SHAKOPEE MDEWAKANTON SIOUX COMMUNITY

Wellhead Protection Plan

2009

2330 SIOUX TRAIL N.W. PRIOR LAKE, MN 55113

Shakopee Mdewakanton Sioux Community
Wellhead Protection Plan

July 15, 2009

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REQUIRED CONTENT OF WELLHEAD PROTECTION PLAN

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Data Elements; Assessment:	4720.5200	2
Wellhead Protection Area and Drinking Water Supply Management Area Delineation:	4720.5305	3
Vulnerability Assessment:	4720.5210	4
Impact of Changes on Water Supply Well:	4720.5220	7
Issues, Problems, and Opportunities:	4720.5230	8
Wellhead Protection Goals:	4720.55240	9
Objectives and Plan of Action:	4720.5250	9
Evaluation Program:	4720.5270	10
Alternate Water Supply; Contingency Strategy:	4720.5280	11

PUBLIC WATER SUPPLY PROFILE

PUBLIC WATER SUPPLY

System Name: McKenna; Sioux Trail
Operator: Jeremy Gosewisch, Public Works Director
Telephone Number: (952) 496-6176

WELLHEAD PROTECTION TEAM

MANAGER
Name: Scott Walz
Telephone Number: (952) 496-6123

LAND AND NATURAL RESOURCES MANAGER
Name: Stanley Ellison
Telephone Number: (952) 496-6158

SUPPORT STAFF
Name: Ole Olmanson
Telephone Number: (952) 233-4238

GENERAL INFORMATION

System/ Well	Minnesota Unique Well Number	Public Water Supply Number
McKenna / Jordan	554090	940926
Sioux Trail / Jordan	525938	930826
Sioux Trail / Ironton-Galesville	253021	990129

Size of Population Served: 14,720 per U.S. Environmental Protection Agency population equivalent calculation in 2008

County: Scott County, Minnesota

EXECUTIVE SUMMARY

The Shakopee Mdewakanton Sioux Community, hereinafter Community, is a federally recognized Indian Tribe with land in Prior Lake and Shakopee, Scott County, Minnesota. Reservation boundaries contain approximately 3000 acres in the Eastern Broadleaf Forest province (Big Woods) of Minnesota. The Community's land base contains over 200 acres of wetlands, two lakes and several intermittent streams.

Currently there are three public water supply wells in use that provide consumers with water. The McKenna system includes Minnesota Unique Well (MUW) #554090, which provided water to 95 residences in 2008. The Sioux Trail system includes MUW #525938 and MUW #253021. The Sioux Trail System provided water to 117 residences, several businesses including an RV park, Dakota Mall, Dakota Sport and Fitness, Playworks, two casinos and one hotel complex in 2008.

Where possible, this Wellhead Protection Plan (WHPP) follows the recommended guidelines from both the Environmental Protection Agency and the Minnesota Department of Health regarding such a plan. Regular communication between the Community and surrounding local units of government and the general public allowed for public involvement during the preparation process.

The Wellhead Protection Areas (WHPAs) for the Jordan aquifer public water supply wells (PWSs) were originally delineated by the Minnesota Department of Health using a groundwater flow model developed using the U.S. Geological Survey's finite-difference code MODFLOW. The WHPA for the Franconia-Ironton-Galesville aquifer public water supply well was originally delineated by the Minnesota Department of Health using the Metropolitan Area Groundwater Lower Aquifers Model - Layers 4 and 5. This model was developed using the Multi-Layer Analytic Element Model (MLAEM) software. These existing WHPAs were modified using a groundwater flow model built by Barr Engineering Company (Barr). This model code was again based on the U.S. Geological Survey's finite-difference code MODFLOW-2000, and the modeling program GMS 6.0 was used for pre- and post-processing.

Drinking Water Supply Management Areas (DWSMAs) were defined based on the Wellhead Protection Area delineation, and the vulnerability of each DWSMA was assessed. The DWSMAs for both Jordan aquifer wells (MUW #554090 and #525938) were found to have a vulnerability rating of **moderate**. The surficial geology and chemical data were the determining factors for these ratings, because the surficial geology around those wells lacks a consistent protective layer, but age dating indicates slow recharge. The DWSMA for the Ironton-Galesville aquifer well (MUW #253021) was found to be **non-vulnerable** due to the extensive protection offered by the overlying St. Lawrence Formation and the upper part of the Franconia Formation.

The Community Land Department completed a search for all known and possible contaminant sources in the McKenna and Sioux Trail wellfields' DWSMAs. This search included a review of existing environmental databases, the completion of an inner wellhead management zone contaminant source inventory and a potential contaminant source survey conducted by staff in the Community Land, Public Works, Maintenance Departments, Community businesses and the SMSC Gaming Enterprise (GE) which oversees the operation of the casinos and associated businesses.

A Plan of Action was adopted based on the vulnerability assessments and contaminant survey results. It is a three-part strategy based on education, services, and regulation. This approach has been applied to all of our primary and secondary goals.

Our primary goals include safe management of wells and underground storage tanks which pose a potential threat to groundwater resources within wellhead protection areas. Secondary goals include managing stormwater runoff, hazardous waste, and septic systems. Secondary goals are included in this plan to increase the protection of ground and surface water resources above what is offered through the primary goals.

This Wellhead Protection Plan complements other plans adopted by the Community for the management of nonpoint source pollution, wetlands, surface water and groundwater, these plans include the *Non-point Source Pollution Management Plan, The Wetland Management Plan, the Separate Storm Sewer System Spill Response Contingency Plan,* and others.

It is the hope of the SMSC Wellhead Protection Committee that members of the public will be better informed by the information contained herein, and that they will be moved to take action in their individual daily lives to minimize potential problems with the quality of water currently enjoyed by residents of the Shakopee Mdewakanton Sioux Community.

Chapter 1: WELLHEAD PROTECTION PLAN UPDATE

In 2001 the Community adopted Minnesota Rules part 4720.5570, subpart 1, item C as a guideline for amending this Plan. The Community will review and update their Wellhead Protection Plans every ten years to ensure that the plan reflects current conditions within the DWSMA. Minnesota Rules part 4720.5570, subpart 1, item A states that a WHPP update is needed if another well is added to the public water supply system. While another well has not yet been added to the Community water supply system, conditions within the DWSMA have changed enough to warrant the update of this WHP plan.

The update of this WHPP included: 1) a review of Community Land Department GIS data, in order to provide up-to-date land use and natural resource distribution maps; 2) a literature review of new research publications that impact the interpretation of local aquifers, water supply projections, and development plans in surrounding communities; 3) the construction of a more detailed groundwater flow model and subsequent re-delineation of ten-year-time-of-travel zones for each well; and 4) a complete review of federal, state, and local contaminant databases and a field survey of potential contaminant sources within the DWSMAs.

CHAPTER 2: DATA ELEMENTS

Data quality can often be the difference between a valid or invalid natural resource plan. The origin of our data is provided, and data quality is discussed at the conclusion of each data element section and elsewhere in the plan as appropriate. Much of this introductory data is not required under the Minnesota Rules, but has been provided for those who have limited experience with the landscape of south central Minnesota.

1.1 LAND-USE AND PUBLIC UTILITIES

Rapid population growth in the Twin Cities metropolitan area over the past ten years has substantially altered the landscape in and around the Community. Agriculture has traditionally dominated land use in the area, but the growing population has resulted in the conversion of land use from agriculture to residential and light commercial. In 2007, Community lands were 41% agriculture, 15% natural, 13% residential, 9% wetland, 11% commercial, and 11% other (drainage, parks and transportation)(figure 1). These numbers are in a constant state of change.

Community parcels consist of trust and fee lands. Trust lands are those parcels held in trust for the Community by the Federal government; state and local civil regulatory laws do not apply, Federal and tribal environmental laws and regulations are generally applicable. Fee lands are owned by the Community but not held in trust; they are subject to federal, state and local laws. All Community parcels are connected to public water, sewer, gas, and electricity (figure 2). Power utility is provided by the Minnesota Valley Electrical Corporation and the Shakopee Public Utilities Commission. State licensed private contractors provide garbage utility. The Community currently has two public water supply wells in the Jordan aquifer (capable of producing a combined 2200 gal/min) and one in the Ironton-Galesville aquifer (capable of producing 800 gal/min). A fourth water supply well penetrates both the Prairie du Chien and Jordan aquifers (capable of producing 850 gal/min); this well is currently used for irrigation of The Meadows at Mystic Lake golf course but could be connected to the public water supply system in the event of an emergency (Appendix A). A handful of private wells are still active, and the Community is actively working to properly seal these wells as they are abandoned. The Community maintains a connection to the Prior Lake municipal water supply system, providing both communities with emergency water supplies. Community sewer service was provided by the Metropolitan Council's Blue Lake Treatment Plant in Shakopee, MN from 1989 until 2006 when a new waste water reclamation facility was constructed by the Community. The new plant has a designed peak wet weather discharge of approximately 2.78 million gallons of wastewater per day (10,523 m^3/day), although the plant is only expected to discharge a maximum of about 0.64 million gallons on an average day.

Community residential housing consists of approximately one half to one-acre lots. Government and commercial development is focused within the central and southern portion of the reservation and primarily consists of the government center, maintenance buildings and casino-related development.

Land Department staff monitor land use and update records frequently. Utilities information is compiled and stored by Bolton & Menk, Inc.; it is considered moderate quality data due tothe rapid growth of the area, the lack of one consistent surveying crew or method, and the fact that we do not have detailed information for non-tribal lands.

1.2 PHYSICAL ENVIRONMENTAL DATA ELEMENTS

1.2.1 Climate

The Community is located near the boundary between the semi-humid climate regime of the eastern U.S. and the semi-arid regime to the west. Because it is located near the center of the North American Continent, Minnesota is subject to a variety of air masses that control its climate. Precipitation and temperature data were obtained from the High Plains Regional Climate Center (http://www.hprcc.unl.edu). Data from an observation station in Jordan, MN were used. The Jordan station is approximately twenty miles west of the Community and represents the nearest long term high quality data source. The climate data does not play a pivotal role in the management of this wellhead protection plan.

Precipitation:

The primary source of moisture for precipitation in Minnesota is the tropical maritime air that moves into the State from the south and southwest. The spatial variation of mean (normal) annual precipitation across Minnesota is determined by proximity to these moist air masses coming northward out of the Gulf of Mexico. The normal annual precipitation total for the period 1948 to 2004 recorded at the weather station in Jordan, MN is 29.00 inches.

Nearly two-thirds of Minnesota's annual precipitation falls during the growing season of May through September, a period during which the Gulf of Mexico moisture is often available (figure 3). Only seven percent of the average annual precipitation falls in the winter (December through February) when the dry polar air masses prevail.

Temperature:

Normal temperatures follow the approximate seasonal distribution that could typically be expected with warm, humid summers and cold, polar air dominated winters. The normal annual temperature for the period 1948 to 2004 was 54.6°F. July is typically the warmest month of the year while January is typically the coolest (figure 3). Cold, dry continental polar air dominates the winter season, occasionally replaced by somewhat milder maritime polar air. Due to the lack of topographic relief, northern polar air masses can travel out of the arctic unimpeded, resulting in temperatures in excess of forty degrees below zero. During the summer, hot dry continental air masses from the desert southwest share predominance with warm and moist maritime tropical air that originates over the Gulf of Mexico. The spring and fall seasons are transition periods composed of alternate intrusions of air from various sources.

1.2.2 Hydrogeology

The Community's hydrogeologic resources include deep regional bedrock aquifers and shallow perched aquifers in unconsolidated glacial and fluvial sediments (table 1). While a few individual supply wells in the area draw water from the unconsolidated sediments, most wells draw water from the Prairie du Chien and Jordan formations. A few wells penetrate the Franconia, Ironton, and Galesville formations at even greater depth. Local well logs, available online in the Minnesota County Well Index (MN CWI) (http://www.health.state.mn.us/divs/eh/cwi/), provide valuable data about the distribution and thickness of geologic units beneath the Community. Additional information about the character of Community aquifers was determined through three aquifer tests conducted on the Jordan and Ironton-Galesville aquifers (Strobel and Delin 1996; Ruhl 1999; Winterstein 2005) and through revised geologic mapping and geophysical research at the Community by the Minnesota Geological Survey (Runkel et al 2005). A review of regional hydrogeologic research provided a sense of aquifer heterogeneity (Pfannkuch 1998; MPCA 1999, Barrett 2002; Ruhl 2002; Runkel et al 2003; Runkel et al 2006). These resources provide high quality data that has a direct bearing on the delineations and well and drinking water supply management area vulnerability assessments. This in turn has an impact on the development of the goals, objectives, plan of action and management sections of this plan.

Bedrock Hydrogeology:

The Community is located on the eastern side of a buried bedrock plateau capped by the Ordovician Prairie du Chien Group. The Minnesota River flows through a bedrock valley to the north of the Community, where bedrock units are exposed in some places. Bedrock beneath the Community is composed of alternating layers of Paleozoic sandstone, shale, and limestone. Groundwater flows relatively slowly through each aquifer's matrix porosity, but may move very rapidly through secondary pores (systematic and nonsystematic fractures and solution features) found in all bedrock aquifers. In general, groundwater flows in a north-northwesterly direction beneath the Community and discharges in the Minnesota River. Localized groundwater flow in the bedrock aquifers varies due to the variable permeability and thickness of each unit (figure 4).

Since the original Community WHPP, the definition of local aquifers has been refined to reflect our improved understanding of groundwater flow. Many traditional aquifers have been subdivided into multiple aquifers and confining layers. For example, the Prairie du Chien-Jordan aquifer is now known to contain two aquifers separated by a leaky confining unit. The Franconia-Ironton-Galesville aquifer also contains two aquifers with a leaky confining unit between them (Table 1). Hydrogeologic mapping was conducted for the Community by the MGS in 2005. Results are presented in figures 5 and 6.

Aquifer tests and groundwater modeling indicate that the Jordan aquifer behaves as an independent confined porous media aquifer, but well logs and outcrops indicate a hydraulic connection to the overlying partially confined Prairie du Chien Aquifer by fractures and solution cavities (Ruhl 1999, Strobel and Delin 1996, Wuolo 2004, Runkel et al 2005). Aquifer tests, groundwater modeling, geophysical logs and well logs indicate that the Ironton-Galesville aquifer is an independent confined aquifer (Appendix A, B), but geologic maps indicate a possible connection between the Ironton-Galesville aquifer and adjacent surficial and bedrock aquifers in buried bedrock valleys (figure 5) (Winterstein 2006, Wuolo 2004, Runkel et al 2005). CFC-12 analysis of groundwater in the Jordan and Ironton-Galesville aquifers indicate that water being pumped from these aquifers is greater than 50 years old (Table 2) (Strobel and Delin 1996, Winterstein 2005).

Surficial Hydrogeology:

The bedrock aquifers are covered by complex glacial deposits that include outwash terraces near the Minnesota River and till at higher elevations to the south (figure 5). In the SMSC, elevation ranges from a high of 1030 at the water tower on Flandreau Trail to a low of 770 feet above sea level at the far northeast corner of the Community. The escarpment separating these two landscapes is a combination of fluvial sediments and till mixed by slumping and stream erosion. Where these surficial sediments have a relatively low vertical hydraulic conductivity, the water table is perched above the potentiometric surfaces of the bedrock aquifers.

Groundwater flow direction in surficial aquifers is difficult to accurately predict due to complex inter-tonguing between impermeable fine-grained sediment and porous sand and gravel. Ten sediment cores were collected (figure 6) (Appendix A) to illustrate the character of surficial deposits across the Community. On the southern half of the Community, water is perched above an impermeable layer of till; this water table generally mimics topography. Below this perched water table, surficial sediments are often unsaturated. On the northern half of the Community, surficial deposits are primarily sand. In these conditions, groundwater moves vertically down into the bedrock aquifers below. Infiltration on the outwash terraces has been monitored by the SMSC since 2004. The maximum observed infiltration rate is 14 cfs (34,000 m^3/day), following large summer storms. Higher infiltration rates are expected if an upstream culvert is enlarged to allow more flow onto the outwash terrace.

1.2.3 Soils

The primary factors that affect the rate of soil formation include climate, topographic relief, soil parent material, time, and the biologic processes of vegetation and organisms.

A soil survey of the Community trust and fee lands was conducted by Peterson Environmental Consulting, Inc. (2000). When compared to the 1959 Scott County Soil Survey, this survey documents the alteration of over 700 acres of the Community by cut and fill activities associated with residential, commercial, and governmental development. Approximately 20% of this land is now impervious surface (figure 7). The available soil data are considered to be high quality. Their greatest use is providing information for land use management and estimates of recharge potential.

Three soil associations were mapped in the Community. The general distribution of the soil associations is shown on figure 7; these boundaries are not exact and should only be used to quickly estimate the most likely soil in an area. The Estherville-Sparta-Dickman association is characterized by nearly level to undulating, well to excessively drained, loamy soils formed in loess mantled sand and gravel deposits on glacial outwash terraces (Peterson Environmental Consulting, Inc. 2000). Minor components of this association include Kasota and Waukegan soils. This association dominates the northern portion of the Community, on the glacial outwash terraces of the Minnesota River.

The Waukegan-Minneiska-Hayden association is characterized by nearly level to very steep well and moderately well drained soils of the escarpment separating the outwash terraces from the till plain (Peterson Environmental Consulting, Inc. 2000). Minor components of this association include Kasota, Dickman, and Storden soils. This association is found along the transition between the northern outwash terrace and the southern glacial moraine in the central portion of the Community, immediately north of Scott County Road 42.

The Hayden-Le Sueur-Webster association is characterized by gently sloping to moderately steep, well drained to very poorly drained soils formed in loamy calcareous glacial till on uplands (Peterson Environmental Consulting, Inc. 2000). Minor components of this association include Lester, Glencoe, Palms, and Houghton soils. This association dominates the southern portion of the Community, on the glacial till deposits.

The runoff and infiltration rates for soils across the Community vary considerably. In general, the northern portion of the Community is characterized by high infiltration and low runoff potential. The opposite is true for the southern Community, where very high runoff rates lead to very low infiltration (figure 7).

1.2.4 Water Resources

Community lands are fully contained within the USGS 8 digit watershed hydrologic unit code 07020012. Within the Community boundaries are approximately 200 acres of wetlands, 2 miles of streams, and 2 lakes totaling 43 acres (Figure 8) (Community Land Department GIS database 2008). The Community utilizes groundwater from the Prairie du Chien, Jordan, and Ironton-Galesville aquifers. The limited Community surface water resources have no significant recreation resource potential, although they do provide important cultural meaning to the Community.

Land Department staff actively identify and monitor surface water resources on tribal lands and have a high level of confidence in this data. Wetland delineations follow the procedures set forth in the 1987 Federal Wetland Delineation Manual. The surface water quality sampling procedures include stringent quality assurance protocols such as the use of state certified labs for sample analysis, the USGS's established sampling protocols and an EPA approved Quality Assurance Project Plan (QAPP) (SMSC 2005). Groundwater used for domestic water consumption is monitored on a daily basis by the Public Works Department. Monthly and yearly groundwater samples are collected by the Public Works Department and the analysis is performed by a state certified lab. Local groundwater age was determined by the USGS, based on CFC-12 (Stobel and Delin, 1996; Winterstein 2005).

Surface Water

Surface water quality in the Community is affected by a variety of land uses. The most important of these are runoff from parking lots and managed turf, which contribute nutrients and sediment to Community wetlands and lakes. Surface water quality has been monitored since 1999 at selected sites (figure 8), and annual water quality sampling reports are submitted to the Environmental Protection Agency (SMSC 2008). A summary of selected water bodies is included here.

There are two lakes in the Community. Arctic Lake is a 15-acre polymicitic lake located on the southern border of Community owned property. The primary land use affecting the lake water quality has been agricultural activities occurring on steep slopes around approximately 1/4 of the lake (table 3). Mystic Lake is a 65-acre basin located east of County Road 83. The primary land use affecting lake water quality is golf course and residential turf management (table 3). The Community manages approximately 1/4 of the lake. Water quality data collection began in 1999.

Over ten acres of stormwater ponds capture runoff from Mystic Lake Casino parking lots; other stormwater ponds capture runoff from residential lots. Water quality in two Community stormwater ponds is monitored to assess pond efficiency in retaining pollutants. Bluffview Pond is a 1.34-acre stormwater pond constructed to treat runoff from a residential housing development (table 3). Petsch Pond is a 5.12-acre storm water pond constructed to hold stormwater runoff from a combined agricultural and residential area (table 3). Petsch Pond was removed during construction of a new residential development in 2005. Water quality data collection began in 1999.

There are many wetlands in the Community; water samples are collected and analyzed at nine of them (figure 8). Data from two wetlands are included in table 3 to illustrate the variability of Community wetland water chemistry. Wetland C1L is surrounded by commercial development; Wetland S1a is in a wooded and residential area. Water quality data collection began in 1999.

Streams in and around the Community are ephemeral, primarily acting as outlets to overflowing ponds and wetlands following snowmelt and summer rainstorms. Four ephemeral streams flow across the Community, and stream discharge and chemistry data were collected at sites 1-5 during the spring, summer and fall, beginning in 1999. Stream discharge data was collected at Lucky 7 Stream beginning in the summer of 2004. Mean annual results are summarized in Tables 4 and 5 below.

Groundwater

Groundwater is pumped from both individual and public water supply wells in the Community (figure 6). The public water supply wells are found in two small wellfields. The McKenna wellfield currently has only one active well open to the Jordan aquifer, Minnesota Unique Well (MUW) #554090.The Sioux Trail wellfield currently has two active public water supply wells open to the Jordan and Ironton-Galesville aquifers: MUW #525938 (Jordan) and MUW #253021 (Ironton-Galesville). A third well, open to both the Prairie du Chien and Jordan aquifers (MUW #705725) is currently used for irrigation but could be connected to the public water supply in the event of an emergency (Appendix A). Public water supply wells are serviced every five years (Appendix C). Private wells most commonly penetrate the Prairie du Chien-Jordan aquifer. A few private wells draw water from unconsolidated valley fill sediments. The Community is actively working to connect private residences to the public water supply and to properly abandon these wells.

<u>Quantity</u>

The modern Community drinking water supply system was finalized in 1999 with the construction of the Ironton-Galesville well. The Community used approximately 181 million gallons of water in 2008, according to Community Public Works Department. This annual volume is expected to rise in the future with increasing commercial and residential development.

Groundwater Use Projection

The Sioux Trail wellfield supplied water to approximately 120 residences, several businesses, two casinos and a hotel complex in 2008. The McKenna wellfield supplied water to approximately 78 residences in 2008. There is one subdivision of nine homes (called Eagle Creek) that is located several miles away from existing SMSC water lines which has its water supplied by the City of Prior Lake. The meters from these homes provide valuable water use data.

Most Community commercial and governmental water use is metered; residential water use is not. Residential water use in the Sioux Trail wellfield can be approximated by subtracting commercial and governmental water use from the total volume of water pumped from the Sioux Trail wellfield, but this leads to an over estimation of residential water use. Water in the McKenna wellfield is used solely for residential purposes and thus provides a better means for estimating residential water use.

Recreational water use throughout the Community (e.g. swimming pools) continues to grow. Improvements to the water distribution system are also occurring. A new wastewater treatment facility and one-million gallon (3,785 m^3) water tower were connected to the Sioux Trail system in late 2006. A water treatment plant and 100,000 gallon (379 m^3) water tower were added to the McKenna wellfield in 2007.

Data from 1999-2008 was used to predict water needs into the future (figure 9, table 6). Average annual residential water use was determined by examining the water meter records from the Eagle Creek subdivision. The average volume of water used per home per year was determined to be 142,000 gallons (537 m^3) based on data from 2006 and 2007. This includes water for swimming pools, lawn care and small private businesses. During these years, the average daily water use per Community member was approximately 177 gallons (0.7 m^3). In 2002, the Metropolitan Council determined that the average per capita daily demand for Twin Cities municipalities was between 45 and 154 gallons. Average water use per household is assumed to remain constant into the future.

After 2005, most new homes will be built on the northern portion of the reservation, which is supplied solely by the McKenna wellfield (Well #554090). Pumping rates at the McKenna well were projected by multiplying the average annual Community household water use by the number of new homes expected to be built there, and adding this volume to pumping volumes in 2008. New home construction is precisely known due to our small population growth.

Pumping rates in the Sioux Trail wellfield will increase with increasing commercial and governmental development. Commercial and governmental water use was projected by extending the linear trend exhibited from 1994-2008 to 2020 (figure 9). Residential water use will increase relative to new home construction which is well known and predictable.

Beginning in 2000, the Ironton-Galesville aquifer (MUW #253021) provided approximately 75% of the water pumped annually from the Sioux Trail wellfield. The Jordan aquifer (MUW #525938) provided the remaining 25% (Ehresman, 2006). The volume of water pumped from each well varies considerably through the year, however, based on well maintenance needs. It is common for one well to supply 100% of the water for up to almost a year at a time. The current Sioux Trail wellfield pumping schedule is a significant change from the original Community WHPP, which assumed 40% of the Sioux Trail wellfield pumping would be assigned to the Ironton-Galesville aquifer and 60% would be assigned to the Jordan aquifer.

The Community is currently monitoring water level fluctuations in the Ironton-Galesville aquifer to determine the regional effects of pumping from that aquifer. Although there are identifiable impacts, there are no known water-use conflicts at this time.

Age

Water from all three PWS wells (MUW #554090, MUW #525938 and MUW #253021) was age tested by the U.S. Geological Survey using the method "Rasmussen 1993 tank no. 2 Standard Oregon Coastal Air" (table 2). The CFC-12 data indicated that the water in all three wells is more than 40 years old.

Quality

The Community's drinking water is tested daily at the McKenna and Sioux Trail pump houses and throughout the distribution system for chlorine, fluoride, and iron. The drinking water is also tested monthly at the McKenna and Sioux Trail pump houses for bacteria. Community drinking water is tested at the McKenna and Sioux Trail pump houses on a three-year cycle for VOCs, SOCs and IOCs. These tests are requested by the EPA and are based on surrounding land uses. Water in the Ironton-Galesville aquifer was initially tested on 9/10/1998, 5 months before the well was completed. The EPA analyzed the results and the water was deemed acceptable for drinking. Chemistry data can be found in Appendix E. Chemistry data indicate that the Community water supply is not immediately vulnerable to nearby land use activities; levels of nitrate+nitrite, pathogens, VOCs, SOCs and IOCs are consistently below EPA limits for drinking water in all public water supply wells.

CHAPTER 3: WHP AND DWSMA DELINEATIONS

The first component of this Wellhead Protection Plan update was the creation of a new groundwater flow model incorporating revised hydrogeologic parameters for Community aquifers. This model was used to delineate new ten-year time-of-travel zones; these zones were then used to define Drinking Water Supply Management Areas (DWSMAs) for the wells. Please refer to the original WHPP for a description of the original ten-year time-of-travel zone delineation process (Appendix F).

3.1 Groundwater Flow Model Overview

Barr Engineering Co. (Barr) developed and calibrated a three-dimensional, regional, groundwater flow model for the Community in 2004. It was updated to reflect a new water use projection based on data through 2005. The groundwater flow model numerically simulates regional groundwater flow through the surficial drift, Prairie du Chien-Jordan, and Franconia-Ironton-Galesville aquifers using the U.S. Geological Survey's finite-difference code, MODFLOW-2000. It was developed and ran in the graphical user interface GMS 4.0 and was capable of simulating both steady-state and transient conditions. A summary of the model is included below; construction details are included in the report, "GMS4.0/MODFLOW Groundwater Flow Model of the Shakopee Mdewakanton Sioux Community" (Wuolo 2004) (Appendix G).

In 2006 this model was updated to run under GMS6.0. It retains all of the original functionality and now derives benefits from the additional features available with GMS6.0.

This model was built for the purpose of delineating time-of-travel zones for wellhead protection areas and evaluating well interference effects from nearby high-capacity wells.

It is important to understand possible sources of error in the model results in order to use the model appropriately. For example:

- The model assumes that aquifers behave as homogeneous porous media; the model does not consider turbulent flow through discrete fracture zones.
- The low resolution of geologic mapping does not allow consideration of small-scale variability in aquifer properties.
- General estimates of effective porosity are applied uniformly throughout the model; effective porosity controls the shape of particle traces.
- Calibration targets are inherently flawed due to measurements by different people, different years, different seasons, the presence of multi-aquifer wells, the presence of nearby pumping, and inaccuracy in ground surface elevation measurements.

One of the largest sources of uncertainty stems from the model's inability to accurately describe turbulent flow directions and rates through fractures and sinkholes. This problem is partially addressed through the ten-year-time-of-travel zone delineation process.

3.1.1 Data Elements

Sources of model data include hydrogeologic studies, data collection activities, and previously constructed groundwater flow models. Initial model parameter values were based on the Minnesota Department of Health's model (MODFLOW code built in GMS 3.1) for source water protection and the Minnesota Pollution Control Agency's Metro Model (Analytic Element model MLAEM code) (Wuolo 2004). The model was refined using additional hydrogeologic data, including:

- Minnesota Geological Survey bedrock elevation and extent data,
- Minnesota Geological Survey County Well Index (CWI) data,
- Minnesota Department of Natural Resources water appropriations data from 2004 SWUDS database,
- Community aquifer test data for two Jordan wells (Strobel & Delin 1996; Ruhl 1999),
- Community well construction and water use data from a water system analysis report prepared by Bolton & Menk, Inc. (2003), and
- Community Public Works data regarding pumping rates and water usage.

3.1.2 Conceptual Model Description

The general characteristics of groundwater flow in an area are most easily described using a conceptual model which illustrates the extent of the model, the number and type of active aquifers and aquitards, and the locations of groundwater recharge and discharge areas (Figure 10) (Wuolo 2004).

Extent of the Model

Due to the regional scope of wellhead protection planning, this model extends a considerable distance beyond the Community's water supply wells. The model is bounded on the north and northwest by the Minnesota River, the major regional groundwater discharge area. The eastern boundary is the Credit River. The model extends south to the headwaters of the Vermillion River.

Aquifers and Aquitards

The Barr model contains four aquifers and one aquitard. The model does not extend below the Franconia-Ironton-Galesville aquifer, because the Community does not pump from deeper aquifers. The base of the Franconia-Ironton-Galesville aquifer sits on the Eau Claire Formation, a laterally extensive regional aquitard. Model hydrostratigraphy is represented by six layers, although only 5 are active. The lowermost layer (Layer 6) represents the Franconia-Ironton-Galesville aquifer. The remaining layers, in ascending order, are: the St. Lawrence Formation, the Jordan Sandstone, the Prairie du Chien Group, the Unconsolidated Quaternary Aquifer, and the Unconsolidated Aquifer (inactive Layer 1). Table 1 provides more details about the character of these units.

Groundwater Recharge and Discharge

The primary source of recharge to the aquifers is infiltrating precipitation. Recharging precipitation is estimated to be between 2 and 12 inches/year. Aquifer recharge also occurs, in smaller volumes, from leakage through the bottom of perched lakes (e.g. Prior Lake) and from losing streams (e.g. Credit River headwaters) (Wuolo 2004).

The primary source of groundwater discharge is seepage into the Minnesota River. Groundwater discharge also occurs at pumping wells, quarries, and from gaining streams (Eagle Creek and Boiling Springs) (Wuolo 2004).

3.1.3 Model Construction

Model Grid

The model domain is subdivided into grid cells; this is the mesh through which a finite difference model such as MODFLOW solves the differential equations of groundwater flow. The model grid is composed of cells that vary from 10 m^2 near the Community's water supply wells to 500 m^2 at the edges of the model. Not all grid cells are active; inactive cells are those not needed as part of the model computation. Examples of inactive cells include areas where the aquifer is not present or cells that go dry during a simulation.

Layer Thickness

The thickness of each model layer is defined by the difference in base elevation between one layer and the layer above it. Elevation data was obtained from the Minnesota Geological Survey and entered into the model as polygon zones of equal elevation (Wuolo 2004).

Horizontal Hydraulic Conductivity

Values of horizontal hydraulic conductivity (K_H) were determined through the model calibration process. Calculated K_H values from local pump tests fall within model ranges (Ruhl 1999, Winterstein 2005). Initial model parameter values were based on the Minnesota Department of Health's model (MODFLOW code built in GMS 3.1) for source water protection and the Minnesota Pollution Control Agency's Metro Model (Analytic Element model MLAEM code) (Wuolo 2004). Table 7 summarizes the K_H values used in this model.

Leakance

Leakance is a term referring to the ease with which water can move between model layers in response to differences in hydraulic head. In this model, leakance values are used to represent the aquitards between aquifer layers; a low leakance value means that a strong aquitard is present below a layer. Leakance values were determined during the calibration process. Table 8 summarized the leakance values used in the model.

Recharge

Recharge is applied to the top of Layer 2 (the uppermost aquifer in the Community model area). Initial recharge values were based on regional studies and range from 0.0381 to 0.254 meters a year (Wuolo 2004). Final recharge values were determined through the model calibration process. The model includes 16 recharge zones, ranging in value from 0.0 to 1801 x 10^{-6} m/day.

Rivers and Lakes

Rivers and lakes in the model are represented in three ways: as MODFLOW Constant Head cells, Rivers, or Drains. Table 9 lists the MODFLOW packages used to represent rivers and lakes and how surface water features were assigned to these packages.

Constant head boundaries

Because the Community model represents only a small component of the regional groundwater flow system, the model needs to account for groundwater moving in and out of the area as through-flow or under-flow. This was done by assigning constant head cells along the edges of the model domain to simulate regional groundwater flow entering and leaving the model. The initial constant head values for the boundaries were obtained largely by a telescoping mesh refinement approach from the regional MDH Scott-Dakota County model. The model calibration process was used to refine the constant head values. Wuolo (2004) determined that the boundaries are set sufficiently far from the area of interest (Community well field) that they should not meaningfully impact the model results.

Pumping wells (steady state)

The model includes high capacity wells, for which there are water appropriations permit records; examples include water supply wells for Prior Lake and Shakopee. Commercial and industrial wells are also included, when data is available. The average daily pumping rates for these wells were originally calculated from annual reported pumping for 2004, these values were updated in 2006. Bottom and top layers are assigned to each well based on the reported aquifer(s) penetrated according to the SWUDS database from MN DNR. The pumping rates assigned to the Community's three public supply wells were determined based on water use projections of 2011 pumping rates. The model was calibrated using these well locations and pumping rates.

3.1.4 Model Calibration

The steady-state groundwater flow model was calibrated using water level observation targets in all five active model layers reported by the Minnesota Pollution Control Agency in their calibration data base for the Metro Model. A total of 465 equally weighted targets were used.

It is important to note that there is substantial uncertainty in the calibration targets, due in part to:

- Measurements at different locations collected at different times of the year and in different years
- Errors in identifying the aquifer(s)
- Data from multi-aquifer wells
- Inaccuracy in the locations of ground surface elevation points
- Effects from nearby pumping

The calibration was performed automatically using automated inverse model PEST. Based on this method, the model is deemed to be acceptably calibrated when used for the purposes for which it was built (delineating time-of-travel zones for wellhead protection areas and evaluating well interference effects from nearby high-capacity wells).

3.2 Ten-Year Time-of-Travel Zone Delineation

Community Drinking Water Supply Management Areas (DWSMAs) were delineated using a ten-year time-of-travel (TOT) criterion defined by the MDH. The MDH delineates DWSMAs using the largest annual actual or projected pumping rate during the time period 5 years prior to the WHP process and 5 years into the future (Table 10). Community pumping stresses were projected for 2011, and 2006 pumping rates were used for surrounding Community wells (as reported in the MN DNR water appropriation permit database).

3.2.1 TOT Zone Delineation Using Groundwater Flow Model

The computer code MODPATH was used to illustrate the 10-year TOT zones created by Community pumping rates. This code relies on solution files from the MODFLOW model to compute the pathways that water particles take from land surface to the well. Sixty starting particles were set at each well, and each particle was set to move backward in time, away from the well, for 10 years. The area that these particles covered in 10 years is designated as the 10-year TOT zone (Figure 11).

3.2.2 TOT Zone Delineation Using MDH Guidance

A new methodology provided by the Minnesota Department of Health, "Guidance for Delineating Wellhead Protection in Fractured and Solution-Weathered Bedrock", was used to evaluate the potential impacts of secondary porosity on Community public supply well (PSW) capture zone analysis (Minnesota Department of Health, 2005). These guidelines were adopted to consider secondary porosity in Community wellhead protection delineation.

The Ironton-Galesville Aquifer is considered to respond to pumping as an equivalent porous media aquifer because 1) it remains hydraulically confined under pumping conditions, 2) caliper and geophysical logs indicate that the aquifer is minimally fractured (Runkel et al, unpublished report, 2005), 3) an aquifer test indicates the absence of recharge boundaries, and a homogeneous, isotropic aquifer, and 4) chemical, isotopic and physical data indicate that the aquifer water is well-mixed and not subject to rapid chemical or physical changes (USGS, 2005) (Table 2).

The Jordan aquifer is considered to respond to pumping as an equivalent porous media aquifer because it remains hydraulically confined under pumping conditions in the Community. MDH Technique 3 was therefore employed to delineate the 10-year TOT zone for the Sioux Trail Jordan aquifer well (MUW#525938). The porous media numerical groundwater flow model was used to delineate the capture zone for the well, assuming all water was supplied by the Jordan aquifer. MDH WHP Delineation Technique 4 was also used to confirm this conclusion (Minnesota Department of Health, 2005). This method applies to wells that are open solely in porous media aquifers and that are hydraulically connected to fracture or solution-weathered bedrock aquifer.

Step 1

The hydraulic connection between the porous media and fractured rock aquifers was assessed. Jordan aquifer test results indicate that there is a hydraulic connection between the Jordan and overlying Prairie du Chein aquifers in the vicinity of the McKenna Jordan aquifer well (MUW# 554090) (Ruhl 1999).

Step 2

A ten-year, calculated fixed radius was generated for each Prairie du Chien and Jordan well, using the following formula:

$$R = \sqrt{\frac{Q}{nL\pi}}$$

Where:

Q	Volume of water pumped out of the aquifer in 10 years
L	Aquifer thickness, defined as the known transmissive portion of the open borehole. Otherwise, thickness is the lesser of the length of the open borehole or 200 ft.
n	Aquifer porosity

A literature review yielded the aquifer porosity values found in Table 11.

Per MDH guidelines, the aquifer thickness is assumed to be the lesser of the open borehole length or 200 ft. In this case, aquifer thickness is considered to equal the open borehole length.

