Chapter 1: Introduction

1.1 Background

The Lincoln-Pipestone Rural Water system (LPRW) wellhead protection plans for the Holland/North Holland drinking water supply management area (DWSMA) and the Verdi DWSMA were originally approved by the Minnesota Department of Health (MDH) on August 15, 2003. Wellhead protection (WHP) is an ongoing process and WHP plans need to be periodically reviewed and updated. Land and groundwater uses within a drinking water supply management area (DWSMA) are likely to change over time and the WHP plan must be modified to reflect those changes. A public water supplier is required to review and update an approved WHP plan every ten years to ensure the plan reflect current conditions with individual DWSMAs.

This amended WHP plan for LPRW was prepared in cooperation with the MDH, Minnesota Department of Natural Resources (DNR), Minnesota Department of Agriculture (MDA), the Pipestone County Environmental Services/ Soil and Water Conservation District and the Lincoln County Soil and Water Conservation District. This plan provides both technical information and management strategies for all four of LPRW well fields located in southwestern Minnesota. The four wellfields are used to supply drinking water to more than 4,400 rural connections and about 10,600 residents in thirty eight (38) cities located within ten (10) Minnesota counties (Appendix E). LPRW also serves communities located in South Dakota but this plan does not address those portions of the Burr and Verdi DWSMAs that extend into South Dakota. The WHP plan contains specific actions that LPRW will take to fulfill WHP requirements that are specified under Minnesota Rules, part 4720.5100 to 4720.5590. Also, the support that Minnesota state agencies, federal agencies, and county agencies will provide is presented to identify their roles in protecting LPRW's drinking water supply. The amended plan is effective for 10 years after the approval date specified by MDH and LPRW is responsible for implementing its WHP plan of action as described in Chapter 9 and Appendix D of this plan. Furthermore, LPRW will evaluate the status of plan implementation at least every two and one half years to identify whether its WHP plan is being implemented on schedule.

1.2 General Description of LPRW Public Water Supply

The following provides a summary of characteristics of each DWSMA that is part of the LPRW source water system.

- **Holland DWSMA** – The Holland well field is located within the North Branch of Pipestone Creek watershed located in the north central part of Pipestone County and covers about 23,474 acres (~37 square miles). The Holland DWSMA (Figure 1) has six production wells which produce on a five-year average, about 336 million gallons per year (MGY) from a shallow glacial outwash channel aquifer (Table 1-1). Raw water from all of the Holland wells exhibit periodic elevated nitrate levels, with some wells exceeding drinking water standards (Appendix A - Table X). The water produced from the high nitrate-nitrogen Holland wells is treated in a reverse osmosis system prior to being distributed to consumers. This treatment process produces drinking water that meets all state and federal drinking water standards.

Table 1-1
Holland Water Supply Well Information

Local Well ID	Unique Number	Use/ Status[1]	Casing Diameter (inches)	Casing Depth (feet)	Well Depth (feet)	Date Constructed/ Reconstructed	Aquifer
H2	505508	P	12	28	37	1991	Glacial Drift
H3	505507	P	12	34	55	1991	Glacial Drift
H4	505510	P	12	24	39	1991	Glacial Drift
H5	505511	P	12	23	32	1991	Glacial Drift
H6	607161	P	12	55	70	1997	Glacial Drift
H9	505512	P	12	27	37	1991	Glacial Drift

[1] Denotes Primary Well

Additional information regarding the physical setting and how the Holland DWSMA delineation and vulnerability assessments were determined are found in *"Wellhead Protection Plan for the Holland Wellfield – Part 1"* in Appendix B.

- **North Holland DWSMA** – This DWSMA (Figure 2) straddles US Highway 71 about three miles north of the Holland water treatment plant in the north central part of Pipestone County and covers about 3088 acres (~4.8 square miles). The North Holland well field draws on a five-year average, about 161 MGY of groundwater from a shallow glacial outwash aquifer using two wells (Table 1-2). Similar to the Holland DWSMA raw water quality, elevated levels of nitrate-nitrogen are present in both wells. The raw water is piped to the Holland water treatment plant for reduction of nitrate levels prior to distribution. This treatment process produces drinking water that meets all state and federal drinking water standards.

Table 1-2
North Holland Water Supply Well Information

Local Well ID	Unique Number	Use/ Status[1]	Casing Diameter (inches)	Casing Depth (feet)	Well Depth (feet)	Date Constructed/ Reconstructed	Aquifer
H7	613137	P	12	62	62	2000	Glacial Drift
H8	613136	P	12	52	72	2000	Glacial Drift

[1] Denotes Primary Well

Additional information regarding the physical setting and how the North Holland DWSMA delineation and vulnerability assessments were determined are found in *"Wellhead Protection Plan for the North Holland Wellfield – Part 1"* in Appendix B.

- **Verdi DWSMA** – The Verdi DWSMA (Figure 3) covering about 9,220 acres (~14.4 square miles) is located in the Spring Creek watershed in the southwestern corner of Verdi Township in Lincoln County. A portion of the DWSMA extends into South Dakota. The Verdi well field of five wells draws on a five-year average,

about 493 MGY of groundwater from a shallow glacial outwash aquifer similar to that of the Holland and North Holland aquifers (Table 1-3). Elevated levels of nitrate-nitrogen is present in four of the five primary wells located in the Verdi aquifer. Raw source water pumped from the Verdi aquifer is managed by blending water between the wells and varying pumping rates from the five wells. The blended water is chlorinated prior to distribution. This blending and treatment process produces drinking water that meets all state and federal drinking water standards.

In 2016 two new LPRW production wells were constructed in South Dakota within the Verdi DWSMA. Raw water from these two wells are piped to the LPRW Verdi treatment and distribution facility. However, Minnesota wellhead protection rules only apply to those wells and associated DWSMA that are located within Minnesota, consequently, these two wells and associated data are not included in this wellhead protection report.

Table 1-3
Verdi Water Supply Well Information

Local Well ID	Unique Number	Use/ Status[1]	Casing Diameter (inches)	Casing Depth (feet)	Well Depth (feet)	Date Constructed/ Reconstructed	Aquifer
V1	149160	P	12	47	62	1978	Glacial Drift
V2	149161	P	12	45.5	57.5	1978	Glacial Drift
V3	149163	P	12	54	67	1978	Glacial Drift
V4	149162	P	12	47	60	1978	Glacial Drift
V5	149182	P	12	54	69	1984	Glacial Drift

[1] Denotes Primary Well

Additional information regarding the physical setting and how the Verdi DWSMA delineation and vulnerability assessments were determined are found in *"Wellhead Protection Plan for the Verdi Wellfield – Part 1"* in Appendix B.

- **Burr DWSMA** –The Burr DWSMAs (Figures 4 and 5) are located about seven miles west of Canby, Minnesota in the southwestern part of Yellow Medicine County. There are ten production wells at scattered locations within two separately delineated drinking water supply management areas. For clarity in this WHP plan, the two delineated Burr DWSMAs are referred to as the 'North unit' and the 'South unit'. The North DWSMA covers about 12,820 acres, of which only about 32 percent is located within Minnesota. The South DWSMA covers about 7,525 acres of which about 50 percent is within Minnesota. Based on a five-year average, about 510 MGY of groundwater pumped from the ten wells is blended and chlorinated prior to distribution to customers at a water treatment plant located in the North DWSMA (Table 1-4). Raw water nitrate-nitrogen data collected by LPRW staff between 2000 and 2015 indicate nitrate levels in all production wells (North and South DSWMAs) at consistently less than 1.00 ppm.

  This WHP plan is applicable to only those areas of the Burr DWSMAs that are within Minnesota. No data regarding potential contaminant sources or land cover on the South Dakota portions of these DWSMAs is presented in this report.

Table 1-4
Burr Water Supply Well Information

Local Well ID	Unique Number	Use/ Status[1]	Casing Diameter (inches)	Casing Depth (feet)	Well Depth (feet)	Date Constructed/ Reconstructed	Aquifer
B1	440325	P	12	140	176	1991	Glacial Drift
B2	527475	P	14	145	195	1993	Glacial Drift
B3	527476	P	14	153	203	1993	Glacial Drift
B4	550052	P	8	433	453	1994	Glacial Drift
B5	637715	P	12	264	300	2000	Glacial Drift
B6	637716	P	20	293	323	2000	Glacial Drift
B7	634546	P	18x12	424	448	2000	Glacial Drift
B8	686536	P	12	222	242	2003	Glacial Drift
B9	694231	P	12	234	269	2003	Glacial Drift
B10	694230	P	12	263	298	2003	Glacial Drift

[1] Denotes Primary Well

Additional information regarding the physical setting and how the Holland DWSMA delineation and vulnerability assessments were determined are found in '*Wellhead Protection Plan for the Burr Wellfield – Part 1'* in Appendix B.

The Holland, North Holland and Verdi DWSMAs all exhibit elevated nitrate-nitrogen in the raw water. Minimal soil cover overlying unconfined drift aquifers, shallow public wells and row crop agricultural land uses expose these vulnerable aquifers to contamination resulting in elevated concentrations of nitrate-nitrogen (Appendix A- reference the page # or fig #). The Burr DWSMA draws groundwater from aquifers that are much deeper than those aquifers used in the other DWSMAs and subsequently do not have elevated nitrate nitrogen in the source water even though the land use in the Burr DWSMA is similar to the other DWSMAs.

LPRW system has agreements with other public rural water systems (Red Rock Rural Water (Minnesota), Osceola Rural Water (Iowa), and Brookings Deuel Rural Water (South Dakota) to augment water supplies as may be needed by each public water supplier. The 2016 LPRW Consumer Confidence Report (CCR) indicates the distribution water contains nitrate-nitrogen at an average level of 7.1 parts per million (ppm) with a range from no detects to 7.1 ppm in the finished water. LPRW distributes water that meet all federal drinking water standards. See Appendix E for the complete CCR and Chapter 3 for a detailed discussion of LPRW public wells and DWSMA vulnerability.

1.3 Plan Appendices

Much of the technical information that was used to prepare this plan is contained in the appendices but is summarized in the main body of this plan. In particular:

- Appendix A contains documents and discussion regarding the data elements used for this plan as specified in the MDH Second Scoping Decision and Notices. This part of the plan is summarized in Chapter 2.

- Appendix B contains the first part of the WHP plan, consisting of the delineation of the wellhead protection area (WHPA), the DWSMA for each well field and the vulnerability assessments for the public water supply wells in each DWSMA. This part of the plan is summarized in Chapter 3.
- Appendix C contains the potential contamination sources inventory (PCSI) for each DWSMA. This inventory is discussed in Chapter 4 in terms of how the inventory was completed for each DWSMA and the process of assigning a level of risk that the various potential contaminant sources may pose to LPRW's source water supply.
- Appendix D contains the wellhead protection measures the WHP team have identified for implementation over the ten year period that its WHP plan is in effect. Chapter 9 provides detail on how action items are determined by the wellhead protection team.
- Appendix E contains documents that support the WHP plan.

Chapter 2: Identification and Assessment of the Data Elements Used to Prepare the Plan

The data elements that are included in this amended wellhead protection plan document the need for WHP measures that will be implemented to help protect the LPRW water supply from potential sources of contamination. LPRW met with representatives from MDH on two occasions to discuss the data elements that are specified in Minnesota Rules, part 4720.5400, for preparing a WHP plan.

A scoping meeting (scoping 1) held on November 9, 2011 and April 4, 2012 identified the data elements required to support the delineation and vulnerability assessment of the WHPA and the DWSMA (Part 1 of the WHP plan) for the Holland, North Holland and Verdi well fields. The amended Part 1 plans for the Holland, North Holland and Verdi wellfields were approved by the MDH on August 8, 2013. On February 27, 2014 a 'scoping 1' meeting was held to identify the data elements required to support the delineation and vulnerability assessment of the WHPA and the DWSMA for the Burr well fields. On March 30, 2016 the Part 1 plan for the Burr wellfields was approved by the MDH.

A second scoping meeting (scoping 2) held on June 25, 2015 discussed the data elements required to complete the remainder of the WHP plan for the Holland, North Holland and Verdi DWSMAs and on April 13, 2016 another scoping 2 meeting was conducted to discuss the data elements required to complete the remainder of the WHP plan for the Burr DWSMA. The second scoping meeting utilizes the completed Part 1 delineation and vulnerability report to select additional data elements which 1) identify potential risks to the public water supply and 2) develop effective management strategies to protect the public water supply relative to each well and DWSMA vulnerability. This becomes the basis for the "remainder of the WHP plan". The results of each meeting were communicated to LPRW by MDH through a formal scoping decision notice and are included in Appendix A.

Appendix A also contains an assessment of each data element identified in the MDH scoping 2 documents for its present and future impact on:

- The use of the public water supply wells,
- Delineation of the WHPAs,
- The quality and quantity of water supplying the public water supply wells, and
- Land and groundwater uses within all the DWSMAs.

Availability of information relating to each data element that is used in this plan was evaluated by staff from the MDH and LPRW. If the evaluation process determines that information pertaining to a particular data element may be considered an issue, concern or opportunity, LPRW can then address identified issues, concerns and opportunities in this plan. In Chapter 6 Tables 6-1, 6-2 and 6-3 lists the issues, concerns and opportunities identified by the LPRW WHP team. Measures identified to address deficiencies found during the data element assessment process in either the quality or quantity of data are included in the plan of action (Chapter 9 and Appendix D).

Appendices A and D also contain supporting documents (maps, tables, exhibits, etc.) that are required by the MDH scoping 2 documents.

Chapter 3: Delineation of the Wellhead Protection Area, Drinking Water Supply Management Area and Vulnerability Assessments

3.1 WHPA and DWSMA Delineation

Figures 1, 2, 3, 4 and 5 show the boundaries of the ERAs, WHPAs and vulnerability assessments of the Holland, North Holland, Verdi and Burr DWSMAs (see Glossary for definitions of DWSMA, ERA and WHPA terms). Consulting firms specializing in groundwater modeling utilized computer simulations of groundwater movement and individual LPRW primary well underground capture zones to delineate an ERA and WHPA for each well field. The DWSMA boundaries for each well field were designated using the following criteria:

- Surface water contribution areas for the Holland, North Holland and Verdi DWSMAs;
- Center-lines of township and county roads and Public Land Survey coordinates for all DWSMAs and also,
- Parcel boundaries for the Holland, North Holland and Verdi DWSMAs.

The WHP amendment process requires the previously state-approved Holland, North Holland and Verdi WHPA and DWSMA delineations and assessments to be reviewed and revised based on changes in water use, new geologic or groundwater data, updated modeling processes, revised scoping requirements or a combination of these factors. The LPRW well fields located in the Burr DWSMAs located in Yellow Medicine County are now included in this WHP plan. Additionally, the total number of primary wells that LPRW uses in the various wellfields has changed and overall water use has increased since the original WHP plan was developed and approved. Nevertheless, the amended DWSMA delineations for the Holland, North Holland and Verdi have not changed in shape and size. A detailed description of the scoping requirements are contained in Appendix A. The process used for delineating each ERA, WHPA and associated DWSMA and preparing the vulnerability assessments for each DWSMA is presented in Appendix B.

