of locations was to decentralize the evaluation. The traditional approach for demonstrating flood damage reduction benefits is to look at the downstream-most area within the watershed or at a few key locations in the watershed that experience the largest impacts due to flooding. The approach developed for the Middle Cedar Plan is to look at several locations throughout the watershed including upper portions of headwaters subwatersheds as well as main-stem Cedar River sites.

The flood damage reduction reporting location for the Village of Reinbeck-Black Hawk Subwatershed is located at the stream crossing at T65/W Avenue north of the City of Reinbeck.

Selection of the flood damage reduction reporting locations was based on the following:

- Areas within the watershed identified as having high or very high flood risk according to the Risk MAP for the Middle Cedar Watershed (FEMA 2015) and were associated with easily recognizable locations (Cities, road intersection).
- Stream segments that were explicitly included in the GHOST Hydrologic and Hydraulic Model (IIHR 2018) and where both stream flow data and stage/elevation data were available.
- Sites on tributaries near the Cedar River were located far enough upstream to avoid the impact of Cedar River flooding on the flow and/or stage of the given tributary.

The flood damage reduction benefits associated with BMP implementation were estimated using results from modeling that was performed as part of the Iowa Flood Center / IIHR's Middle Cedar Watershed Hydrologic Assessment. As a continuous simulation was used for these model runs – in part because design storm simulations lose their meaningfulness at such a large scale – for each location a specific simulated flood event was chosen for analysis. The events were chosen to be as close to the 10-year recurrence interval (return period) as possible for several reasons: first, the most significant flood events (e.g. floods with magnitudes equal to or above the 100-year recurrence interval) may not be significantly impacted by the types of controls that the proposed BMPs provide; second, minor flood events (e.g. floods with magnitudes equal to or below the 5-year recurrence interval) are perhaps not significant enough in terms of damages to be meaningful for reporting risks and/or benefits. Conversely, the ~10-year recurrence interval flood is both large enough to have significant flood damages and small enough to show significant flood damage reductions resulting from BMP implementation, and as such provides a convenient metric that will be meaningful to stakeholders.

The flood event used for the Village of Reinbeck-Black Hawk Creek Subwatershed was 08/28/2015.

By implementing the recommended conservation practices, the flood benefits that would have been achieved during this particular flood event is $360,000 in reduced losses and a 0.2 foot flood stage reduction. Therefore, it is inferred that this reduction in losses would be achieved if an event similar to this one were to happen in the future, assuming all recommended conservation practices were implemented. Maintaining the assumption of full implementation, it is also estimated that the subwatershed would see annual reduced flood losses of $130,000 if annual flood events conform to predicted patterns.