3.2.3 Comparison of Groundwater Model and MDH Method Results

The volume of water projected to be pumped from the Jordan aquifer over a ten-year period (based on the maximum pumping rate between 2001 and 2011) was compared to the volume of water contained by the aquifers within the 10-year TOT zone delineated by the porous media numerical groundwater flow model. The volume of water contained by the aquifer within the model-delineated 10-year TOT zone was calculated for each well using the following formula:

$$Q = A*n*L$$

Where:

Q	Volume of water contained within model-delineated 10-year TOT zone
A	Area of the modeled 10-year TOT zone, based on the maximum pumping rate between 2001 and 2011
L	Aquifer thickness, defined as the known transmissive portion of the open borehole. Otherwise, thickness is the lesser of the length of the open borehole or 200 ft.
n	Aquifer porosity

Because the difference between the volume of water pumped over ten years based on the maximum pumping rate between 2001 and 2011 and the volume of water stored within capture zones delineated by a porous media groundwater flow model is less than 10% when porosity is estimated within the range of published literature values for these aquifer types, the porous media groundwater flow model is an appropriate tool for delineating the Jordan aquifer wells' DWSMAs.

3.3 Drinking Water Supply Management Area Delineation

The purpose of defining a drinking water supply management area is to determine areas where particular land uses must be specially managed because they have a significant chance of affecting the quality of the drinking water supply. DWSMAs are a reflection of the 10-year TOT zones, but they may be shifted slightly beyond the TOT bounds to follow more easily recognizable landmarks such as roads and section lines.

The Community DWSMAs are defined on Figure 11. Any parcel that is wholly or partially included in the WHPA delineation was included in the DWSMA. DWSMA vulnerability (discussed in Chapter 4) was color-coded to reflect differing levels of management: Zone 1 was defined as 100’ surrounding each wellhead. Zone 2 was defined by parcels that contain any portion of the Community DWSMA. Zone 2 will be the focus of multi-jurisdictional drinking water supply management actions.

The previous Community WHPP included specific descriptions of DWSMA boundaries using Township and Range section numbers and property owner names. Rapid urban development in and around the Community makes identifying individual property owners inappropriate for the updated WHPP.

CHAPTER 4: VULNERABILITY ASSESSMENTS

Wellhead protection rules in Minnesota include assessing both well vulnerability and the vulnerability of the drinking water supply management area. Vulnerability assessments were completed for all three public water supply wells during the initial WHPP process and again during this update.

Vulnerability assessments are needed to: 1) determine the degree of risk that land uses may have on the quality of the groundwater entering the public water supply well, 2) guide the amount of effort needed to conduct an inventory of potential contaminant sources, and 3) help define the measures for controlling potential contaminant sources so they do not present a threat to the public water supply well.

The methods used to calculate the vulnerability assessments for each well and the DWSMA have been previously established and used in Minnesota by the Department of Health.

4.1 WELL VULNERABILITY

Well vulnerability assessments address three components: (1) geologic sensitivity, (2) water chemistry and isotopic composition, and (3) well construction, maintenance, and use. Well construction is further characterized by casing integrity, casing depth, pumping rate and distance from sources of contamination. Each component is assigned points based on the characteristics of that component. The points are summed to give an overall assessment of the well vulnerability. If the total score is 45 or greater, the well is considered vulnerable. If the score is between 5 and 40, priority for the phasing-in of the state's WHP program[i] is referenced to the population served and the well is considered not vulnerable.

Geologic sensitivity, and therefore the intrinsic protection provided by the overlying geologic material, is first determined for each well by calculating an "L" score. The vulnerability assessment worksheets in Appendix G contain the "L" scores and the allocation of points for the wells. An "L" score is described in document, "Assessing Well and Aquifer Vulnerability For Wellhead Protection" produced by the Minnesota Department of Health in 1997:

> *To assess geologic sensitivity determine the cumulative thickness of the confining unit(s) and reduce this value to an "L" score. To do this, divide the thickness which overlies the aquifer by ten and round this value down to the nearest whole number. Then, add these numbers to determine the cumulative "L" score. For example, if a confined aquifer were overlain by two clay units that were 33 feet and 25 feet thick respectively, the "L" score for that well would be:*
>
> $$33/10 + 25/10 = L\text{-}3 + L\text{-}2 = L\text{-}5.$$

Confining units by definition in the DNR method must be at least 10 feet in thickness.

The chemical and isotopic data are assessed by considering nitrate-nitrogen concentrations and tritium units or the carbon content. This component of the vulnerability assessment is intended to determine the relative age of the water and further describe the human impact on the groundwater system. Vulnerable wells typically have water that shows signs of recent recharge, such as concentrations of tritium higher than 1 TU. Age dating or recharge characteristics can also be detected by CFC age dating, as was the case with the Community wells. Elevated levels of nitrates (> 1 mg/l) may also be an indicator of recent recharge.

Well construction considers casing integrity, cased depth, pumping rate and isolation distances. Poor casing integrity, whether cracked or not properly grouted, can allow contaminants to enter the well. Generally, the greater the casing depth is below the land surface the more protection that is offered by the overlying geologic materials. Pumping rate can affect the time that it takes for a contaminant to move to the well. As pumping rates rise, the cone of depression expands and the vertical and horizontal migration of contaminants towards the well tends to increase. Complete Community public water supply well logs are located in Appendix A.

The vulnerability of each well was quantified using a Vulnerability Assessment Worksheet developed by the Minnesota Department of Health. Table 14 gives a brief synopsis of the allocation of points calculated for the vulnerability worksheets. For the complete vulnerability assessment worksheets see Appendix G.

4.1.1 McKenna Wellfield - Jordan aquifer Well

A total score of 35 indicates that this well is **non-vulnerable**. A lack of a definite confining layer will be the most important feature when considering activities regarding this well.

A DNR vulnerability rating of “moderate” is indicated for the McKenna Jordan well, based primarily on the “L” score. An “L” score of zero for this well reflects the lack of an effective confining unit above the aquifer (Appendix A). Although over two hundred and fifty feet of material overlies the open hole, no impermeable layer exists between the land surface and the open well hole. The surficial glacial deposits in the vicinity of the McKenna well are composed of 100 feet of mixed sand and gravel. The Prairie du Chien Group, composed of fractured dolomite with thin sandstone layers, begins approximately 110 feet below the surface and extends to a depth of approximately 263 feet below the surface. The Jordan Sandstone aquifer is below the Prairie du Chien Group; it begins at a depth of 263 feet below land surface. CFC-12 analysis indicated that the water in the well was recharged prior to 1945, suggesting water moving vertically will reach the aquifer within several years to decades (Table 2).

The McKenna well was properly installed on September 26, 1994 by Bergerson Caswell, Inc., a licensed well driller. The casing is steel, welded and grouted throughout according to State specifications. On September 23, 2004 the pump was removed and the well was bailed. Fill was removed from 345’ to 370’ (Nubbe 2005). The casing was video-logged and determined to be intact at that time. The McKenna well is cased from land surface to a depth of 264’. The well is open from 264’ to 370’.

While the pumping rate is highly variable throughout the season, the average pumping rate between 1994 and 2005 was approximately 15 gpm, based on Community Public Works records. The 2011 projected pumping rate is 78 gpm (assuming 40,764,609 gal/year). These average rates represent the total volume of water pumped distributed evenly across the time period considered.

Because the McKenna well is greater than 50’ deep, only contaminant sources within 50’ of the wellhead must be considered in the well vulnerability assessment. There are no sources located within 50’ of the well.

Chemical and isotopic data indicate that the McKenna well has not been impacted by land use activities to date. As mentioned previously, CFC-12 data indicate relatively long flowpaths to this well, allowing time for chemical and biological processes to mitigate some possible contaminants. Very low levels of nitrate-nitrite (0.06 ppm) were noted in August of 2005. Nitrate-nitrite levels have never been recorded at levels greater than 1 ppm at this well. The McKenna well has never tested positive for pathogens. Test results for chemical compounds in the well water have never exceeded the background level (Sahba, 2000).

4.1.2 Sioux Trail Wellfield - Jordan aquifer Well

A total score of 35 indicates that this well is **non-vulnerable**. The proximity of the sanitary sewer line will be the most important feature when considering activities regarding this well.

A DNR vulnerability rating of “low” is indicated for the Sioux Trail Jordan well. An “L” score of 5 for this well reflects the presence of approximately 50’ of till above the aquifer (Appendix A). The surficial deposits in the vicinity of the Sioux Trail Jordan well are composed of 140 feet of glacial drift. Nearby boreholes indicate that the drift is composed of 10’ of sandy clay beneath topsoil, followed by 40’ of till, then 100’ of sand over weathered Prairie du Chien bedrock. The Jordan Sandstone aquifer is below the Prairie du Chien Group; it begins at a depth of 297’ below land surface. The CFC-12 data indicated that the water in the well was pre-1955 water, suggesting water moving vertically will reach the aquifer within several years to decades (Table 2).

The Sioux Trail Jordan well was properly installed on August 26, 1993 by Bergerson Caswell, Inc., a licensed well driller. The casing is steel, welded and grouted throughout according to state specifications. In April 2006, the pump was removed and a large volume of sediment was bailed out of the well. Video-logging revealed a breach in the casing near the wellhead (Downhole Well Services, LLC. 2006). Repairs were made immediately. It is possible that road construction near the wellhead in 2005 compromised the casing. The Sioux Trail Jordan well is cased from land surface to a depth of 307’. The well is open from 307’ to 395’.

While the pumping rate is highly variable throughout the season, the average pumping rate between 1994 and 2005 was approximately 86 gpm, based on Community Public Works Department records. The 2011 projected pumping rate is 113 gpm (assuming 59,450,416 gal/year). These average rates represent the total volume of water pumped distributed evenly across the time period considered.

Because the Sioux Trail Jordan well is greater than 50’ deep, only contaminant sources within 50’ of the wellhead must be considered in the well vulnerability assessment. A sanitary sewer line is located within 50’ of the well, because of this the Community will increase the frequency of video inspections to ensure that any possible leaks are detected and repaired as soon as possible.

Chemical and isotopic data indicate that the Sioux Trail Jordan well has not been significantly impacted by land use activities to date. As mentioned previously, CFC-12 data indicate relatively long flowpaths to this well, allowing time for chemical and biological processes to mitigate some possible contaminants. Very low levels of nitrate-nitrite (0.06 ppm) were noted at the Sioux Trail water treatment plant in August of 2005. The source of nitrogen is uncertain, as both the Jordan aquifer and Ironton-Galesville aquifer were being pumped simultaneously. Nitrate-nitrite levels have never been recorded at levels greater than 1 ppm at this well. Water from the Sioux Trail wellfield has never tested positive for pathogens. Water samples collected in the Sioux Trail water treatment plant tested positive for o-Xylene and p&m-Xylene (0.2 and 0.3 μg/L respectively, which is very near the EPA reporting limit of 0.2 μg/L) in July of 2003. Again, the source of these compounds is unclear because both the Jordan and Ironton-Galesville aquifers were being pumped at that time. It is also possible that these compounds were present due to contamination during the sample collection and analysis process. Test results for chemical compounds in the well water have never exceeded the background level (Sahba, 2000).

4.1.3 Sioux Trail Wellfield – Ironton/Galesville Aquifer Well

A total score of 25 indicates that this well is **non-vulnerable**. The proximity to sanitary and storm sewer lines will be the most important features when considering activities regarding this well.

A DNR vulnerability rating of “very low” is indicated for the Sioux Trail wellfield Ironton-Galesville aquifer well. An “L” score of 15 for this well reflects the presence of approximately 50’ of till and 100’ of impermeable silty dolomite, shale and very fine-grained sandstone above the aquifer (Appendix A). The surficial deposits in the vicinity of the Sioux Trail IG well are composed of 170’ of glacial drift. Nearby boreholes indicate that the drift is composed of 10’ of sandy clay beneath topsoil, followed by 40’ of till, then 100’ of sand over weathered Prairie du Chien bedrock. In the Sioux Trail IG well, Prairie du Chien bedrock is encountered at 168’ below land surface. The Jordan Sandstone aquifer is below the Prairie du Chien Group and begins at a depth of 312’. The St. Lawrence Formation, a regional aquitard, is below the Jordan Sandstone. It begins at approximately 493’ below land surface. The thickness of the St. Lawrence Formation and the upper Franconia Formation, as determined from the well log, is approximately 100 feet. Gamma logs, developed during well construction, substantiate the low permeability unit as approximately 80 - 100 feet thick. The CFC-12 data indicated that the water in the well was pre-1945 water, suggesting water moving vertically will reach the aquifer within several years to decades (Table 2).

The Sioux Trail wellfield Ironton-Galesville aquifer well was properly installed on January 1, 1999 by Mineral Services Plus, LLC, a licensed well driller. The casing is steel, welded and grouted throughout according to state specifications. In November 2004, the pump was removed and the well was bailed. Fill was removed from 625' to 638'; Bailing was stopped after 94 hours (Nubbe 2005). The Sioux Trail wellfield Ironton-Galesville aquifer well is cased from land surface to a depth of 570'. The well was open from 570' to 667' immediately after drilling; the hole is currently open from 570' to 638' due to sediment eroding from the walls of the open hole.

While the pumping rate is highly variable throughout the season, the average pumping rate between 1994 and 2005 was approximately 81 gpm, based on Community Public Works records. The 2011-projected pumping rate is 349 gpm. These average rates represent the total volume of water pumped distributed evenly across the time period considered.

Because the Sioux Trail wellfield Ironton-Galesville aquifer well is greater than 50 feet deep, only contaminant sources within 50' of the wellhead must be considered in the well vulnerability assessment. Sanitary and storm sewer lines are located within 50 feet of the well, because of this the Community will increase the frequency of video inspections to ensure that any possible leaks are detected and repaired as soon as possible. In the past household hazardous waste, heavy equipment, and salt storage were located within 500 feet of the well, all of these potential contaminant sources have been moved and no longer affect this well.

Chemical and isotopic data indicate that the Sioux Trail wellfield Ironton-Galesville aquifer well has not been significantly impacted by land use activities to date. As mentioned previously, CFC-12 data indicate relatively long flowpaths to this well, allowing time for chemical and biological processes to mitigate some possible contaminants. Very low levels of nitrate-nitrite (0.06 ppm) were noted at the Sioux Trail pumphouse in August of 2005. Very low levels of nitrate-nitrite (0.06 ppm) were noted at the Sioux Trail water treatment plant in August of 2005. The source of nitrogen is uncertain, as both the Jordan aquifer and Ironton-Galesville aquifer were being pumped simultaneously. Nitrate-nitrite levels have never been recorded at levels greater than 1 ppm at this location. Water from the Sioux Trail wellfield has never tested positive for pathogens. Water samples collected in the Sioux Trail water treatment plant tested positive for o-Xylene and p&m-Xylene (0.2 and 0.3 μg/L respectively, which is very near the EPA reporting limit of 0.2 μg/L) in July of 2003. Again, the source of these compounds is unclear because both the Jordan and Ironton-Galesville aquifers were being pumped at that time. It is also possible that these compounds were present due to contamination during the sample collection and analysis process. Test results for chemical compounds in the well water have never exceeded the background level (Sahba, 2000).

4.2 DWSMA VULNERABILITY

DWSMA vulnerability examines the vulnerability of the aquifer(s) within the 10-year capture zone of each well. It is based on the amount of geologic protection above the aquifer, usually related to the presents of confining layers such as clay and shale. Logs of water supply wells near the tribal PWS wells, a review of chemical and isotopic data for each well, and a review of local geologic mapping were used in this assessment. The Minnesota County Well Index (MDH, 2006), the Scott County Atlas (Balaban, 1982), and the Community Geologic Map (Runkel et. al., 2005) provide information about the vulnerability of the bedrock aquifers to contamination.

4.2.1 McKenna Wellfield

Jordan Aquifer Well

Recent geologic mapping of the Community by the Minnesota Geological Survey indicates that the surficial geology in the McKenna wellfield DWSMA is characterized by less than 50 feet of clay over more than 50 feet of sand and gravel above bedrock which may be susceptible to rapid recharge (Runkel et al 2005). An interval of fractured limestone at the bedrock surface was noted in a private well drilled less than a quarter-mile from the McKenna wellfield public well, increasing the vulnerability of the Jordan aquifer at this location. There are three documented private wells in the well's 10-year TOT (MDH 2006), although only one penetrates the Jordan aquifer.

The construction of a new subdivision, county road, and associated stormwater containment systems in 2005 and 2006 has increased the number of potential contaminants in the DWSMA. Previous land use was primarily agricultural – pasture and row crops.

The surficial geology was the determining factor in the McKenna wellfield Jordan aquifer DWSMA vulnerability assessment (**Error! Reference source not found.**). Because the surficial geology around the McKenna well is composed primarily of sand, gravel and fractured limestone, the McKenna Jordan aquifer DWSMA was determined to have a **moderate vulnerability**. Long flow paths to the well, indicated by CFC data, suggest the DWSMA does not warrant a "vulnerable" rating.

4.2.2 Sioux Trail Wellfield

Jordan Aquifer Well

The Minnesota Geological Survey map of surficial sediments in the Sioux Trail wellfield Jordan aquifer ten-year time-of-travel zone indicates the presence of at least two thick to moderately thick (ten to over a hundred feet) layers of clayey sediments above the Prairie du Chien bedrock. A minor valley eroded into the Prairie Du Chien bedrock beneath the central Sioux Trail wellfield DWSMA increases the likelihood that the bedrock surface may be characterized by solution-enhanced fractures (figures 5 and 6) (Runkel et. al., 2005). There are no private wells in the well's 10-year TOT (MDH, 2006).

The Sioux Trail wellfield Jordan aquifer DWSMA is approaching maximum development potential, reducing the likelihood of new contaminant sources. Land use, surficial geology and long flowpaths (suggested by CFC data) were the determining factors in the Sioux Trail wellfield Jordan aquifer DWMSMA vulnerability assessment. This DWSMA was determined to have a **moderate vulnerability**.

Ironton-Galesville Aquifer Well

Geologic maps, well logs, chemistry data, and flow meter data indicate that the Ironton-Galesville aquifer has a low vulnerability. An examination of the Ironton-Galesville well and gamma logs (Appendix A, B) revealed that there is a confining layer at an approximate depth of 490 feet. The St. Lawrence Formation and the Franconia Formation extend to an approximate depth 600 feet below the surface. Flow meter logging by the Minnesota Geological Survey indicate that porous media flow supplies the majority of water to the Ironton-Galesville well; large fractures were not present locally (Runkel et al 2005). There are 18 wells that penetrate at least part of the Franconia-Ironton-Galesville aquifer within 4 miles of the Community Ironton-Galesville DWSMA, although none of these wells are located within the 10-year TOT for the well (MN CWI, 2005) (figures 5 and 6). Due to the thickness of the protective layers over the drinking water supply management area, the Franconia-Ironton-Galesville DWSMA was determined to be **non-vulnerable**.

CHAPTER 5: CONTAMINANT SOURCE INVENTORY

The Shakopee Mdewakanton Sioux Community Land Department completed a search for all actual and potential contaminant sources in the McKenna and Sioux Trail wellfields' DWSMAs during the original WHPP process. A new contaminant search was conducted for this updated WHPP. This search included a review of EPA Envirofacts multisystem search engine (www.epa.gov/enviro/index.html), a review of the Shakopee Public Utilities Commission Wellhead Protection Plan, the completion of an Inner Wellhead Management Zone Contaminant Source Inventory following MDH guidelines, and a Potential Contaminant Source Survey conducted by the SMSC Land, Public Works and Maintenance Departments (Table 16, Table 17, Figure 13, Figure 14).

CHAPTER 6: PHYSICAL ENVIRONMENT AND LAND USE CHANGES

To determine the expected changes in the physical environment and land uses within and surrounding Community lands, the following sources were examined (Figure 15):

1. Shakopee Mdewakanton Sioux Community Comprehensive Land Use Plan.
2. City of Prior Lake, Minnesota 2020 Comprehensive Plan.
3. Shakopee WHPP

Due to the limited residential space on tribal lands, it is expected that a majority of the agricultural lands on the fee and trust parcels throughout the reservation will be converted to medium density residential housing. This is a current and future tribal priority as the median age of Community Members is twenty-one years and the population is expected to grow. The majority of future tribal residential expansion is likely to occur outside of both drinking water supply management areas. Because of the proximity to the cities, the agricultural areas adjacent to tribal lands are being converted to residential areas. It is expected that increasing residential area will require additional commercial growth as well.

6.1 Land Use (McKenna DWSMA)

Unlike the Sioux Trail DWSMA, much of the McKenna DWSMA lies outside of the Community's boundary. Approximately 24% of the 140 acre McKenna DWSMA is under the sole jurisdiction of the City of Prior Lake. The McKenna DWSMA is composed of a variety of land uses including agriculture, wetland, urban low/medium density residential, high density residential and institutional. The agricultural lands that currently comprise about 40% of the DWSMA, are non-tribal and have had recent crops of corn and beans. The urban low/medium density land use areas account for approximately 35% of the DWSMA and are under the jurisdiction of Prior Lake and the Community. A fitness complex occupies an 8% section of the DWSMA. A large senior living and church complex has been constructed on land that was formerly agricultural or open space and is considered high density residential. This parcel accounts for about 6% of the total DWSMA area. The remaining 11% is made up of institutional, natural or wetland type land uses.

The City of Prior Lake may convert some of the agricultural areas to medium or high density residential housing. All other areas are projected to remain the same throughout 2020.

The increase in Prior Lake residential housing in the McKenna DWSMA will require additional water but these needs will be met with systems that are already in place. At this time the SMSC Public Works Department anticipates the installation of one additional Jordan well to provide backup to the residents in the McKenna area. If this happens care will be taken during well placement to protect the integrity of the current DWSMA. It is likely that the resulting ten year travel time will overlap with the current DWSMA, in which case the DWSMA would be expanded to accommodate both wells.

6.2 Land Use (Sioux Trail Jordan and FIG DWSMAs)

All of the land within the Sioux Trial Jordan and FIG DWSMAs is owned and managed by the Community. Management options vary from parcel to parcel, however, because non-trust land falls under city, county, and state jurisdiction while trust land is under federal jurisdiction. This has implications for such projects as installing a well or permitting for wetland fill. On trust land the Community is required to follow federal laws. On fee lands the Community is required to follow state laws and local ordinances.

A mixture of commercial, institutional, residential and natural areas is the current dominant land uses in the DWSMA. The commercial landscape consists primarily of a casino/hotel complex and the adjacent parking areas, and a recreational vehicle camping area. The grasslands are primarily managed turf and small sections of managed prairie grasses. Though many changes have been made since 2000, it is unlikely that land use will significantly change in the future.

The engineering firm Bolton and Menk, Inc. was employed to conduct a "consumption and supply" study, which was completed in July 2003. The Sioux Trail Jordan DWSMA and the

FIG DWSMA delineations were provided to the engineering firm so due consideration could be given to system expansion. The conclusions of this study indicated that future water needs can be met with increased storage. This additional storage is now in place.

At this time the SMSC Public Works Department anticipates the installation of one additional Jordan well to provide backup to the Sioux Trail well system. If this happens care will be taken during well placement to protect the integrity of the current DWSMA. It is likely that the resulting ten year time will overlap with the current DWSMA, in which case the DWSMA would be expanded to accommodate all three wells.

6.3 Influences of Existing Water and Land Government Programs and Regulation

The various departments that exist within the Community government influence natural resource management through the programs that are implemented and the regulations that are created. While the natural resource programs are in their early stages, the Community is dedicated to their existence.

Examples include:

Program	Department
Drinking water sampling program	Public Works Department
Education program	Land Department
Erosion control	Land Department
Forest management	Land Department
Parks management	Public Works Department
Land use management	Land Department
Plan review	Land Department
Surface water sampling program	Land Department
Wetlands management program	Land Department
Wildlife management	Land Department

The Land Department interacts with each of the departments and businesses within the Community. This is especially true when new projects are proposed which have the possibility of impacting the natural resources. The Land Department staff also reviews plans from surrounding local communities that have the potential to affect the natural resources of the Community. Pollution control permits and drainage issues are examples of projects that the Land Department is involved with.

The combination of the programs mentioned above ensures that the Land Department staff will have input on new projects that have the potential for impact on ground or surface waters.

6.4 Administrative, technical and financial considerations

The Community is dedicated to maintaining a natural resource staff with technical and administrative capabilities in their respective fields. The staff consists of a Land Manager, an

Environmental Specialist, an Assistant Environmental Specialist, a Water Resource Specialist, and two Water Resource Technicians.

The Land Department staff is funded through a combination of SMSC and grant funds. The staff participates in training for various components of natural resource management depending on the project. The SMSC plans to maintain a natural resource staff into the foreseeable future. Thus, there will be a member of the Land Department that will be capable of implementing and managing the Wellhead Protection Program.

Decisions about financial viability are project dependent. The objectives contained in this WHPP are expected to be financially viable. Numerous funding alternatives will be explored before a goal or objective is considered unattainable. To date, no objectives have been compromised due to financial barriers.

<u>Terms employed in the Land Use Section</u>

<u>Shakopee Mdewakanton Sioux Community</u>
Urban Low/Medium Density Residential – Single family homes on one acre lots
Institutional - government institution and/or government maintained facility
Commercial - retail and/or recreation related business

<u>From -City of Prior Lake, Minnesota 2020 Comprehensive Plan</u>
Rural Density - up to one unit per 40 acres
Urban Low-to-Medium Density - up to 10 units per acre
Urban High Density -up to 30 units per acre

CHAPTER 7: EXPECTED CHANGES TO THE GROUND AND SURFACE WATER

As land surrounding the reservation continues to be converted from agriculture to residential, commercial and industrial land uses, the associated water resources will continue to be stressed due to anthropogenic sources.

The majority of the land use changes within the McKenna Drinking Water Supply Management Area are outside of the jurisdictional control of the Community. Although the Community owns the property within the Sioux Trail DWSMAs, jurisdictional control is shared with the State of Minnesota on portions of the property. On these shared portions the Community is required to follow the standard permitting procedures for most ground and surface water projects.

7.1 McKenna DWSMA

The conversion in land use from agricultural to urban medium or high density will continue to bring about several changes that are relevant to water resources(Table 19).

The following are areas of concern, in order of importance, that are associated with an increase in residential area:

I. Increase in the use of groundwater supplies through domestic water use

II. Increase in impervious area
   - a) Increase in peak flow volumes and rates
   - b) Increase in chemicals (i.e. antifreeze, oil, etc.) associated with parking areas
   - c) Decrease in infiltration recharge

III. Increase in managed turf
   - a) Increase in chemicals (i.e. fertilizer and pesticide) associated with managed turf care
   - b) Additional water supplies needed for managed turf care

IV. Increase in public utilities, including sewer, water, electric, telephone and other public utilities

The increase in the use of consumptive water supplies is a primary concern as it relates to the availability of sufficient water supplies to meet Community needs. The conversion to medium and high density urban housing will require additional water but the city of Prior Lake plans to meet these needs with the current system.

It is expected that the current McKenna system consisting of a well, treatment facility and tower will meet the Community needs for at least 20 years, but an additional well is planned for backup purposes. After development of the forest and agricultural land north of the McKenna DWSMA, The Community will have little remaining open land space in the area of the McKenna well and thus changes to the land use are not expected. The area immediately north of the McKenna DWSMA is currently being developed as low density (1 acre lots).

A land use conversion from agriculture to residential will decrease the amount of pesticides, herbicides and fertilizers used to produce row crops. This decrease in row crop management is likely to be replaced with the high intensity management of turf grass and impervious areas. The associated fertilizers, pesticides, herbicides, metals and salts could have detrimental effects on the receiving surface waters. Surface water contamination could lead to intensified algae blooms, vegetation and wildlife habitat loss and a subsequent lack of diversity in the receiving water bodies. Due to the well location upgradient of new Community development, well depth and the relative age of the water currently being withdrawn, groundwater contamination from the aforementioned contaminants is not a primary concern.

The land use changes will require additional sanitary and storm sewer systems as well as other public utilities. Surface water conveyance structures may be expected to have some impact on the surface water resources however; it is the practice of the SMSC to treat all storm water before allowing infiltration. All other utilities are not expected to impact the ground or surface waters within the DWSMA.

7.2 Sioux Trail Jordan DWSMA

Commercial expansion within and near the DWSMA has occurred steadily since the WHP was originally written and approved in 2002. This expansion is expected to slow as most developable sites have been built out. The commercial expansion that does take place will likely be dominated by small business growth. Since the Tribal Council is aware of the DWSMAs, every attempt will be made to protect the surface and groundwater resources.

The following are areas of concern, in order of importance, that are typically associated with an increase in commercial enterprises:

I. Increase in the use of groundwater supplies through commercial water use and new high capacity wells

II. Increase in impervious surface area
   - a) Increase in peak flow volumes and rates
   - b) Increase in chemicals (i.e. antifreeze, oil, etc.) associated with parking areas
   - c) Decrease in infiltration recharge

III. Increase in managed turf
   - a) Increase in chemicals (i.e. fertilizer and pesticide) associated with managed turf care
   - b) Additional water supplies needed for managed turf care

IV. Increase in public utilities, including sewer, water, electric, telephone and other public utilities

V. Increase in hazardous waste

As with the McKenna well, the conversion of land use from agriculture to residential or commercial will decrease the amount of pesticides, herbicides and fertilizers used to produce row crops. This decrease in row crop management is generally replaced with the high intensity management of turf grass and impervious areas. The associated fertilizers, pesticides, herbicides, metals and salts could have detrimental effects on the receiving surface waters. Surface water contamination could include increased algae blooms, vegetation and wildlife habitat loss and a subsequent lack of diversity in the receiving water bodies. Future storm water retention and detention ponds will be designed to limit infiltration or have treatment prior to infiltration, and reduce the volume and rate of water releases. Due to the depths of each well and the relative age of the water currently being withdrawn, possible groundwater contamination from the aforementioned contaminants is not a primary concern.

The land use changes will require additional sanitary and storm sewer systems as well as other public utilities. Surface water conveyance structures may be expected to have some impact on the surface water resources. All other utilities are not expected to impact the ground or surface waters.

7.3 Sioux Trail FIG DWSMA

Because of the non-vulnerable assessment, the areas of concern associated with the FIG DWSMA are limited to an increase in pumping rates and new high capacity wells. It is expected that an increase in commercial area will result in increased groundwater withdrawals. It is not expected that new high capacity wells will be necessary in the next 10 years.

The following are areas of concern, in order of importance:

I. The increase in the use of groundwater supplies through commercial water use

II. The construction of new high capacity wells

III. Contamination introduced through FIG monitoring wells

CHAPTER 8: PROBLEMS AND OPPORTUNITIES

This section has been designed to identify potential problems and opportunities related to the management of the three drinking water supply management areas. In general, Community land use controls are adequate in the areas of groundwater development and groundwater quality control. The Community has made an effort to complement existing county, city, and regional controls and regulations. Strategies for surface water management including storm water, erosion control, wetland protection, and conservation, are being developed which mimic federal, state and city regulations and ordinance where appropriate. Currently, the Community is working on a water resources management plan that will include surface water management strategies. All proposed projects, Community and non-Community, are reviewed by departmental offices.

Through the compilation of this report, associated public review process and subsequent update of the report, issues of concern (both positive and negative) were seen to fall into two categories: technical concerns and administrative concerns.

8.1 Problems

8.1.1 Technical Problems

The problems presented below relate to each of the three DWSMAs with the exception of the potential contaminants, which is not applicable to the Sioux Trail FIG well based on the non-vulnerable assessment.

1. *Inadequate Data*
   Much of this plan is based on a need for detailed local data. Some data, such as climate and soil data, does not have a dramatic impact on the wellhead protection area delineations or ground water susceptibility to contamination. However, aquifer characteristics, pumping rates, and land use have a very large impact on the assessment and subsequent management of the wellhead protection areas. Land use data, in particular, is a difficult data element to track, due to past changes in land use. A system must be maintained to update this data on a regular basis.

2. *Water Quantity/Quality Concerns*
   The population growth of Prior Lake and Shakopee will require additional groundwater supplies for these communities. The Prairie du Chein/Jordan aquifer has been the first choice for high capacity wells because it is the most economically feasible option. Without intensive investigation in the planning stages of well placement, there may be well interference and supply problems. Currently the Minnesota Department of Natural Resources requires extra scrutiny and monitoring for any possible new Prairie du Chein/Jordan well.

   Well construction within the drinking water supply management areas could influence water supply capabilities, alter the drinking water supply management area delineations, and introduce contaminants into the water supply. Because of recent land acquisitions, the Community's Comprehensive Plan is undergoing changes on a continual basis. Land use projections indicate that the SMSC may need to increase groundwater withdrawals. Also, the rate of increase in groundwater use by Community Members and businesses may require additional water supplies in the future. In 2003 a water system analysis was conducted by Bolton & Menk. This analysis concluded that the water needs of the Community in the next ten to twenty years can be met by increasing storage and by cooperating with the surrounding cities. Both of these objectives have been accomplished since the release of this study.

3. *Potential Contaminants*

   Due to a moderate vulnerability assessment, pesticides, herbicides and nutrients as well as storm water runoff rate, quantity and quality are not a primary concern. The Potential Contaminant Source Inventory revealed several areas of concern that the Community must address to ensure high water quality. The potential contaminants of concern include:

   a) Above ground fuel tanks in close proximity to the McKenna and Sioux Trail Jordan DWSMAs
   b) Underground storage tanks in close proximity to the Sioux Trail Jordan DWSMA
   c) Septic systems within the McKenna DWSMA
   d) Agricultural practices within the McKenna DWSMA
   e) High intensity lawn care within the Sioux Trail Jordan DWSMA
   f) Storm sewer line within 50 feet of well (no. 525938)

8.1.2 Administrative Problems

Multi-jurisdictional Management

The McKenna Drinking Water Supply Management Area crosses into the jurisdiction of Prior Lake. From a management stand point this is seen a potential area of concern. Land uses with known contaminants will be difficult to control outside of Community jurisdiction. These jurisdictional issues are a cause for concern to non-Community members as well. Landowners in the McKenna DWSMA have attended public meetings to express concerns that they will face regulation by the Community. This highlights the need for clear communication between the Community and neighboring residents. One possible resolution is to work closely with surrounding communities to develop a memorandum of agreement which clearly states the jurisdictional roles each body has regarding DWSMAs.

8.2 Opportunities

8.2.1 Technical Opportunities

The cooperation between the Community and the City of Prior Lake has afforded the reality of a connection between water systems for emergency supply and backup uses. Data sharing is also occurring between the Community and the surrounding municipalities.

The construction of a waste water treatment facility has provided the Community with the ability to reclaim water that would otherwise be lost to the surface water system. Treated effluent is routed through a series of ponds leading to The Meadows golf course, this water is used as needed for irrigation on the course. Additionally, the waste water treatment facility was built with a 31,000 sq. ft. green roof to aid in storm water retention and temperature abatement. During dry periods, treated effluent from the facility is used to irrigate the roof.

8.2.2 Administrative Opportunities

1. *Public Education*

   Maintaining the quality of the water is a vital interest to all Community and non-Community members. Through education, services and in a limited number of cases regulation, the drinking water will continue to be of high quality. Educating the businesses and the public about the benefits of protecting the groundwater resource is the preferred option. Limiting the rate of increase in groundwater consumption will require educating business and the public about the primary ways in which water is wasted.

2. *Multi-Jurisdictional Cooperation*

   Although the Community is not mandated under State law to create a Wellhead Protection Plan, the Community is attempting to closely follow the State guidelines for wellhead protection. It is hoped that this procedure will produce uniformity in ground water management strategies among surrounding communities. Because the McKenna and Sioux Trail Drinking Water Supply Management Areas are under multiple jurisdictional authorities, several opportunities have been pursued with Prior Lake, Shakopee, Scott County, and the State. These include:

   a) Cooperative efforts in more accurately defining the groundwater flow regime,
   b) Cooperative efforts in public education, and
   c) Sharing of data.

CHAPTER 9: WELLHEAD PROTECTION GOALS

Through the wellhead protection planning process identified goals were used to establish a set of objectives. A careful examination of the goals and objectives in light of the intended scope and contents of this document led to the development of specific action items. The implementation of these action items will aid in the achievement of the objectives and goals.

9.1 Goals

The development of this report has led to the establishment of the following goals:

Continue to maintain drinking water quality levels that meet or exceed all quality standards
Protect aquifers through proper well management
Reduce contamination risks associated with surface activities
Maintain or improve cooperation with nearby governing bodies in an effort to address regional aquifer protection
Reduce water use per capita
Increase public awareness of groundwater issues

9.2 Objectives

The following objectives were developed to address the stated goals:

1. Limit new well development
2. Locate and seal abandoned wells
3. Ensure proper management of storage tanks
4. Identify new contaminant sources
5. Review current drinking water testing schedules and procedures and develop a Quality Assurance Protection Plan
6. Use a variety of media formats to raise public awareness concerning water quality
7. Consider employing water conservation techniques to achieve a target ratio of maximum daily to average daily pumping rates of 2.6 or less
8. Monitor drinking water supply well pumping data
9. Improve surface water quality through testing and management

9.3 Implementation

Objective 1: Limit new well development

Action 1:	Maintain communication with public works department and surrounding local governments to keep abreast of any well installation plans and encourage placement outside of DWSMAs.
Partners:	SMSC, City of Shakopee, City of Prior Lake
Time frame:	Ongoing
Cost:	Staff time

Objective 2: Locate and seal abandoned wells

Action 2a:	Through the use of the Scott County Well Index, communication with surrounding local governments and land acquisition identify abandoned wells within or near the DWSMAs.
Partners:	SMSC, City of Shakopee, City of Prior Lake, Scott County
Time frame:	Ongoing
Cost:	Staff time

Action 2b:	Seal abandoned wells within DWSMAs on Community held lands or recommend sealing of wells on non-Community lands.
Partners:	SMSC, City of Shakopee, City of Prior Lake
Time frame:	Ongoing
Cost:	Staff time, sealing cost for Community wells

Action 2c:	Maintain database of all wells within or near DWSMAs
Partners:	SMSC
Time frame:	Ongoing
Cost:	Staff time

Objective 3: Ensure proper management of storage tanks

Action 3a:	Require all storage tank owners on Community lands to comply with all applicable regulations regarding above and underground storage tanks and work with any storage tank owners on non-Community lands to comply with their local governing body
Partners:	SMSC, other tank owners
Time frame:	Ongoing
Cost:	Staff time

Action 3b:	Require all storage tank owners on Community lands to submit quarterly reports regarding storage tank use to the Land Department
Partners:	SMSC, local tank owners
Time frame:	Quarterly
Cost:	Staff time

Action 3c:	Provide training for tank owners. Training topics to include maintenance, inspection and safety
Partners:	Any tank owner
Time frame:	Every 2-3 years
Cost:	$400

Action 3d:	Consider having staff member obtain EPA certification for tank inspection
Partners:	SMSC, EPA
Time frame:	Within 3 years
Cost:	$0 (if acted upon there may be travel expense)

Action 3e:	Discourage installation of new storage tanks within or near DWSMAs through agreement with surrounding governing bodies
Partners:	SMSC, City of Shakopee, City of Prior Lake
Time frame:	Ongoing
Cost:	Staff time

Objective 4: Identify new or undiscovered contaminant sources

Action 4a:	Monitor redevelopment or new development plans to check for potential contaminant sources within or near the DWSMAs
Partners:	SMSC, City of Shakopee, City of Prior Lake
Time frame:	Ongoing
Cost:	Staff time

Action 4b:	Maintain communication with emergency response departments regarding spills or other activity that could compromise groundwater health within or near the DWSMAs
Partners:	SMSC, SMSC emergency services, City of Shakopee, City of Prior Lake
Time frame:	Ongoing
Cost:	Staff time

Objective 5: Review current drinking water testing schedules and procedures

Action 5a:	Evaluate current methods for drinking water testing to determine if current activity is sufficient. Develop new methods if necessary
Partners:	SMSC, Public Works staff
Time frame:	Within 2 years of Plan approval
Cost:	Staff time

Action 5b: Work with Public Works Department to develop a Quality Assurance Project Plan for sampling
Partners: SMSC, Public Works staff
Time frame: Within 2 years
Cost: Staff time

Objective 6: Use a variety of media formats to raise public awareness concerning water quality

Action 6a: Redevelop and update department website to provide a dynamic medium for water resources information exchange
Partners: SMSC
Time frame: In progress, ongoing
Cost: Staff time

Action 6b: Use the Community newsletter (Iapi Oaye) to provide information regarding wellhead protection
Partners: SMSC
Time frame: Annually
Cost: Staff time

Action 6c: Make copies of the drinking water Consumer Confidence Report available to the public through mail, track racks or electronically
Partners: SMSC
Time frame: Annually
Cost: Staff time, $0-500 (format dependant)

Action 6d: Use mailings to distribute information regarding WHP issues including proper fertilization techniques, waste disposal, septic system maintenance or feedlot management
Partners: SMSC
Time frame: annually on a rotating basis
Cost: Staff time, postage

Objective 7: Consider employing water conservation techniques to achieve a target ratio of maximum daily to average daily pumping rates of 2.6 or less

Action 7a: Investigate use of irrigation restrictions to conserve or moderate water use. Examples include odd / even house number watering days, or irrigation ban during warmest hours of the day
Partners: SMSC, Business Council
Time frame: Within one year of Plan approval

Cost:	Staff time

Action 7b:	Consider requiring all irrigation systems have precipitation sensors installed to reduce water use when it is unnecessary
Partners:	SMSC, Business Council
Time frame:	Within one year of Plan approval
Cost:	Staff time

Objective 8: Monitor drinking water supply well pumping data

Action 8:	Use SCADA systems to monitor pumping rates and aquifer drawdown on all Community drinking water supply wells
Partners:	SMSC, Public Works staff
Time frame:	Ongoing for Sioux Trail water supply, when installed for McKenna
Cost:	Staff time

Objective 9: Improve surface water quality through testing and management

Action 9a:	Require pre-treatment of storm water before infiltration is allowed
Partners:	SMSC
Time frame:	Ongoing
Cost:	Staff time

Action 9b:	Encourage low impact development to promote groundwater recharge. Examples include rain gardens, porous pavement or green roofs
Partners:	SMSC, Business Council
Time frame:	Ongoing
Cost:	Staff time

CHAPTER 10: PROGRAM EVALUATION

An evaluation program is essential during the management phase of the Wellhead Protection Plan to ensure that the plan of action is proceeding accordingly. The Shakopee Mdewakanton Sioux Community will evaluate the progress of the Plan of Action for the McKenna and Sioux Trail DWSMAs on an annual basis.