3.2 Well Vulnerability Assessment

The Part 1 reports for each DWSMA (Appendix B) include a vulnerability assessment for each primary well used by LPRW. These vulnerability assessments are used to help define potential contaminant sources within the DWSMA and to select appropriate measures to reduce the risk a potential contaminant may present to the public drinking water supply. The MDH has produced guidance in determining well vulnerability based on geologic sensitivity mapping, casing integrity, casing depth, pumping rate, isolation distance from any known contaminant source and chemical and isotopic information.

Water supply well information for each primary well located in each DWSMA is listed in detail in Appendix B.

A review of MDH well construction records for each primary well used by LPRW indicates proper materials and construction practices and therefore, the wells themselves are not a potential source of contamination to a specific aquifer. For the amendment process, tritium sampling was not required in primary wells within the Holland or North Holland well fields but was conducted in selected primary wells in the Verdi and Burr well fields.

The following is a summary of the well vulnerability assessments for each LPRW primary well in each DWSMA. Nitrate-nitrogen (nitrate) data is from MDH scoping 2 summary documents located in Appendix A.

Holland well field

- The geologic sensitivity of the surficial outwash aquifer is high or very high because of insufficient thickness of clayey till materials that can slow the downward migration of contaminants from the land surface are present within the majority of the WHPA.
- Nitrate has been identified at concentrations between 4 to 17 mg/L in the primary wells.
- MDH well code considers a well with 50 feet or less of casing in combination with less than 10 feet of a confining layer between the surface and the bottom of the well casing to be classified as a 'sensitive' well. Well casing depth is less than 50 feet in five of the six primary wells.

Therefore, considering the above factors all of the Holland well field production wells are considered to be very highly vulnerable.

North Holland well field

- The geologic sensitivity of the surficial outwash aquifer is high or very high because of insufficient thickness of clayey till materials that can slow the downward migration of contaminants from the land surface are present within the majority of the WHPA.
- Nitrate has been identified at concentrations typically near 19 mg/L in both primary wells.

Therefore, considering the above factors both of the North Holland well field production wells are considered to be very highly vulnerable.

Verdi well field

- The geologic sensitivity of the surficial outwash aquifer is high or very high because of insufficient thickness of clayey till materials that can slow the downward migration of contaminants from the land surface are present within the majority of the WHPA.
- Nitrate has been identified at concentrations from 4 to 21 mg/L in all five of the primary wells.
- Tritium sampling in all five wells indicates tritium levels ranging from 19 to 24 Tritium Units (TU) which indicates surface water quickly recharging the aquifer. A TU of 1 or greater automatically triggers a vulnerable rating.
- MDH well code considers a well with 50 feet or less of casing in combination with less than 10 feet of a confining layer between the surface and the bottom of the well casing to be classified as a 'sensitive' well. Well casing depth is less than 50 feet in three of the five wells.

Therefore, considering the above factors all five of the Verdi well field production wells are considered to be highly vulnerable.

Burr well field

- The geologic sensitivity of the aquifers used in this well field is low because there is sufficient thickness of clayey till materials that can restrict the downward migration of contaminants from the land surface are present within the majority of the 'north unit' WHPA and all of the 'south unit'.
- Well casing depths for all production wells ranges from 140 feet to 424 feet deep.
- Isotopic and water chemistry data from wells in the Burr wellfield indicate the aquifers used contain water that has no detectable levels of human-caused contamination. TU sampling in select wells resulted in less than 1 TU.

Therefore, considering the above factors all ten of the Burr production wells are considered to be not vulnerable.

3.3 DWSMA Vulnerability Assessment

The vulnerability of each of the LPRW DWSMAs (Figures 1, 2, 3 4 and 5) was determined by using geologic, soils, and groundwater chemistry information. A detailed hydrogeology report of each of the LPRW DWSMAs is in Appendix B. Review of geologic information and groundwater quality data for the aquifer within the DWSMA indicate the following:

Holland DWSMA

- The entire drainage basin of the North Branch of Pipestone Creek upstream of the LPRW water treatment plant contributes surface water to the aquifer. This upstream area is referred to as a surface water contribution area (SWCA). Because of a limited amount of low permeability material overlying the aquifer, the connection of surface water to the aquifer and the presence of elevated nitrates in the Holland aquifer, the entire DWSMA is considered highly vulnerable.

North Holland DWSMA

- Surface water runoff from the watershed upslope of the two production wells contributes to recharge of the aquifer used by the North Holland wells. Because of a limited amount of low permeability material overlying the aquifer, the connection of surface water to the aquifer and the presence of elevated concentrations of nitrates in the North Holland aquifer, the entire DWSMA is considered highly vulnerable.

Verdi DWSMA

- The Verdi DWSMA exhibits highly vulnerable geologic conditions near the production wells due to a limited amount of low permeability soil materials overlying the aquifer. Upstream of the Verdi well field, the geologic materials covering the aquifer become thicker which reduces the potential for contaminants to infiltrate vertically into the Verdi aquifer. However, hydrogeology studies (MPCA, 2000) indicate that the Spring Creek drainage basin contributes considerable recharge yearly to the Verdi aquifer. Surface water runoff of precipitation and snow meltwater flowing into Spring Creek can carry potential contaminants that may infiltrate directly into the aquifer within the WHPA. Therefore, the surface water contribution area is rated as highly vulnerable.

Burr DWSMA

- The ten production wells draw groundwater from three separate, deeply buried sand and gravel aquifers. In contrast to the Holland, North Holland and Verdi aquifers, the three aquifers underlying the Burr well fields are covered with significant thicknesses of low permeability materials. There are two areas in the 'north unit' on the Minnesota side of the DWSMA that are considered to have moderate geologic sensitivity but in general, the geologic sensitivity across the Burr DWSMA is considered low.

In summary, the vulnerability of the Holland, North Holland and the Verdi DWSMA has been determined to be very high or high because of insufficient thickness of soil material overlying the aquifers and the connection of the surface water contribution areas to the aquifers used in these DWSMAs (Appendix A) and elevated nitrate levels in the source waters. Generally, the higher the vulnerability rating, the greater the risk that a released contaminant may result in contaminating source water used for drinking water. Therefore, it's important to consider what types of potential contaminant sources can be carried by surface water runoff to groundwater recharge areas where infiltration to an aquifer can occur quickly. Land uses that may contribute nitrates to surface or subsurface water recharge to the aquifers within the three vulnerable DWSMAs is the primary management concern.

The hydrogeology report for the Burr DWSMAs states that existing geologic reports and groundwater chemistry information (Appendix B) indicates that significant thicknesses of low permeability material overlies the three aquifers used by LPRW. There are a few small areas in the North DWSMA unit that are considered moderate

geologic sensitivity. However, in general, the geologic sensitivity across the DWSMA and surrounding each primary well is considered low. Consequently, abandoned or unused wells that may act as a conduit for surface contaminants to enter an aquifer will be the primary management concern in this DWSMA.

Chapter 4: Inventory of Potential Contamination Sources, Establishing Priorities and Assigning Risk to Potential Contamination Sources

Results of the vulnerability assessment of each DWSMA and well vulnerability and the presence or absence of human-caused contaminants in the source water (Appendix B) were used as a base to guide the WHP team in conducting a risk assessment of various potential sources of contamination (PCS).

Scoping documents contained in Appendix A provide details of the various categories of PCS required by MDH to be inventoried in each DWSMA based on geologic vulnerability and well water quality sampling. Further, the data element assessment process as described in Appendix A was used in assigning what impact or level of risk the various potential point and nonpoint sources of contamination that are inventoried may have on LPRW's drinking water supply in each DWSMA.

Discussion of PCSI Requirements Applicable to Surface Water Contribution Areas and Ground Water Capture Areas in the Holland, North Holland and Verdi DWSMAs

- The Verdi, North Holland and Holland DWSMAs have been assigned a very high or high vulnerability ranking throughout each DWSMA because the source water is pumped from shallow, screened wells located in unconfined glacial outwash aquifers (Figures 1, 2 and 3). For the purposes of conducting a potential contaminant source inventory (PCSI) each DWSMA is configured into two areas: 1) a surface water contribution area (SWCA), and 2) a ground water capture area (GWCA). Establishing two separate zones is useful in developing a process to prioritize management actions addressing the different types of potential contaminants inventoried.

- The highly vulnerable SWCA in each of these three DWSMAs is the geographic area that provides recharge to the aquifer within the GWCA from runoff of precipitation or meltwater. The MDH requires the PCSI conducted in each SWCA must include all PCS related to above-ground tanks, hazardous waste generators or handlers, feedlots, land application of agricultural chemicals, commercial fertilizers, animal manure, septic systems and certain types of Class V disposal wells. In addition, other types of both point and nonpoint sources that may be potential sources of nitrate-nitrogen or other potential contaminants of concern are required to be inventoried.

- The very highly vulnerable GWCA is the surface and subsurface area surrounding the production wells in each of the three DSWMAs through which contaminants are likely to move toward and reach a production well or well field. The GWCA is an area that is approximately the same size and shape as the modeled WHPAs (Appendix B) but is displayed on PCS maps and land cover maps with 'squared – off' boundaries using public land survey coordinates or public road right of ways for the purpose of simplifying the identification and prioritizing the management of PCS.

- The very highly vulnerable GWCA of each DWSMA requires a wide range of PCS to be inventoried including all those listed in the SWCA but also wells – including U.S. Environmental Protection Agency Class V wells, underground storage tanks, feedlots and many other types of both point and nonpoint sources of potential contaminants. A complete listing of all the PCSI requirements assigned to each DWSMA are contained in the MDH scoping documents in Appendix A. Nitrate in the source water produced in the Verdi, North Holland and Holland DWSMAs is a concern. Consequently, the WHP team will focus primarily on strategies to identify sources of nitrates and reduce the impact nitrates have on the source waters used by the LPRW system in these three DWSMAs.

Discussion of Burr DWSMAs

Geologic conditions vary slightly across the Burr North DWSMA. A thick layer of clayey glacial till covers most of the North DWSMA and therefore, vulnerability is assessed as low. There are a few areas of coarser-textured till that are ranked as moderate vulnerability (Figure 4). For the purposes of inventorying PCS in the Burr North DWSMA: 1) the low vulnerability assessment for the majority of the DWSMA indicates that, generally, only wells, other types of boreholes or excavations that may reach the aquifer and certain types of EPA Class V wells are likely to impact the production wells, whereas, 2) the moderately vulnerable portions of the Burr North DWSMA requires a wider range of PCS to be inventoried including tanks, leaking tanks, wells, pipelines, spill sites, solid waste facilities, other potential contamination sites and additional types of Class V wells. The entire Burr South DWSMA (Figure 5) is rated as low vulnerability and therefore the PCSI is confined to those PCS listed in item 1 above.

4.1 Conducting the Potential Contaminant Sources Inventory

Introduction

Conducting the PCSI is a multi-phased process. Various local, state and federal data bases are reviewed to determine 1) if the types of PCS as listed in MDH scoping documents for each DWSMA may be present in a specific DWSMA and 2) verification of the location of each PCS. Geographic information system (GIS) mapping techniques are used to display preliminary PCS data on aerial photo base maps and associated PCSI spreadsheets for each DWSMA. The WHP team then reviewed each data point to determine if the location and associated data for each PCS is accurate; a map number was then assigned to each PCS in each DWSMA. This process is repeated for each DWSMA vulnerability sector - low and moderate for the Burr DWSMA and the high or very high vulnerable GWCA and highly vulnerable SWCA for the Holland, North Holland and Verdi DWSMAs.

The geologically sensitive Holland, North Holland and Verdi DWSMAs required a very rigorous process of utilizing GIS techniques, multiple data bases, local knowledge and historical records to sort out which PCS are located where and what the current status of PCS identified may be. The results of these efforts follow in this chapter.

As a start point in the inventory process, the MDH and DNR provided LPRW with information about wells from the Minnesota Well Index and other data bases. These data sources included wells with known and unknown locations and well sealing records that were systematically reviewed by the WHP team to determine if any of the documented wells were located within a DWSMA (or portion thereof) that required a well inventory. Historical photos were also reviewed for possible well or septic system locations. The WHP team also reviewed public water supply well files provided by the MDH and LPRW to determine 1) the location of any unused LPRW wells within each DWSMA, and 2) what the current status of any unused public wells may be (active, sealed or unknown). Because the LPRW DWSMAs are all located in rural areas, no Sanborn Fire Insurance maps are available to assist the WHP team in searching for old wells.

State, federal and local data bases were examined for listings of other types of potential point sources of potential contaminants (septic systems, storage tanks, landfills, feedlots, etc.) listed in the MDH scoping documents for each DWSMA (Appendix A). The same data review procedures as described in the previous paragraph were employed by the WHP team to expand or reduce the PCS list.

Holland, North Holland and Verdi DWSMAs

Elevated nitrate-nitrogen levels in LPRW primary wells located in the GWCAs of the Holland, North Holland and Verdi DWSMAs required the WHP team to inventory and prioritize historical land uses that may be contributing non-point sources of nitrate contamination to ground waters in these vulnerable DWSMAs.

In the three DWSMAs of concern the WHP team considered certain types of land and water uses such as row crops, feedlots and/or associated manure storage facilities, septic systems and crop irrigation systems as presenting a greater possible risk to groundwater quality from nitrate, which is defined as a nonpoint source pollutant. Nitrate contamination of these three aquifers will be discussed in greater detail in this chapter.

The SWCA in each of the three vulnerable DWSMAs contribute storm water runoff which recharge the aquifers within each of the GWCAs. GIS mapping provided the WHP team with data illustrating 1) the different types of land cover that are potential sources of nitrate-nitrogen, 2) areal distribution of the different land cover types, and 3) the quantity and type of point sources of PCS within both the GWCA and SWCA for each DWSMA. The primary wells in each DWSMA were also shown on these maps to better understand the proximity of certain land covers and/or point sources of potential contamination to each primary well. Historic water sampling for nitrate-nitrogen from the primary wells was also reviewed during this process. Utilizing these tools the WHP team concluded that the potential to convey pollutants to the very highly or highly vulnerable GWCAs in the Holland, North Holland and Verdi DWSMAs is of concern. Therefore, developing effective measures to reduce the impact nitrate has on these aquifers is a high priority.

The point and non-point PCS inventoried in each DWSMA were assessed and assigned a level of risk each PCS category may have on the aquifer. The process of 'risk assignment' to each PCS, be it a point or non-point source, is discussed in greater detail later in this chapter. Also, tables in subsection 4.3 illustrate the results of the inventory and assigned risk of PCS for each SWCA and GWCA in each DWSMA.

Burr DWSMAs

The Burr North and South DWSMAs exhibits mostly low with a few areas of moderate vulnerability. The primary wells do not contain any of the contaminants monitored by the state MDH and federal EPA. Therefore, the PCSI was confined to wells, excavations that may reach the source water aquifer (e.g. aggregate mining) and certain types of EPA Class V wells are of concern in the low vulnerable portions of the North DSWMA and the entire South DWSMA. Where the source water aquifer exhibits a moderate vulnerability in the North DWSMA, certain types of PCS that may release contaminants to the subsurface must be inventoried in addition to wells, excavations that may reach the source water aquifer and certain types of EPA Class V wells. These additional PCS include above ground and buried chemical and fuel storage tanks, underground waste disposal practices, pipelines and fuel and chemical spills.

