Prairie City
Source Water Protection Plan

Prepared By:

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Background and Purpose

The term "Source Water" is used to define drinking water in its original environment, either as surface water (rivers, streams, reservoirs, lakes) or as groundwater (aquifers), before being withdrawn, treated, and distributed by a water system. Source Water Protection (SWP) is the act of preventing contaminants from entering public drinking water sources.

The quality of the source water can be influenced by both natural and human activities. The concept of SWP is to manage the areas through which water travels and the activities that occur on the land, in order to protect the quality of the resource. These protection efforts save the community money through improved water quality requiring less treatment, longer life cycle for a well, and less likelihood of having to seek an alternate source or replace the well due to contamination.

There are a total of seven steps listed as keys to source water protection in Iowa. All seven of these steps are essential and required for a proper Source Water Protection Plan. Following are the seven steps of a plan:

Step 1: Organize a source water team
Step 2: Identify your source water areas
Step 3: Inventory well and contaminant sources
Step 4: Assess and rank contaminant sources
Step 5: Develop an action plan
Step 6: Construct or update your emergency response plan
Step 7: Submit and Implement your SWP Plan

Once this plan is completed and implemented it is encouraged that the plan is reviewed and revised on a regular basis. Protecting a community's water source is a continual process and the plan should reflect that.

Public Water Supply Information

The Prairie City public water supply serves approximately 1688 customers and averages approximately 138,000 gallons/day consumption of water. Water is derived from two wells that derive their water from an alluvial aquifer in the South Skunk River valley next to the city of Colfax. Well #1 is approximately 54 feet deep and was drilled in 1991, and well #2R is approximately 48 feet deep and was drilled in 2005.

Treatment consists of induced draft aeration followed by 12,000-gallon detention atop gravity filtration with a 4-compartment gravity sand filter; transfer pump station to one zeolite softener; 2 anionic exchangers for nitrate removal. Public water supply information was obtained from the most recent Sanitary Survey conducted by Iowa DNR field staff.

Figure 1: Prairie City Wells Map

Table 1: Prairie City Well Information

W#	Local Name	Depth (ft.)	Const. date	Status	Aquifer	SWL (ft.)	PWL (ft.)	Aquifer thickness (ft.)	Rate (gpm)
41606	1	54	1/1/1991	Active	Alluvial	17	23	40	338
60881	2R	48	9/28/2005	Active	Alluvial	8	20	40	442

Water Quality

The primary water quality concern for Prairie City water supply is nitrates. Based on our records, finished water at Prairie City has a ten-year average nitrate-N concentration of 4.4 parts per million (ppm), based on 133 total samples. While this is well below the Federal maximum contaminant level of 10 ppm it is still recommended that the community work to address this issue so it does not become a problem in the future.

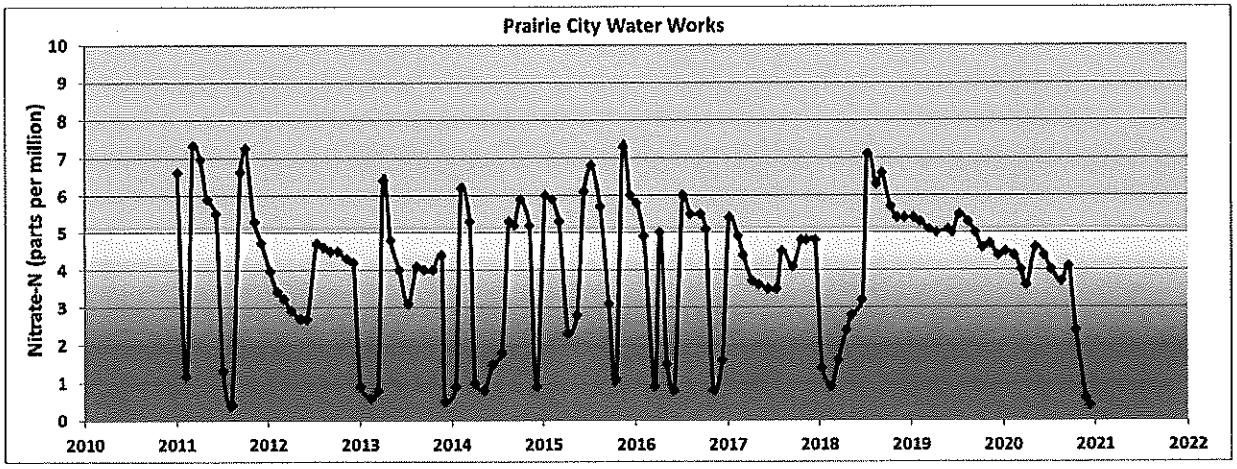

Figure 2: Prairie City Nitrate-N Data Graph

Source Water Team

A motivated and knowledgeable source water team is essential to get the ball rolling on protecting your drinking water. The source water team will guide the development of the plan, and decide which areas should be the most important and addressed accordingly. Most decisions, consequences, funding, and work will happen at the local level and require substantial input from community leaders, landowners, and activists.

Table 2: Source Water Protection Team Information

Name	Affiliation
Chad Alleger	Mayor (Prairie City)
Diane Taylor	City Administrator (Prairie City)
Carl Vandercamp	Public Works (Prairie City)
Ryan Martin	Public Works (Prairie City)
Jake Nolin	Public Works (Prairie City)
Joe Oglesby	Public Works (Prairie City)
Kyle Ament	Iowa DNR
Matthew Dvorak	Iowa DNR

Source Water Area

Without a proper understanding of the area your drinking water comes from, there is little you can do to protect it. In Iowa there are numerous types of surface and groundwater sources available to communities, and each can change with different pumping rates and geologic/surficial conditions. Identifying your source water capture zone area is the most technical of all the source water protection steps, and usually will require a groundwater professional and/or hydrologist to complete. Fortunately, in Iowa most community water systems have already had the source water area defined free of charge by the Iowa SWP Program.

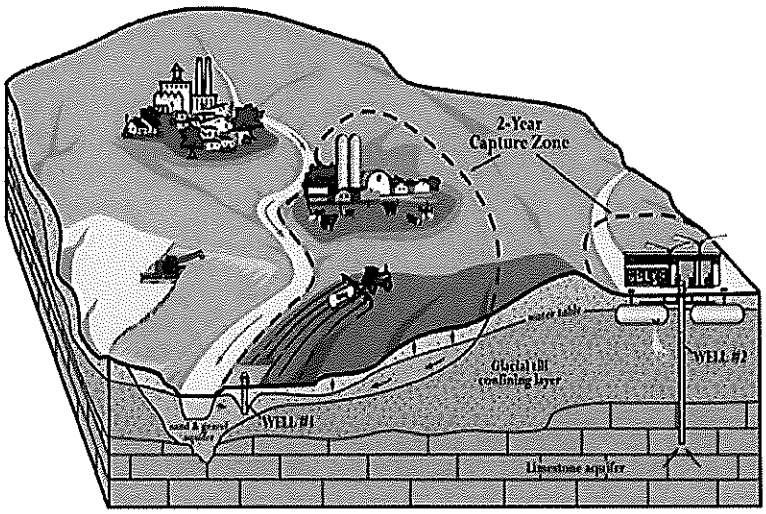

Figure 3: Diagram of two different source water aquifers and associated surface areas (2-year capture zone) from two wells.