The evaluation program exists for several reasons:

1) To ensure that wellhead protection measures are implemented.
2) To evaluate the progress of plan implementation.
3) To make certain that the Wellhead Protection Plan is useful as a reference for tribal planners.

A written Wellhead Protection Program Evaluation Report will be submitted annually to the Environmental Protection Agency in conjunction with the submittal of the Consumer Confidence Report. This timing is preferential as it will include the well water sampling results for the previous year. Copies will also be provided to the Community Business Council, the wellhead protection file, the Minnesota Department of Health and the Minnesota Rural Water Association.

The Evaluation Report will contain a progress report to document implementation of wellhead protection measures during the previous fiscal year. Specifically the progress report will include:

a) The existence and location, with regard to the PWS, of newly discovered potential contaminant sources,
b) Any changes in land use that was not anticipated,
c) New problems or opportunities,
d) An alteration or restructuring of wellhead protection goals,
e) Recent information that would lead to a reassessment of well or DWSMA vulnerability,
f) Any changes in, or the implementation of, the Water Supply Contingency Plan, and
g) The success of the implementation of the plan of action.

CHAPTER 11: WATER SUPPLY CONTINGENCY PLAN

11.1 Purpose

This portion of the Shakopee Mdewakanton Sioux Community Wellhead Protection Plan is intended for use during times when the public water supply suffers partial or total loss of capability to supply water to the consumers.

11.2 Public Water Supply Characteristics

11.2.1 Public Water Supply Source Information

For more information on the public water supply please see Table 20.

11.2.2 Treatment

Sioux Trail System

Water treatment at the Sioux Trail facility is conducted on a daily basis by the Public Works Department. Treatment consists of the following:

- Aeration of raw water
- Pre chlorination
- Addition of potassium permanganate
- Detention
- filtration
- Chemical addition - orthophosphate, fluoride and chlorine

Testing of the Sioux Trail system is also completed on a daily basis for chlorine, iron, manganese and fluoride.

Total coliform tests are performed fifteen times per month at representative sample sites throughout the distribution system. A revised population assessment by the Environmental Protection Agency (EPA) prompted an increase from one per month to its current level.

Other tests, such as metals and VOCs, are conducted according to time lines established by the EPA.

McKenna system

The McKenna facility primarily consists of a pump station with a polyphosphate addition used to sequester the iron and manganese in the water.

Testing of the McKenna system is completed on a daily basis for chlorine and fluoride.

Total coliform tests are performed on a monthly basis at representative sample sites throughout the distribution system.

Other tests, such as metals and VOCs, are conducted according to timelines established by the EPA.

11.2.3 Storage and Distribution

Sioux Trail System

The Sioux Trail System has the capability for 1.3 million gallons of elevated storage. One elevated storage tower (300,000 gal.) is located in Norman Crooks Park adjacent to the Community Center at 2330 Sioux Trail, the second (1 million gal.) is located across from the fire station at 2525 Flandreau Trail. The primary 6” to 10” transmission line for the Sioux Trail water supply follows County Road 83. This system is now looped to allow for the isolation of particular zones.

McKenna Well

The McKenna system has an elevated storage capacity of 100,000 gallons. Individual streets can be isolated throughout the McKenna system. If quantity or quality problems become apparent, service to the non-isolated portions of the system can continue. This system is connected to the Prior Lake water supply which can be utilized during an emergency.

11.2.4 Maps/Plans

Water mains, gate valves and fire hydrants, can be located by obtaining maps from the Public Works Office at 2975 Sioux Trail N.W. Bolton Menk Engineering, Inc. will be contacted should the alternative plans be needed.

11.3 Priority of water users during a water supply emergency

In an emergency, water shortages may exist while the situation is corrected. After the extent of the problem is defined, the next step will be allotting water to consumers. Priorities were established using an overall ranking scheme (Table 21, Table 22). Water consumers were grouped into eighteen categories. These categories were then ranked in order of importance. In the event of an emergency water shortage, consumers or water uses in the lowest ranking categories will not be given access to water until the emergency has been dealt with.

11.4 Alternative Water Supply

11.4.1 Emergency or Backup Wells

The Community has two high production wells serving the Sioux Trail system. One well is withdrawing water from the Jordan Aquifer while the second well is withdrawing water from the Franconia-Ironton-Galesville aquifer. The separate wells provide the capability for mitigation under three circumstances: well contamination, well malfunction, and aquifer contamination. Switching to the other well and flushing the system can mitigate all of these. Both of these wells are connected to the treatment system. The supply system is also looped which allows for isolation of particular areas.

In addition, a high capacity PDC/Jordan well exists and is currently used as supplemental mixing for irrigation water. In an emergency situation, this well could be connected to the Sioux Trail water supply system within two days and act as a back up well until the crisis was resolved. Currently this well is not physically connected to the drinking water system.

The McKenna system is both looped and connected with the Prior Lake water supply system. In the event of an emergency the Community has the option of isolating the affected area or using water from the Prior Lake system as the situation dictates. The McKenna system is planned to be connected with the Sioux Trail system in the next several years, this will provide an alternate water supply for both the McKenna and Sioux Trail consumers.

11.4.2 Emergency Water Supplies, Delivery and Distribution

Mineral Service Plus, LLC is the company responsible for servicing the wells. They have also been contracted to supply water to the Community should total system collapse occur. They have a 2,100 gallon tanker which would be used to transport water from Prior Lake or Savage. Depending on the nature of the problem, the water could be treated and pumped into one of the two (or both) existing pressure storage tanks for Community use. The expected response time for this service is somewhat dependent on weather and the materials needed. In the past, they have provided emergency service to the wells within one to two hours.

In order to ensure the fastest possible response time, communication lines must be clear. The following contact list is on file with Mineral Service Plus, LLC, the Public Works Department, the Land Department, and the Tribal Administrator (Table 23).

11.4.3 Source Management

Because the Sioux Trail system has a well in both the Jordan and Franconia-Ironton-Galesville aquifers, blending water is an option that could be explored. For instance, should the Jordan aquifer exhibit signs of excess nitrates, water could be blended with water from the Franconia-Ironton-Galesville aquifer. However, since water demand currently is not beyond the capabilities of either source of supply, it is more likely that the contaminated source of water would be excluded in preference for the uncontaminated source. In the next several years, the capability may exist for blending McKenna well water with Sioux Trail well water.

11.4.4 Inventory of available emergency equipment and materials

For a list of available emergency equipment and materials, please see Table 24.

11.5 Notification Procedures

Upon discovery of an emergency situation, the Community staff listed in Table 25 will be notified. They will then notify other relevant staff members (Table 26) and coordinate the information release strategy. The information release strategy will depend on the urgency of the situation. Should either the McKenna or Sioux Trail systems become unusable, consumers will be notified by a phone call or house visit immediately. If it is determined that rationing water is necessary, consumers will be notified and provided the information as detailed below.

11.6 Public Information Plan

This portion of the contingency plan is dedicated to the distribution of public information should a quality or quantity problem appear with either the McKenna well or the Sioux Trial wells. This will also apply to problems discovered in the distribution system.

All public notices will contain the following information:

1. A description of the violation or situation, including contaminant levels, if applicable,
2. When the violation or situation occurred,
3. Any potential adverse health effects (using standard health effects language from Appendix B of the public notification rule of the standard monitoring language),
4. The population at risk,
5. Whether alternative water supplies should be used,
6. Procedures that consumers should follow,
7. What the system personnel are doing to correct the violation or situation,
8. When the water system expects to return to compliance or resolve the situation,
9. The name and phone number of the water system operator, and
10. A statement encouraging distribution of the notice to others, where applicable.

Quality

Emergency notice templates have been developed by the Environmental Protection Agency and are based on a tiered system. What is described below is the trigger mechanism of a public notice.

Tier 1 (Immediate Notice, Within 24 Hours)

Notice as soon as practical or within 24 hours via radio, TV, hand delivery, posting or other method specified by Environmental Protection Agency, along with other methods if needed to reach persons served. Public water suppliers must initiate consultation with the EPA within 24 hours. The EPA may establish additional requirements during consultation.

- Fecal coliform violations; failure to test for fecal coliform after initial total coliform sample tests positive
- Nitrate, nitrite, or total nitrate and nitrite MCL violation; failure to take confirmation sample
- Chlorine dioxide MRDL violation in distribution system; failure to take samples in distribution system when required
- Exceedance of maximum allowable turbidity level, if elevated to Tier 1 by primary agency
- Waterborne disease outbreak or other waterborne emergency
- Other violation or situations determined by the primacy agency

Tier 2 (Notice as Soon as Possible, within 30 days)

Notice as soon as practical or within 30 days. Repeat notice every three months until violation is resolved. Community water suppliers: notice via mail or direct delivery. All public water suppliers must use an additional delivery method reasonably calculated to reach other consumers not notified by the first method.

- All MCL, MRDL, and treatment technique violations, except where Tier 1 notice is required
- Monitoring violations, if elevated to Tier 2 by primary agency
- Failure to comply with variance and exemption conditions

Tier 3 (Annual Notice)
Notice within 12 months; repeated every twelve months for unresolved violations. Notices for individual violations can be combined in an annual notice (including the CCR, if public notification requirements can still be met). CWSs: Notice via mail or direct delivery. NCWSs: Notice via posting, direct delivery, or mail. The EPA may permit alternate methods. All PWSs must use additional delivery methods reasonably calculated to reach other consumers not notified by the first method.

- Monitoring or testing procedure violations, unless the EPA elevates to Tier 2
- Operation under a variance and exemption
- Special public notices (fluoride secondary maximum contaminant level (SMCL) exceedance, availability of unregulated contaminant monitoring results)

The primary spokesperson for the media and/or public comment in the event of an emergency or contamination incident will be:

Bill Rudnicki
Tribal Administrator

Cell Phone	**Work Telephone**
612-964-6963	**952-496-6145**

Since the Community is relatively small, information will be distributed directly to the Community members through a team that will be assembled by the Tribal Administrator.

11.7 Mitigation and Conservation Plan

11.7.1 Mitigation

The mitigation section of the Contingency Plan identifies ways to reduce the vulnerability of water supply system to disruption and to improve the Community's response capabilities.

A. Infrastructure maintenance/upgrades/maps
The Sioux Trail system is maintained on a daily basis. As necessary, the chemical feed pumps are maintained and/or refurbished, the service pumps, valves and piping are inspected, and the filter bed is regenerated. Maps are updated as new equipment or distribution lines are installed.

B. Regular inspection of tower, well and pump house
Tower inspection is completed quarterly. The process involves climbing the tower and visually inspecting the tower. The well and pump house are

inspected daily. This includes a visual inspection of the valves, the treatment system and the distribution system.

C. Staff emergency training
Training needs are dictated and scheduled by the Public Works Coordinator. Personnel are trained according to system need, which includes emergency response.

D. System valving to isolate problems
Both the McKenna and Sioux Trail systems have numerous locations that allow for isolation. Now that the systems are looped, the capability exists for the shutdown of portions of the system, while other parts of the system are being fixed, maintained or treated.

E. Sanitation procedures for construction repairs
After construction or maintenance the system is flushed and then chlorinated for 24 hours.

11.7.2 Conservation

a) Public Education:
An education campaign is currently in place. Throughout the development of the Wellhead Protection Plan, Community Members have been kept informed through public notices and newsletter articles. In 1999 a Water Resource Protection Packet was distributed to Community Members. This packet contained ground and surface water information, methods of conservation and pollution prevention, a magnet with conservation methods and a recycling guide. Efforts such as these will be continued periodically.

b) Ordinances:
Several ordinance options are being explored. One such option that has worked well in moderating spikes in residential water use in Shakopee, MN is aimed at reducing the amount used for lawn and landscape maintenance. This ordinance allows lawn watering on even sides of the street on even days of the month and the odd sides of the street on odd days of the month, time restrictions may also be employed to reduce water loss due to evaporation during periods of high temperature. Required use of low flow devices and rainfall gauges used in conjunction with sprinkling systems are additional options that are under consideration.

c) Re-use:
The SMSC water treatment plant uses reverse osmosis to soften the community water supply. This action eliminates the need for commercial and residential water softening units. As a result, the waste water treatment plant effluent will be a viable source for irrigation which will reduce overall pumping values.

CHAPTER 12: PROCEDURES FOR AMENDING AN EXISTING PLAN

As land designation and use continue to evolve around the drinking water supply management areas, amendments to the existing plan will need to be addressed. Amendments are required in the following two cases:

1. The plan must be amended whenever a new well is added to the public water supply system.

2. MDH guidelines stipulate that this plan must be amended every ten years. To ensure that the amendment is finalized before that time, the process must begin no later than eight years after the EPA and MDH approve the initial plan.

This amendment process will allow for changes in the WHP area boundaries to reflect the pumping effects of new wells. Specifically, these new wells may change ground water flow boundaries and/or change the ground water flow field.

The amendment process will follow the same procedures used to develop the initial plan. The Documentation List located at the beginning of this plan details the procedures used to develop this plan.

Plan amendments will also follow the same criteria used in the initial plan. This includes criteria for evaluating vulnerability ratings, determining DWSMA boundaries, assessing potential contaminates, and creating management objectives.

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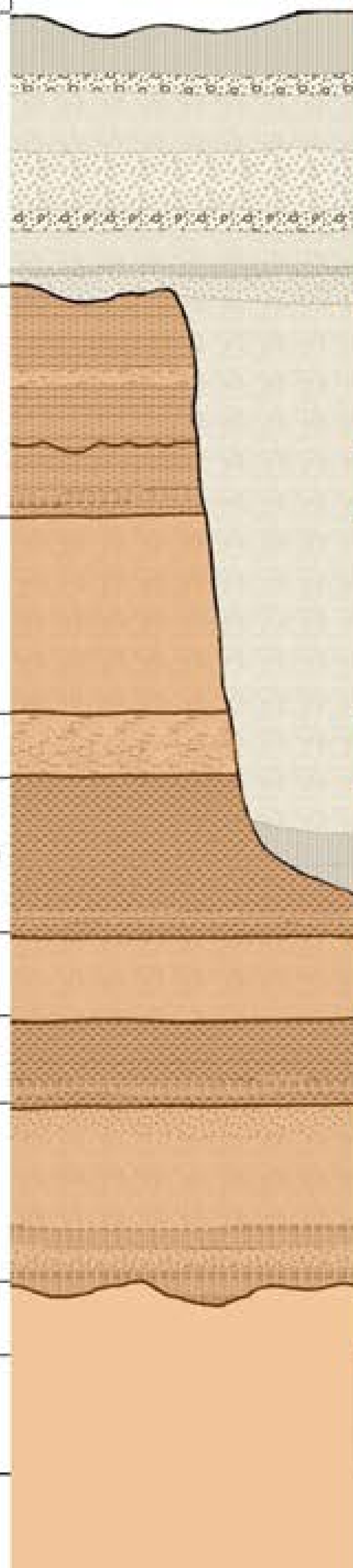
Hydrostratigraphy of the Shakopee Mdewakanton Sioux Community
Scott County, Minnesota

Erathem	System or Series	Formation Or Group *Map Symbols*		Thickness (ft) at SMSC FIG wells	General Lithology near SMSC	Hydrogeologic Unit and Water-bearing Characteristics
Cenezoic	Quaternary	Unconsolidated Glacial Sediments		145-252		**UNCONSOLIDATED QUATERNARY AQUIFER OR CONFINING UNIT** *Horizontal Hydraulic Conductivity (K) (ft/d): 1.61 – 137.14 (Wuolo 2004)* *Sand and Gravel Horizontal K (ft/d): 25 (from grain size analysis of local sediment core)* *Recharge Rates (ft/d): 0.0015 – 0.0019 (Ruhl et al 2002)* Glacial drift serves as a confining unit to the underlying Prairie du Chien - Jordan aquifer. Drift includes outwash, ice-contact, till, lake, terrace, and valley fill deposits. Surficial aquifers can be found in sand and gravel lenses that sit above lower permeability till, where the low hydraulic conductivity of the till prohibits vertical migration of surficial aquifer water. Lateral migration of ground water is likely prohibited from rapid transport by the small pore spaces of the clay till. The local water table is a reflection of these aquifers.
Paleozoic	Lower Ordivician	Prairie du Chein Group *Op*	Shakopee Formation	88-144		**SHAKOPEE PARTIALLY-CONFINED AQUIFER:** *Horizontal K (ft/d): 163 (Runkel et al 2003); up to 1,000' (Stobel & Delin 1996)* *Vertical K (ft/d): 1.75 (Runkel et al 2003)* *Leakage (ft/d): 0 - .0027 (Ruhl et al 2002)* Hydraulic conductivity is primarily due to joints, fractures, and solution cavities in the sandy, dolomite.
			Oneota Dolomite			**ONEOTA LEAKY CONFINING UNIT:** *Horizontal K (ft/d): 7.5 x 10^{7} (Runkel et al 2003)* *Vertical K (ft/d): 1.5 x 10^{4} (Runkel et al 2003)*
	Upper Cambrian	Jordan Sandstone *Cj*		100-181		**JORDAN CONFINED AQUIFER:** *Horizontal K (ft/d): 31 (Ruhl 1999); 25.1 - 40.7(Stobel & Delin 1996)* *Transmissivity (ft^2/d): 6,267 (Ruhl 1999); 4,710 - 7,660 (Stobel & Delin 1996)* *Storativity: 1.193 x 10^{-4}(Ruhl 1999); 8.24 x 10^{-5} - 1.6 x 10^{-4}(Stobel & Delin 1996)* *Ratio of Vertical to Horizontal K: 5.29 x 10-4 (Ruhl 1999)* Hydraulic conductivity is primarily due to flow between course sand grains.
		St. Lawrence Formation *Cs*		45-58		**ST. LAWRENCE LEAKY CONFINING UNIT:** *Vertical K (ft/d): 7.9 x 10^{-5} - 4.6 x 10^{4} (Kanivetsky 1998); 10^{-3} - 0.1(Stobel & Delin 1996); 0 .328 (Wuolo 2004).* Glauconitic quartz sandstone & shale w/occasional dolomite.
		Franconia Formation *Cf*	Reno & Tomah Members	130 - 150		**UPPER FRANCONIA CONFINED AQUIFER:** *Horizontal K (ft/d): <30 – 1,000 (Runkel et al 2005); 1.3 – 7.5 (Runkel et al 2006)* Bedding plane fracture dominates flow.
			Birkmose Member			**LOWER FRANCONIA CONFINING UNIT:** *Vertical K (ft/d): 10^{-3} - 10^{-1} (Runkel et al 2006)*
		Ironton & Galesville Sandstones *Cig*		65-77		**IRONTON-GALESVILLE CONFINED AQUIFER:** *Horizontal K (ft/d): 10 – 14.4 (Winterstein 2003); 1.6 – 7.9 (Runkel et al 2006)* *Transmissivity(ft^2/d): 450-650 (Winterstien 2003)* *Storage coefficient: 4.2 – 5.7 x 10^{-5} (Winterstein 2003)*
		Eau Claire Formation *Cec*		65-80 (USGS)		**EAU CLAIRE CONFINING UNIT** *Horizontal K (ft/d): 0.3 to 3.1(Hunt et al 2003)* The unit consists of interbedded siltstone, mudstone and shale with scattered beds of very fine-grained quartzose sandstone (Hunt et al 2003).
		Mt. Simon Sandstone *Cms*		140-165 (USGS)		**MT. SIMON – HINCKLEY CONFINED AQUIFER** *Horizontal K (ft/d): 4.9 (Hunt et al 2003)* Medium to coarse-grained, poorly cemented quartzose sandstone may contain pebbles to granules of quartz in lower 20' as well as thin beds of mudstone. Fine to coarse-grained quartzose sandstone of the Hinckley sporadically overly the interbedded shale and arkosic sandstone of the Fond du Lac Formation (Stobel & Delin 1996).
Precambrian	Middle Proterozoic	Hinkley & Fond du Lac Formations *MPs*		>1000 (USGS)		
		Solor Church Formation		>1000 (USGS)		**PRECAMBRIAN BASEMENT CONFINING UNIT** The Hinckley and Fond du Lac Formations are composed of interbedded mudstone, siltstone and lithic sandstone (Stobel & Delin 1996). Underlying basalt flows have been largely inferred from gravity and magnetic studies (Stobel & Delin 1996).
		Chengwatana Volcanic Group *MPc*		>1000 (USGS)		



Legend

Dolomite	Sandstone	Sand
Limestone	Crystalline Basement	Clay
Shale	Gravel/Boulders	

Table 1. Generalized regional SMSC hydrostratigraphic column

MUW #	Sample Date	Temp (C)	Estimated Recharge Elv. (ft asl)	[CFC-12] (pmol.kg)	Modeled CFC-12 Recharge Date	Notes
554090	7/9/96	10	880	0.0	1940	Slight contamination with CFC-11?
554090	7/9/96	10	880	0.0	1940	Very old water
554090	7/9/96	10	880	0.0	1940	Recharged before 1940
525938	7/9/96	10	960	6.4	1951.5	Slight contamination with CFC-11?
525938	7/9/96	10	960	8.9	1953.5	Very old water
525938	7/9/96	10	960	8.6	1953.5	Recharged in the 1950's or earlier
253021	9/8/05	11.9	1000	0.005	1942	Early 1940's or older water with some CFC-11 contamination
253021	9/8/05	11.9	1000	0.011	1945	Early 1940's or older water
253021	9/8/05	11.9	1000	0.009	1944	Early 1940's or older water

Table 2. Community groundwater age, based on USGS CFC-12 analysis.

Mean Annual Parameter Value	Mystic Lake	Arctic Lake	Bluffview Pond	Petsch Pond (thru 2004)	Wetland C1L	Wetland S1a
Total Phosphorus (mg/l)	0.107	0.153	0.114	0.259	0.138	0.208
Orthophosphate (mg/l)	0.008	0.005	0.019	0.082	0.009	0.037
NO_2 + NO_3 (mg/l)	0.013	0.019	0.045	0.127	0.019	0.029
Chlorophyll A (mg/l)	58.000	78.000	34.500	21.484	26.680	12.644
Total Kjeldahl Nitrogen (mg/l)	1.824	2.867	1.180	1.190	1.630	1.070
Ammonia (mg/l)	0.022	0.061	0.020	0.050	0.200	0.040
Total Suspended Solids (mg/l)	16.30	16.00	5.27	8.50	11.47	7.81
Temperature (C°)	19.11	20.03	22.44	20.42	19.08	19.29
pH	8.61	8.52	8.33	8.19	7.36	7.20
Specific Conductivity (μS/cm)	465	406	728	200	884	1053
Total Dissolved Solids (g/l)	0.297	0.260	0.466	0.128	0.566	0.674
Dissolved Oxygen (mg/l)	9.06	8.98	9.43	8.19	3.44	3.27
Redox (mV)	417	375	397	419	370	307

Table 3. Mean annual lake, pond and wetland water chemistry

This data is for selected water bodies in the Community bsed on data collected between 1999 and 2006.

Discharge	Stream 1	Stream 2	Stream 3	Stream 4	Stream 5	Lucky 7
Min (m^3/sec)	0.000	0.000	0.000	0.000	0.000	0.000
Mean (m^3/sec)	0.283	0.327	0.271	0.097	2.411	0.052
Max (m^3/sec)	4.613	4.669	7.970	8.892	34.891	0.391

Table 4. Maximum, mean and minimum discharge

Based on data collected from 1999 to 2006 for streams located in the Community. Lucky 7 Stream data from June 2004 to December 2005.

Mean Chemistry Value	Stream 1	Stream 2	Stream 3	Stream 4	Stream 5	Lucky 7
Total Phosphorus (mg/l)	0.08	0.09	1.23	1.15	0.22	NA
Orthophosphate (mg/l)	0.050	0.049	0.868	0.050	0.094	NA
$NO_2 + NO_3$ (mg/l)	6.00	5.26	6.56	0.13	0.04	NA
Chlorophyll A (mg/l)	5.84	7.50	18.20	6.77	2.94	NA
Total Kjeldahl Nitrogen (mg/l)	0.63	0.65	4.31	0.80	1.06	NA
Ammonia (mg/l)	0.02	0.03	0.98	0.08	0.025	NA
Total Suspended Solids (mg/l)	6.79	16.29	19.41	6.36	11.4	NA
Temperature (C°)	16.50	16.31	20.53	18.15	16.41	18.43
pH	7.79	7.99	7.32	7.18	7.30	7.97
Specific Conductivity (µS/cm)	550	540	850	1001	1154	1027
Total Dissolved Solids (g/l)	0.352	0.3454	0.544	0.641	0.738	0.660
Dissolved Oxygen (mg/l)	8.56	9.26	4.68	3.88	6.42	7.69
Redox (mV)	420	430	381	248	401	416

Table 5. Mean water chemistry values

Based on data collected from 1999 to 2005 for streams located in the Community. Lucky 7 Stream data from May 2005 to September 2006.

Year	McKenna Jordan (MUW #554090)	Sioux Trail Jordan (MUW #525938)	Sioux Trail IG (MUW #253021)
1994	3,258,780	35,230,306	*Not online*
1995	3,960,600	48,858,251	*Not online*
1996	5,651,400	67,956,936	*Not online*
1997	6,669,005	85,615,999	*Not online*
1998	7,948,400	95,302,700	*Not online*
1999	9,873,200	14,385,454	92,718,945
2000	14,534,400	3,032,521	110,967,739
2001	11,943,600	48,736,309	84,335,191
2002	10,048,800	35,472,923	90,049,777
2003	9,929,500	51,828,000	92,737,500
2004	9,192,000	79,176,000	27,246,000
2005	12,099,000	55,288,000	79,640,000
2006	11,663,700	13,046,100	136,596,000
2007	15,636,233	76,474,000	68,992,000
2008	24,646,000	147,304,000	8,663,000

Table 6. Volume of water pumped (gallons) from Community public water supply wells

Layer	Number of K_H Zones in Layer	Range of K_H in Layer
1	NA	NA
2	8	0.492 to 41.8 m/day
3	8	3.972 to 66.959 m/day
4	11	0.5 to 76.922 m/day
5	2	0.1 and 5 m/day
6	2	2 and 5 m/day

Table 7. Hydraulic conductivity zones (K_h)

The number and range in values of horizontal hydraulic conductivity (K_H) zones in the SMSC numerical groundwater flow model (Wuolo 2004).

Layer	Number of Leakance Zones in Layer	Range of Leakance in Layer
1	NA	NA
2	16	1.7 to 405.25 x 10^{-6}/day
3	13	1.7 to 7003 x 10^{-6}/day
4	2	1.7 and 17 x 10^{-6}/day
5	2	1.7 and 17 x 10^{-6}/day
6	NA	NA

Table 8. Groundwater model leakance zones

The number and range in values of leakance zones in the SMSC numerical groundwater flow model (Wuolo 2004).

Model Package	Package Assumptions	Surface Water Feature
Constant Head	The water level elevation in the aquifer is user-defined at specific locations. Appropriate at locations where the piezometric elevation is well known, or is known to be relatively constant through time.	Credit River - lower reach
River	The water elevation (stage) in the river feature is user-defined and assumed to never run dry. A river feature transmits water to the aquifer at a rate determined by the hydraulic head difference between river stage elevation and piezometric elevation in the aquifer adjacent to the 'river'.	Credit River - upper reach Deans Lake Flood Plain Lakes Minnesota River Prior Lake
Drain	A stage elevation for the drain feature is calculated by the model, based on the modeled piezometric elevation surface. If the piezometric surface drops below the drain feature, the drain will go dry.	Eagle Creek Former Shiely Quarry Kraemer Quarry

Table 9. MODFLOW packages used

MODFLOW packages used in the SMSC numerical groundwater flow model (Wuolo 2004).

Community Well ID	Year of Max Pumping from 2001 to 2011	Steady State Pumping Rate for Modeled 10-Year TOT Delineation
McKenna Jordan	2011	423 m^3/d (77 gpm)
Sioux Trail Jordan	1998	938 m^3/d (172 gpm)
Sioux Trail IG	2011	1,439 m^3/d (264 gpm)

Table 10. Model pumping rates

Steady-state pumping rates used to delineate ten-year time of travel zones in the SMSC numerical groundwater flow model.

Aquifer	Porosity Value	Data Source
Prairie du Chien Group	0.056	Norvitch and others, 1973
Limestone	0-0.2	Freeze and Cherry, 1979
	0.07 – 0.56	McWhorter and Sunada, 1977
	0.01 – 0.30	Fetter, 1980
	0.01 – 0.1	Todd, 1959
Jordan Sandstone	0.318	Norvitch and others, 1973
Sandstone	0.05-0.30	Freeze and Cherry, 1979
	0.14-0.49	McWhorter and Sunada, 1977
	0.03 – 0.30	Fetter, 1980
	0.1 – 0.2	Todd, 1959

Table 11. Published range in bedrock aquifer porosity values.

Community Well ID	Volume pumped out of aquifer in 10 years at rates used to delineate TOT zones	Aquifer thickness (L)	Estimated Aquifer Porosity (%)*	Calculated, ten-year, fixed radius for each well (R)
McKenna Jordan	1,543,950 m^3 (407,868,400 gal)	32 m (106 ft)	3% (min)	715 m (2,347 ft)
			49% (max)	177.04 m (580 ft)
			25.8% (optimal)	*244 m (800 ft)*
Sioux Trail Jordan	3,423,700 m^3 (905,238,400 gal)	29 m (94 ft)	3% (min)	1,119 m (3,6721 ft)
			49% (max)	277 m (909 ft)
			29.7% (optimal)	*356 m (116 ft)*

Table 12. Ten-year calculated fixed radius for SMSC PWS wells

,Using MDH delineation recommendations (MDH 2005).
*Three estimates of aquifer porosity were used to evaluate the validity of using the porous media numerical groundwater flow model to delineate capture zones for wells in aquifers affected by karst development. Minimum and maximum porosity estimates were used to identify the likely range in well capture zone size. The porosity estimates defined as “optimal” result in less than 1% difference between the volume of water projected to be pumped from the Prairie du Chien and Jordan aquifers over a ten year period (based on the maximum pumping rate between 2001 and 2011) and the volume of water contained by the aquifers within the 10-year TOT zone delineated by the groundwater flow model.

Community Well ID	Area of the modeled 10-year TOT zone	Aquifer thickness (L)	Estimated Aquifer Porosity (%)	Volume of water contained within model-delineated 10-year TOT (Q)
McKenna Jordan.	186,749 m^2 (46 acres)	32 m (106 ft)	3% (min)	179,279 m^3 (47,360,500 gal)
			49% (max)	2,928,224 m^3 (773,554,900 gal)
			25.8% (optimal)	*1,541,780 m^3 (407,295,200 gal)*
Sioux Trail Jordan	396,095m^2 (98 acres)	29 m (94 ft)	3% (min)	344,602 m^3 (91,034,220 gal)
			49% (max)	5,628,505 m^3 (1,486,894,000 gal)
			29.7% (optimal)	*3,411,563 m^3 (901,239,600 gal)*

Table 13. Delineation technique comparisons

Comparison of numerical groundwater flow model delineation results and MDH Technique 4 delineation results.

Well ID	WELL VULNERABILITY Rating	WELL VULNERABILITY Justification	DWSMA VULNERABILITY Rating	DWSMA VULNERABILITY Justification
McKenna Wellfield:				
MUW #554090	Non-Vulnerable	Lack of potential contaminant sources	Moderate	Water >40 years old
Sioux Trail Wellfield:				
MUW #525938	Non-Vulnerable	Presence of confining layer	Moderate	Water >40 years old
MUW #253021	Non-Vulnerable	Presence of multiple protective confining layers	Low	Presence of confining layers; water >40 years old

Table 14. Summary of Community well and DWSMA vulnerability determinations.

	McKenna Wellfield MUW #554090 *(Jordan aquifer)*		Sioux Trail Wellfield MUW #525938 *(Jordan aquifer)*		MUW #253021 *(Ironton-Galesville aquifer)*	
	Points	Description	Points	Description	Points	Description
DNR Vulnerability Rating	25	"L" score: 0	15	"L" score: 5	0	"L" score: 15
Casing Integrity	0	Properly Installed	0	Properly Installed	0	Properly Installed
Casing Depth	5	264'	5	307'	0	570'
Pumping Rate	5	78 gpm: projected 2011 average annual rate	5	113 gpm: projected 2011 average annual rate	5	264 gpm: projected 2011 average annual rate
Isolation Distance from contaminant source	0	No sources	10	sanitary sewer	20	Sanitary and storm sewer
Chemical and isotopic information	0	CFC-12: <1940	0	CFC-12: <1954	0	CFC-12: <1945
Total Score	**35**		**35**		**25**	
Assessment	***Non-vulnerable***		***Non-vulnerable***		***Non-vulnerable***	

- If the score is 45 or more, the well is considered vulnerable.
- If the score is between 5 and 40, priority for phasing into the state's WHP program is referenced to population served.
- If the score is 40 or less, the well is considered not vulnerable.

Table 15. Community PWS well vulnerability assessment summary.

Table 16. Actual and potential contaminant sources within the Sioux Trail DWSMA.

Parcel ID	Site Name	Address	Potential Source	Priority	Information Source
252710010	Shakopee Dakota Convenience Store	15035 Mystic Lake Drive NW Prior Lake MN 55372	Underground Storage Tank (4), Gasoline Service Station	High	SMSC Potential Contaminant Survey
252710150	Shakopee Dakota Convenience Store Car Wash	2515 Dakota Trail NW Prior Lake MN 55372	Registered Storage Tank	High	SPUC WHP
252710210	Shakopee Mdewakanton Sioux Community	2546 Flandreau Trail NW Prior Lake MN 55372	FIG Monitoring Well	High	CWI
252710270	Shakopee Mdewakanton Emergency Services	2525 Flandreau Trail Prior Lake MN 55372	Chemical Storage Facility; Heavy Equipment Storage	High	SMSC Potential Contaminant Survey
253010020 259280020 271820010	Meadows at Mystic lake	15451 Howard Lake Rd NW Prior Lake MN 55372	Fertilizer & Pesticide application	Low	SMSC Potential Contaminant Survey
259280100	Little Six Casino Land Department Cindy Stade-Lieske Amy Stade Nathan Crooks Tracy Stade Alicia Crooks Cherie Crooks-Bathel Danny Crooks	2330 Sioux Trail Prior Lake, MN 55372 2211 Sioux Trail 2211 Sioux Trail 2301 Sioux Trail 14580 Mystic Lake Blvd 2390 Sioux Trail 2370 Sioux Trail 14740 Mystic Lake Blvd	Aboveground Storage Tanks, Chemical Storage, Emergency Generator, Private and Public Wells	High	SPUC Wellhead Protection Plan, SMSC Potential Contaminant Survey, EPA Envirofacts Database, CWI, SMSC Records
259330050	Mystic Lake Casino Hotel – Laundry Department and WRF	2680 154th Street NW Prior Lake MN 55372	Chemical Storage Facility, Permitted Discharges to Water	High	SMSC Potential Contaminant Survey; EPA Envirofacts Database

Parcel ID	Site Name	Address	Potential Source	Priority	Information Source
259330051	Meadows at Mystic Lake, Dakotah Meadows RV Park, Mystic Lake Casino Hotel, Playworks	15616 Howard Lake Rd NW Shakopee MN 55379	Fertilizer & Pesticide application, Golf Course, AST, Chemical Storage Facility, Heavy Equipment Storage, unsealed well, Gasoline Service Station, Hazardous Waste Site (RV pump), Underground Storage Tank , Aboveground Storage Tanks, Hazardous Waste Handler, Golf Course	High	SMSC Potential Contaminant Survey
259330100	Little Six Casino	2330 Sioux Trail NW Prior Lake MN 55372	Closed dump, AST	Moderate	SMSC Land dept records
259330111	Mystic Lake Casino Hotel	2330 Sioux Trail NW Prior Lake MN 55372	Aboveground Storage Tanks, Air Releases Reported	Moderate	SMSC Potential Contaminant Survey, EPA Envirofacts Database
279290010	Shakopee Mdewakanton Sioux Community	3200 Dakota Parkway Prior Lake MN 55372	Well 250096 & 1 Uncertain Well	Low	CWI, SMSC Records
NA	Shakopee Mdewakanton Sioux Community	2330 Sioux Trail NW Prior Lake MN 55372	Cemetary	Low	SMSC Potential Contaminant Survey
NA	ST DWSMA	throughout	Municipal sewage line	Low	SMSC Land dept records
NA	ST DWSMA		3 Stormwater basins	Low	SMSC Land dept records
NA	ST DWSMA	throughout	Wetlands	Low	SMSC Land dept records

Table 17. Actual and potential contaminant sources within the McKenna DWSMA.