The method of collecting PCS data in the Burr DWSMAs is similar to that already described but was augmented by conducting a 'windshield' survey to tally and accurately locate wells and determine status. The results were recorded and mapped in addition to other well information collected from various state data bases. The PCS inventory for the two Burr DWSMAs was confined to those portions of the DWSMAs that are within Minnesota.

4.2 Contaminants of Concern

Holland, North Holland and Verdi DWSMAs

Nitrate contamination of the aquifers used by LPRW in these three DWSMAs has been well documented for many years (Appendix A). Consequently, specific types of land use associated with point and nonpoint sources of nitrate such as row crop production, animal feedlots, manure storage facilities and onsite sewage treatment systems present a high potential of impacting groundwater quality. Nitrate contamination of these aquifers and especially the Holland and North Holland aquifers requires LPRW to 1) blend water from wells with lower nitrate concentrations and 2) operate a reverse osmosis water treatment plant to comply with federal and state drinking water standards for nitrates prior to distribution to consumers.

Levels of nitrates in the two North Holland DWSMA primary wells and one of the Holland wells consistently exceed drinking water standards. Consequently, LPRW is considering closing these three wells because of the high costs associated with reducing the nitrate concentrations in order to meet drinking water standards. The raw source water from the remaining Holland wells also contains elevated nitrate concentrations and must be blended and treated.

Raw water from one of the Verdi DWSMA wells exceeds drinking water standards for nitrate-nitrogen. Therefore, raw water from this well is blended together with the remaining Verdi primary wells to produce drinking water that meets nitrate-nitrogen drinking water standards prior to distribution. Currently, the blending process used in the Verdi DWSMA is meeting drinking water standards but the persistence of elevated levels of nitrate in the Verdi aquifer are of concern and may require additional treatment in the future.

In conclusion, elevated levels of nitrate nitrogen have been detected historically and currently in all LPRW production wells located in the Holland, North Holland and Verdi DWSMAs. All water distributed by LPRW that is pumped from the three DWSMAs is disinfected with chlorine to ensure potability and meets all state and federal drinking water standards.

Burr DWSMAs

None of the human-caused contaminants regulated under the federal Safe Drinking Water Act have been detected at levels indicating that any of Burr wells themselves do not serve to draw contaminants into the aquifer as a result of pumping. In addition, all distributed water is disinfected with chlorine to ensure potability. Further, no naturally occurring contaminants of concern have been detected in LPRW's Burr wells and the water supplier continues to provide safe drinking water that meets or exceeds all state and federal drinking water standards.

See the 2016 Consumer Confidence Report (Appendix E) for additional details regarding source water quality for the LPRW system.

4.3 Inventory Results and Risk Assessment

Background

The LPRW DWSMAs are all located in rural, low population density counties with no cities or concentrations of nonfarm-related activities within the DWSMAs. There are no hazardous materials handling faculties, petroleum or chemical tank farms, landfills or other, similar types of activities located in any of the DWSMAs. Land use in the GWCAs and SWCAs of the three vulnerable DWSMAs is dominated by row crop agriculture and livestock production. Farm sites typically have a well, a septic system and potentially a feedlot and a few, generally small-sized above-ground tanks on site. Tanks less than 1100 gallons are not required to be inventoried. The MDH does not require an inventory of wells that are located within the SWCAs of the Holland, North Holland and Verdi DWSMAs. There are a few gravel pits in two of the DWSMAs but not all are active. Wind-powered electric generators are present in some of the DWSMAs in Pipestone and Lincoln counties but are not considered a potential contaminant source and therefore, were not included in the PCS inventory. No federally-regulated Class V wells were inventoried in any of the LPRW DWSMAs.

One major highway intersects both the Holland and North Holland DWSMAs with many gravel roads crisscrossing all three highly vulnerable DWSMAs. A petroleum pipeline is present in the Holland DWSMA and a railroad track dissects the Verdi DWSMA. Linear features such as roads, pipelines or rail tracks are not required to be inventoried, but do present the potential for accidental spills of petroleum-based products or liquid agricultural products.

Portions of the Burr and Verdi DWSMAs extend into South Dakota (Figures 3, 4 and 5). In accordance to Minnesota wellhead protection requirements the potential contaminant source inventory conducted in these two DWSMAs only included PCS located in Minnesota.

Potential Contaminant Source Inventory Requirements

The MDH WHP rules require a PCS inventory to address all land parcels within a DWSMA and land use information must be included in the inventory. Parcel data for all DWSMAs and PCS are included in GIS-based data submitted to the MDH. The vulnerability assessments of the public water supply wells and DWSMAs are used to determine the extent of PCS inventory.

Potential contaminant source inventories for the two Burr DWSMAs is limited to inventorying only wells in the low vulnerable areas and expanded to above and below ground storage tanks, leaking tank sites, pipelines, different types of storage sites, spills, and other potential contaminated sites and wells in the moderately vulnerable portions of the North Burr DWSMA. These types of PCS are considered ‘point sources’.

In the Holland, North Holland and Verdi DWSMAs, the combination of 1) vulnerable public wells, 2) high or very high vulnerability of the GWCAs and SWCAs, and 3) elevated nitrates in the well water required that the PCS inventory must address all types of land and water uses that include ‘point sources and nonpoint sources’.

The MDH scoping documents provide detailed listings of the types of PCS data based on vulnerability that LPRW must inventory in each DWSMA. MDH PCSI requirements are slightly different in a GWCA compared to a SWCA. Wells are a required PCS to be inventoried in the GWCAs, but not in a SWCA. The PCSI in a SWCA is generally orientated toward those types of PCS that may become transportable due to excessive surface or subsoil water runoff. Each category of PCS must be assigned a level of risk that a particular PCS may pose to the aquifer specific to each DWSMA. Those PCS that are associated with nitrate-nitrogen are of greatest concern. The inventory lists are extensive and therefore, are not listed verbatim here, but can be reviewed in detail in Appendix A.

Assigning Risk

All point and non-point sources of potential contamination were assessed by the WHP team and assigned a level of risk the various PCS categories may have on the aquifers used by LPRW. The level of risk assigned to each type of PCS and/or land cover type addresses 1) the number of units inventoried, 2) its proximity to a public water supply well, 3) the capability of local geologic conditions to absorb a contaminant (geologic vulnerability), 4) the effectiveness of existing regulatory controls, 5) the areal extent of a land use, and 6) the time required for LPRW to obtain cooperation from governmental agencies that regulate a potential contaminant. Assigned risk categories are defined by the WHP team to mean the following:

- A **high (H)** risk potential implies that the potential source type has the greatest likelihood to negatively impact LPRW's water supply and should receive highest priority for management.
- A **moderate (M)** risk potential implies that the potential source type has a moderate likelihood to negatively impact LPRW's water supply and should receive a medium priority for management.
- A **low (L)** risk potential implies that a potential source type may have a marginal or negligible impact on LPRW's water supply and should receive a low priority for management.

The following is a discussion of the results of the point and nonpoint PCS inventory for each DWSMA. Tables are used to present the PCSI and land cover data and associated assigned risk of each PCS and land cover category within the 1) GWCA and SWCA of each individual DWSMAs that are highly vulnerable and 2) the low and moderate vulnerable Burr DWSMAs.

Results of Inventorying of Point Sources of Potential Contamination

A point source of potential contamination can be defined as a stationary location or fixed facility from which pollutants are discharged or emitted or any single, identifiable discharge point of potential pollution, such as a septic system, a tank or feedlot. The following provides a brief overview of the point sources of potential contamination inventoried in each DWSMA.

In the three highly vulnerable DWSMAs, the WHP team identified the following point sources of PCS as sorted by DWSMA, GWCA and SWCA:

- Holland DWSMA
    a. GWCA – 7 subsurface sewage treatment systems, 2 feedlots, 25 wells, 1 water treatment plant.
    b. SWCA - 61 subsurface sewage treatment systems, 39 feedlots, 1 gravel pit.
- North Holland DWSMA
    a. GWCA - 2 subsurface sewage treatment systems, 2 feedlots, 8 wells;
    b. SWCA - 8 subsurface sewage treatment systems, 5 feedlots, 3 gravel pits.
- Verdi DWSMA
    a. GWCA - 8 subsurface sewage treatment systems, 2 feedlots, 23 wells;
    b. SWCA - 28 subsurface sewage treatment systems, 5 feedlots, 1 cemetery.

Most farm sites contain above ground storage tanks that are <1100 gallons in size that are used to hold fuel for equipment. These smaller sized tanks are not required to be inventoried by the MDH. State data bases indicate no tanks >1100 gallons in size are present in the three DWSMAs which do require inventorying. Further, a state data base indicates two minor spills of agricultural products occurred within the Holland DWSMA many years ago but have been remediated and therefore, were not included in the PCSI.

In the low and moderate vulnerability Burr DWSMAs, the WHP team identified the following point sources:

a. North Burr DWSMA - 43 wells (28 are LPRW or DNR wells, 15 are private wells); no tanks >1100 gallons.
b. South Burr DWSMA – 21 wells (5 are LPRW or DNR wells, 16 are private wells).

The following tables (Tables 4-1 through Table 4-3) provide an overview of the point sources of potential contaminant sources inventoried in the GWCA and SWCA of the Holland, North Holland and Verdi DWSMAs. Table 4-4 summarizes the PCSI conducted in the north and south Burr DWSMAs. The tables also reflect an assigned risk to each potential contaminant source inventoried.

Table 4-1
Assigned Risk of Potential Contamination from Point Sources in Holland DWSMA

Point Source Category	Ground Water Contribution Area (Very High Vulnerability)		Surface Water Contribution Area (High Vulnerability)		Remainder of DWSMA (High Vulnerability)	
	Quantity	Risk	Quantity	Risk	Quantity	Risk
Feedlot	2	H	39	H	-	-
SSTS	7	H	52	M	9	L
Wells	25	H	Not Required to Inventory			
Gravel Pit	-	-	1	L	-	-
Waste Water Disposal Site	1	L	-	-	-	-
Spills	-	-	2	L	-	-
Total Point Sources	**35**		**94**		**9**	

A table and maps illustrating the locations of the Holland PCS indicated in Table 4-1 are located in Appendix C: Table 1 and Figures 1, 2, 3 and 4.

In the Holland DWSMA a total of 147 PCS were inventoried of which about 24 percent are located within the GWCA. Within the GWCA, septic systems, feedlots and irrigation wells that may contribute nitrate-nitrogen to the aquifer are of greatest concern. Selecting measures to determine proximity of these PCS in relationship to LPRW wells and surface waters that recharge the GWCA will be helpful in determining 1) the most effective best management practices to reduce the impact of nitrate-nitrogen to the Holland aquifer, and 2) a timeline to implement the selected measures.

Of the inventoried wells within the GWCA, 64 percent are LPRW production or monitoring wells; of the remaining nine (9) wells of which two (2) are irrigation wells, one active and one inactive. The waste water disposal site is a NPDES-permitted discharge associated with the LPRW water treatment plant. Within the SWCA animal feedlots and septic systems are numerous and of concern regarding the potential transport of nitrates to the groundwater recharge area. There is one (1) small gravel pit and two (2) old spill sites (recorded as 'closed' by MDA) located in the SWCA; both of these types of PCS were assigned as a low risk to the Holland aquifer by the WHP team. No USEPA designated Class V wells have been inventoried in the Holland DWSMA.

Table 4-2
Assigned Risk of Potential Contamination from Point Sources in North Holland DWSMA

Point Source Category	Ground Water Contribution Area (Very High Vulnerability)		Surface Water Contribution Area (High Vulnerability)		Remainder of DWSMA (High Vulnerability)	
	Quantity	**Risk**	**Quantity**	**Risk**	**Quantity**	**Risk**
Feedlot	2	H	2	M	2	M
SSTS	2	H	5	M	2	L
Wells	8	H	Not Required to Inventory			
Gravel Pit	-	-	2	M	1	M
Total Point Sources	**12**		**9**		**5**	

A table and maps illustrating the locations of the North Holland PCS indicated in Table 4-2 are located in Appendix C: Table 2 and Figure 5.

In the North Holland DWSMA a total of 25 PCS were inventoried of which about 48 percent are located within the GWCA. Of the inventoried wells within the GWCA, 75 percent are LPRW production or monitoring wells; the remaining two wells are irrigation wells, both active. Also within the GWCA there are two (2) septic systems and two (2) animal feedlots that may contribute nitrate-nitrogen to the aquifer are of greatest concern. Similar to the Holland DWSMA, selecting measures to determine proximity of these PCS in relationship to LPRW wells and surface waters that recharge the GWCA will be helpful in determining 1) the most effective best management practices to reduce the impact of nitrate-nitrogen to the North Holland aquifer, and 2) a timeline to implement the selected measures. No USEPA designated Class V wells have been inventoried in the North Holland DWSMA.

Within the SWCA there are two (2) animal feedlots and five (5) septic systems that are ranked as a moderate concern in contributing nitrate-nitrogen to the groundwater recharge area. There are two (2) active gravel pits within the SWCA and a third, inactive pit located on the north edge of the DWSMA. These gravel pits are considered to be 'wet' pits because the excavations have reached the water table resulting in an elevated potential of introducing potential contaminants to the aquifer used by LPRW. Irrigated row crops located on sandy soils overlying shallow aquifers can impact aquifers with nitrates and therefore, are assigned a high risk by the WHP team.

Table 4-3
Assigned Risk of Potential Contamination from Point Sources in Minnesota Portion of the Verdi DWSMA

Point Source Category	Ground Water Contribution Area (Very High Vulnerability)		Surface Water Contribution Area (High Vulnerability)		Remainder of DWSMA[2] (High Vulnerability)	
	Quantity	Risk	Quantity	Risk	Quantity	Risk
Feedlot	2	H	5	M	-	-
SSTS	7	H	23	M	6	L
Wells	20	H	Not Required to Inventory			
Grave Yard	-	-	1	L		
Total Point Sources	**29**		**29**		**6**	

A table and maps illustrating the locations of the Verdi PCS indicated in Table 4-3 are located in Appendix C: Table 3 and Figures 6, 7 and 8.

Approximately 93 percent of the Verdi DWSMA is located in Minnesota. The PCSI compiled in this WHP plan was conducted only within the Minnesota portion of the Verdi DWSMA.

In the Verdi DWSMA a total of 66 PCS were inventoried of which about 50 percent are located within the GWCA. Similar to the Holland and North Holland DWSMAs, point sources such as wells, septic systems and feedlots that may contribute nitrate-nitrogen to the aquifer are of greatest concern within the GWCA. Similar to the Holland and North Holland DWSMAs, selecting measures to determine proximity of these PCS in relationship to LPRW wells and surface waters that recharge the GWCA will be helpful in determining 1) the most effective best management practices to reduce the impact of nitrate-nitrogen to the Verdi aquifer, and 2) a timeline to implement the selected measures. Of the twenty (20) inventoried wells within the GWCA, 70 percent are LPRW production or monitoring wells with the remaining six (6) wells privately owned. There are no irrigation wells located in the Minnesota portion of the Verdi DWSMA. No USEPA designated Class V wells have been inventoried in the Verdi DWSMA.

