Amendment to the Wellhead Protection Plan Part 1

Delineation of WHPA, DWSMA, and Vulnerability Assessments

Cambridge, Isanti County, Minnesota

CAMBR 135080 | July 24, 2017

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SEH No. CAMBR 135080

July 24, 2017

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Geologist under the laws of the State of Minnesota.

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Glossary of Terms

Data Element. A specific type of information required by the Minnesota Department of Health to prepare a wellhead protection plan.

Drinking Water Supply Management Area (DWSMA). The area delineated using identifiable land marks that reflects the scientifically calculated wellhead protection area boundaries as closely as possible (Minnesota Rules, part 4720.5100, subpart 13).

Drinking Water Supply Management Area Vulnerability. An assessment of the likelihood that the aquifer within the DWSMA is subject to impact from land and water uses within the wellhead protection area. It is based upon criteria that are specified under Minnesota Rules, part 4720.5210, subpart 3.

Emergency Response Area (ERA). The part of the wellhead protection area that is defined by a one-year time of travel within the aquifer that is used by the public water supply well (Minnesota Rules, part 4720.5250, subpart 3). It is used to set priorities for managing potential contamination sources within the DWSMA.

Inner Wellhead Management Zone (IWMZ). The land that is within 200 feet of a public water supply well (Minnesota Rules, part 4720.5100, subpart 19). The public water supplier must manage the IWMZ to help protect it from sources of pathogen or chemical contamination that may cause an acute health effect.

Wellhead Protection (WHP). A method of preventing well contamination by effectively managing potential contamination sources in all or a portion of the well's recharge area.

Wellhead Protection Area (WHPA). The surface and subsurface area surrounding a well or well field that supplies a public water system, through which contaminants are likely to move toward and reach the well or well field (Minnesota Statutes, part 103I.005, subdivision 24).

Well Vulnerability. An assessment of the likelihood that a well is at risk to human-caused contamination, either due to its construction or indicated by criteria that are specified under Minnesota Rules, part 4720.5550, subpart 2.

SEH

Acronyms

DNR - Minnesota Department of Natural Resources

EPA - United States Environmental Protection Agency

FSA - Farm Security Administration

MDA - Minnesota Department of Agriculture

MDH - Minnesota Department of Health

MGS - Minnesota Geological Survey

MnDOT - Minnesota Department of Transportation

MnGEO - Minnesota Geospatial Information Office

MPCA - Minnesota Pollution Control Agency

MWI - Minnesota Well Index

NRCS - Natural Resource Conservation Service

SWCD - Soil and Water Conservation District

UMN - University of Minnesota

USDA - United States Department of Agriculture

USGS - United States Geological Survey

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Prepared for the City of Cambridge

1 Introduction

Short Elliott Hendrickson, Inc. (SEH) amended Part I of the wellhead protection plan (WHP Plan) at the request of the City of Cambridge (PWSID 1300002). The work was performed in accordance with the Minnesota Wellhead Protection Rule, parts 4720.5100 to 4720.5590. The original WHP Plan was first developed for the City in 2006. The Minnesota Department of Health (MDH) requires that wellhead protection plans be reviewed and amended to reflect current conditions every ten years.

This report presents delineations of the wellhead protection area (WHPA) and drinking water supply management area (DWSMA), and the vulnerability assessments for the public water supply wells and DWSMA. **Figure 1** shows the boundaries for the WHPA and the DWSMA. Wellhead protection areas are not delineated for emergency backup wells. The WHPA is defined by a 10-year time of travel. **Figure 1** also shows the emergency response area (ERA), which is defined by a 1-year time of travel. Definitions of rule-specific terms that are used are provided in the "Glossary of Terms."

This report also documents the technical information that was required to prepare this portion of the WHP plan in accordance with the Minnesota Wellhead Protection Rule.

The wells included in the WHP plan are listed in **Table 1**.

Table 1 – Water Supply Well Information for the City of Cambridge

Local Well ID	Unique Number	Use / Status	Case Diameter (inches)	Case Depth (feet)	Well Depth (feet)	Date Constructed / Reconstructed	Aquifer	Well Vulner-ability
1	217867	Emergency	20	151	369	1958	MTPL - Multiple	Vulnerable
4	462851	Emergency	14	260	536	1990	CMSH - Mt.Simon -Hinckley	Not Vulnerable
5	680652	Emergency	16	277	337	2004	CMTS - Mt.Simon	Vulnerable
6	731532	Primary	24 x 18	300	410	2005	CMTS - Mt.Simon	Not Vulnerable
7	735018	Primary	24 x 18	313	422	2006	CMFL - Mt.Simon -Fond du Lac	Not Vulnerable
8	795532	Primary	24 x 18	307	427	2013	CMFL - Mt.Simon -Fond du Lac	Not Vulnerable

2 Assessment of the Data Elements

MDH staff met with representatives of the City and SEH on March 10, 2015, for a scoping meeting that identified the data elements required to prepare Part I of the WHP plan. A copy of the Scoping Decision Notice is provided in **Appendix A**. **Table 2** presents the assessment of these data elements relative to the present and future implications of planning items that are specified in Minnesota Rules, part 4720.5210.

Table 2 – Assessment of Data Elements

Data Element	Present and Future Implications				Data Source
	Use of the Well (s)	Delineation Criteria	Quality and Quantity of Well Water	Land and Groundwater Use in DWSMA	
Precipitation					
Geology					
Maps and geologic descriptions	M	H	H	H	MGS, DNR, USGS
Subsurface data	M	H	H	H	MGS, MDH, MWI, DNR
Borehole geophysics	M	H	H	H	MGS
Surface geophysics	L	L	L	L	Not Available
Maps and soil descriptions					
Eroding lands					
Water Resources					
Watershed units					
List of public waters					
Shoreland classifications					
Wetlands map					
Floodplain map					
Land Use					
Parcel boundaries map	L	H	L	L	Isanti County
Political boundaries map	L	L	L	L	MnGEO, Isanti County
Public Land Survey map	L	H	L	L	MnGEO
Land use map and inventory					
Comprehensive land use map					
Zoning map					
Public Utility Services					
Transportation routes and corridors	L	H	L	L	MnDOT, MnGEO
Storm/sanitary sewers and PWS system map					
Oil and gas pipelines map					
Public drainage systems map or list					
Records of well construction, maintenance, and use	H	H	H	H	City, MWI, MDH
Surface Water Quantity					
Stream flow data					
Ordinary high water mark data					
Permitted withdrawals					
Protected levels/flows					
Water use conflicts					

Data Element	Present and Future Implications				Data Source
	Use of the Well (s)	Delineation Criteria	Quality and Quantity of Well Water	Land and Groundwater Use in DWSMA	
Groundwater Quantity					
Permitted withdrawals	H	H	H	H	City, DNR
Groundwater use conflicts	L	L	L	L	DNR
Water levels	H	H	H	H	MWI, DNR, MDH, City
Surface Water Quality					
Stream and lake water quality management classification					
Monitoring data summary					
Groundwater Quality					
Monitoring data	H	H	H	H	MDH, DNR
Isotopic data	H	H	H	H	MDH, DNR
Tracer studies	L	L	L	L	Not Available
Contamination site data	M	M	M	M	Not Available
Property audit data from contamination sites					
MPCA and MDA spills/release reports	M	L	M	M	MPCA, MDA, City

Definitions Used for Assessing Data Elements:

High (H) - the data element has a direct impact
Moderate (M) - the data element has an indirect or marginal impact
Low (L) - the data element has little if any impact
Shaded - the data element was not required by MDH for preparing the WHP Plan

3 General Descriptions

3.1 Description of the Water Supply System

The city of City of Cambridge obtains its drinking water supply from three primary wells. **Table 1** summarizes information regarding primary and emergency wells.

3.2 Description of the Hydrogeologic Setting

The hydrogeologic setting for the Mt. Simon-Fond du Lac aquifer is described in the 2006 Part 1 Wellhead Protection Plan Part 1 report by Short Elliot Hendrickson Inc. (SEH), 2006. The description of this hydrogeologic setting at the City wells is presented in **Table 3**. Two cross-sections were developed to illustrate geologic and well conditions and provided in **Figure 3** and **Figure 4**.

Table 3 – Description of the Hydrogeologic Setting at the Public Water Supply Wells

Aquifer	Attribute	Descriptor	Data Source
Mt. Simon-Fond du Lac (CMFL)	Aquifer Material	Sandstone	Well 6 (731532), 7 (735018), and 8 (795532) well logs.
	Primary Porosity	0.2	Estimated and porosity values used in the Metro Model 3
	Aquifer Thickness	152 - 167 feet	Well 6, 7, and 8 well logs.
	Stratigraphic Top Elevation	699 - 705 feet MSL	Well 6, 7, and 8 well logs.
	Stratigraphic Bottom Elevation	551 - 536 feet MSL	Well 6, 7, and 8 well logs.
	Hydraulic Confinement	Confined	Well 6, 7, and 8 well logs.
	Transmissivity (T)	Range (CMFL): (3,423 – 9,672 ft^2/day)	The transmissivity of the CMFL aquifer was estimated from an analysis of pumping tests performed on Wells 5 (680652), 6 (731532), and 7 (735018) in 2006 and Well 8 in 2013 as presented in **Appendix B**.
	Hydraulic Conductivity (K)	Reference Value/Range (CMFL): 43.5 ft/day (25.1 – 78.7 ft/day)	The aquifer test plan was approved via email on April 8, 2017, and included as **Appendix B**. The reference value for the hydraulic conductivity of the CMFL aquifer was estimated from a re-analysis of pumping tests performed on Wells 5, 6, and 7 in 2006 and Well 8 in 2013. The reference value is the geometric mean of the tests completed.
	Groundwater Flow Field	Flow to the south-southeast. Hydraulic Gradient: 6.8 x 10^{-4} ft/ft	MWI data and groundwater model results.

4 Delineation of the Wellhead Protection Area

4.1 Delineation Criteria

The boundaries of the WHPA for the City of Cambridge are shown in **Figure 1**. **Table 4** describes how the delineation criteria that are specified under Minnesota Rules, part 4720.5510, were addressed.

Table 4 – Description of the WHPA Delineation Criteria

Criterion	Descriptor	How the Criterion was Addressed
Flow Boundary	Other High-Capacity Wells (**Table 6**)	Pumping amounts for wells within 2 miles of the City's wells (**Table 6**) were updated to the averaged 2005 - 2015 pumped volumes. The pumping rates for the other high-capacity wells from the Metro Model and within the model domain were unchanged. Details on the groundwater flow boundaries used for modeling are presented in Metropolitan Council (2014).
Daily Volume of Water Pumped	See **Table 5**	Pumping information was obtained from the Minnesota Department of Natural Resources Appropriations Permit 1966-0149. The annual pumped volumes were converted to a daily volume pumped by a well.
Groundwater Flow Field	See **Figure 2**	The model calibration process addressed the relationship between the calculated versus observed groundwater flow field.
Aquifer Transmissivity	Reference Value/Range (CMFL): 5,885 ft^2/day 3,423 – 9,672 ft^2/day	The aquifer test plan was approved via email on April 8, 2017, and included as **Appendix B**. The transmissivity of the CMFL aquifer was estimated from an analysis of pumping tests performed on Wells 5 (680652), 6 (731532), and 7 (735018) in 2006 and Well 8 in 2013. The reference value shown is the geometric mean of the tests completed. The reference value for the hydraulic conductivity of the aquifer was estimated from a re-analysis of pumping tests performed on Wells 5, 6, and 7 in 2006 and Well 8 in 2013. The reference value used in modeling is the geometric mean of the tests completed.
Time of Travel	10 years	The public water supplier selected a 10 year time of travel.

Information provided by the City of Cambridge was used to identify the maximum volume of water pumped annually by each well over the previous five-year period, as shown in **Table 5**. Recently, the City changed Well 1 from a primary well to an emergency well. The City has indicated that

past pumping volumes for Well 1 will be equally apportioned among Wells 6, 7, and 8; therefore, the projected pumping rate for the primary wells is each well's 5-year average (2011-2016) pumping rate plus 1/3 of the 5-year average rate of Well 1. Previous pumping values have been reported to the DNR, as required by Groundwater Appropriation Permit 1966-0149. The maximum daily volume of discharge used as an input parameter in the model was calculated by dividing the greatest annual pumping volume by 365 days.

Table 5 – Annual Volume of Water Discharged from Water Supply Wells

Well Name	Unique Number	Total Annual Withdrawal (gal/year) Permit Number: 1966-0149					Maximum Withdrawal 2012 - 2016 (gallons/year)	Projected 2021 Withdrawal (gallons/year)	WHPA Withdrawal Instantaneous Pumping Rate (m^3/day)
		2012	2013	2014	2015	2016			
1	**217867**	33,519,400	31,733,517	40,824,000	**42,849,254**	11,534,572	42,849,254	0	0.0
4	**462851**	0	0	0	0	**0**	0	0	0.0
5	**680652**	**23,855**	6,464	0	0	16	23,855	0	0.0
6	**731532**	**196,292,286**	162,253,433	84,200,285	64,842,295	36,254,548	196,292,286	119,465,952	2035.6
7	**735018**	76,483,046	70,549,648	85,741,816	66,273,032	**161,052,388**	161,052,388	102,717,369	1670.1
8	**795532**	0	7,110,184	72,829,654	**93,800,810**	63,840,608	93,800,810	58,213,634	972.7
Totals		306,318,587	271,653,246	283,595,755	267,765,391	272,682,132		280,396,955	4,678.4

Bolding indicates greatest annual pumping volume

Table 6 – Other Permitted High-Capacity Wells within Two Miles

Unique Number	Well Name	DNR Permit Number	Aquifer	Use	Annual Volume of Water Pumped[1, 2]	10-Year Average Annual Volume of Water Pumped[1]	10-Year Average Annual Volume of Water Pumped (m^3/day)
497376	Opta Food Ingredients Inc	1992-3160	CMTS	Agricultural/Food Processing	44.015	67.5	699.6
686289	Cambridge, City of	1966-0149	CMTS	Municipal/Public Water Supply	9.563	6.9	71.1
217864	Vavra, Roger	1962-0513	CIGLCMTS	Agricultural Crop Irrigation	2.880	17.9	185.2
727860	Anoka Ramsey Community College Cambridge Campus	2006-0300	CMTS	Landscaping/Athletic Field Irrigation	6.116	6.2	64.1
	Pine Village LLC: 2	1967-0122		Private Water Supply; Private Water Supply	7.837	6.7	69.9
456663	Pine Village LLC	1967-0122	CMTS	Private Water Supply	0.311	2.4	25.1
	Cambridge, City Of: 1	2014-2421		Groundwater Dewatering	0.000	0.2	2.2
731143	Great River Energy	2007-0405	CMTS	Thermoelectric Power Cooling - Recirculating; Fire Protection Water Supply	0.287	0.8	8.1

[1] = Expressed as millions of gallons.
[2] = Source year = 2015.
Source: MN Dep't. of Natural Resources Division of Waters - MNDNR Permitting and Reporting System (MPARS)
GIS Data Source: swp.mpars_ii_2015_table

4.2 Method Used to Delineate the Wellhead Protection Area

4.2.1 Porous Media Delineations

The porous media delineations of the WHPA for the City of Cambridge wells were determined using an existing regional MODFLOW model that was developed by Barr Engineering Company for the Metropolitan Council (Metro Council, 2009). MODFLOW is a 3D, cell-centered, finite difference, saturated flow model developed by the U.S. Geological Survey (McDonald and Harbaugh, 1988; Harbaugh et al., 2000).

The regional Metro Model consists of nine layers that represent the major aquifers and aquitards within the seven-county metropolitan area. These layers represent, from top to bottom, the following units: (1) surficial aquifer of glacial deposits; (2) St. Peter Sandstone or Quaternary Buried Artesian Aquifer; (3) Prairie du Chien Group; (4) Jordan Sandstone; (5) St. Lawrence Formation (aquitard); (6) Franconia Formation; (7) Ironton-Galesville Aquifer, (8) Eau Claire Formation (aquitard); and (9) Mt. Simon Sandstone. The regional groundwater model was calibrated to steady-state water levels and river base flows.

A local model limited to an approximately five-mile radius around the primary wells was extracted from the regional seven-county model using telescopic mesh refinement. Constant head boundaries around the limits of the model along with wells, rivers, lakes and infiltration, provided the model boundary conditions.

The model grid was refined around the City of Cambridge wells. Variable grid spacing was used, ranging from 2 meters near the City wells to 250 meters at the edge of the grid. This refinement was required for an accurate computation of the particle flow paths and, therefore, the WHPA delineation.

Prior to their use in the delineations, the following modifications were incorporated in the refined models:

- Local areas of modified horizontal conductivity were included in the model to reflect the hydraulic conductivities in **Table 3**.
- The pumping rates from **Table 5** were assigned to the City wells.
- The pumping rates from **Table 6** were assigned to the permitted high-capacity wells located within two miles of the City wells.
- The porosity value of the CMFL was adjusted to correct the velocity with respect to the change in transmissivity, as describe below.

The MDH provided a spreadsheet that computes appropriate model input values for hydraulic conductivity (K) and porosity (n) that fit the conceptual model provided in the DAP-ATP. To account for the change in velocity (V, where $V = K_h * i/n$) due to the reduction of K by a ratio of 2.53 compared to the original Metro Model calibrated values, the n value had to be equally reduced. This is necessary in order to maintain the MM3 calibrated velocity and therefore not affect travel time computations (which are based on velocity); as a result, the porosity was set to 0.1 in the model rather than 0.2 as described in **Table 3**.

The delineation was performed by backtracking particles from the wells to a 10-year time of travel using the particle tracking MODPATH code. A series of 50 particles were launched at each well.

The resulting WHPA boundaries (**Figure 1**) are a composite of the 10-year capture zones calculated using this model for the base case parameters and the parameter values used in the sensitivity analysis, which are discussed in the following section. The model input files are available in **Appendix C**.

4.3 Results of Model Calibration and Sensitivity Analysis

Model quality is commonly evaluated by three different measures: calibration, sensitivity, and uncertainty analyses. Model calibration is a procedure that compares the results of a model based on estimated input values to measured or "known" values. This procedure is used to define model validity over a range of input values. The result of calibration is an assessment of the general quality of the model and the confidence that may be placed in the model results. As a matter of practice, groundwater flow models usually are calibrated using groundwater elevation and flow (if available).

Sensitivity analysis quantifies the differences in model results produced by the natural variability of a particular parameter. Uncertainty analysis addresses the effects of poor data quality (lack of local detailed information or deficiencies in the data) on the model results. Together, sensitivity and uncertainty analyses are commonly used to evaluate the effects that natural variability and uncertainties in the hydrogeologic data have on the size and shape of the capture zones. In regards to the WHPA delineation, these analyses are used to document that the delineation is optimal, conservative, and protective of public health based on existing information.

4.3.1 Calibration

Model calibration is a procedure that compares the results of a model based on estimated input values to measured or known values. This procedure can be used to define model validity over a range of input values, or it helps determine the level of confidence with which model results may be used. As a matter of practice, groundwater flow models are usually calibrated using water elevation or flux.

The regional Metro Model was calibrated to the MWI database water level targets and stream flow targets developed by the Metropolitan Council (2009). The calibration of the regional model was performed applying an automated calibration procedure using PEST, a parameter estimation code that automatically adjusts the recharge rates and hydraulic conductivity values and compares modeled piezometric heads against measured values at observation well locations until a satisfactory fit is obtained.

The calibrated regional Metro Model provided the boundary conditions at the constant head cells at the boundaries of the refined sub-model. After construction, the refined MODFLOW model calibration was verified by comparing modeled head results to the static water elevations for the observation wells used in the Metro Model that were within the local model domain. The scaled root mean square (RMS) error of the difference between simulated and measured hydraulic heads was 11.5 percent across the model domain and across the nine model layers.

4.3.2 Sensitivity Analysis

Sensitivity is the amount of change in model results caused by the variation of a particular input parameter. Because of the relative simplicity of the model, the direction and extent of the modeled capture zone may be very sensitive to any of the input parameters:

The **pumping rate** directly affects the volume of the aquifer that contributes water to the well. An increase in pumping rate leads to an equivalent increase in the volume of aquifer and an expanded capture zone, proportional to the porosity of the aquifer materials.

> **Results -** The pumping rate defined by WHP rule requirements is the highest rate that can be expected under normal water demand; therefore, with respect to the delineation of the WHPA, the sensitivity of the capture zone to variations in the pumping rate is minimized.

The **direction of groundwater flow** determines the orientation of the capture zone. Variations in the direction of groundwater flow will not affect the size of the capture zone but are important for defining the areas that are contributing water to the well.

> **Results** - The ambient groundwater flow field that is defined in **Figure 2** provides the basis for determining the extent to which each model run reflects the conceptual understanding of the orientation of the capture area for a well. The regional model has been calibrated to hydraulic heads, and the local refined model calibration was verified. The sensitivity of the WHPA to the direction of groundwater flow should not be significant, given the current knowledge of hydraulic head distribution in the aquifer.

The **hydraulic gradient** (along with aquifer transmissivity) determines the rate at which water moves through the aquifer materials.

> **Results** - The regional model has been calibrated to hydraulic heads. The local refined model calibration was verified. The sensitivity of the WHPA to the hydraulic gradient should not be significant, given the current knowledge of hydraulic head distribution in the aquifer.

The **horizontal hydraulic conductivity** influences the size and shape of the capture zone. In the base-case scenario, the hydraulic conductivity of the Mt. Simon-Fond du Lac aquifer was estimated from pumping tests in municipal wells 5, 6, 7, and 8. This value was used in the groundwater model to delineate the 10-year time-of-travel capture zone. Several runs were performed for the range of hydraulic conductivity values that were derived as described in the DAP-ATP (**Appendix B**). The range of hydraulic conductivity values considered in the sensitivity analysis runs is given in **Table 3**.

> **Results** - A change in the hydraulic conductivity of the Mt. Simon-Fond du Lac aquifer slightly shifts the location of the capture zone (**Figure 5**). An increase in hydraulic conductivity slightly extends the length of the capture zone and a decrease in hydraulic conductivity slightly reduces the length of the capture zone.

The aquifer **thickness** and **porosity** influence the size and shape of the capture zone.

> **Results** - Decreasing either thickness or porosity causes a linear, proportional increase in the areal extent of the capture zone.

4.4 Addressing Model Uncertainty

Using computer models to simulate groundwater flow necessarily involves representing a complicated natural system in a simplified manner. Local geologic conditions may vary within the capture area of the City of Cambridge wells, but existing information is not sufficiently detailed to define this degree of variability. In addition, the available groundwater flow modeling techniques may not represent the natural flow system exactly, but the results are valid within a range defined by the reasonable variation of input parameters.

Traditional numerical groundwater models were used to delineate the capture zone for the porous media aquifer that contributes water to the public water supply well. The steps employed for this delineation to address model uncertainty were:

- Pumping Rate - For each well, a maximum historical (five-year) pumping rate or an engineering estimate of future pumping, whichever is greater is applied (Minnesota Rules, part 4720.5510, subpart 4).
- Hydraulic conductivity – The WHPA for the City of Cambridge consists of a composite of the porous media aquifer delineations for a range of hydraulic conductivity values to address variability in aquifer composition.

Capture areas were developed for a range of aquifer permeabilities and a time of travel of 10 years (**Figure 5**). As the model code uses constant input values for each run, several runs were required to include all variations in input parameters. The WHPA for the City of Cambridge consists of a composite of the porous media aquifer delineations for the different input parameters used in the sensitivity analysis. This provides a conservative approach to addressing model uncertainty and produces a WHPA that will likely be most protective of public health.

5 Delineation of the Drinking Water Supply Management Area

The boundaries of the DWSMA were defined by the public water supplier using the following features (**Figure 1**):

- Property or fence lines,
- Road centerlines.

The DWSMA (**Figure 1**) is located within the City of Cambridge and the Township of Cambridge. A GIS shapefile of the DWSMA is provided in **Appendix C**.

6 Vulnerability Assessments

The Part I wellhead protection plan includes the vulnerability assessments for the public water supply wells and DWSMA. These vulnerability assessments are used to help define potential contamination sources within the DWSMA and to select appropriate measures for reducing the risk that they present to the public water supply.

6.1 Assessment of Well Vulnerability

The MDH has developed a database of community and non-community, non-transient public water supply wells in Minnesota that stores information pertinent to well vulnerability and rates the vulnerability of individual wells. A score is calculated for each well based on factors such as well construction, geology at the well site, and chemical data. A higher score correlates to a greater perceived vulnerability. A numeric cutoff is used to identify vulnerable from non-vulnerable wells (MDH, 1997). Vulnerable wells are also identified based on the presence of contamination, such as nitrate-nitrogen in excess of 10 mg/l, or young (post-1953) water, as indicated by the presence of 1 tritium unit or greater in the well water.

The vulnerability assessment for each well used by the City of Cambridge is listed in **Table 2**. The well vulnerability scoring sheets, which include well-specific information such as aquifer setting, well construction, and water quality (including results from tritium and nitrate analysis) are available from the MDH. The vulnerability scoring sheets rate all of the City of Cambridge primary wells as Not Vulnerable. This assessment is based upon the following conditions:

1. Well construction meets current State Well Code specifications (Minnesota Rules, part 4725) and the well itself does not provide a pathway for contaminants to enter the aquifer used by the public water supplier;
2. The geologic conditions at the well site include a cover of clay- and shale-rich geologic materials over the aquifer that is sufficient to retard or prevent the vertical movement of contaminants; and
3. None of the human-caused contaminants regulated under the federal Safe Drinking Water Act have been detected at levels indicating that the wells serve to draw contaminants into the aquifer as a result of pumping.
4. Water samples were collected from Well 6 in September 2012 and analyzed for tritium. No tritium was found in the sample.