Parcel ID	Site Name	Address	Potential Source	Priority	Information Source
252900400	Shakopee Mdewakanton Sioux Community	SMSC NORTH RESIDENTIAL Lot-O-L Block-00A Prior Lake MN 55372	Observation Well (MUW #253020)	High	MN CWI
259220010	Richard & Dolores McKenna	3736 N Berens Rd. NW Prior Lake MN 55379	Gravel Mining Permit	Moderate	SMSC Land dept records
259220011	Richard Palla	13755 McKenna Road	UST, IWS: MUW #178530	High	SMSC Land dept records
259220031	Craig & Wanda Ahlman	3834 N Berens Rd NW Prior Lake MN 55379	Gravel Mining Permit, Well 443579	Moderate	
279220030	Shakopee Mdewakanton Sioux Community	13493 Sumac Lane Prior Lake MN 55372	Chemical Storage (new pumphouse), Emergency generator near well	High	SMSC Potential Contaminant Survey,
259220010 259220020	Dick McKenna	3736 N Berens Rd. NW Prior Lake MN 55379	Individual water supply wells Underground storage tank Septic System	Moderate High High	SMSC Land dept records
NA	McKenna DWSMA	McKenna Road	Municipal Sewage Line	Low	SMSC Land dept records
279220030 259220012 259220011 254520100		McKenna Road	Ag field, potential chemicals	Low	SMSC Land dept records
NA	McKenna DWSMA	McKenna Road	Ephemeral Stream	Low	SMSC Land dept records

DWSMA	Land Use	Jurisdiction	Land Use By Percentage within DWSMA (2000)	Land Use By Percentage Within DWSMA (2020)	Percentage Change
McKenna	Agricultural	Prior Lake	36.2%	0.0%	-36.2%
	Wetland	Minnesota	27.7%	0.0%	-27.7%
	Urban low/medium density residential	Prior Lake	19.1%	34.6%	+15.5%
	Institutional	SMSC	10.6%	10.6%	0.0%
	Natural	Prior Lake	6.4%	0.0%	-6.4%
	Urban high density residential	Prior Lake	0%	54.8%	+54.8%
Sioux Trail	Grassland	Prior Lake/SMSC	24.6%	2.8%	-21.8%
	Commercial	Prior Lake/SMSC	23.4%	61.2%	+37.8
	Wetland	Prior Lake/SMSC	18.7%	15.7%	-3.0%
	Agricultural	Prior Lake/SMSC	13.5%	0.0%	-13.5%
	Forest	Prior Lake/SMSC	8.0%	6.3%	-1.7%
	Institutional proposed parkway	SMSC	5.1%	5.1% 2.1%	0% +2.1%
	Urban low/medium density residential	SMSC	6.7%	6.7%	0%

Table 18. Land use projections within the DWSMAs

Use	Type	2006 Water Demand (gal/yr)	Water Demand Change from 2000 (%)
Car Washes	Commercial	2,447,500	-12%
Casinos	Commercial	39,485,870	-32%
Church	Social	8,500	na
Community Center	Social/Government	624,820	19%
Fire Station	Government	139,500	na
Hotel	Commercial	28,560,000	68%
Public Works	Govenment	925,312	292%
Restaurants	Commercial	14,491,530	420%
Retail	Commercial	549,120	-15%
RV Park	Commercial	525,100	-26%
Service Providers	Social	10,070,400	22%

Table 19. Water use and change by category

	McKenna Well	Sioux Trail Jordan Well	Franconia-Ironton Galesville Well
Supply Source	Jordan Aquifer	Jordan Aquifer	Franconia-Ironton-Galesville Aquifer
Casing Depth (ft.)	273	307	570
Open Hole Depth (ft.)	264 - 370	307 - 395	570 - 667
Well Diameter (in.)	20	24in. to 140 18in. to 187 14in. to 307	20in. to 179 16in. to 570
Open Hole Diameter (in.)	14	13	19.25
UTM North	4955718.23 m	4953736.59 m	4953800.45 m
UTM East	464463.63 m	462402.84 m	4662282.82 m
Well Capacity (gpm)	1000	1200	700
Well Production (gpm)	400	500	500

Table 20. Public water supply characteristics

	Maximum daily use (gpd)	Minimum daily use (gpd)
Sioux Trail System	746,097 (July)	240,777 (December)
McKenna Well	72,861 (July)	11,939 (February)

Table 21. Maximum and Minimum Daily Water Use (2006)

Water Consumer/Uses	Priority
Community Members	1
Government Center	2
Mystic Lake Casino	3
Playworks	4
Little Six Casino	5
Mystic Lake Casino Hotel 1	6
Mystic Lake Casino Hotel 2	7
DDC	8
SMSC Gaming Enterprise	9
Convenience Store	10
Dakota Sport and Fitness	11
Public Works Building	12
SDCS Mall Tenants	13
RV Park	14
SMSC/LSI Watering/Irrigation	15
Car Washes	16
Residential Lawn Watering	17

Table 22. Water supply priorities

Primary Contact	24 Hour Phone Number
Mineral Services Plus	
Danny Nubbe	Mobile: (612) 919-4081, Home: (763) 497-8041
Nick Shultz	Mobile: (612) 919-4079, Home: (952) 466-2633
Secondary Contact	
Scott County Dispatch	(952) 455-1411
City of Prior Lake	HOT LINE: (952) 440-9675
Steve Albrect, Public Works	(952) 447-9890
City of Savage	HOT LINE: (952) 224-3440
Terry Thene, Utilities	(612)-490-8775
City of Shakopee	HOT LINE: (952)-445-6681
Bruce Loney	(952)-233-9361
John Crooks	(952)-233-1511

Table 23. Emergency Water Supply Contacts

Description	Owner	Telephone	Location
Well repair	Mineral Services/ Danny Nubbe	612-919-4081	Cologne, MN
Pump repair	Mineral Services/ Danny Nubbe	612-919-4081	Cologne, MN
Electrician	Ries Electric	612-451-2238	St. Paul, MN
Backhoe	SMSC Public Works	952-496-6176	Prior Lake, MN
Chemical feed	Hawkins Chemical/ SMSC Public Works	612-331-6910	Minneapolis, MN
Meter repair	Mineral Services/ Danny Nubbe	612-919-4081	Cologne, MN
Generator	Ziegler	952-233-4301	Shakopee, MN
Valves	Mineral Services/ Danny Nubbe	612-919-4081	Cologne, MN
Pipe and fittings	Mineral Services/ Danny Nubbe	612-919-4081	Cologne, MN

Table 24. Emergency Equipment and Suppliers

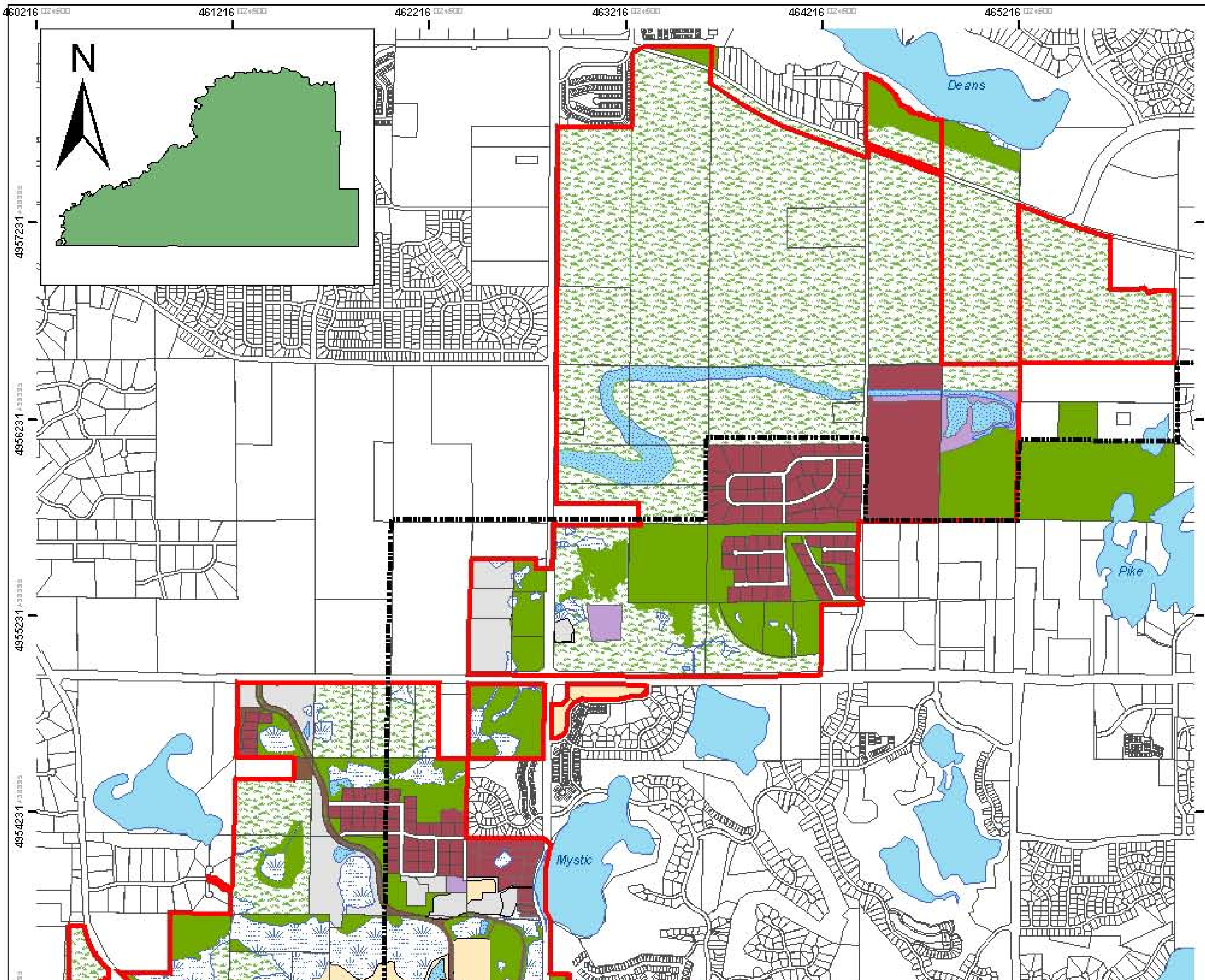
System Personnel	Name	Cell Phone	Work Telephone
Tribal Administrator	Bill Rudnicki	612-964-6963	952-496-6145
Public Works Admin	Jeremy Gosewisch	612-964-6978	952-496-6177
Land Manager	Stan Ellison	612-964-6982	612-496-6158
Gaming Enterprise	Paul Clendening	612-650-5956	952-496-6585
Health Administrator	James Lien		952-496-6114

Table 25. Lead Coordinating Agency - SMSC Staff

System Personnel	Name	Cell Phone	Work Telephone
Tribal Administrator	Bill Rudnicki	612-964-6963	952-496-6145
Public Works Administrator	Jeremy Gosewich	612-964-6978	952-496-6177
Land Manager	Stan Ellison	612-964-6982	612-496-6158
Public Works Asst. Manager	Kurt Ehresman	612-579-9627	952-496-6171
Reclamation Supervisor	Ron Quade	612-385-7377	952-496-9020

Table 26. Incident Assessment Team

Figures



2008 SMSC WHPP

Prepared on: 3/24/2008
Shakopee Mdewakanton Sioux Community
2330 Sioux Trail Northwest
Prior Lake, Minnesota 55372

Projection: Transverse Mercator
Projected Coordinate System: NAD 1983 UTM Zone 15N
Geographic Coordinate System: GCS North American 1983

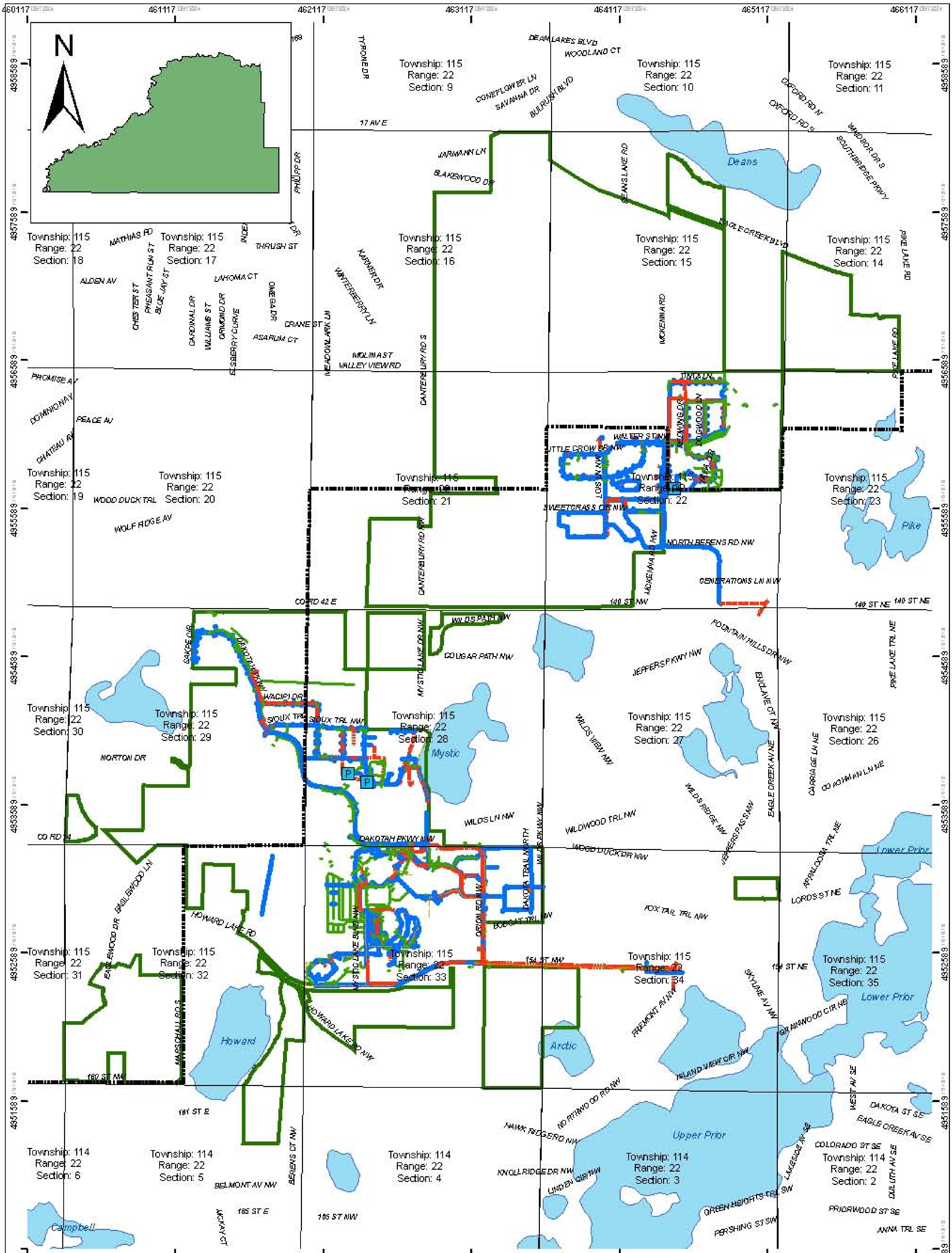
Data provided by Scott County and the SMSC Land Department.

Legend

0 0.25 0.5 1 Miles

- SMSC Boundary
- Shakopee/Prior Lake Boundary
- Lakes and Ponds
- Parcel Boundaries
- Agriculture
- Engineered Drainage
- Commercial
- Institutional
- Natural
- Park
- Residential
- Transportation
- Wetland

Figure 1: Land Use and Property Boundaries



2008 SMSC WHPP

Prepared on: 9/20/2006
Updated 2/11/2008
Shakopee Mdewakanton Sioux Community
2330 Sioux Trail Northwest
Prior Lake, Minnesota 55372
Projection: Transverse Mercator
Projected Coordinate System: NAD 1983 UTM Zone 15N
Geographic Coordinate System: GCS North American 1983
Road, lake, township, range and section data provided by Scott County. Public utility service data provided by Bolton & Menk, Inc. SMSC boundary and public water supply well locations compiled by SMSC Land Department.

Legend

0 0.25 0.5 1 Miles

- SMSC Boundary
- Shakopee/Prior Lake Boundary
- Public Supply Well
- Storm Sewer
- Sanitary Sewer
- Water Main

Figure 2: Public Utilities

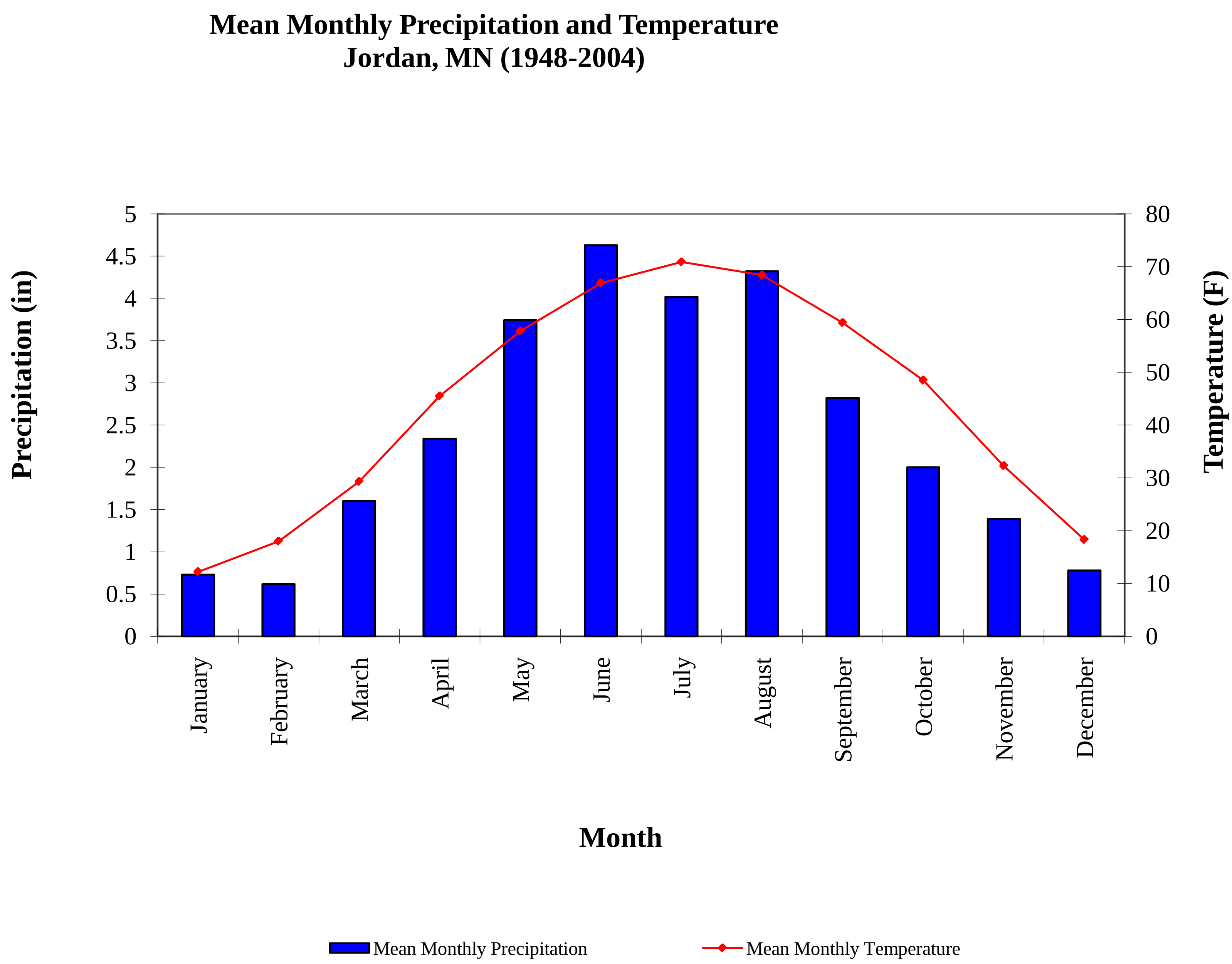
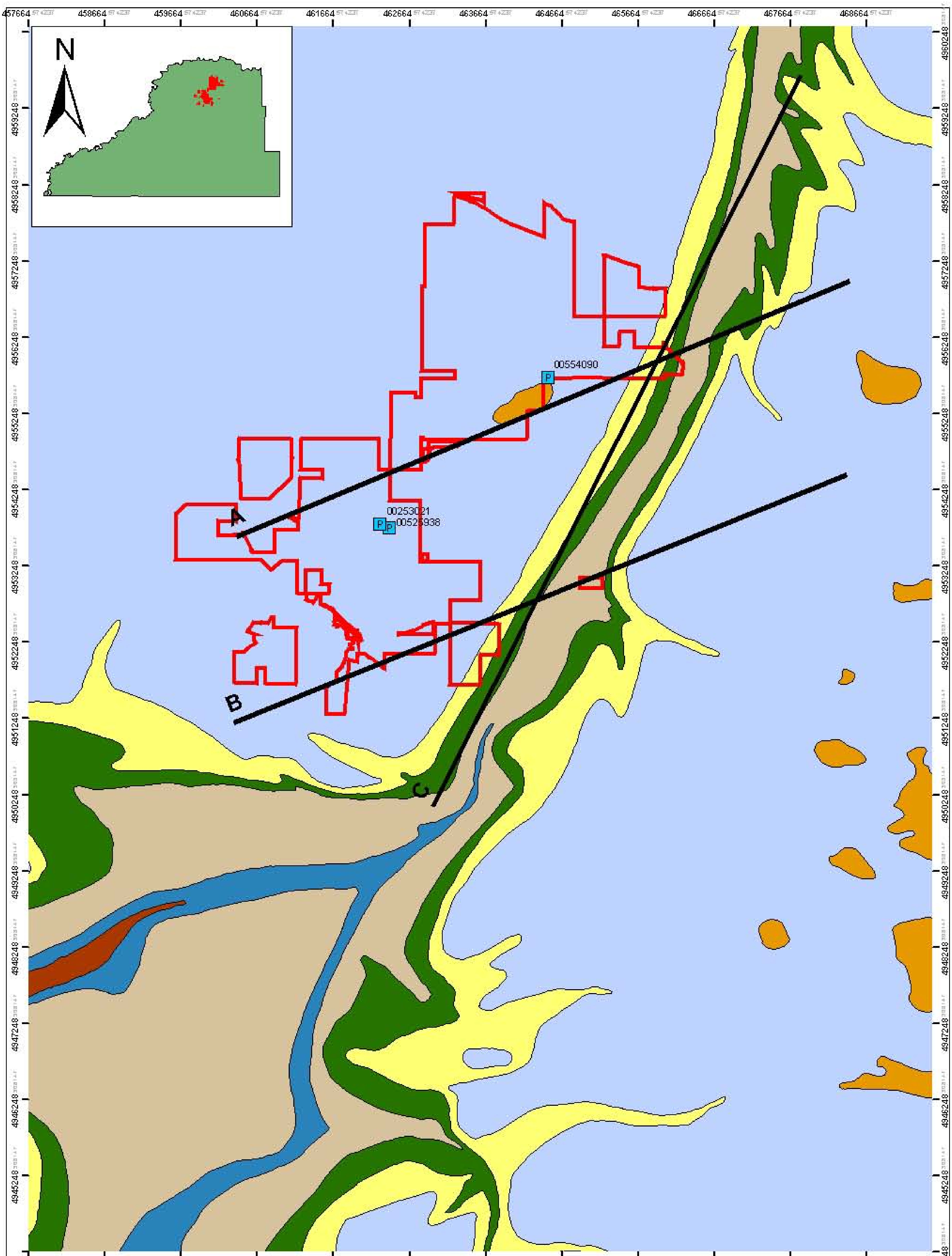


Figure 3. Mean monthly precipitation and temperature, Jordan, Minnesota, 1948-2004.



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Shakopee Mdewakanton Sioux Community
2330 Sioux Trail Northwest
Prior Lake, Minnesota 55372

Projection: Transverse Mercator
Projected Coordinate System: NAD 1983 UTM Zone 15N
Geographic Coordinate System: GCS North American 1983

Geologic cross sections and bedrock atlas provided by the Minnesota Geological Survey (county Atlas C-17)

0 0.5 1 2 Miles

Legend

- St. Peter sandstone
- Prairie du Chien Group, undiv
- Jordan sandstone
- St. Lawrence formation
- Franconia formation
- Ironton_Galesville SS, undiv
- Eau Claire formation
- SMSC Boundary
- Geologic Cross Sections
- Public Water Supply Well

Figure 4: Regional Bedrock Composition

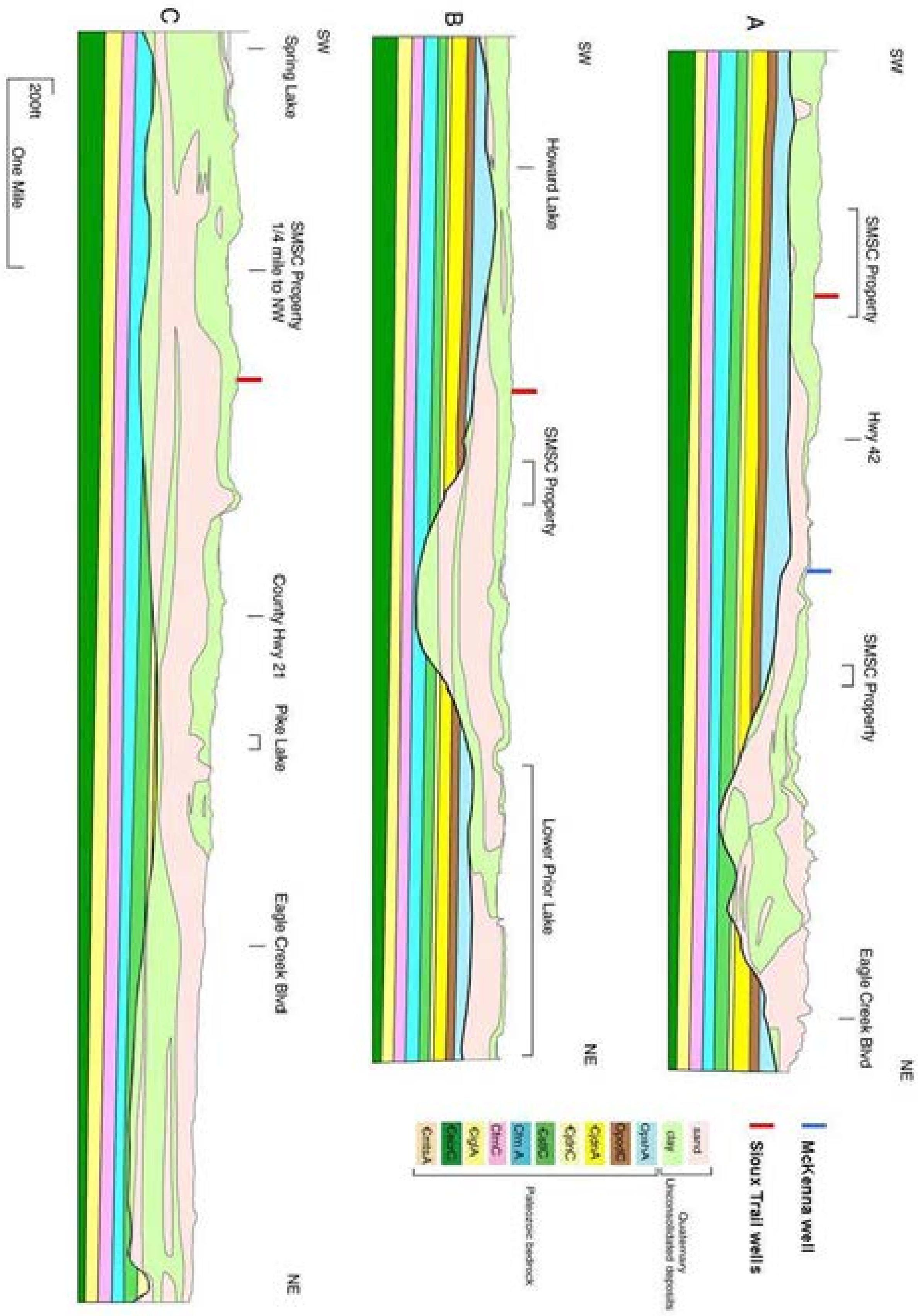
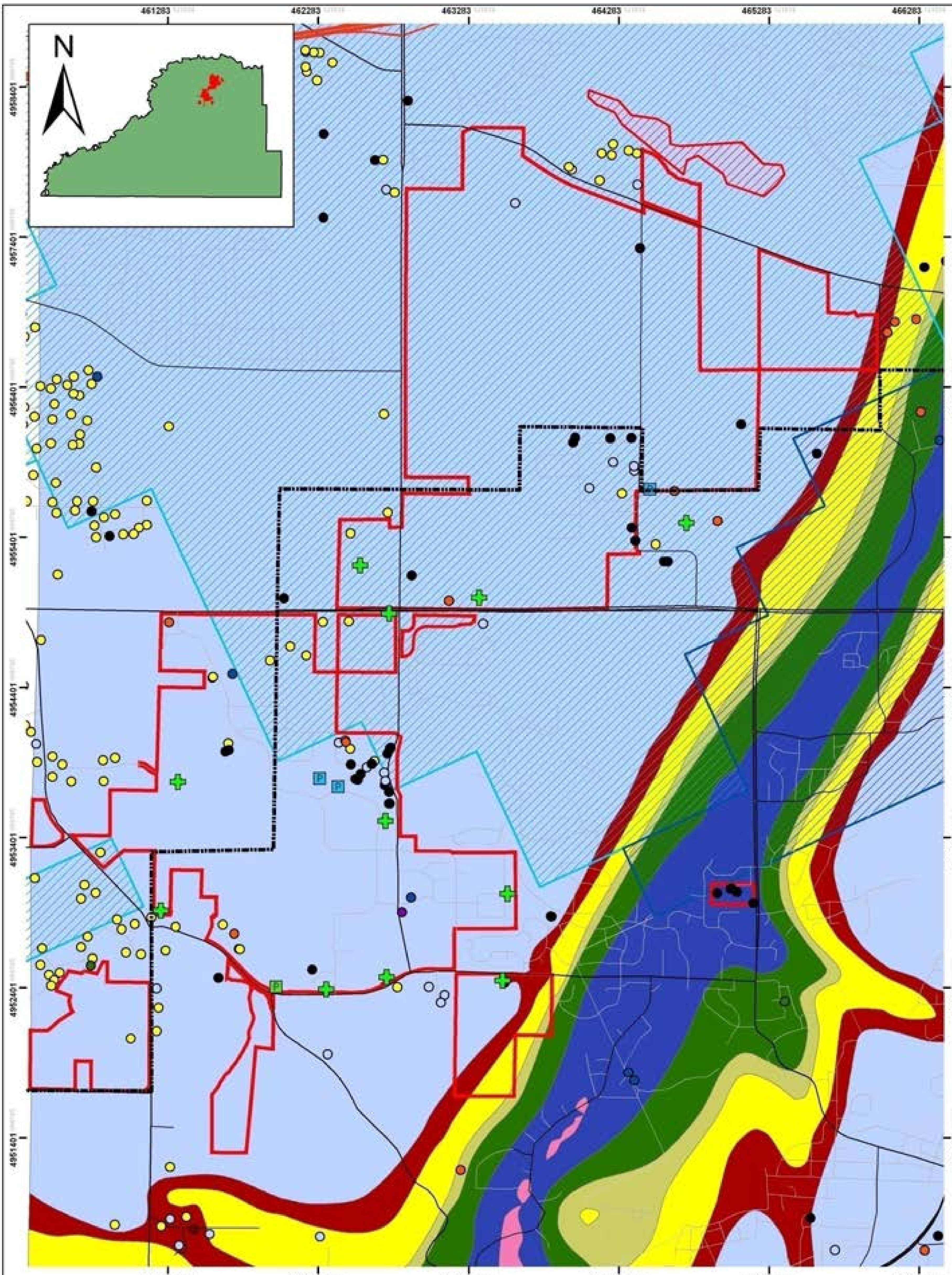


Figure 5. Hydrogeologic cross-sections (see figure 4 for locations). From Runkel et al 2005



2009 SMSC WHPP

Prepared on: 9/20/2006
Updated 2/11/2008
Shakopee Mdewakanton Sioux Community
2330 Sioux Trail Northwest
Prior Lake, Minnesota 55372
Projection: Transverse Mercator
Projected Coordinate System: NAD 1983 UTM Zone 15N
Geographic Coordinate System: GCS North American 1983
Bedrock geology provided by MN Geological survey. Wells provided by MN County Well Index. Recharge and discharge areas provided by Barr Engineering. Road and lake data provided by Scott County

Legend

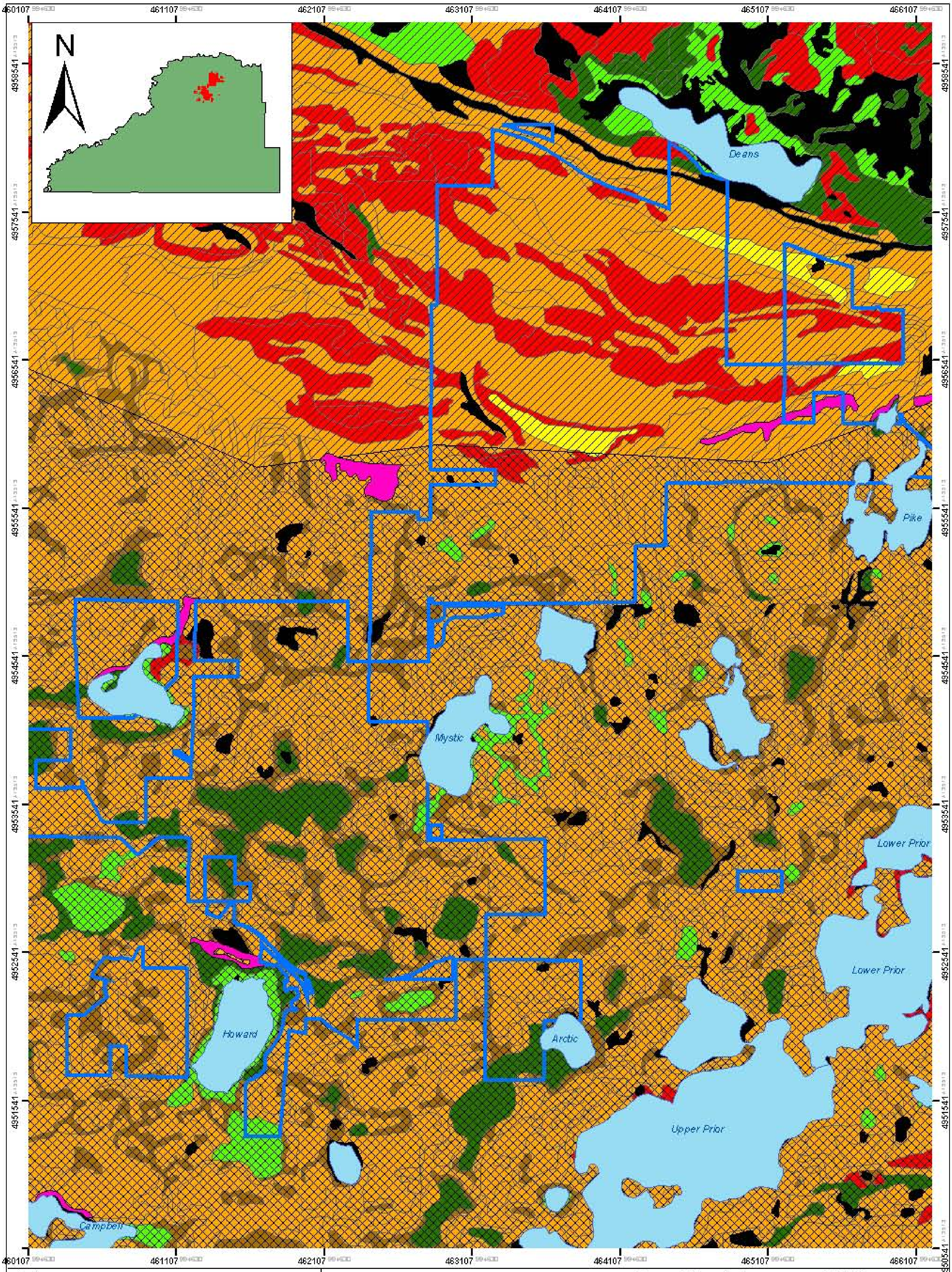
- SMSC Boundary
- Shakopee/Prior Lake Boundary
- Existing SMSC Public Water Supply Well
- Proposed SMSC Public Water Supply Well
- SMSC Borehole
- Recharge = 0 in/yr
- Recharge = ~1 in/yr
- Recharge = ~2.5 in/yr
- Discharge Area
- Shakopee aquifer
- Oneota confining unit
- Jordan aquifer
- Jordan confining unit
- St. Lawrence confining unit
- Franconia aquifer
- Franconia confining unit

Well (color-coded by aquifer)

- Quaternary
- St. Peter
- Prairie du Chien
- Jordan
- St. Lawrence
- Franconia-Ironton-Galesville
- Mt. Simon
- Multiple
- Unknown

0 0.2 0.4 0.8 Miles

Figure 6: Local Bedrock Hydrogeology



2008 SMSC WHPP

Prepared on: 9/20/2006
Updated 2/11/2008
Shakopee Mdewakanton Sioux Community
2330 Sioux Trail Northwest
Prior Lake, Minnesota 55372

Projection: Transverse Mercator
Projected Coordinate System: NAD 1983 UTM Zone 15N
Geographic Coordinate System: GCS North American 1983

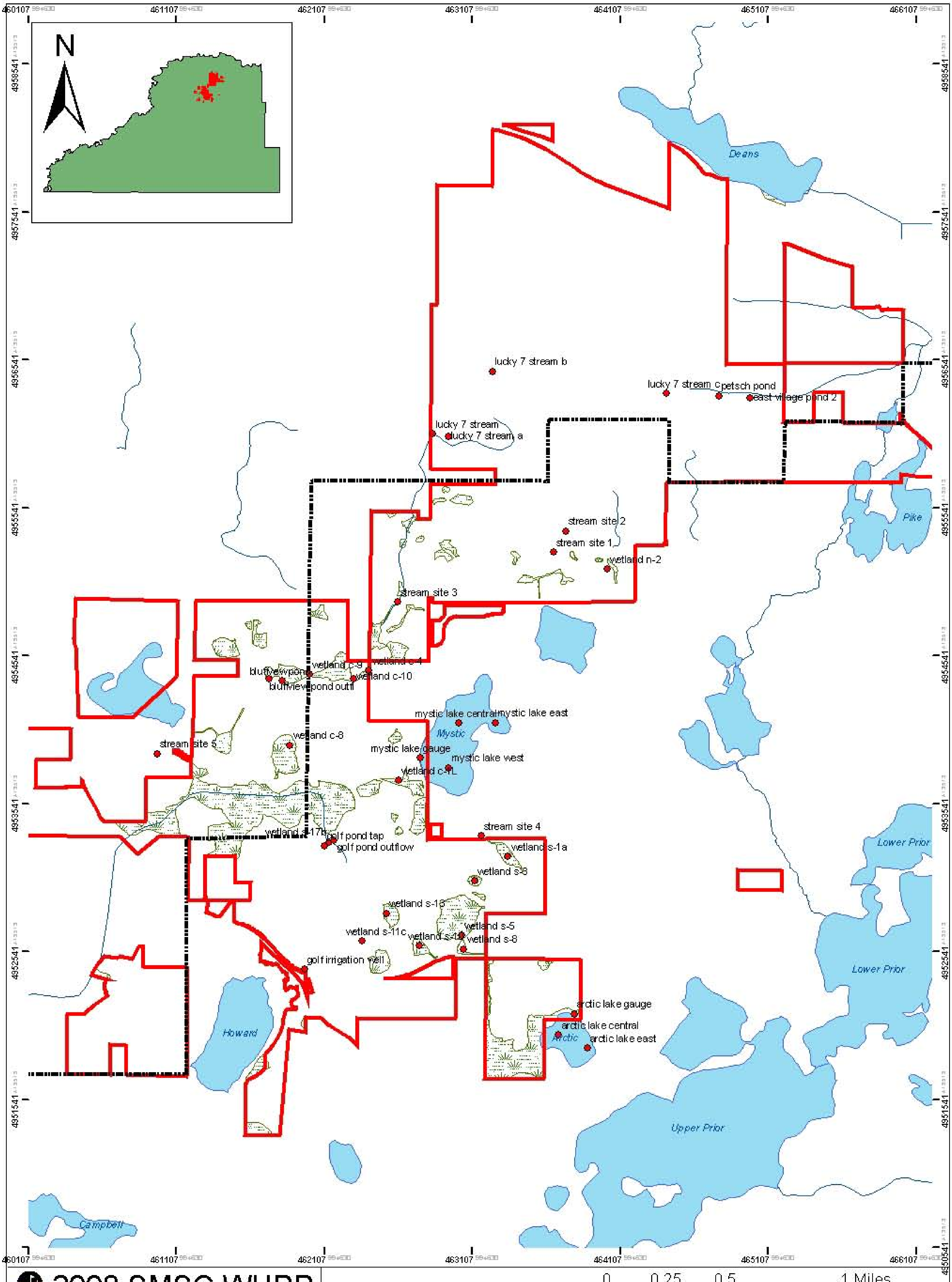
Soil data from Scott County Soil Survey of 1955.