Within the SWCA five (5) animal feedlots and twenty three (23) septic systems were inventoried and are of moderate concern in potentially contributing nitrate-nitrogen to the groundwater recharge area. There is one (1) small cemetery located in the Verdi DWSMA that is considered a low risk to the aquifer.

Table 4-4
Assigned Risk of Potential Contamination from Point Sources (wells)
in the Minnesota portion of the North and South Burr DWSMAs

DWSMA	Number of Wells			Assigned Risk
	ERA[1] (1 Year TOT)	WHPA[1] (10 Year TOT)	Remainder of DWSMA	
North - Low Vulnerability	16	20	2	M
North - Moderate Vulnerability	0	5	0	M
South - Low Vulnerability	5	13	3	M
Totals	21	38	5	

1. See the Glossary (page v) for definitions of ERA, WHPA and TOT

A table and maps illustrating the locations of the Burr PCS indicated in Table 4-4 are located in Appendix C: Table 4 and Figures 9 and 10.

Only about 39 percent of the combined areas of the North and South Burr DWSMAs are located in Minnesota (Appendix C, Figure 17). The PCSI compiled in this WHP plan was only conducted within the Minnesota portions of the two DWSMAs.

The Burr North DWSMA contains thirty eight (38) wells of which seventeen (17) wells (45 percent) are either LPRW or DNR wells. The remaining wells are private, including at least one (1) located on an abandoned farm site.

In the South Burr DWSMA, five (5) of the twenty one (21) wells (about 24 percent) are LPRW or DNR wells with the remainder (16) being private wells. Six (6) of the private wells are located on abandoned farm sites. Little or no information is available about the majority of the private wells, therefore, the WHP team assigned a moderate ranking of potential risk these wells may pose to the multiple aquifers used by LPRW in the Burr DWSMAs. No USEPA designated Class V wells have been inventoried in the North or South DWSMAs.

About 20 percent of the area comprising the Minnesota side of the North Burr DWSMA has been assigned moderate vulnerability which are located in three separate areas, (Figure 4). Within the moderately vulnerable areas no tanks, pipelines or other petroleum-related PCS are present.

Land Cover Inventory and Non-Point Sources of Potential Contamination

By definition, non-point sources (NPS) of pollution are generated and discharged over a broad land area. Pollution derived from NPS can occur when rainwater or snowmelt runs off cultivated fields, roadways, residential yards, feedlots and/or farm sites. This process can transport sediment, nutrients, and organic and/or toxic substances originating from land-use activities, to surface waters or shallow aquifers.

The following tables list the different types of land cover in the SWCA and GWCA of the three highly vulnerable DWSMAs. Each land cover type has been assessed and assigned a risk level by the WHP team based on 1) geologic

vulnerability, and 2) the potential of contaminating the aquifer with nitrate-nitrogen from nonpoint pollution that may be associated with each land cover category. Land cover data is derived from two sources: 1) for the larger sized SWCAs a digitized 2011 national land cover data base was utilized, and 2) upon a WHP team request, 2016 land cover data was collected by LPRW staff. Tables and maps were then generated for the GWCAs using the same land cover categories as defined for the SWCAs. However, in the GWCAs, the category "Farm sites" was used in place of "Developed, Low or Medium Intensity" as designated in the national land cover data base utilized in the SWCAs. A 'farm site' includes the residence, barns, grain bins, storage sheds, livestock yards and shelters and vegetated shelter-belts surrounding a site. LPRW staff then created individual land cover tables and maps for the very highly vulnerable GWCAs. Because the two Burr DWSMAs have low or moderate vulnerability, the WHP team was not required to assign a risk level for any of the land cover types.

Holland DWSMA Land Cover and Nonpoint Source Pollution

The total area of the Holland DWSMA is 23,872 acres, of which the SWCA comprises about 21,370 acres or about 90 percent of the DWSMA. See Appendix C, Figures 11 and 12 for maps illustrating the Holland Land Cover in the SWCA and GWCA as presented in Table 4-5 and Table 4-6.

Table 4-5
Holland SWCA Land Cover and Assigned Risk
of Potential Contamination from Nonpoint Sources of Pollution
(Source: 2011 NLCD Land Cover Data)

Land Cover Categories	Acres	Percent of DWSMA	Assigned Risk
Open water	1.86	0.01	L
Developed, open space	925.36	4.33	L
Developed, low intensity	16.22	0.08	L
Developed, medium intensity	5.1	0.02	L
Developed, high intensity	0.22	0.00	L
Barren land	0.75	0.00	L
Deciduous forest	52.89	0.25	L
Shrub/scrub	0.93	0.00	L
Grassland/herbaceous	2400	11.23	L
Pasture/hay	731.56	3.42	L
Cultivated crops	17047.93	79.77	H
Emergent herbaceous wetlands	187.28	0.88	L
Total	21370.1	99.99	

Table 4-5 Summary - Within the SWCA, about 80 percent of the land cover is cultivated lands with pasture or hay lands comprising about 730 acres of 3.4 percent of the SWCA. Wetlands represent less than 1 percent of the SWCA. Farm sites or rural residences in the SWCA constitute about 0.1 percent of total acreage.

Table 4-6
Holland GWCA Land Cover and Assigned Risk
of Potential Contamination from Nonpoint Sources of Pollution
(Source: LPRW Staff, 2016)

Land Cover Category	Acres	Percent of GWCA	Assigned Risk
Developed, low density (Farm sites)	48.63	1.94	M
Pasture	58.58	2.34	L
Cultivated crops	1771.53	70.81	H
Grassland/herbaceous	623.15	24.91	L
Total	2501.89	100.00	

Table 4-6 Summary - The total area within the Holland GWCA is about 2502 acres. Cultivated cropland amounts to about 71 percent of total acreage in the GWCA. About 27 percent of the GWCA is covered by grasslands or other types of perennial plant cover (pasture). Farm sites constitute about 2 percent of the total GWCA area.

North Holland DWSMA Land Cover and Nonpoint Source Pollution

The total area of the North Holland DWSMA is 3,406 acres, of which the SWCA comprises about 2551 acres or 75 percent of the DWSMA. See Appendix C, Figures 13 and 14 for maps illustrating the North Holland Land Cover in the SWCA and GWCA as presented in Table 4-7 and Table 4-8.

Table 4-7
North Holland SWCA Land Cover and Assigned Risk
of Potential Contamination from Nonpoint Sources of Pollution
(Source: 2011 NLCD Land Cover Data)

Land Cover Category	Acres	Percent Of DWSMA	Assigned Risk
Open water	4.55	0.18	L
Developed, open space	143.84	5.64	L
Developed, low intensity	4.55	0.18	L
Developed, medium intensity	0.89	0.04	L
Barren land	9.24	0.36	L
Grassland/herbaceous	51.36	2.01	L
Cultivated crops	2329.80	91.30	H
Emergent herbaceous wetlands	7.24	0.28	L
Total	2551.47	99.99	

Table 4-7 Summary - Within the SWCA, about 91 percent of the land cover is cultivated lands in the SWCA. Perennial vegetative cover and wetlands constitutes less than 3 percent of the entire North Holland DWSMA. Farm sites or rural residences in the SWCA constitute about 0.2 percent of total acreage.

Table 4-8
North Holland GWCA Land Cover and Assigned Risk
of Potential Contamination from Nonpoint Sources of Pollution
(Source: LPRW Staff, 2016)

Land Cover Category	Acres	Percent of GWCA	Assigned Risk
Developed, low density (Farm sites)	25.00	2.93	M
Cultivated crops	819.48	95.91	H
Grassland/herbaceous	9.97	1.17	L
Total	854.45	100.00	

Table 4-8 Summary - The total area within the North Holland GWCA is about 854 acres. Cultivated cropland amounts to about 96 percent of total acreage in the GWCA. Farm sites constitute about 3 percent of the total GWCA area.

Verdi DWSMA Land Cover and Nonpoint Source Pollution

The total area of the Verdi DWSMA is 8822 acres, of which the SWCA comprises about 6,140 acres or 70 percent of the DWSMA. Land cover percentages reflect only the area within Minnesota. See Appendix C, Figures 15 and 16 for maps illustrating the Verdi Land Cover in the SWCA and GWCA as presented in Table 4-9 and Table 4-10.

Table 4-9
Verdi SWCA Land Cover and Assigned Risk
of Potential Contamination from Nonpoint Sources of Pollution
(Source: 2011 NLCD Land Cover Data)

Land Cover Categories	Acres	Percent of DWSMA	Assigned Risk
Developed, open space	363.33	5.92	L
Developed, low intensity	10.57	0.17	L
Developed, medium intensity	5.68	0.09	L
Developed, high intensity	1.11	0.02	L
Deciduous forest	32.05	0.52	L
Grassland/herbaceous	680.36	11.08	L
Pasture/hay	37.14	0.06	L
Cultivated crops	4971.43	80.97	H
Emergent herbaceous wetlands	38.05	0.62	L
Total	6139.72	99.99	

Table 4-9 Summary - Within the SWCA, about 81 percent of the land cover is cultivated lands with pasture or hay lands comprising about 37 acres or less than 0.1 percent of the SWCA. Grasslands and other forms of herbaceous cover constitutes about 11 percent of the SWCA. Farm sites or rural residences in the SWCA constitute about 0.3 percent of total acreage.

Table 4-10
Verdi GWCA Land Cover and Assigned Risk
of Potential Contamination from Nonpoint Sources of Pollution
(Source: LPRW Staff, 2016)

Land Cover Category	Acres	Percent of GWCA	Assigned Risk
Developed, low density (Farm sites)	16.20	0.60	M
Pasture	161.68	6.03	L
Cultivated crops	2063.38	76.93	H
Grassland/herbaceous	440.81	16.44	L
Total	2682.07	100.00	

Table 4-10 Summary - The total area within the GWCA is about 2682 acres which equates to 30 percent of the portion of the Verdi DWSMA located in Minnesota. Cultivated cropland amounts to about 77 percent of total acreage in the GWCA and about 22 percent being pasture and grasslands cover. Less than 0.1 percent of the Verdi DWSMA is wetlands. Farm sites constitute less than 1 percent of the total GWCA area.

Burr DWSMA Land Cover

The Burr well fields are designated as the North Burr DWSMA and the South Burr DWSMA. Their boundaries adjoin each other at one location (Appendix C, Figure 17). Because the geologic vulnerability is mostly low in these DWSMAs, LPRW is not required to evaluate land cover types for their potential to impact the aquifers used in the two DWSMAs. No determination of land cover types or extent was conducted for those portions of the North and South Burr DWSMAs that are in South Dakota.

Table 4-11
Burr DWSMA - Total Area
(Source: LPRW Staff, 2016)

DWSMA Unit	Total Acres	MN Area (acres)	Percent of DWSMA in MN
North	12,820.80	4,085.19	31.86
South	7,524.71	3,809.63	50.63
Total	20,345.51	7,894.82	38.80

Table 4-11 summarizes the acreage within each DWSMA. The majority of acreage of the two DWSMAs is located in South Dakota. All of the production wells used by LPRW in the two Burr DWSMAs are located in Minnesota; about 39 percent of the total acreage of the two Burr DWSMAs is within Minnesota (see Appendix C, Figure 17).

See Appendix C, Figures 18 and 19 for maps illustrating the North and South Burr DWSMA Land Cover as presented in Table 4-12 and Table 4-13.

Table 4-12
North Burr DWSMA Land Cover – Minnesota Only
(Source: 2011 NLCD Land Cover Data)

Land Cover Categories	Acres	Percent of DWSMA
Cultivated Crops	1,567.21	38.31
Hay/Pasture	1,213.89	29.67
Grassland/Herbaceous	880.50	21.52
Developed, Open Space	186.54	4.56
Emergent Herbaceous Wetlands	114.77	2.81
Open Water	80.80	1.98
Deciduous Forest	40.49	0.99
Woody Wetlands	2.12	0.05
Developed, High Intensity	1.94	0.05
Developed, Medium Intensity	1.56	0.04
Developed, Low Intensity	1.02	0.02
Total	4,090.82	100.00

Table 4-13
Land Cover for Moderately Vulnerable Portion of
North Burr DWSMA - Minnesota Only
(Source: 2011 NLCD Land Cover Data)

Land Cover	Acres	Percent Within Moderate Vulnerability
Cultivated Crops	397.35	48.36%
Hay/Pasture	199.36	24.26%
Herbaceous	153.46	18.68%
Developed, Open Space	44.85	5.46%
Emergent Herbaceous Wetlands	14.40	1.75%
Open Water	8.25	1.00%
Developed, Medium Intensity	1.56	0.19%
Deciduous Forest	1.05	0.13%
Developed, Low Intensity	0.76	0.09%
Developed, High Intensity	0.67	0.08%
Total	821.71	100.00%

Tables 4-12 and 4-13 Summary - The total area of the North Burr DWSMA located within Minnesota is 4,090 acres, or about 32 percent of the total North Burr DWSMA. The moderately vulnerable portions comprise about 822 acres or 20 percent of the North Burr DWSMA. Within the Minnesota component of the North Burr DWSMA, about 38 percent of the land cover is cultivated lands with pasture or hay lands comprising about 30 percent of the DWSMA. Grasslands and other forms of herbaceous cover constitutes about 25 percent of the Minnesota portion of the North Burr DWSMA.

Table 4-14
South Burr DWSMA Land Cover - Minnesota Only
(Source: 2011 NLCD Land Cover Data)

Land Cover Categories	Acres	Percent of DWSMA
Cultivated Crops	1,886.18	49.42
Hay/Pasture	909.77	23.83
Grassland/Herbaceous	728.43	19.08
Developed, Open Space	157.36	4.12
Emergent Herbaceous Wetlands	85.27	2.23
Deciduous Forest	23.61	0.62
Open Water	23.07	0.60
Shrub/Scrub	3.29	0.09
Total	3,816.97	100.00

Table 4-14 Summary - The total area of the South Burr DWSMA located in Minnesota is about 3,817 acres. Cultivated cropland amounts to about 49 percent of the total acreage with about 43 percent being hay/pasture and grasslands cover. The South Burr DWSMA is rated as low vulnerability throughout the DWSMA.

Summary of PCSI

LPRW's source water is derived from five separate well fields resulting in five DWSMAs located in multiple counties within two states. As per Minnesota WHP rules, the PCSI conducted only covers those areas within the state of Minnesota. All of the DWSMAs can be characterized as rural, low density population with agriculture being the dominant land use, especially within the Holland, North Holland and Verdi DWSMAs located in Lincoln and Pipestone counties. The Holland and North Holland DWSMAs are ranked as highly to very highly vulnerable due to geologic conditions and aquifer water quality and are located entirely within Minnesota, whereas, the highly vulnerable Verdi DWSMA extends into South Dakota. The two Burr DWSMAs are ranked as mostly low vulnerability, with the majority of each DWSMA extending into neighboring South Dakota.

The following is a summary of the potential contaminant inventory conducted in the LPRW DWSMAs.

Holland, North Holland and Verdi DWSMAs

- The Holland, North Holland and Verdi DWSMAs are impacted by elevated levels of nitrate-nitrogen in the ground water used by the water supplier.
- LPRW is required to treat the raw water from the Holland and North Holland DWSMAs to reduce the concentrations of nitrate-nitrogen to 10 mg/l or less that is distributed to customers to comply with federal and state drinking water standards.
- Both point sources and nonpoint sources of contamination contribute nitrates to the aquifers in these vulnerable DWSMAs. The PCSI and inventory of land cover data indicate a few, but significant sources of nitrate-nitrogen that require long-term attention: row crop agriculture, animal feedlots and onsite sewage treatment systems.
- In the Holland DWSMA, cultivated crops cover about 70 percent of the GWCA and about 80 percent of the SWCA. Perennial vegetative cover in the GWCA is at about 25 percent but is only about 2 percent of the SWCA. Wetlands cover less than 1 percent in this DWSMA.

- In the North Holland DWSMA, cultivated crops cover about 96 percent of the GWCA and 91 percent of the SWCA. Perennial vegetative cover in the GWCA is at about 1 percent and about 2 percent of the SWCA. Wetlands cover less than 0.5 percent in this DWSMA.
- In the Verdi DWSMA, cultivated crops cover about 77 percent of the GWCA and about 81 percent of the SWCA. Perennial vegetative cover in the GWCA is at about 22 percent and about 12 percent of the SWCA. Wetlands cover less than 1 percent in this DWSMA.
- Combined, wetlands comprise less than 1 percent of the acreage of the Holland, North Holland and Verdi DWSMAs.
- Subsoil tile drainage is present in the Holland and Verdi DWSMAs but actual extent is unknown.
- Irrigation of crop land is concentrated in the North Holland DWSMA but also present in the Holland DWSMA. There are no ground water appropriation permits issued for irrigation use in the Verdi DWSMA.
- Linear-shaped features such as major and minor roads, railroad tracks and pipelines are present in each of the three vulnerable DWSMAs and are considered a potential contaminant source due to potential spills occurring.

Burr DWSMAs

- The majority of the Burr DWSMAs are ranked as low geologic vulnerability with three small areas comprising about 20 percent of the North DWSMA ranked as moderately vulnerable.
- About 61 percent of the total acreage of the North and South Burr DWSMAs is located in South Dakota.
- Ground water quality in the multiple aquifers used in the Burr DWSMAs is good and does not need special treatment to meet all drinking water standards.

Establishing Priorities Regarding Nitrogen Management

Efforts to reduce the impact nitrate-nitrogen sources have on the highly vulnerable aquifers serving the Holland, North Holland and Verdi DWSMAs can be prioritized thusly:

- GWCA zones should be the highest priority for implementing measures to reduce nitrates leaching to the aquifers, followed by the SWCA zones.
- The WHP team assigned levels of risk regarding the nitrate-producing sources could have in each GWCA and SWCA within each DWSMA.
- Nitrogen fertilizers applied to cultivated crops are ranked the greatest risk to the groundwater in both the GWCA and SWCA. Animal feedlots and septic systems are also rank as a high risk in GWCAs with generally, a lower risk posed in the SWCAs.

Each of the three vulnerable DWSMAs present their own problems or issues in addressing the complex problem of excess nitrate-nitrogen in ground water.

- The very large size of the Holland and Verdi DWSMAs poses a challenge to develop and implement effective measures to reduce nitrates from reaching the aquifers and to monitor the success or failure of those measures.
- The three vulnerable DWSMAs are generally covered with a thin veneer of loamy or silty soils overlying sands which can allow for rapid infiltration of nitrate-nitrogen through the root zone and into shallow aquifers via precipitation or irrigation waters.
- Within the three vulnerable DWSMAs, about 80 percent of the land is covered by row crops and 15 percent by some type of permanent cover like pastures, hay, grasslands or woods.
- Nearly all of the historical wetlands in all three DWSMAs have been removed from the landscape. Less than 1 percent of wetlands remain. These natural systems can be effective in reducing nitrate-nitrogen concentrations in surface and subsurface water runoff.

Conclusions

Three of the five DWSMAs managed by LPRW are impacted by elevated nitrate levels in the three aquifers. Water treatment to remove nitrates is required to produce drinking water for the public. However, treatment is expensive due to engineering and structural requirements, maintenance and regulatory obligations. Treatment will remain an important tool for LPRW in the immediate future to continue providing safe, reliable drinking water for its customers. A long-term vision of LPRW, with the assistance of partners, should include the restoration and protection of the aquifers with the eventual closure of water treatment facilities that are now required.

Water quality data collected by LPRW from the period of early 1990s to 2016 (Appendix A) indicate:

- The Holland and North Holland DWSMAs require nitrogen management measures that over the long-term can restore the water quality in these two aquifers in order to provide a more stable and economical source of public water supply.
- The Verdi aquifer and DWSMA, while impacted by nitrate-nitrogen, can benefit from both selective restoration efforts and preservation measures to prevent nitrate levels from rising in the future.
- In the Burr DWSMAs, preservation-orientated measures are reasonable to maintain the current good water quality of the multiple aquifers used by LPRW.

Inner Well Management Zone

A survey was conducted to identify specific categories of PCS that may occur within 200 feet of each public water supply well. This area is referred to as the inner well management zone (IWMZ). The Minnesota State Well Code, administered by the MDH, defines the various categories of contaminants inventoried and establishes required setbacks from public water supply wells for each category of PCS. The IWMZ inventory was conducted by MDH Source Water Protection and LPRW staff with risk prioritization assigned by the MDH. All of the production wells are located in rural areas and are generally isolated from potential sources of contamination.

The following table identifies the type of PCS that may be located within 200 feet of each LPRW production well.

Table 4-15
Potential Contaminant Source Inventory within the
Inner Well Management Zone for LPRW Production Wells

DWSMA	LPRW Well No.	Unique Number	Potential Contaminant Within IWMZ
Holland	H2	505508	None
	H3	505507	1 monitoring well
	H4	505510	None
	H5	505511	None
	H6	607161	1 monitoring well
	H9	505512	1 monitoring well
No. Holland	H7	613137	1 monitoring well
	H8	613136	1 monitoring well
Verdi	V1	149160	1 monitoring well; 1 unused operating well
	V2	149161	1 monitoring well
	V3	149163	2 monitoring wells
	V4	149162	1 monitoring well
	V5	149182	1 monitoring well
Burr - North	B1	440325	1 buried sewer; 2 storm sewers[1]; 1 operating well; 1 pollutant (well located at water treatment plant)
	B2	527475	4 monitoring wells; 2 operating wells (well located at water treatment plant)
	B3	527476	1 buried sewer; 3 monitoring wells; 2 operating wells; 2 pits (well located at water treatment plant)
	B4	550052	1 buried sewer; 3 monitoring wells; 2 operating wells; 2 pits[1] (well located at water treatment plant)
	B5	637715	2 monitoring wells; 1 pit
	B6	637716	3 monitoring wells; 2 pits
	B7	634546	3 monitoring wells; 2 pits; 4 operating wells (well located at water treatment plant)
	B10	694230	1 pit
Burr - South	B8	686536	1 monitoring well; 1 pit (B8 well located in South Dakota)
Burr - South	B9	694231	1 monitoring well; 1 pit (B9 well located in South Dakota)

In summary, in the Verdi, Holland and North Holland DWSMAs there are only monitoring wells or other LPRW operating wells within the IWMZ of each primary well. Within the IWMZ for the Verdi V1 well, there is one unused well that may require sealing if no longer used. There are two separate DWSMAs for the Burr well field, labeled as the North and South DWSMAs. The North Burr DWSMA has a water treatment plant located adjacent to five tightly clustered primary wells. Within this compact area there are storm sewer lines, a sanitary sewer line, multiple monitoring wells, and small backwash basins. Two of the storm sewer lines and one of the pits do not met well code setbacks. LPRW will implement specific measures as prescribed by MDH on the IWMZ forms to address these

potential contaminant sources. The remaining five Burr primary wells are located in isolated sites in the surrounding country side with two of the five wells located in the South DWSMA. Each of these five wells typically have a monitoring well and associated backwash basin located within the 200 foot zone (IWMZ). The monitoring wells are typically used for tracking aquifer static water levels and in some instances source water quality. These types of wells are assigned a low risk to the primary wells because of known construction, purpose and limited access. The other potential contaminant sources inventoried near the water treatment plant are required to be monitored as per specific measures as stated on the individual MDH - IWMZ forms.

The detailed IWMZ inventory forms for each LPRW production well located in Minnesota are on file at the LPRW office in Lake Benton, MN.

Chapter 5: Impact of Land and Water Use Changes on the Public Water Supply Wells

LPRW estimates that the following changes to the physical environment, land use, surface water, and groundwater may occur over the ten-year period that the WHP plan is in effect. This exercise is necessary to determine whether new potential sources of contamination may be introduced in the future and to identify future actions for addressing these anticipated sources. Land and water use changes may introduce new contamination sources or result in changes to groundwater use and quality. Any anticipated changes would likely occur within unincorporated areas, therefore, LPRW will need to rely on Pipestone, Lincoln and Yellow Medicine counties in Minnesota and neighboring counties in South Dakota to enforce any applicable land use ordinances within the multiple DWSMAs providing source wter to LPRW customers.

Day to day administrative duties will be the responsibility of the wellhead protection manager.

The following table describes the anticipated changes to the physical environment, land use, and surface water or groundwater in relationship to 1) the influence that existing governmental land and water programs and regulations may have on the anticipated change, and 2) the administrative, technical, and financial considerations of LPRW and property owners within the DWSMAs.

Table 5-1
Expected Land and Water Use Changes

Expected Change (Physical Environment, Land Use, Surface Water, Ground Water)	Impact of the Expected Change On the Source Water Aquifer	Influence of Existing Government Programs and Regulations on the Expected Change	Administrative, Technical, and Financial, Considerations due to the Expected Change
Physical Environment – All DWSMAs			
No major changes in the physical environment within the Holland, North Holland, Verdi or Burr DWSMAs are expected within the next ten years.	No impact to the source water aquifer anticipated.	No changes, therefore, existing programs or regulations are adequate.	No additional administrative, technical or financial considerations required.
Land Use – Holland, North Holland and Verdi DWSMAs			
1. Row crops and livestock production is the dominate land use in all vulnerable DWSMAs. Acreage in row crops is generally consistent, whereas, livestock production in the Holland and Verdi DWSMAs fluctuates up or down due to market conditions. • Holland DWSMA = 79% land cover in row crops; • North Holland DWSMA = 92% land cover in row crops; • Verdi DWSMA = 80% land cover in row crops.	It is difficult to predict long-term trends insofar as groundwater quality. LPRW nitrate monitoring indicates some wells fluctuate in nitrate concentrations on a seasonal basis, whereas, other wells show less or more nitrates present regardless of the time of year. Nearly all the wells in the vulnerable DWSMAs exhibit elevated nitrate concentrations, with many exceeding the drinking water standard all or parts of the year.	Water quality in these source water aquifers are impacted by land uses. Three wells will be closed in the Holland/North Holland DWSMAs due to high nitrate levels in the source water. Adoption of voluntary BMP programs implemented to address nitrogen losses from cropland to groundwater appear to be ineffective. State and county agencies regulate animal feedlots and associated manure management.	LPRW must rely on local governments regarding land use. The DNR regulates groundwater quantity and MDA and MDH regulates nitrogen impacts to groundwater. However, LPRW must comply with federal and state drinking water standards to assure public health. Costs of treating groundwater to meet nitrate drinking water standards are currently born by LPRW and their customers.
2a. Current enrollment of acreage in the conservation reserve program (CRP) is level. Response of land owners to future CRP enrollments is unknown. 2b. The 2015 Minnesota Buffer Initiative may be applicable to some of the SWCA and GWCA of vulnerable DWSMAs.	2a. Increases in enrollment in long-term row crop reduction programs can lead to a decrease in acreage of row crops grown in vulnerable GWCA thereby decreasing non-point pollutant delivery to the aquifer. 2b. Dependent on design and placement, buffers may reduce nitrates from reaching GWCAs.	2a. Increased voluntary enrollment in CRP easement programs offered on a voluntary basis by USDA and state programs can reduce potential impacts that non-point source pollution may have on aquifer. Adequate funding may be an issue. 2b. Required buffers adjacent to public waters in Minnesota can benefit surface water quality in SWCAs and GWCAs.	2a. The local SWCDs and USDA-FSA/NRCS currently administer various vegetative cover programs that are available to property owners. 2b. BWSR, Pipestone and Lincoln County SWCDs will implement buffer programs as applicable in DWSMAs.

Table 5-1 (Continued)

Expected Change (Physical Environment, Land Use, Surface Water, Ground Water)	Impact of the Expected Change On the Source Water Aquifer	Influence of Existing Government Programs and Regulations on the Expected Change	Administrative, Technical, and Financial, Considerations due to the Expected Change
Land Use (continued) – Holland, North Holland and Verdi DWSMAs			
3. There may be an increase in adoption of BMPs supporting conservation tillage, cover crops and nutrient management practices in vulnerable DWSMAs.	Water quality in the aquifers serving the three vulnerable DWSMAs would benefit from adoption of practices that reduce nitrogen loss from crop lands.	Voluntary conservation practices and nutrient BMP programs offered by USDA and state programs can reduce potential water quality impacts that non-point source pollution can have on aquifers. Adequate funding for conservation programs may be an issue.	The local SWCDs and USDA-FSA/NRCS currently administer various agriculture-related BMP soil and water conservation programs that are available to property owners. Demand for conservation programs may be greater than available funding.
4. LPRW may expand ownership of some lands in the Holland, North Holland and Verdi GWCAs.	Conversion of row crops to permanent vegetative cover in key locations within GWCAs benefits aquifer recharge areas.	Private property transactions are readily addressed by existing regulations.	LPRW Board would consider administrative, financial or technical needs as part of any decision to purchase property to protect source water.
Land Use (continued) – Burr DWSMAs			
1. No expected changes in land use in the two Burr DWSMAs within Minnesota.	No impact to the source water aquifers anticipated.	No changes, therefore, existing programs or regulations are adequate on Minnesota portions of DWSMAs.	No additional administrative, technical or financial considerations required for those portions of DWSMAs located within Minnesota.

Table 5-1 (Continued)

Expected Change (Physical Environment, Land Use, Surface Water, Ground Water)	Impact of the Expected Change On the Source Water Aquifer	Influence of Existing Government Programs and Regulations on the Expected Change	Administrative, Technical, and Financial, Considerations due to the Expected Change
Surface Water – Holland, Verdi and Burr DWSMAs			
1. No major changes in the surface water features within the Holland, Verdi or Burr DWSMAs anticipated. There is no surface water present in the North Holland DWSMA.	There are no surface water appropriation permits in any of the LPRW DWSMAs, therefore, no impact to the source water aquifer anticipated.	Existing governmental rules or regulations applicable to surface waters deemed to be sufficient.	No additional administrative, technical or financial considerations required.
2. Increased soil drainage activities may occur in the Holland, Verdi or Burr DWSMAs.	Increased subsoil tiling may increase surface water flow into the North Branch of Pipestone Creek or Spring Creek. Unknown what impact this activity may have on water quantity or quality in Holland or Verdi GWCAs. No impact to Burr aquifers anticipated.	Public drainage systems are regulated, but no state, federal or local controls on private property subsoil tiling except when impacting certain types of wetlands.	Adoption of voluntary drainage best management practices in DWSMAs can improve water quality in tile water discharges. Legislative action would be required to address artificial drainage activities occurring on private property.
3. Current Holland WTP is exceeding state total dissolved solids discharge limits under low flow conditions.	No impact on aquifer but surface water quality could improve in No. Branch of Pipestone Creek	Existing governmental rules or regulations applicable to surface waters deemed to be sufficient.	Holland WTP will require technical & financial considerations to bring the WTP back into MPCA compliance.
Groundwater – Holland, North Holland, Verdi and Burr DWSMAs			
1. LPRW groundwater appropriations are projected to level off in the future but overall groundwater usage in the Verdi and Holland DWSMAs will likely rise due to increased use of irrigation.	There should not be any impact on the multiple aquifers used by LPRW if current pump rates are maintained.	Existing regulatory programs regarding groundwater appropriation permitting is adequate.	Under current water usage, no additional administrative, technical or financial considerations required.
2. LPRW anticipates shutting down two production wells in the North Holland DWSMA and one production well in the Holland DWSMA due to high concentrations of nitrates in the source waters serving these three wells.	Less demand on aquifers currently serving as source water for the Holland and North Holland DWSMAs. However, new sources of water will be needed to offset the loss of water production in the Holland and North Holland DWSMAs.	Current LPRW groundwater appropriation permit may be revised by the MNDNR.	Administrative, technical or financial considerations will shift to potential new sources of water to offset loss of water production from the Holland and North Holland wells that are closed.

Table 5-1 (Continued)

Expected Change (Physical Environment, Land Use, Surface Water, Ground Water)	Impact of the Expected Change On the Source Water Aquifer	Influence of Existing Government Programs and Regulations on the Expected Change	Administrative, Technical, and Financial, Considerations due to the Expected Change
Groundwater (continued) – Holland, North Holland, Verdi and Burr DWSMAs			
3. LPRW has two new production wells located in the Verdi DWSMA that is located in South Dakota.	Increased appropriation of groundwater from the Verdi aquifer is anticipated.	Production from the new wells is regulated by the state of South Dakota. Also, Minnesota wellhead protection program does not apply to the two South Dakota wells.	No change in technical considerations are anticipated. Additional financial or administrative considerations may occur due to South Dakota requirements.
4. LPRW will increase purchase of water from other sources.	Purchased water will replace the reduced quantity of source water pumped from one or more of the existing wellfields.	Any water purchased for public consumption will meet drinking water standards prior to distribution.	LPRW Board will consider administrative, financial or technical needs in any decision to purchase water for public consumption.
5. The Holland WTP process will no longer need to remove nitrates due to reduced pumping rates from the Holland and North Holland DWSMAs.	Reduced pumping rates from the North Holland and Holland aquifers means less waste water discharged downstream from the water treatment plant.	Alteration of the water treatment plant will require a revised MPCA discharge permit.	LPRW Board will consider administrative, financial or technical needs in managing source waters and treatment requirements.
6. A new water treatment plant may be constructed to service the Verdi DWSMA.	Increased pumping of the Verdi aquifer will occur, primarily from two new wells located in South Dakota.	A new water treatment plant would require state and local permits.	LPRW Board will consider technical, administrative and financial needs to build and operate a new water treatment plant.
7. Currently, acreage under crop irrigation appears to be stable in the Holland/North Holland DWSMAs but there may be increased use in any of the vulnerable DWSMAs in the future.	7a. Additional irrigation wells and increased pumping for irrigation may impact aquifer quantity available for public water supply usage. 7b. Irrigation on coarse-textured soils have been shown by studies to increase the potential for leaching of nitrate nitrogen to shallow aquifers.	7a. The DNR controls groundwater appropriation permits that determines the quantity of groundwater usage per user. 7b. Effectiveness of current voluntary BMPs used to address crop irrigation on sandy soils is undetermined	7. Irrigation wells are addressed by the DNR regarding groundwater appropriation permits. 7b. MDA regulates nitrogen fertilizer to reduce potential negative impacts on groundwater. It is unknown if South Dakota regulates groundwater usage or nitrogen fertilizer management
8. Calcareous fens located in Burr DWSMAs will continue to be monitored for hydrologic conditions.	No impact to the LPRW source water aquifers anticipated.	Existing DNR rules or regulations applicable to maintain water levels in fens may be revised in the future.	No additional administrative, technical or financial considerations required for LPRW.

5.1 Summary of Expected Land and Water Use Changes in the LPRW DWSMAs

- There are no major changes in the physical environment within any of the DWSMAs.
- Agricultural land uses are not expected to change although livestock production may increase dependent on market demand. Continued enrollment in long-term crop retirement programs is stable at this time but future enrollment may be contingent on future crop commodity markets and available program funding. However, new state public waters buffer requirements will have some limited impact on row crop acreage.
- Adoption of nutrient management, conservation tillage practices and use of cover crops may increase in the vulnerable DWSMAs.
- LPRW may expand ownership of land in the vulnerable GWCAs of the Holland, North Holland and Verdi DWSMAs.
- There are no expected changes in land uses within the two Burr DWSMAs. Groundwater monitoring of calcareous fens in the Burr DWSMAs will continue.
- No changes anticipated in surface water features in any of the DWSMAs. However, there may be an increase in subsurface tiling in the Holland, Verdi and Burr DWSMAs in the future. Impacts to surface or groundwater resources due to increased subsoil tiling is unknown at this time.
- LPRW does not anticipate an overall increase in water usage from the DWSMA aquifers but there may be an increase in private wells pumping from the vulnerable aquifers for irrigating crops.
- LPRW will be shutting down three primary wells in the Holland (1) and North Holland (2) DWSMAs. However, two new primary wells located in South Dakota are now in production. In addition LPRW will increase the quantity of water purchased from other public water suppliers.
- LPRW anticipates revising water treatment facilities in the Holland and Verdi DWSMAs.

Chapter 6: Issues, Problems, and Opportunities

6.1 Identification of Issues, Problems and Opportunities

LPRW has identified water and land use issues, problems and opportunities related to 1) the aquifer used by LPRW water supply wells, 2) the quality of the well water, or 3) land or water use within the DWSMAs. LPRW assessed 1) input from public meetings and written comments that it received, 2) the data elements identified by MDH during the scoping meetings, and 3) and the status and adequacy of local units of government official controls and plans on land use and water uses, as well as those of local, state, and federal government programs. The results of this effort are presented in the following table which defines the nature and magnitude of contaminant source management issues in LPRW's four DWSMAs.

Identifying the issues, problems and opportunities as well as resource needs enables LPRW to: 1) take advantage of opportunities that may be available to make effective use of existing resources, 2) set meaningful priorities for source management and 3) solicit support for implementing specific source management strategies.

The following tables contain the issues, problems and opportunities identified by the WHP team for:

- The Holland, North Holland and Verdi vulnerable DWSMAs (Table 6-1).
- The Burr DWSMAs (Table 6-2).
- Those issues, problems and opportunities that apply to all DWSMAs (Table 6-3).

Table 6-1
Issues, Problems and Opportunities: Holland, North Holland and Verdi DWSMAs

Holland, North Holland, Verdi DWSMAs				
Issue Identified	**Impacted Feature**	**Problem Associated with the Identified Issue**	**Opportunity Associated with the Identified Issue**	**Adequacy of Existing Controls to Address the Issue**
1. LPRW wells are completed in shallow, channel aquifers in these three DWSMAs.	Aquifers, well water quality and quantity; DWSMAs.	The GWCAs lack sufficient natural protection and are considered vulnerable to contamination.	State, local technical staff could work with LPRW to develop information for citizens regarding the geology of the area. LPRW could apply for funding via the MDH-SWP grant program.	No official controls needed. This would be a voluntary effort to educate citizens, schools and local governments about the local geology and aquifers.
2. Based on existing water quality data each DWSMA exhibits very high vulnerability in each GWCA and high vulnerability in each SWCA.	Aquifers, well water quality and quantity; DWSMAs	The absence of natural protection in the GWCAs, plus large SWCAs that contribute runoff and recharge to the GWCAs.	2a. LPRW can continue to work with local SWCD and USDA-NRCS offices to reduce runoff rates within SWCAs and improve surface water quality. 2b. LPRW could continue to act on opportunities that arise from time to time to convert row crop lands to permanent vegetative cover in GWCAs. 2c. LPRW can explore opportunities for grant funding from both private and public sources.	Efforts to protect vulnerable aquifers from contaminated runoff is dependent on landowners that voluntarily enroll in applicable state or federal soil and water conservation programs and sufficient funding of effective programs.
3. Well water in LPRW wells indicate nitrate-nitrogen concentrations ranging from 4 to 21 ppm.	Aquifers, well water quality and quantity; DWSMAs	3a. Drinking water pumped from the Holland/North Holland DWSMAs must be treated to meet nitrate drinking water standards. 3b. Two North Holland wells and one Holland well will be shut down due to very high concentrations of nitrate in source water.	3a. LPRW could join with state & federal agencies and Pipestone and Lincoln SWCDs to develop a comprehensive public education program addressing nitrogen management on crop lands within vulnerable DWSMAs. 3b. LPRW can formally request assistance from MDA to develop a comprehensive nitrogen management plan for crop producers located in the three vulnerable DWSMAs. 3c. LPRW can apply for a MDH-SWP grant to implement all NO_3-related measures in the WHP plan.	3a. LPRW is required by state and federal drinking water regulations to monitor raw water quality from wells and meet all drinking water quality standards prior to distribution to consumers. 3b. The MDA is the lead state regulatory agency in Minnesota for nitrogen management planning including all sources of nitrogen and has authority to regulate the use of nitrogen fertilizer if necessary to protect groundwater quality.

Table 6-1 (Continued)
Issues, Problems and Opportunities: Holland, North Holland and Verdi DWSMAs

Holland, North Holland, Verdi DWSMAs				
Issue Identified	**Impacted Feature**	**Problem Associated with the Identified Issue**	**Opportunity Associated with the Identified Issue**	**Adequacy of Existing Controls to Address the Issue**
4a. Holland Water Treatment Plant requires modification to meet discharge permit requirements. 4b. Verdi source water may need treatment due to variability of nitrate concentrations in source water.	Aquifers, well water quality.	4a. The treatment process to reduce nitrates from the Holland wells to meet drinking water standards results in discharging high nitrogen levels into downstream waters that do not meet discharge permit requirements. 4b. LPRW will need to seek financing to construct a water treatment plant in the Verdi DWSMA.	4a. LPRW will reduce raw water production from Holland and North Holland DWSMAs in order to meet permitted total dissolved sediment standards for discharge. 4b. LPRW can apply for state and federal revolving fund programs to address infrastructure needs.	LPRW Board has administrative controls to address the issue. A new public water treatment plant proposal must be reviewed and permitted by the MDH and the MPCA.
5. All three vulnerable DWSMAs are dominated by row crops and livestock production.	Aquifers, well water quality.	Loss of nitrate-nitrogen from applied nitrogen fertilizers is an important environmental concern. Nitrate- nitrogen can move downward past the root zone rapidly, directly into aquifers.	5a. Promote adoption of nitrogen BMPs in the GWCAs as a primary priority and the SWCAs as a secondary priority. 5b. Develop and implement a comprehensive public education program addressing nitrogen management on crop lands within vulnerable DWSMAs.	5a. No official controls in place addressing the use of nitrogen fertilizers. Adoption of nitrogen fertilizer BMPs is voluntary. 5b. LPRW can request assistance from the MDA to develop and implement a nitrogen management educational program.
6. There is a potential for reduced funding from state and federal agencies to implement agricultural-related WHP measures and BMPs called for in this WHP plan.	Aquifers, well water quality.	Groundwater contamination by nitrates would likely increase in the three vulnerable DWSMAs.	LPRW can collaborate with other public water suppliers, citizens and organizations to request congressional and state legislative members to provide full funding for agricultural-related BMPs.	LPRW Board would have to contact state and federal elected officials and request action to adequately fund BMPs addressing nitrogen reduction to aquifers.

Table 6-1 (Continued)
Issues, Problems and Opportunities: Holland, North Holland and Verdi DWSMAs

Holland, North Holland, Verdi DWSMAs				
Issue Identified	**Impacted Feature**	**Problem Associated with the Identified Issue**	**Opportunity Associated with the Identified Issue**	**Adequacy of Existing Controls to Address the Issue**
7. Less than one percent of land cover in vulnerable DWSMAs that is classified as wetlands still exist.	Aquifers, well water quality	Loss of wetlands on the landscape reduces potential to remove nitrates prior to surface water infiltrating into aquifers.	Promote targeted wetland restoration in GWCAs as a primary priority and the SWCAs as a secondary priority. Technical and potentially financial assistance is available from the USDA, BWSR or private organizations for wetland restoration.	Current state rules exempt filling or drainage of Type 1 and 2 wetlands on agricultural lands.
8. Crop irrigation in vulnerable DWSMAs.	Aquifers, well water quality and quantity.	8a. Irrigation on sandy soils or shallow soils overlying sands and gravels transports excess nitrate-nitrogen rapidly to underlying aquifers. 8b. High capacity wells may alter the size and shape of a GWCA or cause interference with LPRW's wells.	8a. Promote adoption of irrigation BMPs. 8b. DNR is reviewing all existing appropriation permits to assure sustainable use of vulnerable aquifers. A proposed irrigation well would be subject to groundwater modeling by the DNR/MDH to determine compatibility with LPRW wells prior to permitting.	8a. MDA and UM have developed BMPs addressing irrigation, however, adoption rates are currently low. 8b. There are adequate state rules in place to address ground water appropriation permitting.
9. Subsoil tiling in the Holland and Verdi SWCAs can increase concentrations of nitrates in surface waters that recharge aquifers under the GWCAs.	Aquifers, well water quality.	Loss of nitrate-nitrogen from the soil is an important environmental concern. Nitrates can be conveyed to surface waters via tile lines. The Holland and Verdi aquifers receive direct recharge from surface water in their GWCAs.	Prioritize and promote adoption of subsoil tile BMPs in GWCAs first and SWCAs secondly. Promote and adopt storm water BMPs for agricultural areas.	Subsoil tiling is not regulated in Minnesota except when conducted within certain types of wetlands and public waters.

