Wellhead Protection Plan

Part 1

Wellhead Protection Area Delineation
Drinking Water Supply Management Area Delineation
Well and Aquifer Vulnerability Assessments

For the
City of Mayer

Steve Robertson

Yarta Clemens Major

Minnesota Department of Health

March, 2006

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Introduction

This report documents the delineation of the wellhead protection area (WHPA), the drinking water supply management area (DWSMA), and the assessments of well and DWSMA vulnerability for the wells used by the City of Mayer (public water supply identification number 1100006). This work was performed in accordance with Minnesota rules (MR4720.5100 – 4720.5590) for preparing and implementing wellhead protection plans for public water supply wells. The Minnesota Department of Health (MDH) prepared this report at the request of the City of Mayer.

The City of Mayer operates two primary water supply wells (unique nos. 220954 and 655479). The wells are located in section 1 of Township 116 North, Range 26 West in Carver County.

The WHPA for the primary water supply wells was determined using both the WHPA Code (EPA 1991) and the Oneka Model (Barnes & Soule 2002) to simulate groundwater flow toward them. The DWSMA boundaries were determined using the following geographic features that the public can visualize 1) public land survey, and 2) roads. Figure 1 shows the boundaries for the WHPA and the DWSMA.

SOURCE WATER ASSESSMENT

The MDH is required under Section 1453 of the 1996 Amendments to the federal Safe Drinking Water Act to prepare source water assessments for all public water supply systems. Congress intends that assessments should be used to educate the water supplier and its customers about the source of their drinking water and potential contaminants that may affect people's health. The following Source Water Assessment for the City of Mayer contains the information specified in Minnesota's source water assessment program description.

Source Water Assessment for the
City of Mayer

Public Water Supply Id. Number: 1100006

Water Supplier Contact: Ms. Luayn Murphy
(952) 657-1502
City of Mayer
P.O. Box 102
Mayer, Minnesota 55360-0102

MDH Contact: Mr. Terry Bovee
(507) 389-6597
Minnesota Department of Health
Nichols Office Center
410 Jackson Street, Suite 500
Mankato, Minnesota 56001-3752
Terry.bovee@health.state.mn.us

Status of the Source Water Protection Plan –

The Minnesota Department of Health has approved the 1) delineation of the wellhead protection area, 2) delineation of the drinking water supply management area, and 3) assessments of well and aquifer vulnerability. The City of Mayer is proceeding with developing the remainder of its wellhead protection plan.

Source Water Protection Area- See Figure 1.

Description of the Source Water – The water supply for the City of Mayer comes from the Jordan aquifer that exhibits confined hydraulic conditions. The aquifer is about 80 feet thick and is overlain by about 200 feet of clay-rich glacial deposits. Generally, groundwater moves in a southeasterly direction within the wellhead protection area.

Wells Used by the City of Mayer

Well Number	Unique umber	Well Use	Aquifer Type	Well Depth (feet)	Well Sensitivity	Aquifer Sensitivity
Well # 1	220994	Primary	Bedrock	280	Low	Low
Well # 2	655479	Primary	Bedrock	260	Low	Low

Aquifer Sensitivity – The aquifer used by the water supplier is considered to exhibit a low sensitivity to potential contamination sources because 1) it is covered by 200 feet of clay-rich glacial deposits that will likely prevent the vertical movement of contamination from potential sources to the aquifer; and 2) no tritium was detected in the well water, indicating that a low rate of vertical recharge to the aquifer occurs.

Well Construction Assessment - The wells used by the City of Mayer meet current State Well Code construction requirements and maintenance requirements for public water supply wells. These factors do not contribute to the susceptibility of the source water to contamination.

Susceptibility of the Source Water to Contamination - The source water used by the city wells is considered not susceptible to potential sources of contamination.

Contaminants of Concern - The principal means by which contamination may migrate to the aquifer used by the City of Mayer is via other wells that reach or penetrate to the same depth as the city's wells. Land uses around these wells may contribute contaminants that are regulated under the federal Safe Drinking Water Act. A listing of these contaminants is available at http://www.epa.gov/safewater.

Results of Monitoring the Source Water – No contaminants regulated under the federal Safe Drinking Water Act have been detected in the source of drinking water used by the City of Mayer. A water sample collected from city well 1 (Unique no. 220954) on 03/26/2002 contained not detectable tritium using an enriched analytical method. This indicates that the well is pumping water that infiltrated from the land surface to the aquifer before the year 1953.

Description of the Hydrogeologic Setting

Assessment of Data Elements -

This section documents how the data elements specified under MR4720.5400 were used to describe the physical environment. There are no detailed studies available to describe local hydrogeologic conditions. Well record data that is contained in the County Well Index database (Figure 2) were used in generating cross section to give a better understanding of the hydrogeology of the area. Figures 3 and 4 show the distribution of the aquifer and its stratigraphic relationships with adjacent geologic materials. The regional geological maps and studies that were used to further define hydrogeologic conditions in the area are provided in the section of this report entitled Selected References (page 13).

The following data elements identified in MR 4720.5400 do not apply because the aquifer exhibits confined hydraulic conditions:

- Information describing soil conditions;
- Information describing surface water resources;
- Information about land use except parcel, political, or public land survey boundaries used to designate the DWSMA;
- Information about public utility services except that describing the public water supply wells and other wells within the DWSMA;
- Information about surface water quantity; and
- Information about surface water quality.

Local Groundwater Conditions –

In the geographic area that includes the WHPA, the aquifer from which the city wells pump has the following characteristics:

- Is composed of coarse-grained sandstone. It is believed to be about 90 feet thick but only 80 feet is open to each of the city wells.
- Exhibits a porosity that is estimated to be 20%;
- Exhibits a base elevation of 680 feet above sea level;
- Exhibits a stratigraphic top elevation of 770 feet above sea level;

- Does not exhibit changes in composition or thickness that constitute a flow boundary (Figures 3 & 4);

- Is covered by 200 feet of clay-rich geologic materials consisting of glacial deposits and/or bedrock; and

- Overlies the St. Lawrence confining bed that retards the vertical movement of aquifer water to stratigraphically lower aquifer materials.

The ambient flow field in the aquifer is oriented southeast with a hydraulic gradient of .0015 (Figure 5).

The aquifer exhibits confined hydraulic conditions as determined by the following:

1) Isotopic analysis of the aquifer water from city well # 1 (unique number 220954) indicates tritium less than the reporting limit of 0 .8 tritium units using an enriched analytical method. This indicates that the aquifer contains water that receives little direct infiltration from surface water;

2) The aquifer is covered by fine- grained geologic materials that exhibit an "L" score of 5 using the criteria for determining geologic sensitivity as defined by the Minnesota Department of Natural Resources (DNR). An "L" score of 5 or greater indicates that the aquifer is likely to exhibit a high degree of hydraulic separation from surface water; and

3) The water elevations measured in the city wells (920 ft. MSL) is higher than the stratigraphic top elevation of the aquifer (770 feet) in which the wells are completed.

Delineation of the Wellhead Protection Area

Criteria Used to Delineate the WHPA

The following criteria for delineating the WHPA as required in MR 4720.5510 were addressed as follows:

Time of travel – 10 years. Also, a one-year time of travel is used to define the emergency response area as specified under 4720.5250.

Flow boundaries – The following conditions define the extent to which flow boundaries must be considered:

-

The aquifer does not encounter any laterally persistent geologic boundaries within the WHPA that constitute a flow boundary. The overlying and underlying geologic materials serve to retard vertical movement of groundwater into or out of the aquifer used by the City of Mayer.

The aquifer exhibits confined hydraulic conditions and no surface water features constitute a flow boundary. Static water elevations for wells completed in the aquifer, are lower than surrounding surface water elevations.

The State Water Use Data System maintained by the DNR was accessed and no other high capacity wells other than those operated by the City of Mayer will influence the boundaries of the WHPA. The annual pumping reported to the DNR for each well is shown in Table 1. Also, the estimated pumping for the next five years is shown.

Well Name	PA Number	Unique Number	2000	2001	2002	2003	2004	Future Pumping
Well # 1	620705	220954	12.5	12.6	16.3	**17.8**	16.8	17.8
Well # 2	620705	655479	-	-	-	8.3	**15.0**	15.0

Table 1. Annual Volume of Water Discharged from Water Supply Wells (Expressed in million of gallons) Bolding indicates greatest annual pumping.

Groundwater Flow Field - The groundwater flow field was determined by compiling static water level elevations from wells that are either completed in the aquifer used by the City of Mayer, or is an adjacent, hydrostratigraphically equivalent aquifer (Figure 5). The angle of ambient groundwater flow toward the wells used by the City of Mayer is 121 degrees east of north with a hydraulic gradient of .0015.

Aquifer transmissivity – The aquifer test method used to determine transmissivity meets the requirements of MR4720.5510, Subpart 6, and the aquifer test plan was approved by MDH on December 14, 2005. A transmissivity value of 3,360 feet^2/day was determined using the specific capacity data for city well # 2, and a high capacity well completed in the same aquifer as the city wells.

Description of the Delineation Method

The wellhead protection area for the City of Mayer was determined using a combination of two different groundwater flow models. The Wellhead Protection Area Code (WHPA Code) version 2.0 was used to delineate 1 – and 10 – year capture zones. A second code, using the analytical groundwater flow method, named Oneka, uses a probability analysis to assess the impacts that local variations in hydrogeologic conditions may have on the well capture zones.

The WHPA Code is a semi-quantitative method for estimating the capture zones for wells that was developed by the U.S. EPA to provide a basic means for delineating wellhead protection areas (EPA, 1991). It produces a conservative estimate of capture zones because aquifer recharge is not used as an input parameter. However, it has limited capabilities to address aquifer settings that exhibit variable geologic conditions or variations in the direction of the groundwater flow field.

It is appropriate to use the WHPA Code for this delineation because no flow boundaries are known to exist in the up-gradient direction of groundwater flow from the wells; at least in the area defined by a 1- and 10-year time of travel. A groundwater flow angle using an azimuth of 121.3 degrees east of north was obtained using the mapping of hydraulic head obtained from water well data (Figure 5). The hydraulic gradient was estimated to be .0015 (Figure 5) and the aquifer thickness was set at 80 feet to reflect the openhole interval in the city wells.

Groundwater flow angles that are 10 degrees greater and 10 degrees less than the angle determined for the flow field were used to compile a composite capture zone as required under MR 4720.5510, Item B, subpart 5. Also, well capture zones were obtained using values that are half and twice that obtained from the estimation of aquifer transmissivity in order to address potential differences in aquifer composition and permeability. The resulting capture zone for wells 1 & 2 (Unique nos. 220954 and 655479) is a composite of all these WHPA Code model runs (Figure 6). The pathlines for all runs were within the 10% certainty zone of the Oneka 10 – year zone probability map). A copy of the input files for the WHPA Code solution is available at MDH.

Oneka was used to estimate probability of the capture zones that were generated by the WHPA Code. Using this model, hydraulic conductivity and thickness are treated as variable input parameters by providing a pre-determined statistical distribution of values for them. The flow field is also treated as a variable parameter within the framework of the analytical solution. It is calculated from a specified network of piezometric head observations that were obtained from water well records (Figure 5). For the solution, Oneka finds the flow field that best fits the network of water level elevations given a number of different combinations of aquifer thickness and transmissivity. The output from the model is a capture zone probability map for the specified time of travel (Barnes and Soule, 2003).

Results of Model Calibration and Sensitivity Analysis

There is nothing to calibrate for the WHPA Code delineation because it is based on calculating flowpath lines using equations that reflect constant hydraulic gradient, aquifer thickness, and aquifer permeability. As such, it is a very simple calculation of the portion of the aquifer that contributes water based on the width of the flow field that is affected by pumping.

The resulting solution is very sensitive to the direction of groundwater flow which is why the State wellhead rules require that a composite capture zone be identified that uses angles of flow that are 10 degrees greater and 10 degrees less than the identified angle of ambient flow.

Oneka provided 1) a mechanism for evaluating the sensitivity of the WHPA Code results to variations in aquifer thickness, 2) hydraulic conductivity, and 3) the orientation of the groundwater flow field. Generally, the WHPA Code results are not affected by changes in aquifer thickness and hydraulic conductivity.

Results of the Uncertainty Analysis

Local variation in geologic conditions may impact the capture area for the wells used by the City of Mayer but the existing subsurface geologic information is not sufficient to identify this. The WHPA Code has limited capabilities to address aquifer inhomogeneity other than varying flow direction and transmissivity as discussed in the previous section. The following items likely impact the delineation of the WHPA:

- Deficiencies in the distribution and the quality of subsurface geologic information that affect the accuracy of the placement of model elements; addition well data may increase the coverage of static water level data to better define the ambient flow field within the aquifer used by the public water supply wells.

- Deficiencies in the methods used to estimate aquifer transmissivity. Aquifer transmissivity for the city of Mayer model was determined from specific capacity test data for city well # 2 and a high capacity well (unique no. 655479 and 655942), completed in the same aquifer as the city wells. However, potential variation in the composition of the aquifer may cause the transmissivity of the aquifer to vary. To address this, the best estimate transmissivity (T) value was varied and the perturbed values (0.5 T and 2 T) were also used in delineating the wellhead protection area. The transmissivity values used in the Oneka model were estimated from 1) pump test data for high capacity wells completed in the same aquifer as the city wells and specific capacity data. Although transmissivity values were obtained from two different sources, the resulting probability maps seem to match up very well.

Using the Oneka model to simulate groundwater flow helps to address some of the uncertainties that are related to aquifer parameters because hydraulic conductivity and thickness were treated as variable input parameters. The one-and ten-year capture zone probability maps were generated for the city wells. The Oneka probability maps fit well with the capture zones calculated from the WHPA Code model (Figure 6). The probability maps for both of the city wells show that uncertainty of capture increases as

the distance from the city wells increases. In order to address the uncertainty of the wellhead protection area boundaries, the probability maps for the two wells were merged with the 10-year capture zone from the WHPA Code model (Figure 6).

Both groundwater models used to delineate the WHPA do a good job simulating the ambient groundwater flow field. However, these models assume relatively uniform aquifer properties (thickness and transmissivity) throughout the domain that should be evaluated as new subsurface geologic information become available during implementation of the wellhead protection plan. Also as new information becomes available, the thickness and extent of the overlying confining material (clay-till) should be re-evaluated to verify that it is continuous throughout the WHPA. The city should work with the MDH to verify the locations of wells that are constructed within a three mile radius of the city wells.

Delineation of the Drinking Water Supply Management Area

The boundaries of the Drinking Water Supply Management Area (DWSMA) were determined with the assistance of the City of Mayer. The boundaries were determined by using 1) the centerlines of highways, and roads, and 2) public land survey coordinates.

Assessment of Well Vulnerability

The wells used by the City of Mayer exhibit the following conditions:

1) Well construction meets current state Well Code specifications (MR 4725) and a well itself, does not provide a pathway for contaminants to enter the aquifer used by the City of Mayer;

2) The geologic conditions at each well site include a cover of clay-rich geologic materials over the aquifer that is sufficient to retard or prevent the vertical movement of contaminants; and

3) None of the contaminants regulated under the federal Safe Drinking Water Act have been detected in samples from the wells.

Therefore, the wells used by the City of Mayer are not considered to be vulnerable and exhibit a low well sensitivity as indicated in the source water assessment (vulnerability wooksheets, Appendix II).

Assessment of DWSMA Vulnerability

Review of geologic information and groundwater quality data for the aquifer within the DWSMA indicate the following:

1) Isotopic and water chemistry data from wells located within the DWSMA indicate that the aquifer contains water that has a small component of recent recharge and, therefore, exhibits a low susceptibility to potential sources of contamination with the exception of improperly constructed or maintained wells; and

2) Review of the geologic logs contained in the County Well Index and geological maps and geological cross sections (Figures 3 and 4) indicate that the aquifer exhibits a low geologic sensitivity throughout the DWSMA and is isolated from direct vertical recharge of surface water.

Therefore, the vulnerability of the DWSMA has been determined to be low as in the source water assessment (pages 6 & 7).

Selected References

Barnes, R. J and R. Soule, ONEKA: A Simple Analytical Element Model for Stochastic Capture Zone Delineation, draft, November 17, 2002.

Barnes, R. J. and R. Soule, A Simple Analytical Element Model for Probabilistic Capture Zones, draft paper, September 4, 2003.

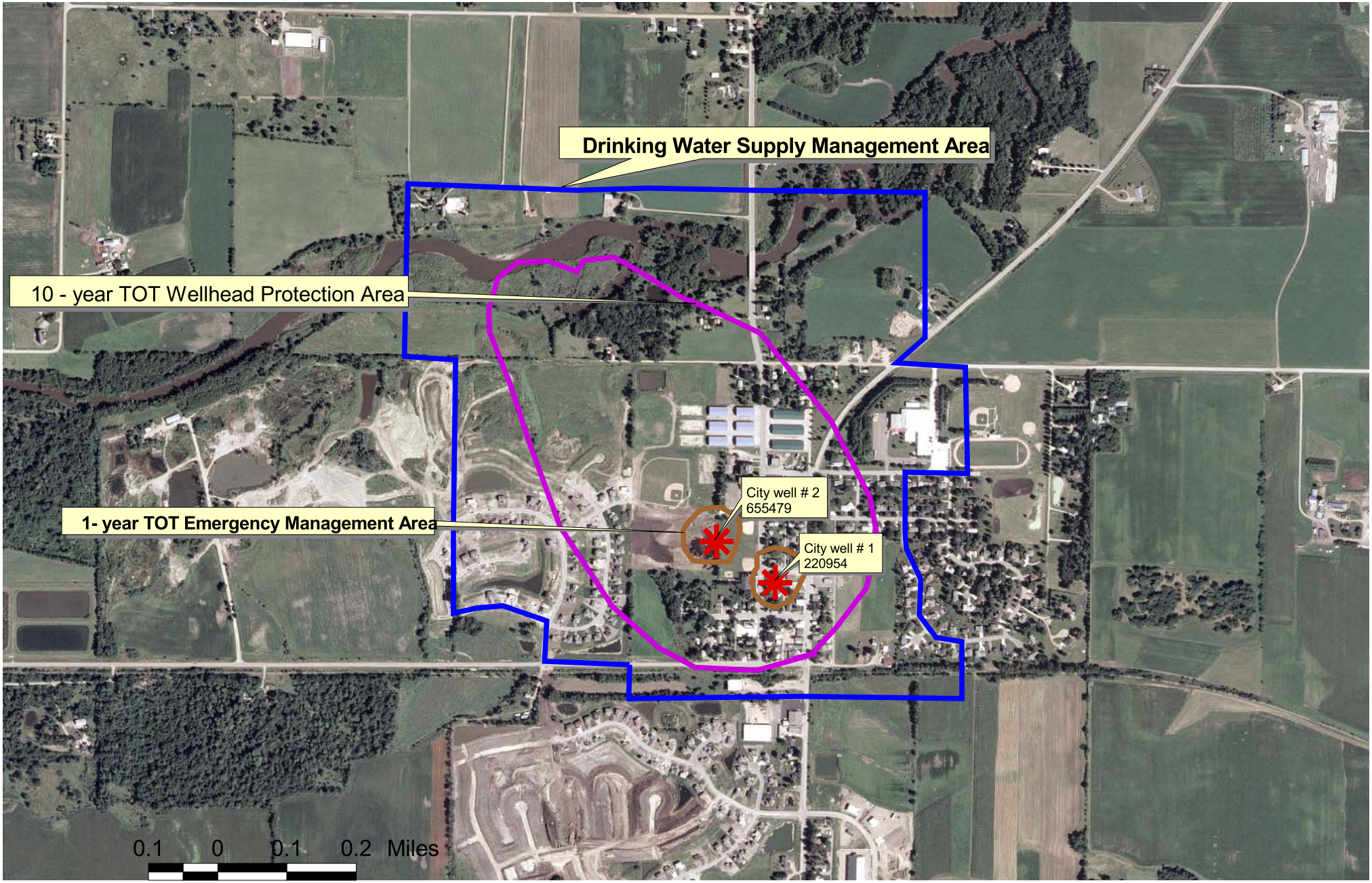
Falteisek, Jan, (1991), Criteria and Guidelines for Assessing Geologic Sensitivity of Ground Water Resources in Minnesota, Minnesota Department of Natural Resources, Division of Water. P. 122.

United States Environmental Protection Agency, (1991), A Modular Semi-Analytical Model for the Delineation of Wellhead Protection Areas, Version 2.0

United States Geological Survey Water Supply Paper 2219 (1984), Hydrogeological Setting and the Potentiometric Surfaces of Regional Aquifers in the Hollandale Embayment, Southeastern Minnesota, 1970-80.

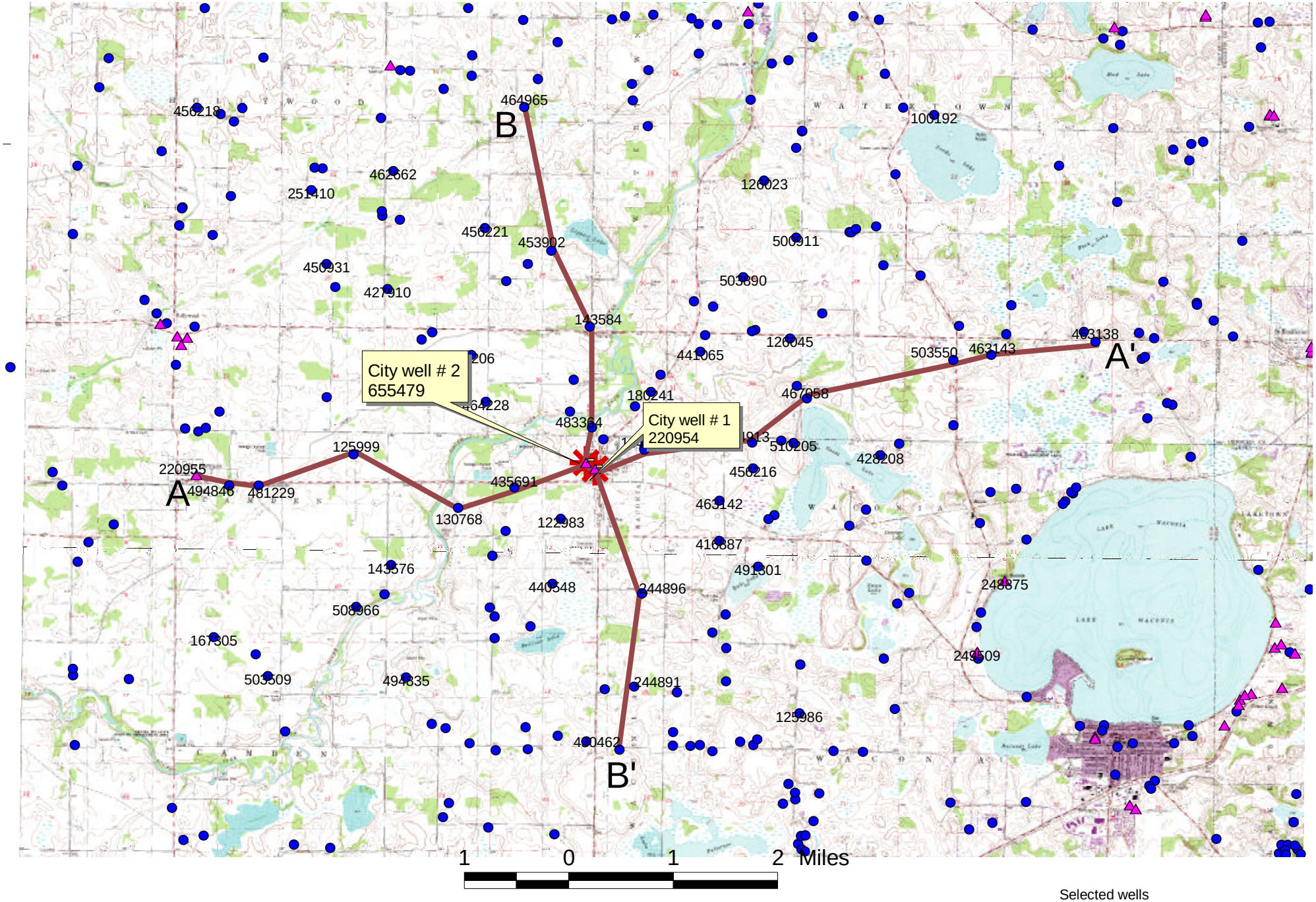
APPENDIX I

FIGURES USED IN THIS REPORT



Emergency Management Area
City of Mayer DWSMA
City of Mayer WHPA
Mayer City wells

Figure 1. City of Mayer Wellhead Protection Area and, Drinking Water Supply Management Area.



1 0 1 2 Miles

Selected wells
- non-PWS well
- PWS well
- Cross section lines
- Mayer City wells

Figure 2. Database Map and Trends of Cross Sections

Figure 3. Cross Section AA'

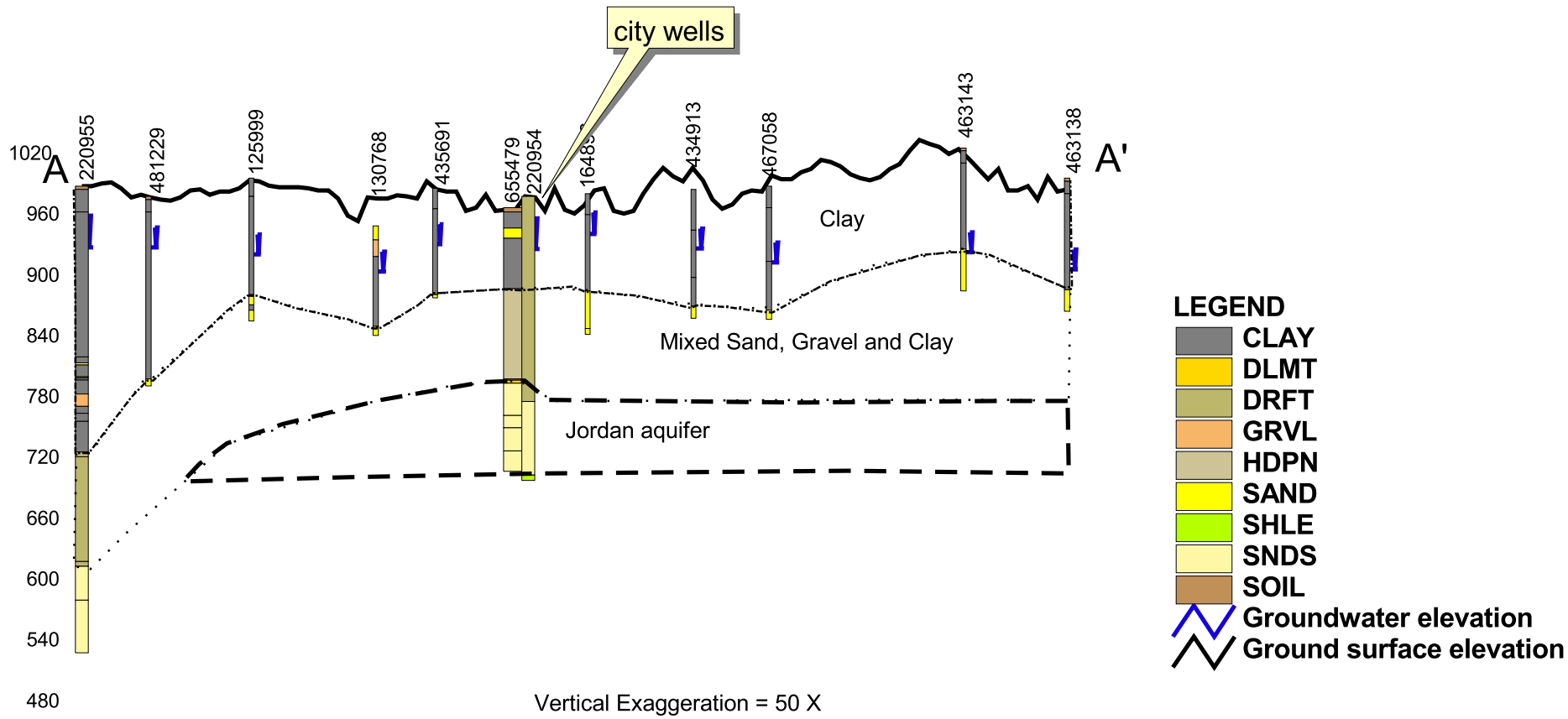
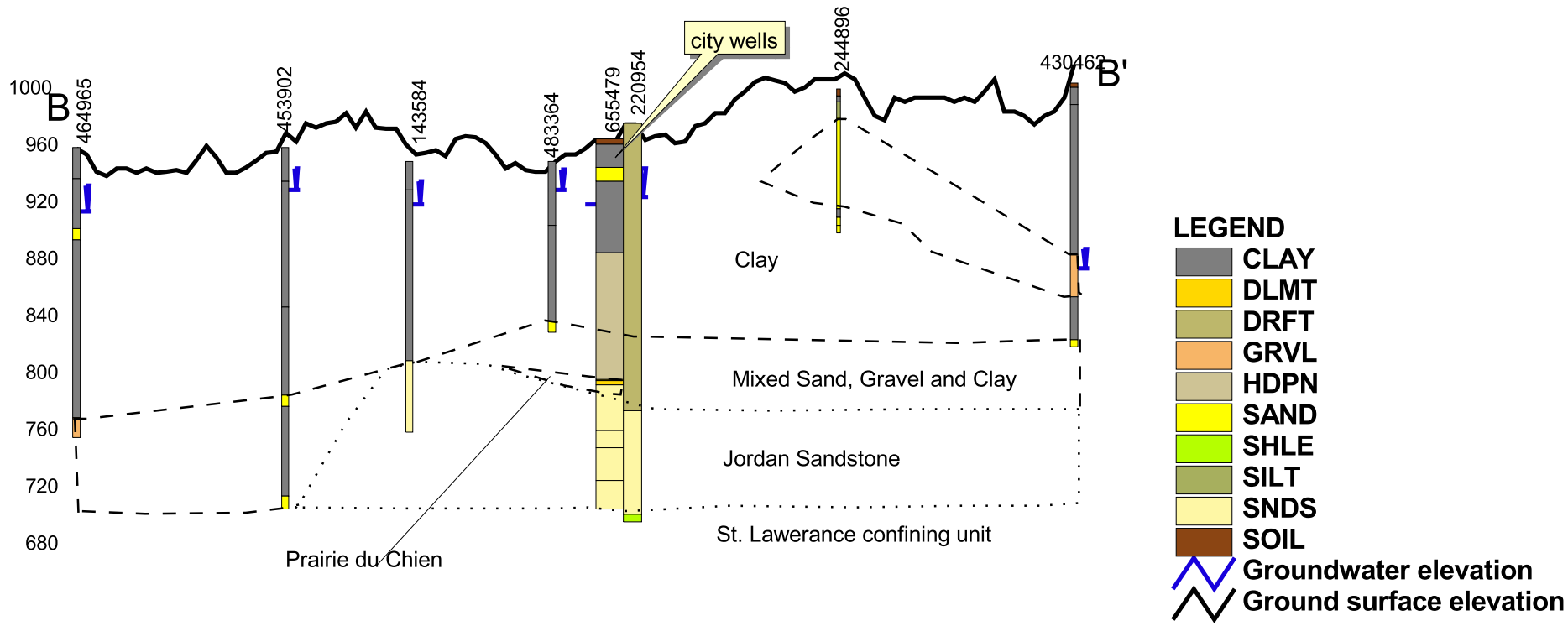


Figure 4. Cross Section B- B'



Vertical Exaggeration = 50 X

0 2 Miles

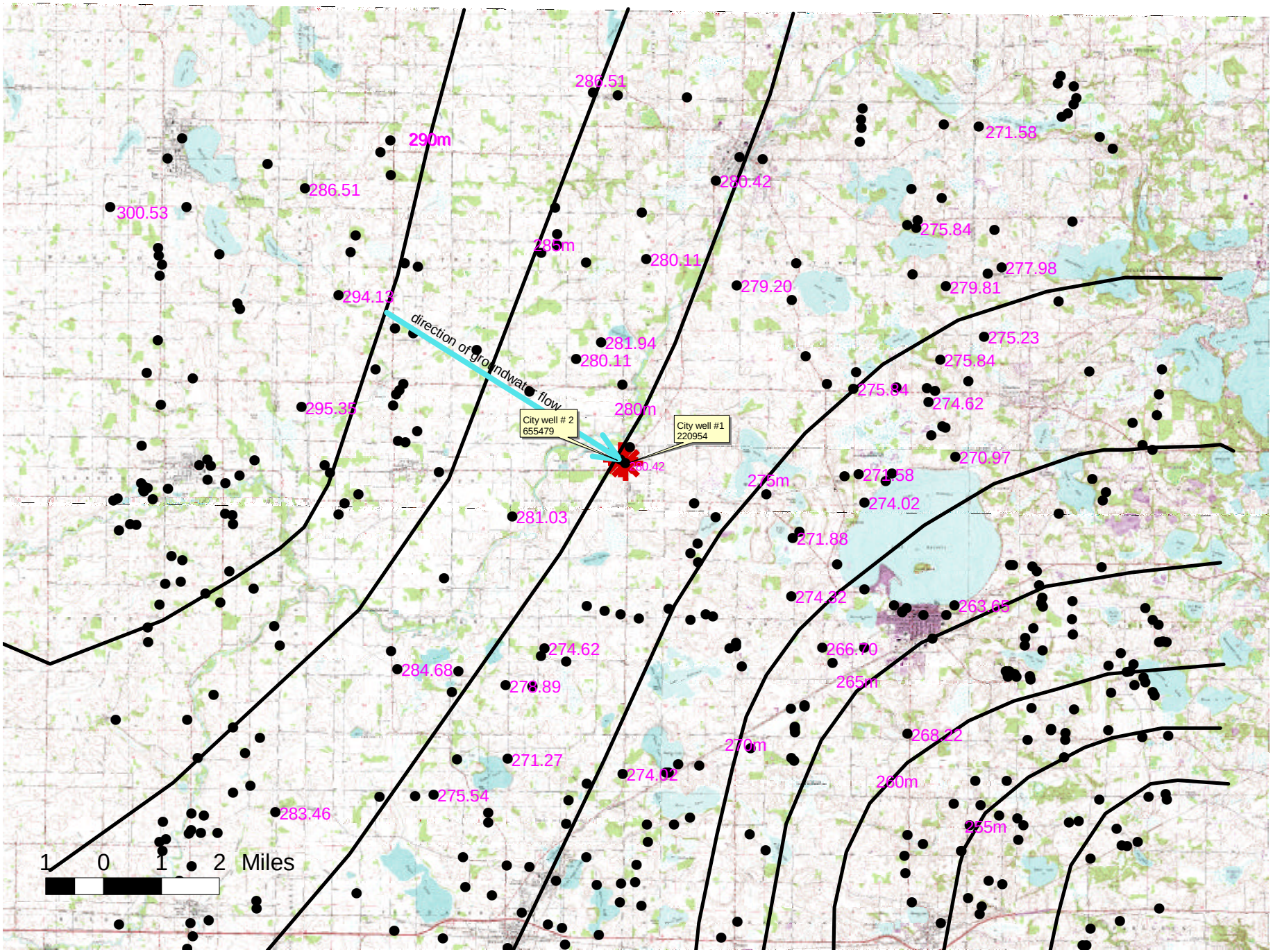


Figure 5. Distribution of Hydraulic Head within the Aquifer used by the City of Mayer

Groundwater flow direction
Flow field in the Jordan aquifer
wells completed in the Jordan aquifer
City of Mayer wells

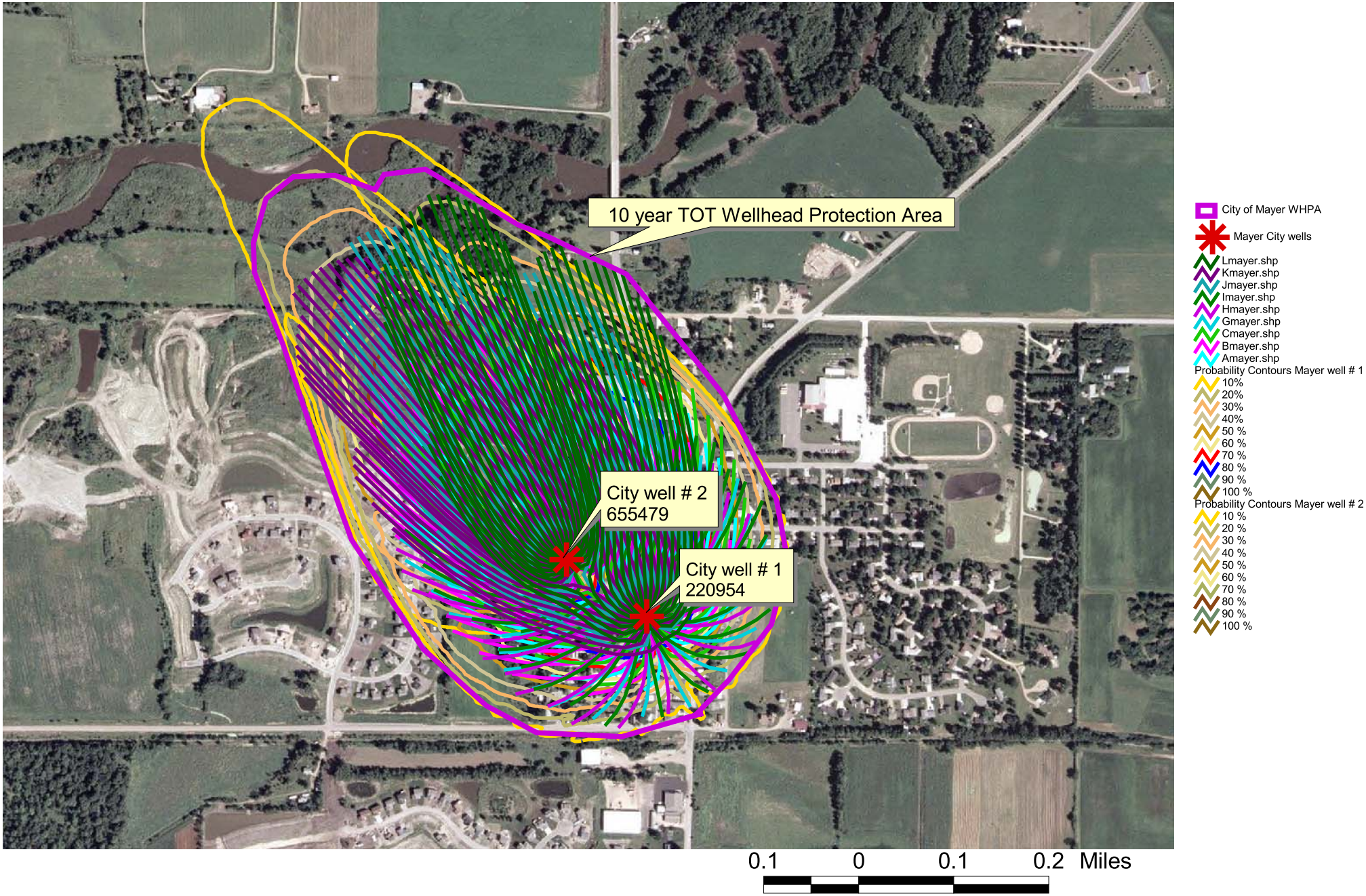
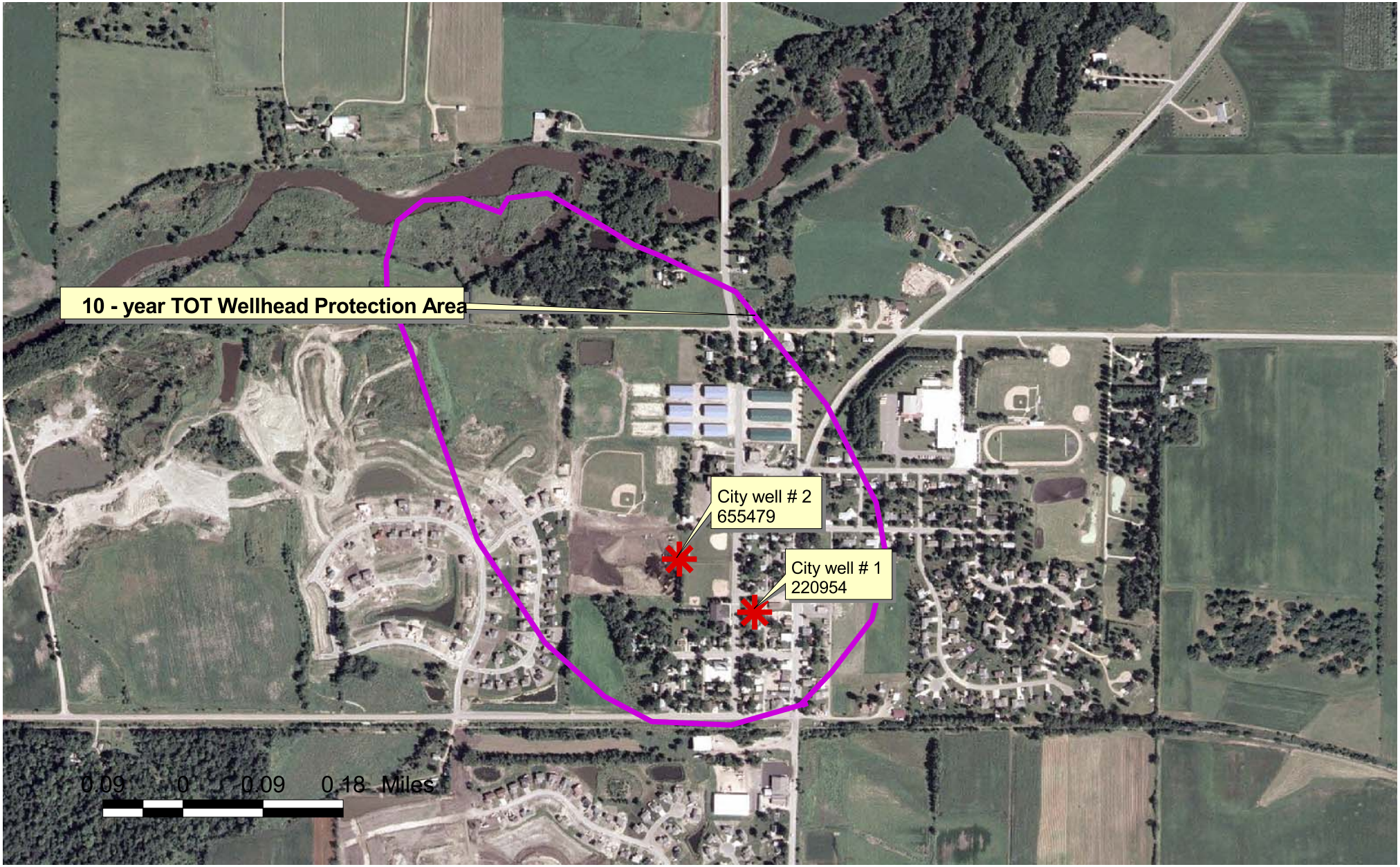


Figure 6. Pathlines for WHPA Code runs and,
Oneka Probability Contours.



0.1 0 0.1 0.2 Miles

Figure 7. Wellhead Protection Area

City of Mayer WHPA

Mayer City wells

APPENDIX II – WELL VULNERABILITY WORKSHEET AND MUNICIPAL WELL RECORDS

Unique Well Number 220954

County Carver
Quad Mayer
Quad Id 106B

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
MINNESOTA STATUTES CHAPTER 1031

Entry Date 1988/05/26
Update Date 2004/03/24
Received Date

Wellname MAYER 1

Township	Range	Dir	Section	Subsection	Field Located	MGS
116	26	W	1	ADADCA	Elevation	972.00 ft.

Well Owner MAYER 1

MAYER MN 55360 Changed

Contact CITY OF MAYER
413 BLUEJAY AV
MAYER MN 55360-

Description	Color	Hardness	From	To (ft.)
DRIFT			0	202
SANDSTONE			202	275
SHALE			275	280

Remarks

First Bedrock Jordan
Last Strat St.Lawrence
Aquifer Jordan
Depth to Bedrock 202.00 ft.

Well Depth 280.00 ft
Depth Completed 280.00 ft
Date Well Completed 1962/11/08

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ YES ☐ NO
From ft. to

Use Community Supply

Casing Type Steel (black or lov Drive Shoe? ☐ YES ☐ NO
Diameter 10 Depth 202
10.00 in. from 0.00 to 202.00 ft. ____ lbs/ft

Hole Diameter (in.)

Screen No
Make Type
Diamter Slot Length Set

Open Hole(ft.) From 202.0 to 280.0

Static Water Level
52.00 ft. Land surface Date measured 1962/11/08

Pumping Level (below land surface)
ft. after hrs. pumpting g.p.m.

Well Head Completion
Pitless adapter manufacturer ____ Model ____
☐ Casing Protection ☐ 12 in. above grade
☐ At-grate (Environmental Wells and Borings ONLY) ☐ Basement offset

Grouting Information Well grouted? ☐ YES ☐ NO

Nearest Known Source of Contamination
-999 feet ____ Direction ____ Type
Well disinfected upon completion? ☐ YES ☐ NO

Pump
☐ Not Installed Date Installed ____
Manufacture's name ____
Model number ____ HP 0.00 Volts ____
Length of drop pipe ____ Material ____ Capacity ____ g.p.m
Type

Abandoned Wells
Does property have any not in use and not sealed well(s)? ☐ YES ☐ NO

Variance
Was a variance granted from the MDH for this well? ☐ YES ☐ NO

Well Contractor Cerfication
Mueller Well Co. 96460
License Business Name Lic. or Reg No.

Name of Driller Date

County Well Index v.5 REPORT Printed on 10/11/2004

HE-01205-07 (Rev. 2/99)

Unique Well Number 655479

County Carver
Quad Mayer
Quad Id 106B

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
MINNESOTA STATUTES CHAPTER 1031

Entry Date 2002/01/24
Update Date 2002/02/17
Received Date

Wellname MAYER 2

Township	Range	Dir	Section	Subsection	Field Located	MGS
116	26	W	1	ADABCB	Elevation	972.00 ft.

Well Depth 260.00 ft **Depth Completed** 260.00 ft **Date Well Completed** 2001/11/20

Drilling Method Cable Tool

Drilling Fluid Water

Well Hydrofractured? ☐ YES ☑ NO
From ft. to

Well Owner MAYER 2
MAYER MN 55360- Changed

Contact CITY OF MAYER
413 BLUE JAY AV
MAYER MN 55360-

Use Community Supply

Casing Type Steel (black or lo\ Drive Shoe? ☑ YES ☐ NO
Diameter 16 Depth 173
16.00 in. from 0.00 to 173.00 ft. 62.58 lbs/ft

Hole Diameter (in.)
20.0(To 77.0
15.0(To 260.0

Description	Color	Hardness	From	To (ft.)
DIRT	BLACK	SOFT	0	4
SANDY CLAY	GRAY	SOFT	4	20
SAND & ROCK		SOFT	20	30
SANDY CLAY	GRAY	MEDIUM	30	80
HARDPAN FINE SAND & CLAY	GRAY	HARD	80	169
HARDPAN FINE SAND & CLAY	GRAY	HARD	169	170
ROCK	BROWN/TA	HARD	170	173
SANDROCK-CLEAN	GRAY/PINK	SOFT	173	205
SHALE & SANDROCK	YELLOW/WI	SOFT	205	217
SANDROCK-CLEAN	YELLOW/WI	SOFT	217	240
SHALE & SANDROCK GRN/WHT (		MED-HRD	240	260

Screen Yes
Make JOHNSON Type stainless steel
Diamter Slot Length Set
10.00 35 87 173 ft. to 260 ft.

Open Hole(ft.) From to

Static Water Level
46.10 ft. Land surface Date measured 2001/03/05

Pumping Level (below land surface)
104.40 ft. after 6.00 hrs. pumping 1000.00 g.p.m.

Well Head Completion
Pitless adapter manufacturer _____ Model _____
☐ Casing Protection ☑ 12 in. above grade
☐ At-grate (Environmental Wells and Borings ONLY) ☐ Basement offset

Grouting Information Well grouted? ☑ YES ☐ NO
Material Neat Cement From 0.0 To 77.0 ft. 5.50 Sacks

Nearest Known Source of Contamination
150 feet SW Direction BOW Type
Well disinfected upon completion? ☑ YES ☐ NO

Pump
☐ Not Installed Date Installed 2001/11/09
Manufacture's name BYRON JACKSON
Model number MGL HP 50.00 Volts 460
Length of drop pipe 150.(Material _____ Capacity 500 g.p.m
Type Submersible

Remarks
GAMMA LOGGED 2-16-2001. M.G.S. NO. 4137.

Abandoned Wells
Does property have any not in use and not sealed well(s)? ☐ YES ☑ NO

Variance
Was a variance granted from the MDH for this well? ☑ YES ☐ NO

Well Contractor Cerfication
Bergerson-Caswell 27058
License Business Name Lic. or Reg No.
KROELLS, J.
Name of Driller Date

First Bedrock Prairie Du Chien Group **Aquifer** Jordan
Last Strat Jordan **Depth to Bedrock** 169.00 ft.

MINNESOTA DEPARTMENT OF HEALTH
SECTION OF DRINKING WATER PROTECTION
SWP Vulnerability Rating

121 East 7th Place St. Paul MN 55101 - 2114
P.O. Box 64975 St. Paul MN 55164 - 0975

PWSID: 1100006 | TIER: 6
SYSTEM NAME: Mayer | WHP RANK:
WELL NAME: Well #1 | UNIQUE WELL #: 00220954

COUNTY: Carver | TOWNSHIP NUMBER: 116 | RANGE: 26 W | SECTION: 1 | QUARTERS: AAD

CRITERIA:		DESCRIPTION:	POINTS:
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	Low	20
L Score	:	0	
Geologic Data From	:	Well Record	
Year Constructed	:	1962	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	202	5
Well Depth	:	280	
Casing grouted into borehole?		Unknown	0
Cement grout between casings?		Not applicable	0
All casings extend to land surface?		Yes	0
Gravel - packed casings?		No	0
Wood or masonry casing?		No	0
Holes or cracks in casing?		No	0
Isolation distance violations?			0
Pumping Rate	:	250	5
Pathogen Detected?			NOT VULNERABLE
Surface Water Character			NOT VULNERABLE
Maximum nitrate detected	:	<1 04/01/1975	NOT VULNERABLE
Maximum tritium detected	:	<.8 03/26/2002	NOT VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			NOT VULNERABLE
Carbon 14 age	:	Unknown	0

Wellhead Protection Score	30
Wellhead Protection Vulnerability Rating	NOT VULNERABLE

Vulnerability Overridden:

COMMENTS

Low rating is based on records of surrounding wells that are not as deep as this well. A very low rating was not assigned because of the uncertainty of estimating confinig layers in the lower part of the glacial deposits.

MINNESOTA DEPARTMENT OF HEALTH
SECTION OF DRINKING WATER PROTECTION
SWP Vulnerability Rating

121 East 7th Place St. Paul MN 55101 - 2114
P.O. Box 64975 St. Paul MN 55164 - 0975

PWSID: 1100006 | TIER: 6
SYSTEM NAME: Mayer | WHP RANK:
WELL NAME: Well #2 | UNIQUE WELL #: 00655479

COUNTY: Carver | TOWNSHIP NUMBER: 116 | RANGE: 26 W | SECTION: 1 | QUARTERS: ADAB

CRITERIA:		DESCRIPTION:	POINTS:
Aquifer Name(s)	:	Jordan	
DNR Geologic Sensitivity Rating	:	Very low	15
L Score	:	5	
Geologic Data From	:	Well Record	
Year Constructed	:	2001	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	173	10
Well Depth	:	260	
Casing grouted into borehole?		Yes	0
Cement grout between casings?		Not applicable	0
All casings extend to land surface?		Yes	0
Gravel - packed casings?		No	0
Wood or masonry casing?		No	0
Holes or cracks in casing?		No	0
Isolation distance violations?			0
Pumping Rate	:	500	5
Pathogen Detected?			0
Surface Water Character			0
Maximum nitrate detected	:	<.05 05/06/2002	0
Maximum tritium detected	:	Unknown	0
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0

Wellhead Protection Score	30
Wellhead Protection Vulnerability Rating	NOT VULNERABLE

Vulnerability Overridden:

COMMENTS

L-score of 5 comes from gray sandy clay from 30-80 feet which is assumed to be Des Moines Lobe till. The underlying hardpan zone might also qualify for additional L-score if better defined.