6.2 Assessment of the Drinking Water Supply Management Area Vulnerability

The vulnerability of the DWSMA is moderate and is based upon the following information:

1. Isotopic and water chemistry data: Well 5 (680652) and Well 6 (731532) were analyzed for tritium in 2006. Well 5, an emergency backup well, had tritium at 14 TU and Well 6 had <0.8 TU. Wells 5, 6, and 7 (735018) were analyzed for nitrate which was not detected in any of the wells.
2. Review of the geologic logs contained in the MWI database and geological maps and reports indicate that the aquifer exhibits a low geologic sensitivity throughout the DWSMA. The L-scores from wells within or close to the DWSMA were provided by the MDH and reviewed. L-scores are based on the thickness of low-permeability units (for example, clay or shale) at the well location (MnDNR, 1991). In the vicinity of the Cambridge DWSMA, L-scores vary from 4 to 7 that 40 feet to 70 feet of low-permeability material overlies the Mt. Simon-Fond du Lac Aquifer (**Figure 6**). Approximately 40 feet of shale as the Eau Claire Formation overlies the aquifer in the vicinity of the public water supply wells (**Figure 3** and **Figure 4**) which acts as a bedrock confining unit over the Mt. Simon-Fond du Lac Aquifer. The Mt.

Simon-Fond du Lac Aquifer near the City of Cambridge is, therefore, isolated from the direct vertical recharge of surface water.

Tritium detection is indicative of vulnerability and therefore increases the vulnerability of the setting. Cross-sections indicate the aquifer has good protection from contaminants due to the presence of 40 feet of Eau Claire Formation aquitard. However, other wells penetrating the Eau Claire could act as a pathway for human-derived contaminants to reach the Mt. Simon that would otherwise be protected by the overlying geology.

7 Recommendations

The following plan implementation action item recommendations have been made for the City of Cambridge to consider. The recommendations are referenced to the plan implementation category under which it can be incorporated and will be further evaluated during the preparation of the Part II WHP Plan Update.

Plan Implementation Category – Data Collection
Work with MDH hydrologist to collect tritium samples from Well 7 (735018) and Well 8 (795532) which do not have tritium data by year seven of plan implementation. Tritium is one of the water quality parameters used for well vulnerability assessments. Pumping from Wells 6, 7, and 8 will be greater than historic levels due to Well 1 (217867) having been changed to an emergency backup well and its pumping volume apportioned among the remaining wells.

Plan Implementation Category – Data Collection
The City should evaluate sealing emergency backup wells Well 1 (217867) and Well 5 (680652). Work with MDH hydrologist to collect tritium and contaminant (e.g., nitrate) samples from the wells by year three of plan implementation. Both wells have had tritium detected and Well 1 has also had nitrate detected. The samples results, along with a down-hole video log will help evaluate the integrity of the wells; if the wells have an integrity issue, they may act as a conduit for potential contaminants into the Mt. Simon aquifer.

8 Selected References

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Minnesota Department of Natural Resources (MnDNR), Division of Waters (1991), *Criteria and Guidelines for Assessing Geologic Sensitivity of Ground Water Resources in Minnesota*. Prepared for the Legislative Commission on Minnesota Resources. 122pp.

Short Elliott Hendrickson Inc. (2006), *Wellhead protection area and drinking water supply management area delineations and vulnerability assessments, part 1 wellhead protection plan, Cambridge, Minnesot*a, St. Paul, Minn., 93 p.

9 Standard of Care

The interpretations presented in this report are based on local data collected during this study and previous studies, such as current and historical pumping tests and regional data collected from governmental agencies. Data collected and analyzed by others and used in this report may not be precise or accurate. This Plan does not account for any variations that may occur between points of exploration; geologic and hydrogeologic conditions likely differ across the study area. Also, it must be noted that seasonal and cyclical fluctuations in the hydrogeologic characteristics and properties of the aquifers will occur.

The scope of this report and the corresponding groundwater flow model and calculations is limited to the delineation of capture zones for the City of Cambridge municipal wells. Use of the groundwater flow model by other parties or for other purposes is not advised. Use or modification of the model for purposes other than the delineation of capture zones must be done with caution and a full understanding of the inherent assumptions and limitations of the data.

This Plan represents our understanding of the significant aspects of the local geologic and hydrogeologic conditions; the conclusions are based on our hydrogeologic and engineering judgment, understanding and perspective, and represent our professional opinions. These opinions were arrived at in accordance with the currently accepted standard of care for geologic and engineering practices at this time and location. No warranty is implied or intended.

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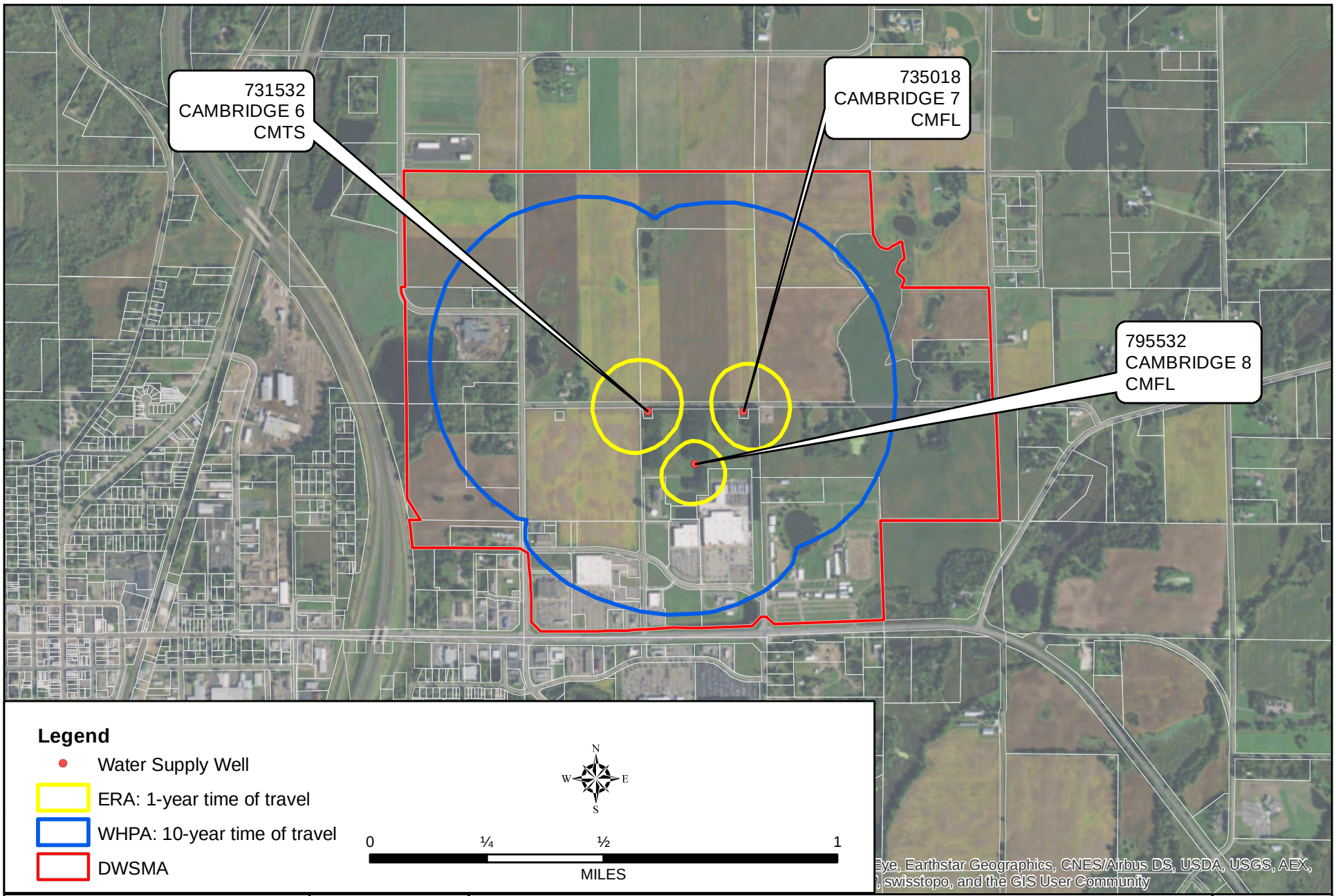
Figures



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3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

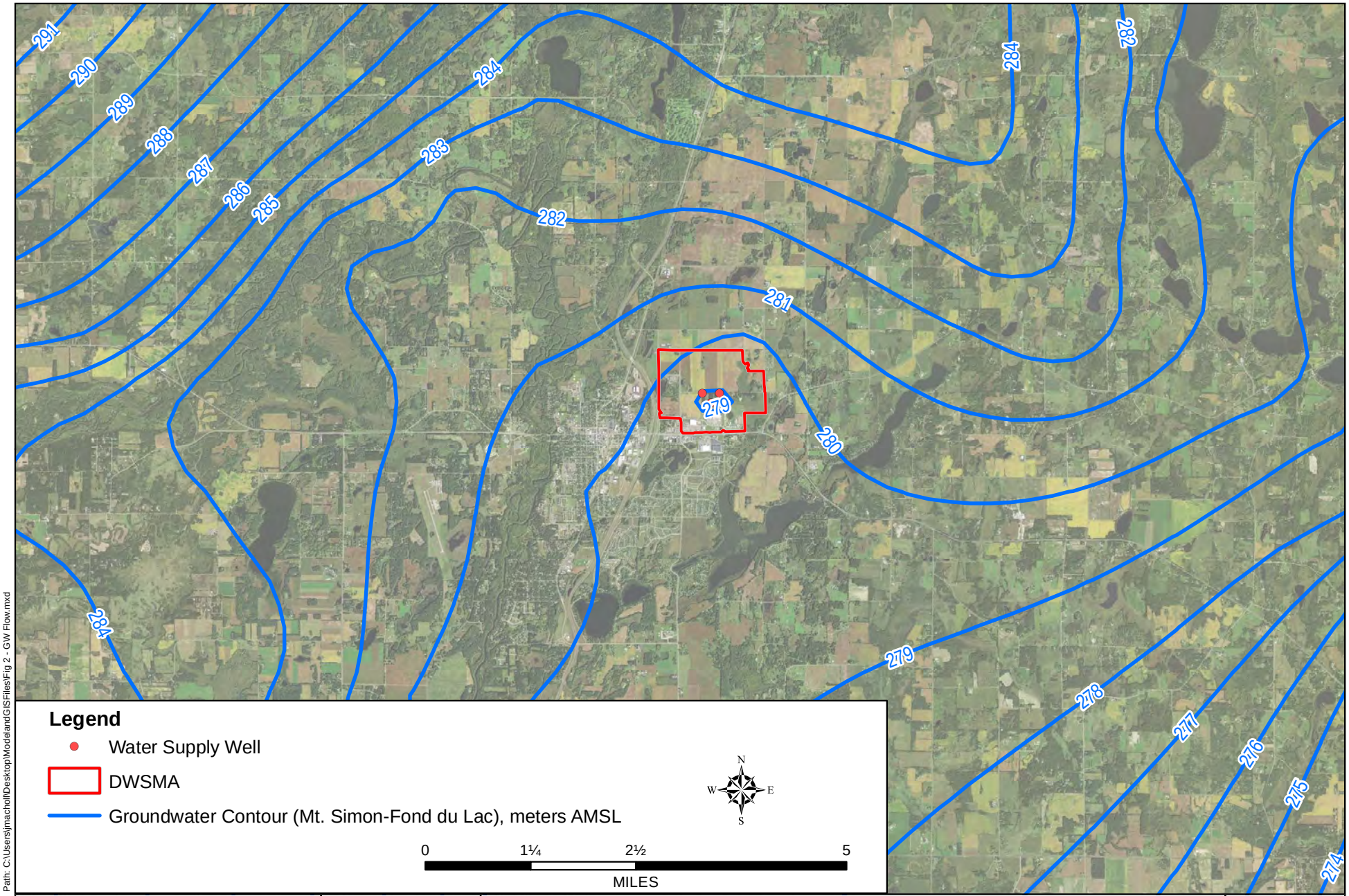
Project: CAMBR 135080
Print Date: 7/20/2017

Map by: jmacholl
Projection: NAD 83 UTM Zone 15N
Source: ESRI, MDH, MnGEO

CAMBRIDGE WELLHEAD PROTECTION AREA

Cambridge Wellhead Protection Plan Amendment Part 1
Isanti County, Minnesota

Figure 1



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SEH
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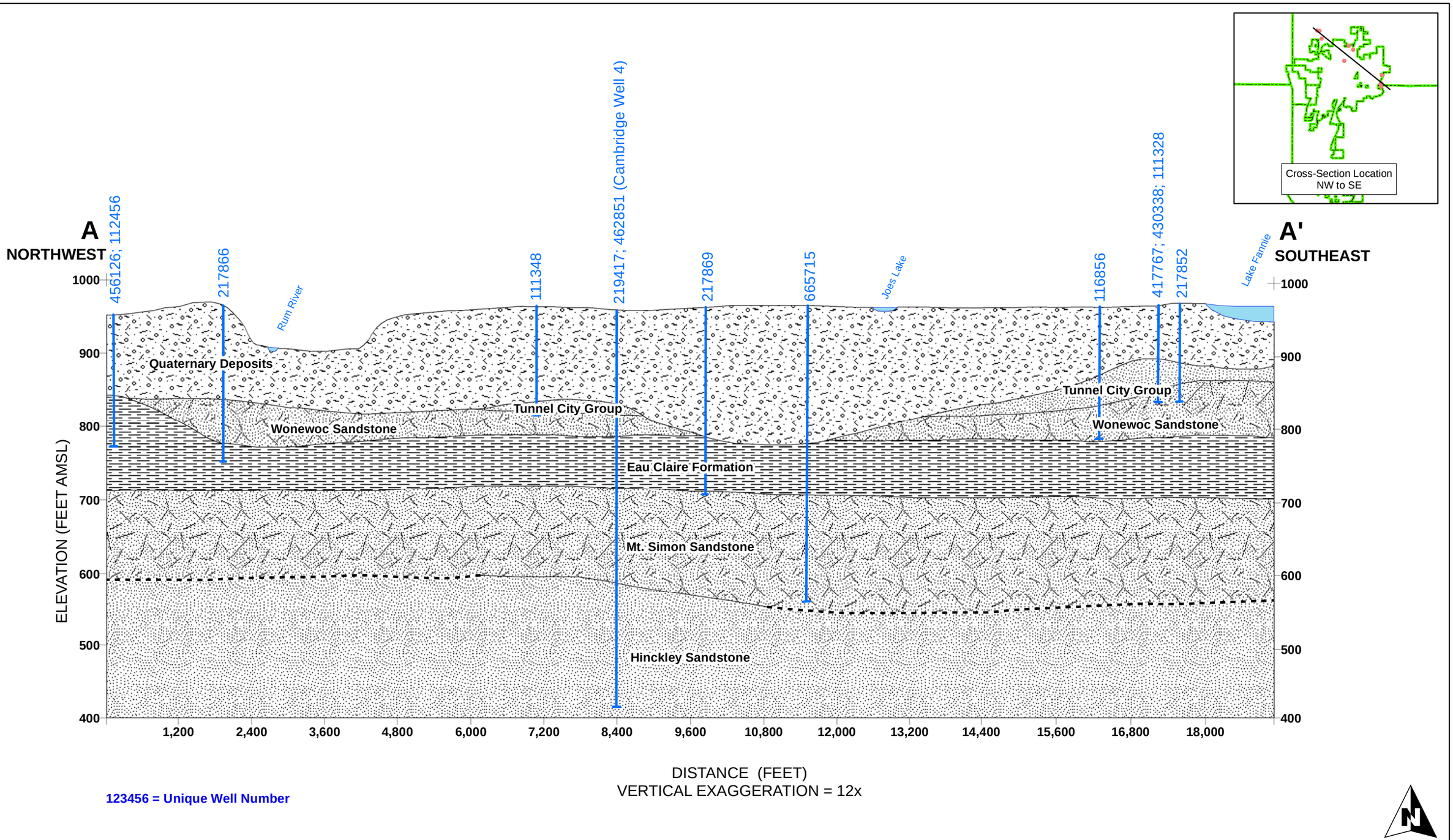
Print Date: 6/22/2017

Map by: jmacholl
Projection: NAD 83 UTM Zone 15N
Source: MDH, NAIP, MnGEO

MODELED GROUNDWATER FLOW FIELD

Cambridge Wellhead Protection Plan Amendment Part 1
Isanti County, Minnesota

Figure 2



DISTANCE (FEET)
VERTICAL EXAGGERATION = 12x

123456 = Unique Well Number

SEH
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Project Number
CAMBR 135080

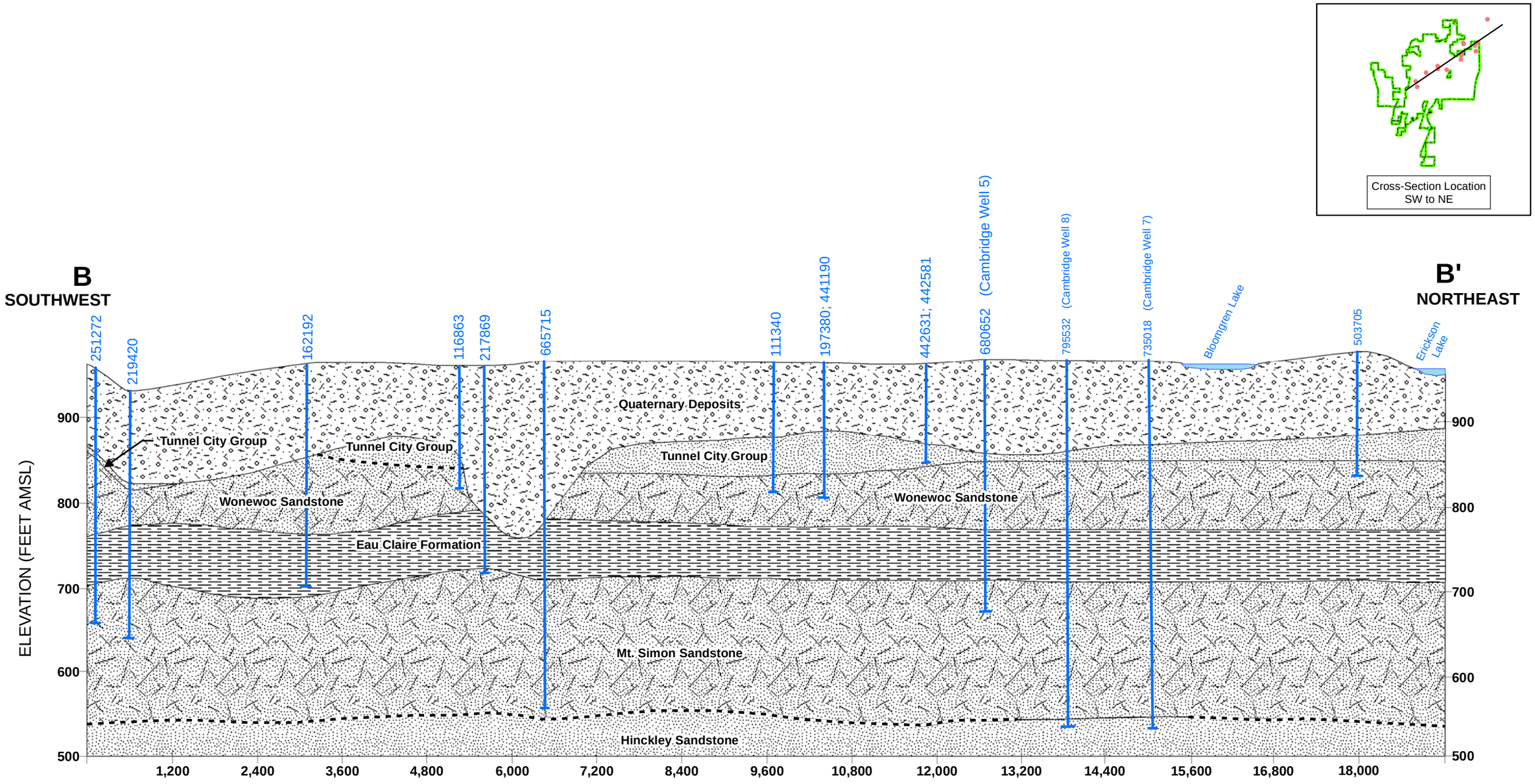
Date
04/27/2016

WELLHEAD PROTECTION PLAN - PART I

Cambridge, Minnesota

Typical Geologic Cross-section NW to SE

Figure 3



SEH
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Project Number
CAMBR 135080

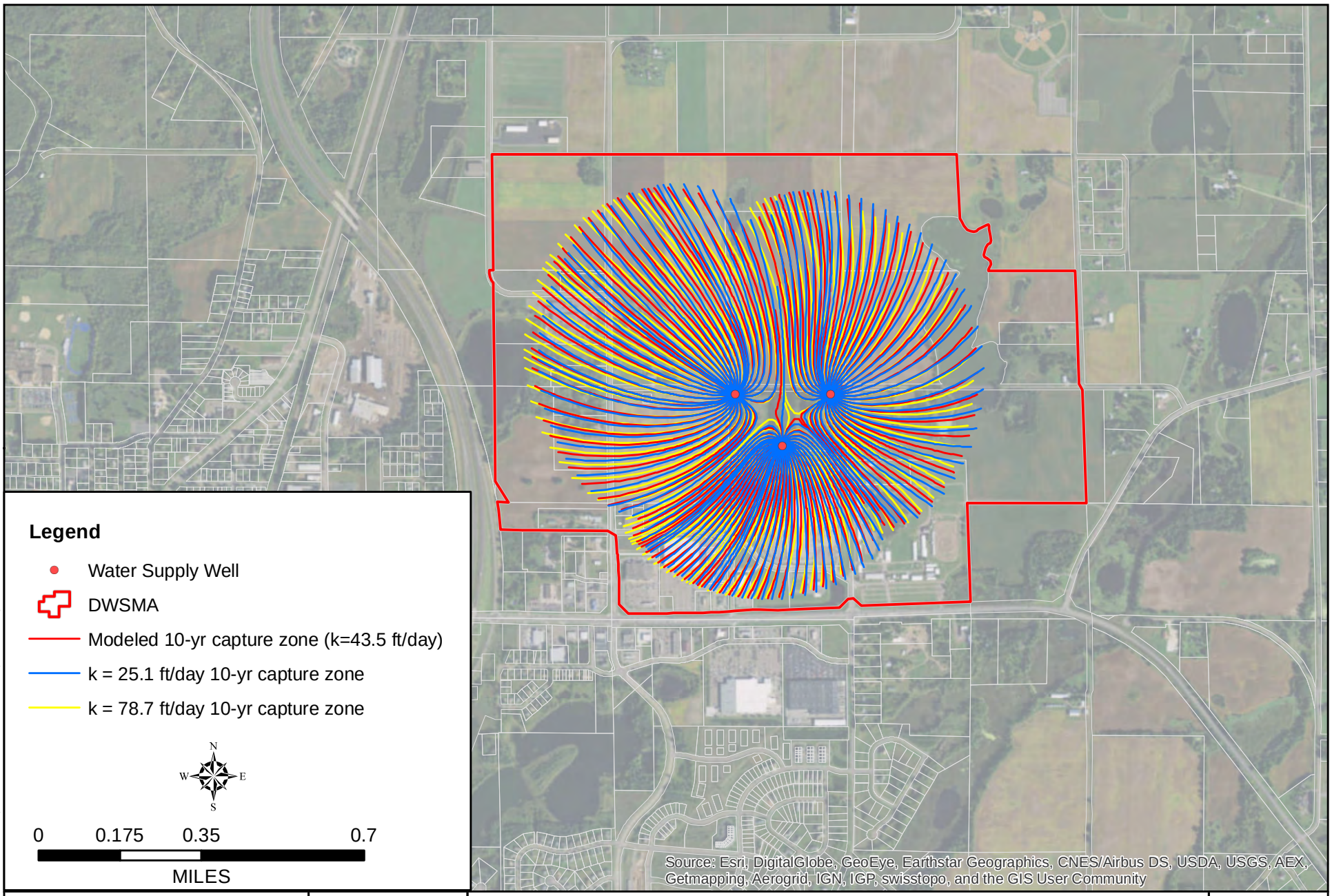
Date
04/27/2016

WELLHEAD PROTECTION PLAN - PART I

Cambridge, Minnesota

Typical Geologic Cross-section SW to NE

Figure 4



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SEH
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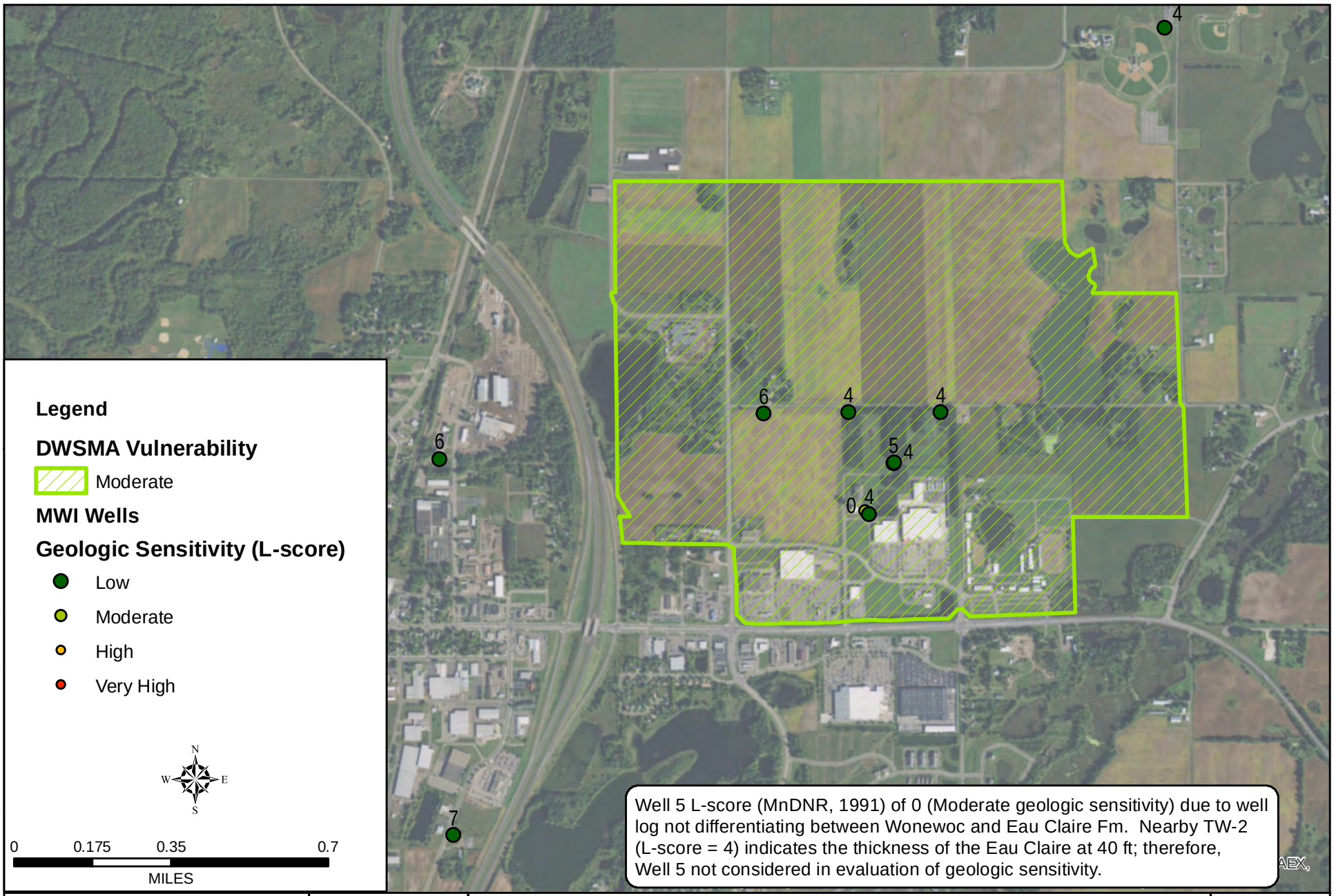
Project: CAMBR 135080
Print Date: 7/20/2017