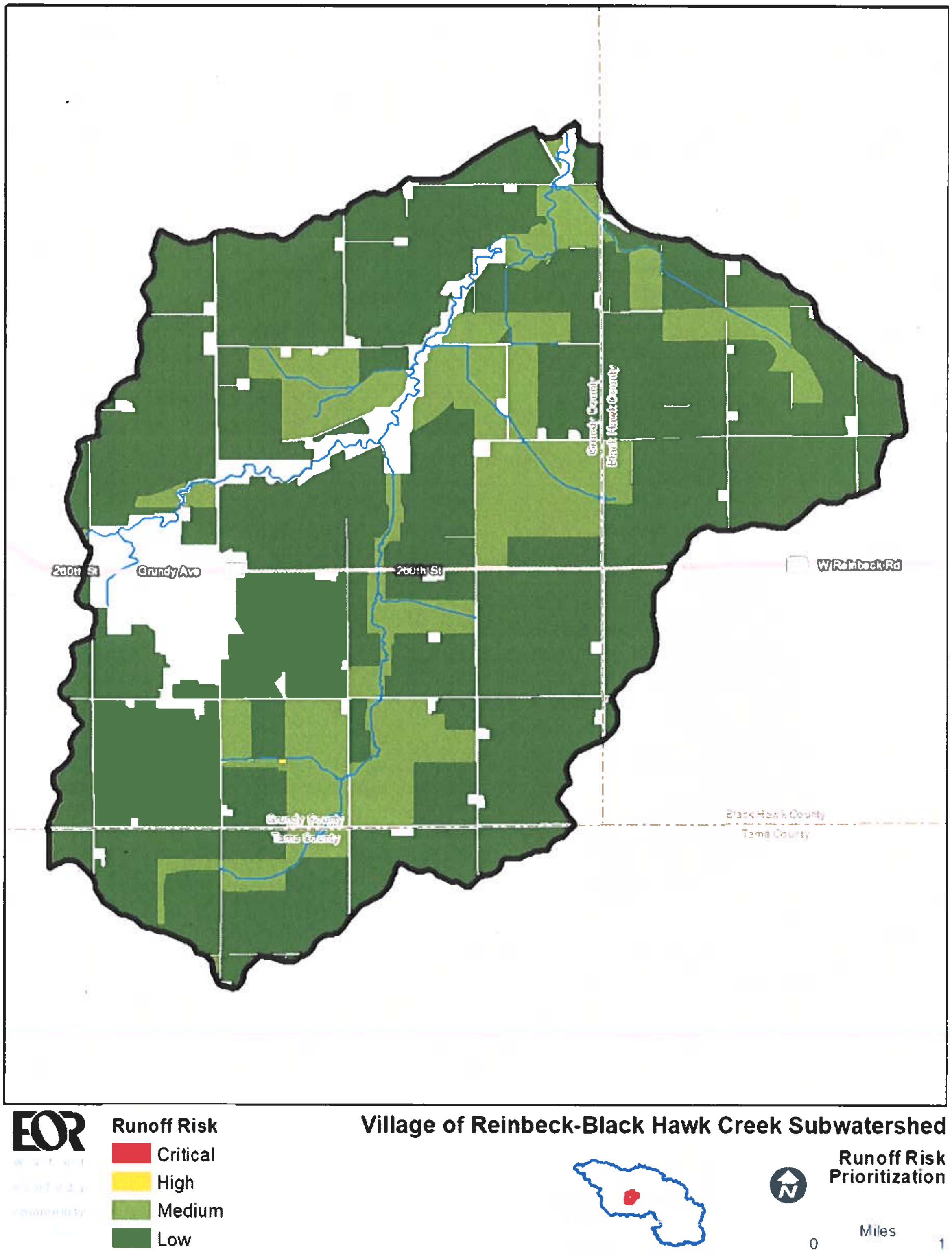


Figure 10: Runoff Risk for Village of Reinbeck-Black Hawk Creek Subwatershed

Four maps are provided as a guide for implementation within the Village of Reinbeck-Black Hawk Creek Subwatershed. Each map contains information for the prioritization of different conservation practices. These maps are located in Appendix A. The implementation process for this subwatershed should utilize these maps and tables as a guide for conservation practice prioritization.

Map #1 includes practices with a specified location, but no rank. These include drainage water management practices (in-field), denitrifying bioreactors (edge of field), and saturated buffers (riparian area management). These practices do not have a specific criteria that would provide a helpful guide for implementation. However, the CSR map may serve as a first step for assessing implementation potential of the practices. The locations suitable for implementing each of these practices, as determined by the ACPF analysis are shown in this map.

Map #2 includes practices with a specified location that have been ranked individually using different parameters. These practices include grassed waterways (in-field), nutrient removal wetlands (edge of field), and riparian buffers (riparian area management).

Grassed waterways are beneficial in locations where gullies are most likely to form in streams. Moore's Stream Power Index (SPI) is applied to these practices to determine ideal locations for implementation. The SPI determines which locations for these practices have the highest stream power, therefore determining areas where gullies are more likely to form. Therefore, the grassed waterways in locations with the highest relative SPI were ranked in highest priority. All grass waterways shown in red should be prioritized for implementation.

Riparian buffers are ranked based on the relative runoff risk associated with the area draining to each practice. Riparian buffers located in areas of relatively high runoff risk should be prioritized over those in areas with a smaller runoff risk.

The N*utrient Removal Wetlands* are ranked based on the CSR because of the large cost and amount of land associated with wetlands. These wetlands are labeled based on CSR mean, starting with the lowest CSR mean at #1. The ranked wetlands are listed in Table 11.