Legend

- SMSC Boundary
- Steep Land
- Glacial Moraine (Till)
- Glacial Outwash Terrace
- A: High Infiltration/Low Runoff
- B: Moderate Infiltration/Moderate Runoff
- C: Low Infiltration/High Runoff
- D: Very Low Infiltration/Very High Runoff
- A/D: Drained areas are Group A; Undrained are D
- B/D: Drained areas are Group B; Undrained are D
- Unclassified

0 0.2 0.4 0.8 Miles

Figure 7: Soils



2008 SMSC WHPP

Prepared on: 9/20/2006
Updated 2/11/2008
Shakopee Mdewakanton Sioux Community
2330 Sioux Trail Northwest
Prior Lake, Minnesota 55372

Projection: Transverse Mercator
Projected Coordinate System: NAD 1983 UTM Zone 15N
Geographic Coordinate System: GCS North American 1983

Data provided by Scott County and the SMSC Land Department.

Legend

- SMSC Boundary
- Shakopee/Prior Lake Boundary
- Surface Water Monitoring Sites
- Wetland
- Lakes and Ponds
- Stream

Figure 8: Surface Water Resources

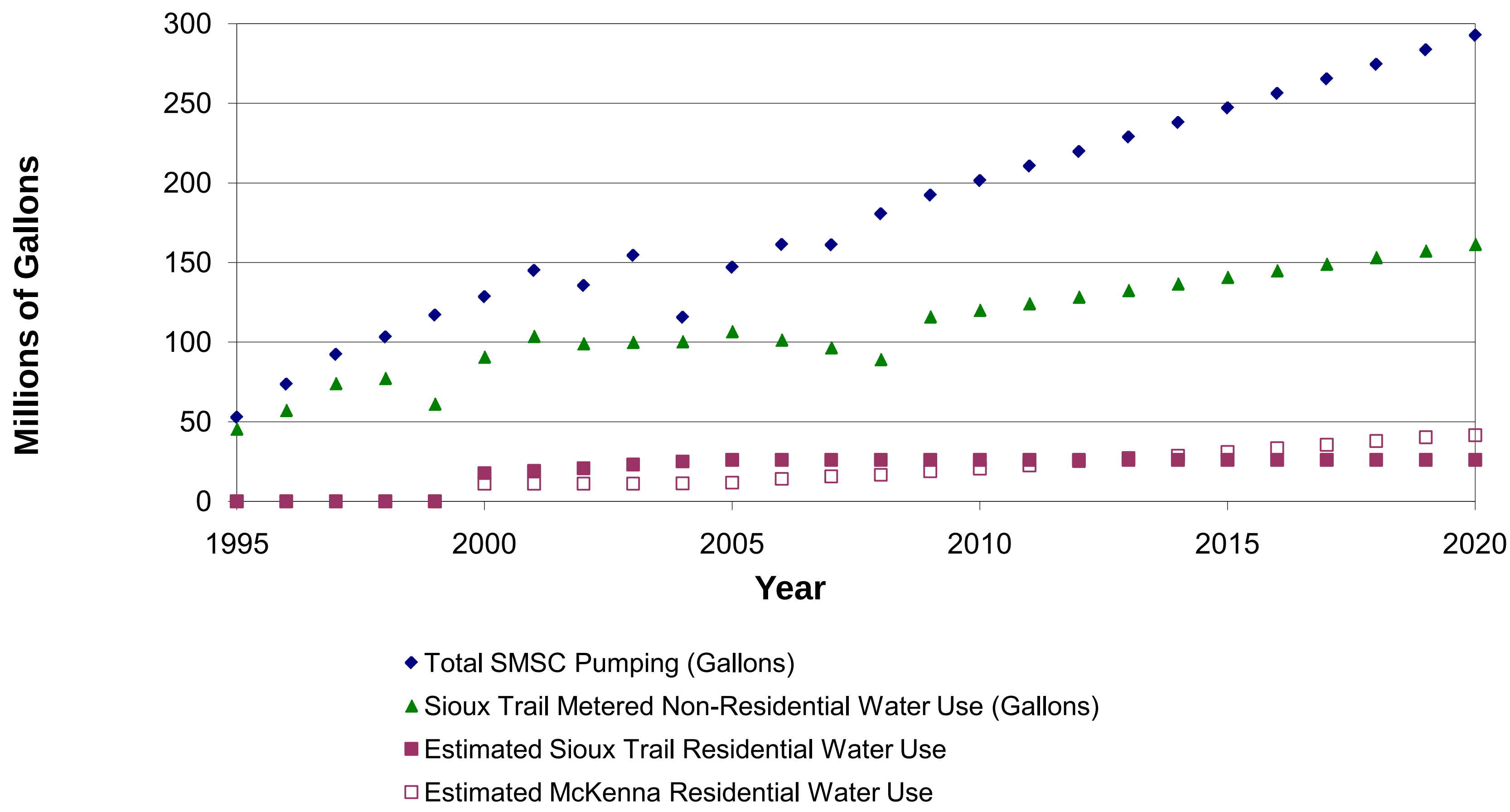


Figure 9. Historical and projected Community annual water use (gallons/year)

Values after 2008 are projected.

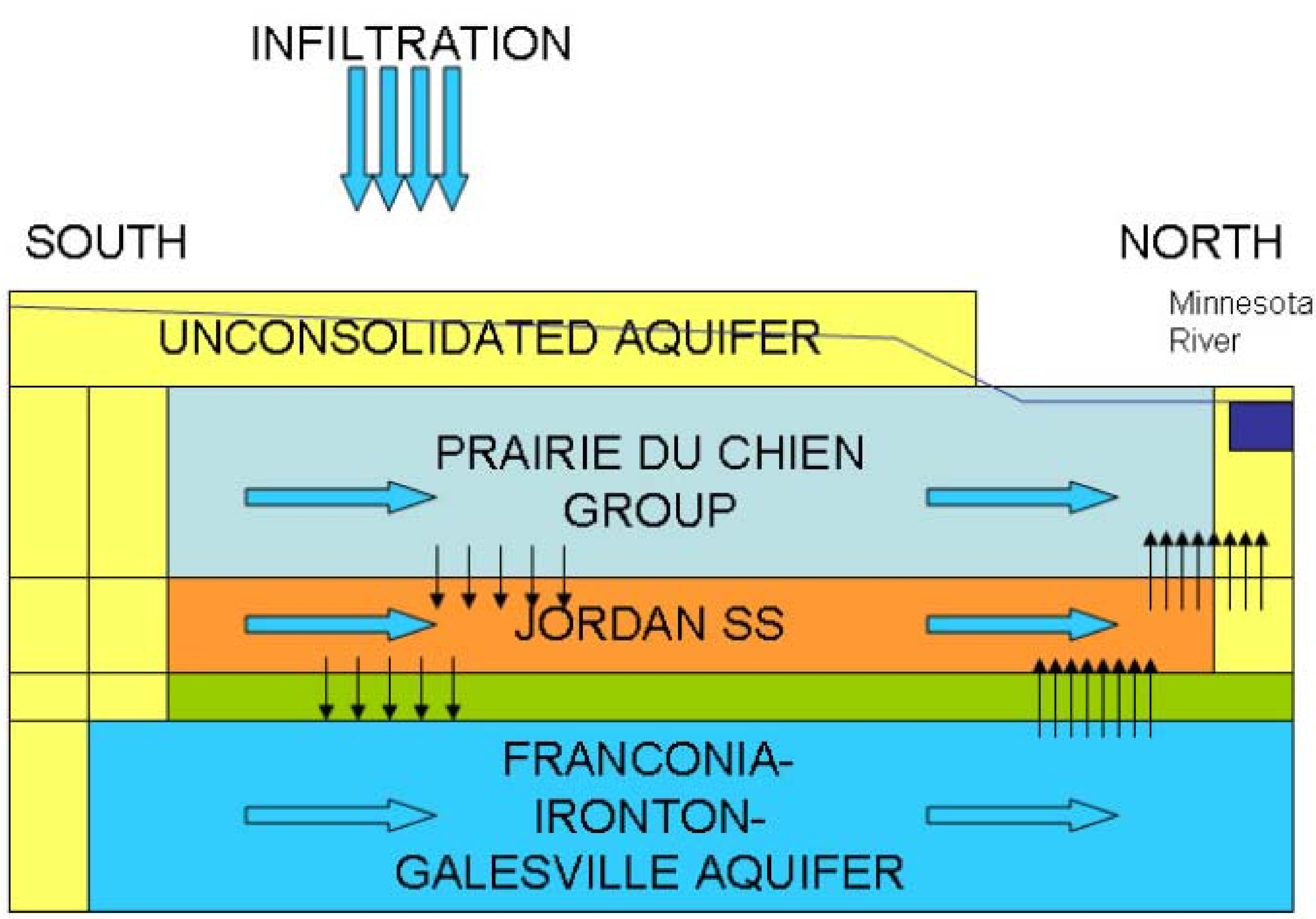
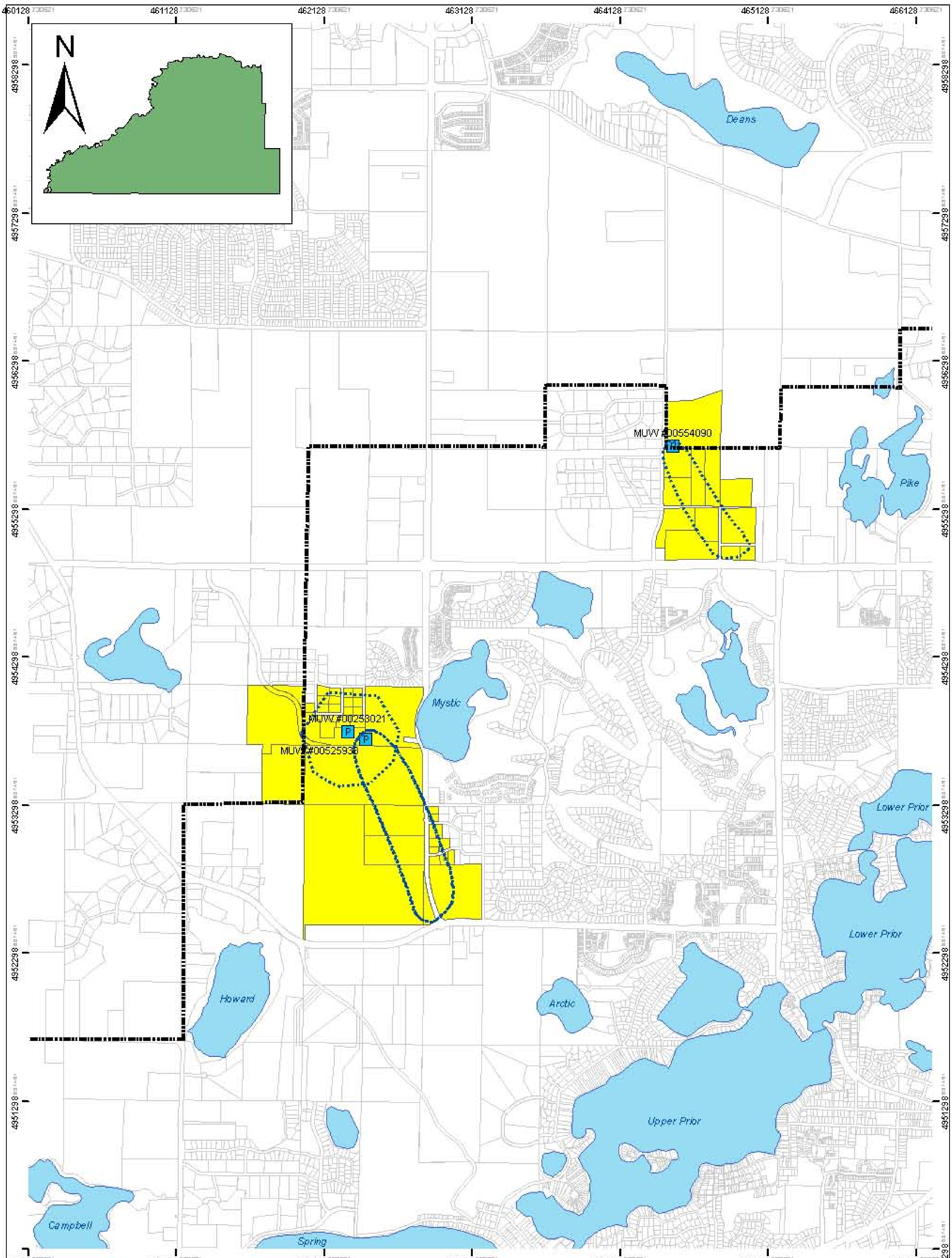


Figure 10. Conceptual groundwater flow model for the SMSC water supply (Wuolo 2004).



2008 SMSC WHPP

Prepared on: 9/20/2006
Updated 3/1/2008
Shakopee Mdewakanton Sioux Community
2330 Sioux Trail Northwest
Prior Lake, Minnesota 55372

Projection: Transverse Mercator
Projected Coordinate System: NAD 1983 UTM Zone 15N
Geographic Coordinate System: GCS North American 1983

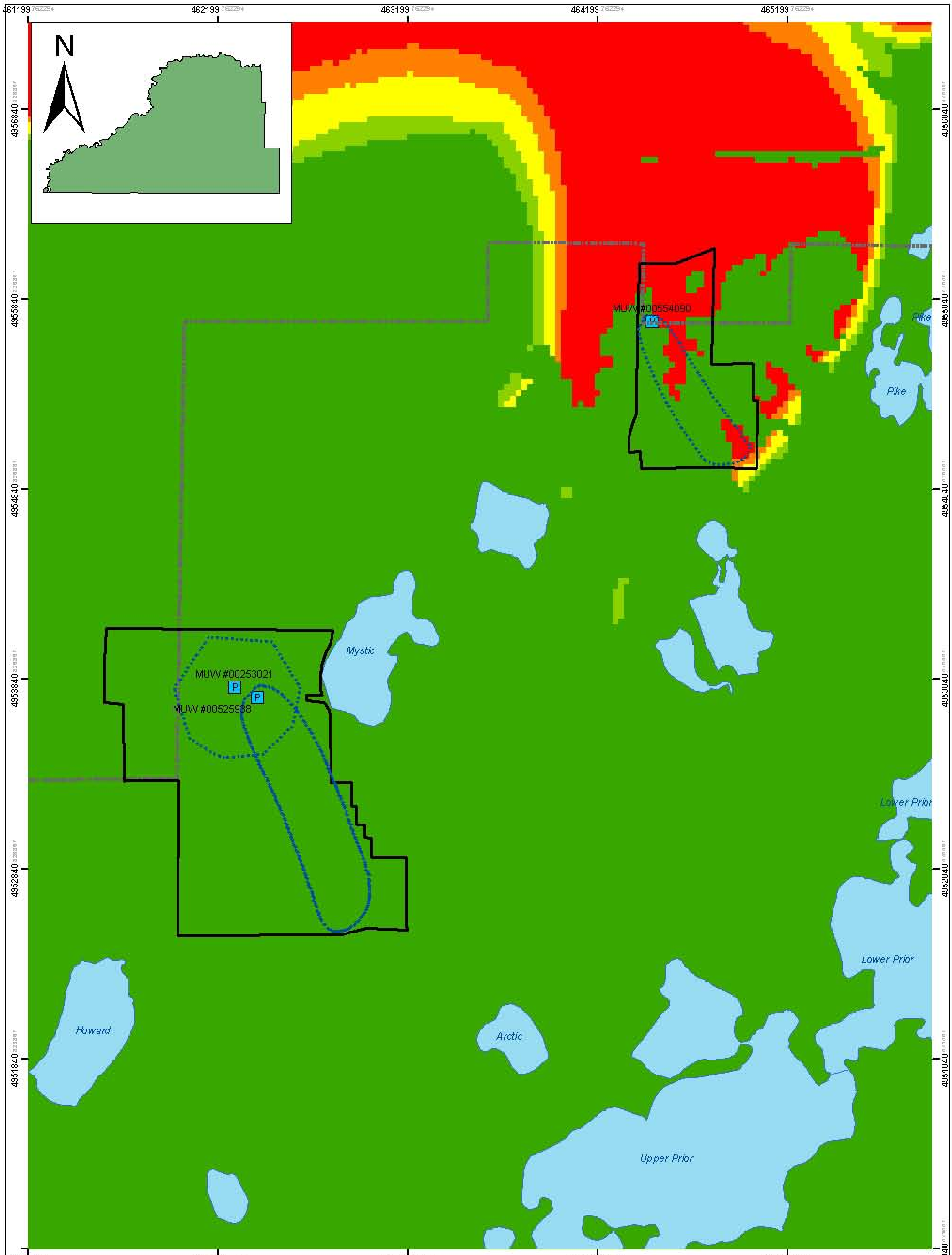
Data provided by Scott County and the SMSC Land Department.

Legend

0 0.25 0.5 1 Miles

- 10 year time of travel
- Shakopee/Prior Lake Boundary
- SMSC Boundary
- PWS Well
- DWSMA

Figure 11: Drinking Water Supply Management Areas



2008 SMSC WHPP

Prepared on: 10/7/2008
Shakopee Mdewakanton Sioux Community
2330 Sioux Trail Northwest
Prior Lake, Minnesota 55372

Projection: Transverse Mercator
Projected Coordinate System: NAD 1983 UTM Zone 15N
Geographic Coordinate System: GCS North American 1983

Data provided by Scott County (Atlas C-17 plate 6) and the SMSC Land Department.

Legend

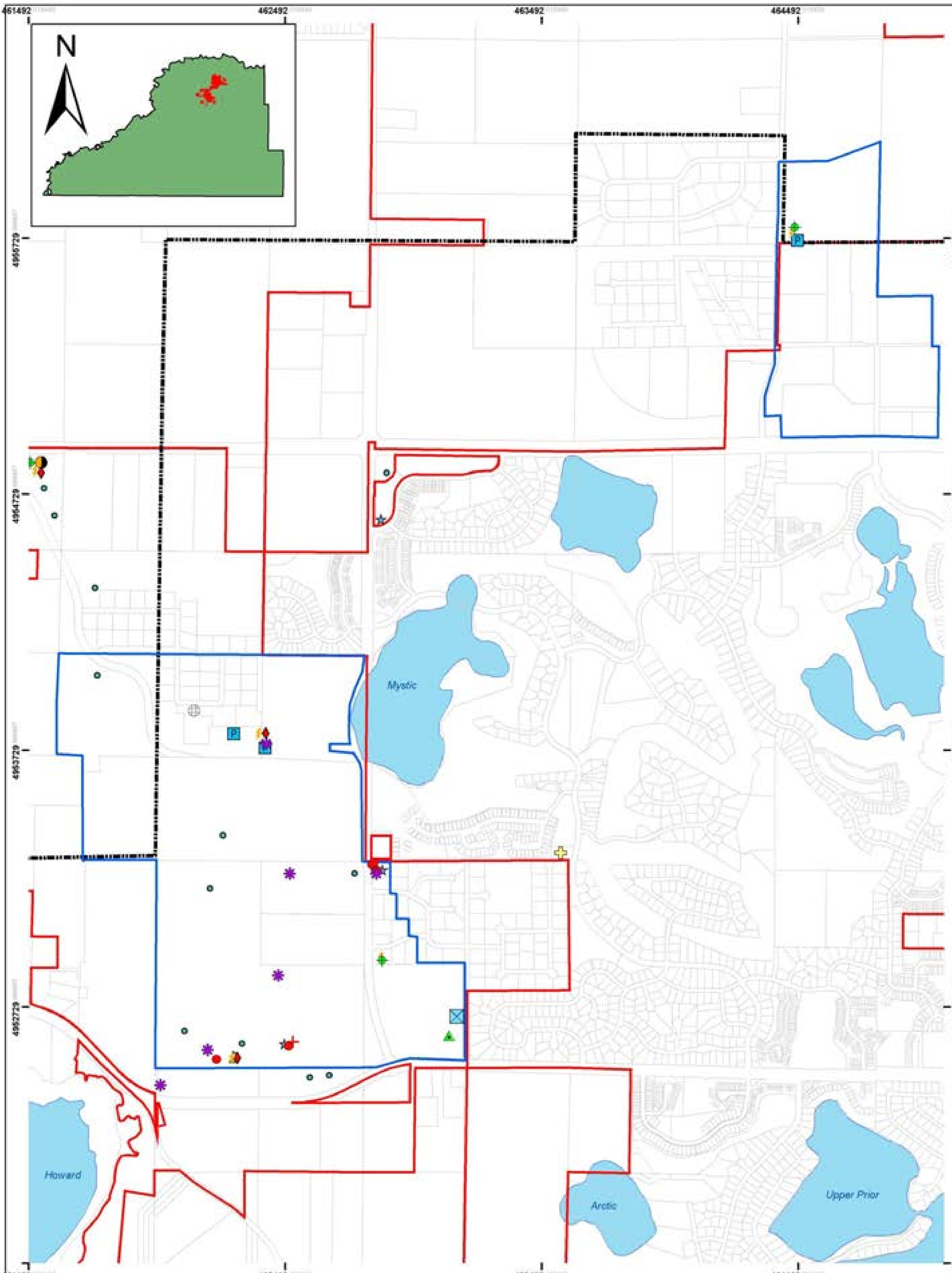
Bedrock recharge rates

- Very fast - Hours to months
- Fast - Weeks to years
- Moderate - Years to decades
- Slow - Decades to a centruy or more
- Very slow - A century or more

- DWSMA
- Shakopee/Prior Lake Boundary
- SMSC Boundary
- PWS Well

0 0.2 0.4 0.8 Miles

Figure 12: Estimated Rate of Recharge for the Bedrock Surface



2008 SMSC WHPP

Prepared on: 3/24/2008
Shakopee Mdewakanton Sioux Community
2330 Sioux Trail Northwest
Prior Lake, Minnesota 55372

Projection: Transverse Mercator
Projected Coordinate System: NAD 1983 UTM Zone 15N
Geographic Coordinate System: GCS North American 1983

Data provided by Scott County and the SMSC Land Department.

Legend

- Above Ground Storage
- Cemetary
- Chemical Storage Facility
- Commercial Laundry and Drycleaning
- Documented Petroleum Spill
- Fertilizer/Pesticide
- Gasoline Service Station
- Hazardous Waste Site
- Hazardouse Waste Handler
- Heavy Equipment Storage
- Household Hazardous Waste
- Salt and Gravel Storage
- Lawn Equipment / Chemical Storage
- Stormwater Basin
- Under Ground Storage
- Waste Water Reclamation Facility
- SMSC PWS Well
- DWSMA
- Shakopee/Prior Lake Boundary
- SMSC Boundary

0 0.125 0.25 0.5 Miles

Figure 13: Potential Contaminant Sources

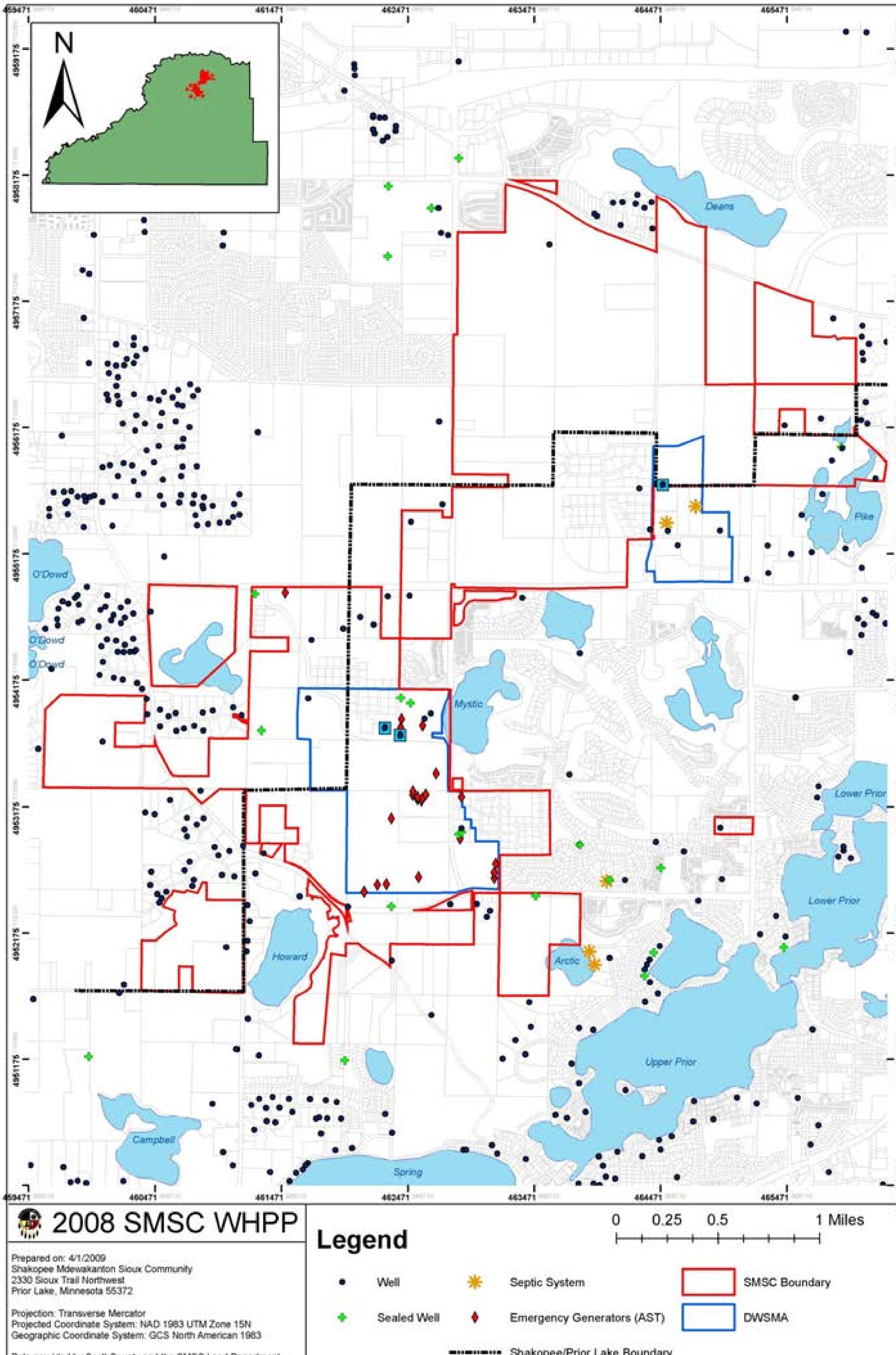
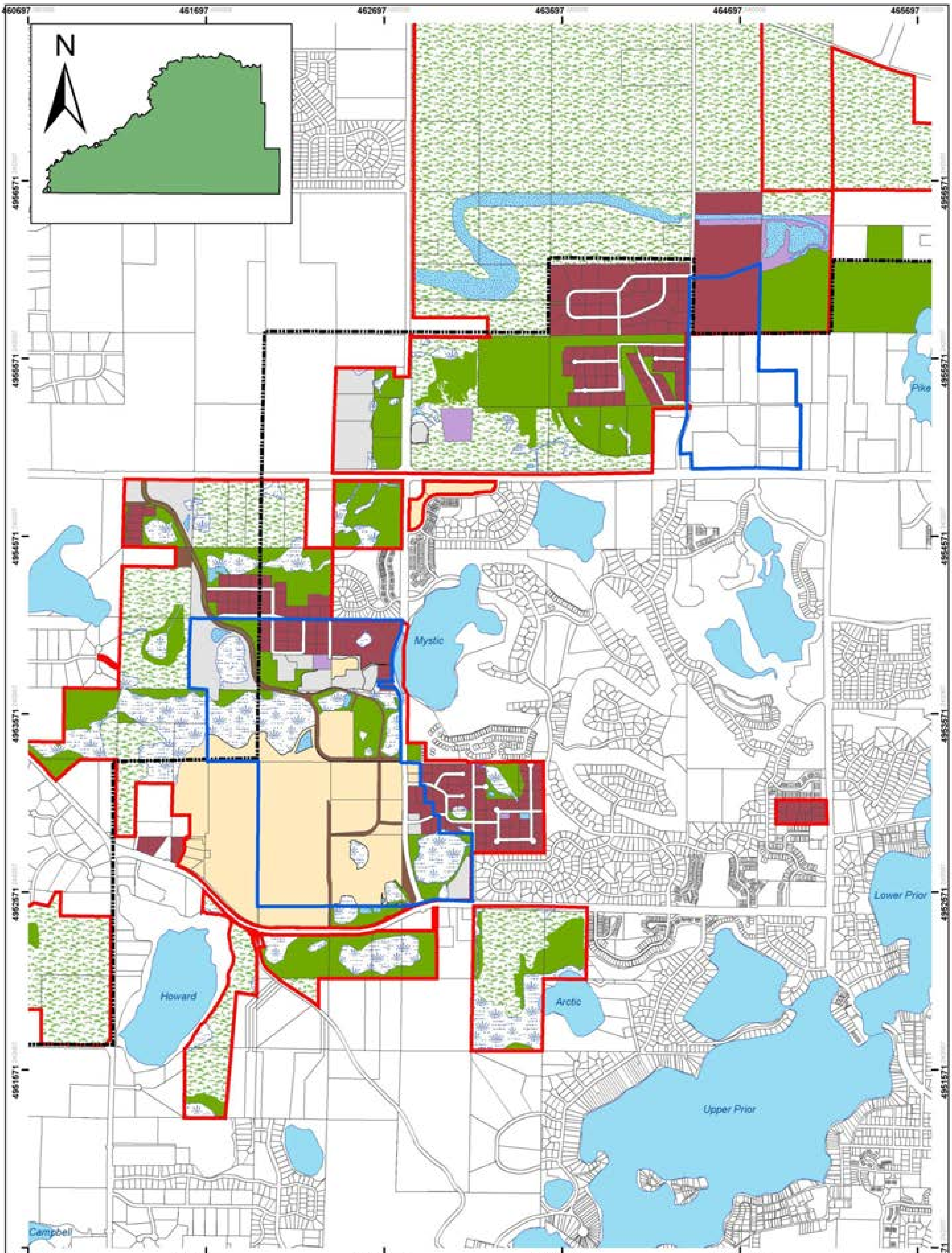


Figure 14: Potential Contaminant Sources - Wells and Generators



2008 SMSC WHPP

Prepared on: 3/24/2008
Shakopee Mdewakanton Sioux Community
2330 Sioux Trail Northwest
Prior Lake, Minnesota 55372

Projection: Transverse Mercator
Projected Coordinate System: NAD 1983 UTM Zone 15N
Geographic Coordinate System: GCS North American 1983

Data provided by Scott County and the SMSC Land Department.

Legend

SmallerDWSMA
Shakopee/Prior Lake Boundary
SMSC Boundary
Lakes and Ponds
Agriculture
Engineered Drainage
Commercial
Institutional
Natural
Park
Residential
Transportation
Wetland

0 0.25 0.5 1 Miles

Figure 15: Community Land Use

GLOSSARY

A

Anisotropy - The condition under which one of more of the hydraulic properties of an aquifer vary according to the direction of flow.

Aquifer - A subterranean layer of porous material (such as rock, gravel or sand) containing water which may be withdrawn from wells for human use.

Aquifer Recharge Zone - Region in which water from rain or snow percolates (sinks) into an aquifer, replenishing the supply of groundwater.

Aquitard - A low permeability unit that can store groundwater and also transmit it slowly from one aquifer to another.

Aquifuge - An absolutely impermeable unit that neither stores nor transmits water.

Artificial Recharge Well - A well that is used to recharge depleted aquifers and may inject fluids from a variety of sources such as lakes, streams, domestic wastewater treatment plants, other aquifers, etc.

C

Casing - A pipe or cubing placed in a well or boring to: A) prevent the walls from caving; B) seal off surface drainage; or C) prevent gas, water, or other fluids from entering the well.

Confining Layer/Unit - A rock unit having a very low hydraulic conductivity that restricts the movement of groundwater either into or out of adjacent aquifers.

Class V Injection Well - This is a well classification used by the United States Environmental Protection Agency. A Class V Injection Well includes drainage wells, geothermal re-injection wells, domestic wastewater disposal wells, mineral and fossil fuel recovery related wells, industrial/commercial/utility disposal wells, recharge wells, and miscellaneous wells (which includes abandoned drinking water wells).

Community Water Supply System - A public water system that pipes water for human consumption to at least 15 service connections used by year-round residents, or one that regularly serves at least 25 year-round residents. Examples include municipalities, housing subdivisions, apartment buildings, mobile home parks, hospitals, and correctional facilities.

Contamination - The presence or addition of any substance to water which is or may become injurious to the health, safety, or welfare of the general public or private individuals using the well; and which is or may become injurious to domestic, commercial, industrial, agricultural, or other uses which are being made of such water.

D

Delineation - The process used to determine the Well Head Protection Area boundaries.

Discharge - The volume of water flowing in a stream or through an aquifer past a specific point in a given period of time.

Dissolution channels - Water moving through a rock (such as limestone) may dissolve some of the rock, leaving void spaces or dissolution channels. This is an example of a secondary opening.

Drinking Water Supply Management Area (DWSMA) - The area around the drinking water supply well that will be managed. This area contains the entire WHPA. The boundaries are determined using identifiable landmarks, such as roads and property boundaries.

E

Ephemeral Stream - A stream that runs for very short periods of time, on the order of a day.

Evapotranspiration - The sum of evaporation (the process by which water passes from the liquid to the vapor state) and transpiration (the process by which plants give off water vapor through their leaves).

F

Filter strip - An area between a water body and human land use is left in permanent vegetation, in order to filter pollutants out of runoff and prevent erosion.

Fluvial - Related to streams or rivers.

G

Geologic/Bedrock Sensitivity - Refers to the intrinsic ability of earth materials to protect a well or well field from contaminant sources. The DNR defines geologic sensitivity as being proportional to the time required for water to move vertically from the land surface to an aquifer. Shorter travel times mean the geologic sensitivity is greater; whereas, longer times indicate a lower sensitivity.

Greenway - Same as Filter Strip.

Groundwater - The water contained below the surface of the earth in the saturated zone including - without limitation - all water, whether under confined, unconfined, or perched conditions, in near-surface unconsolidated sediment or regolith, or in rock formations deeper underground.

H

Hydraulic Conductivity - Depends on the size and arrangement of the water-transmitting openings (pores). The volume of water that will move in a unit of time under a unit hydraulic gradient through a unit area. A coefficient of proportionality describing the rate at which water can move through a permeable medium. The density and kinematic viscosity of the water must be considered in determining hydraulic conductivity.

Hydraulic Head - The sum of the elevation head, the pressure head, and the velocity head at a given point in an aquifer.

Hydraulic Gradient - The slope of the water table or potentiometric surface.

Hydrostratigraphic Units - A geologic unit that can be defined as either an aquifer or aquitard.

I

Impermeable - Being unable to transmit water through a material.

Infiltration - The flow of water downward from the land surface into and through the upper soil layers.

Intermittent Stream - A stream which does not run all year long.

L

Local Unit of Government - A statutory or home rule charter city, town, county, soil and water conservation district, watershed district, organization formed for the joint exercise of powers under Minnesota Statutes, section 471.59, local health board, or other special purpose district of authority with local jurisdiction in water and related land resources management.

Layer 4 - This is a component of the conceptual model used to map groundwater movement in the Fraconia-Ironton-Galesville aquifer. Layer 4 refers to the Fraconia-Ironton-Galesville aquifer, which is separated from the Jordan Sandstone above by the St. Lawrence Formation.

Leaky Layer 3-4 - This is a component of the conceptual model used to map groundwater movement in the Fraconia-Ironton-Galesville aquifer. Leaky Layer 3-4 refers to the St. Lawrence Formation, a regional confining layer that generally allows only negligible leakage to lower aquifers.