Map by: jmacholl
Projection: NAD 83 UTM Zone 15N
Source: ESRI, MGS, MnGEO

POROUS MEDIA CAPTURE ZONE DELINEATION

Cambridge Wellhead Protection Plan Amendment Part 1
Isanti County, Minnesota

Figure 5



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SEH
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Project: CAMBR 135080
Print Date: 7/20/2017

Map by: jmacholl
Projection: NAD 83 UTM Zone 15N
Source: MDH, MWI, NAIP

DWSMA VULNERABILITY

Cambridge Wellhead Protection Plan Amendment Part 1
Isanti County, Minnesota

Figure 6

Appendix A

Scoping Decision Notice 1

MINNESOTA
MDH
DEPARTMENT OF HEALTH

COPY

Protecting, maintaining and improving the health of all Minnesotans

March 25, 2015

Mr. Todd Schwab, Utilities Director
City of Cambridge
300 Third Avenue Northeast
Cambridge, Minnesota 55008

Dear Mr. Schwab:

Subject: **Scoping Decision Notice No. 1 for the City of Cambridge, PWSID 1300002, for Amending the Wellhead Protection Plan**

This letter provides notice of the results of the Scoping 1 meeting that I and John Freitag (Minnesota Department of Health) held with Todd Blank, and Sue Wojtkiewicz (Short Elliott Hendrickson, Inc.) on March 10, 2015, to amend your wellhead protection plan. During the meeting, we discussed the preparation of Part I of a Wellhead Protection Plan that will document the 1) delineation of a wellhead protection area, 2) delineation of a drinking water supply management area, and 3) assessments of well and aquifer vulnerability related to these areas for the primary water supply wells used by the city of Cambridge. As you may remember, the wellhead protection area is the surface and subsurface area surrounding your public water supply wells through which contaminants are likely to move and affect your drinking water supply. The drinking water supply management area is the area delineated using identifiable landmarks that reflect the wellhead protection area boundaries as closely as possible.

The city will have until February 27, 2018, to submit the amendment of its entire Wellhead Protection Plan, Part I and Part II. The Minnesota Department of Health (MDH) highly recommends that half of the time allotted be dedicated to completing Part II of the plan.

It is our understanding that you will be contracting a consultant to prepare the delineations and vulnerability assessments for the city for amending its Wellhead Protection Plan. MDH has a draft Request for Proposal (RFP) that can be used to help select a consultant that has experience in wellhead protection planning and, in particular, with preparing a Part I report. Please contact me at the phone number below if you want to discuss using the draft RFP.

At our meeting, we discussed rule requirements and the types of information needed to amend the Part I report. The Wellhead Protection Plan must be prepared in accordance with Minnesota Rules, parts 4720.5100 to 4720.5590. General wellhead protection requirements and criteria for delineating the wellhead protection area and data reporting are presented in Minnesota Rules, parts 4720.5500 to 4720.5510.

The enclosed Scoping Decision Notice No. 1 formally identifies the information the city must provide to MDH to meet rule requirements for amending and preparing Part I of the Wellhead Protection Plan. The wellhead rule refers to the existing information required for wellhead planning as data elements. Much of this information is available in the public domain, as described in the Scoping Decision Notice No. 1 form.

You only need to provide the information that is not in the public domain and, therefore, not available to MDH. The Scoping Decision Notice No. 1 form also 1) lists the Minnesota unique well number and well construction for each well that will be included in the Wellhead Protection Plan [Table 1]; 2) lists the pumping volumes for each well [Table 2]; and 3) includes maps of the well locations. A summary of the information that the PWS needs to provide is included at the end of the Scoping Decision Notice No. 1 form.

After your consultant has had an opportunity to develop a conceptual model of the local hydrogeologic setting, we would like to meet with your consultant to discuss the proposed delineation approach. This pre-delineation meeting may be accomplished by a conference call if 1) MDH approves and 2) the consultant provides figures for the discussion beforehand. The porous media delineation could be performed using the Metro Model 3 that Barr Engineering developed for the Metro Council or the Isanti-Chisago-Anoka Counties model that MDH developed. Local detail and/or new information should be added as required and recalibration should be performed to reflect the hydrogeological conditions near the city wells.

If the vulnerability analysis shows that there are highly vulnerable areas within the DWSMA, then the need for including a conjunctive delineation should also be assessed.

Prior to finalizing the wellhead protection area boundaries, we highly recommend that we informally review preliminary model results and assess whether any changes are needed to meet rule requirements. Model input and solution files should be submitted in electronic form. The same applies to geographical data, such as the wellhead protection area and drinking water supply management area. When geographic data are submitted electronically, ArcInfo export or ArcView shapefile formats are preferred. It will greatly accelerate our review if these geographic data use the 1983 North American Datum (NAD83), Universal Transverse Mercator, Zone 15 North (UTM, Z15N) projection, with meter distance units. Other datum and projection systems are acceptable as long as they are documented. Specific questions regarding electronic geographic data can be directed to Michael Baker, Source Water Protection Unit, at 651/201-4651.

Finally, it is our understanding that you will serve officially as the wellhead protection manager on behalf of the city. You are responsible for providing written notice to local units of government of the city's intent to amend the Wellhead Protection Plan, as required by the wellhead protection rule

(part 4720.5300, subpart 3). A copy of this notice should be forwarded to MDH and must include a list of the city's wells, their unique well numbers, and contact information for you as Wellhead Protection manager. If you do not have a copy of your original notice from your previous WHP Plan, your Source Water Protection Unit Planner, John Freitag, can provide you with some examples of the notification of intent that other communities have used. Please contact him at 651/201-4669.

In closing, we look forward to working with you on amending your Wellhead Protection Plan. If you have any questions regarding our comments, please contact me at 651/201-4577 or at amal.djerrari@state.mn.us.

Sincerely,

Amal Djerrari, Hydrologist
Source Water Protection Unit
Environmental Health Division
P.O. Box 64975
St. Paul, Minnesota 55164-0975

AMD:ds-b
Enclosures: Scoping Decision Notice No. 1; Summary of Data Requested; Table 1 - Public Water Supply Well Information; Table 2 - Annual Volume of Water Pumped From PWS Wells; Table 3 - Permitted High-Capacity Wells; Maps of Well Locations
cc: John Freitag, Source Water Protection Unit, Metro Office
Ron Struss, Minnesota Department of Agriculture
Todd Blank, Short Elliott Hendrickson Inc.

SCOPING DECISION NOTICE No. 1
(Vulnerable Setting)

The purpose for the first Scoping Meeting, as required by Minnesota Rules, part 4720.5310, is to discuss the information necessary for preparing the Part I Report of a Wellhead Protection Plan. The Part I Report identifies the area that provides the source of drinking water for the public water supply (PWS) so that the PWS can develop land use or management practices to protect their groundwater resource from contamination. Specifically, the Part I Report documents the delineation of the wellhead protection area (WHPA), the delineation of the drinking water supply management area (DWSMA), and assesses the vulnerability of the PWS wells and DWSMA.

The wellhead rule (Minnesota Rules, part 4720.5310) refers to the information required for wellhead planning as data elements. This form lists the data elements stated in Minnesota Rules, part 4750.5400. The Minnesota Department of Health (MDH) uses this form to designate which data elements are needed to prepare the Part I Report, based on the hydrogeological setting, vulnerability of the wells, and aquifer information known at the time of the Scoping 1 Meeting.

Name of Public Water Supply **City of Cambridge** **(PWSID = 1300002)**		**Date** March 25, 2015
Name of the Wellhead Protection Manager Mr. Todd Schwab, Utilities Director		
Address 300 Third Avenue Northeast	**City** Cambridge	**Zip** 55008
Unique Well Numbers 217867 (Well 1), 731532 (Well 6), 735018 (Well 7), and 795532 (Well 8)		**Phone** (763) 689-1800

Instructions for Completing the Scoping No. 1 Form

N	D	V	S	
X				**N** = If this box is checked with an "X," this data element is **NOT** necessary for the **Part I Report** of your Wellhead Protection Plan. This data element may be identified later at the Scoping 2 Meeting and used for the Part 2 Report. Please go to the next data element.

N	D	V	S	
	X			**D** = If this box is checked with an "X," the preparer of the Part I Report is **required** to use this information for the **DELINEATION** of the WHPA or the DWSMA. If there is no check in the "S" box, this information is available in the public domain or is at MDH.

N	D	V	S	
		X		**V** = If this box is checked with an "X," the preparer of the Part I Report is **required** to use this information for the **VULNERABILITY** assessment of the PWS well(s) or the DWSMA. If there is no check in the "S" box, this information is available in the public domain or is on-file at MDH.

N	D	V	S	
			X	**S** = If this box is checked with an "X," the PWS **must SUBMIT** the information to MDH.

DATA ELEMENTS ABOUT THE PHYSICAL ENVIRONMENT

A. PRECIPITATION

N	D	V	S	
X				A.1: An existing map or list of local precipitation gauging stations.

Technical Assistance Comments:

N	D	V	S	
X				A.2: An existing table showing the average monthly and annual precipitation, in inches, for the preceding five years.

Technical Assistance Comments:

B. GEOLOGY

N	D	V	S	
	X	X	X	B.1: An existing geologic map and a description of the geology, including aquifers, confining layers, recharge areas, discharge areas, sensitive areas as defined in Minnesota Statutes, section 103H.005, subdivision 13, and groundwater flow characteristics.

Technical Assistance Comments: Information of this type is required to characterize the geologic and hydrogeologic setting of the PWS well field(s). This information is used to define aquifer geometry, location and magnitude of the recharge and discharge areas, and groundwater flow information. Aquifer tests or alternatives listed in MN Rules, part 4720.5510, subpart 6, can be used to help characterize flow in the aquifer. Reference all information used to develop the conceptual model of the geologic setting and submit to MDH only the information that is not available in the public domain.

N	D	V	S	
	X	X	X	B.2: Existing records of the geologic materials penetrated by wells, borings, exploration test holes, or excavations, including those submitted to the department.

Technical Assistance Comments: Information of this type may be useful to refine the understanding of the geologic and hydrogeologic setting on a local basis. Submit only if the PWS or city has information of test drilling or site investigations conducted by the city that is not available in the public domain.

N	D	V	S	
	X	X	X	B.3: Existing borehole geophysical records from wells, borings, and exploration test holes.

Technical Assistance Comments: Information from geophysical records may provide additional information about aquifer thickness, well construction, and water level information at a local scale. Submit only if the information is not available in the public domain.

N	D	V	S	
	X	X	X	B.4: Existing surface geophysical studies.

Technical Assistance Comments: Information from geophysical studies may be useful to refine the understanding of the geology on a local basis. Submit only if the information is not available in the public domain.

C. SOILS

N	D	V	S	
X				C.1: Existing maps of the soils and a description of soil infiltration characteristics.

Technical Assistance Comments:

N	D	V	S	
X				C.2: A description or an existing map of known eroding lands that are causing sedimentation problems.

Technical Assistance Comments:

D. WATER RESOURCES

N	D	V	S	
X				D.1: An existing map of the boundaries and flow directions of major watershed units and minor watershed units.

Technical Assistance Comments:

N	D	V	S	
X				D.2: An existing map and a list of public waters as defined in Minnesota Statutes, section 103G.005, subdivision 15, and public drainage ditches.

Technical Assistance Comments:

N	D	V	S	
X				D.3: The shoreland classifications of the public waters listed under sub-item (2), pursuant to part 6120.3000 and Minnesota Statutes, sections 103F.201 to 103F.221.

Technical Assistance Comments:

N	D	V	S	
X				D.4: An existing map of wetlands regulated under Chapter 8420 and Minnesota Statutes, section 103G.221 to 103G.2373.

Technical Assistance Comments:

N	D	V	S	
X				D.5: An existing map showing those areas delineated as floodplain by existing local ordinances.

Technical Assistance Comments:

DATA ELEMENTS ABOUT THE LAND USE

E. LAND USE

N	D	V	S	
	X		X	E.1: An existing map of parcel boundaries.

Technical Assistance Comments: This information may be helpful in delineating the DWSMA, if available. If this information is provided, identification numbers must be provided for each parcel. An electronic format for the map is preferable.

N	D	V	S	
	X		X	E.2: An existing map of political boundaries.

Technical Assistance Comments: Please provide this information if the boundaries have been updated/changed. This information may help delineate the DWSMA. An electronic format for the map is preferable.

N	D	V	S	
	X			E.3: An existing map of public land surveys, including township, range, and section.

Technical Assistance Comments: This information is available in the public domain and may be used to delineate the DWSMA.

N	D	V	S	
X				E.4: A map and an inventory of the current and historical agricultural, residential, commercial, industrial, recreational, and institutional land uses and potential contaminant sources.

Technical Assistance Comments:

N	D	V	S	
X				E.5: An existing, comprehensive land-use map.

Technical Assistance Comments:

N	D	V	S	
X				E.6: Existing zoning map.

Technical Assistance Comments:

F. PUBLIC UTILITY SERVICES

N	D	V	S	
	X			F.1: An existing map of transportation routes or corridors.

Technical Assistance Comments: This information is available in the public domain and may be used to delineate the DWSMA.

N	D	V	S	
X				F.2: An existing map of storm sewers, sanitary sewers, and the public water supply systems.

Technical Assistance Comments:

N	D	V	S	
X				F.3: An existing map of gas and oil pipelines used by gas and oil suppliers.

Technical Assistance Comments:

N	D	V	S	
X				F.4: An existing map or list of public drainage systems.

Technical Assistance Comments:

N	D	V	S	
	X	X	X	F.5: An existing record of construction, maintenance, and use of the public water supply well(s) and other wells within the drinking water supply management area.

Technical Assistance Comments: If the information is different than that on-file with MDH, please provide 1) the pumping rates for the current and previous years, and the projected annual pumping rates for the next five years for each well in the PWS; and 2) well record(s) for the PWS well(s). Information about the PWS well(s) may affect the vulnerability assessment due to rehabilitation/reconstruction of a well or changes in pumping rates.

DATA ELEMENTS ABOUT WATER QUANTITY

G. SURFACE WATER QUANTITY

N	D	V	S	
X				G.1: An existing description of high, mean, and low flows on streams.

Technical Assistance Comments:

N	D	V	S	
X				G.2: An existing list of lakes where the state has established ordinary high water marks.

Technical Assistance Comments:

N	D	V	S	
X				G.3: An existing list of permitted withdrawals from lakes and streams, including source, use, and amounts withdrawn.

Technical Assistance Comments:

N	D	V	S	
X				G.4: An existing list of lakes and streams for which state protected levels or flows have been established.

Technical Assistance Comments:

N	D	V	S	
X				G.5: An existing description of known water-use conflicts, including those caused by groundwater pumping.

Technical Assistance Comments:

H. GROUNDWATER QUANTITY

N	D	V	S	
	X	X	X	H.1: An existing list of wells covered by state appropriation permits, including amounts of water appropriated, type of use, and aquifer source.

Technical Assistance Comments: Please submit this information for wells that are not permitted by the DNR because this information may be useful in identifying the hydrologic boundary conditions that could affect the size and shape of the WHPA boundaries.

N	D	V	S	
	X	X	X	H.2: An existing description of known well interference problems and water-use conflicts.

Technical Assistance Comments: Please notify MDH of well interference problems of which the PWS is aware. Interference problems with other wells, if present, likely indicate a hydrologic boundary that would need to be considered in making the WHPA delineation.

N	D	V	S	
	X	X	X	H.3: An existing list of state environmental boreholes, including unique well number, aquifer measured, years of record, and average monthly levels.

Technical Assistance Comments: Only submit monthly water level measurements (with unique well numbers and dates) if this information is not available in the public domain.

DATA ELEMENTS ABOUT WATER QUALITY

I. SURFACE WATER QUALITY

N	D	V	S	
X				I.1: An existing map or list of the state water quality management classification for each stream and lake.

Technical Assistance Comments:

N	D	V	S	
X				I.2: An existing summary of lake and stream water quality monitoring data, including: 1. bacteriological contamination indicators; 2. inorganic chemicals; 3. organic chemicals; 4. sedimentation; 5. dissolved oxygen; and 6. excessive growth or deficiency of aquatic plants.

Technical Assistance Comments:

J. GROUNDWATER QUALITY

N	D	V	S	
	X	X	X	J.1: An existing summary of water quality data, including: 1) bacteriological contamination indicators; 2) inorganic chemicals; and 3) organic chemicals.

Technical Assistance Comments: Submit if the PWS has information that is not available in the public domain, because the information may help explain groundwater flow paths.

N	D	V	S	
	X	X	X	J.2: An existing list of water chemistry and isotopic data from wells, springs, or other groundwater sampling points.

Technical Assistance Comments: Submit if the PWS has information that is not available in the public domain, because the information may help explain groundwater flow paths.

N	D	V	S	
	X	X	X	J.3: An existing report of groundwater tracer studies.

Technical Assistance Comments: Submit if the PWS has information that is not available in the public domain, because the information may help explain groundwater flow paths.

N	D	V	S	
		X	X	J.4: An existing site study and well water analysis of known areas of groundwater contamination.

Technical Assistance Comments: Submit if the PWS has information on contaminant sources not available in the public domain, because these reports may contain additional geologic or hydrogeologic information.

N	D	V	S	
X				J.5: An existing property audit identifying contamination.

Technical Assistance Comments:

N	D	V	S	
	X	X		J.6: An existing report to the Minnesota Department of Agriculture and the Minnesota Pollution Control Agency of contaminant spills and releases.

Technical Assistance Comments: Notify MDH of reports on spills or contaminant releases that are on-file with the PWS or city but are not in the public domain. These reports do not need to be submitted but MDH staff would like to review the reports.

City of Cambridge
Summary of Data Request
Specific Data to be Provided to MDH by PWS

As discussed during the first Scoping Meeting on March 10, 2015, the public water supply (PWS) will provide the following information for Part I of their Wellhead Protection Plan to the Minnesota Department of Health. The number of the data element that refers to the information needed to prepare the Part I Report is listed in the parenthesis at the end of each request.

1) Municipal well information: Use Tables 1 and 2, the well records for the PWS well(s), and a map showing the location(s) of all the PWS well(s), to review the accuracy of 1) all PWS well construction, 2) well locations, and 3) pumping information. (F.5)

   Table 1 lists well use and construction for each of the PWS wells. Have you reconstructed any wells? Are there well records for reconstructed wells?

   The enclosed map shows the locations of the primary public water supply well(s). Please let us know if you feel the wells are not correctly located. These locations must be used to delineate your wellhead protection areas.

   Table 2 shows the available pumping information and indicates what information the PWS needs to provide for the delineation of the capture zone. Please provide 1) the pumping data for 2012 and 2013 that was sent to the Minnesota Department of Natural Resources, 2) whether this rate was measured or estimated, and 3) the projected annual pumping amounts for the next five years.

2) Provide a copy of any aquifer test or specific capacity information for the PWS well(s) that was obtained during well construction, maintenance, or repair. (B.1)

3) Is there an existing map of parcel and/or political boundaries that could be used for defining the Drinking Water Supply Management Area (DWSMA)? If you wish to use parcel lines, please provide the parcel identification number for each parcel boundary along with the map. Have the city boundaries changed? If the city boundaries have changed, please provide the new boundaries. The boundaries of the DWSMA may be larger if political boundaries are used instead of the parcel boundaries. (E.1 and E.2)

4) Are there other private well records, soil boring reports, geophysical studies, or water level measurements in your files that MDH staff did not identify at the scoping meeting and that would be available for MDH staff to review and copy? (B.2, B.3, B.4, and H.3)

5) Identify reports that you have on-file relating to leaks/contamination sites that may be a concern to your drinking water supply that MDH may review and copy. (J.4)

6) Do your files contain water chemistry data, such as bacteria, virus, inorganic, organic, or isotopic results from wells or other groundwater sampling points, not currently available to MDH that MDH may review and copy? (J.1 and J.2)

7) Identify reports that you have in your files relating to groundwater tracer studies that have been conducted. (J.3)

8) Provide information about other high-capacity wells in your area that may not be permitted and are not listed on the attached Table 3. (H.1)

9) Describe any conflicts over water use that the PWS has been involved with, such as 1) private wells that went dry (or well interference) or 2) springs or wetlands that were affected. Was the Department of Natural Resources involved in resolving the conflict? (G.5 and H.2)

Table 1- Water Supply Well Information
City of Cambridge

Local Well Name	Unique Number	Type	Casing Diameter (inches)	Casing Depth (feet)	Well Depth (feet)	Date Constructed	Aquifer	Well Vulnerability
Well 1	217867	Primary	20	151	369	1958	CEMS - Eau Claire-Mt.Simon	Vulnerable
Well 4	462851	Emergency	14	260	536	1990	CMSH - Mt.Simon-Hinckley	Not Vulnerable
Well 5	680652	Emergency	16	277	337	2004	CMTS - Mt.Simon	Vulnerable
Well 6	731532	Primary	24 x 18	300	410	2005	CMTS - Mt.Simon	Not Vulnerable
Well 7	735018	Primary	24 x 18	313	422	2006	CMTS - Mt.Simon	Not Vulnerable
Well 8	795532	Primary	24 x 18	307	427	2013	CMTS - Mt.Simon	Not Vulnerable

Table 2 - Annual Volume of Water Pumped from Wells
City of Cambridge

Well Name	Unique Number	Type	Total Annual Withdrawal (gal/year) Permit Number: 1966-0149					Maximum Withdrawal 2009 - 2013 (gallons/year)	Projected 2018 Withdrawal (gallons/year)	Withdrawal used in Previous WHP Plan (gallons/year)
			2009	2010	2011	2012	2013			
Well 1	217867	Primary	**38,554,000**	13,230,000	33,492,000	33,519,400	31,733,517	38,554,000		182,208,000
Well 4	462851	Emergency	0	0	0	0	0	0		137,021,000
Well 5	680652	Emergency	**1,169,712**	0	0	23,855	6,464	1,169,712		106,032,500
Well 6	731532	Primary	80,076,357	**225,348,046**	198,627,231	196,292,286	162,253,433	225,348,046		125,012,500
Well 7	735018	Primary	**211,953,976**	46,088;500	43,062,930	76,483,046	70,549,648	211,953,976		125,012,500
Well 8	795532	Primary	0	0	0	0	**7,110,184**	7,110,184		
Totals			331,754,045	284,666,546	275,182,161	306,318,587	271,653,246	484,135,918		675,286,500

Source: The DNR State Water Use Database System (SWUDS), Permit Number Permit Number 1966-0149.