Table 11: Nutrient Removal Wetland Rankings for Village of Reinbeck-Black Hawk Creek Subwatershed

Rank	Mean CSR	Basin Size (HA)	Drainage Area (HA)	Rank	Mean CSR	Basin Size (HA)	Drainage Area (HA)
1	57.72	4.78	83.73	20	80.35	4.84	159.96
2	72.20	7.47	158.78	21	80.63	6.82	323.39
3	73.54	15.20	300.38	22	80.67	5.39	88.49
4	73.55	4.69	78.42	23	80.72	2.51	64.33
5	73.61	3.61	69.94	24	81.26	8.22	162.06
6	73.91	4.59	102.21	25	82.19	3.25	60.03
7	74.95	10.73	200.73	26	83.87	7.27	139.67
8	75.91	2.82	126.39	27	83.90	7.22	246.70
9	76.24	10.64	342.63	28	84.43	3.96	66.29
10	76.38	4.36	136.16	29	84.51	4.12	139.53
11	76.42	6.93	202.71	30	85.20	3.16	98.47
12	76.65	3.56	169.96	31	86.44	5.58	169.32
13	77.45	5.63	241.52	32	87.82	4.09	124.90

Map #3 includes practices ranked based on the relative slope steepness within the subwatershed. These include contour buffer strips (in-field) and terraces (in-field). Their implementation is prioritized based on slope steepness rather than runoff risk because such practices are found all across the landscape and not just adjacent to streams. Both contour buffer strips and terraces reduce sheet and rill erosion, which is why they are most valuable on steeper slopes. Therefore, these practices should be prioritized in locations where slopes are steepest in relation to the subwatershed's landscape.

Map #4 prioritizes practices based on runoff risk. These practices include all the soil health practices (cover crops, extended rotations, nitrogen management, and phosphorus management), no-till (in-field), perennial cover (edge of field), and WASCOBs (edge of field). All of these practices are recommended across the watershed and are very valuable in reducing the pollutant loads in runoff. Therefore, land with a relatively higher runoff risk should be prioritized for these practices.

8. EVALUATION AND MONITORING

Refer to the Middle Cedar Watershed Management Plan for detailed recommendations for monitoring in the watershed. The Iowa Soybean Association (ISA), in cooperation with the City of Cedar Rapids, currently conducts snapshot water quality monitoring in the the Village of Reinbeck – Black Hawk Creek Subwatershed (refer to Section 3.7.1). This monitoring provides vital information that can be used to detect trends in water quality and help prioritize conservation effort. The ISA monitoring should be continued into the future as a minimum level of water quality monitoring.

Potential expansion of water quality monitoring in the Village of Reinbeck - Black Hawk Creek Subwatershed could include the following:

- Increase the number of samples that are taken throughout the year, targeting a wide range of flow conditions.
- Measure stream flow using either a continuous flow logger or develop a rating curve to be used with stream stage measurements.
- Conduct *E. coli* / bacteria monitoring per Iowa water quality assessment guidelines.
- Add Total Phosphorus to the monitored parameters or develop a relationship between Dissolved Reactive Phosphorus and Total Phosphorus to be used as a reference point.