M

Metro Model - This is the short form for the 'Twin Cities Metropolitan Groundwater Model'. It is a computer model that simulates regional groundwater flow in the seven-county Twin Cities metropolitan area. It was developed by the staff from the MPCA. It is based on the analytic element method and simulates multi-aquifer groundwater flow.

P

Pathogens - Disease-producing organisms.

Perennial stream - A stream which holds water throughout the year.

Permeability - A measure of how easily water can flow through material (such as through an aquifer).

Potentiometric surface - The water level in tightly cased wells open to a confined aquifer stands at the level of the potentiometric surface of the aquifer.

Porosity - The ratio of void space to the total volume of a soil or rock. This measurement tells us how much water a rock can contain when it is saturated.

Public Water Supply Well (PWS) - A public water supply well provides drinking water for human use to 15 or more service connections OR to 25 or more persons for at least 60 days a year. A public water supply well is further defined as either a Community or nonCommunity water supply well.

Pumping Discharge Rate - The volume of water discharged by a well per unit of time.

R

Recharge area - An area in which there are downward components of hydraulic head in an aquifer. Infiltration moves downward into the deeper parts of an aquifer in a recharge area.

Rock outcrop/subcrop - An exposed section of bedrock.

S

Storativity - The volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head. It is equal to the product of specific storage and aquifer thickness. In an unconfined aquifer, the storativity is equivalent to the specific yield. Also called storage coefficient.

Stormwater Management Structures - These are structures put in place to mitigate the impacts of storm runoff.

Strata - A single layer of sedimentary rock, generally consisting of one kind of matter representing continuous deposition.

Subsurface geochemistry - Chemistry of the soils and bedrock beneath the land surface.

T

Ten Year Time-Of-Travel Zone - An area within which groundwater will move through a portion of an aquifer and the overlying geologic materials and into a well in less than 10 years.

Topographic relief - The difference in elevation between the highest and lowest points of a geographic area.

Transmissivity - The rate at which water of a prevailing density and viscosity is transmitted through a unit width of an aquifer or confining bed under a unit hydraulic gradient. It is a function of properties of the liquid, the porous media, and the thickness of the porous media.

V

Vegetated swale - When runoff channels on slopes are planted in permanent vegetation to reduce gully erosion.

Vulnerability - Refers to the susceptibility of a water supply to contamination from activities at the land surface.

W

Water Table - The level in the saturated zone at which the hydraulic pressure is equal to atmospheric pressure and is represented by the water level in unused wells.

Wellhead Protection Area (WHPA) - The area where water supplying a public well comes from. Can also be thought of as the recharge area to the public well. Ultimately the area to be managed by the WHP plan. These boundaries are scientifically calculated.

List of Acronyms Used in this Report:

BMP – Best Management Practice
CWS - Community Water Supply
DWSMA - Drinking Water Supply Management Area
EPA - Environmental Protection Agency
FIG - Fraconia-Ironton-Galesville
MCL - Maximum Contaminate Level
MDH - Minnesota Department of Health
MPCA -Minnesota Pollution Control Agency
MRDL - Maximum Recommended Daily Limit
MLAEM -Multi-Layer Analytic Element Model
MNDNR - Minnesota Department of Natural Resources
COMMUNITY - Shakopee Mdewakanton Sioux Community
PDJ - Prairie du Chien-Jordan
ppm - parts per million
PWS - Public Water Supply
IWS - Individual Water Supply
USGS - United States Geological Survey
VARELSs - Variable Strength Areal Elements
VOC - Volatile Organic Compound
WHP - Wellhead Protection Plan
WHPA - Wellhead Protection Area

APPENDICES

APPENDIX A: SMSC WELL AND BOREHOLE LOGS

EPA PWS ID # 5294501

MINNESOTA DEPARTMENT OF HEALTH

WELL RECORD

Minnesota Statutes Chapter 103I

MINNESOTA UNIQUE WELL NO. **554090**

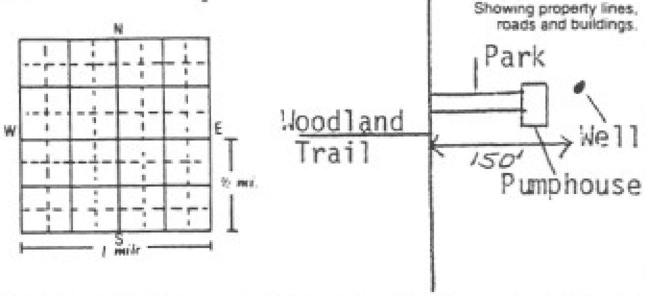
WELL LOCATION

County Name: Scott

Township Name	Township No.	Range No.	Section No.	Fraction
Prior Lake	115N	22W	22	SE ¼ SE ¼ NE ¼

Numerical Street Address and City of Well Location or Fire Number: McKenna Road and Woodland Trail

Show exact location of well in section grid with "X". Sketch map of well location. Showing property lines, roads and buildings.



WELL DEPTH (completed): 370 ft. **Date Work Completed:** 9/26/94

DRILLING METHOD: ☒ Cable Tool ☐ Driven ☐ Dug ☐ Auger ☐ Rotary ☐ Jetted ☐

DRILLING FLUID: Water

USE: ☐ Domestic ☐ Irrigation ☐ Test Well ☐ Monitoring ☒ Public ☐ Dewatering ☐ Heating/Cooling ☐ Industry/Commercial ☐ Remedial ☐

CASING: ☒ Steel ☐ Plastic ☐ — Drive Shoe? ☒ Yes ☐ No — ☐ Threaded ☒ Welded

CASING DIAMETER	WEIGHT	HOLE DIAM.
20 in. to 114 ft.	78.6 lbs./ft.	20 in. to 273 ft.
14 in. to 264 ft.	54.57 lbs./ft.	14 in. to 370 ft.
in. to ft.	lbs./ft.	in. to ft.

SCREEN Make / Type / Slot/Gauze / Set between ft. and ft. FITTINGS:

OPEN HOLE from 264 ft. to 370 ft. Diam. / Length

PROPERTY OWNER'S NAME: Shakopee Mdewakanton Sioux Community

Mailing address if different than property address indicated above.

2330 Sioux Trail NW
Prior Lake, MN 55372

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Sand and gravel			0	23
Fine hard sand			23	100
Fine hard sand/gravel			100	110
Lime rock			110	196
Lime rock & sandstone			196	216
Lime rock broken & sandstone			216	220
Lime rock broken			220	225
Lime rock		hard	225	263
Sandstone	Yellow		263	290
Sandstone	Tan		290	315
Sandstone	White		315	325
Sandstone	Tan		325	370

Use a second sheet, if needed

STATIC WATER LEVEL: 137 ft. ☒ below ☐ above land surface. Date measured 8/2/94

PUMPING LEVEL (below land surface): 136'3" ft. after 12 hrs. pumping 500 g.p.m.

WELL HEAD COMPLETION: ☒ Pitless adapter manufacturer Baker Monitor Model ☒ Casing Protection Fence ☒ 12 in. above grade

GROUTING INFORMATION: Well grouted? ☒ Yes ☐ No. Grout Material ☒ Neat cement ☐ Bentonite; from 264 to 0 ft. 28 ☒ yds. ☐ bags

NEAREST KNOWN SOURCE OF CONTAMINATION: feet direction type. Well disinfected upon completion? ☒ Yes ☐ No

PUMP: ☐ Not installed. Date installed 11/9/94. Manufacturer's name Byron Jackson. Model number — HP 125 Volts —. Length of drop pipe ft. Capacity g.p.m. Pressure Tank Capacity. Type: ☒ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet ☐

ABANDONED WELLS: Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

Well on reservation - for information only

WELL CONTRACTOR CERTIFICATION

This well was drilled under my supervision and in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Bergerson-Caswell, Inc. — 27058
Licensee Business Name — Lic. or Reg. No.

[signature] — 11/30/94
Authorized Representative Signature — Date

Bud Ledbeter — 11/30/94
Name of Driller — Date

IMPORTANT - FILE WITH PROPERTY PAPERS
WELL OWNER COPY — 554090

HE-01205-04 (Rev. 5/92)

146926

PWS (1700019)

MINNESOTA DEPARTMENT OF HEALTH

WELL RECORD

Minnesota Statutes Chapter 103I

MINNESOTA UNIQUE WELL NO. **525938**

WELL LOCATION

County Name: Scott

Township Name	Township No.	Range No.	Section No.	Fraction
Prior Lake	115	22	28	SW NE SW

Numerical Street Address and City of Well Location: 2330 Sioux Tr. NW, Prior Lake, MN

or Fire Number:

Show exact location of well in section grid with "X". Sketch map of well location. Showing property lines, roads and buildings.

N / W / E / S — ½ mi. — 1 mile

WELL DEPTH (completed): 395 ft.

Date Work Completed: 8/26/93

DRILLING METHOD

☒ Cable Tool ☐ Driven ☐ Dug ☐ Auger ☐ Rotary ☐ Jetted ☐ ______

DRILLING FLUID: Water

USE

☐ Domestic ☐ Monitoring ☐ Heating/Cooling ☐ Irrigation ☒ Public ☐ Industry/Commercial ☐ Test Well ☐ Dewatering ☐ Remedial ☐ ______

CASING — Drive Shoe? ☒ Yes ☐ No

☒ Steel ☐ Threaded ☒ Welded ☐ Plastic ☐ ______

CASING DIAMETER	WEIGHT	HOLE DIAM.
24 in. to 140 ft.	94.62 lbs./ft.	23 in. to 154 ft.
18 in. to 187 ft.	70.59 lbs./ft.	17 in. to 307 ft.
14 in. to 307 ft.	54.57 lbs./ft.	13 in. to 395 ft.

PROPERTY OWNER'S NAME

Shakopee Mdewakanton Sioux Community

Mailing address if different than property address indicated above.

2330 Sioux Trail NW
Prior Lake, MN 55372

SCREEN ______ Make ______ Type ______ Slot/Gauze ______ Set between ______ ft. and ______ ft.

OPEN HOLE from 307 ft. to 395 ft. Diam. ______ Length ______ FITTINGS: ______

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Drift	Brown	Med	0	142
Limestone	Buff	Med/Hard	142	154
Limestone/sand/grvl	Buff	Soft	154	187
Limestone	Buff	Hard	187	297
Sandstone	White	Soft	297	380
Sandstone	Red/Rust	Med	380	394
Shale	Gray	Med	394	395
MODERATE				

Use a second sheet, if needed

STATIC WATER LEVEL: 206 ft. ☒ below ☐ above land surface Date measured 8/11/93

PUMPING LEVEL (below land surface): 232 ft. after 17 hrs. pumping 1,000 g.p.m.

WELL HEAD COMPLETION

☐ Pitless adapter manufacturer ______ Model ______
☐ Casing Protection ______ ☐ 12 in. above grade

GROUTING INFORMATION

Well grouted? ☒ Yes ☐ No

Grout Material ☐ Neat cement ☐ Bentonite

from 307 to 0 ft. 30 ☐ yds. ☐ bags
from 140 to 0 ft. 8 ☒ yds. ☐ bags
from ______ to ______ ft. ______ ☐ yds. ☐ bags

NEAREST KNOWN SOURCE OF CONTAMINATION

75 feet North direction Sewer type

Well disinfected upon completion? ☒ Yes ☐ No

PUMP

☐ Not installed Date installed 11/23/93

Manufacturer's name: Byron Jackson

Model number: 11MQH HP 150 Volts 480

Length of drop pipe: 290 ft. Capacity 1,000 g.p.m.

Pressure Tank Capacity: water tower

Type: ☒ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet ☐ ______

ABANDONED WELLS

Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

Well is on Reservation for Information only

C93-2716

WELL CONTRACTOR CERTIFICATION

This well was drilled under my supervision and in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Bergerson-Caswell, Inc. — 27058
Licensee Business Name — Lic. or Reg. No.

[signature] Authorized Representative Signature — 9/25/93

Earl Baker
Name of Driller — 9/25/93

IMPORTANT - FILE WITH PROPERTY PAPERS
WELL OWNER COPY

525938

HE-01205-04 (Rev. 5/92)

For Information Only

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes, Chapter 103I

MINNESOTA UNIQUE WELL NO. **705731**

WELL LOCATION

County Name: Scott

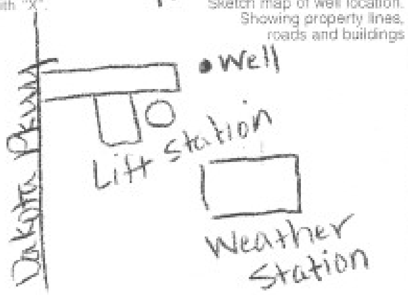
Township Name	Township No.	Range No.	Section No.	Fraction
Prior Lake	115N	22W	29	¼ ¼ ¼

GPS LOCATION: Latitude ____ degrees ____ minutes ____ seconds ____
Longitude ____ degrees ____ minutes ____ seconds ____

House Number, Street Name, City, and Zip Code of Well Location or Fire Number: Co. Rd. 42 & Dakota Pkwy, Prior LK.

Show exact location of well in section grid with "X". (N, S, E, W; ½ Mile; 1 Mile)

Sketch map of well location. Showing property lines, roads and buildings.



PROPERTY OWNER'S NAME/COMPANY NAME: Shakopee Mdewakanton Sioux Community

Property owner's mailing address if different than well location address indicated above.
Land Management Dept.
2350 Sioux Trail NW
Prior Lake, Mn 55372

WELL OWNER'S NAME/COMPANY NAME: Same

Well owner's mailing address if different than property owners address indicated above.

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Drift	Brown	med	0	145
Limestone	Brown	hard	145	265
Sandstone	white	soft	265	365
St. Lawrence	Green	hard	365	410
Franconia	Green	hard	410	555
Ironton	White	med	555	620
Eau Claire	Green	hard	620	

Use a second sheet, if needed

REMARKS, ELEVATION, SOURCE OF DATA, etc.

IMPORTANT - FILE WITH PROPERTY PAPERS
WELL OWNER COPY

705731

WELL DEPTH (completed): 620 ft.

Date Work Completed: 10-01-04

DRILLING METHOD: ☐ Cable Tool ☐ Auger ☐ Driven ☒ Rotary ☐ Dug ☐ Jetted ☐

DRILLING FLUID: Bentonite

WELL HYDROFRACTURED? ☐ Yes ☐ No
FROM ____ ft. TO ____ ft.

USE: ☐ Domestic ☐ Noncommunity PWS ☐ Community PWS ☒ Monitoring ☐ Environ. Bore Hole ☐ Irrigation ☐ Dewatering ☐ Heating/Cooling ☐ Industry/Commercial ☐ Remedial ☐

CASING: ☒ Steel ☐ Plastic ☐
Drive Shoe? ☐ Yes ☐ No ☐ Threaded ☐ Welded ☐

CASING DIAMETER		WEIGHT	HOLE DIAM.
8 in. to	145 ft.	lbs./ft.	12 in. to 145 ft.
4 in. to	520 ft.	lbs./ft.	8 in. to 520 ft.
in. to	ft.	lbs./ft.	4 in. to 620 ft.

SCREEN ____ Make ____ Type ____ Diam. ____ Slot/Gauze ____ Length ____
Set between ____ ft. and ____ ft. FITTINGS ____

OPEN HOLE: FROM ____ ft. TO ____ ft.

STATIC WATER LEVEL: 184 ft. ☒ below ☐ above land surface Date measured ____

PUMPING LEVEL (below land surface): 250 ft. after 4 hrs. pumping 20 g.p.m.

WELL HEAD COMPLETION
☐ Pitless adapter manufacturer ____ Model ____
☐ Casing Protection ☒ 12 in. above grade
☐ At-grade (Environmental Wells and Boring ONLY)

GROUTING INFORMATION
Well grouted ☒ Yes ☐ No
Grout material ☒ Neat cement ☐ Bentonite ☐ Concrete ☐ High Solids Bentonite
from 0 to 520 ft. 45 ☒ yds. ☐ bags
from ____ to ____ ft. ____ ☐ yds. ☐ bags
from ____ to ____ ft. ____ ☐ yds. ☐ bags

NEAREST KNOWN SOURCE OF CONTAMINATION: 50 feet W direction sewer line type

Well disinfected upon completion ☐ Yes ☐ No

PUMP: ☒ Not installed Date installed ____
Manufacturer's name ____
Model number ____ HP ____ Volts ____
Length of drop pipe ____ ft. Capacity ____ g.p.m.
Type: ☐ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet ☐

ABANDONED WELLS: Does property have any not in use and not sealed well(s) ☐ Yes ☒ No

VARIANCE: Was a variance granted from the MDH for this well? ☐ Yes ☒ No TN# ____

WELL CONTRACTOR CERTIFICATION
This well was drilled under my supervision and in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Mineral Service Plus, LLC — Licensee Business Name; 10622 — Lic. or Reg. No.

[signature] — Authorized Representative Signature; 10-01-04 — Date

Nicholas G. Schultz — Name of Driller

HE-01205-08 (Rev. 5/02)

IC 140-0020

For Information Only

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes, Chapter 103I

MINNESOTA UNIQUE WELL NO. **705730**

WELL LOCATION

County Name: Scott

Township Name	Township No.	Range No.	Section No.	Fraction
Prior Lake	115N	22W	33	¼ ¼ ¼

GPS LOCATION: Latitude ___ degrees ___ minutes ___ seconds ___ Longitude ___ degrees ___ minutes ___ seconds ___

House Number, Street Name, City, and Zip Code of Well Location: Co. Rd. 83 + Dakota Tr, Prior Lake — or Fire Number ___

Show exact location of well in section grid with "X". (N, S, E, W; ½ Mile; 1 Mile)

Sketch map of well location. Showing property lines, roads and buildings

PROPERTY OWNER'S NAME/COMPANY NAME: Shakopee Mdewakanton Sioux Community

Property owner's mailing address if different than well location address indicated above.
Land Management Dept.
2350 Sioux Trail NW
Prior Lake, Mn 55372

WELL OWNER'S NAME/COMPANY NAME: Same

Well owner's mailing address if different than property owners address indicated above.

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Drift	Brown	med	0	252
Limestone	Brown	hard	252	340
Sandstone	Orange	soft	340	445
St. Lawrence	Green	hard	445	502
Franconia	Green	hard	502	635
IrontonGalesville	white	hard	635	712
Eau Claire	Green	hard	712	

Use a second sheet, if needed

REMARKS, ELEVATION, SOURCE OF DATA, etc.

WELL DEPTH (completed): 712 ft.

Date Work Completed: 10-14-04

DRILLING METHOD: ☐ Cable Tool ☐ Auger ☐ Driven ☒ Rotary ☐ Dug ☐ Jetted ☐

DRILLING FLUID: Bentonite

WELL HYDROFRACTURED? ☐ Yes ☒ No FROM ___ ft. TO ___ ft.

USE: ☐ Domestic ☐ Noncommunity PWS ☐ Community PWS ☒ Monitoring ☐ Environ. Bore Hole ☐ Irrigation ☐ Dewatering ☐ Heating/Cooling ☐ Industry/Commercial ☐ Remedial ☐

CASING: ☒ Steel ☐ Plastic ☐ — Drive Shoe? ☐ Yes ☐ No ☐ Threaded ☐ Welded ☐

HOLE DIAM.

CASING DIAMETER		WEIGHT	HOLE DIAM.
8 in. to 252 ft.		lbs./ft.	12 in. to 252 ft.
4 in. to 623 ft.		lbs./ft.	8 in. to 623 ft.
in. to ft.		lbs./ft.	4 in. to 712 ft.

SCREEN ___ Make ___ Type ___ Slot/Gauze ___ Set between ___ ft. and ___ ft.

OPEN HOLE FROM 623 ft. TO 712 ft.

Diam. ___ Length ___ FITTINGS ___

STATIC WATER LEVEL: 245 ft. ☒ below ☐ above land surface Date measured ___

PUMPING LEVEL (below land surface): 250 ft. after 4 hrs. pumping 20 g.p.m.

WELL HEAD COMPLETION: ☐ Pitless adapter manufacturer ___ Model ___ ☐ Casing Protection ___ ☒ 12 in. above grade ☐ At-grade (Environmental Wells and Boring ONLY)

GROUTING INFORMATION: Well grouted ☒ Yes ☐ No

Grout material ☒ Neat cement ☐ Bentonite ☐ Concrete ☐ High Solids Bentonite

from 0 to 623 ft. 23 ☒ yds. ☐ bags
from ___ to ___ ft. ___ ☐ yds. ☐ bags
from ___ to ___ ft. ___ ☐ yds. ☐ bags

NEAREST KNOWN SOURCE OF CONTAMINATION: 30 feet W direction Sewer line type

Well disinfected upon completion ☐ Yes ☐ No

PUMP: ☒ Not installed Date installed ___
Manufacturer's name ___
Model number ___ HP ___ Volts ___
Length of drop pipe ___ ft. Capacity ___ g.p.m.
Type: ☐ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet ☐

ABANDONED WELLS: Does property have any not in use and not sealed well(s) ☐ Yes ☒ No

VARIANCE: Was a variance granted from the MDH for this well? ☐ Yes ☒ No TN# ___

WELL CONTRACTOR CERTIFICATION
This well was drilled under my supervision and in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Mineral Service Plus, LLC — 10622
Licensee Business Name — *Lic. or Reg. No.*

[signature] — 10-14-04
Authorized Representative Signature — *Date*

Greg Segler
Name of Driller

IMPORTANT - FILE WITH PROPERTY PAPERS
WELL OWNER COPY
705730

HE-01205-08 (Rev. 5/02)

IC 140-0020

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

MINNESOTA UNIQUE WELL NO. 00253021

WELL LOCATION

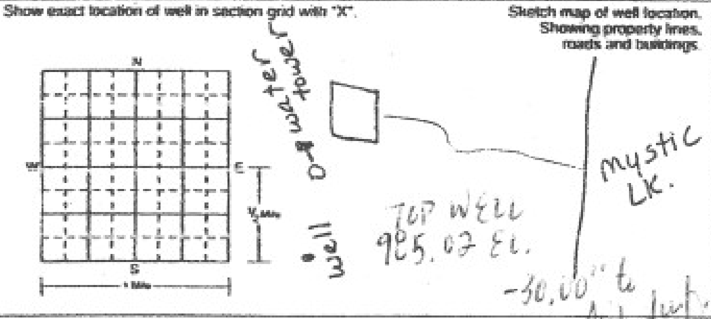
County Name: Scott

Township Name	Township No.	Range No.	Section No.	Fraction
Pr_ _ Lake	115	22	28	SW ¼ NE ¼ SW ¼

House Number, Street Name, City, and Zip Code of Well Location:

or Fire Number:

Show exact location of well in section grid with "X". Sketch map of well location. Showing property lines, roads and buildings.



WELL DEPTH (completed): 667 feet

Date Work Completed: 1/29/99

DRILLING METHOD
- ☐ Cable Tool
- ☐ Driven
- ☐ Dug
- ☐ Auger
- ☒ Rotary
- ☐ Jetted
- ☐

DRILLING FLUID: bentonite

USE
- ☐ Domestic
- ☐ Irrigation
- ☐ Test Well
- ☐ Monitoring
- ☒ Community PWS
- ☐ Noncommunity PWS
- ☐ Dewatering
- ☐ Heating/Cooling
- ☐ Industry/Commercial
- ☐ Remedial
- ☐

CASING: ☒ Steel ☐ Plastic ☐ Threaded ☒ Welded ☐
Drive Shoe? ☒ Yes ☐ No

CASING DIAMETER		WEIGHT	HOLE DIAM.
20 in.	to 179 ft.	78.60 lbs./ft.	26 in. to 179 ft.
16 in.	to 570 ft.	62.58 lbs./ft.	19 1/4 in. to 570 ft.
in.	to ft.	lbs./ft.	in. to ft.

PROPERTY OWNER'S NAME
Shakopee Mdewakanton Sioux Community

Property owner's mailing address if different than well location address indicated above.

2330 Sioux Trail NW
Prior Lake, MN 55372

SCREEN
Make
Type
Slot/Gauze
Set between ft. and ft. FITTINGS:

OPEN HOLE from 570 ft. to 667 ft.
Diam.
Length

STATIC WATER LEVEL: 200 ft. ☒ below ☐ above land surface Date measured

PUMPING LEVEL (below land surface): 375 ft. after 32 hrs. pumping 560+ g.p.m.

WELL OWNER'S NAME
Shakopee Mdewakanton Sioux Community

Well owner's mailing address if different than property owner's address indicated above.

sa

WELL HEAD COMPLETION
- ☐ Pitless adapter manufacturer Baker Monitor Model
- ☐ Casing Protection ☒ 12 in. above grade
- ☐ At-grade (Environmental Wells and Borings ONLY)

GROUTING INFORMATION
Well grouted? ☒ Yes ☐ No
Grout Material ☒ Neat cement ☐ Bentonite ☐ Concrete ☐ High Solids Bentonite
from ___ to ___ ft. ___ ☐ yds. ☐ bags
from ___ to ___ ft. ___ ☐ yds. ☐ bags
from ___ to ___ ft. ___ ☐ yds. ☐ bags

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Drift. Mixed clay & gravel	gray	medium	0	168
Limestone	brown	med./hard	168	312
Sandstone	pink/red	med./hard	312	493
Dolimite	green & black	hard	493	551
Dolimite	green	medium	551	595
Sandstone	white	soft	595	635
Shale	gray	hard	635	656
Siltstone	white/gray	medium	656	667

Use a second sheet, if needed

NEAREST KNOWN SOURCE OF CONTAMINATION
175 feet southwest direction salt sand shed type
Well disinfected upon completion? ☒ Yes ☐ No

PUMP
☐ Not installed Date installed January 29, 1999
Manufacturer's name Byron Jackson
Model number 12 H/10 MQ HP 150 Volts 480
Length of drop pipe 450 ft. Capacity g.p.m.
Pressure Tank Capacity variable speed
Type: ☒ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet ☐

ABANDONED WELLS
Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

VARIANCE
Was a variance granted from the MDH for this well? ☐ Yes ☒ No

REMARKS, ELEVATION, SOURCE OF DATA, etc.

Th_ well is located on an Indian Reservation
This log is for informational use only.
2' Contour map = 299.62 m asl elevation @ ground
Survey/gps = 299.47 m asl elevation @ ground

WELL CONTRACTOR CERTIFICATION

This well was drilled under my supervision and in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Mineral Service Plus LLC — Licensed Business Name — 10622 Lic. or Reg. No.

[signature] Authorized Representative Signature — 1/29/99 Date

Danny A. Nubbe — Name of Driller — 1/29/99 Date

MINN. DEPT. OF HEALTH COPY

HE-01205-05 (Rev. 1/95)

For Information Only

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes, Chapter 103I

MINNESOTA UNIQUE WELL NO. 705725

WELL LOCATION

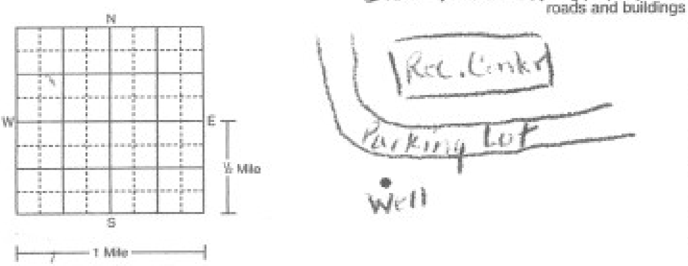
County Name: Scott

Township Name	Township No.	Range No.	Section No.	Fraction
Prior Lake	T115N	R22W	33	¼ ¼ SW

GPS LOCATION: Latitude ____ degrees ____ minutes ____ seconds ____
Longitude ____ degrees ____ minutes ____ seconds ____

House Number, Street Name, City, and Zip Code of Well Location or Fire Number: 2100 Trail of Dreams Prior Lake Shakopee Sioux Community

Show exact location of well in section grid with "X". Sketch map of well location. Showing property lines, roads and buildings



PROPERTY OWNER'S NAME/COMPANY NAME: Shakopee Mdewakanton Sioux Community

Property owner's mailing address if different than well location address indicated above.
2330 Sioux Trail NW
Prior Lake, Mn 55372

WELL OWNER'S NAME/COMPANY NAME: Same

Well owner's mailing address if different than property owners address indicated above.

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Drift	Brown	med	0	170
Lime Rock	Brown	hard	170	250
Lime Rock	Brown	hard	250	278
Sandstone	white	med	278	386

Use a second sheet, if needed

REMARKS, ELEVATION, SOURCE OF DATA, etc.
Golf Course Production Well
SMSC GPS (Trimble GeoXT) @ land surface:
N: 4952406.287 m
E: 462803.433 m elv: 296.784 m asl

WELL DEPTH (completed): 386 ft.

Date Work Completed: 04 09 04

DRILLING METHOD: ☐ Cable Tool ☐ Auger ☐ Driven ☒ Rotary ☐ Dug ☐ Jetted ☐

DRILLING FLUID: Bentonite Quick Foam

WELL HYDROFRACTURED? ☐ Yes ☒ No
FROM ____ ft. TO ____ ft.

USE: ☐ Domestic ☐ Noncommunity PWS ☐ Community PWS ☐ Monitoring ☐ Environ. Bore Hole ☒ Irrigation ☐ Dewatering ☐ Heating/Cooling ☐ Industry/Commercial ☐ Remedial ☐

CASING: ☒ Steel ☐ Plastic ☐
Drive Shoe? ☐ Yes ☐ No ☐ Threaded ☐ Welded

CASING DIAMETER	WEIGHT	HOLE DIAM.
16 in. to 170 ft.	lbs./ft.	19 in. to 170 ft.
12 in. to 250 ft.	lbs./ft.	15 ½ in. to 250 ft.
in. to ft.	lbs./ft.	11 ¾ in. to 386 ft.

SCREEN ____
Make ____
Type ____ Diam. ____
Slot/Gauze ____ Length ____
Set between ____ ft. and ____ ft. FITTINGS ____

OPEN HOLE: FROM 250 ft. TO 386 ft.

STATIC WATER LEVEL: 143 ft. ☒ below ☐ above land surface Date measured ____

PUMPING LEVEL (below land surface): ____ ft. after ____ hrs. pumping ____ g.p.m.

WELL HEAD COMPLETION
☒ Pitless adapter manufacturer Baker Model 7'
☐ Casing Protection ____ ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Boring ONLY)

GROUTING INFORMATION
Well grouted ☒ Yes ☐ No
Grout material ☒ Neat cement ☐ Bentonite ☐ Concrete ☐ High Solids Bentonite
from 0 to 250 ft. 28 ☒ yds. ☐ bags
from ____ to ____ ft. ____ ☐ yds. ☐ bags
from ____ to ____ ft. ____ ☐ yds. ☐ bags

NEAREST KNOWN SOURCE OF CONTAMINATION: 150 feet West direction Pond type
Well disinfected upon completion ☒ Yes ☐ No

PUMP
☐ Not installed Date installed 07-01-04
Manufacturer's name American Marsh
Model number ____ HP 60 Volts 460
Length of drop pipe 231 ft. Capacity 800 g.p.m.
Type: ☐ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet ☐

ABANDONED WELLS
Does property have any not in use and not sealed well(s) ☐ Yes ☒ No

VARIANCE
Was a variance granted from the MDH for this well? ☐ Yes ☒ No TN# ____

WELL CONTRACTOR CERTIFICATION
This well was drilled under my supervision and in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Mineral Service Mns, LLC — Licensee Business Name
10622 — Lic. or Reg. No.

[signature] — Authorized Representative Signature
June 16 - 2004 — Date

Greg Segler — Name of Driller

BLACK WELL CONTRACTOR COPY 705725

✓ Lanya (her comments in green)

GEOLOGIC LOG LEGGETTE, BRASHEARS & GRAHAM, INC. ST. PAUL, MINNESOTA	OWNER: Shakopee Mdewakanton Sioux Community BORING NO. C-1 PAGE 1 OF 1 PAGES
LOCATION: Mystic Lake Casino	SCREEN: NA
Prior Lake, MN	DIAMETER: NA SLOT NO. NA
DATE COMPLETED: 10-Aug-05	SETTING: NA
DRILLING COMPANY: Traut Wells Daryl Karasch-driller	SAND PACK: NA
Waite Park, MN	SETTING: NA
DRILLING METHOD: Roto Sonic	CASING: NA
SAMPLING METHOD: Cuttings	SETTING: NA
OBSERVER: D. Strand	SEAL TYPE: NA
REFERENCE POINT: Grade	SETTING: NA
REFERENCE POINT ELEVATION: 992.7	DEVELOPMENT: NA
STICK-UP:	DURATION: NA
SURFACE COMPLETION:	WATER LEVEL:
REMARKS:	YIELD:

Geologic logging conducted at Braun Intertec's warehouse at 11001 Hampshire Avenue South, Minneapolis, MN

Gradation and hydrometer tests 151, 181, and 223 feet.

Petrology tests 151, 181, and 223 feet.

DEPTH IN FEET (below grade) FROM	TO	UNIFIED SOIL CLASSIFICATION — USCS (all logs)	GEOLOGIC DESCRIPTION
0.0	5.0	~~OH~~ OL	TOPSOIL, NO;
5.0	22.0	CL, ~~sandy~~	SANDY CLAY, brown.
22.0	30.0	CL	TILL, gray.
30.0	37.0	ML, ~~clayey~~	CLAYEY SILT, trace sand and gravel.
37.0	78? ~~80.0~~	CL	TILL, gray.
78? ~~80.0~~	(90) ~~86.0~~	CL, ~~sandy~~	CLAY, sandy, brown.
(90) ~~86.0~~	~~234.0~~	SP-SM with gravel	SAND to SAND and GRAVEL, ~~brown~~ 90 per gamma log
		SP-SM with gravel	fine to medium sand with gravel 86-108 feet.
		SP-SM (Lab 151' and 181' SP-SM)	fine to medium sand; some fine sand; trace gravel 108-185 feet.
		SP-SM with gravel and cobbles	with gravel and cobbles 195-200 feet.
	SM	SP-SM with gravel	with gravel 218-220 feet.
185.0	234.0	~~SP-SM with gravel (Lab 223' SM)~~	~~SAND to SAND and GRAVEL.~~ SILTY SAND, fine grained. brown (per Traut log)
234.0	242.0	CL	TILL, brown.
242.0	255.0	SM	SILT and ~~FINE~~ SAND, gray. fine
255.0	260.0	CL, ~~sandy~~	SANDY CLAY, gray per Traut log
260.0	266.0	ML	SILT, brown.
86	108	SP	SAND, fine to medium grained, with gravel
108	185	SP-SM	SAND with silt, fine to medium grained, trace Gra
			195-200 with gravel and cobbles
			218-220 with gravel

GEOLOGIC LOG LEGGETTE, BRASHEARS & GRAHAM, INC. ST. PAUL, MINNESOTA	
	OWNER: Shakopee Mdewakanton Sioux Community
	BORING NO. C-2
	PAGE 1 OF 1 PAGES
LOCATION: Mystic Lake Casino	SCREEN: NA
Prior Lake, MN	DIAMETER: NA SLOT NO. NA
DATE COMPLETED: 10-Aug-05	SETTING: NA
DRILLING COMPANY: Traut Wells Daryl Karasch-driller	SAND PACK: NA
Waite Park, MN	SETTING: NA
DRILLING METHOD: Roto Sonic	CASING: NA
SAMPLING METHOD: Cuttings	SETTING: NA
OBSERVER: D. Strand	SEAL TYPE: NA
REFERENCE POINT: Grade	SETTING: NA
REFERENCE POINT ELEVATION: 993.1	DEVELOPMENT: NA
STICK-UP:	DURATION: NA
SURFACE COMPLETION: tests	WATER LEVEL:
REMARKS:	YIELD:

Geologic logging conducted at Braun Intertec's warehouse at 11001 Hampshire Avenue South, Minneapolis, MN

Gradation and hydrometer tests 146, 166, and 181 feet.

Petrology 146, 166, and 181 feet.

DEPTH IN FEET (below grade) FROM	TO	UNIFIED SOIL CLASSIFICATION	GEOLOGIC DESCRIPTION
0.0	5.0	~~OH~~ OL	TOPSOIL.
5.0	12.5	CL	CLAY, brown.
12.5	77.0	CL	TILL, gray.
77.0	82.0	CL, ~~sandy~~	SANDY CLAY; brown; dry; very hard and broken up.
82.0	100.0	SC ~~with gravel~~	CLAYEY SAND and Gravel; dry; very hard and broken up; can be crumbled with force. brown (traut)
100.0	105.0	~~SM~~ SP - SM	SAND, fine and SILT; trace clay; trace cobbles; becomes sandier with depth. (brown - traut)
105.0	110.0	SC ~~with gravel~~	CLAYEY SAND and Gravel; dry; very hard and broken up. brown (traut)
110.0	112.0	SP-SC	SAND, fine to coarse; some clay; brown; moist.
112.0	117.0	CL	TILL; sandy; brown; dry; hard.
117.0	122.0	SP-SM ~~with gravel and cobbles~~	SAND, fine to coarse and GRAVEL; with cobbles; brown; dry.
122.0	127.0	SP-SM	SAND, fine to coarse; grades coarser with depth; brown; moist.
127.0	140.0	SP-SM ~~with gravel~~	SAND, fine to very coarse; little fine to coarse gravel; trace cobbles; grades coarser then finer. brown (traut)
140.0	146.0	SP-SM	SAND, fine to coarse; grades finer with depth; brown.
146.0	150.0	~~SP~~-SM ~~(Lab 146' SM)~~	SILTY SAND, fine; trace silt; becomes sandier with depth. brown (traut)
150.0	160.0	SP-SM	SAND, fine; some medium sand. brown (Traut)
160.0	188.0	SP-SM ~~(Lab 166' SM' and 181' SP-SM)~~	SAND, fine to medium; trace coarse sand; becomes finer 175-180 then coarser. brown (traut) 165-170 moted trace cla
188.0	190.0	SP-SM ~~with gravel and cobbles~~	SAND, fine and GRAVEL, and COBBLES. brown (traut)
190.0	192.0	SP-SM	SAND, fine to coarse. brown (traut)
192.0	198.0	~~SP with gravel and cobbles~~ SP - SM	SAND, fine to coarse and GRAVEL, and COBBLES.
198.0	200.0	SP-SC ~~with gravel and cobbles~~	SAND, GRAVEL, and COBBLES; clayey and very hard. tan, weathered limestone (traut)

S:\Tech\Mystic Lake\Hydrogeo\ GEOLOG

GEOLOGIC LOG
LEGGETTE, BRASHEARS & GRAHAM, INC.
ST. PAUL, MINNESOTA

OWNER: Shakopee Mdewakanton Sioux Community	
BORING NO. C-3	
PAGE 1 OF 1 PAGES	
LOCATION: Mystic Lake Casino	SCREEN: NA
Prior Lake, MN	DIAMETER: NA SLOT NO. NA
DATE COMPLETED: 10-Aug-05	SETTING: NA
DRILLING COMPANY: Traut Wells Daryl Karasch-driller	SAND PACK: NA
Waite Park, MN	SETTING: NA
DRILLING METHOD: Roto Sonic	CASING: NA
SAMPLING METHOD: Cuttings	SETTING: NA
OBSERVER: D. Strand	SEAL TYPE: NA
REFERENCE POINT: Grade	SETTING: NA
REFERENCE POINT ELEVATION: 905.2	DEVELOPMENT: NA
STICK-UP:	DURATION: NA
SURFACE COMPLETION:	WATER LEVEL:
REMARKS:	YIELD:

Geologic logging conducted at Braun Intertec's warehouse at 11001 Hampshire Avenue South, Minneapolis, MN

DEPTH IN FEET (below grade) FROM	TO	UNIFIED SOIL CLASSIFICATION	GEOLOGIC DESCRIPTION
0.0	5.0	~~OH~~ L	TOPSOIL.
5.0	10.0	CL	CLAY, brown.
10.0	12.5	CL, ~~sandy~~	SANDY CLAY, brown; trace black.
12.5	15.0	ML	SILT, brown.
15.0	20.0	CL	TILL; sandy; brown; dry; hard.
20.0	28.0	SP-SC	CLAYEY SAND, fine to medium; locally more sandy and coarsens with depth. brown (traut)
28.0	72.0	CL	TILL, gray.
72.0	120.0	SP-SM	SAND, fine; trace medium to coarse; very blocky and dry. brown (traut)
		SP-SM	cobble at 75 feet.
		SP-SM	more coarse 80-82 feet. 85'-90'
		SP-SC	~~clayey 85~~ ~~some clay 100-105 feet.~~ clayey 85' – 115' w/trace gravel
		SP ~~with cobbles~~	cobbles at 107-109 feet.
		SW P	Fine medium to coarse sand 110-115 feet.
120.0	127.5	SP ~~with gravel~~	SAND and GRAVEL, very fine to very coarse; grades coarser with depth. brown (traut)
127.5	130.0		BEDROCK; very fine clean quartz sand with a rock plug. tan (traut)

GEOLOGIC LOG LEGGETTE, BRASHEARS & GRAHAM, INC. ST. PAUL, MINNESOTA	OWNER: Shakopee Mdewakanton Sioux Community BORING NO. C-4 PAGE 1 OF 1 PAGES
LOCATION: Mystic Lake Casino	SCREEN: NA
Prior Lake, MN	DIAMETER: NA SLOT NO. NA
DATE COMPLETED: 10-Aug-05	SETTING: NA
DRILLING COMPANY: Traut Wells Daryl Karasch-driller	SAND PACK: NA
Waite Park, MN	SETTING: NA
DRILLING METHOD: Roto Sonic	CASING: NA
SAMPLING METHOD: Cuttings	SETTING: NA
OBSERVER: D. Strand	SEAL TYPE: NA
REFERENCE POINT: Grade	SETTING: NA
REFERENCE POINT ELEVATION: 928.5	DEVELOPMENT: NA
STICK-UP:	DURATION: NA
SURFACE COMPLETION:	WATER LEVEL:
REMARKS:	YIELD:

Geologic logging conducted at Braun Intertec's warehouse at 11001 Hampshire Avenue South, Minneapolis, MN

Gradation and hydrometer tests 111 feet.