Table 3
Permitted High-Capacity Wells within 2.0 miles
City of Cambridge

Unique Number	Well Name	DNR Permit Number	Aquifer	Use	Annual Volume of Water Pumped* ▲	Daily Volume (cubic meters)
497376	Opta Food Ingredients Inc	1992-3160	CMTS	Agricultural/Food Processing	55.4	574.0
217864	Vavra, Roger	1962-0513	CIGLCMTS	Agricultural Crop Irrigation	28.8	299.0
686289	Cambridge, City of	1966-0149	CMTS	Irrigation	22.2	230.0
727860	Anoka Ramsey Community College Cambridge Campus	2006-0300	CMTS	Landscaping/Athletic Field Irrigation	6.0	63.0
456663	Pine Village Mobile Park	1967-0122	CMTS	Private Water Supply	2.8	29.0
731143	Great River Energy	2007-0405	CMTS	Thermoelectric Power Cooling	0.3	3.0
456953	Munkberg Farms Inc	1979-3143	CMTS	Agricultural Crop Irrigation	0.00	0.00
219420	Mn Dept Of Human Services	1975-3199	CIGLCMTS	Commercial/Institutional Water Supply	0.00	0.00
219418	Cambridge, City of	1966-0149	CECRCMTS	Municipal/Public Water Supply	0.00	0.00
217868	Cambridge, City of	1966-0149	PMHNPMFL	Municipal/Public Water Supply	0.00	0.00
214507	Munkberg Farms Inc	1966-0074	CIGE	Agricultural Crop Irrigation	0.00	0.00

* = Expressed as millions of gallons. Source year = 2013.
Source: MN Dep't. of Natural Resources Division of Waters - State Water Use Data System (SWUDS)
GIS Data Source: SWP.mpars_ii_2013

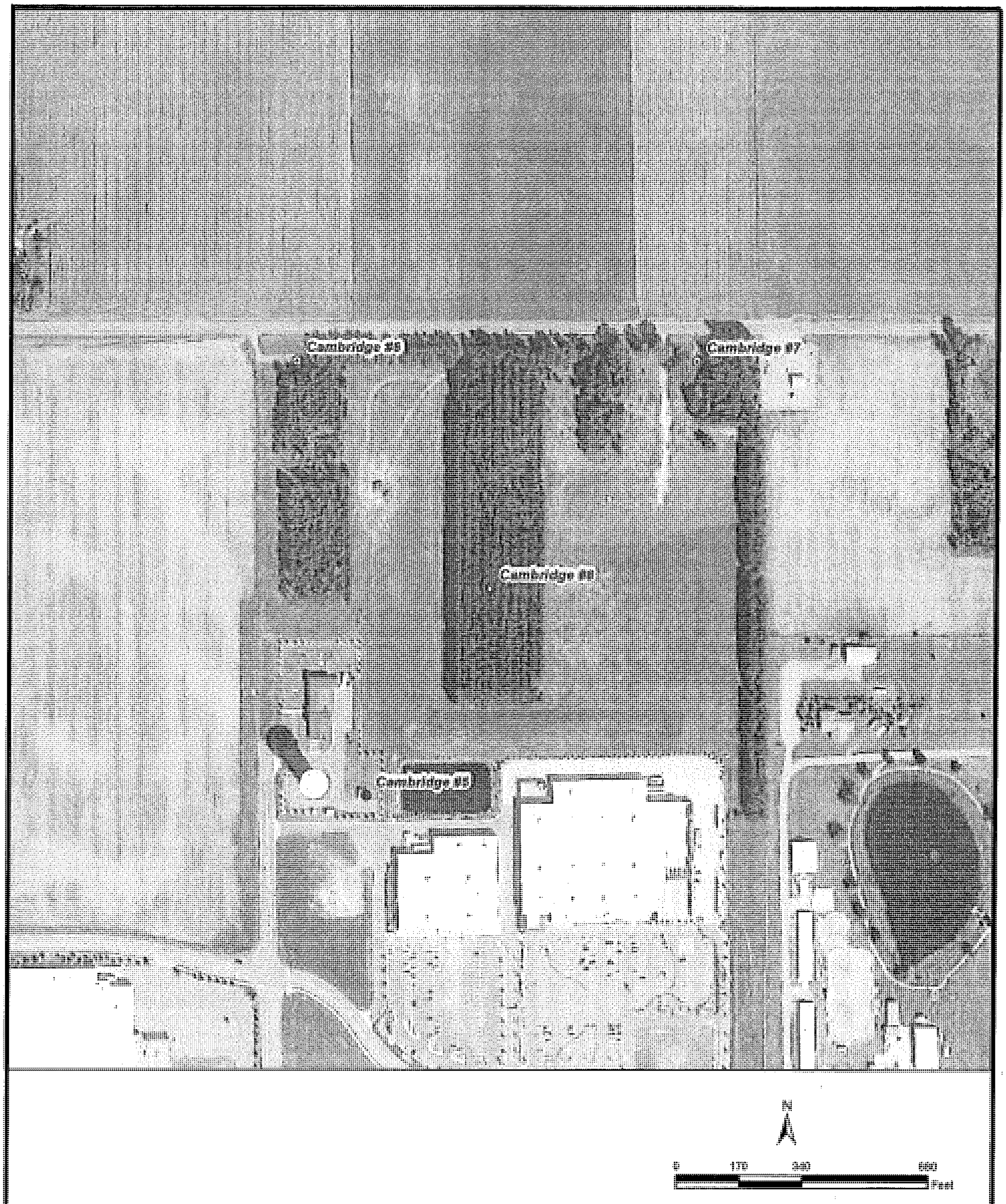

Figure 1a - Well Locations
City of Cambridge

Figure 1a - Well Locations
City of Cambridge

AGENDA
FIRST SCOPING MEETING
Wellhead Protection Planning
Plan Amendment
Consultant

PWS: City of Cambridge (PWSID# 1300002) **Date 3/10/2015**

Attending: **City of Cambridge**
Amal Djerrari, Hydro, MDH
John Freitag, Planner, MDH

10:00 Program Overview
A. Background
B. Part I and Part II activities

10:05 Part I Contents
A. WHPA Delineation
1. Five criteria required by rule
(travel-time, daily volume of water pumped, groundwater flow field, flow boundaries, and transmissivity)
2. Fracture Flow Delineation: Not required.
3. Conjunctive Delineation: Must be assessed if vulnerability is high (right now vulnerability is lo
4. Uncertainty evaluation
5. Pre-delineation meeting
B. DWSMA Delineation
C. Vulnerability Assessment
1. Wells
2. DWSMA

10:25 Reporting and Deliverables
A. Part I WHP Plan (templates available)
B. Electronic vs. hard copy submittals
1. Projection and datum registration

10:30 Data Element Checklist
A. Review checklist

10:35 Administrative and Procedural Steps
Need to Designate a WHP Manager
WHP Team
Budget
Council/Board Presentation/Informational Meeting
WHP Plan Submittal Date - February 27, 2018
Grants (Implementation Grants/Competitive Grants)

10:45 Specific Steps in the Next 60 days
MDH Will Send to PWS a Template of the Notice to LGUs and a Workplan.
MDH Will Send a Scoping Letter and a Scoping Notice Within 30 days.
PWS Needs to Notify to Local Units of Government Notification Within 60 days of Its Intent to Start Working on WHP (Notice and Workplan)
Part I RFP (template available)

City of Cambridge Work Plan

Projected Completion

Step	Date (Month/Year)
Pre-Plan Development	
Letter From MDH Initiating Plan Development	Feb-2015
Public Meeting Held with LUGs (can be combined with Public Information meeting required for the Part 1)	
WHP Manager Appointed	Mar-2015
LUG Team Established (Optional)	TBD
Wellhead Protection Team Appointed	TBD
Part I	
Scoping 1 Meeting Held	Mar-2015
MDH Scoping Decision (Letter)	Apr-2015
Notice of Intent Sent to Local Units of Government (LUGs)	Jun-2015
Prepare Aquifer Test Plan and Submit to MDH	Sep-2015
MDH Approval of Test Plan	Oct-2015
Wellhead Protection Area (WHPA) Delineation	
Drinking Water Supply Management Area (DWSMA) Delineation	
Conduct Vulnerability Assessment	
Vulnerability and DWSMA Submitted to MDH	Jan-2016
MDH Approval of DWSMA, WHPA and Vulnerability Assessments	Mar-2016
Vulnerability, WHPA and DWSMA Submitted to LUGs	Apr-2016
Public Meeting Held	May-2016
Part II	
Scoping 2 Meeting Held	Jun-2016
MDH Scoping Decision (Letter)	Jul-2016
Inventory of Potential Source Contamination	
Management Portion of Plan	
Submit Plan to LUGs	Sep-2017
Consider Comments Received by LUGs	Nov-2017
Public Hearing Held	Dec-2017
Submit Plan to MDH	Feb-2018
MDH Review	May-2018
MDH Approval	May-2018
Provide Notice to LUGs About Plan Approval	Jul-2018
Begin Plan Implementation	Jul-2018

Name of Person Completing This Form	

Table 1
Water Supply Well Information
City of Cambridge

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4	462851	Emergency	14	260	536	1990	CMSH - Mt.Simon-Hinckley	Not Vulnerable
5	680652	Emergency	16	277	337	2004	CMTS - Mt.Simon	Vulnerable
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Annual Volume of Water Pumped from Wells
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456953	Munkberg Farms Inc	1979-3143	CMTS	Agricultural Crop Irrigation	0.00	0.00
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219418	Cambridge, City of	1966-0149	CECRCMTS	Municipal/Public Water Supply	0.00	0.00
217868	Cambridge, City of	1966-0149	PMHNPMFL	Municipal/Public Water Supply	0.00	0.00
214507	Munkberg Farms Inc	1966-0074	CIGE	Agricultural Crop Irrigation	0.00	0.00

* = Expressed as millions of gallons. Source year = 2013.
Source: MN Dep't. of Natural Resources Division of Waters - State Water Use Data System (SWUDS)
GIS Data Source: SWP.mpars_ii_2013

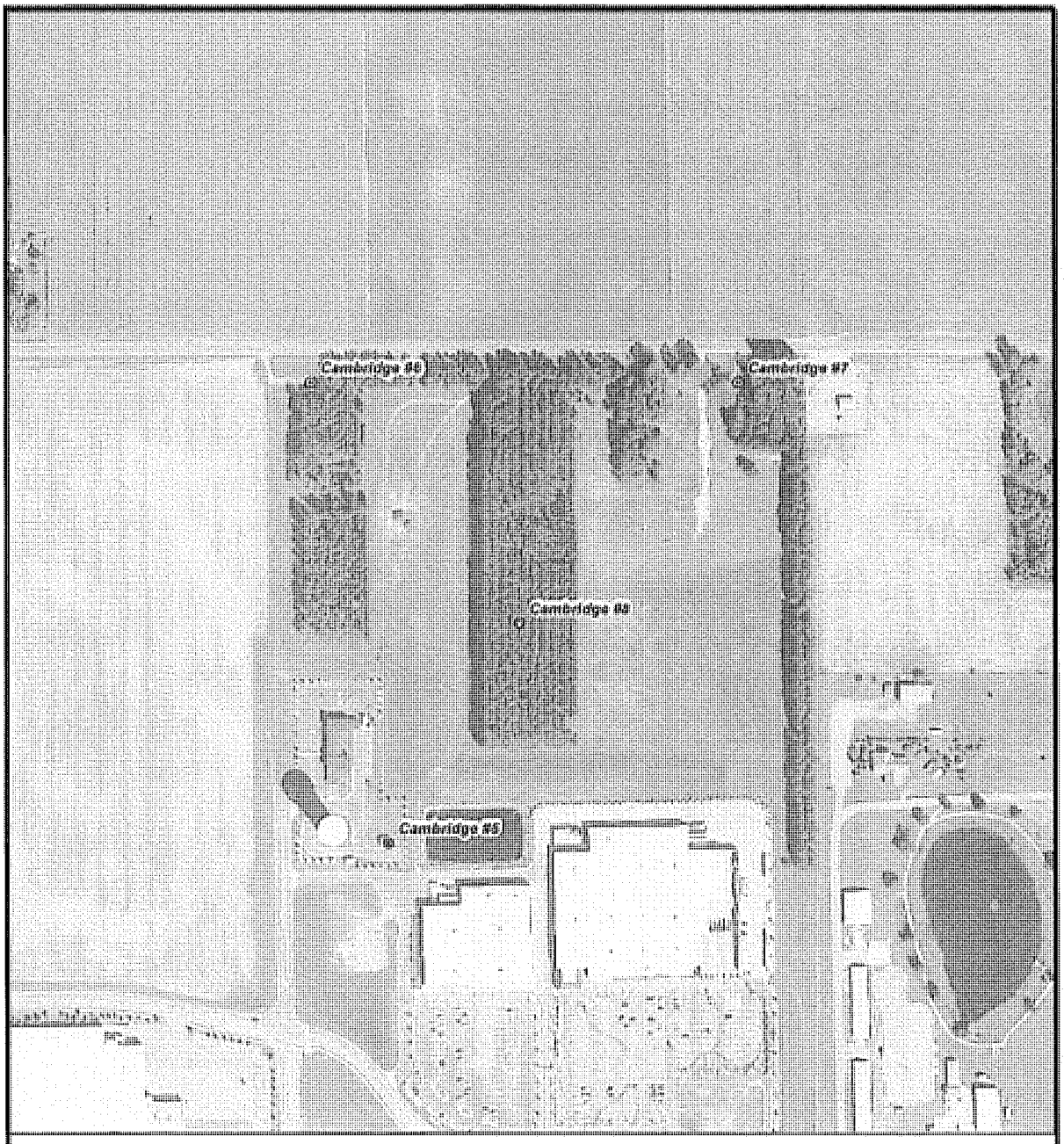
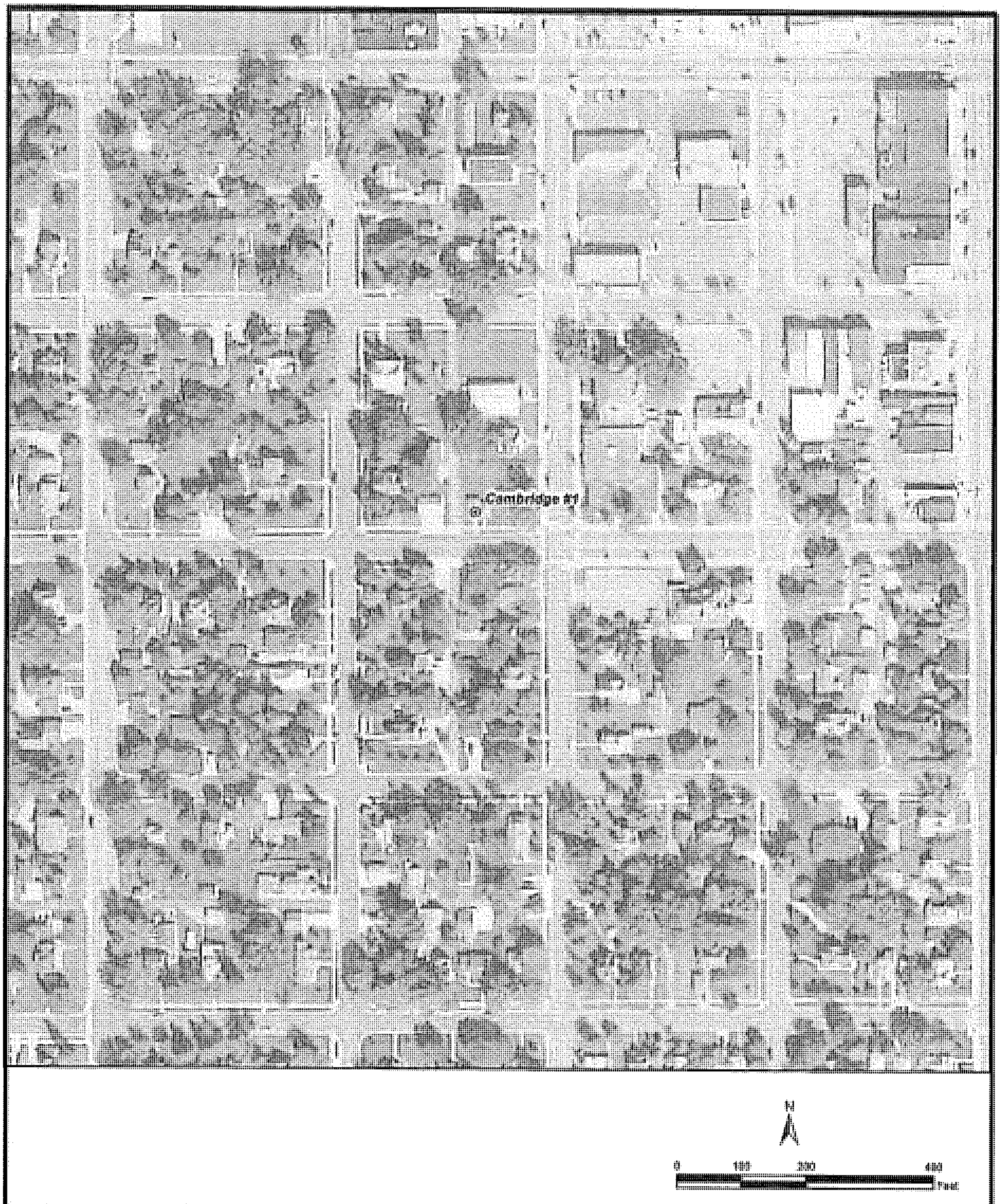
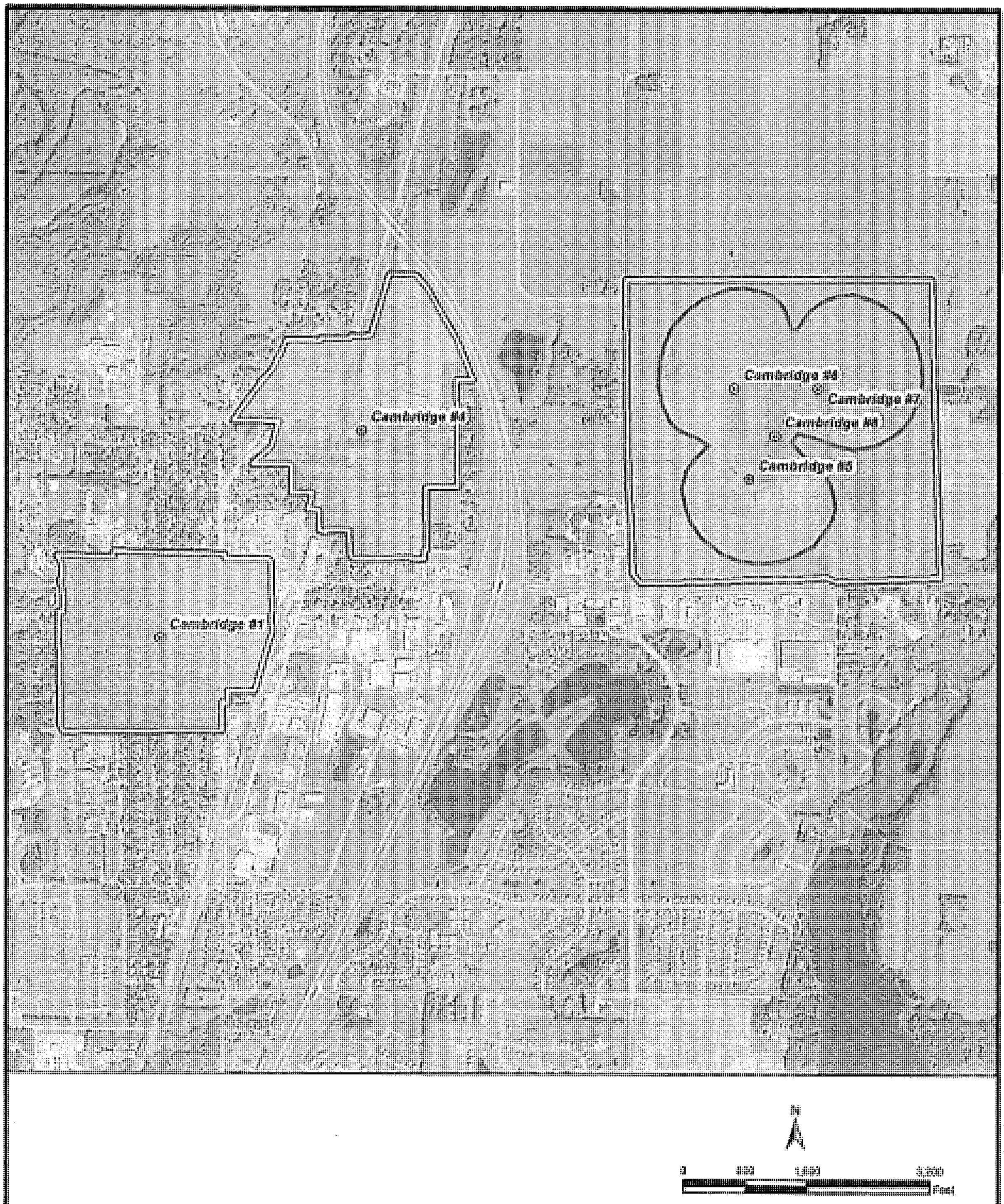


Figure 1a - Well Locations
City of Cambridge



MDH

Figure 1a - Well Locations
City of Cambridge



MDH

2006 DWSMA, DWSMA Vulnerability and Wellhead Protection Area City of Cambridge

Unique Well Number: **217867**

County: Isanti
Quad: Cambridge
Quad Id: 152C

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

Entry Date: 1990/10/09
Update Date: 2014/08/18
Received Date:

Well Name CAMBRIDGE 1

Township	Range	Dir	Section	Subsection	Field Located Elevation
36	23	W	32	AACABA	MDH 963.00 ft.

Well and Contact Address CAMBRIDGE 1
322 3RD ST SW
CAMBRIDGE MN 55008 Changed

Well Depth	Depth Completed	Date Well Completed
368.50 ft	368.50 ft	1958/00/00

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ YES ☐ NO
From ft. to

Use Community Supply

Casing Type Steel (black or low Drive Shoe? ☐ YES ☐ NO
Diameter 20 Depth 151
20.00 in. from 0.00 to 151.00 ft. lbs/ft

Hole Diameter (in.)

Description	Color	Hardness	From	To (ft.)
SANDY CLAY			0	40
CLAY, SOME SAND			40	70
HARD BROWN CLAY	BROWN		70	90
HARD RED CLAY	RED		90	103
HARD CLAY & SAND			103	118
SANDROCK			118	128
SANDROCK & SHALE			128	325
SOFT SANDROCK			325	341
SANDROCK & SHALE			341	368
RED SHALE	RED		368	368

Screen No
Make
Diamter Slot Length Set
Type

Open Hole(ft.) From 151.0 to 368.5

Static Water Level
39.00 ft. Land surface Date measured 1958/00/00

Pumping Level (below land surface)
82.00 ft. after 72.50 hrs. pumping 300.00 g.p.m.

Wellhead 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
feet Direction Type
Well disinfected upon completion? ☐ YES ☐ NO

Pump
☐ Not Installed Date Installed 1958/00/00
Manufacture's name FAIRBANK MORSE
Model number HP 25.00 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
Keys Well Co. 62012
License Business Name Lic. or Reg No.

Remarks
BEFORE 1990 THIS WAS WELL NO. 2. ORIGINAL TOWNSITE BLK 4 LOT 8-9-10.

First Bedrock CWOC Aquifer Eau Claire-MLSimon
Last Strat CMTS Depth to Bedrock 118.00 ft.

Name of Driller Date

Unique Well Number	County	Isanti	MINNESOTA DEPARTMENT OF HEALTH	Entry Date	1990/10/09
217868	Quad	Cambridge	**WELL AND BORING RECORD**	Update Date	2014/03/25
	Quad Id	152C	*MINNESOTA STATUTES CHAPTER 1031*	Received Date	

Well Name CAMBRIDGE 3

Township	Range	Dir	Section	Subsection	Field Located Elevation	USGS	ft.
36	23	W	32	ABCCCC		920.00	

Well and Contact Address CAMBRIDGE 3
626 MAIN ST N
CAMBRIDGE MN 55008 Changed

Well Depth	Depth Completed	Date Well Completed
630.00 ft	630.00 ft	1965/05/00

Drilling Method Cable Tool

Drilling Fluid | **Well Hydrofractured?** ☐ YES ☐ NO From ft. to

Use Abandoned

Casing Type Steel (black or low Drive Shoe? ☐ YES ☐ NO Diameter 12 Depth 352

20.00	in. from	0.00	to 220.00 ft.		lbs/ft
16.00	in. from	200.00	to 346.00 ft.		lbs/ft
12.00	in. from	340.00	to 352.00 ft.		lbs/ft

Hole Diameter (in.)

Description	Color	Hardness	From	To (ft.)
BROWN SAND	BROWN		0	25
CLAY & ROCK			25	80
GRAVEL & SAND			80	100
SANDROCK			100	121
SANDROCK (DIRTY)			121	129
BROWN SANDROCK	BROWN		129	132
SANDROCK (DIRTY)			132	134
SANDROCK WITH SMALL STON			134	137
SANDROCK (DIRTY)			137	142
CLAY & STONES			142	144
SANDROCK (DIRTY)			144	146
SANDROCK, NOT TOO HARD			146	151
SANDROCK, NOT TOO HARD			151	164
SHALE & SANDROCK			164	209
SHALE & SANDROCK			209	220
JORDAN SANDROCK & SHALE			220	230
JORDAN SANDROCK & SHALE			230	330
RED SAND	RED		330	335
RED SAND	RED		335	338
RED SANDROCK (HARD)	RED		338	465
YELLOW SANDROCK	YELLOW		465	485
YELLOW & PINK SANDROCK	YEL/PNK		485	505
PINK SANDROCK	PINK		505	530
RED SANDROCK & SHALE	RED		530	569
RED SANDROCK & SHALE	RED		569	570
RED SHALE (STICKY)	RED		570	613
RED SHALE & STREAKS OF BLU	RED/BLU		613	630

Screen No | **Open Hole(ft.)** From 339.0 to 630.0
Make Type
Diamter Slot Length Set

Static Water Level (Multiple SWL)
6.40 ft. Land surface Date measured 2000/07/18

Pumping Level (below land surface)
250.00 ft. after 12.00 hrs. pumping 700.00 g.p.m.