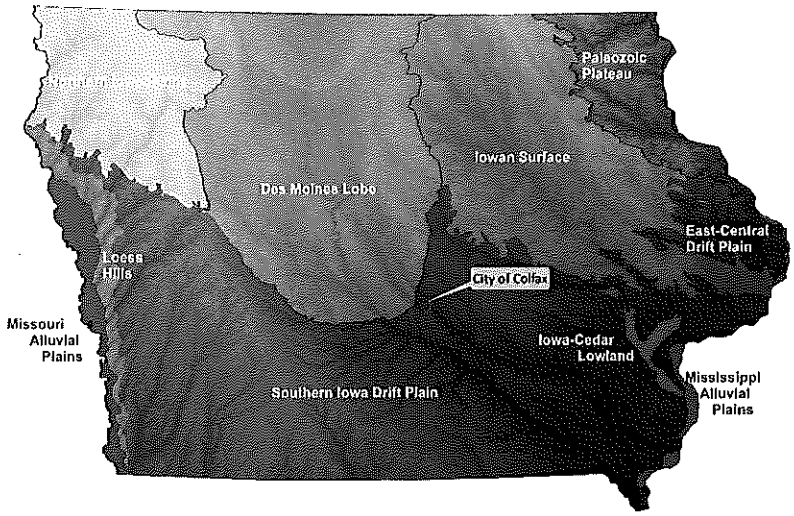

Figure 4: Landforms of Iowa. (modified from Prior, 1991)

Surficial Geology

The Prairie City drinking water wells, located outside the city of Colfax, are in the Southern Iowa Drift Plain, the largest of the landforms in Iowa. There is a layer of glacial drift covering bedrock over much of this surface. However, the age of this surface has allowed greater time for erosion to shape it, leading to rolling hills which slope towards rivers and streams with a well-connected drainage network.

Aquifer

Prairie City gets its water from the alluvial aquifer associated with the South Skunk River. Alluvium is material that is deposited by rivers throughout a river valley. Over the course of time, and under the right conditions, rivers can deposit thick layers of sand and gravel throughout their river valley which make for a productive and dependable source of groundwater. Alluvial aquifers are an important source of water across the entire state of Iowa, but their lateral extent is restricted to river valleys.

Alluvial aquifers are also known as surficial aquifers as these are unconfined aquifers that have no impermeable material between the surface and the aquifer. Groundwater and surface water interactions are closely tied in alluvial settings, and these aquifers are highly susceptible to contaminants at or near the surface.

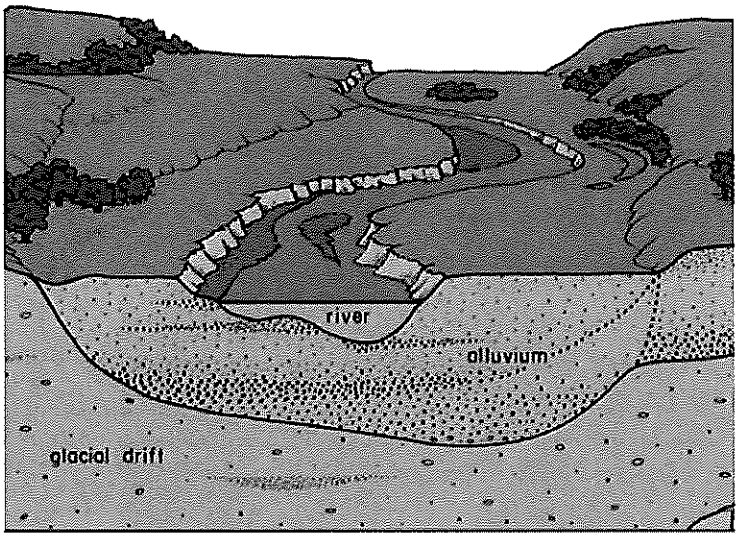

Figure 5: Cross section of a typical alluvial plain and aquifer. (Iowa's Groundwater Basics, 2003)

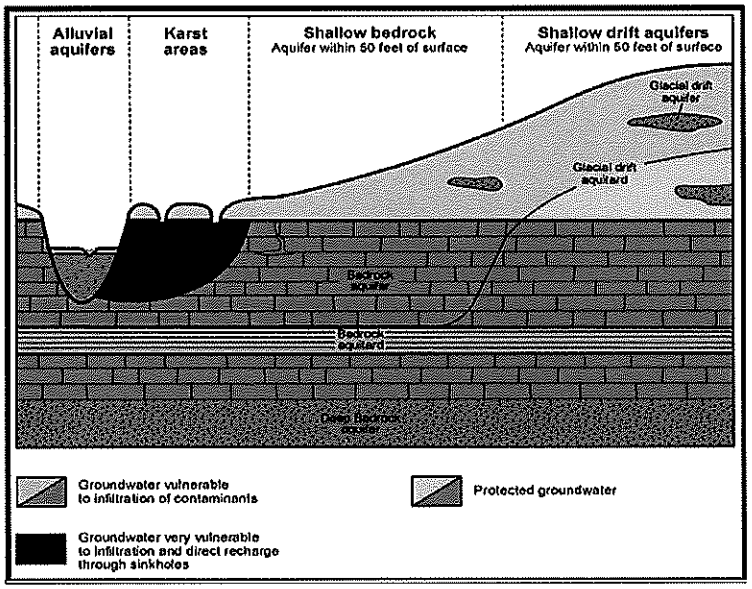

Figure 6: Diagram demonstrating aquifer susceptibility to contamination. (Iowa's Groundwater Basics, 2003)

Susceptibility to Contamination

The determination of susceptibility recognizes that certain aquifers are better protected than others. Research has shown that the thickness of subsurface layers that impede the movement of water, such as clay, till, or shale, can be used to estimate the probability of contaminants entering the aquifer. For this reason, the source water program has designated four categories of susceptibility based on the cumulative confining layer thickness above the aquifer.

Confining layer thickness	Susceptibility designation
<25 feet	Highly susceptible
25 to 50 feet	Susceptible
50 to 100 feet	Slightly susceptible
>100 feet	Low susceptibility

The data shows the alluvial aquifer associated with the South Skunk River that Prairie City gets its water from has less than 25 feet of confining layer making it highly susceptible to contamination from the surface.

Capture Zone Delineation

Sufficient information was available concerning the wells, aquifer and pumping conditions to produce a computer modeled estimate of the source water area. Visual MOFLOW Flex 7.0 was utilized to model the capture zones. For the water supply, the source area was divided and prioritized to show where we estimate groundwater to flow during "time of travel" periods; typically 2, 5, and 10-years. For additional information on the modeled capture zone please contact Matthew Dvorak with the Iowa DNR Source Water Protection Program (matthew.dvorak@dnr.iowa.gov; 515-725-8468)

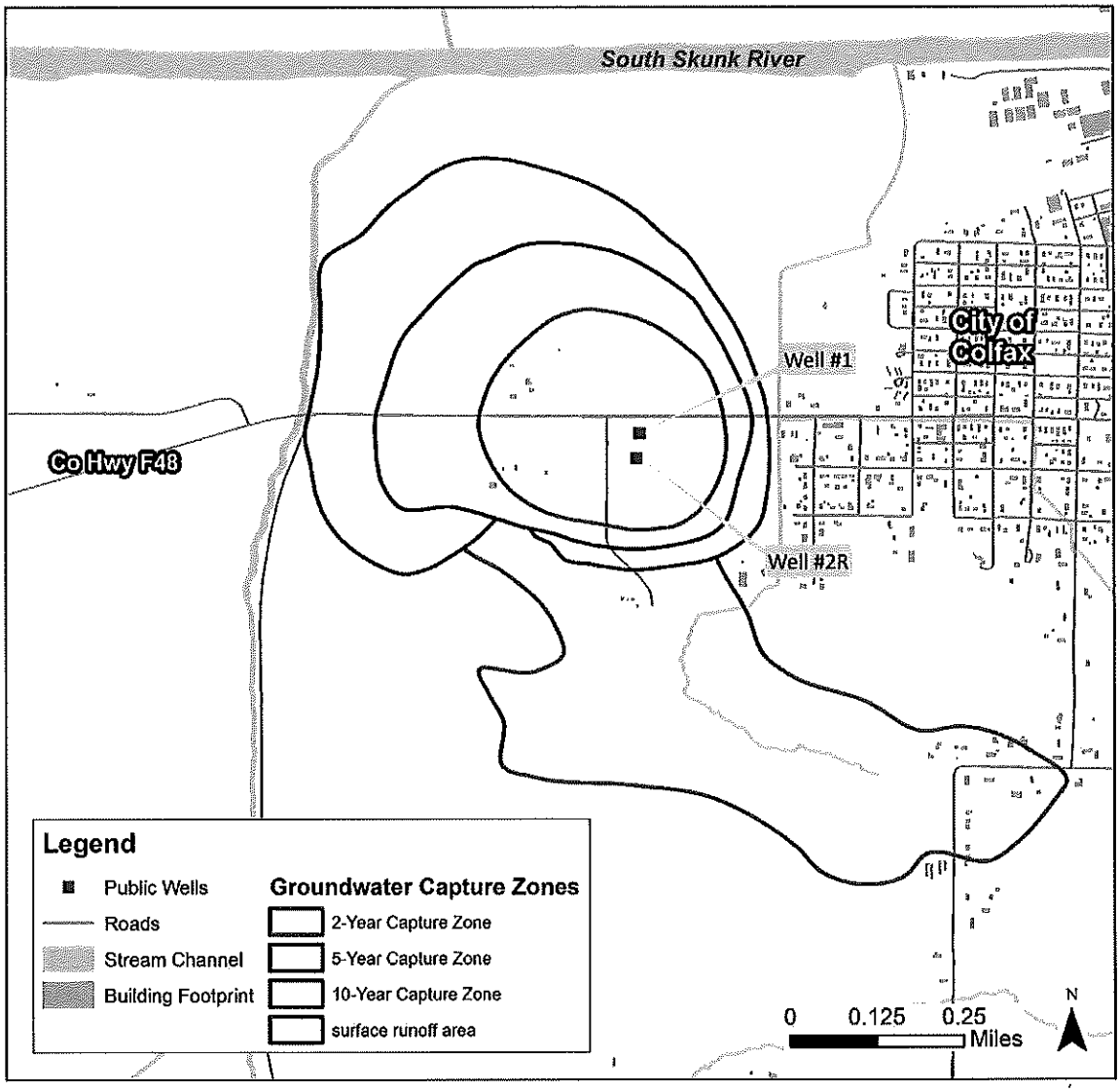

Figure 7: Modeled Capture Zones

Well and Contaminant Source Inventory

All potential contaminant sources and conduits, such as improperly abandoned wells, need to be thoroughly tracked and inventoried for a successful Source Water Protection (SWP) Plan. Having an accurate and thorough potential contaminant source list is the foundation for better source water protection. Most potential drinking water contaminants are associated with activities or objects that contain a chemical, or a mix of chemicals, that can be harmful to ingest. These sources include both point (i.e. gas tanks) and nonpoint (i.e. row-crop) inputs. The map number in the table corresponds to the number on the contaminant source inventory map.

Table 3: Potential Contaminant Source Inventory

Map No.	Site Name	Site Type	Site Address
Capture zone: 2-year time of travel			
1	Private Septic System	Septic System	11310 Hwy F48 W Colfax, IA 50054
2	Private Septic System	Septic System	11289 Hwy F48 W Colfax, IA 50054