200 Wash 126 feet

DEPTH IN FEET (below grade) FROM	TO	UNIFIED SOIL CLASSIFICATION	GEOLOGIC DESCRIPTION
0.0	1.0	~~OH~~ L	TOPSOIL.
1.0	10.0	CL, ~~sandy~~	SANDY CLAY, brown, dry.
10.0	12.5	CL	TILL, gray.
12.5	15.0	CL	CLAY, brown.
15.0	35.0	CL	TILL; gray; dry; very hard.
35.0	50.0	CL, ~~sandy and gravelly~~	TILL, very sandy and gravelly, cobbles locally, brown;
50.0	55.0	SP	SAND, fine; trace medium to coarse sand; trace fine gravel with depth, brown, dry. cobbles (traut)
~~55.0~~	~~65.0~~	~~SP-SC, with gravel~~	~~SAND, very fine to coarse; some silt; little fine gravel; very broken up and crumbly.~~ 90'-120' Fining upward
~~65.0~~	~~90.0~~	~~SP-SC, with gravel~~	~~SAND, very fine to coarse; some silt; little fine to coarse gravel; very broken up and crumbly.~~
55 ~~90.0~~	117 ~~119.0~~	SM (Lab ~~111' SM~~)	SILTY SAND, fine to medium; trace gravel. brown (traut)
117 ~~119.0~~	132.0	~~SP~~-SM	SAND, very fine to fine. brown (traut)
132.0	145.0	SP-SM	SAND, fine to medium; trace gravel.
145.0	160.0		BEDROCK.

GEOLOGIC LOG
LEGGETTE, BRASHEARS & GRAHAM, INC.
ST. PAUL, MINNESOTA

OWNER: Shakopee Mdewakanton Sioux Community	
BORING NO. C-5	
PAGE 1 **OF** 1 **PAGES**	
LOCATION: Mystic Lake Casino	**SCREEN:** NA
Prior Lake, MN	**DIAMETER:** NA **SLOT NO.** NA
DATE COMPLETED: 10-Aug-05	**SETTING:** NA
DRILLING COMPANY: Traut Wells Daryl Karasch-driller	**SAND PACK:** NA
Waite Park, MN	**SETTING:** NA
DRILLING METHOD: Roto Sonic	**CASING:** NA
SAMPLING METHOD: Cuttings	**SETTING:** NA
OBSERVER: D. Strand	**SEAL TYPE:** NA
REFERENCE POINT: Grade	**SETTING:** NA
REFERENCE POINT ELEVATION: 967.8	**DEVELOPMENT:** NA
STICK-UP:	**DURATION:** NA
SURFACE COMPLETION:	**WATER LEVEL:**
REMARKS:	**YIELD:**

Geologic logging conducted at Braun Intertec's warehouse at 11001 Hampshire Avenue South, Minneapolis, MN

Gradation and hydrometer tests 146 feet.

200 Wash 126 and 171 feet

DEPTH IN FEET (below grade) FROM	TO	UNIFIED SOIL CLASSIFICATION	GEOLOGIC DESCRIPTION
0.0	1.0	~~OH~~ L	TOPSOIL.
1.0	15.0	CL, ~~with sand~~	CLAY; little sand; brown.
15.0	77.0	CL	TILL, gray.
77.0	80.0	SP	SAND, fine to medium; trace coarse sand; trace fine gravel; brown.
80.0	88.0	CL	TILL, gray.
88.0	100.0	SP-SM	SAND, fine to coarse; locally more fine; trace ~~fine to coarse~~ gravel; brown; dry.
100.0	107.0	CL	TILL, brownish gray.
107.0	110.0	ML-CL	SILTY CLAY ~~SILT and CLAY and TILL~~; brown, dry, ~~hard.~~
110.0	112.0	~~SP-~~SC	CLAYEY SAND, fine; little medium sand; trace coarse sand; ~~locally clayey~~.
112.0	120.0	SC	CLAYEY SAND, fine to medium; some coarse sand; trace ~~fine to coarse~~ gravel; brown.
120.0	175.0	SP-SM	SAND, fine to medium; trace coarse.
		~~SP~~-SM (Lab 146' SM)	Very fine to fine sand 138-140 feet and, silty sand, 145-147 feet.
		SP	More coarse sand and trace fine gravel 160-175 feet.
		SP-SM	More fine sand 167-170 feet.
175.0	190.0	SC ~~with gravel~~	CLAYEY ~~CLAY and~~ SAND with ~~and~~ GRAVEL ~~soup that has hardened; very dry and crumbly but very hard.~~
			Not as much gravel from 180-190 feet. Orange.
			Weathered? Bedrock suspected to begin near 180 feet.

GEOLOGIC LOG LEGGETTE, BRASHEARS & GRAHAM, INC. ST. PAUL, MINNESOTA	
	OWNER: Shakopee Mdewakanton Sioux Community
	BORING NO. C-6
	PAGE 1 **OF** 1 **PAGES**

LOCATION: Mystic Lake Casino	**SCREEN:** NA
Prior Lake, MN	**DIAMETER:** NA **SLOT NO.** NA
DATE COMPLETED: 11-Aug-05	**SETTING:** NA
DRILLING COMPANY: Traut Wells Daryl Karasch-driller	**SAND PACK:** NA
Waite Park, MN	**SETTING:** NA
DRILLING METHOD: Roto Sonic	**CASING:** NA
SAMPLING METHOD: Cuttings	**SETTING:** NA
OBSERVER: D. Strand	**SEAL TYPE:** NA
REFERENCE POINT: Grade	**SETTING:** NA
REFERENCE POINT ELEVATION: 983.0	**DEVELOPMENT:** NA
STICK-UP:	**DURATION:** NA
SURFACE COMPLETION:	**WATER LEVEL:**
REMARKS:	**YIELD:**

Geologic logging conducted at Braun Intertec's warehouse at 11001 Hampshire Avenue South, Minneapolis, MN

Gradation and hydrometer tests 62, 142, 172, and 192 feet.

200 Wash 182.5 feet. Petrology 172 feet.

DEPTH IN FEET (below grade) FROM	TO	UNIFIED SOIL CLASSIFICATION	GEOLOGIC DESCRIPTION
0.0	2.0	O~~H~~ L	TOPSOIL.
2.0	18.5	CL~~, sandy, with gravel and cobbles~~	SANDY CLAY; little gravel and cobbles; brown.
18.5	85.0	CL ~~(Lab 62' SC)~~	TILL, gray.
85.0	92.0	SC	CLAYEY SAND, fine to medium; trace gravel and cobbles.
92.0	115.0	SP~~-SC~~ -SM	SAND, fine to medium; trace clay, gravel and cobbles; brown; dry; blocky.
115.0	145.0	SP ~~with gravel and cobbles~~ ~~(Lab 142' GP)~~	SAND, fine to coarse and GRAVEL and COBBLES; gray; dry. Cobble zone 135-145 feet.
145.0	150.0	SP	SAND, fine; trace medium to coarse sand; trace fine to coarse gravel; whitish brown.
150.0	180.0	~~SW~~ SP-SM ~~(Lab 172' SP-SM)~~	SAND, fine to medium (sandbox sand); brown. Slightly more coarse sand 178-180 feet.
180.0	183.5	S~~W~~ P	SAND, medium to coarse; trace fine to medium sand; well sorted.
183.5	187.5	SP	SAND, fine to medium; trace coarse sand; trace 1- to 2-inch cobbles.
187.5	190.0	SP-SM	SAND, fine; trace medium to coarse sand.
190.0	200.0	~~SW (Lab 192' SW-SM)~~ SP-SM	SAND, fine to medium (sandbox sand); trace coarse sand and fine gravel locally.
200.0	205.0	CL~~, sandy~~	SANDY CLAY, dark brown. trace cobbles
205.0	210.0		BEDROCK, yellow slurry with rock pieces.

GEOLOGIC LOG LEGGETTE, BRASHEARS & GRAHAM, INC. ST. PAUL, MINNESOTA	OWNER: Shakopee Mdewakanton Sioux Community BORING NO. C-7 PAGE 1 OF 1 PAGES
LOCATION: Mystic Lake Casino	SCREEN: NA
Prior Lake, MN	DIAMETER: NA SLOT NO. NA
DATE COMPLETED: 11-Aug-05	SETTING: NA
DRILLING COMPANY: Traut Wells Daryl Karasch-driller	SAND PACK: NA
Waite Park, MN	SETTING: NA
DRILLING METHOD: Roto Sonic	CASING: NA
SAMPLING METHOD: Cuttings	SETTING: NA
OBSERVER: D. Strand	SEAL TYPE: NA
REFERENCE POINT: Grade	SETTING: NA
REFERENCE POINT ELEVATION: 966.4	DEVELOPMENT: NA
STICK-UP:	DURATION: NA
SURFACE COMPLETION:	WATER LEVEL:
REMARKS:	YIELD:

REMARKS:
Geologic logging conducted at Braun Intertec's warehouse at 11001 Hampshire Avenue South, Minneapolis, MN
Gradation and hydrometer tests 121, 127, and 141 feet.
Petrology 127 and 141 feet.

DEPTH IN FEET (below grade) FROM	TO	UNIFIED SOIL CLASSIFICATION	GEOLOGIC DESCRIPTION
0.0	5.0	CL	CLAY; little sand; brown; fill?
5.0	10.0	OH	TOPSOIL and CLAY, black and brown., fill ?
10.0	27.5	CL	TILL, gray, some brown mottling.
27.5	45.0	SP-SC ~~SP-SC~~ ~~SP-SC~~ SM	SAND, fine to coarse; ~~some clay; gray~~ clayey, gray sandier 33-35 siltier 35-37
45.0	47.0	ML	SILT, gray.
47.0	107.0	CL	TILL, gray.
107.0	115.0	SP ~~with gravel and cobbles~~ SM	SAND, fine; some gravel and cobbles.
115.0	120.0	SP ~~with gravel and cobbles~~ SM	SAND, fine to coarse, with gravel and cobbles.
120.0	130.0	~~SP with gravel and cobbles (Lab 121' SP-SM and 127' SM)~~ SM	SILTY SAND, fine; some gravel and cobbles.
130.0	135.0	SP ~~with gravel and cobbles~~	SAND, fine to coarse and GRAVEL; some cobbles.
135.0	150.0	SP ~~with gravel and cobbles (Lab 141' SP-SM)~~	SAND, fine to coarse; some gravel and cobbles. ~~(Overall the interval from 107-150 is sand, gravel, and cobbles.)~~
150.0	158.0	SP-SM	SAND, very fine to fine; trace medium to coarse sand; trace gravel; ~~dry; powdery.~~
158.0	160.0		BEDROCK, ~~[illegible]~~ carbonate rock chips.

GEOLOGIC LOG
LEGGETTE, BRASHEARS & GRAHAM, INC.
ST. PAUL, MINNESOTA

OWNER: Shakopee Mdewakanton Sioux Community
BORING NO. C-8
PAGE 1 **OF** 1 **PAGES**

LOCATION: Mystic Lake Casino Prior Lake, MN	**SCREEN:** NA **DIAMETER:** NA
DATE COMPLETED: 11-Aug-05	**SETTING:** NA
DRILLING COMPANY: Traut Wells Daryl Karasch-driller Waite Park, MN	**SAND PACK:** NA **SETTING:** NA
DRILLING METHOD: Roto Sonic	**CASING:** NA
SAMPLING METHOD: Cuttings	**SETTING:** NA
OBSERVER: D. Strand	**SEAL TYPE:** NA
REFERENCE POINT: Grade	**SETTING:** NA
REFERENCE POINT ELEVATION: 971.3	**DEVELOPMENT:** NA
STICK-UP:	**DURATION:** NA
SURFACE COMPLETION:	**WATER LEVEL:**
REMARKS:	**YIELD:**

Geologic logging conducted at Braun Intertec's warehouse at 11001 Hampshire Avenue South, Minneapolis, MN

200 Wash 101 feet.

DEPTH IN FEET (below grade) FROM	TO	UNIFIED SOIL CLASSIFICATION	GEOLOGIC DESCRIPTION
0.0	5.0	O~~H~~ L	TOPSOIL.
5.0	15.0	CL, ~~sandy~~	SANDY CLAY, brown and black mottled.
15.0	67.0	CL, ~~sandy~~	TILL, gray.
67.0	87.0	SC ~~with cobbles~~	CLAYEY SAND, very fine to medium; some cobbles; trace coarse sand and fine gravel; brown; dry; very hard; blocky.
87.0	108.0	SP ~~with gravel~~	SAND, fine to coarse and GRAVEL; trace cobbles; gray.
108.0	110.0	~~SW (Lab 101' SP)~~ SP	SAND, fine; little medium sand; brown; dry. (beach sand)
110.0	115.0	SP ~~with gravel~~	SAND, fine to coarse; little fine to coarse gravel; becomes finer with depth.
115.0	127.0	SP ~~with gravel and cobbles~~ ~~ML~~	SAND and GRAVEL, fine to coarse; with cobbles. Silt layer 117 to 118 feet.
127.0	145.0	~~Cobbles with SP~~ GP	COBBLES; some sand and gravel.
145.0	150.0	SP-SM	SAND, fine to coarse; brown; grades to a finer sand 148-150 feet.
150.0	155.0	SC, ~~gravelly~~	CLAYEY SAND and GRAVEL (top of bedrock?).
155.0	160.0		BEDROCK; broken up rock mixed with cores of rock; powdery 158-160 feet.

GEOLOGIC LOG LEGGETTE, BRASHEARS & GRAHAM, INC. ST. PAUL, MINNESOTA	OWNER: Shakopee Mdewakanton Sioux Community BORING NO. C-9 PAGE 1 OF 1 PAGES
LOCATION: Mystic Lake Casino	SCREEN: NA
Prior Lake, MN	DIAMETER: NA
DATE COMPLETED: 11-Aug-05	SETTING: NA
DRILLING COMPANY: Traut Wells Daryl Karasch-driller	SAND PACK: NA
Waite Park, MN	SETTING: NA
DRILLING METHOD: Roto Sonic	CASING: NA
SAMPLING METHOD: Cuttings	SETTING: NA
OBSERVER: D. Strand	SEAL TYPE: NA
REFERENCE POINT: Grade	SETTING: NA
REFERENCE POINT ELEVATION: 947.4	DEVELOPMENT: NA
STICK-UP:	DURATION: NA
SURFACE COMPLETION:	WATER LEVEL:
REMARKS:	YIELD:

Geologic logging conducted at Braun Intertec's warehouse at 11001 Hampshire Avenue South, Minneapolis, MN

DEPTH IN FEET (below grade)		UNIFIED SOIL CLASSIFICATION	GEOLOGIC DESCRIPTION
FROM	TO		
0.0	7.0	~~OH~~ L	TOPSOIL.
7.0	15.0	CL, ~~sandy~~	SANDY CLAY, brown and black mottled.
15.0	53.0	CL	TILL, gray.
53.0	55.0	SP	SAND, fine to very coarse; trace fine gravel.
55.0	97.0	CL	TILL, gray.
97.0	100.0	CL	~~CLAY and~~ TILL, brown.
100.0	103.0	SW	SAND, fine to medium (sandbox sand); brown.
103.0	112.0	SC	CLAYEY SAND; fine to very coarse; trace gravel and cobbles.
112.0	117.0	CL	TILL, brown.
117.0	122.0	SP-SM	SAND, fine to medium. Locally very dry/blocky/hard but crumbles to a fine sand.
122.0	140.0	SP-SM ~~with gravel~~	SAND and GRAVEL; very fine to very coarse; trace fine cobbles; with silt locally; very heterogeneous.
140.0	145.0		Appears to be top of bedrock. Yellow slurry of rock fragments mixed with sand gravel.
145.0	150.0		ROCK fragments; 1 mm to 4 cm; yellow; dry; dusty.

GEOLOGIC LOG
LEGGETTE, BRASHEARS & GRAHAM, INC.
ST. PAUL, MINNESOTA

OWNER: Shakopee Mdewakanton Sioux Community
BORING NO. C-10
PAGE 1 **OF** 1 **PAGES**

LOCATION: Mystic Lake Casino
Prior Lake, MN
DATE COMPLETED: 11-Aug-05
DRILLING COMPANY: Traut Wells Daryl Karasch-driller
Waite Park, MN
DRILLING METHOD: Roto Sonic Sonic
SAMPLING METHOD: Cuttings
OBSERVER: D. Strand
REFERENCE POINT: Grade
REFERENCE POINT ELEVATION: 930.9
STICK-UP:
SURFACE COMPLETION:
REMARKS:
Geologic logging conducted at Braun Intertec's warehouse at 11001 Hampshire Avenue South, Minneapolis, MN

SCREEN: NA
DIAMETER: NA
SETTING: NA
SAND PACK: NA
SETTING: NA
CASING: NA
SETTING: NA
SEAL TYPE: NA
SETTING: NA
DEVELOPMENT: NA
DURATION: NA
WATER LEVEL:
YIELD:

DEPTH IN FEET (below grade)		UNIFIED SOIL CLASSIFICATION	GEOLOGIC DESCRIPTION
FROM	TO		
0.0	16.0	CL with sand	SANDY CLAY, brown, trace black.
16.0	20.0	SP-SM	SAND, very fine to very coarse; trace gravel and cobbles; brown.
20.0	30.0	ML, ~~sandy~~	SILT with very fine to fine sand, brown.
30.0	42.5	ML with sand	SILT; with a little very fine sand; gray.
42.5	45.0	SP-SM	SAND, very fine to very coarse; some silt; gray.
45.0	72.0	CL	TILL, gray.
72.0	80.0	SP-SM with gravel ~~SP-SM~~	SAND and GRAVEL, very fine to very coarse; gray. Considerably more fine sand and less gravel 78-80 feet.
80.0	85.0	SP-SC	SAND, fine to medium; trace coarse sand; trace clay locally.
85.0	90.0	SP-SM with gravel	SAND and GRAVEL, very fine to very coarse; gray.
90.0	94.0	~~SW~~ SP	SAND, fine to medium; trace coarse sand; (sandbox sand). Slightly more coarse 93-94 feet.
94.0	110.0	CL	TILL, gray.
110.0	125.0	CL	TILL, brown.
125.0	135.0	CL, ~~sandy~~	SANDY CLAY; brown; very hard and blocky. ~~Possibly TILL.~~
135.0	140.0		Appears to be top of bedrock. Yellow slurry of rock fragments mixed with sand gravel.
140.0	150.0		BEDROCK; rock fragments becoming more competent with depth.

APPENDIX B: COMMUNITY GEOPHYSICAL LOGS

Summit Envirosolutions, Inc. 10201 Wayzata Boulevard, Suite 100 Minneapolis, Minnesota 55305 Phone: (612)595-8888 Fax: (612)595-0888	BOREHOLE: No. 6 LOGS: Natural Gamma

PROJECT: **Mdewakanton Sioux Well No. 6** DATE: **January 16, 1998**
CLIENT: **Mineral Services Plus, LLC.** COUNTY: Scott
LOCATION: Prior Lake STATE: Minnesota

BOREHOLE DATA

DRILLING CONTRACTOR: Mineral Service Plus, LLC. CUSTOMER TD: 642 feet
ELEV: ? DEPTH REF: T.O. 20" Casing LOGGER TD: 649 feet

RUN	BIT RECORD			CASING RECORD		
NO.	Bit Size	From	To	Size/Wgt/Thk.	From	To
1	21 inch	0 feet	160 feet	20 inch	0 feet	160 feet
2	19 inch	160 feet	570 feet	8 inch	0 feet	570 feet
3	7 7/8"	570 feet	649 feet			

DRILL METHOD: Rotary DATE DRILLED: 1/16/98 TIME SINCE CIRC: 1 week
HOLE MEDIUM: water FLUID LEVEL: 209 feet MUD TYPE: Bentonite
VISCOSITY: WEIGHT: Rm at Deg

GENERAL DATA

LOGGED BY: James H. Traen OTHER SERVICES: RVC Video Inspection
WITNESS: Mr. Danny Nubbe UNIT/TRUCK: 501

LOGGING DATA

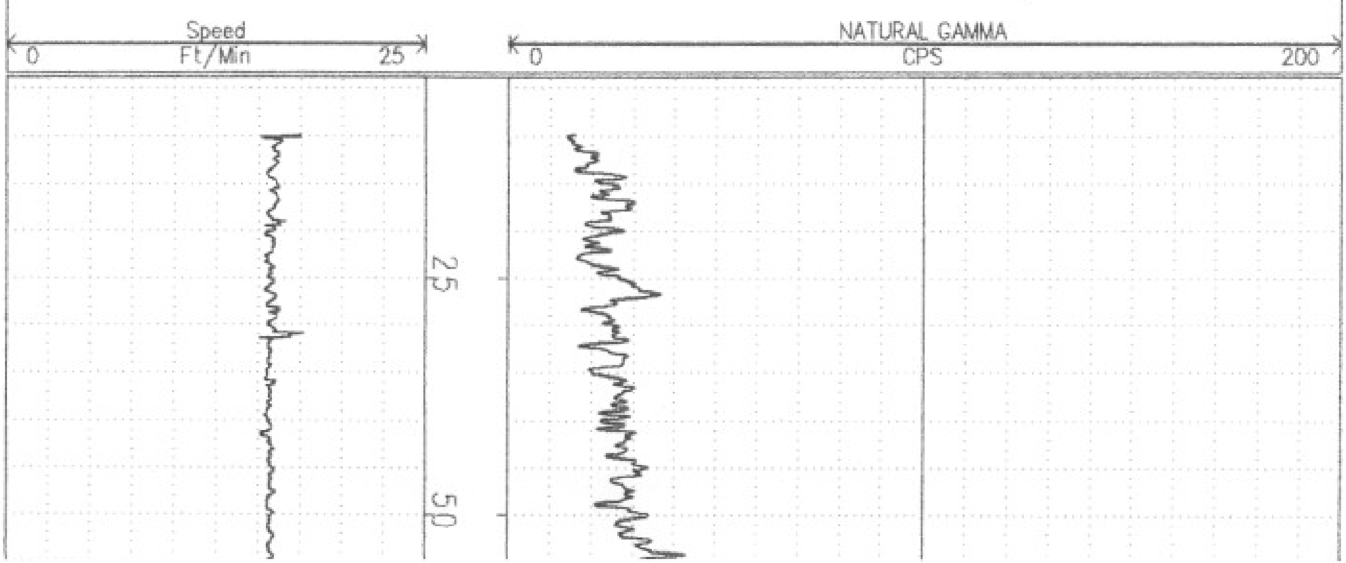
LOG FUNCTION	RUN NO.	EQUIPMENT MODEL	PROBE S.N.	UPHOLE S.N.	LOGGING DIG INT FEET	SPEED FT/MIN	DETECTOR TYPE	SOURCE TYPE	SIZE GBq	LOGGED INTERVAL FROM	TO	INT. FEET	COMMENTS
N. Gamma	two	MGXII	2312	1038	0.1 ft	15'/m	Scintillom.			10 ft	649ft		

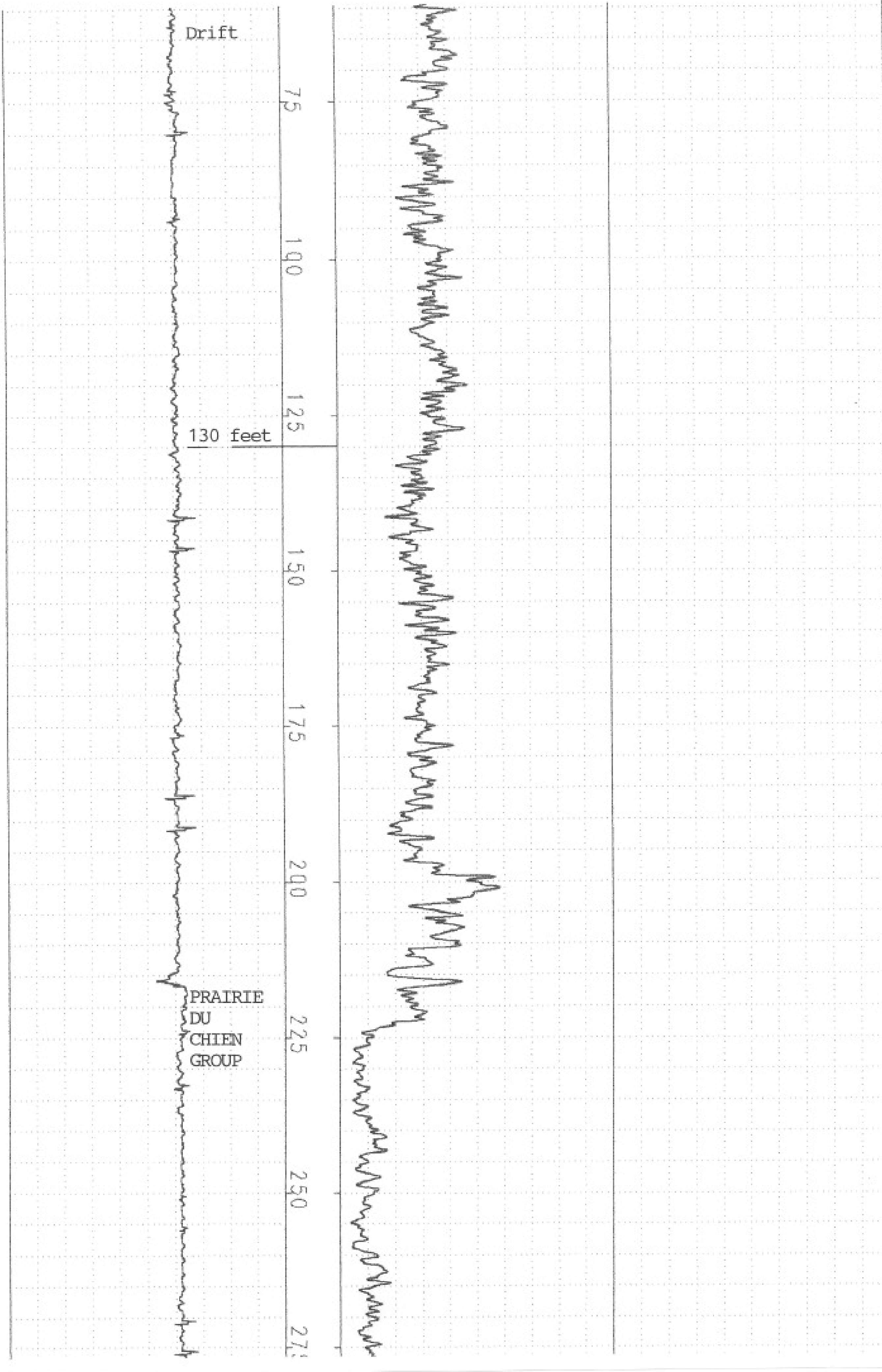
DIGITAL FILE NAME(S): DOWN.GA1 Filter: Two Point Weighted Average
REMARKS:

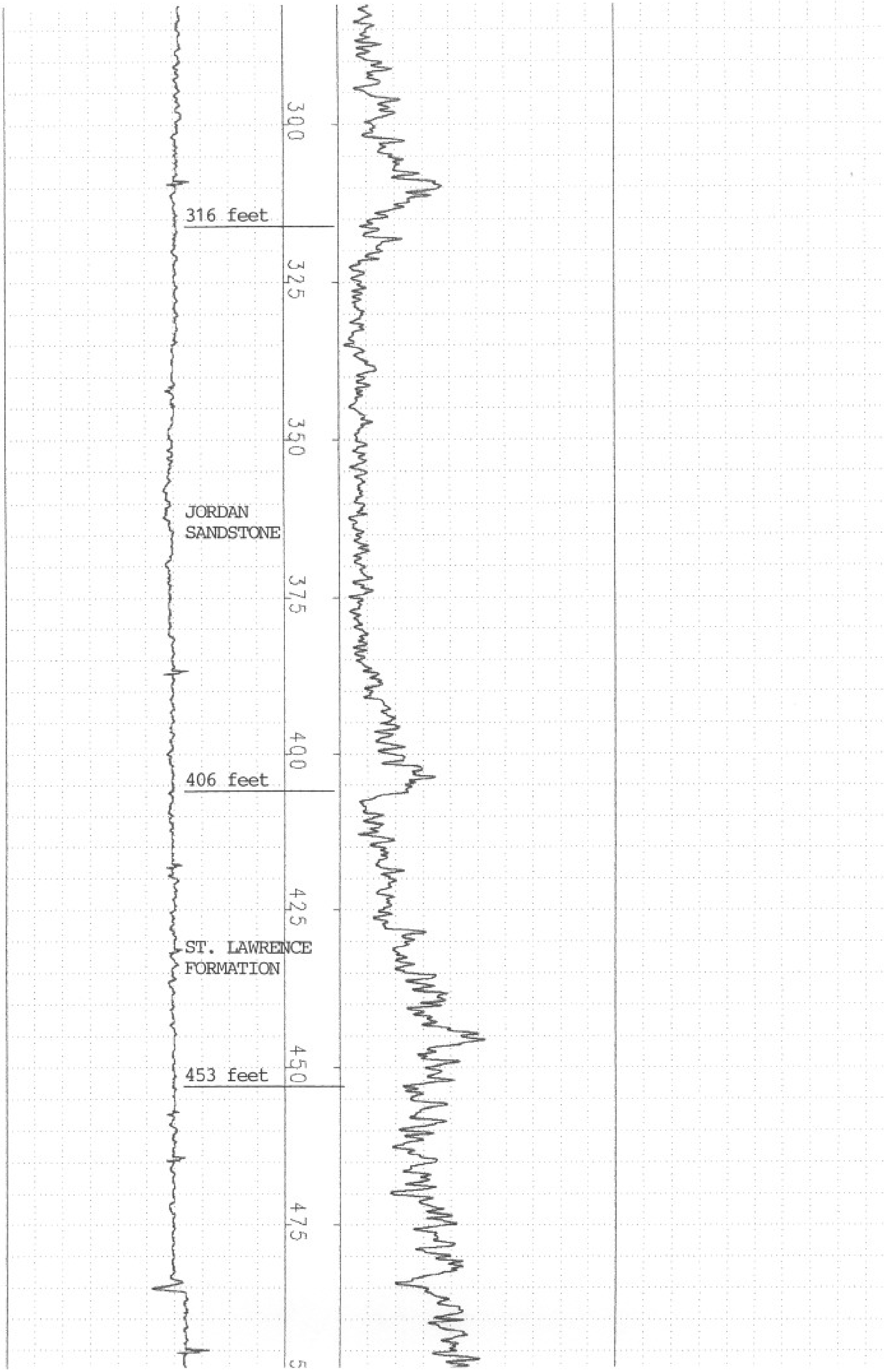
Township Name:
Township No.:
Range No.:
Section No.:

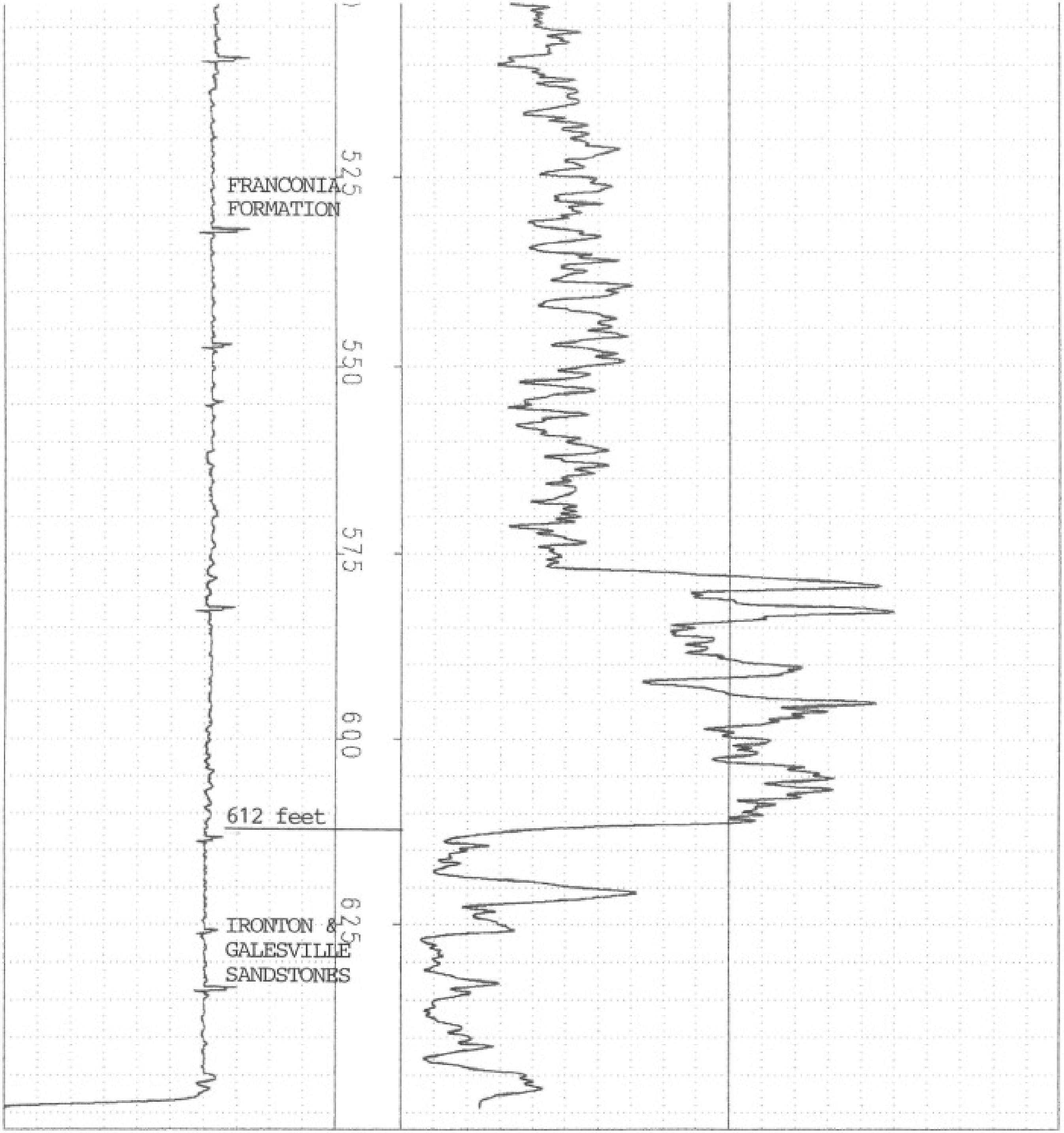
Minnesota Unique Well No.:
MGS Quad No.:
MGS Cutting Set No.:
Street Address: Sioux Trail

SHAKOPEE MDEWAKANTON SIOUX COM. WELL NO. 6 JAN. 16, 1998




Drift
75
100
125
130 feet
150
175
200
PRAIRIE
DU
CHIEN
GROUP
225
250


300
316 feet
325
350
JORDAN
SANDSTONE
375
400
406 feet
425
ST. LAWRENCE
FORMATION
450
453 feet
475


FRANCONIA FORMATION
525
550
575
600
612 feet
625
IRONTON & GALESVILLE SANDSTONES

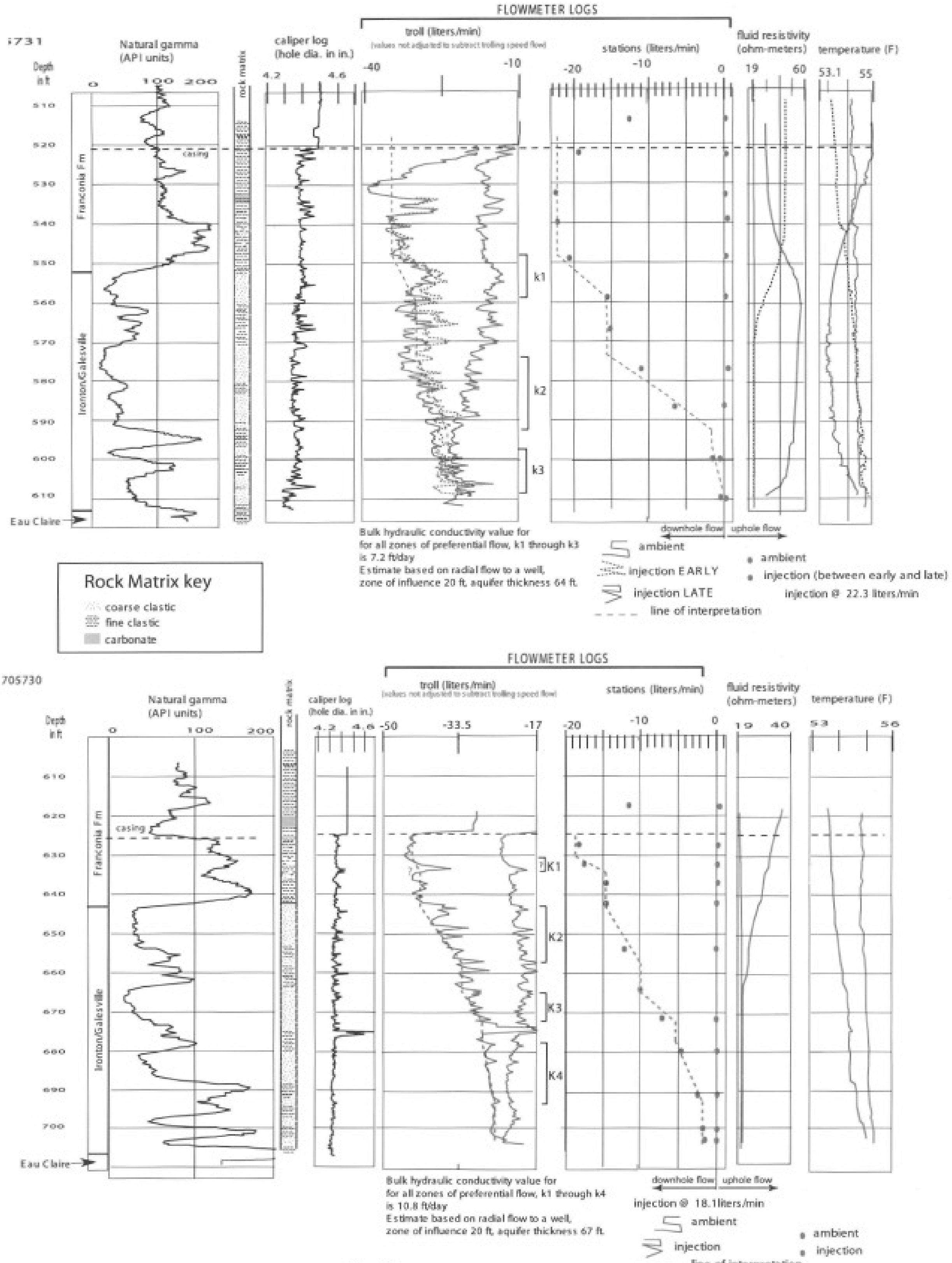

FLOWMETER LOGS
Natural gamma (API units)
rock matrix
caliper log (hole dia. in in.)
troll (liters/min)
(values not adjusted to subtract trolling speed flow)
stations (liters/min)
fluid resistivity (ohm-meters)
temperature (F)
Depth in ft
Franconia Fm
Ironton/Galesville
Eau Claire
casing
k1
k2
k3
Bulk hydraulic conductivity value for for all zones of preferential flow, k1 through k3 is 7.2 ft/day
Estimate based on radial flow to a well, zone of influence 20 ft, aquifer thickness 64 ft.
downhole flow
uphole flow
ambient
injection EARLY
injection LATE
line of interpretation
injection (between early and late)
injection @ 22.3 liters/min
Rock Matrix key
coarse clastic
fine clastic
carbonate
705730
K1
K2
K3
K4
Bulk hydraulic conductivity value for for all zones of preferential flow, k1 through k4 is 10.8 ft/day
Estimate based on radial flow to a well, zone of influence 20 ft, aquifer thickness 67 ft.
injection @ 18.1liters/min
injection

Fig 7

APPENDIX C: WELL MAINTENANCE RECORDS

Mineral Service Plus, LLC
Geothermal Field Systems

16409 371st Avenue
Green Isle, MN 55338

(320) 238-0195
Fax (320) 238-0198
Toll Free 1-800-WATER-71
(928-3771)

December 19, 2005

Ms. Lanya Ross
SMSC, Land Management
2330 Sioux Trail NW
Prior Lake, MN 55372

RE: Community Water Well Information

Dear Lanya:

Please review the following information concerning maintenance performed on the community wells and pumps by Mineral Service Plus, LLC.