Wellhead 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
feet Direction Type
Well disinfected upon completion? ☐ YES ☐ NO

Pump
☐ Not Installed Date Installed 1965/00/00
Manufacture's name FAIRBANK MORSE
Model number HP 100.00 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.

Remarks
BEFORE 1990 THIS WAS WELL NO. 4. M.G.S. NO. 530. GAMMA LOGGED & TV 7-18-2000. WELL SEALED 3-9-2001 BY KEYS WELL DRILLING CO. H-163638. DNR HAS (3) TRANSDUCERS AT 585', 510', AND 400 '. WELL SEALED 03-09-2001 BY 62012 ORIGINAL USE MU - MUNICIPAL

First Bedrock CECR **Aquifer** Hinckley-Fond Du Lac
Last Strat PMFL **Depth to Bedrock** 151.00 ft.

Name of Driller Date HE-01205-07 (Rev. 2/99)

Unique Well Number: **219418**

County Isanti
Quad Cambridge
Quad Id 152C

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

Entry Date 1990/10/09
Update Date 2014/03/31
Received Date

Well Name CAMBRIDGE 2

Township	Range	Dir	Section	Subsection	Field Located Elevation	MDH
36	23	W	32	BADAAA	924.00	ft.

Well and Contact Address CAMBRIDGE 2

CAMBRIDGE MN 55008 Changed

Well Depth	Depth Completed	Date Well Completed
326.00 ft	326.00 ft	1954/08/00

Drilling Method Cable Tool

Drilling Fluid

Well Hydrofractured? ☐ YES ☐ NO From ft. to

Use Abandoned

Casing Type Steel (black or low Drive Shoe? ☐ YES ☐ NO Hole Diameter (in.)
Diameter 20 Depth 143
24.00 in. from 0.00 to 84.00 ft. lbs/ft
20.00 in. from 0.00 to 143.00 ft. lbs/ft

Description	Color	Hardness	From	To (ft.)
SAND & GRAVEL			0	14
SANDY CLAY			14	23
SAND			23	32
SANDY CLAY & GRAVEL			32	86
HARDPAN			86	102
SHALE & SANDROCK			102	192
SHALE			192	202
SANDROCK			202	232
SANDROCK & SHALE			232	262
SANDROCK			262	325
RED SHALE	RED		325	326

Screen No
Make
Diamter Slot Length Set
Type
Open Hole(ft.) From 143.0 to 326.0

Static Water Level
-2.00 ft. Land surface Date measured 1954/08/00

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

Wellhead 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
feet Direction Type
Well disinfected upon completion? ☐ YES ☐ NO

Pump
☐ Not Installed Date Installed 1954/08/00
Manufacture's name POMONA
Model number HP 25.00 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
Keys Well Co. 62012
License Business Name Lic. or Reg No.

Remarks
BEFORE 1990 THIS WAS WELL NO. 3. CONGERS ADD. BLK 4 FLOWING WELL. SEALED 5-23-2011 BY 1347; PREVIOUS USE: PC PUMPING TEST DURATION: 12 HOURS

First Bedrock CECR
Last Strat PMHN
Aquifer Eau Claire-Mt.Simon
Depth to Bedrock 102.00 ft.

Name of Driller Date

Unique Well Number **462851**

County Isanti
Quad Cambridge
Quad Id 152C

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

Entry Date 1992/07/30
Update Date 2014/03/21
Received Date

Well Name CAMBRIDGE 4

Township	Range	Dir	Section	Subsection	Field Located Elevation	MDH
36	23	W	28	CABDCD		950.00 ft.

Well Address CAMBRIDGE 4
545 EMERSON AV N
CAMBRIDGE MN 55008 Changed

Contact Address CITY OF CAMBRIDGE
139 1ST ST E
CAMBRIDGE MN 55008 Changed

Well Depth	Depth Completed	Date Well Completed
536.00 ft	536.00 ft	1990/08/03

Drilling Method Non-specified Rotary

Drilling Fluid Bentonite

Well Hydrofractured? ☐ YES ☐ NO From ft. to

Use Community Supply

Casing Type Steel (black or low Drive Shoe? ☑ YES ☐ NO
Diameter 14 Depth 260
14.00 in. from 0.00 to 260.00 ft. 54.57 lbs/ft

Hole Diameter (in.)
14.0(To 260.0
14.0(To 536.0

Description	Color	Hardness	From	To (ft.)
SANDY CLAY	BROWN		0	30
GRAY CLAY/GRAVEL MIX	GRAY		30	85
GRAVEL	BLK/RED		85	95
CLAY & GRAVEL MIX	GRAY		95	110
STONEY CLAY	GRAY		110	173
STONEY CLAY	GRAY		173	178
SHALE LIGHT GREEN-WHITE	GRN/WHT		178	190
SANDSTONE & SHALE	YEL/WHT		190	235
SANDSTONE & SHALE	YEL/WHT		235	280
SANDSTONE & SHALE	GRAY		280	305
SANDSTONE	GRAY		305	365
SHALE	RED		365	370
SANDSTONE & SHALE	RED/WHT		370	450
SHALE	RED		450	452
SANDSTONE & SHALE RED/PIN	VARIED		452	536

Screen No
Make Type
Diamter Slot Length Set

Open Hole(ft.) From 260.0 to 536.0

Static Water Level
28.00 ft. Land surface Date measured 1990/07/20

Pumping Level (below land surface)
61.70 ft. after 8.00 hrs. pumping 1000.00 g.p.m.

Wellhead 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 260.0 ft. 7.50 Cubic yards

Nearest Known Source of Contamination
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
Renner E.H. Well 71015
License Business Name Lic. or Reg No.
HEISEL, M.

Remarks
GAMMA LOGGED 4-12-1990. M.G.S. NO. 3024.

First Bedrock CECR Aquifer Mt.Simon-Hinckley
Last Strat PMHN Depth to Bedrock 173.00 ft.

County Well Index v.5 **REPORT** Printed on 2/27/2015

Name of Driller Date

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

Unique Well Number **680652**

County Isanti
Quad Cambridge
Quad Id 152C

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

Entry Date 2004/10/07
Update Date 2014/08/18
Received Date 2004/09/13

Well Name CAMBRIDGE 5

Township	Range	Dir	Section	Subsection	Field Located Elevation	MDH
36	23	W	27	CACCDC		964.00 ft.

Well Address CAMBRIDGE
3RD AV NE & BALSAM ST
CAMBRIDGE MN 55008 Changed

Contact Address CITYOF CAMBRIDGE
626 MAIN ST N
CAMBRIDGE MN 55008

Well Depth	Depth Completed	Date Well Completed
340.00 ft	337.00 ft	2004/07/19

Drilling Method Non-specified Rotary

Drilling Fluid Bentonite

Well Hydrofractured? ☐ YES ☑ NO From ft. to

Use Community Supply

Casing Type Steel (black or low Drive Shoe? ☑ YES ☐ NO
Diameter 16 Depth 277
16.00 in. from 0.00 to 277.00 ft. lbs/ft

Hole Diameter (in.) 20.0(To 277.0

Description	Color	Hardness	From	To (ft.)
TOP SOIL	BLACK		0	1
SANDY CLAY	TAN		1	8
SANDY CLAY	RED/BRN		8	18
SAND & GRAVEL			18	30
SANDY CLAY	BLUE		30	52
SANDY CLAY	RED/BRN		52	61
BOULDER			61	62
SANDY CLAY	RED/BRN		62	79
BOULDERS & GRAVEL			79	112
FRANCONIA			112	121
IRONTON-GALESVILLE			121	199
EAU CLAIRE			199	260
MT. SIMON SANDSTONE			260	340

Screen Yes
Make JOHNSON
Diamter Slot Length Set
8.00 15 60 277 ft. to 337 ft.

Open Hole(ft.) From to
Type stainless steel

Static Water Level
30.10 ft. Land surface Date measured 2004/06/21

Pumping Level (below land surface)
191.90 ft. after 24.00 hrs. pumping 700.00 g.p.m.

Wellhead 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 To 277.0 ft. 12.00 Cubic yards

Nearest Known Source of Contamination
50 feet Direction SDF Type
Well disinfected upon completion? ☑ YES ☐ NO

Pump
☑ Not Installed Date Installed
Manufacture's name
Model number HP 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
Thein Well Co. 34625
License Business Name Lic. or Reg No.
GRABOWSKI, D.

Remarks

First Bedrock CTCG Aquifer Mt.Simon
Last Strat CMTS Depth to Bedrock 112.00 ft.

County Well Index v.5 REPORT Printed on 2/27/2015

Name of Driller Date

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

Unique Well Number **731532**

County Isanti
Quad Cambridge
Quad Id 152C

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

Entry Date 2005/11/15
Update Date 2014/08/18
Received Date 2006/01/26

Well Name CAMBRIDGE 6

Township	Range	Dir	Section	Subsection	Field Located Elevation	MDH
36	23	W	27	CABBBB		968.00 ft.

Contact Address CITY OF CAMBRIDGE
300 3RD AV NE
CAMBRIDGE MN 55008 Changed

Well Address CAMBRIDGE 6
2820 337TH AV NE
CAMBRIDGE MN 55008 Changed

Well Depth	Depth Completed	Date Well Completed
417.00 ft	410.00 ft	2005/12/20

Drilling Method Dual Rotary

Drilling Fluid

Well Hydrofractured? ☐ YES ☑ NO
From ft. to

Use Community Supply

Casing Type Steel (black or low Drive Shoe? ☑ YES ☐ NO
Diameter 18 Depth 300
24.00 in. from 0.00 to 120.00 ft. 94.62 lbs/ft
18.00 in. from 0.00 to 300.00 ft. 70.59 lbs/ft

Hole Diameter (in.)
24.0(To 120.0
24.0(To 300.0

Description	Color	Hardness	From	To (ft.)
FINE SAND	BROWN	SOFT	0	5
SAND	BROWN	MEDIUM	5	35
SAND/GRAVEL	BROWN	MEDIUM	35	40
CLAY	GRAY	MEDIUM	40	45
SAND	BROWN	MEDIUM	45	60
ROCK/GRAVEL	GRAY	MEDIUM	60	65
GRAVEL/CLAY	BRN/GRY	MEDIUM	65	70
SAND/GRAVEL/ROCK	BROWN	MEDIUM	70	105
SANDSTONE/SHALE	TAN/GRN	SOFT	105	113
SANDSTONE/SHALE	TAN/GRN	SOFT	113	116
SANDSTONE/SHALE	TAN/GRN	SOFT	116	195
SANDSTONE	TAN	HARD	195	200
SANDSTONE/SHALE LAYERS	TAN/GRN	SFT-MED	200	222
SANDSTONE/SHALE LAYERS	TAN/GRN	SFT-MED	222	230
SHALE/SANDSTONE LAYERS	GRN/TAN	SFT-MED	230	255
SANDSTONE SHALE	TAN/GRN	SFT-MED	255	265
SANDSTONE SHALE	TAN/GRN	SFT-MED	265	290
SANDSTONE	TAN	SFT-MED	290	390
SANDSTONE/SHALE LAYERS PI	VARIED	HARD	390	400
SANDSTONE	TAN	HARD	400	410
SANDSTONE/SHALE LAYERS PI	VARIED	HARD	410	417

Screen Yes
Make JOHNSON
Diamter Slot Length Set
12.00 25 120 290 ft. to 410 ft.

Open Hole(ft.) From to
Type stainless steel

Static Water Level
27.00 ft. Land surface Date measured 2005/12/20

Pumping Level (below land surface)
110.00 ft. after 1.00 hrs. pumping 600.00 g.p.m.

Wellhead 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 To 290.0 ft. 20.00 Sacks
Material Neat Cement From To 290.0 ft. 16.00 Cubic yards

Nearest Known Source of Contamination
600 feet W Direction SEW Type
Well disinfected upon completion? ☑ YES ☐ NO

Pump
☑ Not Installed Date Installed
Manufacture's name
Model number HP 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
Traut, Mark J. Wells 73646
License Business Name Lic. or Reg No.
FEIA, E.

Remarks
GAMMA LOGGED 2-3-2006. M.G.S. NO. 4511. LOGGED BY JIM TRAEN.

First Bedrock CTCG Aquifer Mt.Simon
Last Strat PMFL Depth to Bedrock 105.00 ft.

Name of Driller Date

Unique Well Number: **735018**

County Isanti | Quad Cambridge | Quad Id 152C

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

MINNESOTA STATUTES CHAPTER 1031

Entry Date 2005/11/03 | Update Date 2014/08/18 | Received Date 2006/01/26

Well Name CAMBRIDGE 7

Township	Range	Dir	Section	Subsection	Field Located	MDH Elevation
36	23	W	27	CAAABA		967.00 ft.

Well Address WELL#7
2958 337TH AV NE
CAMBRIDGE MN 55008 Changed

Contact Address CITY OF CAMBRIDGE
300 3RD AV NE
CAMBRIDGE MN 55008 Changed

Well Depth	Depth Completed	Date Well Completed
431.00 ft	422.00 ft	2006/01/10

Drilling Method Dual Rotary

Drilling Fluid Water

Well Hydrofractured? ☐ YES ☑ NO From ft. to

Use Community Supply

Casing Type Steel (black or low Drive Shoe? ☑ YES ☐ NO
Diameter 18 Depth 313
24.00 in. from 0.00 to 120.00 ft. 94.62 lbs/ft
18.00 in. from 0.00 to 313.00 ft. 70.59 lbs/ft

Hole Diameter (in.)
24.0(To 120.0
23.0(To 295.0

Description	Color	Hardness	From	To (ft.)
V-FINE SILTY SAND	BROWN	SOFT	0	5
FINE SAND	BROWN	SOFT	5	34
SAND & GRAVEL	BROWN	SOFT	34	37
SILT	GRAY	SOFT	37	40
CLAY & COURSE GRAVEL	BROWN	SOFT	40	65
MED SAND	BROWN	SOFT	65	72
COARSE GRAVEL/ROCKS/BOUL	BRN/BLK		72	102
COARSE SAND & ROCKS	BROWN	MEDIUM	102	107
COARSE GRAVEL/ROCKS/ BOU	BRN/BLK	HARD	107	114
COARSE GRAVEL W/ SHALE 50/	VARIED	MEDIUM	114	116
SHALE	GREEN	SOFT	116	122
SHALE W/ SANDSTONE 50/50	GRN/TAN	MEDIUM	122	126
SANDSTONE	TAN	SOFT	126	223
SANSTONE & SHALE 60/40	TAN/GRN	SOFT	223	243
SANDSTONE & SHALE CEMENT	TAN/GRN	MEDIUM	243	263
SHALE	GREEN	SOFT	263	268
SANDSTONE & SHALE 50/50	TAN/GRN	SOFT	268	275
SANDSTONE	TAN	SOFT	275	370
SANDSTONE	TAN/YEL	SOFT	370	384
SANDSTONE	VARIED	MEDIUM	384	395
SANDSTONE	PINK	MED-HRD	395	413
SHALE & SANDSTONE 50/50 CE	RED/PNK	HARD	413	431

Screen Yes | **Open Hole(ft.)** From to

Make JOHNSON | Type stainless steel

Diamter	Slot	Length	Set
12.00	25	120	302 ft. to 422 ft.

Static Water Level
24.00 ft. Land surface Date measured 2006/01/06

Pumping Level (below land surface)
73.00 ft. after 1.00 hrs. pumping 650.00 g.p.m.

Wellhead 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 ____ To 290.0 ft. 18.50 Cubic yards

Nearest Known Source of Contamination
200 feet E Direction VOC Type
Well disinfected upon completion? ☑ YES ☐ NO

Pump
☑ Not Installed Date Installed ____
Manufacture's name ____
Model number ____ HP ____ 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
Traut, Mark J. Wells 73646
License Business Name Lic. or Reg No.
TRAUT, T.

Remarks
GAMMA LOGGED 2-3-2006. M.G.S. NO. 4483. LOGGED BY JIM TRAEN.

First Bedrock CTCG | Aquifer Mt.Simon
Last Strat PMFL | Depth to Bedrock 114.00 ft.

Name of Driller Date

Unique Well Number: **795532**

County Isanti | Quad Cambridge | Quad Id 152C

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

Entry Date 2013/05/20 | Update Date 2014/03/20 | Received Date 2013/07/23

Well Name CAMBRIDGE 8

Township	Range	Dir	Section	Subsection	Field Located Elevation	MGS
36	23	W	27	CACAAB	965.00	ft.

Well Address CAMBRIDGE 8

CAMBRIDGE MN 55008

Contact Address CITY OF CAMBRIDGE

300 THIRD AV NE

CAMBRIDGE MN 55008 Changed

Well Depth	Depth Completed	Date Well Completed
427.00 ft	427.00 ft	2013/05/17

Drilling Method Dual Rotary

Drilling Fluid Water

Well Hydrofractured? ☐ YES ☑ NO — From ft. to

Use Community Supply

Casing Type Steel (black or low | Drive Shoe? ☑ YES ☐ NO | Diameter 18 | Depth 307

24.00 in. from 0.00 to 115.00 ft. lbs/ft

18.00 in. from 0.00 to 307.00 ft. lbs/ft

Hole Diameter (in.)

23.0(To 312.0

17.2(To 427.0

Description	Color	Hardness	From	To (ft.)
SILTY SAND	BROWN	SOFT	0	5
FINE SAND	BROWN	SOFT	5	34
GRAVEL	BROWN	SOFT	34	39
CLAY & GRAVEL	GRAY	MEDIUM	39	46
CLAY & GRAVEL	BROWN	MEDIUM	46	65
GRAVEL/ROCKS/BOULDERS BR	VARIED	HARD	65	106
SHALE	GREEN	MEDIUM	106	107
SHALE	GREEN	MEDIUM	107	120
SHALE	GREEN	MEDIUM	120	124
SANDSTONE/SHALE LENSES	TAN/GRN	MEDIUM	124	150
SANDSTONE/SHALE LENSES	TAN/GRN	MEDIUM	150	160
SANDSTONE	TAN	SOFT	160	200
SANDSTONE/SHALE LENSES	TAN/GRN	SOFT	200	215
SHALE/SANDSTONE	BRN/TAN	MEDIUM	215	216
SHALE/SANDSTONE	BRN/TAN	MEDIUM	216	220
SHALE/SANDSTONE	GRN/TAN	MEDIUM	220	255
SANDSTONE & SHALE RED TAN	VARIED	MEDIUM	255	260
SANDSTONE & SHALE RED TAN	VARIED	MEDIUM	260	275
SANDSTONE/SHALE LENSES	TAN/GRN	SOFT	275	295
SANDSTONE	WHITE	SOFT	295	350
SANDSTONE	YELLOW	SOFT	350	380
SANDSTONE/SHALE LENSES	PNK/RED	MEDIUM	380	385
SANDSTONE	PNK/YEL	SOFT	385	395
SANDSTONE	PNK/WHT	SOFT	395	420
SANDSTONE/SHALE LENSES	PNK/RED	SOFT	420	423
SANDSTONE/SHALE LENSES	PNK/RED	SOFT	423	427
SHALE	RED	MEDIUM	427	427

Screen Yes — **Open Hole(ft.)** From to

Make JOHNSON — Type stainless steel

Diamter	Slot	Length	Set	
11.25	30	130	296	ft. to 426 ft.

Static Water Level

39.70 ft. Land surface — Date measured 2013/05/16

Pumping Level (below land surface)

72.20 ft. after 2.00 hrs. pumping 350.00 g.p.m.

Wellhead 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 Driven casing seal — From ____ To 115.0 ft. — 34.00 Sacks

Material Neat Cement — From ____ To 297.0 ft. — 15.00 Cubic yards

Nearest Known Source of Contamination

____ feet ____ Direction ____ Type

Well disinfected upon completion? ☑ YES ☐ NO

Pump

☑ Not installed — Date installed ____

Manufacture's name ____

Model number ____ HP ____ 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

Mark J Traut Wells, Inc. 1404

License Business Name — Lic. or Reg No.

BUTCH/DAN

Remarks

GAMMA LOGGED 5-17-2012. M.G.S. NO. 5319. LOGGED BY JIM TRAEN. DRILLERS: BUTCH GAUSTAD & DAN POHLKAMP.

First Bedrock CTCG — Aquifer Mt.Simon

Last Strat PMFL — Depth to Bedrock 107.00 ft.

Name of Driller — Date

625 Robert St. N. St. Paul MN 55155
P.O. Box 64975 St. Paul MN 55164 - 0975

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

PWSID: 1300002
SYSTEM NAME: Cambridge
WELL NAME: Well #1

TIER: 2
WHP RANK:
UNIQUE WELL #: 00217867

COUNTY: Isanti | TOWNSHIP NUMBER: 36 RANGE: 23 W | SECTION: 32 | QUARTERS: AAAC

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Eau Claire-Mt. Simon	
DNR Geologic Sensitivity Rating	:	Low	20
L Score	:	3	
Geologic Data From	:	Well Record	
Year Constructed	:	1958	
Construction Method	:	Cable Tool/Bored	0
Casing Depth	:	151	10
Well Depth	:	368	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	450	5
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	5.9 05/27/2009	30
Maximum tritium detected	:	5.5 05/11/2006	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		65
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
NITRATE DATA FROM PWSD 1989, 11/68 SAMPLE. Previous tritium result of 16.8TU on 5/16/2000.

Date Report Generated: 3/2/2015

625 Robert St. N. St. Paul MN 55155
P.O. Box 64975 St. Paul MN 55164 - 0975

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

PWSID: 1300002 | TIER: 2
SYSTEM NAME: Cambridge | WHP RANK:
WELL NAME: Well #4 | UNIQUE WELL #: 00462851

COUNTY: Isanti | TOWNSHIP NUMBER: 36 RANGE: 23 W | SECTION: 28 | QUARTERS: CABD

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Mt. Simon-Hinckley	
DNR Geologic Sensitivity Rating	:	Low	0
L Score	:	12	
Geologic Data From	:	Well Record	
Year Constructed	:	1990	
Construction Method	:	Rotary/Drilled	0
Casing Depth	:	260	5
Well Depth	:	536	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	750	10
Pathogen Detected?			NOT VULNERABLE
Surface Water Characteristics?			NOT VULNERABLE
Maximum nitrate detected	:	.12 04/09/2007	NOT VULNERABLE
Maximum tritium detected	:	<.8 05/16/2011	NOT VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		15
Wellhead Protection Vulnerability Rating	:		NOT VULNERABLE
Vulnerability Overridden	:		

COMMENTS
62 feet of Eau Claire accounted for in L-score.

625 Robert St. N. St. Paul MN 55155
P.O. Box 64975 St. Paul MN 55164 - 0975

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

PWSID: 1300002
SYSTEM NAME: Cambridge
WELL NAME: Well #5

TIER: 2
WHP RANK:
UNIQUE WELL #: 00680652

COUNTY: Isanti | TOWNSHIP NUMBER: | RANGE: | SECTION: | QUARTERS:

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Mt. Simon	
DNR Geologic Sensitivity Rating	:	Low	0
L Score	:	6	
Geologic Data From	:	Well Record	
Year Constructed	:	2004	
Construction Method	:	Rotary/Drilled	0
Casing Depth	:	277	5
Well Depth	:	337	
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?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	300	5
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	<.05 08/22/2005	0
Maximum tritium detected	:	14 05/11/2006	VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		10
Wellhead Protection Vulnerability Rating	:		VULNERABLE
Vulnerability Overridden	:		

COMMENTS
61 feet of Eau Claire accounted for in L-score.

625 Robert St. N. St. Paul MN 55155
P.O. Box 64975 St. Paul MN 55164 - 0975

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

PWSID: 1300002 | TIER: 2
SYSTEM NAME: Cambridge | WHP RANK:
WELL NAME: Well #6 | UNIQUE WELL #: 00731532

COUNTY: Isanti | TOWNSHIP NUMBER: | RANGE: | SECTION: | QUARTERS:

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Mt. Simon	
DNR Geologic Sensitivity Rating	:	Low	15
L Score	:	4	
Geologic Data From	:	Well Record	
Year Constructed	:	2005	
Construction Method	:	Rotary/Drilled	0
Casing Depth	:	300	5
Well Depth	:	410	
Casing grouted into borehole?		Yes	0
Cement grout between casings?		Unknown	5
All casings extend to land surface?		Yes	0
Gravel - packed casings?		No	0
Wood or masonry casing?		No	0
Holes or cracks in casing?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	725	10
Pathogen Detected?			NOT VULNERABLE
Surface Water Characteristics?			NOT VULNERABLE
Maximum nitrate detected	:	<.05 07/22/2014	NOT VULNERABLE
Maximum tritium detected	:	<.8 09/07/2012	NOT VULNERABLE
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		35
Wellhead Protection Vulnerability Rating	:		NOT VULNERABLE
Vulnerability Overridden	:		

COMMENTS
43 feet of Eau Claire accounted for in L-score.