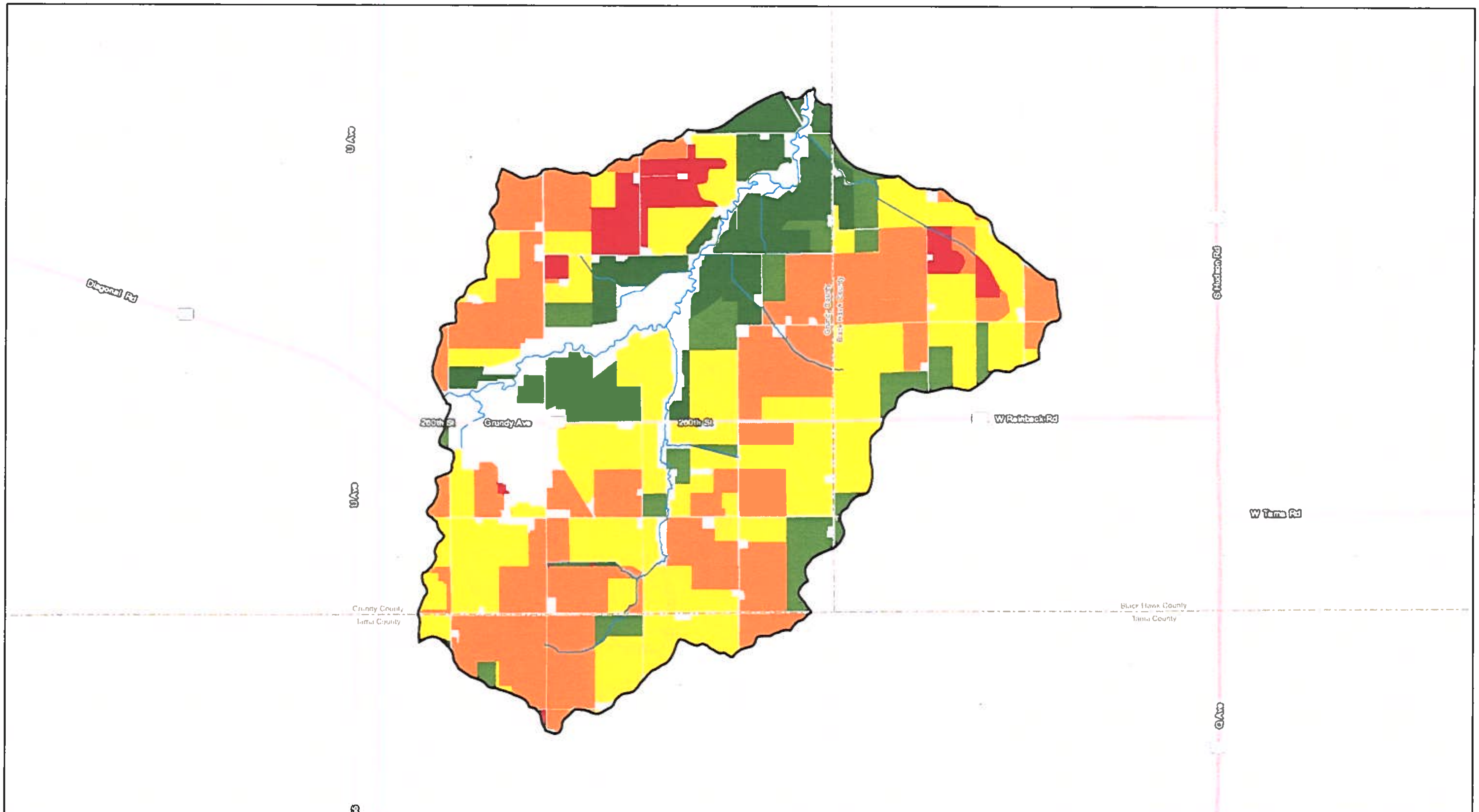
In addition to conducting water quality monitoring, there are other other tools that can be used to evaluate the effectiveness of watershed management efforts. The Iowa Nutrient Management Strategy developed an approach described as the Logic Model for developing measurable indicators of desirable change. The model consist of four main areas of indicators.

- **Inputs**: people, funding, agency resources, and private sector resources.
- **Human**: partner organizations, partner agribusinesses, farmer knowledge and attitude, and point source communities and management knowledge and attitude.
- **Land**: land use changes, practice adoption, and point source implementation.
- **Water**: calculated load reduction, measured loads in priority watersheds, organized watershed reported load changes, and measured loads at existing monitoring stations.

Data collected by the Iowa Soybean Association monitoring program, if expanded as described above, can be used to develop the indicators in the Water category.

Refer to the Middle Cedar Watershed Management Plan for further details on recommended methodologies for evaluating progress being made in achieving the goals developed in this subwatershed management plan.

APPENDIX A. APPENDIX A CONSERVATION PRACTICE PRIORITIZATION MAPS



Prioritization of Conservation Practices:
Contour Buffer Strips and Terraces

Slope Steepness

- Low
- Medium
- High

Village of Reinbeck-Black Hawk Creek Subwatershed

Conservation Practice Prioritization

Map #3

Miles

0 1 2