JORDAN WELL, Sioux Trail

Scheduled to be pulled & do maintenance winter 2005 / 2006

JORDAN WELL, McKenna Road

Pump removed and well bailed, pump repaired and reinstalled on 9/23/04
Fill removed from 345' to 370'

FRANCONIA IRONTON GALESVILLE WELL

Pump removed and well bailed, pump reworked and reinstalled 11/04
Fill removed from 625' to 638', bailing was stopped after 94 hours of bailing

If you have any questions, please do not hesitate to call us.

Sincerely,
MINERAL SERVICE PLUS, LLC

Danny A. Nubbe
President

MINERAL SERVICE PLUS, LLC
GEOTHERMAL FIELD SYSTEMS
16409 – 371st Ave., Green Isle, MN 55338
Phone: (320) 238-0195
Fax: (320) 238-0198

Date: October 30, 2006

TO: Mr. Stan Ellison

Total Pages: 2

FROM: Danny A. Nubbe
President

RE: Jordan Well #4

Message:

Dear Stan:

The work on Jordan Well #4 was completed and included grinding out the weld joint just below the pitless unit and re-welding the joint triple pass.

The crack was discovered during the video inspection and repaired prior to the re-installation of the well pump.

If you should have any questions, please do not hesitate to call us.

APPENDIX D: PUBLIC WATER SUPPLY WELL CHEMISTRY

Analytical method	Units	EPA MCL (MCGL)	1998			2000		2003		2005		2006
			I/G Well	McKenna Treatment Plant	Sioux Trail Treatment Plant	McKenna Treatment Plant	Sioux Trail Treatment Plant	Sioux Trail Treatment Plant	McKenna Treatment Plant	McKenna Treatment Plant	Sioux Trail Treatment Plant	PDC/J (Golf) Well
1,1-Dichloroethane	µg/L	5.0						ND	ND			
1,1,1,2-Tetrachloroethane	µg/L							ND	ND			
1,1,2,2-Tetrachloroethane	µg/L							ND	ND			
1,2,3-Trichlorobenzene	µg/L							ND	ND			
1,2,4-Trichlorobenzene	µg/L							ND	ND			
1,1,1-Trichloroethane	µg/L	3.0						ND	ND			
1,1,2-Trichloroethane	µg/L	5.0						ND	ND			
1,2,3-Trichloropropane	µg/L							ND	ND			
1,1,2-Trichloroflouroethane	µg/L							ND	ND			
1,2,4-Trimethylbenzene	µg/L	70.0						ND	ND			
1,3,5-Trimethylbenzene	µg/L							ND	ND			
1,2-Dichloroethane	µg/L							ND	ND			
1,1-Dichloroethene	µg/L							ND	ND			
1,2-Dibromo-3-chloropropane (DBCP)	µg/L	0.2						ND	ND			
1,2-Dibromoethane (EDB)	µg/L							ND	ND			
1,2-Dichlorobenzene	µg/L							ND	ND			
1,3-Dichlorobenzene	µg/L							ND	ND			
1,4-Dichlorobenzene	µg/L							ND	ND			
1,2-Dichloropropane	µg/L							ND	ND			
1,3-Dichloropropane	µg/L							ND	ND			
2,2-Dichloropropane	µg/L							ND	ND			
1,1-Dichloropropene	µg/L							ND	ND			
2-Chlorotoluene	µg/L							ND	ND			
2,4-D	µg/L	70.0						ND	ND			
2,4-DB	µg/L							ND	ND			
2,4,5-T	µg/L							ND	ND			
2,4,5-TP (Silvex)	µg/L	50.0						ND	ND			
3,5-Dichlorobenzoic Acid	µg/L							ND	ND			
4-Chlorotoluene	µg/L							ND	ND			
4-Nitrophenol	µg/L							ND	ND			
Acetone	µg/L							ND	ND			
Aciflurofen	µg/L							ND	ND			
Allyl chloride	µg/L							ND	ND			
Ammonia as N	mg/L											0.28
Antimony	µg/L	6.0						ND	ND			
Arsenic	mg/L	0.01	0.002		0.0056			ND	ND			
Barium	mg/L	2.0	0.05	0.163	0.476			.290	.198			
Bentazon	µg/L							ND	ND			
Benzene	µg/L	5.0	0.2					ND	ND			

Analytical method	Units	EPA MCL (MCGL)	1998			2000		2003		2005		2006
			I/G Well	McKenna Treatment Plant	Sioux Trail Treatment Plant	McKenna Treatment Plant	Sioux Trail Treatment Plant	Sioux Trail Treatment Plant	McKenna Treatment Plant	McKenna Treatment Plant	Sioux Trail Treatment Plant	PDC/J (Golf) Well
Bentazon	µg/L							ND	ND			
Benzene	µg/L	5.0	0.2					ND	ND			
Beryllium	mg/L	0.004		0.00008				ND	ND			
Bicarbonate Alkalinity	mg/L											340
Boron	mg/L		0.14									
Bromobenzene	µg/L							ND	ND			
Bromochloromethane	µg/L							ND	ND			
Bromodichloromethane	**µg/L**	**(0.0)**						**ND**	**0.7**	**1.7**	**0.6**	
Bromoform	µg/L	(0.0)						ND	ND	ND	ND	
Bromomethane	µg/L							ND	ND			
Cadmium	mg/L	.005			0.00053			ND	ND			
Calcium	mg/L		110		71.0							81
Carbonate Alkalinity	mg/L											ND
Carbon tetrachloride	µg/L	5.0L						ND	ND			
Chloramben	µg/L							ND	ND			
Chlorobenzene	µg/L	100.0						ND	ND			
Chloride	mg/L											ND
Chlorodibromomethane	µg/L							ND	ND	1.1	ND	
Chloromethane	µg/L							ND	ND			
Chloroform	µg/L		0.6					0.2	0.8	1.9	2.3	
Chlorophyll A	mg/L											2.0
Chromium	µg/L	100.0						ND	ND			
cis-1,2-Dichloroethene	µg/L							ND	ND			
cis-1,3-Dichloropropene	µg/L							ND	ND			
Cynide, Free	µg/L	200.0						ND	ND			
Dibromoacetic Acid	µg/L									ND	ND	
Dibromomethane	µg/L							ND	ND			
Dicamba	µg/L							ND	ND			
Dichloroacetic Acid	**µg/L**	**(0.0)**								**ND**	**1.8**	
Dichlorodiflouromethane	µg/L							ND	ND			
Dichloroflouromethane	µg/L							ND	ND			
Dichlorprop	µg/L							ND	ND			
Dinoseb	µg/L	7.0						ND	ND			
Ethylbenzene	µg/L	700.0						ND	ND			
Ethyl ether	µg/L							ND	ND			
Fluoride	mg/L	4.0	0.23	0.15	0.20			1.1	1.0			
Glyphosate	µg/L	700.0						ND	ND			
Gross Alpha	pCi/L	15.0	12±4		15.6	5.8	4.2	4.5				
Gross Beta	pCi/L	50.0	12±2		14.0		8.0					
Hardness, Total	mg/L		420									

Analytical method	Units	EPA MCL (MCGL)	1998			2000		2003		2005		2006
			I/G Well	McKenna Treatment Plant	Sioux Trail Treatment Plant	McKenna Treatment Plant	Sioux Trail Treatment Plant	Sioux Trail Treatment Plant	McKenna Treatment Plant	McKenna Treatment Plant	Sioux Trail Treatment Plant	PDC/J (Golf) Well
Hexachlorobutadiene	µg/L							ND	ND			
Iron	mg/L	0.3	0.8	0.429	1.627							
Isopropyltoluene	µg/L							ND	ND			
Lead	mg/L	0.015		0.0019								
Magnesium	mg/L		36		29.0							35
Manganese	mg/L	0.05	0.06	0.167	0.283							
MCPA	µg/L							ND	ND			
MCPP	µg/L							ND	ND			
Mercury	µg/L	2.0						ND	ND			
Methylene Chloride	µg/L	5.0	1.3					ND	ND			
Methyl ethyl ketone (MEK)	µg/L							ND	ND			
Methyl isobutyl ketone (MTBK)	µg/L							ND	ND			
Methyl tertiary butyl ether (MTBE)	µg/L							ND	ND			
Monobromoacetic Acid	µg/L									ND	ND	
Monochloroacetic Acid	µg/L									ND	ND	
Napthalene	µg/L							ND	ND			
n-Butylbenzene	µg/L							ND	ND			
Nickel	µg/L							ND	ND			
Nitrate	mg/L	10			0.03							
Nitrate+Nitrite	mg/L									ND	ND	0.069
n-Propylbenzene	µg/L							ND	ND			
Orthophosphate as P	mg/L											0.024
Pentachlorophenol (PCP)	µg/L	1.0						ND	ND			
o-Xylene	µg/L							0.2	ND			
Picloram	µg/L	500.0						ND	ND			
Phosphorus, Total as P	mg/L											0.026
p-Isopropyltoluene	µg/L							ND	ND			
p&m-Xylene	µg/L							0.3	ND			
Potassium	mg/L				3.00							
Potassium	mg/L											4.1
Radium-226	PCi/L					0.79		0.72			0.72	
Radium-228	PCi/L					0.87		1.1-1.8			1.1	
sec-Butylbenzene	µg/L							ND	ND			
Selenium	µg/L	50.0						ND	ND			
Silver	mg/L	0.1		0.00035	0.00043							
Sodium	mg/L	250	7		4.60							6.1
Styrene	µg/L	100.0						ND	ND			
Sulfate	mg/L	250	58	4	6							10
Tetrachloroethene	µg/L							ND	ND			
Tetrahydrofuran (THF)	µg/L							ND	ND			

			1998			2000		2003		2005		2006
Analytical method	Units	EPA MCL (MCGL)	I/G Well	McKenna Treatment Plant	Sioux Trail Treatment Plant	McKenna Treatment Plant	Sioux Trail Treatment Plant	Sioux Trail Treatment Plant	McKenna Treatment Plant	McKenna Treatment Plant	Sioux Trail Treatment Plant	PDC/J (Golf) Well
tert-Butylbenzene	µg/L							ND	ND			
Thallium	µg/L	0.5						ND	ND			
Total Alkalinity	mg/L											340
Total Dissolved Solids	mg/L	500	430	265	311							
Total Kjeldahl N	mg/L											ND
Total Suspended Solids	mg/L											ND
Total Trihalomethanes	µg/L	100	0.6									
Toluene	µg/L	1000	0.9					ND	ND			
trans-1,2-Dichloroethene	µg/L							ND	ND			
trans-1,3-Dichloropropene	µg/L							ND	ND			
Trichloroacetic Acid	µg/L	(300.0)								0.6	ND	
Trichlorethene (TCE)	µg/L	5.0	2.5					ND	ND			
Trichloroflouromethane	µg/L							ND	ND			
Turbidity	NTU	0.5-1.0	11									
Vinyl chloride	µg/L	2.0						ND	ND			
Zinc	mg/L	5.0	0.01									

ND = Non-Detect

APPENDIX E: ORIGINAL SMSC WHPP (Enclosed CD)

APPENDIX F: VULNERABILITY WORKSHEETS

Vulnerability Assessment Worksheet

Well Name/No. Sioux Trail Ironton-Galesville aquifer Well

Public Water Supplier ID No. 990129 Minnesota Unique Well No. 253021

1. DNR vulnerability rating – assign the following point values:	
Very High	Vulnerable
High	Vulnerable
Moderate	25 points
Low ("L" score of 1 o 3)	20 points
Low ("L" score of 4 to 7)	15 points
Very Low ("L" score of 8 to 11)	10 points
Very Low ("L" score of 12 or greater) (~120 to 150 ft of protective geologic units)	5 points
TOTAL POINTS	5 points
2. Casing integrity – assign the following point values:	
Each breach of the casing	20 points
Each casing string not grouted or extending to the land surface	10 points
Each category for which information requested is unknown	5 points
Each string of properly installed casing	0 points
TOTAL POINTS	0 points
3. Casing depth – assign the following point values:	
<50 feet	20 points
50 to 200 feet	10 points
201 to 500 feet	5 points
>500 feet (570 ft)	0 points
TOTAL POINTS	0 points
4. Pumping rate – assign the following point values:	
>1000 gallons/minute	20 points
501 to 1000 gallons/minute (max annual pumping rate is in this range)	10 points
50 to 500 gallons/minute (average annual pumping rate is in this range)	5 points
<50 gallons/minute	0 points
TOTAL POINTS	5-10 points

5. Isolation distance from contaminant source	
For wells <50 feet deep, assign 10 points to each source located within 100 feet of the well For wells >50 feet deep, assign 10 points to each source located within 50 feet of the well	10 points
TOTAL POINTS	10 points

6. Chemical and isotopic information:	
Volatile Organic Compounds Detection (o,m mxylene detected at pump house on 7/03)	Vulnerable
Synthetic Organic Compounds Detection	Vulnerable
Nitrate-Nitrogen Results	
>10 parts/million	Vulnerable
>3 but ≤10 parts/million	30 points
1 to 3 parts/million	10 points
<1 parts/million	
Tritium Results	
>1 TU	Vulnerable
<1 TU	0 points
^{14}Carbon Results	
For wells in which the ^{14}carbon content of the water indicates an age approximation of at least several centuries, subtract 20 points from the score.	
TOTAL POINTS	0 points

7. Grand total score:	
1. DNR Vulnerability Rating	5
2. Casing Integrity	0
3. Casing Depth	0
4. Pumping Rate	5-10
5. Isolation Distance from Contaminant Sources	10
6. Chemical and Isotopic Information	0
GRAND TOTAL	20-25
➢ If the score is 45 or more, the well is considered vulnerable. ➢ If the score is between 5 and 40, priority for phasing into the state's WHP program is referenced to population served. ➢ If the score is 0 or less, the well is considered not vulnerable.	Moderately Vulnerable

Vulnerability Assessment Worksheet

Well Name/No. Sioux Trail Jordan aquifer Well (Well #4)

Public Water Supplier ID No. 930826 Minnesota Unique Well No. 525938

1. DNR vulnerability rating – assign the following point values:	
Very High	Vulnerable
High	Vulnerable
Moderate	25 points
Low ("L" score of 1 o 3)	20 points
Low ("L" score of 4 to 7) (~40 to 50 ft of protective geologic units)	15 points
Very Low ("L" score of 8 to 11)	10 points
Very Low ("L" score of 12 or greater)	5 points
TOTAL POINTS	15 points
2. Casing integrity – assign the following point values:	
Each breach of the casing (1 breach found in 4/06 but repaired immediately)	20 points
Each casing string not grouted or extending to the land surface	10 points
Each category for which information requested is unknown	5 points
Each string of properly installed casing	0 points
TOTAL POINTS	0 points
3. Casing depth – assign the following point values:	
<50 feet	20 points
50 to 200 feet	10 points
201 to 500 feet (307 ft)	5 points
>500 feet	0 points
TOTAL POINTS	5 points
4. Pumping rate – assign the following point values:	
>1000 gallons/minute	20 points
501 to 1000 gallons/minute	10 points
50 to 500 gallons/minute (both max and average annual pumping rate is in this range)	5 points
<50 gallons/minute	0 points
TOTAL POINTS	5 points
5. Isolation distance from contaminant source	

For wells <50 feet deep, assign 10 points to each source located within 100 feet of the well For wells >50 feet deep, assign 10 points to each source located within 50 feet of the well	10 points
TOTAL POINTS	10 points
6. Chemical and isotopic information:	
Volatile Organic Compounds Detection (o,m mxylene detected at pump house on 7/03)	Vulnerable
Synthetic Organic Compounds Detection	Vulnerable
Nitrate-Nitrogen Results	
>10 parts/million	Vulnerable
>3 but ≤10 parts/million	30 points
1 to 3 parts/million	10 points
<1 parts/million	
Tritium Results	
>1 TU	Vulnerable
<1 TU	0 points
^{14}Carbon Results	
For wells in which the ^{14}carbon content of the water indicates an age approximation of at least several centuries, subtract 20 points from the score.	
TOTAL POINTS	0 points
7. Grand total score:	
1. DNR Vulnerability Rating	15
2. Casing Integrity	0
3. Casing Depth	5
4. Pumping Rate	5
5. Isolation Distance from Contaminant Sources	10
6. Chemical and Isotopic Information	0
GRAND TOTAL	35
➢ If the score is 45 or more, the well is considered vulnerable. ➢ If the score is between 5 and 40, priority for phasing into the state's WHP program is referenced to population served. ➢ If the score is 0 or less, the well is considered not vulnerable.	Moderately Vulnerable

Vulnerability Assessment Worksheet

Well Name/No. McKenna Jordan aquifer Well

Public Water Supplier ID No. 940926 Minnesota Unique Well No. 554090

1. DNR vulnerability rating – assign the following point values:	
Very High	Vulnerable
High	Vulnerable
Moderate	**25 points**
Low (“L” score of 1 o 3)	20 points
Low (“L” score of 4 to 7)	15 points
Very Low (“L” score of 8 to 11)	10 points
Very Low (“L” score of 12 or greater)	5 points
TOTAL POINTS	**25 points**
2. Casing integrity – assign the following point values:	
Each breach of the casing	20 points
Each casing string not grouted or extending to the land surface	10 points
Each category for which information requested is unknown	5 points
Each string of properly installed casing	**0 points**
TOTAL POINTS	**0 points**
3. Casing depth – assign the following point values:	
<50 feet	20 points
50 to 200 feet	10 points
201 to 500 feet (264 ft)	**5 points**
>500 feet	0 points
TOTAL POINTS	**5 points**
4. Pumping rate – assign the following point values:	
>1000 gallons/minute	20 points
501 to 1000 gallons/minute	10 points
50 to 500 gallons/minute (both max and average annual pumping rate is in this range)	**5 points**
<50 gallons/minute	0 points
TOTAL POINTS	**5 points**

5. Isolation distance from contaminant source	
For wells <50 feet deep, assign 10 points to each source located within 100 feet of the well For wells >50 feet deep, assign 10 points to each source located within 50 feet of the well	0 points
TOTAL POINTS	0 points
6. Chemical and isotopic information:	
Volatile Organic Compounds Detection	Vulnerable
Synthetic Organic Compounds Detection	Vulnerable
Nitrate-Nitrogen Results	
>10 parts/million	Vulnerable
>3 but ≤10 parts/million	30 points
1 to 3 parts/million	10 points
<1 parts/million	
Tritium Results	
>1 TU	Vulnerable
<1 TU	0 points
^{14}Carbon Results	
For wells in which the ^{14}carbon content of the water indicates an age approximation of at least several centuries, subtract 20 points from the score.	
TOTAL POINTS	0 points
7. Grand total score:	
1. DNR Vulnerability Rating	25
2. Casing Integrity	0
3. Casing Depth	5
4. Pumping Rate	5
5. Isolation Distance from Contaminant Sources	0
6. Chemical and Isotopic Information	0
GRAND TOTAL	35
➢ If the score is 45 or more, the well is considered vulnerable. ➢ If the score is between 5 and 40, priority for phasing into the state's WHP program is referenced to population served. ➢ If the score is 0 or less, the well is considered not vulnerable.	Moderately Vulnerable

Appendix G: SMSC Contaminant Spill History

Contaminant release records are maintained by the SMSC Land Department.

Date	Location	Substance	Volume	Action Taken
4/2/1997	Adjacent to the Sioux Trail Jordan Aquifer wellhead	Diesel fuel	Unknown, but assumed to be less than 15 gallons	Asphalt and soil removed.
8/2/2001	Shakopee Dakota Convenience Store	Gasoline	Estimated to be 10-15 gallons	Pumps were closed. Prior Lake Fire Department flushed drain lines. MPCA contacted.
4/1/2002	Dakotah Meadows RV Park	Gasoline	Estimated to be less than 10 gallons	Prior Lake Fire Department responded to call for assistance.
2/15/2003	Job-site storage yard at Mystic Lake Casino	Hydraulic fluid	Approximately 20 gallons	Sand was used to absorb oil under the parked crane. Snow and ice prevented fluid from seeping into ground. Contaminated sand and soil was removed.
9/3/2003	2400 Mystic Lake Drive	Diesel fuel	4 gallons	Runoff was captured using dikes and absorbent was used to contain fuel. LSI sweeper collected debris.
4/6/2004	The Meadows at Mystic Lake golf course Jordan Aquifer irrigation wellhead	Diesel fuel	25-40 gallons	West Central Environmental Consultants cleaned the majority of the spill. Bay West was contracted to clean wetlands contaminated by the spill.
11/15/2005	McKenna water tower construction	Hydraulic fluid	Approximately 15 gallons	Stevens Drilling & Environmental excavated the impacted soil

3/12/2008	SMSC Public Works Building	Hydraulic fluid Shell DONAX TD	Approximately 7 gallons	Allowed to evaporate
3/19/2008	SMSC #1 Convenience Store	Gasoline	Small amount <20 gallons from underground pipe	Contamination levels below action threshold. No action taken
8/20/2008	SMSC #1 Convenience Store	Gasoline storage tank leak	Unknown quantity < 100 gallons	650 tons of contaminated soil were removed and disposed of through Waste Management
10/15/2008	Mystic Lake parking ramp	Hydraulic fluid	Unknown quantity < 10 gallons	Concrete surface cleaned up with booms, spill pads, and spill dry.

Appendix H: Potential Contaminant Source Survey

January 23, 2001

Potential Contaminant Source Survey

A. Primary Resident:

B. Business Name (if applicable): Dakotah Meadows Golf Course Facility

C. Address: Trail of Dreams

D. Phone: (   )

E. City: Prior Lake   Zip Code 55372

F. Description of Location:

Nature of the Property

Residential [ ] | Commercial [X] | Agricultural [ ] | Industrial [ ]

Government Site [X] | Natural [ ] | Other [ ] (   )

Potential Sources of Contamination

Circle the potential sources listed below that you have identified at this site. In the space provided indicate the quantity of each source. (Example: ___(2)___)

MAP CODE	POTENTIAL SOURCE	QUANTITY	MAP CODE	POTENTIAL SOURCE	QUANTITY
ABW	Abandoned Water Well		IW	Injection Well	
AGS	Above Ground Storage	(1)	L	Landfill	
ARW	Artificial Recharge Well		O/N	Orchard/Nursery	
A	Animal		MSS	Manure Spreading and Storage	
ASY	Auto Salvage Yard		MSL	Municipal Sewage Line	
C	Cemetery		NRL	Non-residential Utility Lines	
CSF	Chemical Storage Facility	(1)	O/GW	Oil/Gas Well	
DW/C	Drainage Well/Canal		P	Pasture	
D	Dump		Q	Quarry	
F/P	Fertilizer/ Pesticide	(1)	RR	Railroad	
GSS	Gasoline Service Stations		ST	Septic Tank	
GC	Golf Course	(1)	SSDW	Service Station Disposal Well	
GSB	Grain Storage Bin		SB	Stormwater Basins	(1)
HWS	Hazardous Waste Site	(1)	L,R,Cr	Lake, River, Creek	
HES	Heavy Equipment Storage	(1)	UST	Underground Storage Tanks	
H	Highway		WW	Water Well	
O	Other		O	Other	

OFFICE USE ONLY	
Source Number:	PWS Well Number:
Inventory Person:	See Attached Map No:

Potential Contaminant Source Survey

A. Primary Resident:

B. Business Name (if applicable): S ΔCS

C. Address: 15035 Mystic Lk Dr. ~~[illegible]~~ Prior Lake, MN 55372

D. Phone: (952) 445-5520

E. City: Prior Lake   Zip Code 55372

F. Description of Location: Convenience Store / Gas Station

Nature of the Property

Residential ☐ | Commercial ☒ | Agricultural ☐ | Industrial ☐

Government Site ☐ | Natural ☐ | Other ☐ (   )

Potential Sources of Contamination

Circle the potential sources listed below that you have identified at this site. In the space provided indicate the quantity of each source. (Example: __(2)__)

MAP CODE	POTENTIAL SOURCE	QUANTITY	MAP CODE	POTENTIAL SOURCE	QUANTITY
ABW	Abandoned Water Well		IW	Injection Well	
AGS	Above Ground Storage		L	Landfill	
ARW	Artificial Recharge Well		O/N	Orchard/Nursery	
A	Animal		MSS	Manure Spreading and Storage	
ASY	Auto Salvage Yard		MSL	Municipal Sewage Line	
C	Cemetery		NRL	Non-residential Utility Lines	
CSF	Chemical Storage Facility		O/GW	Oil/Gas Well	
DW/C	Drainage Well/Canal		P	Pasture	
D	Dump		Q	Quarry	
F/P	Fertilizer/ Pesticide		RR	Railroad	
GSS	Gasoline Service Stations	(1)	ST	Septic Tank	
GC	Golf Course		SSDW	Service Station Disposal Well	
GSB	Grain Storage Bin		SB	Stormwater Basins	
HWS	Hazardous Waste Site		L,R,Cr	Lake, River, Creek	
HES	Heavy Equipment Storage		UST	Underground Storage Tanks	(4)
H	Highway		WW	Water Well	
O	Other		O	Other	

OFFICE USE ONLY

Source Number:	PWS Well Number:
Inventory Person:	See Attached Map No:

January 2006

Potential Contaminant Source Survey

A. Primary Resident:

B. Business Name (if applicable): DAKOTAH MEADOWS RV PARK

C. Address: 2341 PARK PLACE

D. Phone: (952) 445-8800

E. City: PRIOR LAKE MN Zip Code 55372

F. Description of Location:

Nature of the Property

Residential [ ]	Commercial [X]	Agricultural [ ]	Industrial [ ]
Government Site [ ]	Natural [ ]	Other [ ] ( )	

Potential Sources of Contamination

Circle the potential sources listed below that you have identified at this site. In the space provided indicate the quantity of each source. (Example: ②)

MAP CODE	POTENTIAL SOURCE	QUANTITY	MAP CODE	POTENTIAL SOURCE	QUANTITY
ABW	Abandoned Water Well		IW	Injection Well	
AGS	Above Ground Storage		L	Landfill	
ARW	Artificial Recharge Well		O/N	Orchard/Nursery	
A	Animal		MSS	Manure Spreading and Storage	
ASY	Auto Salvage Yard		MSL	Municipal Sewage Line	
C	Cemetery		NRL	Non-residential Utility Lines	
CSF	Chemical Storage Facility		O/GW	Oil/Gas Well	
DW/C	Drainage Well/Canal		P	Pasture	
D	Dump		Q	Quarry	
F/P	Fertilizer/ Pesticide		RR	Railroad	
GSS	Gasoline Service Stations	3 pumps	ST	Septic Tank	
GC	Golf Course		SSDW	Service Station Disposal Well	
GSB	Grain Storage Bin		SB	Stormwater Basins	
HWS	Hazardous Waste Site	1 RV Dump	L,R,Cr	Lake, River, Creek	
HES	Heavy Equipment Storage		UST	Underground Storage Tanks	two
H	Highway		WW	Water Well	
O	Other		O	Other	

OFFICE USE ONLY	
Source Number:	PWS Well Number:
Inventory Person:	See Attached Map No:

Potential Contaminant Source Survey

A. Primary Resident: Mdewakanton Emergency Services

B. Business Name (if applicable):

C. Address: 2525 Flandreau Trail

D. Phone: (952) 233-1077

E. City: Prior Lake Zip Code 55372

F. Description of Location: South east corner of the intersection of Flandreau Trail + County Road #83

Nature of the Property

Residential [ ] Commercial [ ] Agricultural [ ] Industrial [ ]

Government Site [X] Natural [ ] Other [ ] ( )

Potential Sources of Contamination

Circle the potential sources listed below that you have identified at this site. In the space provided indicate the quantity of each source. (Example: (2))

MAP CODE	POTENTIAL SOURCE	QUANTITY	MAP CODE	POTENTIAL SOURCE	QUANTITY
ABW	Abandoned Water Well	0	IW	Injection Well	0
AGS	Above Ground Storage	0	L	Landfill	0
ARW	Artificial Recharge Well	0	O/N	Orchard/Nursery	0
A	Animal	0	MSS	Manure Spreading and Storage	0
ASY	Auto Salvage Yard	0	MSL	Municipal Sewage Line	0
C	Cemetery	0	NRL	Non-residential Utility Lines	0
CSF	Chemical Storage Facility	10	O/GW	Oil/Gas Well	0
DW/C	Drainage Well/Canal	0	P	Pasture	0
D	Dump	0	Q	Quarry	0
F/P	Fertilizer/ Pesticide	0	RR	Railroad	0
GSS	Gasoline Service Stations	0	ST	Septic Tank	0
GC	Golf Course	0	SSDW	Service Station Disposal Well	0
GSB	Grain Storage Bin	0	SB	Stormwater Basins	0
HWS	Hazardous Waste Site	0	L,R,Cr	Lake, River, Creek	0
HES	Heavy Equipment Storage	1	UST	Underground Storage Tanks	0
H	Highway	0	WW	Water Well	0
O	Other		O	Other	

OFFICE USE ONLY

Source Number:	PWS Well Number:
Inventory Person: 9/01 John O'Regan	See Attached Map No: See back

Potential Contaminant Source Survey

A. Primary Resident:

B. Business Name (if applicable): Mystic Lake Casino Hotel

C. Address:

D. Phone: 952) 496 - 6585

E. City: Prior Lake

Zip Code ? 55372

F. Description of Location:

Nature of the Property

Residential [ ] | Commercial [X] | Agricultural [ ] | Industrial [ ]

Government Site [ ] | Natural [ ] | Other [ ] ( )

Potential Sources of Contamination

Circle the potential sources listed below that you have identified at this site. In the space provided indicate the quantity of each source. (Example: ②)

MAP CODE	POTENTIAL SOURCE	QUANTITY	MAP CODE	POTENTIAL SOURCE	QUANTITY
ABW	Abandoned Water Well		IW	Injection Well	
AGS	Above Ground Storage		L	Landfill	
ARW	Artificial Recharge Well		O/N	Orchard/Nursery	
A	Animal		MSS	Manure Spreading and Storage	
ASY	Auto Salvage Yard		MSL	Municipal Sewage Line	
C	Cemetery		NRL	Non-residential Utility Lines	
CSF	Chemical Storage Facility		O/GW	Oil/Gas Well	
DW/C	Drainage Well/Canal		P	Pasture	
D	Dump		Q	Quarry	
F/P	Fertilizer/ Pesticide		RR	Railroad	
GSS	Gasoline Service Stations		ST	Septic Tank	
GC	Golf Course		SSDW	Service Station Disposal Well	
GSB	Grain Storage Bin		SB	Stormwater Basins	
HWS	Hazardous Waste Site		L,R,Cr	Lake, River, Creek	
HES	Heavy Equipment Storage		UST	Underground Storage Tanks	
H	Highway		WW	Water Well	
O	Other		O	Other Generators	

[signature]

OFFICE USE ONLY

Source Number:	PWS Well Number:
Inventory Person:	See Attached Map No:

January 23, 2006

Potential Contaminant Source Survey

A. Primary Resident:

B. Business Name (if applicable): Sioux Trail Pump House

C. Address: 2330 Sioux Trail NW

D. Phone: ( )

E. City: Prior Lake | Zip Code 55372

F. Description of Location:

Nature of the Property

Residential ☐ | Commercial ☐ | Agricultural ☐ | Industrial ☐

Government Site ☐ | Natural ☐ | Other ☐ ( )

Potential Sources of Contamination

Circle the potential sources listed below that you have identified at this site. In the space provided indicate the quantity of each source. (Example: ___(2)___)

MAP CODE	POTENTIAL SOURCE	QUANTITY	MAP CODE	POTENTIAL SOURCE	QUANTITY
ABW	Abandoned Water Well		IW	Injection Well	
AGS	Above Ground Storage		L	Landfill	
ARW	Artificial Recharge Well		O/N	Orchard/Nursery	
A	Animal		MSS	Manure Spreading and Storage	
ASY	Auto Salvage Yard		MSL	Municipal Sewage Line	
C	Cemetery		NRL	Non-residential Utility Lines	
CSF	Chemical Storage Facility	(1)	O/GW	Oil/Gas Well	
DW/C	Drainage Well/Canal		P	Pasture	
D	Dump		Q	Quarry	
F/P	Fertilizer/ Pesticide		RR	Railroad	
GSS	Gasoline Service Stations		ST	Septic Tank	
GC	Golf Course		SSDW	Service Station Disposal Well	
GSB	Grain Storage Bin		SB	Stormwater Basins	
HWS	Hazardous Waste Site		L,R,Cr	Lake, River, Creek	
HES	Heavy Equipment Storage		UST	Underground Storage Tanks	
H	Highway		WW	Water Well	
O	Other		O	Other Generator	(1)

OFFICE USE ONLY	
Source Number:	PWS Well Number:
Inventory Person:	See Attached Map No:

Potential Contaminant Source Survey

A. Primary Resident: Playworks

B. Business Name (if applicable):

C. Address: 2200 Trail of Dreams

D. Phone: (952) 445-7529

E. City: Prior Lake — Zip Code 55372

F. Description of Location:

Nature of the Property

Residential ☐ | Commercial ☐ | Agricultural ☐ | Industrial ☐

Government Site ☐ | Natural ☐ | Other ☑ (Family Ent & Child Care Facility)

Potential Sources of Contamination

Circle the potential sources listed below that you have identified at this site. In the space provided indicate the quantity of each source. (Example: ___②___)

MAP CODE	POTENTIAL SOURCE	QUANTITY	MAP CODE	POTENTIAL SOURCE	QUANTITY
ABW	Abandoned Water Well		IW	Injection Well	
AGS	Above Ground Storage		L	Landfill	
ARW	Artificial Recharge Well		O/N	Orchard/Nursery	
A	Animal		MSS	Manure Spreading and Storage	
ASY	Auto Salvage Yard		MSL	Municipal Sewage Line	
C	Cemetery		NRL	Non-residential Utility Lines	
CSF	Chemical Storage Facility		O/GW	Oil/Gas Well	
DW/C	Drainage Well/Canal		P	Pasture	
D	Dump		Q	Quarry	
F/P	Fertilizer/ Pesticide		RR	Railroad	
GSS	Gasoline Service Stations		ST	Septic Tank	
GC	Golf Course		SSDW	Service Station Disposal Well	
GSB	Grain Storage Bin		SB	Stormwater Basins	
HWS	Hazardous Waste Site		L,R,Cr	Lake, River, Creek	
HES	Heavy Equipment Storage		UST	Underground Storage Tanks	①
H	Highway		WW	Water Well	
O	Other		O	Other	

OFFICE USE ONLY	
Source Number:	PWS Well Number:
Inventory Person:	See Attached Map No: