



November 1997

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Final Report

James A. Berg St. Paul, MN November 1997



Minnesota DNR Waters



Acknowledgments

We would like to thank members of the Minnesota Geological Survey (David Southwick, Dale Setterholm, Carrie Patterson, Bruce Bloomgren, and Emily Bauer) for suggestions made in the early stages of the project regarding general exploration areas, for their guidance during the drilling phase of the project, for reviewing the draft version of this report, and especially for completing gamma and resistivity logs of the test holes. Staff from the U.S. Geological Survey also reviewed a draft copy of the report. We would also like to thank the cooperators (City of Worthington, City of Luverne, Rock County Rural Water, Lincoln County Rural Water, and the City of Marshall Utilities) for participating in the project and lending logistical support during the drilling portion of the project.

Department of Natural Resources/Division of Waters support that made this project possible includes: project management, mud logging, and report review by Tom Gullett and Brian Rongitsch; mud logging and report review by Evan Drivas, mud logging by Mike Liljegren; drafting and graphics by Jerry Johnson and Jim Zicopula; geophysics and report review by Todd Petersen; and report review by Sarah Tufford, Laurel Reeves, Jennie Leete, and Dave Leuthe.

Partial funding for this project was approved by the 1995 Minnesota laws, Chapter 220, Section 5, Subdivision 3, as recommended by the Minnesota Legislative Water Commission.

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Summary

During the summer of 1997, 12 mud rotary test holes were drilled, logged, and sealed at selected locations in the eastern portion of Yellow Medicine County, west central Lyon County, and northern Pipestone County. These test holes were drilled as the final phase of the Southwestern Minnesota Groundwater Exploration Project 1996-1997. Previously, during the 1996 field season 17 test holes were completed. The results of the 1996 test hole drilling were summarized in a "Progress Report" that was submitted to the Minnesota Legislature. The purposes of the test holes include: 1) finding the most productive aquifers in areas closest to the major public water suppliers, and 2) obtaining geological information to help predict the locations of the best aquifers for future use.

The test holes drilled during the summer of 1997 ranged in depth from 120 to 537 feet. All of the test holes penetrated the Quaternary section. In addition, the upper portion of the Cretaceous section was penetrated at locations where Cretaceous rocks were present.

In the eastern portion of Yellow Medicine County three of the six test holes penetrated 32 to 60 feet of fine to very coarse sand in the basal Quaternary. The depth to the top of this sand body was approximately 150 feet below ground surface. The sand layers encountered in the test holes are part of the one to two mile wide Wood Lake aquifer. This aquifer crosses the eastern portion of Yellow Medicine County with a northwest-southeast orientation.

Two aquifer tests, conducted in 1976 and 1985, using wells in the Hanley Falls/Cottonwood area, indicated Wood Lake aquifer transmissivities ranging from 73,430 gallons/day/foot (gpd/ft) to 264,970 gpd/ft. Hydraulic conductivities of 1,200 gallons/day/foot squared (gpd/ft squared) to 5,300 gpd/ft squared indicated this is a good aquifer.

Fifty-five cumulative feet of basal Quaternary sand were discovered in the Lyon County 42-2 test hole. The depth to the top of the sand layer was 323 feet. Very few deep wells or test holes exist in this area. Therefore, the nature and extent of this sand body is unknown. Limited data suggests this sand body is associated with a northwest-southeast sub-Quaternary drainage pattern.

Sand layers of adequate thickness for groundwater production were not found in any of the four 121 to 294 foot deep test holes drilled near the Lincoln-Pipestone Holland Well Field. Based on these results, additional test drilling to the deeper portions of the Quaternary near the Holland Well Field is not recommended.



1.0 Introduction

The 1995 legislature funded this project from a proposal that was initiated by the Minnesota Water Well Contractors Association. The purpose of the project is to help characterize the geologic and hydrologic conditions in southwestern Minnesota where water supplies are difficult to locate. The original name of the project was the "Grid Drilling Program". One of the exploration strategies considered during the early stages of the project was to drill test holes at regularly spaced intervals or in a grid pattern. The test holes, however, were located based on available geologic information. Therefore, the name has been changed to the Southwestern Minnesota Groundwater Exploration Project 1996-1997. This report is the second volume of a two part set of reports. The first volume titled "Progress Report" was issued in February 1997 (Berg, James A., 1997).

The legislature appropriated \$50,000 from the General Fund to DNR Waters to be matched by an equal amount of money from non-state sources for a total program budget of \$100,000 for the biennium. The non-state sources included: the City of Worthington, City of Luverne, Rock County Rural Water System, Lincoln-Pipestone Rural Water System, and the City of Marshall. The study area (Figure 1) was defined based on regional geology and the locations of the water suppliers that chose to participate. Specifically the project was designed to: 1) find potentially productive aquifers near the major public water suppliers, and 2) obtain geological information to help predict the locations of the best aquifers for future investigations.

The purpose of this volume is to summarize information gathered during the 1997 field season from portions of Yellow Medicine, Lyon, and Pipestone Counties. The test hole drilling locations (Figure 2) were chosen based on regional subsurface geology that was researched and compiled by DNR Waters for this project. The Minnesota Geological Survey (MGS), the U.S. Geological Survey (USGS), the project participants, and a consulting firm representing three of the participants reviewed the drilling plan and provided suggestions. The regional subsurface geology and target areas were discussed with all of these parties during the spring of 1996.

2.0 Regional Geology

Previous work in the study area was reviewed prior to drilling in order to locate promising test hole sites. Understanding the regional geology of the area was important for locating areas suitable for test drilling and for interpreting the results of the test drilling.

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2.1 Stratigraphy

The general stratigraphy of the area is shown in Figure 3. The Precambrian basement consists of hard igneous and metamorphic rock types. The upper layer of the Precambrian bedrock in parts of the Yellow Medicine County has been weathered to a whitish clay saprolite. The Precambrian basement is overlain by a soft bedrock layer composed of Cretaceous shale, sandstone and silty marlstone units. The Cretaceous bedrock is overlain by unconsolidated Pleistocene glacial sediments and other Quaternary deposits. The Cretaceous sandstone and Quaternary sand layers were the primary target formations of this project.

2.1.1 Cretaceous

The Cretaceous sedimentary rocks of southwestern Minnesota were deposited near the eastern shore of a large inland sea (Setterholm, D.R., 1990). The floor of the inland sea had very little topographic relief similar to the present land surface. The east-west trending Sioux Quartzite Ridge which occurs in the southwestern portion of the study area (Figure 4) was partly exposed during the Cretaceous period.

2.1.2 Quaternary

The Quaternary section consists of Pleistocene or glacial age sediments deposited from 8,000 years to 2 million years before the present (B.P.) and Holocene (recent post-glacial) unconsolidated sediments. Quaternary sediment deposition was separated from Cretaceous sediment deposition by a long period during which no deposition occurred (unconformity). The Cretaceous deposits were exposed and eroded for a very long time, creating a distinctive sediment layer just above the Cretaceous bedrock. This layer is referred to in this report as the basal Quaternary (BQ) because it is found at the base of the Quaternary. The exact age of this layer is unknown. The basal Quaternary sediments are composed of unconsolidated sand and clay deposited in fluvial (stream deposits) and lacustrine (lake deposits) settings.

The remaining overlying portions of the Quaternary sediments can be divided based on surface exposures and subsurface evidence indicating boundaries between till layers (Patterson, 1995). The upper two units of Quaternary sediments (Units 1 and 2) in the study area are composed predominantly of silty clay tills and outwash sands from Wisconsin and Late Wisconsin advances of the Des Moines glacial lobe (Figure 5). These units were deposited over most of the study area with the exception of Rock County, southwestern Pipestone County, and extreme southwestern Lincoln County.

The Pre-Wisconsin till/outwash units have been divided based on evidence from drill cuttings indicating previous land surface exposure. Where driller's or geologist's logs noted a change from an unoxidized color (such as gray) to an oxidized color (such as yellow, yellow-brown or tan), the color change was interpreted as the upper contact of a glacial unit that had previously been exposed to the land surface. In addition, thick sand layers and boulder/cobble zones were interpreted as representing the top or near top of the glacial till/outwash unit. At least three glacial till/outwash units (Units 3, 4 and 5) can be identified in the Pre-Wisconsin section within the Lyon County study area. Perhaps, only two Pre-Wisconsin or Pre Late Wisconsin till/outwash units exist in the Yellow Medicine County study area.

2.1.3 Area Type Logs

Gamma and resistivity logs that represent typical geologic conditions in the area (type logs) have been included from Yellow Medicine County/Wood Lake area (Figures 6) and the Lyon County/Three Mile Creek area (Figure 7). The stratigraphic designations were made by referring to the geologist's mud logs and by comparison with other gamma and resistivity logs in the area. The gamma and resistivity logs are a continuous depth records of the natural radiation and electrical resistivity of the subsurface formations measured from inside the drill hole. The geologist's mud log is a depth record of the subsurface geology created by identifying pieces of rock and sediment in the drilling mud that are circulated to the surface from the bottom of the drill hole. The till unit tops were commonly identified by a lower gamma reading indicating a higher quartz sand content. The higher quartz sand content was interpreted as evidence of deposition in an exposed environment during a glacial recession.

The unit designations within Lyon County/Three Mile Creek area have been tentatively correlated with units within the Burr Well Field/Lake Cochrane area (described in the "Progress Report") based on gamma/resistivity log similarities. For instance, that portion of the glacial deposits in the Lyon County/Three Mile Creek area identified as Unit 5 was deposited by the same glaciation as a Unit 5 in the Burr Well Field/Lake Cochrane area. No attempt has been made to correlate between these areas and other areas within the region (Rock and Nobles Counties, Yellow Medicine County, or Pipestone County).

2.2 Topography

Much of the study area topography is depicted in the top layer (land surface) of Figure 4. The region consists of a topographically high Prairie Couteau to the west where Lake Benton, Pipestone, and Luverne are located, and a low relief, lower elevation surface in the eastern portion of the area where Marshall and Worthington are located. The Prairie Coteau strongly influences groundwater flow direction (Bradt, R., 1997). The Prairie Coteau was created by deposition from successive glaciations and erosion of the adjoining lowlands by glaciation (Patterson, C. J., 1995).

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3.0 Yellow Medicine County/Wood Lake Aquifer

3.1 Summary of Test Hole Information

The locations of the DNR test holes in this area are shown in Figure 8. Test hole depths ranged from 190 to 239 feet. All the test holes were drilled into the saprolite layer (weathered bedrock) which exists beneath the Quaternary section. Table 1 presents a summary of the potentially productive sand layers that were encountered in the Yellow Medicine County/Wood Lake area. The depth ranges of these intervals were determined from drilling rates, lithology from cuttings (mud log or driller's log), resistivity log responses, and gamma log responses. A fast drilling rate is often a good indicator of sand, sandstone, and gravel layers. A low gamma response (recorded by the line on the right side of the log), interpreted in conjunction with the mud log, indicates a high quartz sand content. These characteristics often correspond to material with good aquifer potential. The electrical resistivity of the layers is recorded as the solid line on the left portion of the log. The resistivity values are controlled by the groundwater chemistry and the permeability/porosity of the layers. A high resistivity response often suggests that the sand layer has good aquifer potential.

These test holes were located based on a sub-Quaternary topography map that was created by the DNR from available well logs in the area. A buried valley, incised into the sub-Quaternary surface, was believed to exist in the area. Three of the six test holes drilled along this buried valley penetrated this 50 to 60 foot sand layer at the base of the Quaternary. This sand layer will be referred to as the Wood Lake aquifer since the town of Wood Lake is located directly over the aquifer (Figure 9).

Table 1 Glacial Drift Sand Layers/Yellow Medicine County

Test Hole #	Depth Range (feet)	Elevation Range (Feet)	Thicknes (feet)	ss Comments	Unit
87-3	150-210	899-839	60	Drilled very fast. Medium to coarse and very coarse sand. Low gamma response.	Wood Lake aquifer
87-4	159-210	902-851	51	Drilled very fast. Very fine to coarse sand. Low gamma response.	Wood Lake aquifer
87-6	151-183	902-870	32	Drilled very fast. Fine to coarse sand. Low gamma response. High resistivity response.	Wood Lake aquifer

3.2 Aquifer Distribution

The information from the test holes was used to revise and update maps (Figures 8 and 9) that were created at the beginning of the project. Descriptions of Pleistocene exposures near the confluence of the Yellow Medicine and Minnesota Rivers were provided by Carrie Patterson of the Minnesota Geological Survey. The interpretations of these exposures are included on cross section C-C'. Selected cross sections have been included in this report as Figures 10 through 12.

Cross section locations are shown on Figure 8. Prominent regional features are visible on the cross sections. The Minnesota River Valley is shown on the northeast ends of the cross sections. The Yellow Medicine Shear Zone (Chandler, Val W., 1991) is shown in cross sections B-B' and C-C' as a graben-like feature. Portions of the buried valley may have followed faults within the shear zone.

3.2.1 Sand Thickness Map - Wood Lake Aquifer

A simple sand thickness map of the Wood Lake aquifer, representing the area where sand layers are 20 feet thick or greater, is shown in Figure 9. Many wells penetrate this aquifer in the area, especially around Wood Lake. Most of these wells, however, were not drilled through the entire thickness of the Wood Lake aquifer sand. Therefore, reliable

interpretations of the sand thickness within the greater-than 20 foot contour cannot be made with the information currently available. In areas where sand thickness data are scarce, the trend of the main sand body was projected based on the underlying Pre-Quaternary topography (Figure 8).

The maximum sand thickness within the valley is commonly 50 to 60 feet. The width of the sand-filled portion of the valley ranges from less than a mile in the northwest portion of the mapped area (southern Lac Qui Parle County) to approximately 2 miles in the Wood Lake area.

3.3 Pumping Capacity and Water Quality

The results of two separate pumping tests of the Wood Lake aquifer in the Hanley Falls/Cottonwood vicinity were available from the DNR Water Appropriation files. In February 1976, a farm well with a 12 inch diameter screen set at a depth of 130 to 162 feet (915 to 883 feet elevation NGVD) on the Stanley Berg property, was test pumped by representatives of the U.S. Geological Survey and the DNR. The well, located approximately 2 miles west of Hanley Falls (Figure 9), was pumped for 24 hours at an average rate of 299 gallons per minute (gpm). Water level data was collected from the pumping well, and abandoned farm well located approximately one mile west of the Berg well, and another farm well located approximately one mile south of the Berg well. The transmissivities calculated at these three locations ranged from 174,490 gallons/day/foot (gpd/ft) to 264,970 gpd/ft. Using an aquifer thickness of 50 feet, the hydraulic conductivities range from 3,490 gallons/day/foot squared (gpd/ft squared) to 5,300 gpd/ft squared.

A test production well completed in 1985 by the City of Cottonwood (PW-85-1) was drilled approximately three miles north of the Cottonwood city limits. The well was completed with a 10-inch diameter screen from 157 to 207 feet (903 to 853 feet elevation NGVD). The well was test pumped at a rate of 840 gallons for 48 hours (B.A. Liesch Associates, Inc., 1985). A water quality sample was collected at approximately 47.7 hours into the test.

The late-time (100 to 2500 minutes) transmissivity value of 73,430 gpd/ft was calculated observation well data (OBS-84-A) gathered 50 feet from the Cottonwood test production well. Assuming an aquifer thickness of 60 feet, the hydraulic conductivity of the aquifer in this area is approximately 1,200 gpd/ft squared. The hydraulic conductivities values from the City of Cottonwood and Berg aquifer tests are in the middle to upper range for clean sand (Freeze and Cherry, 1979) which indicates the Wood Lake is a good aquifer.

The water quality sample collected from the Cottonwood test production well during the pumping test was analyzed for a wide range of parameters. Only total dissolved solids (TDS) and sulfates are summarized for this report. TDS was calculated by summing the reported constituents (total, as reported). The TDS and sulfate concentrations from the test production well sample were 1,074 milligrams per liter (mg/l) and 820 mg/l, respectively.

4.0 Lyon County/Three Mile Creek Area

4.1 Summary of Test Hole Information

Two test holes were drilled in this area at locations shown in Figure 13. Test holes 42-1 and 42-2 were drilled through the Quaternary sediments into the Cretaceous shale to depths of 538 and 520, respectively. Potential aquifer sand layers with thicknesses of 20 feet or greater are shown in Table 2. Unit names are shown for each layer based on stratigraphy that was developed in the Burr Well Field/Lake Cochrane Area (Berg, James A., 1997).

Table 2 Glacial Drift Sand Layers - Lyon County

Test Hole #	Depth Range (feet)	Elevation Range (Feet)	Thickn (feet)	ess	Unit
42-1	90-126	1450-1414	36	Drilled fast. Medium to very coarse sand with gravel. Low to medium gamma response. Medium to high resistivity response.	3
42-2	55-107	1470-1418	52	Drilled very fast except through cobble zone. Gravel and coarse to very coarse sand. Low gamma response. High resistivity response.	3
42-2	323-358	1202-1167	35	Drilled very fast. Very fine to coarse sand. Low gamma response. High resistivity response.	BQ
42-2	370-390	1155-1135	20	Drilled very fast. Fine to very coarse sand with gravel. Low to medium gamma response. Medium to high resistivity response.	BQ

4.2 Aquifer Distribution

The main objectives of test holes 42-1 and 42-2 were to search for thick basal Quaternary sand layers or pre-Wisconsin glacial outwash channels associated with drainage off the northeastern flank of the Sioux Ridge highlands. The distribution of sand layers within the lower Quaternary or sub-Quaternary stratigraphic units should be associated with low areas in the sub-Quaternary topography that are shown in Figure 13. Although data are very scarce, the thick basal Quaternary sand layers encountered in test hole 42-2 appear to be associated with a northwest-southeast trending buried valley shown on the sub-Quaternary topography map (Figure 13).

An interpretation of the sub-Quaternary drainage pattern and a line showing the northeastern boundary of basal Quaternary sediments are shown on the Figure 13 inset map. The basal Quaternary northeastern boundary has been interpreted to correspond with the Des Moines Lobe subglacial till boundary (Patterson, Carrie, J., 1995). Presumably basal Quaternary sediments northeast of this line have been subglacially eroded or completely reworked in the Des Moines Lobe scour area. The association of basal Quaternary sand layers to pre-Quaternary topographic low areas are shown on cross sections A-A' (Figure 14) and B-B'(Figure 15).

5.0 Pipestone County/ Holland Well Field Area

Our test drilling program in Pipestone County was centered around the existing Lincoln-Pipestone Holland Well Field at the request of the Lincoln-Pipestone Rural Water System. The well field consists of several wells which produce water from a shallow alluvial aquifer associated with the North Branch Pipestone Creek. The purpose of the test drilling in this area was to determine if deeper sand layers existed within the underlying glacial till or at the base of the Quaternary section.

Throughout the Quaternary and Cretaceous Periods, this area has been near the topographically highest portion of the region. Therefore, minimal sand deposits were expected to be associated with the glacial tills. No sediments at all were deposited or preserved during the Cretaceous Period in this area. In an effort to find the best possible locations for testing the basal Quaternary sediments, seismic refraction data was acquired at six locations within a mile radius of the Holland Well Field (Figure 16). This data revealed an undulating Precambrian bedrock surface at depths of approximately 100 to 150 feet below ground surface (Appendix 3). Test holes 59-1, 59-3, and 59-4 were drilled over the lowest bedrock surface locations according to the seismic data. This strategy was used to maximize the potential for finding sand at the base of the Quaternary. Test hole 59-2 was located with available well data three miles east of the Holland Well Field over a relatively thick Quaternary section.

The depths to the Precambrian in test holes 59-1, 59-3, and 59-4 (near the Holland Well Field) ranged from 121 to 140 feet. Test hole 59-2 (located three miles east of the Holland Well Field) penetrated the Precambrian Sioux Quartzite at 294 feet below ground surface. No significantly thick sand layers were found in any of the test holes.

6.0 Conclusions and Recommendations

This document is the second and final report of results from the Southwestern Minnesota Groundwater Exploration Project 1996-1997. This volume contains results of test drilling completed during the 1997 field season. This last phase of drilling included six -190 to 239 foot test holes in the eastern portion of Yellow Medicine County, two - 520 to 538 foot test holes in west central Lyon County, and four - 121 to 294 foot test holes in northern Pipestone County. The Yellow Medicine and Lyon County test holes were drilled in cooperation with the City of Marshall Utilities. The Pipestone County test holes were drilled in cooperation with Lincoln-Pipestone Rural Water.

Test drilling in eastern Yellow Medicine County helped define and characterize the basal Quaternary Wood Lake aquifer. The top of the aquifer was encountered at depths of 150 to 159 feet below ground surface at three of the six DNR test hole locations. The main portion of the Wood Lake aquifer consists of 50 to 60 feet of fine to very coarse sand.

The thickness, sand grain size, and areal extent of the Wood Lake aquifer suggests it should be able to produce large volumes of water at high pumping rates. Two pumping tests conducted in the Hanley Falls/Cottonwood area indicate aquifer transmissivities of 73,430 gpd/ft to 264,970 gpd/ft. Assuming and aquifer thickness of 50 to 60 feet, the hydraulic conductivity of the aquifer in this area ranges from 1,200 gpd/ft squared to 5,300 gpd/ft squared. These values indicate an aquifer capable of supplying the high volumes of water required by municipalities and rural water suppliers. The TDS and sulfate concentrations from the City of Cottonwood test production well water sample were 1,074 mg/l and 820 mg/l, respectively.

Fifty-five cumulative feet of basal Quaternary sand were discovered in the Lyon County 42-2 test hole at a depth of 323 feet. The sand body consisted of two layers of fine to very coarse sand separated by a 12 foot thick clay layer. Very few deep wells or test holes exist in this area. Therefore, the nature and extent of this sand body is unknown. Limited data suggests this sand body is associated with a northwest-southeast pre-Quaternary drainage pattern. Additional test drilling will be required to determine the basal Quaternary aquifer potential in this area.

Sand layers of adequate thickness for groundwater production were not found in any of the four 121 to 294 foot deep test holes drilled near the Lincoln-Pipestone Holland Well Field. This area has been near the topographically highest portion of the region throughout the primary periods of sand deposition (Cretaceous and Quaternary). Therefore, the relative lack of sand in the Quaternary section is not surprising. Based on these results, additional test drilling to the deeper portions of the Quaternary near the Holland Well Field is not recommended.

7.0 References

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Glossary

Aquifer	A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield economical quantities of water to wells and springs.
Cretaceous	A period that lasted from 136 million years to 64 million years before the present.
Fluvial	Pertaining to streams and the deposits and landforms produced by streams.
Formation	A rock unit distinguished from adjacent deposits by some common character such as composition or origin.
Gamma/	
resistivity log	A continuous depth record of the natural radiation and electrical resistivity of the subsurface formations measured from inside the drill hole. Low gamma readings and higher resistivity readings together may suggest that an aquifer is present.
Glacial till	Unsorted and unstratified glacial material, generally unconsolidated, directly deposited by and underneath a glacier without subsequent reworking by meltwater. Consisting of a heterogeneous mixture of clay, silt, sand, gravel, and boulders ranging widely in size and shape.
Groundwater	The water contained in interconnected pores in an aquifer.
Hydraulic	
conductivity	A coefficient of proportionality describing the rate at which water can flow through a permeable medium. Specifically, the flow rate of a water volume per unit of time through a given cross sectional area (i.e. gallons/day/square foot). A larger number indicates a better aquifer.
Lacustrine	Pertaining to lakes and the deposits and landforms produced by lakes.
Lithology	The composition of a rock or formation.

Mud log A depth record of the subsurface geology created by identifying pieces of rock and sediment in the drilling mud that are circulated to the surface from the bottom of the drill hole. Outwash Stratified sand and gravel removed or washed out from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of an active glacier. Permeability The property or capacity of porous rock, sediment, or soil for transmitting a fluid; it is a measure of the relative ease of fluid flow under unequal pressure. The more permeable the formation, the better it functions as an aquifer. **Porosity** The percentage of the bulk volume of a rock or soil that is occupied by water or air filled voids, whether isolated or connected. Higher porosity values that are connected indicate a better aquifer. Pleistocene The first epoch of the Quaternary Period. Characterized by the spreading and recession of continental ice sheets. Precambrian The earliest geologic era covering all the time before the Cambrian Period (570 million years before present). Quaternary A latest period of time in the stratigraphic column occurring 0 to 2 million years before the present. This period consists of glacial (Pleistocene) and post-glacial (Holocene) deposits. Sandstone A bedded sedimentary rock composed largely of sand grains which are cemented together by various binding materials such as silica or calcite. Shale A fine grained sedimentary rock formed by the consolidation of clay, silt, or mud. It is characterized by finely laminated structure. Sulfate Dissolved mineral found in some groundwater composed of one sulfur atom and four oxygen atoms. Derived from the dissolution of gypsum or anhydrite. Higher values indicate water that is less desirable for general use without treatment. Stratigraphy The study of stratified rocks or sediments especially their sequence in time, the character of the rocks or sediments and the correlation of beds in different localities.

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Topography Representing the surface features of a region including its relief, lakes, and rivers etc.
 Transmissivity The rate at which water is transmitted through a unit width of an aquifer, under a unit hydraulic gradient, extending the full saturated height of the aquifer. A larger value indicates a better aquifer.

Wisconsin

The last glaciation of the Pleistocene Epoch.

Appendix 1 - Figures







Figure 3

Stratigraphy of southwestern Minnesota (Modified from Setterholm, D.R. 1990)




Figure 4 Topography of land and bedrock surfaces in southwestern Minnesota (Patterson, C. 1995)



Figure 5

Des Moines lobe glacier in Minnesota during the Late Wisconsin (Modified from Wright, H.E. 1972)





Figure 6 Type gamma/resistivity log - Wood Lake aquifer area Yellow Medicine County





Figure 7 Type gamma/resistivity log - Three Mile Creek area Lyon County



Sub-Quaternary topography Yellow Medicine County

-4 • •

















Sub-Quaternary Drainage



KEY

- Data from well or test hole that penetrated the Sub-Quaternary section
- (42-2)_© DNR test hole B B

Cross section location

Top of Sub-Quaternary surface elevation contour (feet) -1100 -

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Generalized paleodrainage direction ~

Depression on mapped surface <1000 elevation

2 3 Scale in Miles



CROSS SECTION FIGURE NUMBER A-A' 14 B--B' 15

Figure 13

Sub-Quaternary topography and drainage pattern Lyon County/Three Mile Creek Area 







T107N

Figure 16 Refraction seismic lines and test hole locations Holland Well Field area

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Appendix 2 Drilling Logs and Sealing Records

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Drilling Log - Minnesota Department of Natural Resources Page 1 of 1							
Site ID#: 87-1		County: Yellow Medicine					
Geologist: Jim Berg		Driller: George Grim - LTP					
Date: 5/20/9	97	Drilling Method: 6	6" mud rotary	7			
Location: T	Location: T114N R41W Section 10 DDDBAA						
Depth (ft)	Description		Thickness	Drilling Notes			
0	Clay, silty, sandy, yellow brown		23				
23	Clay, silty, sandy, gray		47				
70	Clay, silty, sandy, gray, with sand	llayers	5	very fast			
75	Clay, silty, sandy, gray		. 77				
152	Sand, medium to very coarse with clay. Cobbles from 162' to 169'.	17	rough 162'- 169'				
169	Clay, silty, sandy, gray	8					
177	Clay, white with angular quartz grains (weathered bedrock)		54				
231	Bottom of hole			very slow and rough			
		·.					
	Interpreted from geologist's mud log and the gamma-resistivity log						
			-				

Site ID#: 87-2		County: Yellow Medicine		
Geologist: Jim Berg		Driller: George C	irim - LTP	
Date: 5/22/	97	Drilling Method:	6" mud rotary	/
Location: T	114N R41W Section24 BCCBCC			
Depth (ft)	Description		Thickness	Drilling Note
0	Clay, silty, sandy, yellow brown		. 5	
5	Clay, silty, sandy, gray		46	
51	Sand and gravel with abundant dark gray shale clasts		6	
57	Clay, silty, sandy, gray	Clay, silty, sandy, gray		
64	Clay, silty, sandy, gray, with abundant thin clay layers		48	
112	Clay, silty, sandy, gray. Sand @ 142'-144'		53	
165	Clay, white to whitish green (weathered bedrock)		35	
200	Bottom of hole			
	Interpreted from geologist's mud log and the gamma-resistivity log			
6				
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Drilling Lo	og - Minnesota Department of Na	tural Resources	H	Page 1 of 1	
Site ID#: 87	7-3	County: Yellow N	County: Yellow Medicine		
Geologist: Evan Drivas		Driller: George Grim - LTP			
Date: 5/27/	97	Drilling Method:	6" mud rotary	7	
Location: T	114N R40W Section21 DDDDDA	L			
Depth (ft)	Description		Thickness	Drilling Notes	
0	Clay, silty, sandy, brown		15		
15	Clay, silty, sandy, gray	<u></u>	35		
50	Cobbles		1	very slow	
51	Sand, fine to medium		16		
67	Clay, silty, sandy, gray		83	rough 70'	
150	Sand, medium to coarse		50		
200	Sand, medium to very coarse		10		
210	Clay, white (weathered bedrock)		30		
240	Bottom of hole	<u></u>			
	Interpreted from geologist's mud gamma-resistivity log	log and the			
<u></u>					
<u> </u>					
		···· ·· ······························			

Site ID#: 87-4 County: Yellow Medicine				
Geologist: Jim Berg		Driller: George Grim - LTP		
Date: 6/3/9	7	Drilling Method: 6" mud rotary		
Location: 1	114N R39W Section 24 DDDDD			
Depth (ft)	Description		Thickness	Drilling Note
0	Clay, silty, sandy, yellow brown	······································	24	
24	Clay, silty, sandy, gray		32	
56	Clay, silty, sandy, gray, with abur	dant sand layers	25	
81	Sand, very fine to very coarse		9	
90	Clay, silty, sandy, gray		69	chatter @ 130'
159	Sand, very fine to coarse	▼	.51	
210	Bedrock, weathered angular pieces with greenish white clay @ 214'-217'.		7	Rough and slow
217	Bottom of hole			
<u></u>		- <u></u>		
	Interpreted from geologist's mud gamma-resistivity log	log and the		
		<u> </u>		
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Drilling Log - Minnesota Department of Natural Resources Page 1 of 1					
Site ID#: 87-5		County: Yellow Medicine			
Geologist: Jim Berg/Evan Drivas		Driller: George Grim - LTP			
Date: 5/30/9	97	Drilling Method: 6	6" mud rotary	7	
Location: T	113N R39W Section 2 ADDDDD				
Depth (ft)	Description		Thickness	Drilling Notes	
0	Clay, silty, sandy, light brown		20		
20	Clay, silty, sandy, gray		58	chatter 35'-40'	
78	Sand, medium to coarse with abu gray clay	ndant layers of	17		
95	Clay, silty, sandy, gray		60	chatter 130'	
155	Clay, soft, black, organic, not calcareous		8		
163	Clay, greenish white (weathered bedrock)		27		
190	Bottom of hole				
	Attempted gamma-resistivity log. Tool could not pass 50 foot depth.				
				· · · ·	
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Site ID#: 87-6		County: Yellow Medicine		
Geologist: Evan Drivas		Driller: George Gi	rim - LTP	ð
Date: 5/29/	97	Drilling Method: (5" mud rotary	τ
Location: T	113N R39W Section 3 BAAAAA			
Depth (ft)	Description		Thickness	Drilling N
0	Clay, silty, sandy, light brown		20	
20	Clay, silty, sandy, gray, sand @ 3	7'-38'	43	
63	Sand	- 1997 - 79 1997 - 1997 - 1 99	2	
65	Clay, silty, sandy, gray		86	chatter 70 80', 95'-1
151	Sand, fine to coarse		32	
183	Clay, white to greenish gray (weathered bedrock)		37	
220	Bottom of hole		· ·	
· · · · · · · · · · · · · · · · · · ·	Interpreted from the geologist's n gamma-resistivity log.	nud log and the		
				· · · · · · · · · · · · · · · · · · ·
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Drilling Log - Minnesota Department of Natural Resources Page 1 of 1					
Site ID#: 42-1		County: Lyon			
Geologist: Jim Berg/Tom Gullett		Driller: George Grim- LTP			
Date: 7/2/97		Drilling Method: 6	5" mud rotary		
Location: T111N R43W Section 27 CBBBBA					
Depth (ft)	Description		Thickness	Drilling Notes	
0	Soil, dark gray		2		
2	Sand, coarse with gravel		49		
51	Clay, silty, sandy, gray		75		
90	Sand, medium to very coarse with	n gravel	36		
126	Clay, silty, sandy, gray		27	Rock @144'	
153	Sand, coarse with gravel		9	Rock @153'	
162	Clay, silty, sandy, gray		58		
220	Sand, coarse to very coarse		13		
233	Clay, silty, sandy, gray		147		
380	Clay, silty, sandy, gray with 2' to 5' thick interbedded sand layers		54		
434	Shale, black with white clay layers		9		
443	Siltstone and dark gray shale (Niobrara)		77		
520	Shale, dark gray		19		
539	Bottom of hole				
	Interpreted from geologist's mud resistivity log.	log and gamma -			
· · · · · · · · · · · · · · · · · · ·					
			<i>,</i> -		

Drilling Log - Minnesota Department of Natural Resources Page 1 of 2						
Site ID#: 42-2 County: Lyon						
Geologist: Jim Berg Drille		Driller: George G	Driller: George Grim - LTP			
Date: 6/4/97		Drilling Method:	6" mud rotary	7		
Location: T	Location: T111N R43W Section 27 ADDDCA					
Depth (ft)	Description		Thickness	Drilling Notes		
0	Clay, silty, sandy, yellow brown		14			
14	Clay, silty, sandy, gray	<u></u>	41			
55	Gravel and coarse to very coarse sand. Cobbles 102'-107'		52	very slow and rough 99-109'		
107	Cobbles		2			
109	Clay, silty, sandy, gray		31			
140	Clay, silty, sandy, gray, with sand layers		24			
164	Clay, silty, sandy, gray. Cobble @ 199'		102			
266	Clay, soft brown (lake sediment)		3			
269	Clay, silty, very sandy, gray		54			
323	Sand, very fine to coarse. Cobble @ 323'		35			
358	Clay, silty, sandy, gray		12			
370	Sand, very fine to very coarse wit	h gravel	20			
390	Clay, silty, sandy, gray		12			
402	Sand		6			
408	Clay, silty, sandy, gray		7			
415	Sand		5			
420	Shale, soft, dark gray		8			
428	Siltstone and dark gray and olive gray shale (Niobrara)		75	rough @ 439'		
503	Shale, olive gray		17			
520	Bottom of hole	· · · · · · · · · · · · · · · · · · ·				
Drilling Lo	og - Minnesota Department of Na	tural Resources	F	age 2 of 2		
--	--	---------------------------------------	-----------	---------------		
Site ID#: 42-2 County: Lyon						
Geologist:	Jim Berg	Driller: George G	rim - LTP			
Date: 6/4/9	7	Drilling Method: 6" mud rotary				
Location: T	1111N R43W Section 27 ADDDC	A				
Depth (ft)	(ft) Description		Thickness	Drilling Note		
455	Shale (no sample return - Niobrar	ra)	27	very fast		
482	Shale, soft, dark gray and olive gr	ray	38			
520	Bottom of hole			2		
	Interpretation from geologist's m gamma-resitivity log.	ud log and				
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ite ID#: 59-1 County: Pipeston		e			
Tom Gullett	Driller: George G	Driller: George Grim- I TP			
97	Drilling Method:	6" mud rotary	7		
107N R45W Section 7 DCDCD	DC				
Descriptio	n .	Thickness	Drilling N		
Soil, black		1			
Clay, silty, sandy, brown		2			
Clay, silty, sandy, olive gray	9.* 4 <u>6</u>	17			
Clay, silty, sandy, yellow to ol	ay, silty, sandy, yellow to olive brown				
Clay, silty, sandy, gray		20	Rough @		
Clay, silty, sandy, olive brown with quartzite fragments. Thin white clay layer @ 140'		5	Rough @		
Quartzite, weathered, light pink		: 4			
Bottom of hole	Bottom of hole				
Interpreted from geologist's m resistivity log.	ud log and gamma -				
	Tom Gullett 97 107N R45W Section 7 DCDCD Description Soil, black Clay, silty, sandy, brown Clay, silty, sandy, olive gray Clay, silty, sandy, olive gray Clay, silty, sandy, gray Clay, silty, sandy, olive brown fragments. Thin white clay lay Quartzite, weathered, light pin Bottom of hole Interpreted from geologist's m resistivity log.	Figure 1 County: Pipeson Tom Gullett Driller: George G 97 Drilling Method: 107N R45W Section 7 DCDCDC Description Soil, black Clay, silty, sandy, brown Clay, silty, sandy, olive gray Clay, silty, sandy, olive gray Clay, silty, sandy, gray Clay, silty, sandy, gray Clay, silty, sandy, olive brown with quartzite fragments. Thin white clay layer @ 140' Quartzite, weathered, light pink Bottom of hole Interpreted from geologist's mud log and gamma - resistivity log.	Tom Gullett Driller: George Grim- LTP 97 Drilling Method: 6" mud rotary 107N R45W Section 7 DCDCDC Thickness Soil, black 1 Clay, silty, sandy, brown 2 Clay, silty, sandy, olive gray 17 Clay, silty, sandy, olive gray 20 Clay, silty, sandy, gray 20 Clay, silty, sandy, olive brown with quartzite fragments. Thin white clay layer @ 140' 5 Quartzite, weathered, light pink 4 Bottom of hole		

Drilling Lo	og - Minnesota Department of Na	tural Resources	P	Page 1 of 1	
Site ID#: 59-2 County:		County: Pipestone	Pipestone		
Geologist:	Jim Berg	Driller: George Grim- LTP			
Date: 7/16/	97	Drilling Method:	6" mud rotary	<i>I</i> .:	
Location: T	107N R45W Section 10 ABBAAB				
Depth (ft)	Description	<u></u>	Thickness	Drilling Notes	
0	Clay, silty, sandy, brown		65		
65	Clay, silty, sandy, gray		5		
70	Clay, silty, sandy, yellow brown v layers @ 95-100'	with a few sand	45		
115	Clay, silty, sandy, gray		15		
130	Clay, silty, sandy, yellow brown to grayish yellow brown		50		
180	Clay, silty, sandy, gray		10		
190	Clay, gray (lake clay?)		5		
195	Clay, silty, sandy, yellow brown		10		
205	Clay, silty, sandy, gray to dark gray		75	fast drilling 205'-215'	
280	Clay, silty, very sandy, dark gray		14	fast drilling 280'-290'	
294	Quartzite, pink, hard			· · · · · · · · · · · · · · · · · · ·	
294	Bottom of hole				
		······································			
	Interpreted from geologist's mud resistivity log.	log and gamma -			
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Site ID#: 5	Site ID#: 59-3 County:		e	
Geologist:	Tom Gullett Dri	ller: George G	rim- LTP	
Date: 7/22/97 Drilling M		lling Method:	6" mud rotary	7
Location: 7	107N R45W Section 6 CCCCCC			
Depth (ft)	Description		Thickness	Drilling 1
0	Soil, dark gray		3	
3	Clay, silty, sandy, light brown to olive brown	e yellow	27	
30	Clay, silty, sandy, gray		30	
60	Clay, silty, sandy, yellow brown to br	own	35	
95	Gravel and small cobbles	Gravel and small cobbles		
100	Clay, silty, sandy, yellow brown	silty, sandy, yellow brown		
131	Quartzite, weathered, whitish pink		. 3	
134	Bottom of hole			
2				
	Interpreted from geologist's mud log a resistivity log.	and gamma -		
		ν ^τ .		

Drilling Lo	og - Minnesota Department of Na	tural Resources	ŀ	Page 1 of 1
Site ID#: 5	9-4	County: Pipestor	ne	
Geologist:	Tom Gullett	Driller: George (Grim- LTP	
Date: 7/24/	97	Drilling Method	: 6" mud rotary	/ - spade bit
Location: T	107N R46W Section 12 BAA			
Depth (ft)	Description		Thickness	Drilling Notes
0	Soil, black		3	
3	Clay, silty, sandy, olive brown		32	
35	Clay, silty, sandy, gray		25	~
60	Clay, silty, sandy, yellow brown	to olive brown	25	
85	Clay, silty, sandy, gray		30	
115	Clay, silty, sandy, olive brown w pebbles	vith abundant	6	
121	Quartzite, weathered, pink		1	
122	Bottom of hole			
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Well	\mathcal{D}	rilling	



DRILLERS LOG

Drilled for <u>Minnesota DNR</u>

By <u>Hutchinson</u> Office

Location of Test Hole ID # 87-1 Yellow Medicine Co 114 41 10 DDB

_ Test Hole No. ____ Well No. ___

Size of test hole 64" Date started 5/19/1997 Date completed 5/20/1997 Total Hours

FORMATIONS DRILLED							
TYPE OF FORMATION	COLOR OF FORMATION	STARTED AT WHAT DEPTH	ENDED AT WHAT DEPTH	THICKNESS OF FORMATION			
Top soil	black	0	3	3			
Clay w/sand	brown	3	21	18			
Clay w/sand	gray	21	29	8			
<u>Clay w/coarse sand</u>	gray	-29	63	34			
Rock	black	63	63 ¹ 2	1 ₂			
<u>Clay w/coarse sand</u>	gray	63 ¹ 2	72	8 ¹ 2			
Sand (Coarse)	gray/black	72	73 ¹ 2	1 ¹ 2			
Coarse sand w/clay	gray	73 ¹ 2	82	8 ¹ 2			
<u>Clay w/coarse sand</u>	gray	82	123	41			
Sandy clay	gray	123	154	31			
Sand (Coarse and dirty)	gray/black	154	164	10			
Sand (Coarse)	gray/black	164	170	6			
Rock	white	170	172	2			
Gravely clay	colored	172	174	2			
Rock	white	174	177	3			
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Signed George Grimm

FARGO, N.D. HUTCHINSON, MN. Image: Stress of test hole Image: Stress of test hole Stress of test hole						
Size of test hole <u>64</u> "Date started <u>5/19/1997</u>	Date completed: <u>5/</u>	20/1997	Total H	lours		
FORMA	TIONS DRILLED	****		T		
TYPE OF FORMATION	COLOR OF FORMATION	STARTED AT WHAT DEPTH	ENDED AT WHAT DEPTH	THICKNESS OF FORMATION		
Top soil	, black	0	2	2		
Sandy clay	brown	2	23	21		
Clay w/sand	gray	23	64	41		
Clay w/coarse sand	gray	64	73	9		
Gravely clay	gray	73	74	11		
Sandy clay	gray	74	109	35		
Sand (Coarse)	black/gray	109	110	1		
Gravely clay	grav	110	112	2		
Sandy clay	gray	112	137	25		
Sand (Coarse)	colored	137	139	22		
Sandy clay	gray	139	155	16		
Sand (Çoarse)	colored	155	160	5		
Sandy clay	gray	160	164	4		
Gravely clay	colored	164	165	11		
Rock	white	165	167	2		
Sandy clay	gray	167	171	4		
Rock	colored	171	172	<u> </u>		
Gravely clay	gray	172	182	10		
Sandy clay (Coarse)	colored	182	193	<u> </u>		
-Quartz	clear	193	228	35		
_Quartz	white/green	228	231			
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	Enterprises, Inc.
Well	Drilling

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DRILLERS LOG

Drilled for <u>Minnesota DNR</u>			By <u>Hutch</u>	ninson	.Office
Location of Test Hole # 87-2	Yellow Medicine Co	114 41 24 BCC		·	
		Test Hole I	No. <u>3</u>	Well No	

Size of test hole ______ Date started ______ Date _____ Date completed ______ 5/23/1997 ______ Total Hours ______

FORMATIONS DRILLED						
TYPE OF FORMATION	COLOR OF FORMATION	STARTED AT WHAT DEPTH	ENDED AT WHAT DEPTH	THICKNESS OF FORMATION		
Top soil	black	0	3	3		
Sandy clay	brown	3	13	10		
Sandy clay	gray	13	51	38		
Gravely shale	black	51	56	5		
Sandy clay	gray	56	59	3		
Gravely clay	gray/black	59	72	13		
Sand (Coarse)	colored	72	81	9		
Rock	white	81	82	1		
Sandy clay	gráy	82	93	11		
Sand	gray	93	99	6		
Sandy clay	gray	99	144	45		
Sand	gray	144	146	2		
Sandy clay	gray	146	162	16 .		
Shale	gray	162	176	14		
Clay	white	176	180	4		
Clay	green	180	200	20		

Signed ____ George Grimm

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		Enterprises, Onc.
Well	\mathcal{D}	rilling



DRILLERS LOG By Hutchinson Drilled for ______Minnesote DNR _____Office Yellow Medicine Co. 114 40 21 ADDD Location of Test Hole _____ ID #_87-3____ _____Test Hole No. ______Well No. ______ Size of test hole _______ Date started _______ Date completed _______ 5/29/1997 _____Total Hours _____ FORMATIONS DRILLED STARTED AT WHAT DEPTH ENDED AT WHAT DEPTH COLOR THICKNESS TYPE OF FORMATION OF FORMATION OF FORMATION

Top soil	black	0	3	3
Sandy clay	brown	3	21	18
Sandy clay	gray	21	151	130
Sand	gray	151	183	32
Sandy clay	gray	183		4
Sandy clay	tan/white		191	4
Sandy clay	green	191	220	29
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	Enterprises, Inc. Drilling
Wett	



DRILLERS LOG

Drilled for <u>Minnesota DNR</u>	·		By <u>Hutchinson</u>	Office
Location of Test Hole ID # 87-4	Yellow Medicine Co.	114 40 24 DDC		
			-	

Size of test hole _______ Date started _______ Date completed _______ 6/3/1997 ______ Total Hours ______

____. Test Hole No. _____Well No. _

FORMATIONS DRILLED				
TYPE OF FORMATION	COLOR OF FORMATION	STARTED AT WHAT DEPTH	ENDED AT WHAT DEPTH	THICKNESS OF FORMATION
Top soil	black	0	1	1
Sandy clay	brown	11	24	23
Sandy clay	gray	24	56	32
Sand (Dirty)	gray	56	58	2
Sandy clay	gray	58	68	10
Sand & clay lenses	gray	68	75	7
Sandy clay	gray	75	85	10
Sand (Dirty) w/ little clay	gray	85	94	9
Sandy clay	gray	94	160	66
Sand (Dirty)	brown	160	164	4
Sand	brown	164	211	47
Rock	colored	211	217	6

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Enterprises, Onc. Well Drilling	FARGO, N.D. HUTCHINSON, MN.	Sec	N	
D	RILLERS LOG	_ 11-		-
Drilled forMINNESOTA DNK		By	iteninson	Office
ocation of Test HoleID# 87=5Yellow_Me	<u>edicine Co 113 39 2</u>	ADA	-	
	Test I	Hole No	2Well N	0
Size of test hole <u>$6\frac{1}{4}$</u> Date started <u>$5/30/1997$</u>	Date completed6/2	/1997	Total H	lours
FOR	MATIONS DRILLED		-	
TYPE OF FORMATION	COLOR OF FORMATION	STARTED AT WHAT DEPTH	ENDED AT WHAT DEPTH	THICKNESS OF FORMATION
Top soil	black	0	3	3
Sandy clay	brown	3	20	17
Sandy clay	gray	20	24	4
Gravely clay	gray	24	32	8
Sandy clay	gray	32	56	24
Rock	white	56	57	1
Sandy clay	gray	57	74	17
	grav	74	76	2
Sand (Dirty)	6149			2
Sand (Dirty) Sandy clay	gray	76	78	
Sand (Dirty) Sandy clay Sandy clay (Coarse)	gray gray	76 78	78 157	79
Sand (Dirty) Sandy clay Sandy clay (Coarse) Clay	gray gray black	76 78 157	78 157 159	79 2
Sand (Dirty) Sandy clay Sandy clay (Coarse) Clay Sandy clay	gray gray black gray/black	76 78 157 159	78 157 159 167	79 2 8
Sand (Dirty) Sandy clay Sandy clay (Coarse) Clay Sandy clay Sandy clay	gray gray black gray/black white	76 78 157 159 167	78 157 159 167 180	79 2 8 13
Sand (Dirty) Sandy clay Sandy clay (Coarse) Clay Sandy clay Sandy clay	gray gray black gray/black white	76 78 157 159 167	78 157 159 167 180	79 2 8 13
Sand (Dirty) Sandy clay Sandy clay (Coarse) Clay Sandy clay Sandy clay	gray gray black gray/black white	76 78 157 159 167	78 157 159 167 180	79 2 8 13
Sand (Dirty) Sandy clay Sandy clay (Coarse) Clay Sandy clay Sandy clay	gray gray black gray/black white	76 78 157 159 167	78 157 159 167 180	79 2 8 13
Sand (Dirty) Sandy clay Sandy clay (Coarse) Clay Sandy clay Sandy clay	gray gray black gray/black white	76 78 157 159 167	78 157 159 167 180	79 2 8 13

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	Enterprises, Onc.
Well	Drilling



DRILLERS LOG

Drilled for <u>Minnesc</u>	ota DNR				By_	Hutchinson	Office
Location of Test Hole	ID # 87-6	Yellow Medicine Co.	113 39 3	BAB			
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Size of test hole <u>6¹z"</u> Date started <u>5/29/1997</u> Date completed <u>5/29/1997</u> Total Hours

FORMATIONS DRILLED				
TYPE OF FORMATION	COLOR OF FORMATION	STARTED AT WHAT DEPTH	ENDED AT WHAT DEPTH	THICKNESS OF FORMATION
Top soil	black	0	2	2
Clay	brown	2	12	10
Sandy clay	brown	12	16	4
Sandy clay	gray	-16	46	30
Gravely clay	gray	46	48	2
Sandy clay	gray	48	52	4
Rock	colored	52	53	1
Sand	colored	53	69	16
Sandy clay	gray	69	126	57
Rock	white	126	127	1
Gravely clay	gray	127	134	. 7
Gravel	colored	134	140	6
Sandy clay	gray	140	151	i1
Sand	gray	151	212	61
Sandy clay	white	212	220	8

STP Enterprises, Gnc. Well Drilling	FARGO, N.D. HUTCHINSON, MN.	$ \begin{array}{c} \uparrow \\ N \\ \hline \\ N \\ \hline \\ X \\ \hline \\sw \\sw \\ \hline \\sw \\sw \\ \hline \\sw \\sw \\ \hline \\sw \\sw \\ \hline \\sw \\ $

DRILLERS LOG

Minnesota	DNR
	Minnesota

By <u>Hutchinson</u> Office

Location of Test Hole ID # 42-1 Lyon county 111 43 27 CBB

_____Test Hole No. _____Well No. _____

Size of test hole <u>6³/</u>____Date started <u>7-2-1997</u>____Date completed <u>7-11-1997</u>_____Total Hours

FORMATIONS DRILLED				
TYPE OF FORMATION	COLOR OF FORMATION	STARTED AT WHAT DEPTH	ENDED AT WHAT DEPTH	THICKNESS OF FORMATION
Top soil	black	0	· <u>1</u>	1
Gravely clay	brown	1	4	3
Gravel	colored	4	56	52
Sandy clay coarse	gray	56	94	38
Sand & gravel	colored	94	129	35
Sandy clay	gray	129	134	5
Sand coarse	colored	134	135	1
Sandy clay w/pebbles	gray	135	144	9
Rock	white	144	145	1
Sandy clay rocky	gray	145	158	13
Sand	colored	158	161	3
Sandy clay w/pebbles	gray	161	224	63
Sand coarse	colored	224	236	12
Sandy clay w/lenses	gray	236	249	13
Sandy clay pebbly	gray	249	351	102
Sandy clay fine	gray	351	379	28
Sandy clay w/lenses	gray	379	391	12
Sandy clay rocky	gray	391	442	51
Shale & hard pan	black/gray	442	539	97
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	Enterprises, Inc.
Well I	Drilling



DRILLERS LOG

By <u>Hutchinson</u> Office

Location of Test Hole _____ ID # 42-2 Lyon Co 111 43 27 ADD

Drilled for <u>Minnesota DNR</u>

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_____. Test Hole No. _____8____. Well No. ______

Size of test hole _______ Date started _______ Date completed _______ Date completed ________ Total Hours _______

FORMATIONS DRILLED								
TYPE OF FORMATION	COLOR OF FORMATION	STARTED AT WHAT DEPTH	ENDED AT WHAT DEPTH	THICKNESS OF FORMATION				
Top soil	black	0	2	2				
Sandy clay	brown	2	9	7				
Gravel	brown	9	10	1				
Sandy clay	yellow	10	14	4				
Sandy clay	gray	14	16	2				
Sandy clay	yellow	16	19	3				
Sandy clay	gray	19	57	38				
Gravel	colored	57	72	15				
Gravel & clay layers	gray	72	80	8				
Gravel	colored	80	107	27				
Rock	white	107	108	1				
Sandy clay	gray	108	146	38				
Sandy clay (Coarse)	gray	146	180	34				
Sandy clay	gray	180	267	87				
Sand	white	267	271	4				
Sandy clay	gray	271	295	24				
Sandy clay (soft)	gray	295	340	45				
Sand (Dirty)	gray	340	369	29				
Clay	gray	369	371	2				
Sand (Dirty & coarse) little clay	gray	371	390	19				
Rocky clay	gray	390	438	48				
Sandy clay (Coarse)	colored	438	467	29				
Sandy clay w/shale	gray/black	467	519	52				

George Grimm

Enterprises, Onc.	FARGO, N. HUTCHINS	D. ON, MN.	l	N	
Well Drucemy	DRILLERS LO	DG	Sec	/T10	 IZR45
Drilled for			By	urchinson	Orrice
Location of Test Hole ID# 59-1 Pipes	stone county	107 45	7 CBD		
		Test	Hole No1	2Well No)
Size of test hole <u>6 1/4</u> Date started <u>7-23-97</u>	7Date co	mpleted7_	24-97	Total H	ours
FOI	RMATIONS DR	ILLED		· · · · · · · · · · · · · · · · · · ·	
TYPE OF FORMATION			STARTED AT WHAT	ENDED AT WHAT	THICKNESS OF

1 1

	FORMATION	DEPTH	DEPTH	FORMATION
Top soil	black	0	3	3
Sandy clay	brown	3	4	1
Gravely	colored	4	5	1
Sandy clay	brown	5	15	10
Sandy clay	gray	15	21	6
Sandy clay	brown	21	32	11
Sandy clay	green/brown	32	44	12
Sandy clay gray	layers brown	44	112	68
Sandy clay	gray	112	127	15
Sandy clay	white/gray	127	136	9
Rock	. red	136	137	1
Sandy clay	brown/tan	137	140	3
Rocky sandy clay	red/white/gr	ay 140	143	3
	· · · · · · · · · · · · · · · · · · ·			
		1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -		

FAR HUT FAR HUT Brilled for Minnesota DNR Location of Test Hole	IGO, N.D. TCHINSON, MN. ERS LOG	Sec _ 1 ByHU _10_ABB	↑ N LOT _107	
Size of test hole <u>6 1/4</u> Date started <u>7-14-97</u>	Test Date completed7-2	Hole No. <u>10</u> 1–97	Well No	ours
FORMATIO	NS DRILLED		<u></u>	
TYPE OF FORMATION	COLOR OF FORMATION	STARTED AT WHAT DEPTH	ENDED AT WHAT DEPTH	THICKNESS OF FORMATION
Top soil	Black	0	1	1
Clay	yellow & bro	wn l	23	22
Sandy clay	Brown gray	52	61	9
Sandy clay	gray	61	71	10
Sandy clay	brown	71	97	26
Sandy clay	gray	97	126	29
Sandy clay	brown	126	147	21
Sandy clay	gray	147	164	17
Sandy clay	brown/gray	164	294	130
Rock	red	294	295	1
			<u> </u>	
· · · · · · · · · · · · · · · · · · ·				
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Drilled for <u>Minnesota DNR</u> Location of Test Hole <u>ID# 59-3 Pipestone</u>	FARGO, N.D. HUTCHINSON, MN. DRILLERS LOG	Sec By <u>H</u> cccccc	NX 6T1	07R45
Size of test hole <u>6 1/4</u> Date started <u>7-22-97</u>	Date completed 7_	t Hole No	⊥Well N Total ⊦	0
FO	RMATIONS DRILLED			
TYPE OF FORMATION	COLOR OF FORMATION	STARTED AT WHAT DEPTH	ENDED AT WHAT DEPTH	THICKNESS OF FORMATION
Top soil	black	0	3	3
Sandy clay	brown	3	36	33
Sandy clay layers	gray/brown	36	42	12
Sandy clay	gray	42	65	17
Sandy clay	brown/green	ı 65	95	30
Gravely sand	colored	95	97	2
Sandy clay	brown	97	131	34
Rock	red	131	134	3
		·	-	
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97	\mathcal{D}
	Enterprises, Onc.
Well D	Drilling

FARGO, N.D. HUTCHINSON, MN.

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	S	` w	s	E	-
Sec. 12.	T	1	07.	R .	4.6

DRILLERS LOG

Drilled for <u>Minnesota DNR</u>		Ву	HutchinsonOffice
Location of Test HoleID# 59-4	Pipestone county	107 46 12 BAA	

Size of test hole <u>6 1/4</u> Date started <u>7-24-97</u> Date completed <u>7-25-97</u>

_____Test Hole No. _____Well No. ___

_____ Total Hours _____

FORMATIONS DRILLED								
TYPE OF FORMATION	COLOR OF FORMATION	STARTED AT WHAT DEPTH	ENDED AT WHAT DEPTH	THICKNESS OF FORMATION				
Top soil	black	0	3	3				
Sandy clay	brown	3	41	38				
Sandy clay	gray	41	59	18				
Sandy clay	brown/gray	59	74	15				
Clay	gray	74	99	5				
Sandy clay	brown	99	87	8				
Clay	gray	87	101	14				
Sandy clay	brown	101	105	4				
Clay	gray	105	120	15				
Sandy clay	white/gray	120	121	1				
Rock	red	121	122	1				
	•							
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· · · · · · · · · · · · · · · · · · ·			1					
		1	1					

				LINKS	COTA C	
WELL OR BORING L	OCATION		14/-1			
County Name			WEL		DUH	Minnesota Unique No.
Tellow Med	licine			Mi	nnesota	Statutes, Chapter 103I Or W-series No. (Leave blank if not known)
Township Name	Township No.	Range No.	Section No.	Fraction (s	m. → lg.)	Date Sealed Date Well or Boring Constructed
	114	<u> </u>	10		4 Q 24	5/20/1997 5/10/1007
Northank	ess or Fire Nun	nber and City	of Well or Bor	ing Locatio	1 1	J 69 1331 J 13 1371
Numerical calent had		und ony		-9 200au		Depth Betore Sealingft. Original Depth ft.
about location of	well or boring		Skotch	nam of well	or boring	
in section grid with "X"			location	showing	property	
N			lines, ro	ada, and bu	ilidings.	WELL/BORING
				·		🗋 Water Supply Well 📋 Monit, Well
				n. F		Env. Bore Hole 🗇 Other It 🗍 below 💭 above land -unface
w+-++-	·			·		CASING TYPE(S)
	T			•		
		mile				
┝╍┿╍┿╍┥	X			-		CASING
Lille S	¥. لــــلــــلــــلــــلــــــلــــــــــ	<u> </u>		7		Diameter Depth Set in oversize hole? Annualar space initially grouted?
1 mil	e#•					In from to ft. I yes I No I yes L to L Jaknown
BOPERTY OWNER	S NAME			<u> </u>		in, from to ft.
Property owner s mailing	address if differ	ent than well to	cation address	indicated at	ove	in, from to ftYes NoYes NoUnknown
						SCREEN/OPEN HOLE
						Screen from NONE to ft Open Hole from to tt
VELL OWNER'S NAM	1E					
Minnesote	DNR					
Vell owner's mailing add	lress if different t	han property o	wher's address	indicated at	iove.	Type of Obstruction/Debris:Fill
500 Lofewa	tte Rd					
Ct Daul	MOI 5	5155				PUMP
St. Ieur		3133				TURN NONE
				or		
GEOLOGICAL MAT	ERIAL	COLOR	FORMATIO	N FRON	то	
not known, indicate est	imated formation	n log from near	by well or born	g		T METHOU USED TO SEAL ANNULAH SPACE BETWEEN 2 CASINGS, OR CASING AND BORE HOLE:
7	hed					No Annular Space Exits
LOY ALLACI						Annular space grouted with tremie pipe
<u>.</u>						Lasing Perforation/Hemoval
1						in. from to ft. Perforated Permoved
· .	1			-	1	
						Type of perforator
					+	U Other
						GROUTING MATERIAL(S)
					1	
					+	Grouting Material NEAT CEMENT from 177 to 2 tt. 12 bags
					<u> </u>	from to ft base
					1	
					1	from to ft bags
						from to 4
						Dags
EMARKS, SOURCE	OF DATA, DIF	FICULTIES	N SEALING	- <u>1999</u>		UNSEALED WELLS AND BORINGS
<u>A</u>	1					Other unsealed well or boring on property? Yes, No
87-	- 1					LICENSED OR REGISTERED CONTRACTOR CERTIFICATION
						This well or boring was sealed in accordance with Minnesota Rules, Chapter 4725. The information the second s
						true to the best of my knowledge.
						The Contraction of the Contracti
						LaT.P. Enterprises Inc.
						Contractor Business Charger prises Inc
						Contractor Business Enterprises Inc
						Contractor Business Inc License
						Contractor Business Disc License License 9/10/1997
						Contractor Business The License License And Strategy Signature
PORTANT.= - = -	172 3800E5					Contractor Business The License License March - 46 Authorized Répresentative Signature 9/10/1997
PORTANTIFILE A		²⁷⁷ H	 1.01	336	5	Contractor Business The License Inc. Authonized Répresentative Signature 9/10/1997 Authonized Répresentative Signature 9/10/1997 Name of Person Sealing Well or Boring

WELL OR BORING County Name Yellow Mor			LL OR BORING LOCATION MINNESOTA WELL AND BO			Minnesota Well and Boring Sealing No. Minnesota Unique No. or W-series No. (Leave blank (not known)	H 103366
Township Name	Township No	b. Range No.	Section No. Fr	action (sm> Ig.	Date Sealed	Date Well or Boring Construct	ed
Normania	114	41	10	W*SE *SE *	5/20/1997	5/19/1997	
Numerical Street Add	dress or Fire Nu	umber and City	of Well or Boring	Location			
					Depth Before Sealing231	tt. Original Depth 231	(I.
Show exact location in section grid with ">	of well or boring (".	9	Sketch may location, s	o of well or boring howing property	AQUIFER(S)	STATIC WATER LEVEL	
N	4		lines, roads	and buildings.	WELL/BORING	Measured 🗌 Estimated	1
					Water Supply Well Monit. Well		_
·					Lev. Bore Hole Other	[ft. [_] belov	w l_i above land surface
w		E T			CASING TYPE(S)		
					Steel Plastic Tile Other	NONE	·
	X	4 mie			CASING		
	<u> </u>	.*			Diameter Depth	Set in oversize hole?	Annualar space initially grouted?
1 m	nile 🛱 e			1	in. from to	ft. Yes No	
PROPERTY OWNER	R'S NAME		······································		in. from to	ft. 🗌 Yes 📋 No	Yes cwn
c operty owner's mailir	ng address if diffe	erent than well lo	ocation address ind	icated above.	in, from to	ft. 🗌 Yes 🗌 No	🗌 Yes 🚊 👘 nown
					SCREEN/OPEN HOLE	—	
					NONE	1	
						ii. Upen Hole from	ισ π.
WELL OWNER'S NA	ME						
Minnesota	DNR					Obstruction	
Well owner's mailing ac	ddress if different	t than property o	wher's address ind	licated above.	Type of Obstruction/Debris/Fill	······	
500 Lafay	rette Ro	d.		:	Obstruction/Debris/Fill removed? Yes	🗌 No	
St. Paul,	, MN 53	5155			PUMP		
					Type NONE		
GEOLOGICAL MA	ATERIAL	COLOR	HARDNESS OF FORMATION	FROM TO	Removed Not Present Other		
If not known, indicate e	estimated formation	on log from near	rby well or boring.	·······	METHOD USED TO SEAL ANNULAR SPACE	BETWEEN 2 CASINGS, OR CAS	ING AND BORE HOLE:
Log attac	hed				Annular Space Exits		
					Casing Perforation/Removal		
					in from	to #	
						to n.	
					in. from	to ft.	Perforatedmoved
					Type of perforator		
					1		
}	~ ~				Other	·	
					GROUTING MATERIAL(S)		
					Grouting Material neat cement f	rom 231 to 2	ft bags
					f	rom to	tt bags
					1 f	rom to	ft bags
				┝──┝─		from to	ft bars
REMARKS, SOURC	E OF DATA, DI	IFFICULTIES	IN SEALING		UNSEALED WELLS AND BORINGS		
87-	· \				Other unsealed well or boring on property?		
					LIVENSED ON REGISTERED CONTRACTOR		
					This well or boring was sealed in accordance w true to the best of my knowledge.	rith Minnesota Rules, Chapter 4725	5. The information 🚽 👘 report is
					-	x*	· · · · · · · · · · ·
					L.T.P. Enterprises In	BC 34	license 5
							License · 🖜 🖝 -
					C/lan /	lan	4/14.1447
					Authorized Representative Signature		••
		DTV I			Seorge Grimm Name of Person Sealing Well or Boring		
PAPERS-WELLOW	WITH PROPE NNER COPY	HTY H	103.	366	the contract of the country want of boining		
HE-01434-02					1		10/958

WELL OR BORING	LOCATION					esota Well and Boring ing No.	H 103367				
County Name	44-4		WEL	L AND BOH Minnesota	ING SEALING RECORD Statutes. Chapter 1031	Minn or W	esota Unique No. -series No.		<u> </u>		
Yellow me	Towashin No	Danga Na	Contine Ma	Fraction (sm -> id)	Date Sealed	Leave	aave olank if not known:				
Normania	114	41	24	W 14 SW. DW.	5/23/1997		5/22/1	997			
Numerical Street Add	ress or Fire Numb	er and City	of Well or Bo	ring Location	Depth Before Sealing	+ C	Driginal Depth 200				
Show exact location of	of well or boring		Sketch	map of well or boring	AQUIFER(S)	s	TATIC WATER LEVEL				
In section grid with X			location lines, ro	ads, and buildings.	WELL/BORING		🗌 Maasured 🛛 Estima	ited			
+-+-+-+					Env. Bore Hale Char		t 🖸 5	elow 🗌 above .	and surface		
w	E				CASING TYPE(S)					·····	
					Steel Plastic Tile Other	NONE	ζ				
	······································	e 、			CASING						
L L L L L					Diameter Depth		Set in oversize hol	e? Annua	ar space in:	ally grouted?	
1 mi	ile His				in. from to	ft.	Yes h	io <u> </u>	U NC	Unknown	
PROPERTY OWNER	'S NAME				in from to	ft.	🗌 Yes 🗌 N	lo 🗌 Yes	🗋 No	🗍 Unknown	
Property owner's mailin	g address if differen	t than well lo	cation address	indicated above.	in. from to	ft.	🗌 Yes 🗌 N	lo 🗌 Yes	🗌 No	Unknown	
					SCREEN/OPEN HOLE						
					Screen from NONE to	ft. (Open Hole from	to	ft.		
				·····	OBSTRUCTION/DEBRIS/FILL		······				
WELL OWNER'S NAM	ME				Obstruction Debris Fill	No Obstr	ruction				
Weil owner's mailing ad	dress if different that	in property o	wner's address	indicated above.	Type of Obstruction/Debris/Fill						
500 Lafay	ette RD				Obstruction/Debris/Fill removed?	<u> </u>	No				
St Paul,	MN 5515	5		-	PUMP						
					Type						
GEOLOGICAL MA	TERIAL C	OLOR	FORMATIC	ON FROM TO	METHOD USED TO SEAL ANNULAR SPAC	CE BET	WEEN 2 CASINGS. OR C	ASING AND BOR	E HOLE:		
f not known, indicate es	stimated formation k	og trom near	by well or borin	ig.	No Annular Space Exits		·····,···				
Log attac	hed				Annular space grouted with tremie pipe						
					Casing Perforation/Removal						
					in. from	to	ft.	Periora	ted 🗌	Removed	
					in. from	to	ft.	Perfora	ted	Removed	
					Type of perforator		·				
					C Other						
					GROUTING MATERIAL(S)						
					Grouting Material Deat compat	from	200 to 2	ft 	yards	bags	
						_ from .	to	ft	yards	bags	
<u> </u>						_ from .	to	ft	yards	bags	
						from	to	ft	19175	hade	
		A 1 1 1 1 1 1 1 1 1 1							ru: 17	uays	
IEMARKS, SOURCE	E OF DATA, DIFFI	CULTIES I	N SEALING		UNSEALED WELLS AND BORINGS	□ v~					
81-	2				LICENSED OR REGISTERED CONTRACTO	OR CER	TIFICATION	······			
					This well or boring was sealed in accordance true to the best of my knowledge.	e with Mi	innesota Rules, Chapter 4	725. The informati	or ,a -	res report is	
					ITP Entornation	. T	-		(5.86	
					Contractor Business Name		6	License or	Registran	`•	
				,	$ _{n}$	/	les-		9/10	(1997	
		-			Authorized Representative Signature	\sim		i	lare Gare		
MPORTANT-FILE	уль рафреат		. ^	1007	Name of Person Sealing Well or Boring						
APERS-WELL CA	MERICOPY	П		<i>⇒</i> 011						10/95P	
HE-01434-02										10/apH	

Count: Name WELL AND DOMINGUES LACLING INCOMP Minnesota Unique No. Image: No. Ye11ow Medicine Township No. Range No. Section No. Fraction (sm. + ip) Date Sealed Date Well or Bong Constructed Sandnes 114 40 21 se 'see 'ne + ' 5/29/1997 Date Sealed Date Well or Bong Constructed Sandnes 114 40 21 se 'see 'ne + ' 5/29/1997 Onginal Depti Signe Adults ''umerical Street Address or Fire Number and City of Well or Bong Location Depti Before Sealing 220 tt Onginal Depti 220 * Strick Asset: tocatic of well or boring Steatch map of well or boring Single Adulfer Multiaculfer Multiaculfer Multiaculfer Multiaculfer Multiaculfer Multiaculfer Measured Estimated ''umerical Street Address of offerent than well location address indicated above. Single Adulfer Other Mont. Well Mont. Well ''umerical Street Name - - - - - - - - - - - - - - - - - - -	land surface
Township Nome Range No. Range No. Saction No. Fraction (sm. → lg.) Date Sealed Date Well or Boring Constructed Sandness 114 40 21 # 4 # 5 * 10 * 10 * 10 * 10 * 10 * 10 * 10 *	land surface
Sandnes 114 40 21 set 'se 'ne ' 5/29/1997 5/27/1997 "umencal Street Address or Fire Number and City of Well or Boring Location Depth Before Sealing 220 tr original Depth 220 r Shite Mark Address or Fire Number and City of Well or Boring in set Address of Well or Boring in set Address of Well or Boring in set Address and Buildings AQUIFER(S) STATIC WATER LEVEL STATIC WATER LEVEL N Sketch map of well or boring in set Address and Buildings Multiaquifer Multiaquifer Measured Estimated N Well BORING Well BORING Well BORING Measured Estimated Well BORING Well BORING Well BORING Measured Estimated Well BORING Well BORING Measured Estimated Depth Set in Oversize hole? Annu Well BORING Inform to ft Yes No Yes PROPERTY OWNER'S NAME Inform to ft Yes No Yes Struction/Debries Name Sone Enclose Inform to ft Yes No Yes Structory Owner's making address if different than well location	land surface
**Lumerical Street Address of Fire Number and City of Well or Boring Location Depth Before Sealing 220 to orginal Depth 220 results of conginal Depth 220 results of well or boring location. showing property lines, roads, and buildings. Static map of well or boring location. showing property lines, roads, and buildings. N Static map of well or boring location. showing property lines, roads, and buildings. Static map of well or boring location. showing property lines, roads, and buildings. Static Matter Level. N VELLBORING Measured Estimated WELLBORING Measured Estimated WELLBORING Steel Plastic Tile Other Mont. Well CASING TYPE(S) Steel Plastic Tile Other N Steel Plastic Tile Other N In mile Casing Diameter Depth et in oversize hole? Anul PROPERTY OWNER'S NAME In. from to ft. Yes No Yes Scheer Nourie's making address if different than well location address indicated above. In. from to ft. Yes No Well COWNER'S NAME Obstruction/Debris/Fill Obstruction/Debris/Fill Obstruction/Debris/Fill <	land surface
Steich map of well or borning in service syst: tocation of the system of the syste	land surface
Ines, roads, and buildings. WELLBORING Measured Estimated Well_BORING Monit. Well Measured Estimated Well_BORING Monit. Well Monit. Well Well_BORING Monit. Well Measured Estimated Well_BORING Casing TYPE(s) Stell Casing TYPE(s) Stell Plastic Tile Other MONTE Mainteet Depth Set in oversize hole? Annu In. from to ft. Yes No Yes PROPERTY OWNER'S NAME In. from to ft. Yes No Yes Proceny cover's making address if different than well location address indicated above. ScreenvoPen HoLe Screen from MONTE No Yes Screen from MONTE To ft. Open Hole from to To Well cowner's making address if different than property owner's address indicated above. Obstruction/Debris/Fill Obstruction/Debris/Fill Obstruction/Debris/Fill Well cowner's making address if different than property owner's address indicated above. Obstruction/Debris/Fill No Pup Sto Daff ayette kd.	land surface
Weil: OWNER'S NAME CASING TYPE(S) PROPERTY OWNER'S NAME Set in oversize hole? PROPERTY OWNER'S NAME in. from PROPERTY OWNER'S NAME in. from Property owner's mailing address if different than well location address indicated above. in. from Screen from NONE Screen from NONE Well: OWNER'S NAME in. from Property owner's mailing address if different than well location address indicated above. in. from Screen from NONE Screen from NONE Obstruction (Debris/Fill) Obstruction Obstruction/Debris/Fill Obstruction/Debris/Fill Obstruction/Debris/Fill Obstruction/Debris/Fill GEOLOGICAL MATERIAL COLOR HARDNESS OF FROM TO Removed Not Present Other	land surface
W S S Steel Plastic Tile Other NONSE PROPERTY OWNER'S NAME	ialar space initially grouted?
Steel Plastic Tile Other NONE S CASING Diameter Depth Set in oversize hole? Annu	alar space initially grouted?
S CASING Diameter Depth Set in oversize hole? Annu.	alar space initially grouted?
S	ft.
PROPERTY OWNER'S NAME Protery owner's mailing address if different than well location address indicated above. In. from	[www.
	ft.
SCREEN/OPEN HOLE Screen from NONE toft. Open Hole fromto OBSTRUCTION/DEBRIS/FILL OBSTRUCTION/DEBRIS/FILL Minnesota DNR Nell owner's mailing address if different than property owner's address indicated above. 500 Lafayette Rd. St. Paul, MN 55155 GEOLOGICAL MATERIAL COLOR HARDNESS OF FROM TO To	ft.
Screen from NORE toft. Open Hole fromto WELL OWNER'S NAME Minnesota DNR Neil owner's mailing address if different than property owner's address indicated above. 500 Lafayette Rd. St. Paul, MN 55155 GEOLOGICAL MATERIAL COLOR HARDNESS OF FROM TO Removed Not Present Other	ft.
WELL OWNER'S NAME OBSTRUCTION/DEBRIS/FILL Minnesota DNR □ Obstruction □ Debris □ Fill No Obstruction Yell owner's mailing address if different than property owner's address indicated above. Type of Obstruction/Debris/Fill	
Minnesota DNR I occurs I occu	
500 Lafayette Rd. Obstruction/Debris/Fill removed? Yes No St. Paul, MN 55155 PUMP Type NONE GEOLOGICAL MATERIAL COLOR HARDNESS OF FROM TO Removed Not Present Other	
St. Paul, MN 55155 PUMP Type NONE GEOLOGICAL MATERIAL COLOR HARDNESS OF FORMATION FROM TO Removed Not Present Other	
GEOLOGICAL MATERIAL COLOR HARDNESS OF FROM TO Removed Not Present Other	
GEOLOGICAL MATERIAL COLOR HARDNESS OF FROM TO HINTONY IN TO HINTONY INTO HINTONY IN TO HINTONY IN TA HINTONY INTO HINTO HINTONY INTO HINTYYYYYYYYYY	
f not known, indicate estimated formation ion from nearby well or borgan METHOD USED TO SEAL ANNULAR SPACE BETWEEN 2 CASINGS, OR CASING AND BO	RE HOLE:
Casing Perforation/Removal	
in. from ft.	rated 🗌 Removed
in. from to ft.	rated 🗌 Removed
	· · · · · · · · · · · · · · · · · · ·
Grouting Material Nest cement from 220 to 2 ft. 2.5	yards bags
from to ft	yards bags
from to ft	yards bags
from to ft	yardsbags
REMARKS, SOURCE OF DATA, DIFFICULTIES IN SEALING UNSEALED WELLS AND BORINGS	
87-3 Other unsealed well or boring on property? Yes No LICENSED OR REGISTERED CONTRACTOR CERTIFICATION	
This well or boring was sealed in accordance with Minnesota Rules, Chapter 4725. The informative to the best of my knowledge.	ation contained in this report
L.T.F. Enterprises inc.	or Registration No
Authorized Representative Signature	9/10/1997 Date
MPORTANT-FILE WITH PROPERTY H 02368	

WELL OR BORING LOC	ATION		WELL	MINNESOT	ta de ORI	PARTMENT OF HEALTH	Mir Sei	nnesota Well and Boring aling No.	н 103371		
Yellow Med	icine			Minnes	sota S	tatutes. Chapter 103I	Or \ /Lea	W-series No. Weblank if not known?			
Township Name Tow	vnship No. 114	Range No.	Section No. 24	Fraction (sm. →	> lg.) 8€4	Date Sealed 6/3/1997		Date Well or Boring Constructe 6/3/1997	d		
Numerical Street Address	or Fire Numb	per and City	of Well or Bori	ng Location		Depth Before Sealing	tt.	Original Dectn217			
Show exact location of well in section grid with "X". N	l or boring		Sketch n location, lines, roa	showing prop showing prop ds, and building	oring perty igs.	AQUIFER(\$) Single Aquifer Multiaquifer WEL/BORING Water Supply Well Monit, Well TEnv. Bore Hole Other		Measured Costimated	C abuve land surface		
w	E				ļ	CASING TYPE(S)	i	NP			
		ile				🗍 Steel 🔲 Plastic 📄 Tile 📋 Other	NU		·		
S 1 mile						CASING Diameter Depth	ft.	Set in oversize hole?	Annualar space extractly grouted?		
I PROPERTY OWNER'S NA				· · ·		in. from to	ft.	🗌 Yes 🗌 No	🗌 Yes 🗌 No 🗍 Unknown		
Property owner's mailing add	ress if differer	nt than well ic	ocation address	ndicated above.		in. from to	ft.	🗌 Yes 🔲 No	🗌 Yes 📃 No 🗍 Unknown		
	~				ł	SCREEN/OPEN HOLE					
						Screen from NONE to to	ft.	Open Hole from	_ to ft.		
WELL OWNER'S NAME		<u> </u>					No Obs	struction			
Minnesota I Well owner's mailing address	if different that	an property o	wner's address	ndicated above.		Type of Obstruction/Debris/Fill	10 00.				
500 Lafavet	te Rd					Obstruction/Debris/Fill removed?		No			
St. Paul,	MN 55	155			F	PUMP					
						Type NONE					
GEOLOGICAL MATERI	AL C	OLOR	FORMATION	FROM T		METHOD USED TO SEAL ANNULAR SPAC	CE BE	TWEEN 2 CASINGS, OR CASI	NG AND BORE HOLE:		
Log attache	d					No Annular Space Exits Annular space grouted with tremie pipe Casing Perforation/Removal					
					_	In. from	_ to _	ft.	Perforated C Removed		
						in. from	to _		Perforated Removed		
						Type of perforator			·		
						Other					
					ľ	GROUTING MATERIAL(S)					
				_		Grouting Material	from	217 to _2 ft	. yards bags		
]		from	to ft	yards bags		
· · · · · · · · · · · · · · · · · · ·					-		from	to ft	yards bags		
							. from	to ff	t vards baos		
REMARKS, SOURCE OF	DATA, DIFF	ICULTIES I	N SEALING			UNSEALED WELLS AND BORINGS					
87-4						Other unsealed well or boring on property? LICENSED OR REGISTERED CONTRACTO					
						This welf or boring was sealed in accordance true to the best of my knowledge.	with N	Minnesota Rules, Chapter 4725.	The information contained in this report is		
						L.T.P. Enterprises	In	<u>c.</u>	Linner of Barrier Ma		
									License of Hegistranion, vo		
				:		Authonzed Representative Signature	-6	Kue-			
· · · · · · · · · · · · · · · · · · ·	and the state of the	<u> </u>				George Grimm					
MPORTANT-FILE WITH PAPERS-WELL OWNER HE-01434-02	PROPERT COPY	[∨] H	100	371		name or resort Sealing well of boring			10/95R		

WELL OR BORING LOCATIO	N				Minnesota Well and Boring Sealing No.	H 103370
County Name	-	WELL	AIND BU Minnesol		Minnesota Unique No. or W-series No.	
Township Name Townshi	DE ip No. Range No	. Section No. Fra	ction (sm. → I	.) Date Sealed	Date Well or Boring Constructe	ed
Posen 11.	3 39	2 n.	* se 1	6/2/1997	5/30/1997	1
Numerical Street Address or Fi	re Number and Cit	y of Well or Boring	Location	Depth Before Sealing	ft. Original Depth180	(t
Show exact location of well or b	oring	Sketch map	of well or born		STATIC WATER LEVEL	
N		lines, roads	and buildings.	WELL/BORING	Measured Estimated	
			-	🔲 Water Supply Well 🔲 Monit. Well		
	-			Env. Bore Hole Other	ft. 🗌 below	above land surface
w			•	CASING TYPE(S)		
			ы. ^{на}	Steel Plastic Tile Other	NONE	
	i mile			CASING		
	±			Diameter Depth	Set in oversize hole?	Annualar space initially grouted?
1 mile	- it a			in. from to	ft. 🗌 Yes 🗌 No	🗌 Yes 🛄 🦢 La hown
PROPERTY OWNER'S NAME				in. from to	ft. 🗌 Yes 🗌 No	Yes
Property owner's mailing address	if different than well	iocation address indi	cated above.	in. from to	ft. 🗌 Yes 🗌 No	Yes Errown
2				SCREEN/OPEN HOLE		
					A	· · ·
				Screen from to	tt. Open Hole from	
WELL OWNER'S NAME					Obstruction	
Minnesota DN	8				Obstruction	
Well owner's mailing address if dif	ferent than property	owner's address indi	cated above.	Type of Obstruction/Debris/Fill		
500 Lafayette	Rd.			Obstruction/Debris/Fill removed? Yes	No	
St. Paul, M	55155			PUMP		
		T				
GEOLOGICAL MATERIAL	COLOR	FORMATION	FROM TO		BETWEEN 2 CASINGS OF CASI	
If not known, indicate estimated fo	rmation log from nea	arby well or boring.		XNO Angular Space Exits	BETWEEN 2 CASINGS, ON CASI	
Log attached				Annular space grouted with tremie pipe		
_				Casing Perforation/Removal		
				in. from	to ft.	Perforated Bemoved
						Defended C Comment
		+		in. irom	to ft.	
	+	ļ		Type of perforator		
				Other		
				GROUTING MATERIAL(S)		
				-		
				Grouting Material Neat chepat	rom 180 to 2	t. 1.75 yards bags
· · · · · · · · · · · · · · · · · · ·					rom to t	t yards bags
						• uordo
					IUIII IO 1	u yaros bags
					from to	ft yards bags
REMARKS, SOURCE OF DAT	A, DIFFICULTIES	IN SEALING		UNSEALED WELLS AND BORINGS		
87-5				Other unsealed well or boring on property?	Yes XX No	
Ū				LICENSED OR REGISTERED CONTRACTOR	CERTIFICATION	
				This well or boring was sealed in accordance w true to the best of my knowledge.	ith Minnesota Rules, Chapter 4725	. The information contained in this report is
				T M D Determine T		4168L
				Contractor Business Name		License or Registration No
				1011-1	10.	9/10/1997
				Autrorized Representative Signature	Kelen-	Daie
· .						
		Autoria		Ceorge Grimm		
MPORTANT-FILE WITH PR	CPERT / H	103	370	Hame of Ferson Sealing Well of Boring		
HE-01434-02				L		10/958

WELL OR BORING LOCATION County Name Yellow Medicine		MINNESOTA WELL AND BO Minnesot	A DEPARTMENT OF HEALTH DRING SEALING RECORD Data Statutes, Chapter 1031 Minnesota Unique No. or W-series No. Leave black if not knowe
Township Name Township No. Besidnes 113	Range No. 39	Section No. Fraction (sm. → lo 3 av ac av	Ig.) Date Sealed Date Well or Comag Constructed 5/29/1997 5/29/1997
Numerical Street Address or Fire Numb	per and City o	of Weil or Boring Location	Depth Before Sealing 220ft Orginal Dentr 220ft.
Show exact location of well or boring in section grid with "X"		Sketch map of well or bori location, showing proper lines, roads, and buildings.	Ing AQUIFER(S) STATIC WATER LEVEL ITY Single AquiferMutilaquifer Mutilaquifer MeasuredEutimatedMeasuredEutimated Measured EutimatedMeasured ft belowscove and surface CASING TYRE(S)
	le		CASING THE(S) Steel Plastic Tile Other NONE CASING Diameter Depth Set in oversize hole? Annualar space initially grouted?
PROPERTY OWNER'S NAME		<u> </u>	in. from to ft.
Property owner's mailing address if differen	nt than well loc	ation address indicated above.	in. fromtott. Yes No Yes No Unknown SCREEN/OPEN HOLE Screen from NONE toft. Open Hole fromtoft.
VELL OWNER'S NAME <u>Minnesote DNR</u> Neil owner's mailing address if different tha	an property ow	ner's address indicated above.	OBSTRUCTION/DEBRIS/FILL
500 Lafayette Rd St. Paul, MN 5	5155		Obstruction/Debris/Fill removed? Yes No PUMP Type
	OLOR	FORMATION FROM TO	Removed Not Present Other Method USED TO SEAL ANNULAR SPACE BETWEEN 2 CASINGS OR CASING AND BORE HOLE
Log attached			No Annular Space Exits Annular space grouted with tremie pipe Casing Perforation/Removal
			GROUTING MATERIAL(S) Grouting Material Nest cement from to to bags
			trom to ft bags
87-6			Other unsealed well or boring on property? Yes LICENSED OR REGISTERED CONTRACTOR CERTIFICATION This well or boring was sealed in accordance with Minnesota Rules, Chapter 4725. The information • rs report is true to the best of my knowledge.
		* *	Authonized Representative Signature
MPORTANT-FILE WITH PROPERT 34PERS-WELL OWNER DOP / HE-01434-02	H	103389	Ceorge Crimm Name of Person Sealing Well or Boring

		1 N	INNESOTA D	DEPARTMENT OF HEALTH Minnescta Well and Boring				
County Name	.	WELL	AND BOR	RING SEALING RECORD Sealing No. H JU3373				
County Mame			Minnesota	Statutes, Chapter 103I or W-series No.				
Lyon				(Leave blank if not known)				
Township Name Township	No. Range No.	Section No. Fra	iction (sm> lg.)	Date Sealed Date Weli or Boring Constructed				
Island Lake 11	1 43	27 IN	¹⁴ DW ¹⁴ SW ¹⁴	<u>7/11/1997</u> 7/2/1997				
Numerical Street Address or Fire	Number and City	of Well or Boring	Location	Depth Before Sealingft Original Depthtttt.				
Show exact location of well or bo	oring	Sketch map	of well or boring	AQUIFER(S) STATIC WATER LEVEL				
in section grid with X.		lines, roads	and buildings.					
	7							
	-1			The N. Bore Hole Other				
wl								
2-+				Steel Plastic Tile Other NONE				
				CASING				
	±			Diameter Depth Set in oversize hole? Annualar space initially grouted?				
1 mile	- Ans			in, from to ft. 🔲 Yes 🛄 No . 📄 Yes 🚍 the Coll Unknown				
PROPERTY OWNER'S NAME				in, from to ft. 📋 Yes 🛄 No 📄 Yea 🗔 No 🗔 Unknown				
Property owner's mailing address if	different than well in	ocation address indi	cated above.	in, from to ft. Yes No Yes No Unknown				
				SCREEN/OPEN HOLE				
				Screen from to ft. Open Hole from to ft.				
				OBSTRUCTION/DEBRIS/FILL				
WELL OWNER'S NAME				Obstruction Fill Fill No Obstruction				
Minnesota DNR	vant than oranget a	wanda address undi	cated above					
well owners making address in dire	sen nan propeny c	wher's address indi	caled above.	l ype of Obstruction/Debris/Fill				
500 Lafayette	Rd.			Obstruction/Debris/Fill removed? Yes No				
St. Paul, MN	55155			PUMP				
				TypeNONE				
GEOLOGICAL MATERIAL	COLOR	HARDNESS OF	FROM TO	Removed Not Present Other				
If not known, indicate estimated form	nation log from near	by well or boring.		METHOD USED TO SEAL ANNULAR SPACE BETWEEN 2 CASINGS, OR CASING AND BORE HOLE				
				So Annular Space Exits				
Log attached				Annular space grouted with tremie pipe				
	ļ			Casing Perforation/Removal				
				in. from to ft.				
	+							
			·	Type of perforator				
				Other				
······································	/							
	ļ			Grouting Material Neat coment from 539 to ft yards bags				
				from to ft yards bags				
				from to ft var bags				
	·			4				
				trom to ft vart bags				
REMARKS, SOURCE OF DATA	, DIFFICULTIES	IN SEALING		UNSEALED WELLS AND BORINGS				
47-1		~		Other unsealed well or boring on property? 🗋 Yes 💂 No				
. 2 .				LICENSED OR REGISTERED CONTRACTOR CERTIFICATION				
				This well or boring was sealed in accordance with Minnesota Rules, Chapter 4725. The information and a construction of the report is				
				true to the best of my knowledge.				
*				L.T.P. Enterprises Inc.				
				Contractor Business Name				
				Les Chier riviger				
				Authonzed Hepresentative Signature				
	p===	0 1 2		Name of Person Sealing Well or Bonng				
PAPERS-WELL DANER COP	, H	113.	5/3					
HE-01434-02				10/95A				

		da metaji za z	MINNESOTA D	EPARTMENT OF HEALTH Minnesota Well and Boring
County Name		WELL	AND BOR	ING SEALING RECORD Sealing No. H 103372
1 700			Minnesota	Statutes, Chapter 103I or W-series No.
Township Name Township	No. Range No.	Section No. Fra	action (sm> Ig.)	Date Sealed Date Well or Boring Constructed
reland Lake 111	43	27	4 co %ne *	6/6/1997 6/4/1997
Numerical Street Address or Fire	Number and City	of Well or Boring	Location	0/0/1337
				Depth Before Sealingft. Original Depthit.
Show exact location of well or bor	ring	Sketchanar	of well or boring	AQUIFER(S) STATIC WATER LEVEL
in section grid with TX .		location, si lines, roads	, and buildings.	Single Aquifer Multiaquifer
N	Ţ			Water Supply Well Monit Well
╞╌┯╌┿╌╅╌╅╌╅╴╅╴╅╴	┥ ┥			Env. Bore Hole 🗌 Other ft. 🗌 below 🔲 above land surface
w	E			CASING TYPE(S)
	*			
	i mile	· • •		
				Diameter Depth Set in oversize hole? Annualar space initially prouted?
S 1 mile	*.			In. from to ft.
0000000/0000				
PHOPERTY OWNER'S NAME				
Property owner's mailing address if o	different than well l	ocation address indi	cated above.	in. from to ft.
				SCREEN/OPEN HOLE
				Screen from to ft. Open Hole from to ft.
				OBSTRUCTION/DEBRIS/FILL
WELL OWNER'S NAME	······································			🗌 Obstruction 🔲 Debris 🛄 Fill 👿 No Obstruction
Minnesota DNR Well owner's mailing address if differ	ent than property of	wner's address indi	cated above.	Type of Obstruction/Debra/Fill
500 Larayette I	KG.			Obstruction/Debris/Fill removed? Yes No
St. Paul, MN	22722	•		
		HAPPNESS OF		
GEOLOGICAL MATERIAL	COLOR	FORMATION	FROM TO	
If not known, indicate estimated form:	ation log from nea	rby well or boring.		
Log attached				Annular space grouted with tremie pipe
_				Casing Perforation/Removal
				in from to ft Perforated Bemoved
				in. from to ft.
				Type of perforator
	,			Grouting Material Neat cenent from 519 to ft. 44 yards bags
				vards bags
				from to ft yards bags
				from to ft yards bags
A A A	DIFFICULTIES	IN JEALING		
42-2				
				This well or botton was sealed in accordance with Minnesota Bulas. Chapter 4725. The information starts out to this report is
				true to the best of my knowledge.
-				LTP Entoneting Inc
				Lolor Contractor Business Name License or Registration No
				la fland flan erintiger
				Authonized Hepresentative Signature
				George Grimm
MPORTANT-FILE WITH PROF		1001		Name of Person Sealing Well or Boring
PAPERS-WELL OWNER COPY	<u> </u>	103.	512	
HE-01434-02				10/95R

WELL OR BORING L County Name PIPestone			WELL	MINNESOTA D AND BOR Minnesota	EPARTMENT OF HEALTH Mir ING SEALING RECORD Statutes, Chapter 1031	nesota Well and Boring Iling No. nesota Unique No. V-series No. e blank if not known)	н 103376		
Township Name	Township No.	Range No.	Section No. F	raction (sm> Ig.)	Date Sealed	Date Well or Boring Constructe	d		
Grange	107	45	7	88 2W 5W	7/24/1997	7/23/1997	· · · · · · · · · · · · · · · · · · ·		
Numerical Street Addr	ess or Fire Num	ber and City	of Well or Borin	Į Location	Depth Before Sealingft.	Original Depth			
Show exact location o in section grid with "X"	f well or boring		Sketch ma location,	p of well or boring showing property	AQUIFER(S)	STATIC WATER LEVEL			
N			lines, road	s, and buildings.	WELL/BORING	Measured Estimated			
					Water Supply Well Monit. Well	t 🗌 bolew			
	-+-+-+								
		nie					· · · · · · · · · · · · · · · · · · ·		
					Diameter Depth	Set in oversize hole?	Annualar space initially grouted?		
S Ma 1 mil	e ¥e				in. from to ft.	🗋 Yes 🗌 No	🗋 Yes 🔚 🐂 🗍 Uninown		
PROPERTY OWNER	SNAME				in. from to ft.	🗌 Yes 🗌 No	Yes 🔄 town		
Property owner's mailing	address if differen	ot than wall !-	cation address	licated above	in from to "		Yes C : aknown		
, openy owner's mailing	y audress in uniere	ni indri well (C	oation address In	nualeu abuve.					
					Sereen to 4		to the		
					OBSTRUCTION/DEBRIS/FILL		. w II.		
WELL OWNER'S NAM	ЛЕ				Obstruction Debris Fill No Obs	struction	:		
Minnesota Well owner's mailing add	DNR dress if different th	an property o	wner's address in	icated above.	Type of Obstruction/Debris/Fill				
500 T afam	atta Dd					No			
St. Paul.	MN 55	155			PUMP				
				•	Type NONE				
GEOLOGICAL MAT		COLOR	HARDNESS O	FROM TO	Removed Not Present Other				
If not known, indicate est	timated formation	log from near	by well or boring.	·J	METHOD USED TO SEAL ANNULAR SPACE BET	TWEEN 2 CASINGS, OR CASI	NG AND BORE HOLE:		
Log attac	hed				No Annular Space Exits Annular space grouted with tremie pipe				
					Casing Perforation/Removal				
					in. from to to	ft.	Perforated Removed		
					in from to	#			
						n.			
· · · · · · · · · · · · · · · · · · ·					Type of perforator				
					Other				
					GROUTING MATERIAL(S)				
					Grouting Material _Neat_compate from	143 to 2 tt	yards bags		
					trom	ππ	yarus Dags		
					from	to ft	yards bags		
				<u>}</u>	from	to fi	t yards bags		
REMARKS, SOURCE	OF DATA, DIFF	ICULTIES I	N SEALING	<u>I</u>	UNSEALED WELLS AND BORINGS				
59-1					Other unsealed well or boring on property?	es XXNo			
	L .				LICENSED OR REGISTERED CONTRACTOR CEI	RTIFICATION			
					This well or boring was sealed in accordance with N true to the best of my knowledge.	linnesota Rules, Chapter 4725.	The information contained in this report is		
					L.T.P. Enterprises Inc	•	71686		
۰.					Contractor Business Name		License or Registration No.		
	•				C/a-1	Dur-	9/10/1997		
					Authorized Representative Signature		Dare		
					George Grimm				
IMPORTANT-FILE W		ry H	03	376	Name of Person Sealing Well or Boring				
HE-01434-02	NEH COPY		الية المرة عند. 				10/95 F		

			1	MINNESOTA D	EPARTMENT OF HE	ALTH	Mir	nesota Well and Boring	
WELL OR BORING L	OCATION		WELL	AND BOR	ING SEALING	RECORD	Se	aling No.	H 103374
				Minnesota	Statutes Chapter 102			nnesota Unique No.	
Pipestone			1			<i></i>	Ur (Lea	vv-Series NO. Ive blank if not known)	
Township Name	Township No.	Range No.	Section No. Fr	action (sm> Ig.)	Date Sealed		_	Date Well or Boring Construct	ed
GTADES	107	45	10 🖬	* DN * D& *	7/21/1	997		7/14/	1997
Numerical Street Addre	ess or Fire Num	ber and City	of Well or Boring	Location					
					Depth Before Sealing _	295	ft.	Original Depth295	
show exact location of	well or boring		Sketch ma	p of well of boring	AQUIFER(S)			STATIC WATER LEVEL	
in section grid with "X".			location, s	showing property	🗌 Single Aquifer 📋	Multiaquifer			
N					WELL/BORING			🗌 Measured 🛄 Estimated	1
┟╍┿╍┿╍┿╸┽┓	C				Water Supply Well	Monit. Well		_	
					Env. Bore Hole	Other		ft. Delov	w above land surface
w	Ε				CASING TYPE(S)			· · · · · · · · · · · · · · · · · · ·	
					Steel Plastic I		NON	TR	
		nile							
┝╍┿╍┿╍┿╍	·++				Diamotor	Dopth		Sou in oversize hele?	
, S	╶┶╼╼┶╼╼┙╶┸╴ ╵				Diameter	Depth		Set in oversize hole?	Annualar space initially grouted?
% 1 mile	• it ie				in. from	to	ft.	Yes No	
ROPERTY OWNER'S	S NAME				in. from	to	ft.	🗌 Yes 🗌 No	Yes Sown
roperty owner's mailing	address if differe	ent than well id	ocation address inc	licated above.	in. from	to	ft.	Yes No	Yes
					SCREEN/OPEN HOLE				anna 1996 an ann an Aonaichte ann an Aonaic Anna 1996 ann an Aonaichte
					NO!	re _{io}	4	Open Hole from	to #
							n.		_ w n.
					OBSTRUCTION/DEBR	IS/FILL			
Vell Owner 5 nam	<u>רא</u> ת				Obstruction)ebris 🗌 Fill 🙀 I	No Ob	struction	
ell owner's mailing add	ress if different th	an property o	wner's address inc	licated above.	Type of Obstruction/De	ebris/Fill			
			ς.	-					
JUU LELAY	NOT EET	•			Obstruction/Debris/Fill	removed?		N0	
St. Paul,	MM 33	122	4*		PUMP				
					Type NONK				
GEOLOGICAL MAT	ERIAL	COLOR	HARDNESS OF	FROM TO	Removed N	ot Present 🗌 Oth	er		
not known, indicate est	imated formation	log from near	by well or boring.	LI	METHOD USED TO SE	AL ANNULAR SPAC	CE BE	TWEEN 2 CASINGS, OR CAS	ING AND BORE HOLE:
		<u> </u>	, <u> </u>		X No Annular Space	Exits			
Log attach	1ed				Annular space grou	uted with tremie pipe			
					Casing Perforation	/Removal			
					1-	(
					m.		to	π.	
					in.	from	to	ft.	Perforated — Pernoved
				<u> </u>					
					Type of perforator			·	
					□ `Other				
· · · · · · · · · · · · · · · · · · ·						(0)			
				<u>├</u>	GROUTING MATERIA	L(3)			
	-				Grouting Material 37		600-	205 10 2	4 21
					Grouing material	rat cement	100	· - 47] ··	varits bags
			[<u>├</u>			. from	to	ft yaras bags
						<u></u>	. from	to	ft bags
				+			from	n to	ft. varas bage
EMARKS, SOURCE	OF DATA, DIF	FICULTIES I	N SEALING		UNSEALED WELLS A	ND BORINGS			
56-7					Other unsealed well or	boring on property?	ΠY	es 🙀 No	
<u> </u>	-				LICENSED OR REGIS	TERED CONTRACTO	OR CE	RTIFICATION	
					This well or borno was	sealed in accordance	a with	Minnecota Bules, Chapter 4725	The information of the multiple states report is
					true to the best of my k	nowiedge.			
					_	-			a
					L.T.P. E	nterprises	Ir	16 <u> </u>	6
					Contractor Business N			<u> </u>	License or Response to
			· · ·			/ -	/	1.	-
					Authorized Berreser	The Signature	5	Klein	2/10/1997
					Autonzeu nepresente	are signature			
					-				
PODTANT CUC		TV]		ം ച	Name of Person Sealing	ng Well or Boring			
APERS-WELLOW	VEB COPY	• H -	103	3/4					
E-01434-02					L				10/955
									,0/331

	OCATION				EPARTMENT OF HEALTH Minnesota Well and Boring H 103375			
County Name VYELL AND BORI Minnesota S					ING SEALING RECORD Statutes, Chapter 103/ Minnesota Unique No. or W-series No.			
Pipestone	Taurahin Ma	Deservite	Section No. 1 Er	nation (and a la	(Leave blank if not known)			
i ownship Name	i ownsnip ivo.	Hange No.	Section No.	action (sm. → ig.,	Date Sealed Date Well of Boring Constructed			
Grange	107	45	6 5	" SV "SV '	7/22/1997 7/22/1997			
Numerical Street Addre	ess or Fire Num	ber and City	of Well or Boring	Location	Depth Before Sealingft. Original Depth134ft.			
Show exact location of	well or boring		Sketch ma	p of well or boring	AQUIFER(S) STATIC WATER LEVEL			
in section grid with "X".			location. a	nowing property and buildings.	Single Aquifer Multiaquifer			
					Water Supply Well Monit. Well			
· .				,	😰 Env. Bore Hole 🔲 Other ft. 🗋 below 🗍 above land surface			
w	+-+-++_				CASING TYPE(S)			
	T T							
		nile			Steel Plastic Tile Cher NOBB			
┝╍┿╍┿╍┿╍					CASING			
X	╧┷╧┷				Diameter Depth Set in oversize hole? Annualar space initially grouted?			
1.mile					in. from to ft.			
PROPERTY OWNER'S	S NAME				in. from to ft.			
Property owner's mailing	address if differe	nt than well lo	cation address ind	licated above.	In, from to ft.			
					SCREEN/OPEN HOLE			
					NONE			
					Screen from to ft. Open Hole from to ft.			
					OBSTRUCTION/DEBRIS/FILL			
WELL OWNER'S NAM	E							
Well owner's mailing addr	ress it allferent th	an property o	wner's address inc	licated above.	Type of Obstruction/Debris/Fili			
			¢.					
500 Lataye	tte Rd.			1				
St. Paul,	MN 551	55		•				
GEOLOGICAL MAT	ERIAL	COLOR	FORMATION	FROM TO				
If not known, indicate estin	mated formation	log from near	by well or boring.	· · · · · · · · · · · · · · · · · · ·	METHOD USED TO SEAL ANNULAR SPACE BETWEEN 2 CASINGS, OR CASING AND BORE HOLE.			
					Annular Space Exits			
Log accace	80				Casing Perforation/Removal			
					in. from to ft.			
					in. from to ft.			
					Type of perforator			
					Other			
	e				GROUTING MATERIAL(S)			
				<u> </u>	Grouting Material Neat cenent from 134 to 2 ft. 14 .475 bags			
					6			
					irom το π οags			
			<u></u>	<u>† </u>	from to ft bags			
	<u> </u>			<u>├</u>	from to fit is base i			
REMARKS, SOURCE	OF DATA, DIFF	ICULTIES I	N SEALING		UNSEALED WELLS AND BORINGS			
59-3	•				Other unsealed well or boring on property? U Yes 🙀 No			
					LICENSED OR REGISTERED CONTRACTOR CERTIFICATION			
					This well or boring was sealed in accordance with Minnesota Rules, Chapter 4725. The informative of export is true to the best of my knowledge.			
					· · · · · · · · · · · · · · · · · · ·			
					L.R.P. Enterprises Inc			
					(/ m. / / 100)/10/1007			
					Authorized Representative Signature			
					George Grimm			
IMPORTANT-FILE WI	TH PROPER	т н	103	275	Name of Person Sealing Well or Boring			
PAPERS-WELL OWN	IER COPY				10/05R			

			1	MINNESOTA [PARTMENT OF HEALTH	Minr	esota Well and Boring		
WELL OR BORING L	OCATION		WEI		ING SEALING RECORD	Sea	ling No.	H 1033//	
County Name						Minr	Minnesota Unique No.		
Pipestone				wiinnesota	Statutes, Chapter 1031	OF W	e blank if not known)		
Township Name	Township No.	Range No.	Section No	. Fraction (sm> Ig.	Date Sealed	1	Date Well or Boring Constructe	ed	
Trov	107	46	1 2	ne "ne "ny	7/25/1997		7/96/10	997	
Numerical Street Addr	ess or Fire Num	ber and City	of Well or B	oripa Location	172372071		// 64/ 1.		
					Depth Before Sealing 122	ft. (Original Depth122	ft.	
Show exact location of	f well or boring		Sketch	man of well or boring	AQUIEER(S)		STATIC WATER LEVEL		
in section grid with "X"			locatio	n, showing property	Single Aquifer I Multiaguifer	ľ	STATIC WATCH LEVEL		
N			lines,	roads, and buildings.	WELL/BORING		🗌 Measured 🔲 Estimated		
				· ·	🗋 Water Supply Well 📋 Monit. Well				
					TEnv. Bore Hale D Other		ft. 🔲 below	 above and surface 	
	·				CASING TYPE(S)				
w + + + + +	┿┿┥┺								
┝╍┿╍┿╍┿╸	-┽-┽-┥│				Steel Plastic Tile Cother	-NO1	æ		
	% п	ule			CASING			· · · · · · · · · · · · · · · · · · ·	
					Diameter Depth		Set in oversize hole?	Annualar space initially grouted?	
S	a sk				in from to	ft	□ Yes □ No	Yes No Unknown	
1 111									
PROPERTY OWNER	S NAME				in. from to	ft.	🗌 Yes 🗌 No	🗌 Yes 🔲 No 🗍 Unknown	
		<u>.</u>							
Property owner's mailing	address if differe	nt than well ic	ocation addres	ss indicated above.	in. trom to	t.			
					SCREEN/OPEN HOLE				
					Screen from NONTE to	#	Onen Hole from	to #	
						_ 11.			
WELL OWNER'S NAM	NE DITO				Obstruction Debris Fill C	lo Obst	ruction		
Well owner's mailing add	tress if different th	an property o	wner's addre	s indicated above.	Type of Obstruction/Debris/Fill			•	
								· ·	
500 Lifaye	ette Rd.				Obstruction/Debris/Fill removed? Yes		No		
St. Paulm	MN 551	55			PUMP				
				~	Туре				
			HARDNES	S OF	Removed Not Present Other	ər	:		
GEOLOGICAL MAT	TERIAL (COLOR	FORMAT	ON FROM TO	METHOD USED TO SEAL ANNUL AP SPACE	ERET			
If not known, indicate est	timated formation	log from near	by well or bor	ing.	The mode date to seve an ocan space		WEEN 2 CASINGS, ON CASI	AND BORE HOLE.	
Tee etter	ad l				No Annular Space Exits				
Log artaci					Annular space grouted with tremie pipe			u a construction de la construct	
					Casing Perforation/Removal				
					in. from	to	ft.	Perforated C Removed	
					1				
					in. from	_ to _	ft.	Perforated E Removed	
					Time of an dealers				
					Other				
					GROUTING MATERIAL (S)	_			
					Grouting Material Neat coment	from	122 10 2		
								yando	
						from	to f	t yaros bags	
								-	
	. 1	,]	from	to' f	t vards bags	
				·	4	tear	**	ft	
						. nom		ward ward bags	
REMARKS, SOURCE	OF DATA, DIFI	FICULTIES I	N SEALING	<u> </u>	UNSEALED WELLS AND BORINGS			,	
- 0 - A	_				Other unsealed well or boring on property?	🗆 Ye	s 🖵 No		
57-4	ſ				LICENSED OR REGISTERED CONTRACTOR	RCER	TIFICATION		
					I his well or boring was sealed in accordance to the best of my knowledge.	with M	linnesota Rules, Chapter 4725	. The information the et a this report is	
					ITD The second s	T		7122	
					Contractor Business Name	136	-	License or Hangest state at	
						/	1		
					111/0-1		110	9/10/1007	
			· .		Authorized Representative Signature				
					1				
<u> </u>					George Grim				
MPORTANT-FILE A			· C	~ <u>)</u> / /	Name of Person Sealing Well or Boring				
PAPERS-WELL OW	NER COPY	н	3. U	- 5 i					
						_			



Appendix 3 Seismic refraction depth models, Holland Well Field area



Pipestone County Seismic Line GRDD

GRDD Chart

hart



Pipestone County Seismic Line GRDE

GRDE Chart



Pipestone County Seismic Line GRDF


Pipestone County Seismic Line GRDG



Pipestone County Seismic Line GRDH

GRDH Chart



Pipestone County Seismic Line GRDI

GRDI Chart