Table 6-1 (Continued)
Issues, Problems and Opportunities: Holland, North Holland and Verdi DWSMAs

Holland, North Holland, Verdi DWSMAs				
Issue Identified	**Impacted Feature**	**Problem Associated with the Identified Issue**	**Opportunity Associated with the Identified Issue**	**Adequacy of Existing Controls to Address the Issue**
10. Currently there is no comprehensive approach to monitoring and managing ground water quality and quantity within the three vulnerable aquifers.	Aquifers, well water quality and quantity; DWSMAs	There is limited hydrological data available to: a) define aquifer boundaries, and b) quantify the association between SWCA runoff rates and GWCA recharge rates, and c) determine aquifer capabilities during drought conditions.	Development of an effective surface water and ground water monitoring program for each DWSMA would provide a better understanding of water quality and quantity in each aquifer. The MPCA's TMDL study on Pipestone Creek could be a framework for a broader monitoring plan. More effective water management practices can be a result of a comprehensive monitoring program.	Ground water appropriation permits are regulated by the DNR which is currently studying the hydrology of the No. Branch of Pipestone Creek. This study will lead to better understanding of how the Holland DWSMA can provide sustainable water yields for various uses. Pipestone Creek's TMDL process could be a framework for implementing a groundwater/surface water monitoring program.
11. SSTS determined to be imminent public health threats can contaminate aquifers.	Aquifers, well water quality.	SSTS that discharge to the surface could contaminate any of the three aquifers. There is limited SSTS-related data to determine if septic systems are in compliance with local and state standards. It is unknown what septic system standards are in place in South Dakota.	LPRW GWCAs could be made a high priority for SSTS compliance inspections followed by SWCAs. MDH SWP or MPCA grants that may assist in costs to conduct SSTS compliance inspections and improve records. Low interest loan programs available to counties from MDA or BWSR can address SSTS issues in DWSMAs.	Lincoln and Pipestone County have adopted state rules addressing SSTS issues.
12. The Holland and Verdi DWSMAs are a challenge to manage due to large areas, land uses, multiple jurisdictions and varying environmental requirements.	Aquifers, well water quality and quantity; DWSMAs	LPRW has no authority regarding land uses and must rely on multiple counties and states to utilize land use and environmental programs to protect groundwater. A portion of Verdi DWSMA is within South Dakota.	LPRW can request those counties and states that administer land use and/or environmental regulations to collaborate in the development of a coordinated system to track land use or environmental program outcomes to protect groundwater in the three DWSMAs.	Currently, there is no means to readily coordinate management strategies or correlate county or state responsibilities regarding environmental outcomes in the three vulnerable DWSMAs.

Table 6-1 (Continued)
Issues, Problems and Opportunities: Holland, North Holland and Verdi DWSMAs

Holland, North Holland, Verdi DWSMAs				
Issue Identified	**Impacted Feature**	**Problem Associated with the Identified Issue**	**Opportunity Associated with the Identified Issue**	**Adequacy of Existing Controls to Address the Issue**
13. Transportation corridors like major and minor highways, pipelines and a railroad are located within DWSMAs.	Aquifers, well water quality.	Accidental spills of various liquid products from trucks, pipelines or trains could contaminate any of the three aquifers.	LPRW can work with fire departments, state emergency teams, and pipeline and railroad companies to a) increase awareness of the three DWSMA boundaries and geological conditions within each GWCA and SWCA and, b) promote spill response training for local responders.	LPRW can continue to work with MN Dept. of Transportation, Pipestone and Lincoln counties and the Rapid City, Pierre & Eastern railroad and Office of Pipeline Safety to improve communications between all parties and inform all about the potential impact that spills may have on LPRW source water.
14. LPRW does not have any authority to develop or administer official controls regarding the impacts some land uses may have on aquifers used by LPRW.	Aquifers, well water quality and quantity.	Current land use controls or policies in Pipestone and Lincoln counties may be limited in scope to reduce potential impacts of nitrates on groundwater in vulnerable DWSMAs.	14a. LPRW can convert crop land to permanent vegetative cover in the GWCAs by purchase of land or easements from willing property owners in the three vulnerable DWSMAs. 14b. LPRW could request counties to adopt wellhead protection overlay districts and/or other land use practices that would provide greater ground water protection in the GWCAs of each vulnerable DWSMA.	Minnesota does not control land uses on a local level – only counties can develop local land use regulations. It is unknown what type of land use rules the state of South Dakota may have in place to address potential impacts land uses may have on groundwater.
15. Unused or abandoned wells, unpermitted petroleum or chemical tanks, unpermitted manure storage facilities located in the three vulnerable DWSMAs can pose a threat to the aquifers.	Aquifers, well water quality.	Unused/unsealed or poorly maintained wells may provide a direct route for contaminants to reach an aquifer. Smaller fuel or chemical tanks and unpermitted manure storage facilities can leak into aquifers if not managed properly.	LPRW can work with the state and local agencies to continue inventory and prioritize wells, tanks and manure storage facilities and educate owners about best management practices applicable to these PCS within each DWSMA. LPRW can apply for MDH-SWP grants for assistance in addressing unsealed wells within the GWCAs, and developing educational materials addressing tanks and manure storage facilities.	LPRW will need to work with citizens and state and county agencies to: a) locate all wells and promote proper sealing of any abandoned or unused wells located within the three GWCAs; and b) promote BMP practices for smaller tanks and manure storage facilities located within vulnerable DWSMAs.

Table 6-2
Issues, Problems and Opportunities: <u>Burr DWSMAs</u>

Burr North and South DWSMAs				
Issue Identified	**Impacted Feature**	**Problem**	**Opportunity**	**Adequacy of**

		Associated with the Identified Issue	Associated with the Identified Issue	Existing Controls to Address the Issue
1. A better understanding of the hydrologic conditions in the Burr aquifers used by LPRW would benefit future WHPA delineations.	Aquifers, well water quality and quantity, possibly future DWSMA boundaries.	Burr primary wells use three separate sand and gravel aquifers, but current hydrologic data is insufficient to clearly define the properties of each aquifer.	A detailed hydrogeologic study of the groundwater resources in this area would provide valuable information for future groundwater appropriation management.	No official controls needed to conduct a hydrogeological study. However, collaboration with the appropriate Minnesota and South Dakota state agency hydrogeologists would be beneficial.
2. The majority of the area of both DWSMAs are located within South Dakota.	Aquifers, well water quality and quantity, DWSMAs.	Minnesota WHP funding can't be used within DWSMAs outside of Minnesota.	LPRW can a) inform the appropriate South Dakota agency of the WHP plan and b) request future technical and/or financial assistance from South Dakota in managing those portions of the two DWSMAs located in South Dakota.	Currently unknown if South Dakota has any controls regarding the placement, construction or sealing of wells or any funding available to address wells.
3. The PCSI was only completed in those portions of the two DWSMAs that are located within Minnesota.	Aquifers, well water quality and quantity, DWSMAs.	The groundwater flow direction is from the SW (So. Dakota) to the NE (MN), therefore, there is a potential of unused or abandoned wells with unknown locations that could pose contamination issues in the aquifers used by LPRW.	LPRW can work with the appropriate agency in South Dakota to request technical and financial assistance to conduct a PCSI of wells in the two DWSMAs	A well inventory in the South Dakota portions of the DWSMAs would have to comply with any applicable rules administered by South Dakota or their counties.
4. There may be unused or abandoned wells in the two DWSMAs that may be unsealed or poorly maintained.	Aquifers, well water quality.	Unused/unsealed or poorly maintained wells may provide a direct route for contaminants to reach an aquifer.	LPRW can work with the MDH and Yellow Medicine County to continue to inventory and prioritize wells within or near the two DWSMAs. LPRW can apply for a MDH-SWP grant for assistance in locating and sealing wells that are determined to be abandoned or unused within the Minnesota side of the two DWSMAs.	LPRW will need to work with citizens, counties, MDH and South Dakota staff to locate wells and promote the proper sealing of any abandoned or unused wells located within the two DWSMAs.

Table 6-3
Issues, Problems and Opportunities: <u>All LPRW DWSMAs</u>

All LPRW DWSMAs				
Issue Identified	**Impacted Feature**	**Problem Associated with the Identified Issue**	**Opportunity Associated with the Identified Issue**	**Adequacy of Existing Controls to Address the Issue**

1. New high capacity wells constructed in or near DWSMAs may influence the shape and size of WHPAs, GWCAs or DWSMAs.	Aquifer, DWSMA and potentially water well quantity and quality.	1a. A large capacity well could potentially impact the ability of a LPRW's water supply well to supply water. 1b. LPRW doesn't have any controls regarding use or placement of a new high capacity well or pumping rates which may influence the capture area of LPRW wells. 1c. South Dakota may have a different approach to managing high capacity wells than Minnesota.	1a. LPRW will need to work closely with the MDH and DNR to identify any new high capacity wells which may be drilled within or near DWSMAs. 1b. MDH & the DNR can assist LPRW to determine if a high capacity well may influence the capture area of LPRW wells. 1c. Request South Dakota officials to conduct a process to determine is a new high capacity well may impact a LPRW well.	1a. Current Minnesota state law and rules requires all wells to be constructed according to state well construction codes and setbacks. 1b. DNR & MDH consider the potential impact a high capacity well may have on water quality or quantity of a LPRW well prior to permitting. 1c. LPRW would have to contact the appropriate South Dakota agency to determine what regulations or policies are in place regarding high capacity wells.
2. Managing PCSI data base for multiple DWSMAs. No PCSI completed for the majority of the two Burr DSWMAs.	Aquifer, well water quality	2a. Large, highly vulnerable DWSMAs (Holland, North Holland and Verdi) create a large PCSI for each DWSMA is a challenge to manage the PCSI of each DWSMA. 2b. Difficult to develop management strategies for Burr DWSMAs without complete PCSI.	2a. LPRW could apply for a MDH-SWP grant to develop and manage a GIS-based PCSI data base. 2b. LPRW could request the appropriate South Dakota agency to assist LPRW in conducting a PCSI for portions of the Burr DWSMAs.	PCSI data must meet MDH WHP rule data reporting requirements.
3. Budgeting and tracking WHP implementation efforts in each DWSMA	Aquifer, well water quality and quantity.	Variable DWSMA vulnerabilities, primary and secondary priorities (GWCAs and SWCAs), very large areas in most of the DWSMAs, and multiple funding sources and jurisdictions create a complex challenge to manage implementation efforts in each DWSMA and system-wide.	LPRW could apply for grants from appropriate state, county agencies or private organizations to collaborate in the development and implementation of a GIS-based management system that merges implementation measures and current PCSI data.	LPRW Board can take action to develop a WHP management system that meets their needs

Table 6-3 (Continued)
Issues, Problems and Opportunities: <u>All LPRW DWSMAs</u>

All LPRW DWSMAs				
Issue Identified	**Impacted Feature**	**Problem Associated with the Identified Issue**	**Opportunity Associated with the Identified Issue**	**Adequacy of Existing Controls to Address the Issue**
4. LPRW has limited resources to implement the	Aquifer, water well quality and DWSMA.	With limited resources implementing the WHP plan could be a challenge for the LPRW Board.	LPRW could partner with the county and state agencies that may have regulatory authority or	A MDH-SWP grant program is available to a public water supplier with an approved WHP plan to implement the WHP plan.

wellhead protection plan.			programs to assist LPRW in WHP implementation.	
5. Class V drainage wells may be present within any of the DWSMAs.	Aquifer, water well quality and DWSMA.	Motor vehicle repair or maintenance-related facilities using a Class V drainage well may allow oil, grease and other auto-related pollutants to infiltrate into the soil and/or aquifer.	LPRW can provide the public and owners of such businesses with educational materials regarding Class V drainage wells. Counties could adopt ordinances to control the use of Class V wells within a DWSMA.	Federal EPA rules ban Class V drainage wells associated with motor vehicle-related businesses in all WHP areas.
6. It is important to educate the citizens within the DWSMA and county officials and other local or state agencies about LPRW's WHP program.	Aquifer, water well quality and quantity and DWSMA	Periodic turnover in elected officials and staff from various local and state agencies can be a challenge to maintain continuity and momentum in future WHP plan implementation efforts.	LPRW staff can work with MDH SWP or MRWA staff to provide WHP-related information to elected officials, citizens and other local or state technical staff. This keeps decision-makers informed of the importance and need for effective WHP plan implementation as they relate to LPRW's drinking water supply. LPRW could join with Pipestone and Lincoln Counties to develop a comprehensive public education program addressing spills, storm water or nutrient and pesticide management within the DWSMAs.	LPRW can formally request assistance from MDH, MRWA, county environmental offices and SWCDs in the development of appropriate educational materials related to WHP.

6.2 Summary of Issues, Opportunities and Problems associated with LPRW DWSMAs

A. Identified issues within Holland, North Holland and Verdi DWSMAs.
   - LPRW wells are located in geological sensitive, shallow aquifers that are very vulnerable to contamination from nitrate-nitrogen. Nitrate concentrations range from 4 to 21 parts per million across these three DWSMAs.
   - All three DWSMAs are dominated by row cropping and livestock production.
   - Water treatment processes require upgrading and expansion to all three DWSMAs.
   - Less than one percent of land cover in the three DWSMAs is classified as wetlands.
   - Crop irrigation and subsoil tiling as crop management tools contribute nitrates to the aquifers used by LPRW.
   - Transportation (highways, pipeline and railroad) corridors may be a source of accidental spills that could impact the aquifers.
   - Various types of point sources of potential contaminant sources - abandoned wells, tanks, septic systems and manure storage facilities can pose a threat to the aquifers if not properly managed.

B. Identified issues within Burr DWSMAs.
   - Greater understanding of the hydrologic conditions of the Burr aquifers would be beneficial.
   - The majority of the land area of the two DWSMAs are in South Dakota. Consequently, the PCSI was only completed on the Minnesota side of these DWSMAs.
   - There are unused or abandoned wells located in these DWSMAs that may pose a threat to the aquifers.

C. Identified issues that apply to all LPRW DWSMAs.
   - High capacity wells (new or existing) may impact size or shape of a DWSMA.
   - There is currently no comprehensive approach to monitoring and managing groundwater quality and quantity in the aquifers used by LPRW.
   - The DWSMAs are generally of very large size, covering multiple state and local governments and environmental regulations, thereby creating a management challenge to LPRW and partners.
   - There is a need to develop a comprehensive, GIS-based data management and budget plan to keep PCSI current and track WHP implementation efforts in all DWSMAs.
   - A WHP/Groundwater-orientated educational plan should be developed for citizens and elected officials in those areas served by LPRW.

The primary issue facing LPRW is high concentrations of nitrates present in the Holland, North Holland and Verdi aquifers. The surficial geologic and soil properties within the three vulnerable DWSMAs produce rapid surface water infiltration which quickly provide recharge to the three aquifers. Overlying this highly vulnerable geologic setting are dominant land uses that require high levels of nitrogen management: 1) extensive row crop agriculture, 2) livestock production facilities and associated manure management, and 3) irrigation of croplands on soils with rapid infiltration rates.