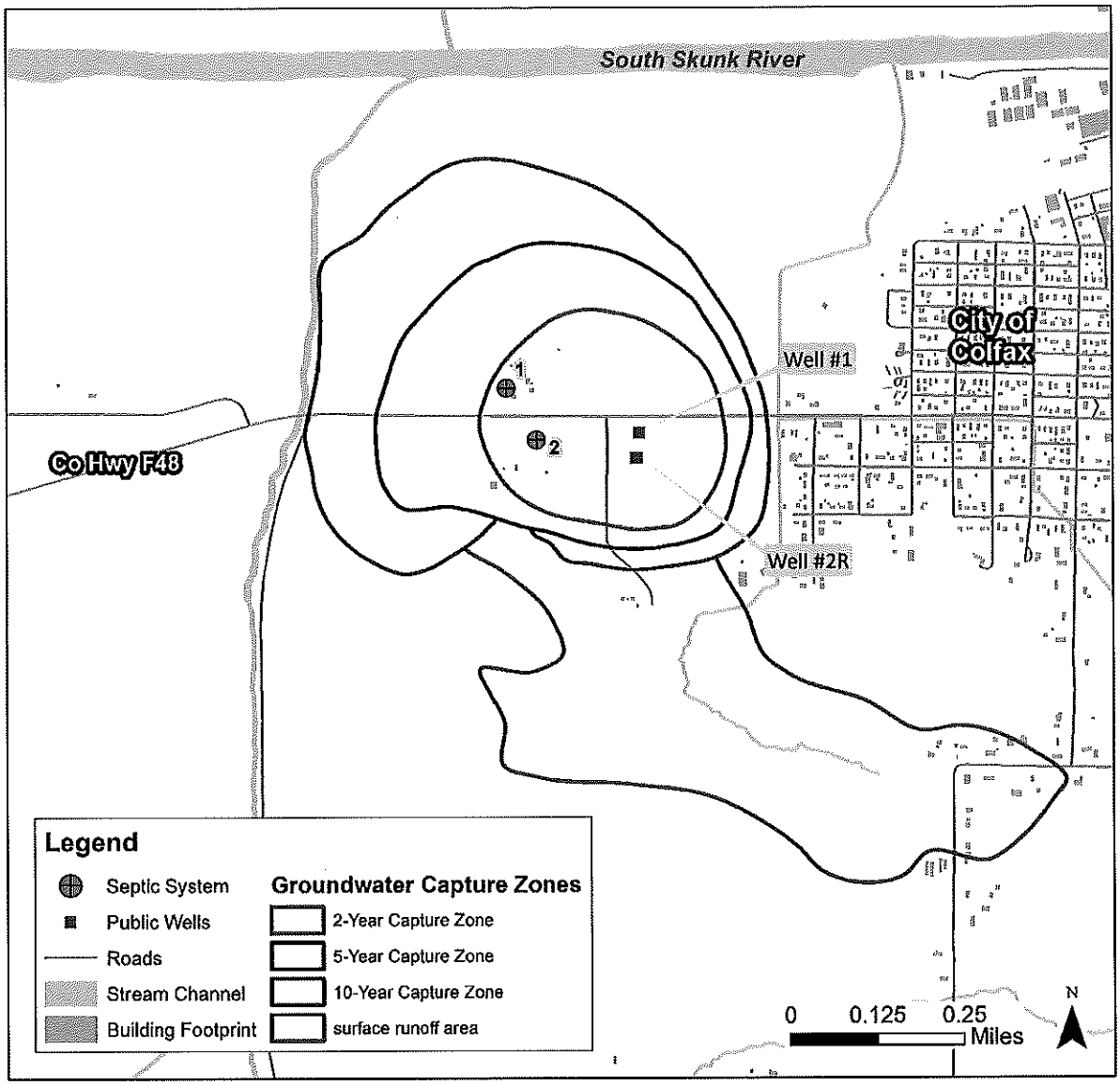

Figure 8: Modeled Capture Zones

Non-community Well Inventory

Improperly maintained or abandoned wells are a concern as they act as a direct conduit for contaminants to reach the aquifer. Three of the wells on this list were identified as improperly abandoned and needing closed during the planning process. The map number in the table corresponds to the corresponding number on the map.

Table 4: Non-Community Well Inventory

Map No.	Well Owner	Well ID Source	Depth (ft.)	Date Drilled/ permitted
Capture zone: 2-year time of travel				
1	Prairie City (monitoring well)	SWP Team	Ukn	Ukn
2	Prairie City (monitoring well)	SWP Team	Ukn	Ukn
Capture zone: surface runoff area				
3	Colfax Golf Course	Private well tracking system	95	4/16/2008

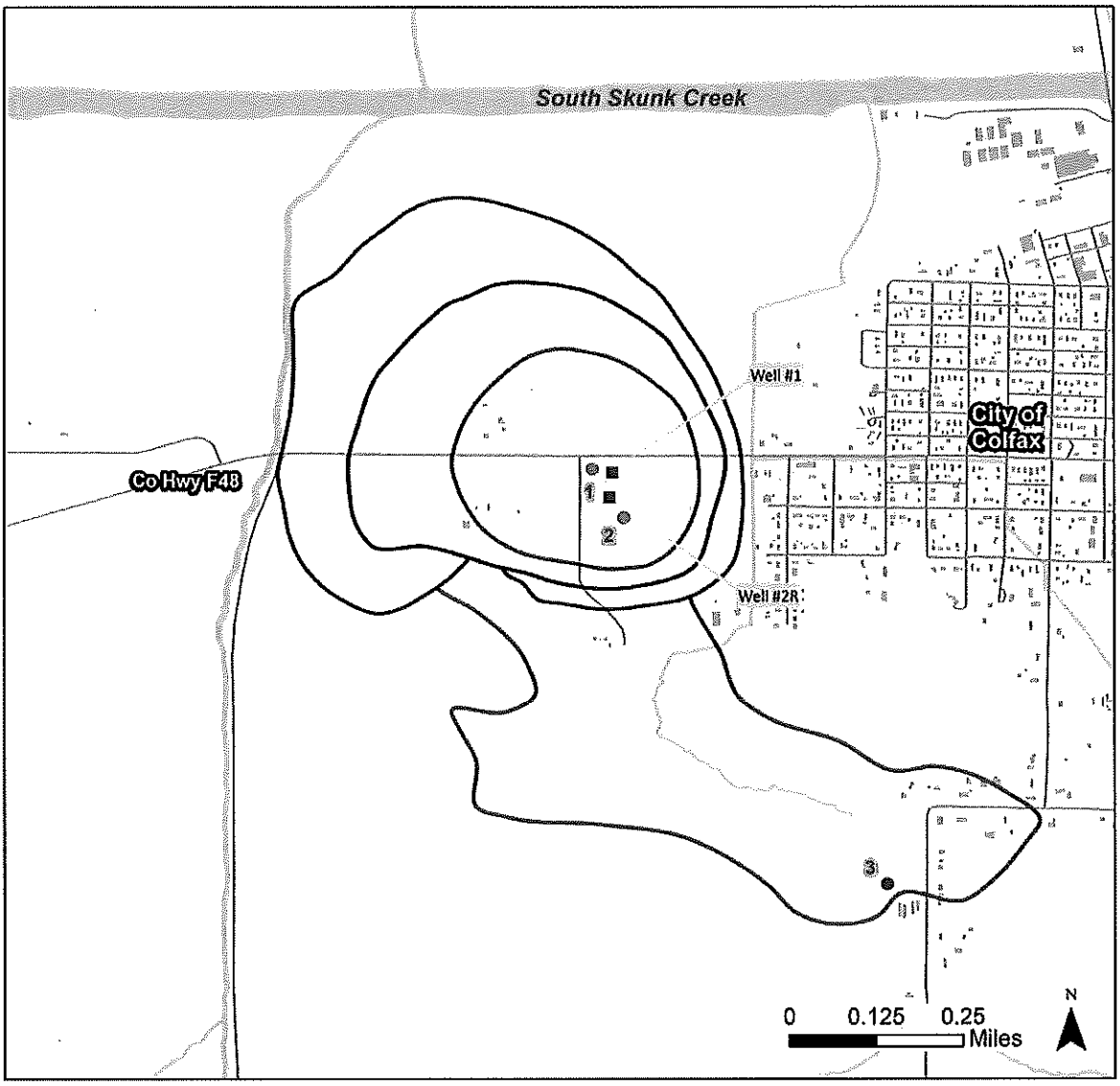

Figure 9: Non-community Well Map

Land Use

Most groundwater originates as infiltration from the land surface from rainfall. Because of this land use can have a major impact on both ground water quality and quantity. Different land use types can introduce potential contaminants that may be applied to the land like pesticides, herbicides, and fertilizers, or through infrastructure like leaking storm or sanitary sewers. Land use can also affect quantity by limiting recharge from impermeable surfaces like roads and parking lots. For this reason it is important to consider the different land use types in the source water protection area and what impact it may have on the aquifer.