625 Robert St. N. St. Paul MN 55155
P.O. Box 64975 St. Paul MN 55164 - 0975

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

PWSID: 1300002
SYSTEM NAME: Cambridge
WELL NAME: Well #7

TIER: 2
WHP RANK:
UNIQUE WELL #: 00735018

COUNTY: Isanti | TOWNSHIP NUMBER: | RANGE: | SECTION: | QUARTERS:

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Mt. Simon	
DNR Geologic Sensitivity Rating	:	Low	15
L Score	:	4	
Geologic Data From	:	Well Record	
Year Constructed	:	2006	
Construction Method	:	Rotary/Drilled	0
Casing Depth	:	295	5
Well Depth	:	422	
Casing grouted into borehole?		Yes	0
Cement grout between casings?		Unknown	5
All casings extend to land surface?		Yes	0
Gravel - packed casings?		No	0
Wood or masonry casing?		No	0
Holes or cracks in casing?		Unknown	0
Isolation distance violations?			0
Pumping Rate	:	900	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	<.05 07/22/2014	0
Maximum tritium detected	:	Unknown	0
Non-THMS VOCs detected?			0
Pesticides detected?			0
Carbon 14 age	:	Unknown	0
Wellhead Protection Score	:		35
Wellhead Protection Vulnerability Rating	:		NOT VULNERABLE
Vulnerability Overridden	:		

COMMENTS
45 feet of Eau Claire accounted for in L-score.

625 Robert St. N. St. Paul MN 65155
P.O. Box 64975 St. Paul MN 55164 - 0975

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

PWSID: 1300002
SYSTEM NAME: Cambridge
WELL NAME: Well #8

TIER: 2
WHP RANK:
UNIQUE WELL #: 00795532

COUNTY: Isanti | TOWNSHIP NUMBER: | RANGE: | SECTION: | QUARTERS:

CRITERIA		DESCRIPTION	POINTS
Aquifer Name(s)	:	Mt. Simon	
DNR Geologic Sensitivity Rating	:	Low	15
L Score	:	4	
Geologic Data From	:	Well Record	
Year Constructed	:	2013	
Construction Method	:	Rotary/Drilled	0
Casing Depth	:	307	5
Well Depth	:	427	
Casing grouted into borehole?		Yes	0
Cement grout between casings?		Yes	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	:	850	10
Pathogen Detected?			0
Surface Water Characteristics?			0
Maximum nitrate detected	:	Unknown	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
44 feet of Eau Claire accounted for in L-score.

Appendix B

DAP-ATP

MINNESOTA MDH DEPARTMENT OF HEALTH
Environmental Health Division
Drinking Water Protection Section
Source Water Protection Unit
P.O. Box 64975
St. Paul, Minnesota 55164-0975

Determination of Aquifer Properties and Aquifer Test Plan (DAP-ATP) Form

Public Water Supply ID:	1300002	PWS Name:	Cambridge

Contact Information for Person Completing this Form

Name:	Melanie Niday, PG
Address:	SEH
	1200 25th Avenue South
City, State, Zip:	St. Cloud, MN 563010
Phone, Fax, e-mail:	320.229.4346, 888.908.8166, mniday@sehinc.com

Aquifer Properties Determination Methods

- [x] 1) An existing pumping test that meets the requirements of wellhead protection rule part 4720.5520 and that was previously conducted on a well connected to the public water supply system.
- [ ] 2) An existing pumping test that meets the requirements of wellhead protection rule part 4720.5520 and that was previously conducted on another well in a hydrogeologic setting determined by the department to be equivalent.
- [ ] 3) A proposed new test to be conducted on a new or existing well connected to the public water supply system and that meets the requirements for larger-sized water systems (wellhead protection rule part 4720.5520). A test plan must be approved before conducting the test.
- [ ] 4) A proposed new test to be conducted on a new or existing public well connected to the public water supply system and that meets the requirements for smaller-sized water systems (wellhead protection rule part 4720.5530). A test plan must be approved before conducting the test.
- [ ] 5) An existing pumping test that does not meet the requirements of wellhead protection rule part 4720.5520 and that was previously conducted on: 1) a public water supply well or 2) another well in a hydrogeologic setting determined by the department to be equivalent.
- [ ] 6) Existing specific capacity test(s) conducted on the public water supply well(s) or specific capacity tests conducted on other wells in a hydrogeologic setting determined by the department to be equivalent.
- [ ] 7) An existing published transmissivity value.

- Include all test data and analysis documentation with the estimated transmissivity, ft^2/day, when the aquifer properties determination method is; 1, 2, 5, 6, or 7, listed above.
- Attach detailed aquifer test plan for methods 3 or 4.

Submitted by: Melanie Niday	Prof. License: PG# 30346	Date: 4/7/2016

To request this document in another format, please call our Section Receptionist (651/201-4700) or Division TTY (651/201-5797).

Rationale for: 1) Aquifer Properties Determination or 2) Proposed New Test

Briefly describe the rationale for: 1) selected method to determine aquifer properties from existing data, **or** 2) a new aquifer test to be conducted on the pumped well referenced below. Include unique well numbers of all wells that were (or will be) monitored during data collection. How does the existing or proposed test deviate from the ideal. (e.g. rate, duration, no. of obwells, interfering wells, etc.) Attach documentation as necessary.

Aquifer Name:	Mt. Simon/Fond du Lac	☑ Confined	☐ Unconfined	☐ Fractured Rock

To determine aquifer properties from existing data, pumping test data from a 24-hour pump test conducted on May 28-29, 2013, following construction of system's newest well (Well 8, Unique Number 795532), was analyzed and data from the January 2006 pump test was re-evaluated. The 2013 pumping test covers a 24-hour time period plus recovery, includes data for the pumping well and a monitoring well, and the pumping rate was equal to the well's maximum capacity (1000 gpm). In addition, data was recorded using pressure transducers and flow rate was measured with a flow meter. An observation well (Unique No. 792109) was also constructed and monitored. Well construction records and map of well locations utilized in the 2013 pumping test are provided in Attachment 1 and water level measurements and AQTESOLV files are provided digitally.

The 2013 data were analyzed in 2016 using a number of methods to test method assumptions and an aquifer thickness of 167 ft that was obtained from the Well 8 construction log. The pumping well and monitoring well data were analyzed collectively and individually and partial penetration of the wells in the aquifer was accounted for in the analyses. Water level fluctuations due to well interference are typical of the wellfield; such fluctuations were noted in the later part of the test and didn't influence the analysis of the early data. Results are provided in Attachment 2. The geometric mean transmissivity for the multiple analyses of the 2013 data is 5105.1 ft²/day with a geometric mean hydraulic conductivity (k) of 40.70 ft/day. The low calculated storage coefficients on all tests are typical of confined aquifers. These values represent a fair potential for capacity with a moderate to high hydraulic conductivity.

The previous analysis of the January 2006 data (Attachment 3) assumed an aquifer thickness of 300 feet. For this analysis, aquifer thickness was changed to 150 feet, as evidenced by well construction records, and k recalculated from the transmissivity. Attachment 4 shows the updated values. The geometric mean transmissivity for the 2006 data was found to be 7,155 ft²/day, resulting in a k value of 47.7 ft/day.

The geometric mean of all k values calculated as part of this determination of aquifer properties is 43.5 ft/day, which is proposed to be the representative kh for the aquifer for WHPA and DWSMA delineation. The range of values that will be used in the uncertainty/sensitivity analysis are 25.1 ft/day to 78.7 ft/day, the minimum to maximum k determined during this analysis of existing data. This range of values is consistent with published values of the Mt. Simon – Hinckley aquifer.

Proposed New Test Information Summary

Pumped Well Name (Unique Number):		**Test Duration (Hours):**	
Location: X, Y (meters) UTM-Z15N or Lat-Lon (decimal degrees) datum: NAD83		**Pump Type:**	
		Discharge Rate:	
Number of Observation Wells:		**Flow Rate Measuring Device Type:**	

- A map showing the location of the pumping well and observation well(s) must be included.

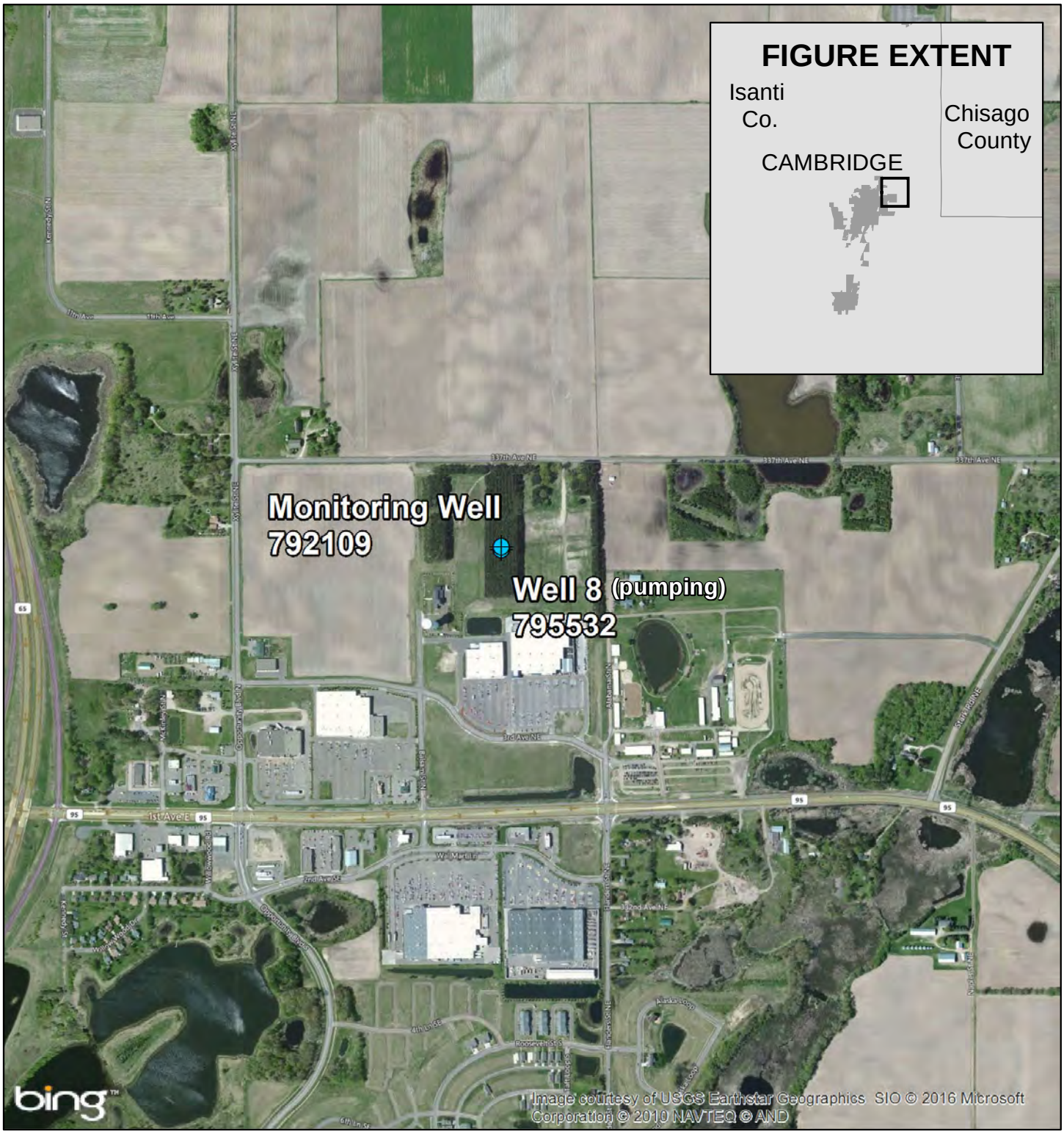
List the unique number of each public water supply well to which this DAP-ATP Form applies

217867					
462851					
680652					
731532					
735018					
795532					

Reviewed by: Amal Djerrari	**Approved:** ◉ Yes ○ No	**Approval Date:** 4/8/2016

Attachment 1

Well Construction Reports and Well Locations for Cambridge 2013 Pump Test



Location of Pumping Well (Well 8, 795532) and Monitoring Well (792109) Utilized during Cambridge May 28-29, 2013 24-Hour Pump Test

N
W E
S

0 500 1,000 2,000
FEET
METERS
0 150 300 600

Note: Monitoring Well is located 20' north of Well 8

Source: Bing Maps, MnGeo

Well 8

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

MINNESOTA UNIQUE WELL AND BORING NO. 795532

WELL OR BORING LOCATION

County Name: Isanti

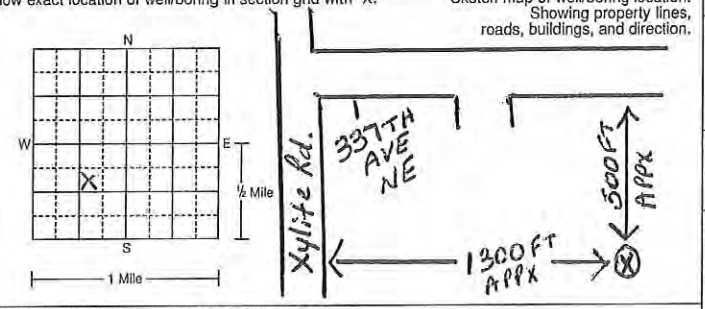
Township Name	Township No.	Range No.	Section No.	Fraction
Cambridge	36	23	27	SW¼ NE¼ SW¼

GPS LOCATION: Latitude 45 degrees 34 minutes 41 seconds N; Longitude 93 degrees 11 minutes 47 seconds W

House Number, Street Name, City, and ZIP Code of Well Location: "None Assigned" Cambridge 55008

Fire Number:

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



PROPERTY OWNER'S NAME/COMPANY NAME: City of Cambridge Well #8

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

300 Third Ave NE
Cambridge, MN 55008

WELL OWNER'S NAME/COMPANY NAME

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

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
See Attached Sheet.....				

Use a second sheet, if needed.

REMARKS, ELEVATION, SOURCE OF DATA, etc.

MINN. DEPT. OF HEALTH COPY 795532

WELL/BORING DEPTH (completed): 427 ft. DATE WORK COMPLETED: 5-17-13

DRILLING METHOD: ☐ Cable Tool ☐ Driven ☐ Auger ☒ Rotary ☐ Other Dual Rotary

DRILLING FLUID: H_2O WELL HYDROFRACTURED? ☐ Yes ☒ No From ft. To ft.

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

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

CASING Diameter	Weight	Specifications	HOLE DIAM.
24 in. To 115 ft.	lbs./ft.		23 in. To 312 ft.
18 in. To 307 ft.	lbs./ft.		17 1/4 in. To 427 ft.
in. To ft.	lbs./ft.		in. To ft.

SCREEN: Make Johnson Stainless Steel; Type 12" Tele; Slot/Gauze 30 slot; Set between ft. and 296 and 426 ft.

OPEN HOLE: From ft. To ft.; Diam. 11 1/4; Length 130 ft; FITTINGS k-packer, filler ri

STATIC WATER LEVEL: 39.7 ft. ☒ Below ☐ Above land surface; Measured from grade; Date measured 5-16-13

PUMPING LEVEL (below land surface): 72.2 ft. after 2 hrs. pumping 350 g.p.m.

WELLHEAD COMPLETION: ☐ Pitless/adapter manufacturer Model ☐ Casing protection ☒ 12 in. above grade ☐ At-grade ☐ Well House ☐ Hand Pump 24 inches

GROUTING INFORMATION (specify bentonite, cement-sand, neat-cement, concrete, cuttings, or other)

Material neat cement	From 0	To 297 ft.	15	☒ Yds.	☐ Bags
Material	From	To ft.		☐ Yds.	☐ Bags
Material	From	To ft.		☐ Yds.	☐ Bags
Driven casing seal	From 0	To 115	34		Bags

NEAREST KNOWN SOURCE OF CONTAMINATION: none feet direction type

Well disinfected upon completion? ☒ Yes ☐ No

PUMP: ☒ Not installed Date installed

Manufacturer's name

Model Number HP Volts

Length of drop pipe ft. Capacity g.p.m.

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

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

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

WELL CONTRACTOR CERTIFICATION

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

Mark J Traut Wells, Inc. 1404
Licensee Business Name Lic. or Reg. No.

Dan Traut 589 5-21-13
Certified Representative Signature Certified Rep. No. Date

Butch Gaustad & Dan Pohlkamp
Name of Driller

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

Obs. Well

MINNESOTA UNIQUE WELL AND BORING NO. 792109

WELL OR BORING LOCATION

County Name: Isanti

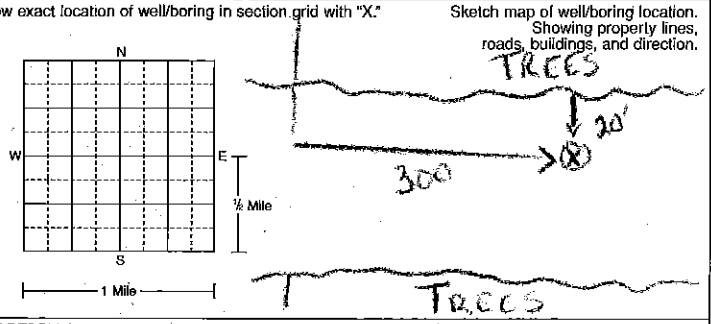
Township Name	Township No.	Range No.	Section No.	Fraction
Cambridge	36	23	27	SW NE SW (¼ ¼ ¼)

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

House Number, Street Name, City, and ZIP Code of Well Location: Not assigned 337th Ave NW Cambridge 55008

Fire Number:

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



PROPERTY OWNER'S NAME/COMPANY NAME: City of Cambridge

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

300 3rd Ave. NE
Cambridge, MN 55008

WELL OWNER'S NAME/COMPANY NAME: Same

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

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Fine Sand	Brown	S	0	4
Clay	Brown	M	4	7
Fine Sand	Brown	S	7	35
Sand & Gravel	Brown	M	35	39
Clay	Gray	M	39	50
Clay	Brown	M	50	55
Fine Sand	Brown	S	55	59
Clay	Brown	M	59	64
Sand & Gravel	Brown	S/M	64	107
Shale	Green	M	107	120
Sandstone	Tan&Wht	S	120	220
Sandstone	Tan	M	220	290
Sandstone	White	H	290	340

Use a second sheet, if needed.

REMARKS, ELEVATION, SOURCE OF DATA, etc.: MW-1

WELL CONTRACTOR COPY 792109

WELL/BORING DEPTH (completed): 340 ft. DATE WORK COMPLETED: 9-13-12

DRILLING METHOD: ☐ Cable Tool ☒ Driven ☐ Auger ☒ Rotary ☐ Other

DRILLING FLUID: Bentonite

WELL HYDROFRACTURED? ☐ Yes ☒ No From ____ ft. To ____ ft.

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

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

HOLE DIAM.

CASING

Diameter	To	Weight	Specifications	HOLE DIAM. To
2 in.	330 ft.	3.65 lbs./ft.		6 in. To 340 ft.
____ in.	____ ft.	____ lbs./ft.		____ in. To ____ ft.
____ in.	____ ft.	____ lbs./ft.		____ in. To ____ ft.

SCREEN — OPEN HOLE From 2" ft. To ____ ft.

Make: Johnson
Type: Stainless Steel — Diam.: 2"
Slot/Gauze: 10 — Length: 10'
Set between 330 ft. and 340 ft. — FITTINGS:

STATIC WATER LEVEL: 37 ft. ☒ Below ☐ Above land surface — Measured from: Land — Date measured: 9-13-12

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

WELLHEAD COMPLETION
☐ Pitless/adapter manufacturer ____ Model ____
☐ Casing protection ____ ☒ 12 in. above grade
☐ At-grade ☐ Well House ☐ Hand Pump

GROUTING INFORMATION (specify bentonite, cement-sand, neat-cement, concrete, cuttings, or other)

Material	From	To		
Cement	0	325 ft.	3 1/4 X	☐ Yds. ☐ Bags
____	____	____ ft.	____	☐ Yds. ☐ Bags
____	____	____ ft.	____	☐ Yds. ☐ Bags
Driven casing seal	____	____	____ Bags	

NEAREST KNOWN SOURCE OF CONTAMINATION: N/A ____ feet ____ direction ____ type

Well disinfected upon completion? ☒ Yes ☐ No

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

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

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

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

Mark J. Traut Wells, Inc. — 1404
Licensee Business Name — Lic. or Reg. No.

Dan Traut — 589 — 10-11-12
Certified Representative Signature — Certified Rep. No. — Date

Perry Storkamp & Phil Ratke
Name of Driller

IC 140-0020 HE-01205-13 (Rev. 11/10)

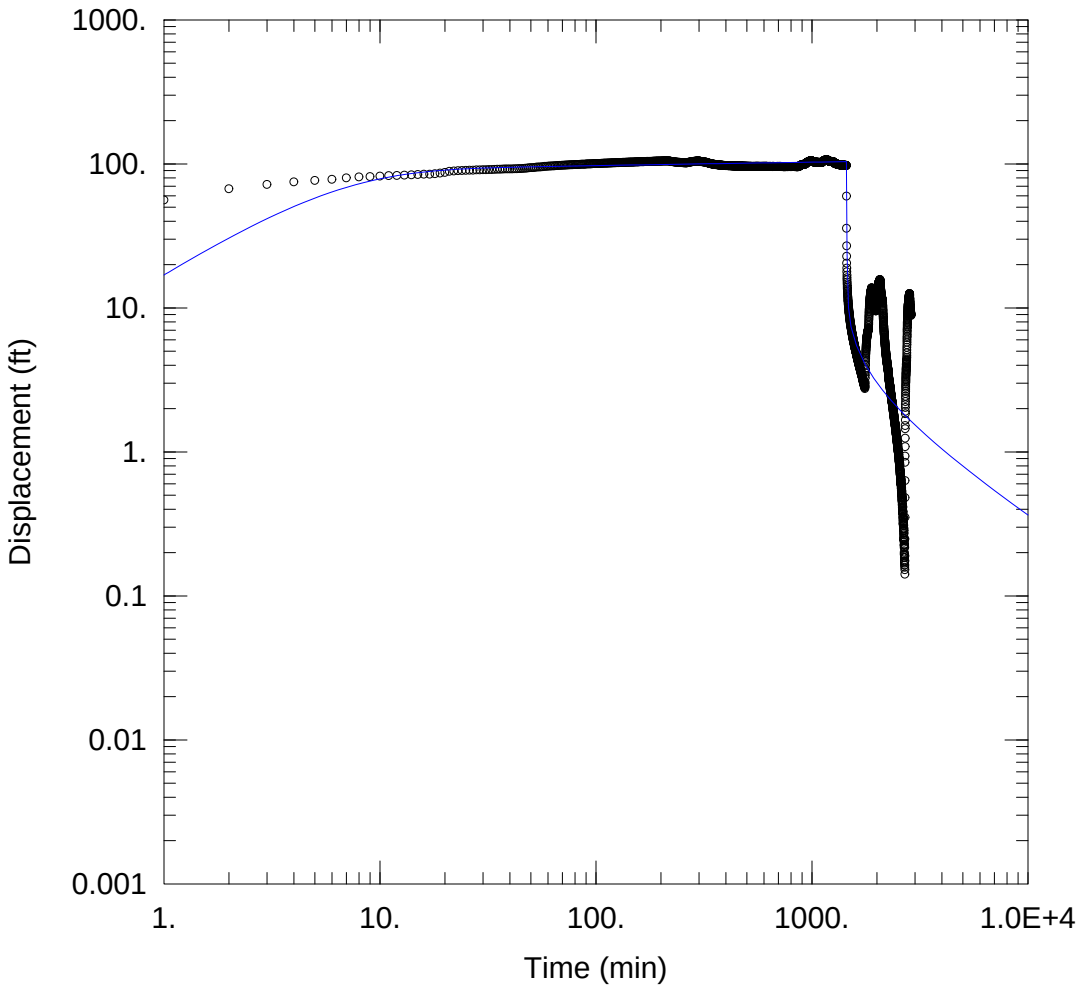
Attachment 2

2013 Pump Test Results for Cambridge Well 8 (795532)

Pump Test Analysis Summary for Cambridge Well 8 (795532)

Data Source	Method	T (ft^2/d)	k (ft/d)	b (ft)	S
Well 8 and MW Pumping and Recovery Data	Confined: Papadopulos-Cooper	4805.9	28.78	167	7.58E-10
	Confined: Cooper-Jacob	4598.8	27.54	167	1.69E-10
	Confined: Theis	4805.9	28.78	167	2.47E-09
Well 8 Recovery Data	Theis (Recovery)	4187.9	25.08	167	—
MW Recovery Data	Theis (Recovery)	3422.8	45.04	76	—
Well 8 Pumping and Recovery Data	Papadopulos-Cooper	6574.3	39.37	167	7.79E-16
	Cooper-Jacob	5090.2	30.48	167	2.53E-12
	Theis	6740	40.36	167	3.79E-15
MW Pumping and Recovery Data	Papadopulos-Cooper	5984	78.74	76	8.37E-11
	Cooper-Jacob	5585.8	73.50	76	1.28E-10
	Theis	5347.4	70.36	76	9.47E-09
	Min	*3422.8*	*25.08*	*76*	*7.788E-16*
	Mean	*5194.8*	*44.36*	—	*1.453E-09*
	Max	*6740.0*	*78.74*	*167*	*9.473E-09*
	Standard Deviation	*949.3*	*19.26*	—	*2.933E-09*
	Geometric Mean	*5105.1*	*40.70*	—	*1.838E-11*

Test Date: May 28-29, 2013



WELL TEST ANALYSIS

Data Set: C:\Users\jmacholl\Desktop\CambridgeModel\Data\AQTESOLV\CAMBR2013_Well8_P-C.aqt
Date: 04/01/16 Time: 11:44:52

PROJECT INFORMATION

Company: SEH
Client: CAMBR
Project: 135080
Location: Cambridge, MN
Test Well: No 8 795532
Test Date: 3/17/2015

AQUIFER DATA

Saturated Thickness: 167. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 8	471048.551	202731.068