The WHP team has considered all of the issues, problems and opportunities presented in Tables 6-1, 6-2 and 6-3 resulting in a variety of goals, objectives and implementation actions (Chapters 8 and 9) to address these concerns.

6.3 Comments Received

There have been several occasions for local governments, state agencies and the general public to identify issues and comment on LPRW's WHP plan. At the beginning of the planning process, local units of government were notified that LPRW was going to develop its WHP plan and were given the opportunity to identify issues, as well as to comment. A public information meeting was held to review the results of the delineation of the WHP areas, DWSMAs, and the vulnerability assessments; meetings of the WHP team were open to the public. Also, a public hearing was held before the completed WHP plan was sent to MDH for state agency review and approval.

Chapter 7: Existing Authority and Support Provided by Local, State and Federal Governments

LPRW has no legal authority to control land uses or to develop and implement regulatory programs. Therefore, LPRW will have to rely upon partnerships formed with local units of government and state and federal agencies with regulatory controls or resource management programs in place to help implement its WHP plan. The level of support that a local, state, and federal agency can provide to help offset the risk that is presented by a potential contamination source will depend up on its legal authority as well as the resources that are available to local governments.

7.1 Existing Controls and Programs of LPRW

LPRW has identified the following controls and/or programs that it has in-place that can be used to support the management of potential contamination sources within the DWSMA.

Table 7-1
Controls and Programs of LPRW

Type of Control or Program	Program Description
LPRW has no official controls regarding land uses or environmental regulations.	LPRW must abide by all local, state and federal laws and rules applicable to producing, treating and distributing drinking water.
LPRW establishes fees for providing drinking water to LPRW system customers.	Fees are used to cover costs of producing, treating and distributing drinking water.
LPRW, as an organization or in partnership with others, can apply for grants or loans from federal or state agencies and/or private organizations to assist in funding drinking water protection efforts.	Most grants are typically targeted toward mitigating identified environmental issues impacting groundwater. Grants may also be available to assist in developing efficient data management practices. Federal or state loans may be available to address infrastructure needs (water treatment, distribution, etc.)

7.2 Local Government Controls and Programs

The following departments or programs within Pipestone, Lincoln and Yellow Medicine counties may be able to assist LPRW with issues relating to potential contamination sources that 1) have been inventoried or 2) may result from changes in land and water use within the DWSMA.

Table 7-2
Controls and Programs of Local Agencies

Government Unit	Name of Control/Program	Program Description
Pipestone County Conservation and Zoning Department Lincoln County Environmental Services Department Yellow Medicine County Land and Resources Department	1. Zoning and Conditional Use Permits 2. Shoreland Ordinance 3. Feedlots & manure storage facilities serving <1000 animal units 4. Subsurface Sewage Treatment System (SSTS) Ordinance 5. Solid Waste Program including Household Hazardous Waste Collection 6. Floodplain Management 7. Emergency Management	1. Sets standards and orderly growth of various land uses within a County and allows a County to apply permit conditions to land uses they deem necessary. 2. Sets standards and orderly growth within Shoreland districts adjacent to designated public waters. 3. Sets standards for animal feedlots within a county. 4. Sets standards for septic systems within a county. 5. Provides education to landowners regarding solid waste and a collection program for disposing of household hazardous waste. 6. Administers federal floodplain rules. 7. Emergency response to man-made or natural disasters.
Pipestone, Lincoln and Yellow Medicine County Soil and Water Conservation Districts	1. Agricultural BMPs 2. Well sealing (Yellow Medicine, Pipestone) 3. Wetland management 4. Water Planning 5. Ag BMP programs 6. State Cost-Share programs 7. Reinvest in Minnesota program 8. Clean Water Land and Legacy grant funding programs	All three SWCDs promotes the protection of water and soil resources in the county through educational programs, providing technical assistance to property owners, cost-sharing and collaboration with other local, state and federal agencies.

7.3 State Agency and Federal Agency Support

MDH will serve as the contact for enlisting the support of other state agencies on a case-by-case basis regarding technical or regulatory support that may be applied to the management of potential contamination sources. Participation by other state agencies and the federal government is based on legal authority granted to them and resource availability.

The following table identifies specific regulatory programs or technical assistance that state and federal agencies may provide to LPRW to support implementation of its WHP plan. It is likely

that other opportunities for assistance may be available over the ten-year period that the plan is in effect due to changes in legal authority or increases in funding granted to state and federal agencies. Therefore, the table references opportunities available when LPRW's WHP plan was first approved by MDH.

Table 7-3
State and Federal Agency Controls and Programs
Supporting WHP Plan Implementation

Government Unit	Type of Program	Program Description
MN Dept. of Health (MDH)	State Well Code (MR Chapter 4725) Source Water Protection	MDH has authority over the construction of new wells and sealing of wells. MDH staff in the Well Management Program offers technical assistance for enforcing well construction, maintaining setback distances for certain contamination sources, and well sealing. MDH can provide technical and financial assistance to LPRW for WHP activities and also help identify technical and financial support that other governmental agencies can provide.
MN Dept. of Natural Resources (DNR)	Water Appropriation Permitting (MR Chapter 6115) Public Waters (Shoreland zoning, streams & buffer requirements)	DNR controls permitting of new high capacity wells and requests to increase pumping rates for an existing groundwater or surface water appropriation permit. Establishes special requirements for land uses, vegetative cover and soil disturbances within shore land areas adjacent to protected waters.
MN Pollution Control Agency (MPCA)	Feedlot Rules; Registered Storage Tank; Storm water management; Subsurface Soil Treatment Systems	MPCA regulates minimum state-wide standards for county feedlot regulations and regulates feedlots >1000 animal units and manure storage facilities. Also administers programs addressing liquid storage tanks, septic systems and storm water management.
MN Dept. of Agriculture (MDA)	Nitrogen Management; Chemical Storage and Preparation facilities; Chemical and fertilizer spills;	MDA administers programs which regulate the storage and application of nutrients (fertilizers) and chemicals (pesticides and herbicides) and provide financial and technical assistance programs to farmers.
MN Board of Water and Soil Resources (BWSR)	1 Watershed, 1 Plan Local Water Planning Conservation Implementation Wetland Programs	BWSR programs provide financial and technical assistance to county soil and water districts to implement local conservation programs. Also promotes local and regional watershed planning and wetland reestablishment/restoration efforts.
U.S. Dept. of Agriculture (USDA)	FSA - Federal Farm Bill Programs (EQIP, CRP, CSP, etc.); NRCS - Soil health, soil and water conservation BMP programs; Wetland restoration;	The local USDA Service Center (FSA and NRCS) can provide technical and financial support for qualifying individual property owners and farmers through the current federal Farm Bill programs.

Government Unit	Type of Program	Program Description
	Rural Development - Funding for clean and reliable drinking water systems.	Long term, low interest loans for drinking water sourcing, treatment, storage and distribution
Environment Protection Agency (EPA)	Shallow Disposal Well Program	EPA has the regulatory authority over Class V Injections Well or also known as Shallow Disposal Wells.

7.4 Support Provided by Nonprofit Organizations

The Minnesota Rural Water Association will assist LPRW with implementing its WHP plan by providing 1) reference education and outreach materials for landowners, 2) technical support for implementing specific individual WHP action items listed in the plan, and 3) assisting LPRW with assessing the results of plan implementation.

Chapter 8 – Goals

Goals define the overall purpose for the WHP plan, as well as the end points for implementing objectives and their corresponding actions. The WHP team identified the following goals after considering the impacts that 1) changing land and water uses have presented to drinking water quality over time and 2) future changes that need to be addressed to protect the community's drinking water:

1. **Maintain a safe and adequate drinking water supply for LPRW customers which meet all state and federal drinking water standards.**

2. **Increase awareness among public officials, land owners and the general public about nitrate pollution in aquifers serving the Holland, North Holland and Verdi DWSMAs.**

3. **Reduce nitrate-nitrogen levels in the Holland, North Holland and Verdi aquifers to a level that would no longer require nitrate removal technology to provide safe, potable water to the public.**

4. **Increase awareness among public officials, land owners and the general public about the importance of protecting public drinking water supplies.**

5. **Support the development of a groundwater management plan that addresses drinking water resources within all DWSMAs.**

6. **Support ongoing data collection efforts to enhance current and future WHP activities.**

Chapter 9 - Objectives and Plan of Action

Objectives provide the focus for ensuring that the goals of the WHP plan are met and that priority is given to specific actions that support multiple outcomes of plan implementation. Both the objectives and the wellhead protection measures (actions) that support them are based on assessing 1) the data elements (Chapter 2 and Appendix A), 2) the potential contaminant source inventory (Chapter 4 and Appendix C), 3) the impacts that changes in land and water use present (Chapter 5) and 4) issues, problems, and opportunities referenced to administrative, financial, and technical considerations (Chapter 6).

9.1 Objectives

The following objectives have been identified to support the goals of the WHP plan for LPRW:

1. Communicate with the public about wellhead protection.
2. Utilize community involvement to protect drinking water.
3. Develop and implement a comprehensive nitrogen-reducing program using best management practices on all crop lands within vulnerable DWSMAs to reduce groundwater contamination from nitrates.
4. Identify and engage with partners to define aquifer restoration and/or preservation needs.
5. Manage wells that are owned and operated by LPRW.
6. Provide guidance to private property owners to properly manage potential contaminant sources.
7. Collect, monitor and evaluate data necessary to support WHP Plan implementation.

9.2 Establishing Priorities

WHP measures reflect the administrative, financial, and technical requirements needed to address the risk to water quality or quantity presented by each type of potential contamination source. Not all of these measures can be implemented at the same time, so the WHP team assigned a priority to each. A number of factors must be considered when WHP action items are selected and prioritized (part 4720.5250, subpart 3):

- Contamination of the public water supply wells by substances that exceed federal drinking water standards.
- Quantifiable levels of contamination resulting from human activity.
- The location of potential contaminant sources relative to the wells.
- The number of each potential contaminant source identified and the nature of the potential contaminant associated with each source.
- The capability of the geologic material to absorb a contaminant.
- The effectiveness of existing controls.
- The time needed to acquire cooperation from other agencies and cooperators.
- The resources needed, i.e., staff, money, time, legal, and technical resources.

Nitrate nitrogen has historically been the contaminant of concern for the public water supply wells in the Holland, North Holland and Verdi DWSMAs. Management strategies within each vulnerable DWSMA should continue to focus on minimizing the impact of nitrate sources on the public water supply's aquifers. If opportune, implementation of nitrate reducing measures should concentrate in the GWCAs of each DWSMA first followed by nitrate-reducing efforts within the SWCAs.

9.3 WHP Measures and Action Plan

Based upon these factors, the WHP team has identified WHP measures (actions) that will be implemented by LPRW over the 10-year period that its WHP plan is in effect. The objective that each measure supports is noted as well as 1) the lead party and any cooperators, 2) the anticipated cost for implementing the measure and 3) the year or years in which it will be implemented.

The following categories are used to further clarify the focus that each WHP measure provides, in addition to helping organize the measures listed in the action plan:

A. Education and Outreach
B. Potential Contaminant Source Management
C. Water Resource Planning
D. WHP Coordination, Evaluation and Reporting
E. Monitoring, Data Collection and Assessment
F. Contingency Planning

Appendix D contains tables for each of the above categories that lists each measure that will be implemented over the 10-year period that LPRW's WHP plan is in effect, including the priority assigned to each measure. Unless otherwise specified, all efforts to implement identified measures listed in Appendix D must be summarized by the eighth year after WHP approval to coincide with the beginning of the formal process to amend this current version of the WHP plan.

Dates noted in the tables are a target date to implement the WHP action and may be modified to fit the schedule of LPRW. The WHP Manager is the lead responsible party for all actions so that implementation activity can be tracked. The cost for each action is an estimate and could vary significantly from what is indicated. The in-kind cost means that LPRW is already conducting a related activity and the action is carried out as an item already budgeted through normal LPRW activity. LPRW fully intends to implement all actions listed in Appendix D, however, completion of the action items are subject to the availability of resources sufficient to complete them.

9.4 Commitments from Cooperators

The agencies listed in Table 9-1 have indicated they will support LPRW with implementing the WHP actions as listed in Appendix D in which they are identified. Support levels may vary for implementation efforts over the timeline of this WHP plan based on agency staffing and budgetary requirements.

Table 9-1 – Cooperating Agencies and Assigned Actions

Agency	Education & Outreach	Potential Contaminant Source Management	Land Use Planning	WHP Coordination, Evaluation and Reporting	Monitoring, Data Collection and Assessment	Contingency Planning
County offices	Tables A1 & A-2	Tables B-1 & B-2	Table C	Table D	-	TBD

BWSR	TBD	Table B-2	-	-	-	-
DNR	TBD	Table B-2	-	-	Tables E-1 & E-2	-
MDA	Table A-1	Table B-2	-	-	Tables E-1 & E-2	-
MDH	Tables A1 & A-2	Tables B-1, B2 & B-3	-	-	Tables E-1 & E-2	-
MPCA	TBD	TBD	-	-	TBD	-
MRWA	Tables A1 & A-2	Tables B-1, B-2 & B-3	-	Table D	-	-
SWRDC	-	-	Table C	-	-	-
SWCD	Tables A1 & A-2	Table B-2	-	Table D	-	-
USEPA	-	Table B-1	-	-	-	-

TBD – To Be Determined. Various local, state or federal agencies may provide assistance to LPRW dependent on the resources necessary to implement a particular measure.

Chapter 10 - Evaluation Program

Evaluation is used to support plan implementation and is required under Minnesota Rules, part 4720.5270 prior to amending LPRW's WHP plan. Plan evaluation is specified under Chapter 9.1, Objective 5 and provides the mechanism for determining whether WHP action items are achieving the intended result or whether they need to be modified to address changing administrative, technical, or financial resource conditions within the DWSMAs. LPRW has identified the following procedures that it will use to evaluate the success with implementing its WHP plan.

1. The WHP team will meet, at a minimum, every two-and-one-half years to assess the status of plan implementation and to identify issues that impact the implementation of action steps throughout the DWSMAs; and
2. LPRW will prepare a written report that documents how it has assessed plan implementation and the action items that were carried out over the life of this WHP plan. The report will be presented to MDH at the first scoping meeting held with LPRW to begin amending the WHP plan.

Chapter 11 - Contingency Strategy

The WHP plan includes a contingency strategy that addresses disruption of the water supply caused by either contamination or mechanical failure. LPRW has a Minnesota Department of Natural Resources water supply plan in effect that was approved by the DNR on June 20, 2017 and fulfills the contingency planning requirements for wellhead protection. A copy of the plan is available for public review during regular business hours at the LPRW office located in Lake Benton, Minnesota and is hereby referenced in this section. Appendix E contains the DNR approval letter.

APPENDICES

Appendix A

DWSMA Scoping Documents and Assessment of Data Elements

Appendix B

WHPA and DWSMA Delineation/Vulnerability Reports (Part 1 of the WHP Plan for each DWSMA)

Appendix C

Potential Contaminant Source Inventory, Land Cover and Associated Data

Appendix D

WHP Plan Implementation Measures for All DWSMAs

Appendix E

Supporting Documents