Table 5: Summary of land cover types (2020) by percentage of total

Capture zone	Row Crop	Alfalfa	Grassland	Wetlands	Developed Areas	Forested Areas	Total Acres
2-year	59.8	4.0	24.9	0.8	8.8	1.6	55
5-year	65.5	2.8	24.9	1.1	3.6	2.1	63
10-year	79.2	3.2	12.0	0.0	2.7	2.9	83
surface runoff area	27.0	1.2	32.2	0.3	18.9	20.3	129

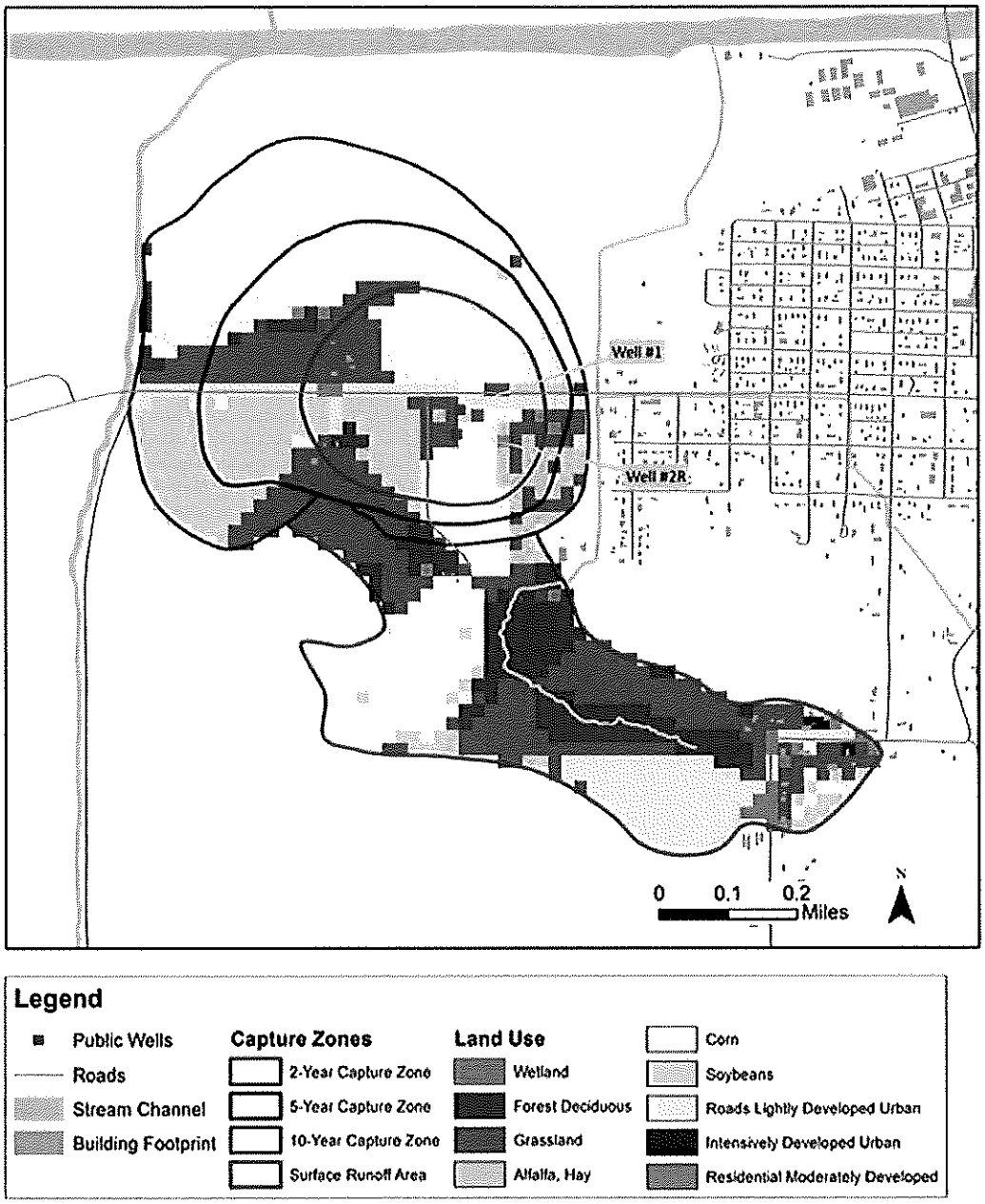

Figure 10: Land Use Map

Contaminant Source Inventory Rank

Once all the wells, land use types, and potential contaminant sources in your source water area are identified and inventoried, the next step is to estimate the risks posed to your water supply from each

source. A systematic evaluation of the relative risk of contamination from each source identified in the inventory will allow the team to determine which potential threats are greatest and which source water implementation efforts should be considered first. A good risk assessment is the best basis for setting priorities to manage your source water area and protect your water supply.

For ranking purposes each contaminant source was assigned a general classification of low, medium, or high. High indicates a contaminant source that poses an immediate risk to water quality in the aquifer, medium indicates a moderate risk that may require some preventative measures to ensure they don't pose a greater risk in the future, and low indicates no current risk.

Table 6: Point Source Priority Ranking

Map No.	Site Name	Site Type	Description	Priority
Capture zone: 2-year time of travel				
1	Private Septic System	Septic System	Active septic system at 11310 Hwy F48 W Colfax, IA 50054	High
2	Private Septic System	Septic System	Active septic system at 11289 Hwy F48 W Colfax, IA 50054	High

Table 7: Non Community Wells Priority Ranking

Map No.	Well Owner	Priority
Capture zone: 2-year time of travel		
1	Prairie City (monitoring well)	High
2	Prairie City (monitoring well)	High
Capture zone: surface runoff area		
3	Colfax Mineral Springs Co	Low

High Priority Land Use

Row Crop Agriculture

Row crop agriculture is a major contributor of nitrates in groundwater (source), particularly in shallow aquifer systems like the alluvial aquifer that the Prairie City draws its drinking water from. In addition to nitrates agricultural chemicals like pesticides and herbicides can also pose a risk to a drinking water source.

Developed Land Use

Developed land use like residential and commercial districts presents many potential contaminant sources that could contaminate a shallow aquifer. Fertilizers and chemicals used on lawns, chemicals stored on the property, and leaking sewer lines can all be potential contaminant sources that could pollute an aquifer.