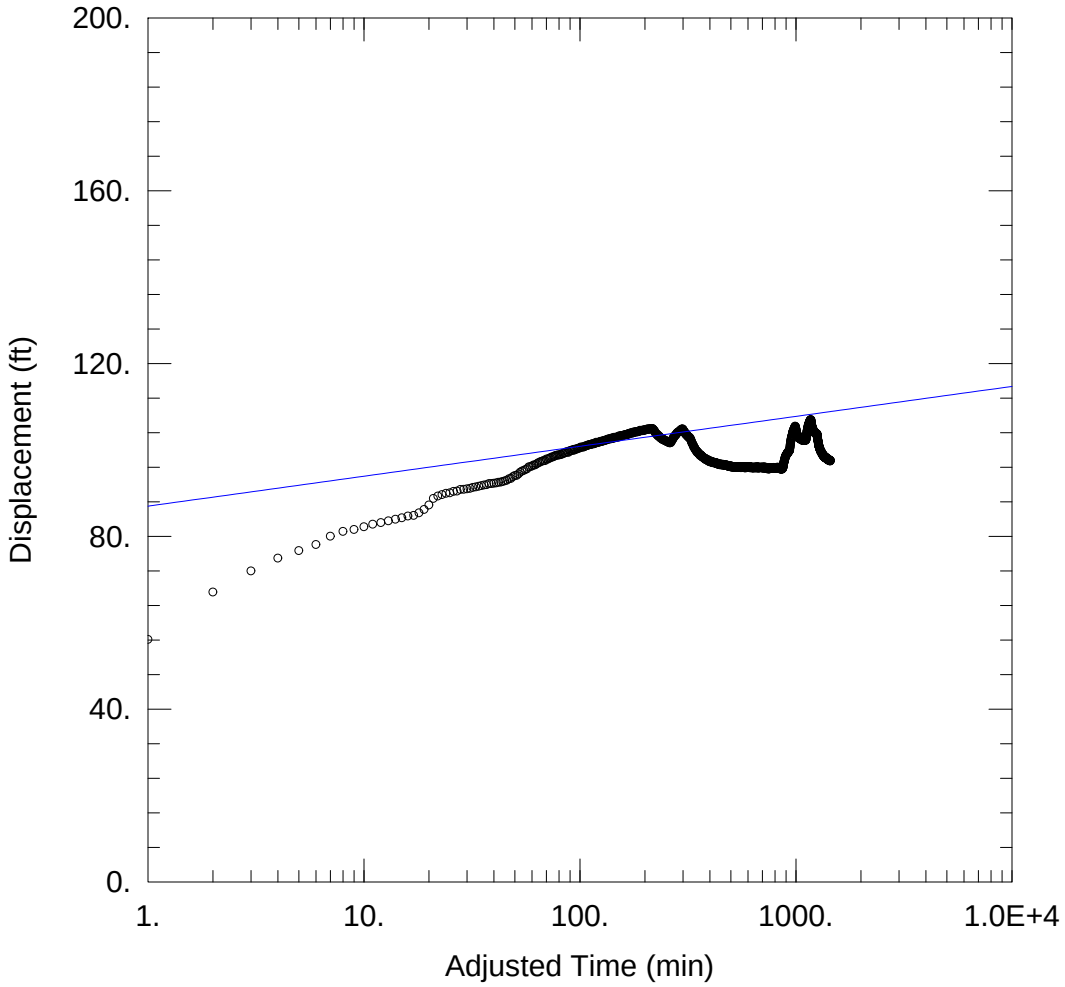
Observation Wells

Well Name	X (ft)	Y (ft)
○ Well 8	471048.551	202731.068

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 6574.3 ft^2/day S = 7.788E-16
r(w) = 0.9375 ft r(c) = 1.5 ft



WELL TEST ANALYSIS

Data Set: C:\Users\jmacholl\Desktop\CambridgeModel\Data\AQTESOLV\CAMBR2013_Well8_C-J.aqt
Date: 04/01/16 Time: 11:43:29

PROJECT INFORMATION

Company: SEH
Client: CAMBR
Project: 135080
Location: Cambridge, MN
Test Well: No 8 795532
Test Date: 3/17/2015

AQUIFER DATA

Saturated Thickness: 167. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 8	471048.551	202731.068

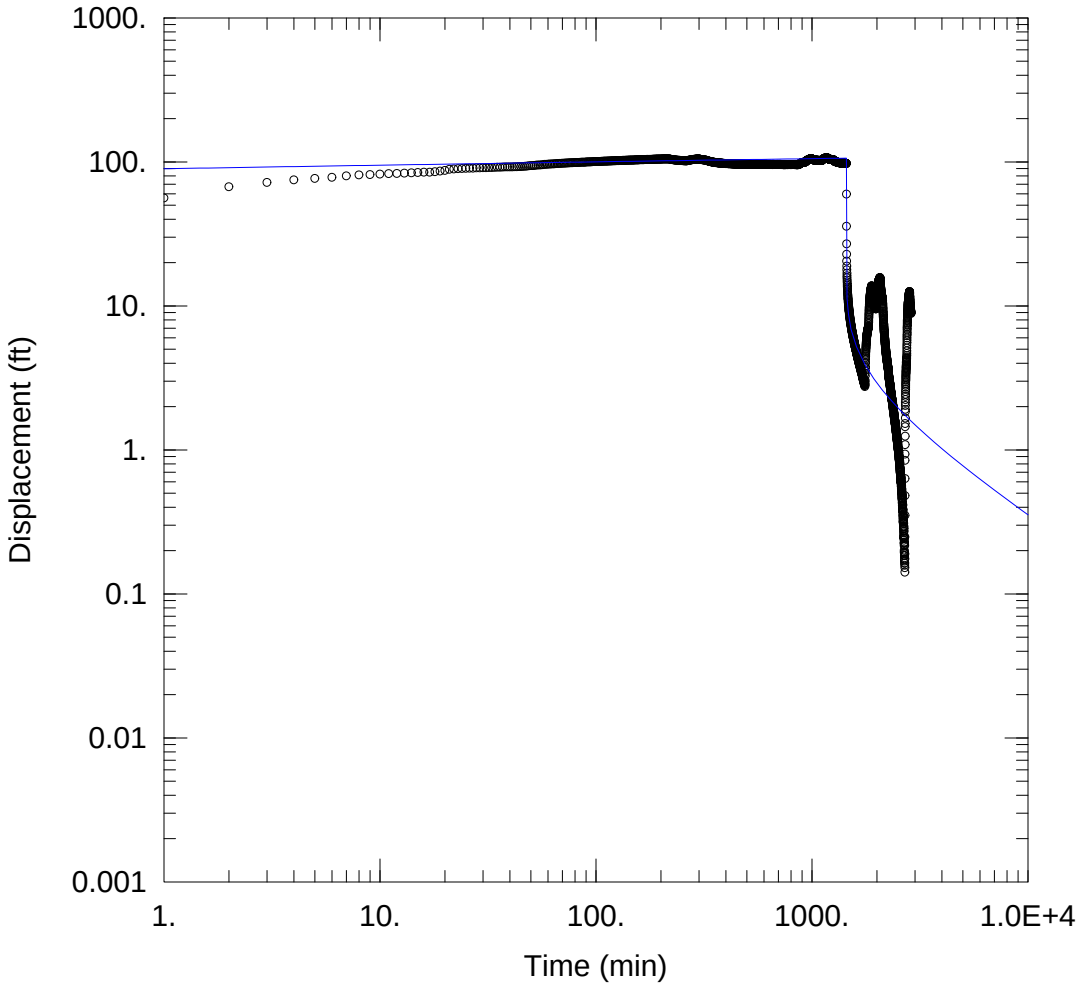
Observation Wells

Well Name	X (ft)	Y (ft)
◦ Well 8	471048.551	202731.068

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 5090.2 ft^2/day S = 2.534E-12



WELL TEST ANALYSIS

Data Set: C:\...\CAMBR2013_Well8_Theis.aqt
Date: 04/01/16 Time: 10:25:02

PROJECT INFORMATION

Company: SEH
Client: CAMBR
Project: 135080
Location: Cambridge, MN
Test Well: No 8 795532
Test Date: 3/17/2015

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 8	471048.551	202731.068

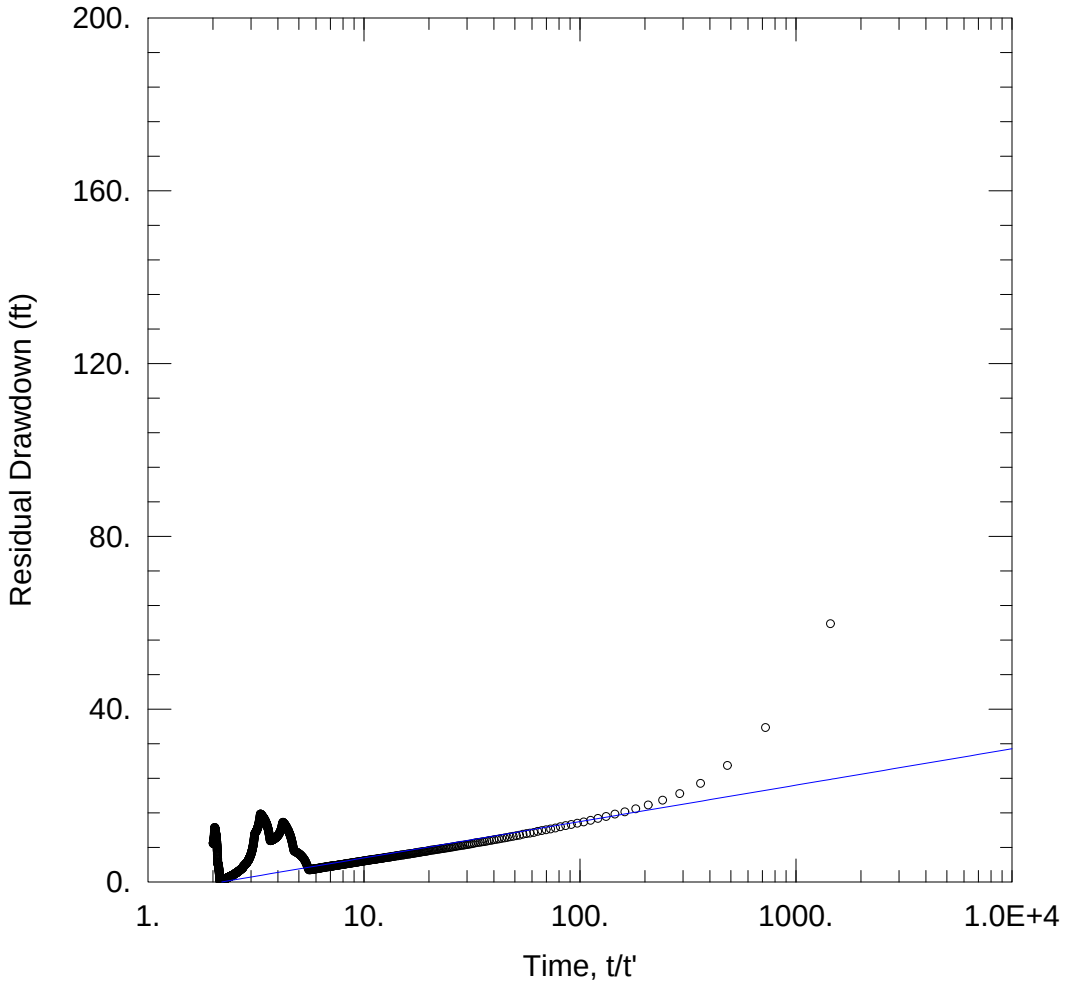
Observation Wells

Well Name	X (ft)	Y (ft)
◦ Well 8	471048.551	202731.068

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 6740. ft^2/day
S = 3.794E-15
Kz/Kr = 0.1
b = 167. ft



WELL TEST ANALYSIS

Data Set: C:\...\CAMBR2013_Well8_Theis-Recovery.aqt
Date: 04/01/16 Time: 10:11:46

PROJECT INFORMATION

Company: SEH
Client: CAMBR
Project: 135080
Location: Cambridge, MN
Test Well: No 8 795532
Test Date: 3/17/2015

AQUIFER DATA

Saturated Thickness: 167. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 8	471048.551	202731.068

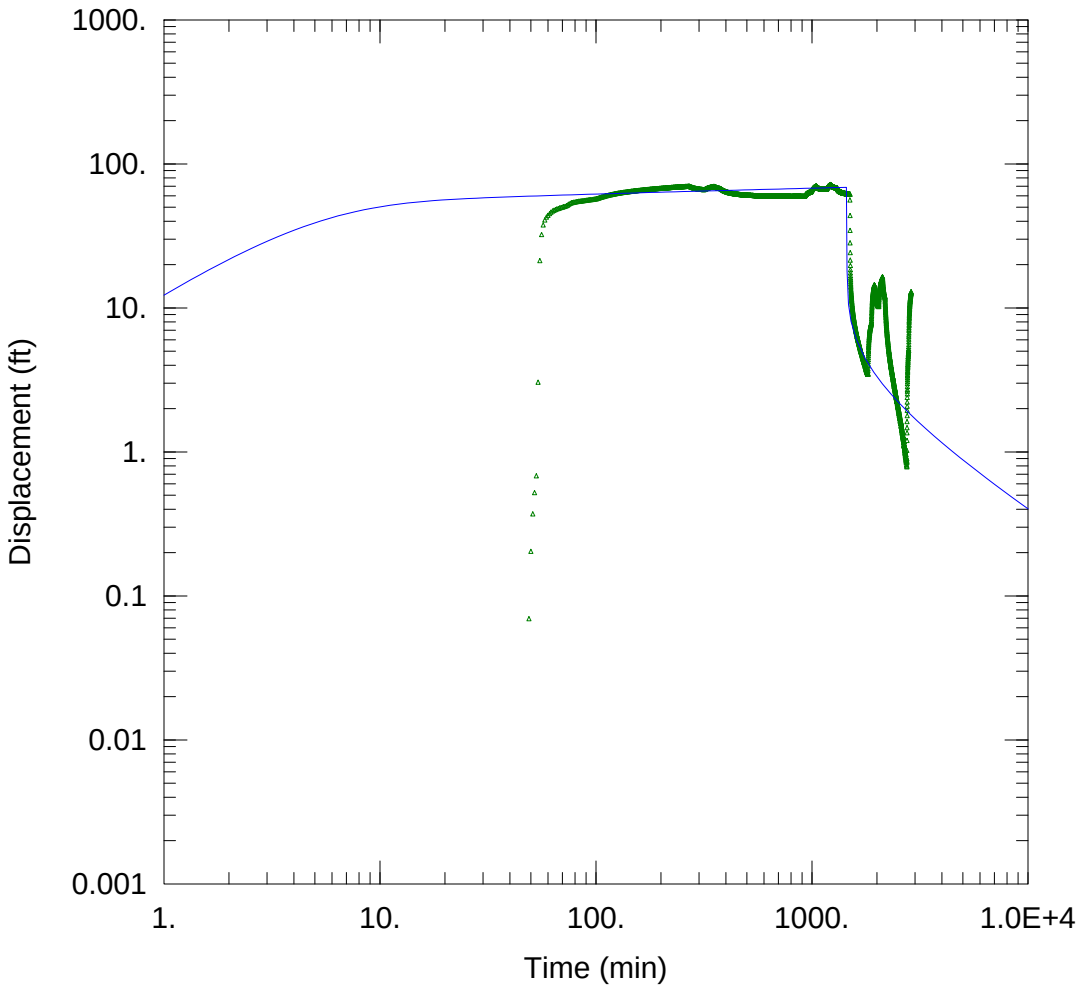
Observation Wells

Well Name	X (ft)	Y (ft)
○ Well 8	471048.551	202731.068

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 4187.9 ft^2/day S/S' = 2.196



WELL TEST ANALYSIS

Data Set: C:\Users\jmacholl\Desktop\CambridgeModel\Data\AQTESOLV\CAMBR2013_MW_P-C.aqt
Date: 04/01/16 Time: 10:58:55

PROJECT INFORMATION

Company: SEH
Client: CAMBR
Project: 135080
Location: Cambridge, MN
Test Well: No 8 795532
Test Date: 3/17/2015

AQUIFER DATA

Saturated Thickness: 167. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 8	471048.551	202731.068

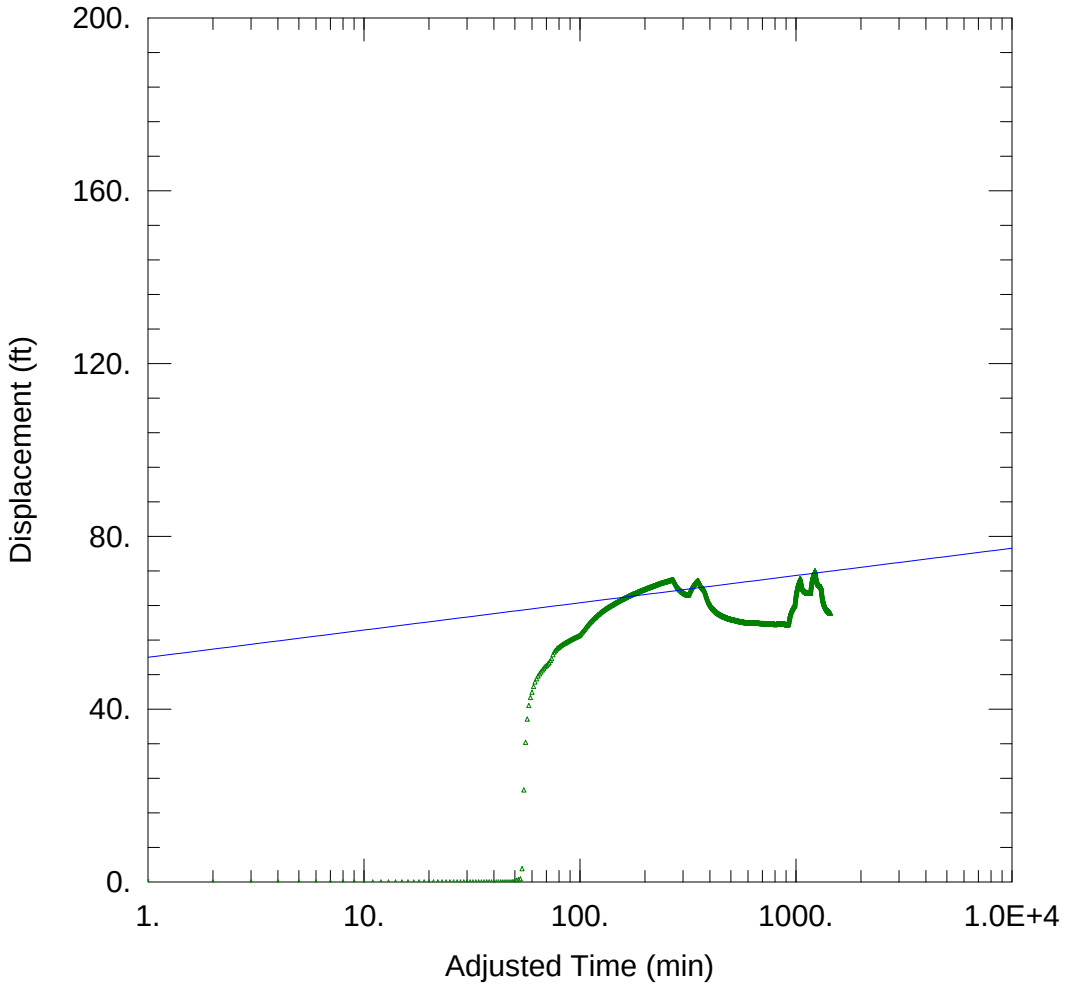
Observation Wells

Well Name	X (ft)	Y (ft)
MW 792109	471048.551	202751.068

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 5948. ft^2/day S = 8.369E-11
r(w) = 0.9375 ft r(c) = 1.5 ft



WELL TEST ANALYSIS

Data Set: C:\Users\jmacholl\Desktop\CambridgeModel\Data\AQTESOLV\CAMBR2013_MW_C-J.aqt
Date: 04/01/16 Time: 11:05:08

PROJECT INFORMATION

Company: SEH
Client: CAMBR
Project: 135080
Location: Cambridge, MN
Test Well: No 8 795532
Test Date: 3/17/2015

AQUIFER DATA

Saturated Thickness: 167. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 8	471048.551	202731.068

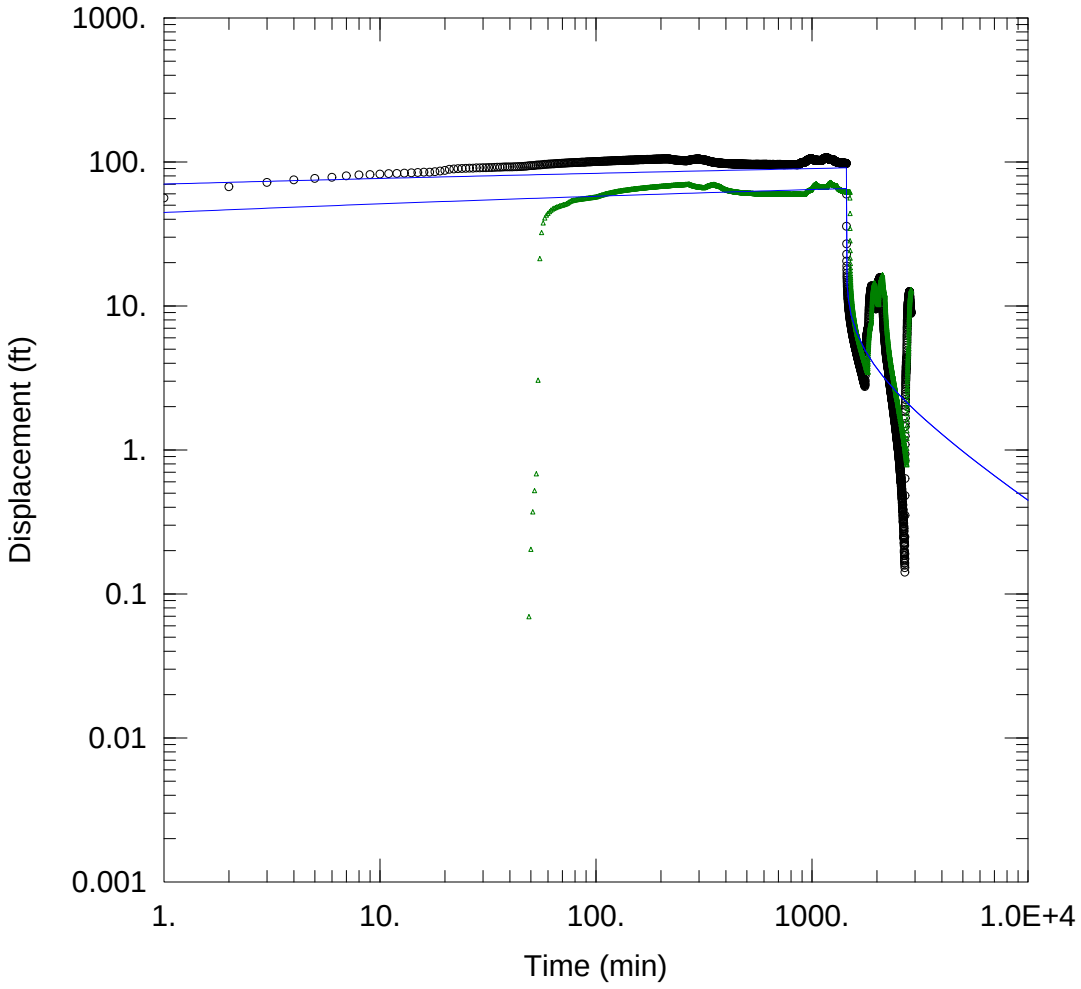
Observation Wells

Well Name	X (ft)	Y (ft)
MW 792109	471048.551	202751.068

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 5585.8 ft^2/day S = 1.277E-10



WELL TEST ANALYSIS

Data Set: C:\Users\jmacholl\Desktop\CambridgeModel\Data\AQTESOLV\CAMBR2013_MW_Theis.aqt
Date: 04/01/16 Time: 10:52:12

PROJECT INFORMATION

Company: SEH
Client: CAMBR
Project: 135080
Location: Cambridge, MN
Test Well: No 8 795532
Test Date: 3/17/2015