Action Plan

Activity	Target Completion Date	Responsible Party	Comments
Planning and Maintenance			
SWP Initial Meeting	November 2021	SWP Team	
SWP Follow Up Meeting	April 2022	SWP Team	
Annual SWP Review Meeting	Annually beginning in 2023	SWP Team	Annual review to address any address any new concerns and update the plan accordingly
Implement recommendations from current and future sanitary surveys	Ongoing	SWP Team	
Action Items			
Isotope Sampling	January 2022	Prairie City	Analyzing the nitrogen isotopes of nitrates in the well will allow for a better determination of the source of the nitrates.
Well closures	December 2023	Prairie City	Multiple wells were identified during the planning phase that are abandoned and should be closed.
Implement Recommended Agricultural BMP's	December 2023	Iowa DNR, NRCS, Prairie City	Work with landowners to implement BMP's that will reduce the amount of nitrates leaching to groundwater from agricultural land use
Work with Septic Systems Owners on Maintenance	July 2023	Prairie City	Discuss the need for upkeep on septic system to ensure systems are not contaminating drinking water wells
Monitoring Plan	July 2023	Prairie City	Recommend a monthly raw water sampling plan from both wells.
Well maintenance	Ongoing	Prairie City	Maintain records and maintenance of water supply wells
Water Supply Expansion Sites	Ongoing	Prairie City	explore sites for possible expansion of water supply in the future
Talk to Colfax Country Club about Prairie City SWP area	October 2022	Iowa DNR	Talk to the Colfax Country Club about the potential impact of having a golf course in the SWP area of the Praire City drinking water wells.

Description of Action Plan Items

Isotope Sampling

Prairie City's most significant water quality issue is the presence of nitrates in its source water. Within the Prairie City source water protection area there are numerous potential sources of nitrates. In order to address the problem. To address the issue, any information that could point to the likely source of nitrates in the source water would be of great value.

Table 8 Nitrate concentration and stable Isotope values from Prairie City water supply wells

Well #	Nitrate Concentration (mg/L)	$\delta^{15}N$ (‰)	$\delta^{18}O$ (‰)
1	0.487	+16.2	+9.71
2R	5.31	+4.80	+2.66

One useful tool in tracing the source of nitrates in groundwater is an analysis of the stable isotopes of nitrate nitrogen and oxygen. Different sources of nitrates often have isotopically distinct signatures of nitrogen and oxygen which allows one to narrow the potential sources of nitrogen with isotopic analysis.

Prairie City sampled both wells for analysis of nitrate nitrogen and oxygen isotopes on January 24th, 2022 (*Appendix B*). Well #1 had $\delta^{15}N$ and $\delta^{18}O$ values of +16.2 ‰ and +9.71 ‰ respectively, and well #2R had $\delta^{15}N$ and $\delta^{18}O$ values of +4.80 ‰ and +2.66 ‰ respectively. While sampling for isotopes the city also sampled both wells for nitrate concentration. Nitrate measurements in well #1 and well #2R measures 0.487 mg/L and 5.31 mg/L.

There is a significant difference in nitrate concentration and nitrate isotope signatures. This

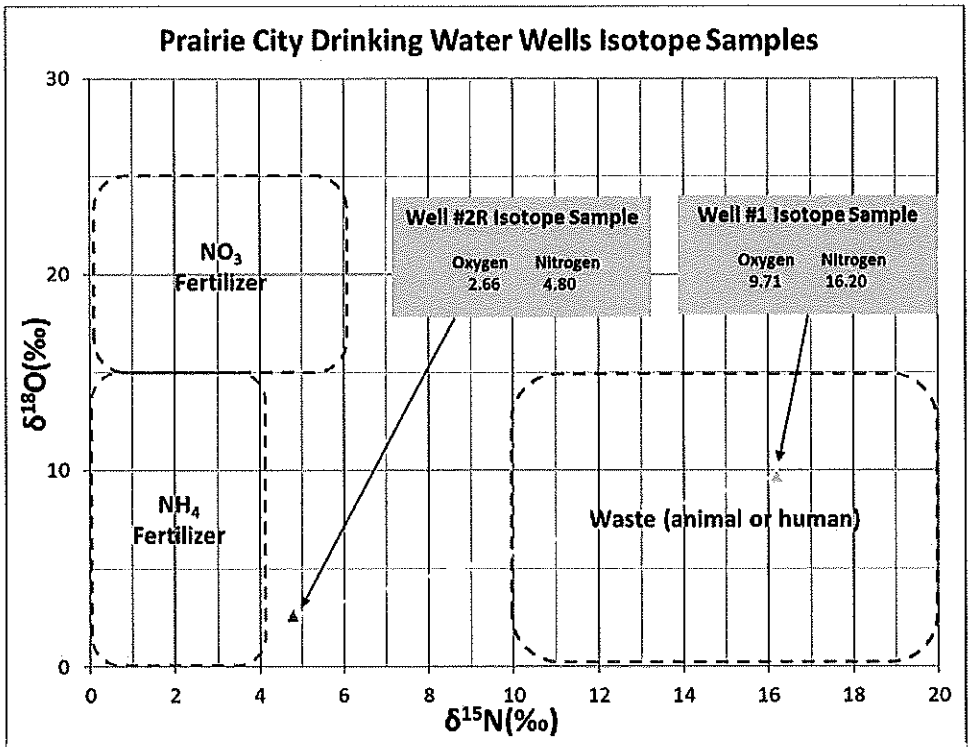

Figure 11: Isotope samples from Prairie City Drinking Water Wells and typical values from different sources of nitrates (Kendall and Aravena, 2000)

indicates that the wells are being affected by different sources of nitrates. The isotope signatures of nitrogen and oxygen for well #2R are consistent with nitrates from ammonium nitrate synthetic fertilizer. The isotope signatures for well #1 are consistent with animal or human waste. There are several potential sources of human or animal waste in the source water protection area. It could be from manure being land applied in the area. It could also be from the two septic systems in the two-year capture zone. It is also important to note that there is a much higher concentration of nitrates in well #2R than well #1. This indicates that ammonium nitrate synthetic fertilizer applied in the southern portion of the source water protection area is primary source of nitrates. Because there is only one set of samples a long-term monitoring plan of nitrate concentration in raw well water from both wells is suggested to determine if nitrate concentrations in well #2R are consistently higher than well #1.