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 8	471048.551	202731.068

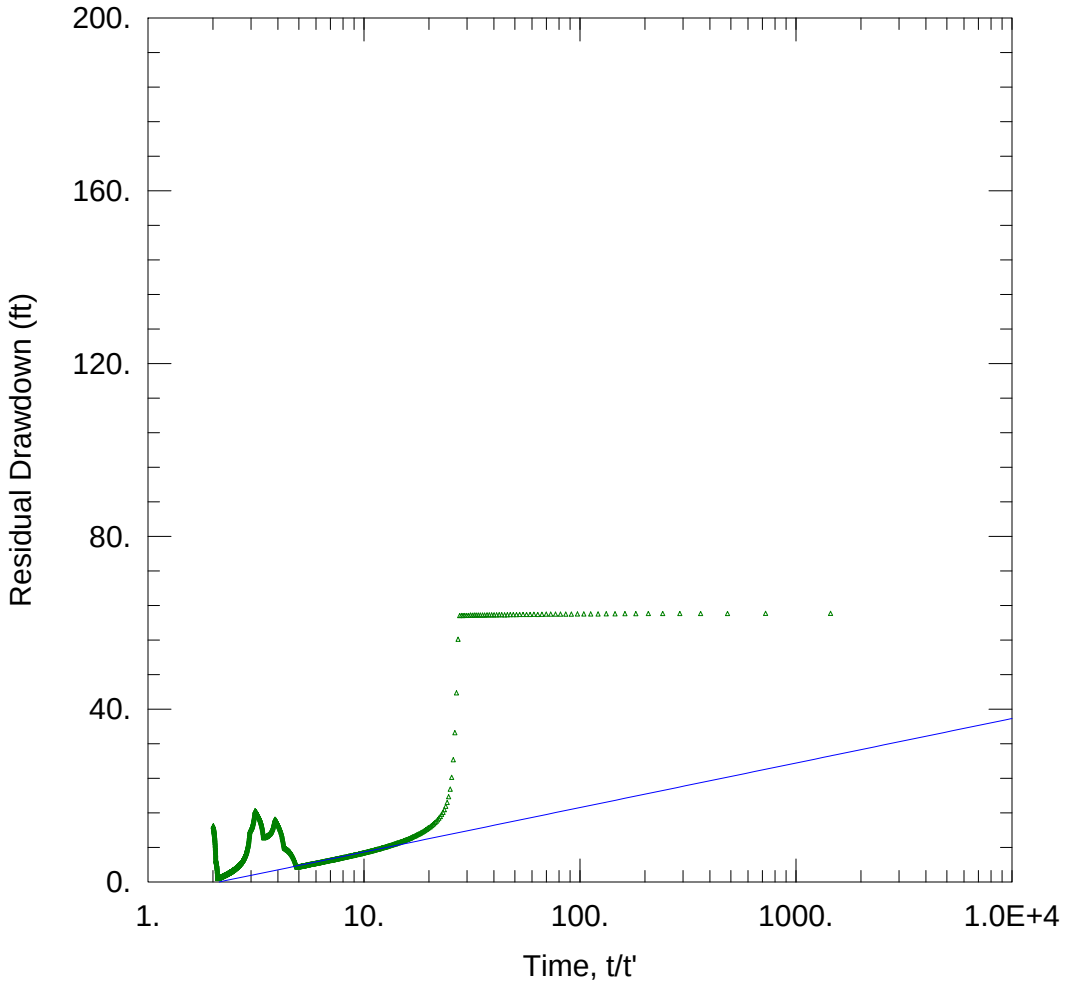
Observation Wells

Well Name	X (ft)	Y (ft)
○ Well 8	471048.551	202731.068
▵ MW 792109	471048.551	202751.068

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 5347.4 ft^2/day
S = 9.473E-9
Kz/Kr = 0.1
b = 167. ft



WELL TEST ANALYSIS

Data Set: C:\...\CAMBR2013_MW_Theis-Recovery.aqt
Date: 04/01/16 Time: 10:55:46

PROJECT INFORMATION

Company: SEH
Client: CAMBR
Project: 135080
Location: Cambridge, MN
Test Well: No 8 795532
Test Date: 3/17/2015

AQUIFER DATA

Saturated Thickness: 167. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 8	471048.551	202731.068

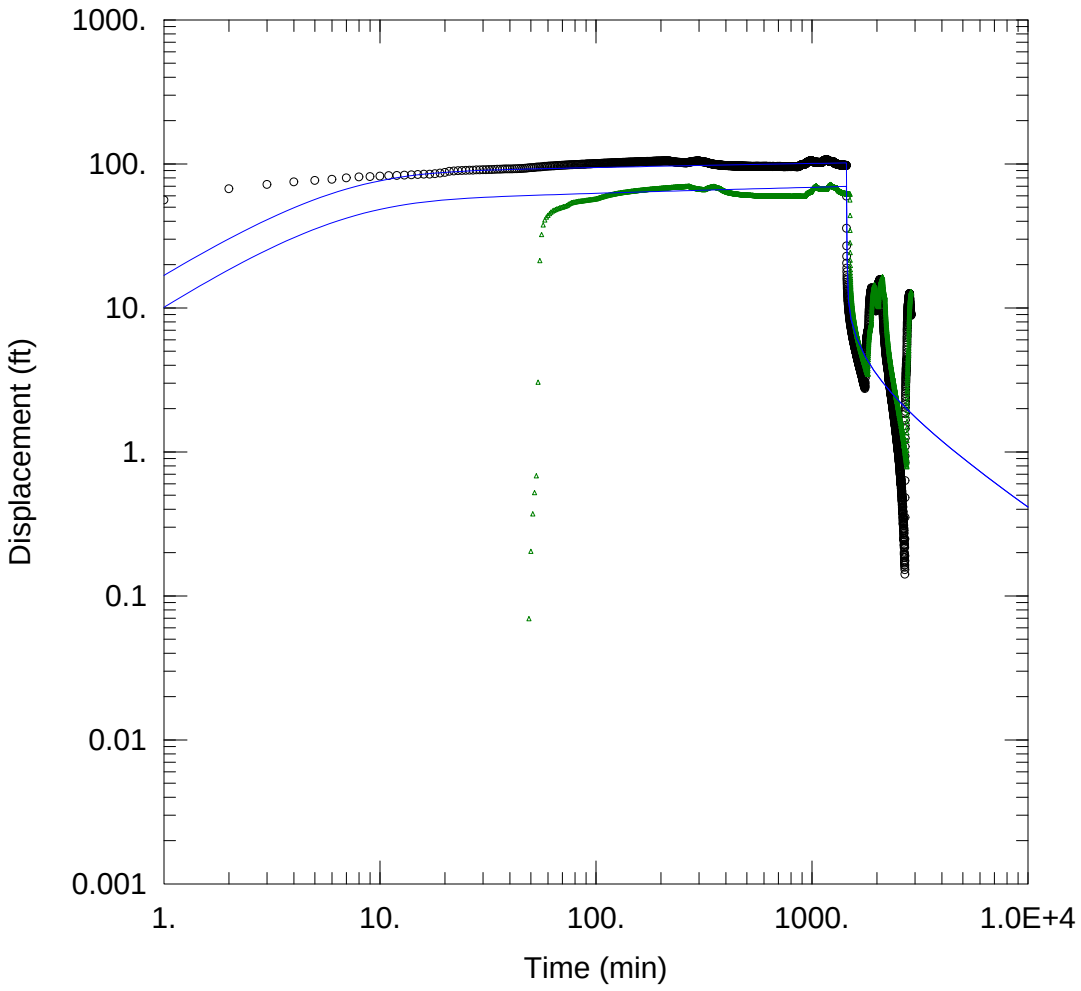
Observation Wells

Well Name	X (ft)	Y (ft)
MW 792109	471048.551	202751.068

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 3422.8 ft^2/day S/S' = 2.139



WELL TEST ANALYSIS

Data Set: C:\...\CAMBR2013_Well8andMW_P-C.aqt
Date: 04/01/16 Time: 10:32:03

PROJECT INFORMATION

Company: SEH
Client: CAMBR
Project: 135080
Location: Cambridge, MN
Test Well: No 8 795532
Test Date: 3/17/2015

AQUIFER DATA

Saturated Thickness: 167. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 8	471048.551	202731.068

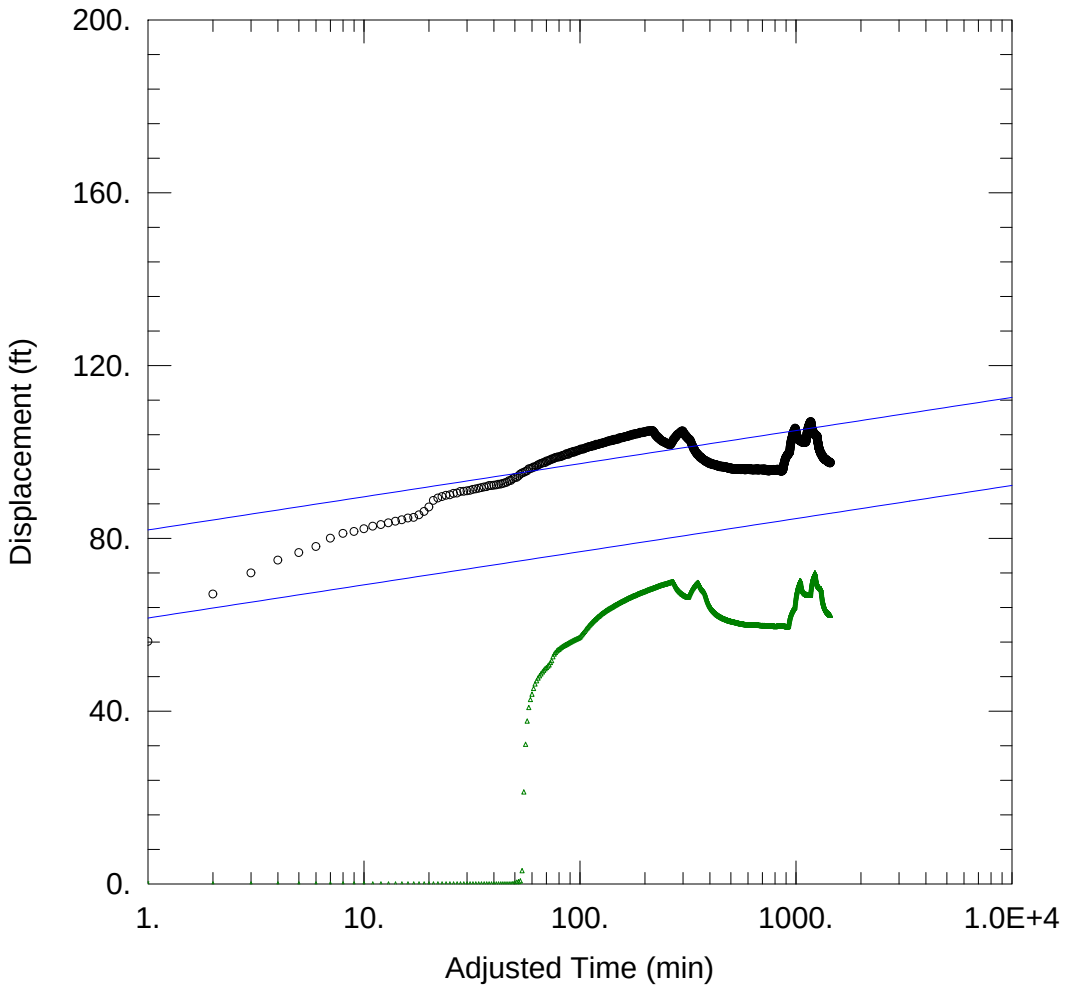
Observation Wells

Well Name	X (ft)	Y (ft)
○ Well 8	471048.551	202731.068
▵ MW 792109	470712.866	202929.463

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 5782.4 ft^2/day S = 3.108E-13
r(w) = 0.9375 ft r(c) = 1.5 ft



WELL TEST ANALYSIS

Data Set: C:\...\CAMBR2013_Well8andMW_C-J.aqt
Date: 04/01/16 Time: 10:41:35

PROJECT INFORMATION

Company: SEH
Client: CAMBR
Project: 135080
Location: Cambridge, MN
Test Well: No 8 795532
Test Date: 3/17/2015

AQUIFER DATA

Saturated Thickness: 167. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 8	471048.551	202731.068

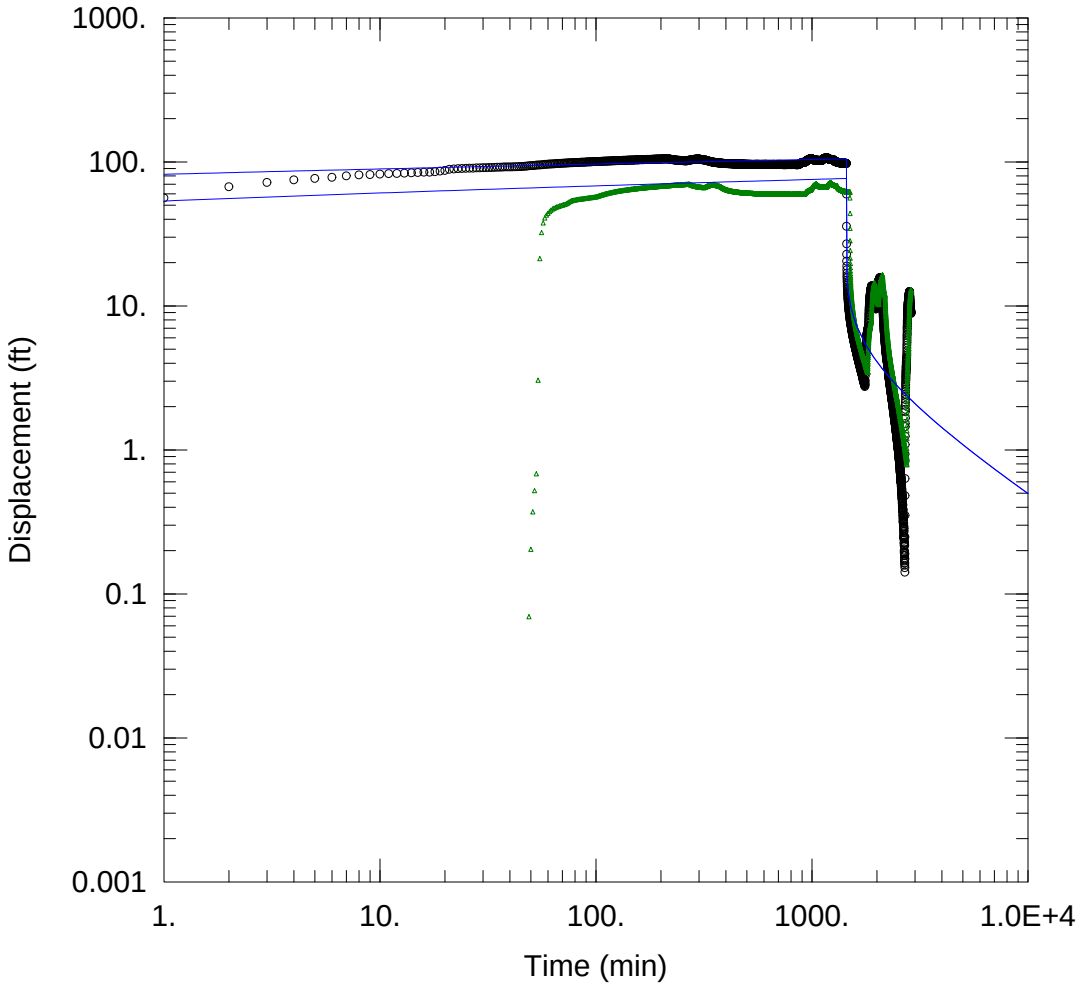
Observation Wells

Well Name	X (ft)	Y (ft)
○ Well 8	471048.551	202731.068
▵ MW 792109	471048.551	202751.068

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 4598.8 ft^2/day S = 1.691E-10



WELL TEST ANALYSIS

Data Set: C:\...\CAMBR2013_Well8andMW_Theis.aqt
Date: 04/01/16 Time: 10:39:55

PROJECT INFORMATION

Company: SEH
Client: CAMBR
Project: 135080
Location: Cambridge, MN
Test Well: No 8 795532
Test Date: 3/17/2015

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well 8	471048.551	202731.068

Observation Wells

Well Name	X (ft)	Y (ft)
○ Well 8	471048.551	202731.068
▵ MW 792109	471048.551	202751.068

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 4805.9 ft^2/day
S = 2.465E-9
Kz/Kr = 0.1
b = 167. ft

Attachment 3

2006 Pump Test Results for Cambridge Well 7 (735018)

SEH

TECHNICAL MEMORANDUM

TO: Gail Haglund, PG - Minnesota Department of Health

FROM: Craig L. Kurtz, PG

DATE: February 20, 2006

RE: Cambridge WHPP Aquifer Pumping Test
SEH No. A-CAMBR0419.01

Background

This Technical Memorandum summarizes the aquifer pumping test conducted by the City of Cambridge, Minnesota (City) on its bedrock, source water aquifer - the Mount Simon-Hinckley. The test was performed in accordance with the Minnesota Wellhead Protection Rules (MN Rules Chapter 4720.5320 and 4720.5520), and the *Aquifer Test Plan* submitted to the Minnesota Department of Health (MDH) staff in January 2006.

Test Description

The aquifer pumping test was completed on January 23, 24 and 25, 2006. It consisted of a background, 48-hour, non-pumping period, a 24-hour pumping phase, and a 24-hour non-pumping recovery phase.

Well 7 (Unique Well No. 735018) was used as the pumping well, and Wells 5 and 6 (Unique Nos. 680652 and 731532 respectively) were used as non-pumping observation wells. All three wells are open to the Mount Simon-Hinckley Aquifer. The logs of the three wells are included with this memorandum in Attachment A. During the pumping phase, Cambridge Municipal Well 7 was pumped continuously at a constant rate.

The approximate distances of the observation wells from Well 7 are provided in Table 1 below:

Table 1 – Distances between Observation Wells and Pumping Well

Observation Well	Approximate Distance from Pumping Well (Well 7) (ft.)
5	1,465
6	1,085

Hermit 1000® electronic data loggers and In-Situ® pressure transducers were utilized in Wells 5, 6, and 7 to monitor and record the groundwater levels and drawdown throughout the test. Groundwater levels were measured and recorded on a logarithmic schedule during the pumping and recovery phases of the test in Well 7. Linear recording schedules were used in Wells 5 and 6 (one minute and 30 seconds, respectively).

The groundwater level monitoring and recording equipment was temporarily installed in the wells on January 21, 2006. Prior to the pumping phase, Wells 5, 6, and 7 were not pumped for at least

48 hours. The 24-hour pumping phase of the test was started at 8:50 a.m. on January 23, 2006 and ended at 8:50 a.m. on January 24, 2006. Pumping rates were calculated and monitored by regularly recording the volume of groundwater pumped from Well 7. A totalizer was used to measure the volume of groundwater pumped, and the totalizer readings were recorded at the intervals required in the Wellhead Protection Rule. The field notes are provided in Attachment B. The calculated pumping rates ranged from 943 to 994 gallons per minute (gpm). The average rate throughout the entire pumping phase was 950 gpm, and the rate did not fluctuate more than 10% between readings.

Well 7 was turned off, and the recovery phase of the test initiated at 8:50 a.m. on January 24. The recovery phase ended at approximately 9:00 a.m. on January 25. The electronic monitoring equipment was removed from the wells on January 25.

Data Analysis

The groundwater level data collected during the background, pumping, and recovery phases of the test have been submitted to MDH staff on a computer disk with this Technical Memorandum. The groundwater level data collected from the three wells during the pumping and recovery phases of the test were analyzed using AQTESOLV® software. The analysis consisted of matching the data to an appropriate type-curve solution, resulting in a calculated aquifer transmissivity and storativity estimate. Time-drawdown graphs of the data obtained during the test are provided in Attachment C.

Results

The maximum groundwater drawdown levels observed at the three wells at the end of the pumping phase are summarized in the following table. The static groundwater levels recorded prior to the pumping phase are also provided.

Table 2 - Static and Pumping Groundwater Levels

Well	Static Groundwater Level (ft. below grade)	Maximum Groundwater Drawdown (ft.)
5	34.90	5.61
6	37.00	10.77
7	32.52	83.78

The specific capacity for Well 7 is 11.3 gpm/ft of drawdown. Based on previous pumping tests, the specific capacities of Wells 5 and 6 are 4.3 and 4.9 gpm/ft of drawdown, respectively.

No distinct hydrogeologic flow boundaries were detected in the aquifer from this test. In addition, no obvious hydrogeologic influence or interference from the use of other wells open to the Mount Simon-Hinckley Aquifer was observed.

Since the groundwater levels were continuing to decrease in the pumping and observation wells at the end of the pumping phase, it appears that the aquifer is hydraulically confined. Therefore, the data was analyzed using the Theis (1935) and the Papadopulos-Cooper (1967) confined system solutions. The Papadopulos-Cooper solution type curve appeared to most closely match the signature of the groundwater level drawdown data from Well 7. The Theis and Papadopulos-

Cooper solution type-curves appear to both equally match the data from the non-pumping observation wells.

Semi-confined ("leaky") analytical solutions were also applied to the data, but the calculated aquifer transmissivity and storativity values did not appreciably change, and the leakage coefficients were significantly small, suggesting the aquifer is mostly confined. The results of the data analyses from the aquifer pumping test are summarized in Table 3.

Table 3 - Results of Aquifer Pumping Test

Data Source	Analysis Solution	Transmissivity (ft^2/day)	Storativity Value	Permeability* (ft/day)
Wells 5, 6, 7 Pumping and Recovery Data	Confined: Papadopulos-Cooper (1967)	6,172	0.000186	20.6
Wells 5 and 6 Pumping and Recovery Data	Confined: Theis (1935)	6,982	0.000165	23.3
	Confined: Papadopulos-Cooper (1967)	6,597	0.000159	22.0
Well 5 Pumping and Recovery Data	Confined: Theis (1935)	9,456	0.000323	31.5
	Confined: Papadopulos-Cooper (1967)	9,672	0.000249	32.2
Well 6 Pumping and Recovery Data	Confined: Theis (1935)	6,896	0.000101	23.0
	Confined: Papadopulos-Cooper (1967)	7,448	5.62×10^{-5}	24.8
Well 7 Pumping and Recovery Data	Confined: Papadopulos-Cooper (1967)	5,141	2.68×10^{-7}	17.1
Arithmetic Mean		7,296	0.000155	24
Geometric Mean		7,155	0.0000703	23.8

** Assumes an aquifer thickness of 300 feet.*

The transmissivity values derived from the analyses of the combined pumping and recovery sets of the data from the observation wells were considered to be the most representative of the aquifer's characteristics. However, when the data from the wells were analyzed collectively as a combined dataset and then individually, the transmissivity values were not consistent. Therefore, a range of transmissivity values (5,141 to 9,672 ft^2/day) will be utilized for the Wellhead Protection Area delineations. These values will be translated into aquifer permeabilities ranging from approximately 17.1 to 32.2 ft/day.

Conclusions

The aquifer pumping test conducted on Well 7 for the City's Wellhead Protection Plan appears to have been completed in accordance with the Minnesota Wellhead Protection Rule. It has provided valid and useful information regarding the local characteristics, parameters, and capabilities of the source water bedrock aquifer - the Mount Simon-Hinckley. The representative, average transmissivity, storativity, and permeability values for the aquifer are 7,155 ft^2/day, 0.0000703, and 23.8 ft/day, respectively. However, to address uncertainties inherently related to this pumping test and the aquifer, a range of transmissivities and permeabilities will be used in the groundwater flow modeling for the City's Wellhead Protection Plan.

c: Todd Schwab, Assistant Director of Public Works, City of Cambridge
Todd Blank, PE, City Engineer, SEH Inc.

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Attachment 4

Analysis of Existing Pumping Test Data

Re-evaluation of 2006 Aquifer Pumping Test Results

Data Source	Analysis Solution	Transmissivity (ft^2/dav)	Storativity Value	Permeability* (ft/dav)	Permeability** (ft/dav)
Wells 5, 6, 7 Pumping and Recovery Data	Confined: Papadopulos- Cooper (1967)	6,172	0.000186	20.6	41.1
Wells *5* and 6 Pumping and Recovery Data	Confined: Theis (1935)	6,982	0.000165	23.3	46.5
	Confined: Papadopulos-Cooper (1967)	6,597	0.000159	22.0	44.0
Well *5* Pumping and Recovery Data	Confined: Theis (1935)	9,456	0.000323	31.5	63.0
	Confined: Papadopulos-Cooper (1967)	9,672	0.000249	32.2	64.5
Well 6 Pumping and Recovery Data	Confined: Theis (1935)	6,896	0.000101	23.0	46.0
	Confined: Papadopulos-Cooper (1967)	7,448	5.62×10^{-5}	24.8	49.7
Well 7 Pumping and Recovery Data	Confined: Papadopulos- Cooper (1967)	5,141	2.68×10^{-7}	17.1	34.3
Arithmetic Mean		7,296	0.000155	24	49
Geometric Mean		7,155	0.0000703	23.8	47.7

* Original Calculation - assumes b = 300'

* Updated Calculation - assumes b = 150'

Existing Pumping Test Analysis Results

Data Source	Pump Test Date	Method	T (ft^2/d)	k (ft/d)
Well 8 and MW Pumping and Recovery Data	2013	Confined: Papadopulos-Cooper	4,806	28.8
		Confined: Cooper-Jacob	4,599	27.5
		Confined: Theis	4,806	28.8
Well 8 Recovery Data	2013	Confined: Theis (Recovery)	4,188	25.1
MW Recovery Data	2013	Confined: Theis (Recovery)	3,423	45.0
Well 8 Pumping and Recovery Data	2013	Confined: Papadopulos-Cooper	6,574	39.4
		Confined: Cooper-Jacob	5,090	30.5
		Confined: Theis	6,740	40.4
MW Pumping and Recovery Data	2013	Papadopulos-Cooper	5,984	78.7
		Cooper-Jacob	5,586	73.5
		Theis	5,347	70.4
Wells 5, 6, 7 Pumping and Recovery Data	2006	Confined: Papadopulos- Cooper (1967)	6,172	41.1
Wells *5* and 6 Pumping and Recovery Data	2006	Confined: Theis (1935)	6,982	46.5
		Confined: Papadopulos-Cooper (1967)	6,597	44.0
Well *5* Pumping and Recovery Data	2006	Confined: Theis (1935)	9,456	63.0
		Confined: Papadopulos- Cooper (1967)	9,672	64.5
Well 6 Pumping and Recovery Data	2006	Confined: Theis (1935)	6,896	46.0
		Confined: Papadopulos- Cooper (1967)	7,448	49.7
Well 7 Pumping and Recovery Data	2006	Confined: Papadopulos- Cooper (1967)	5,141	34.3
		Minimum	3,423	25.1
		Maximum	9,672	78.7
		Mean	6,079	46.2
		Standard Deviation	1,622	16.5
		Geometric Mean	5,885	43.5

Appendix C

Model Files and GIS Shapefiles (Electronic Submittal)

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SEH