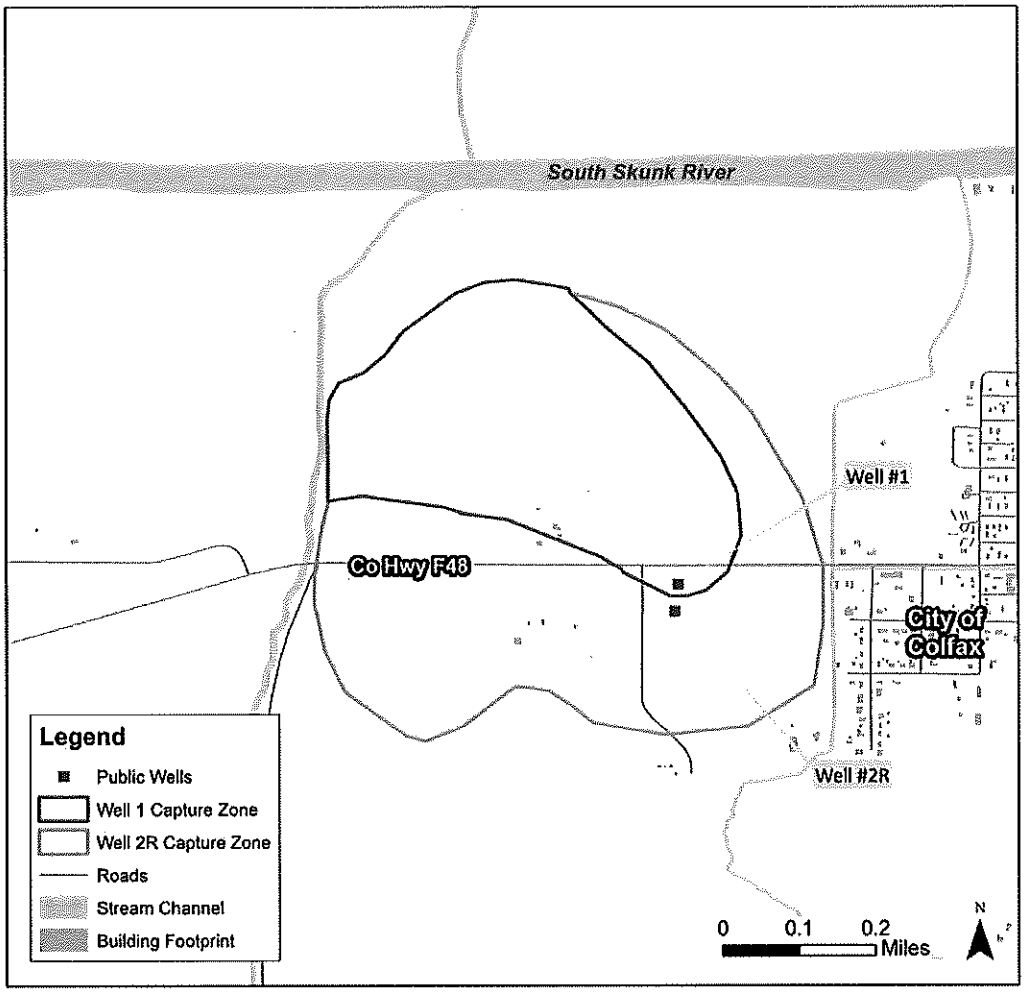

Figure 12. Map displaying the separate 10 year capture zones of wells #1 and #2R.

Well Closures

One of the goals of any Source Water Protection plan should be to identify and address any improperly abandoned wells in the source water protection area. Special attention should be given to wells identified in the 2, 5, and 10-year capture zones as these wells provide a direct conduit for contaminants to enter the aquifer. During the development of the source water protection plan it was mentioned that multiple monitoring wells still exist in field surrounding the drinking water wells. Ensuring these wells are properly plugged is a high priority for this SWP plan due to close proximity of the wells to the drinking water wells.

Implement Recommended Agricultural Best Management Practices (BMP)

Agricultural BMP's can address a number of issues associated with agricultural practices, including nitrogen concentrations in soil and groundwater. Prairie City along with the Iowa DNR and the NRCS should work with the local landowners in the source water protection area to discuss the different BMP's that could be implemented to reduce the amount of nitrates leeching to groundwater from agricultural activities. The effectiveness of BMP's can vary depending on differing factors such as landscape, soil type, agriculture practices, and so on. Based on Correspondence with the local NRCS office (*Appendix B*) the following practices would be most effective in the area:

Nutrient Management - Managing the source, amount, timing, and placement of plant nutrients and soil amendments to improve crop nutrient use efficiency and minimize nutrient losses to surface and groundwater.

Conservation Cover - Areas or strips of land maintained in permanent vegetation to help control and trap nutrients and sediment.

- Reduces nutrient movement to groundwater by increasing plant uptake.
- Buffers are strategically located on the landscape to protect sensitive areas such as surface waters, sinkholes, wells and tile inlets.

Residue and Tillage Management, No-till - No-till reduces soil erosion, reduces surface runoff, increases organic matter and increases soil water holding capacity.

Cover Crops - Grasses, legumes, and forbs planted for seasonal vegetative cover.

- Cover crops take up nutrients that would otherwise be lost through surface or drainage water.
- Reduces compaction, increases water infiltration and water holding capacity.
- Source of feed for livestock.

The 2018 Farm Bill provides a new opportunity for farmers and landowners to receive 75 percent financial assistance rates for key water quality practices located in source water protection (SWP) priority areas.

NRCS programs that could potentially fund these practices at this time include:

- Environmental Quality Incentives Program (EQIP)
- Conservation Stewardship Program (CSP)
- Regional Conservation Partnership Program (RCPP)
- Agricultural Conservation Easement Program (ACEP)

FSA program to potentially fund Conservation Cover (327) at this time includes:

- Conservation Reserve Program (CRP)

Work with Septic Systems Owners on Maintenance

A properly constructed and maintained septic system is generally not a threat to a drinking water system. However, an improperly maintained septic system can be a significant source of contamination in a drinking water well. It is recommended the city correspond with the land owners to ensure they are properly maintaining their septic systems and are aware of the presence of their septic systems in the two-year capture zone of Prairie City's drinking water wells. A fact sheet on management of septic systems in source water protection areas may be found at the following web address: https://www.epa.gov/septic/source-water-protection-practices-bulletin.

Monitoring Plan

The two wells showed a difference in concentration of nitrates as well as a difference in the isotopic signature of nitrate nitrogen. This suggests that the two wells may have different sources of nitrates. For this reason, the DNR suggests a monthly monitoring plan of nitrates in the wells to determine if there is a consistent difference between the two wells which will help inform the city on what area in the source water protection area needs to be focused on for addressing the nitrate contamination in the wells.

Well Maintenance

We encourage the city of Prairie City to work with a well contractor to develop a regular maintenance plan for its drinking water wells. Preventative maintenance will help extend the life of the well and avoid the need for costly rehabilitation of a well or drilling of a new well (Wagner, 2018). It is also important to keep records for the wells if available including:

- Well logs
- Sampling Results
- Inspection Reports
- Well Maintenance invoices and logs

Water Supply Expansion Sites

Prairie City is encouraged to develop a plan for the expansion of its water supply in the event one of its current wells fails. Identifying possible locations where the city could place a well in the future would allow the city to maintain a zone of control in that area in the eventuality that a new well needs to be drilled.

Talk to Colfax Country Club about Prairie City SWP area

The Colfax Country Club manages a nine hole golf course, a portion of which is in the surface runoff area of the source water protection area. Kyle Ament had a conversation with members of the Colfax Country Clubs board of directors informing them of this and the potential impacts of the golf courses activities on the water source for Prairie City.

Emergency Response Affidavit

6.1. Emergency Response Plan Affidavit

The Safe Drinking Water Act amendments of 1986 and 1996 established the concept of wellhead protection, and subsequently the Source Water Protection Program. The program is currently overseen by the Iowa Department of Natural Resources (DNR) and attempts to prevent potential contaminants from entering source waters and prepare for situations in which drinking water may be impaired through contamination, power outage and treatment or distribution system interruptions. In order to ensure a public water supply's preparedness in such events, a Contingency/Emergency Plan has been required in every approved Source Water Protection Plan (SWPP) or Wellhead Protection Plan (WHPP). Due to recent and growing concerns over water system security and due to many systems having previously prepared such a plan under the provisions of the 2002 Bioterrorism Act, the DNR is now allowing an affidavit in lieu of including a completed Contingency/Emergency Plan within the submitted SWPP/WHPP. Although public water supplies do not need to send DNR completed plans, each must have an accessible and up-to-date plan in case a catastrophic event occurs within their system. It is necessary for the completed water supply Contingency/Emergency Plan to contain the following information, at a minimum:

- Contact information for the city's mayor, city clerk, water/wastewater operator.
- Contact information for the city's power company, a professional electrician, a professional plumber and an equipment repair company.
- System's critical users must be identified and a plan for immediate notification must be created. (i.e. hospitals, nursing homes, schools, etc.)
- Contact information for local media, including newspaper, radio and television.
- Contact information for a certified laboratory, local emergency contacts, state and local public health departments and the National Guard.
- Contact information for the DNR's 24 hour emergency contact and the local DNR field office.

I, Jodie Wyman, representing the City of Prairie City certify that a Contingency / Emergency Plan has been created for our public water supply system and that this information can be presented to the DNR upon request.

Jodie Wyman
Signature

9/26/2022
Date

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Resource Links

https://www.iowadnr.gov/

- The home web page for the Iowa DNR.

https://www.iowadnr.gov/sourcewater

- Home page for the Source Water Protection program. This website includes descriptions of Iowa's Source Water Protection program, links to Source Water Protection documents like the Source Water Protection Guidebook, and other supporting materials like Iowa Groundwater Basics.

https://programs.iowadnr.gov/sourcewater/

- Source Water Tracker web page which includes Phase 1, Phase 2, and other relevant Source Water Protection documents for Public Water Supplies.

https://www.epa.gov/sourcewaterprotection

- Information on Source Water Protection from the Federal level.

http://www.ia.nrcs.usda.gov/

- Iowa NRCS website that contains information about conservation practices and government programs for conservation.

https://www.nutrientstrategy.iastate.edu/

- The Iowa Nutrient Reduction Strategy homepage. The Iowa Nutrient Reduction Strategy is a science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico.

Appendix A. Correspondence with NRCS

From: **Baxter, Nichole - NRCS, Newton, IA** <nichole.baxter@usda.gov>
Date: Fri, Jan 28, 2022 at 3:10 PM
Subject: RE: [External Email]Colfax and Prairie City Source Water Protection Plans
To: Ament, Kyle <kyle.ament@dnr.iowa.gov>
Cc: Sande, Aaron - NRCS, Newton, IA <aaron.sande@usda.gov>

Kyle,

Upon review of your reports and the location of the sites, we have determined the following BMP's would be most effective in the capture zone on agricultural land:

- Nutrient Management (590)
- Conservation Cover (327)
- Conservation Crop Rotation (328)
- Residue and Tillage Management, No-till (329)
- Cover Crops (340)
- Forage & Biomass Planting (512)
- Integrated Pest Management (595)

I've attached the Iowa NRCS SWP flyer that lists eligible practices for SWP in 2021. The second attachment is a nice flyer Minnesota NRCS created that provides a general description of some of these practices, along with a few other practices not mentioned above.

NRCS programs that could potentially fund these practices at this time include:

- Environmental Quality Incentives Program (EQIP)
- Conservation Stewardship Program (CSP)
- Regional Conservation Partnership Program (RCPP)
- Agricultural Conservation Easement Program (ACEP)

FSA program to potentially fund Conservation Cover (327) at this time includes:

- Conservation Reserve Program (CRP)

Please let me know if this is what you were looking for or if you need something different.

Have a nice weekend!

Nichole S. Baxter

Resource Conservationist – Jasper, Marion, Marshall & Story Co.
Natural Resources Conservation Service

808 Iowa Speedway Drive
Newton, IA 50208-3008
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Appendix B. Isotope and Nitrate Data from Water Supply Wells

Water Sciences Laboratory
Analytical Report

Nebraska Water Center
Daugherty Water for Food Global Institute

Nebraska Water Center, a part of the
Robert B. Daugherty Water for Food Global Institute at the University of Nebraska
e:dsnow1.unl.edu | p: 1 402.472.7539 | f: 1 402.472.9599 | c: 1 402.304.3748

Results Reported To:
Carl Van Der Kamp
Iowa DNR - City of Prairie City
P.O. Box 607
Jefferson Street
Prairie City, IA 50228
515-979-3120
prairiecitysbrplant@gmail.com

Project: 22_VanC_IA_DNR_PRAIRIE_CITY_L
Sampled By: Carl Van Der Kamp
Received: 01/28/2022
Received By: Victoria Dey
Batch: W22047

Protocol: 12_06_01_07
Nitrogen-15 and Oxygen-18 in Nitrate Isotopes using azide reduction and Trace gas Preconcentrator
Protocol Reference:
McIlvin, Matthew R.; Altabet, Mark A. (2005) Chemical conversion of nitrate and nitrite to nitrous oxide for nitrogen and oxygen isotopic analysis in freshwater and seawater. *Anal. Chem.*, 77, 5589-5595.

**** *Results of Analysis* ****

Lab ID	Sample ID	Collection Date	δ15N-NO3 (‰)	δ18O-NO3 (‰)	Analysis Date
22-477	WELL 1	01/24/2022	+16.2	+9.71	02/22/2022
22-479	WELL 2R	01/24/2022	+4.80	+2.66	02/22/2022

$$\delta\,(‰) = \frac{R_{sample} - R_{standard}}{R_{standard}} \times 1000$$

Rstandard: D/H= 0.00015575, 18O/16=0.0020052; Standard Mean Ocean Water; 15N/14N=0.0036765 Atm Nitrogen, 13C/12C = 0.0112372 PDB

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Project: 22_VanC_IA_DNR_PRAIRIE_CITY_L
Sampled By: Carl Van Der Kamp
Received: 01/28/2022
Received By: Victoria Dey
Batch: W22046

Protocol: 02_03_01
Nitrate_Nitrite Cd-Reduction BPA 353.2

Protocol Reference:
Seal Analytical EPA 127A Nitrate-N + Nitrite-N in Drinking and Surface Waters Domestic and Industrial Wastes.

**** *Results of Analysis* ****

Lab ID	Sample ID	Collection Date	NO3+NO2-N (mg/L)	Analysis Date
22-471	WELL 1	01/24/2022	0.487	01/28/2022
22-473	WELL 2R	01/24/2022	5.31	01/28/2022

Detection Limit: 0.060